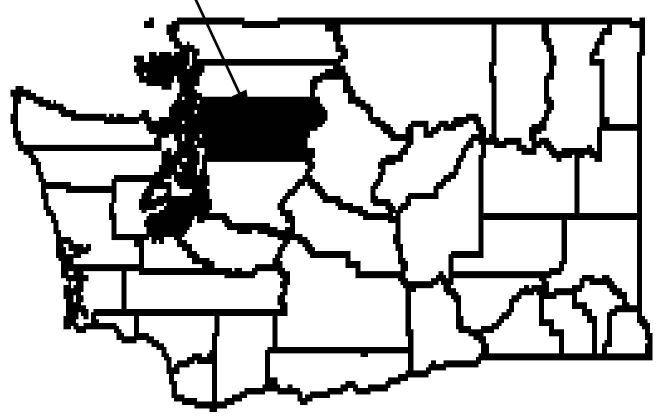
FLOOD INSURANCE STUDY

Volume 1 of 3

SNOHOMISH COUNTY, WASHINGTON

AND INCORPORATED AREAS



Community Name	Community Number
ARLINGTON, CITY OF	530271
BOTHELL, CITY OF	530075
BRIER, CITY OF	530276
DARRINGTON, TOWN OF	530233
EDMONDS, CITY OF	530163
EVERETT, CITY OF	530164
GOLD BAR, CITY OF	530285
GRANITE FALLS, TOWN OF	530287
INDEX, TOWN OF	530166
LAKE STEVENS, CITY OF	530291
LYNNWOOD, CITY OF	530167
MARYSVILLE, CITY OF	530168
MILL CREEK, CITY OF	530330
MONROE, CITY OF	530169
MOUNTLAKE TERRACE, CITY OF	530170
MUKILTEO, CITY OF	530235
SNOHOMISH, CITY OF	530171
SNOHOMISH COUNTY, UNINCORPORATED AREAS	535534
STANWOOD, CITY OF	530172
SULTAN, CITY OF	530173
WOODWAY, TOWN OF	530308

PRELIMINARY

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
53061CV001B

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the Community Map Repository. Please contact the Community Map Repository for any additional data.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with community officials and check the Community Map Repository to obtain the most current FIS report components.

This FIS report was revised on _________. Users should refer to Section 10.0, Revisions Description, for further information. Section 10.0 is intended to present the most up-to-date information for specific portions of this FIS report. Therefore, users of this report should be aware that the information presented in Section 10.0 supersedes information in Sections 1.0 through 9.0 of this FIS report.

Initial Countywide FIS effective date: November 8, 1999
Revised Countywide FIS effective date: September 16, 2005

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FLOOD INSURANCE STUDY
SNOHOMISH COUNTY, WASHINGTON AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Snohomish County, including the Cities of Arlington, Bothell, Brier, Edmonds, Everett, Gold Bar, Lake Stevens, Lynnwood, Marysville, Mill Creek, Monroe, Mountlake Terrace, Mukilteo, Snohomish, Stanwood, and Sultan; the Towns of Darrington, Granite Falls, Index, and Woodway; and the unincorporated areas of Snohomish County (referred to collectively herein as Snohomish County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the City of Bothell is geographically located in King and Snohomish Counties. The City of Bothell is included in its entirety in this FIS report.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This study was prepared to include incorporated communities within Snohomish County, as well as the unincorporated areas, into a countywide FIS. Information on the authority and acknowledgments for each jurisdiction included in this countywide FIS, as compiled from previously printed FIS report narratives, is shown below.

The hydrologic and hydraulic analyses affecting the Cities of Arlington, Gold Bar, Marysville, Monroe, Mukilteo, Snohomish, Stanwood, and Sultan; the Towns of Darrington, Index, and Woodway; and the unincorporated areas of Snohomish County were performed by the U.S. Army Corps of Engineers (USACE), Seattle District, for the Federal Emergency Management Agency (FEMA), under Interagency Agreement No. H-07-76, Project Order No. 13. This work, which was completed in 1981, covered all significant flooding sources affecting these communities.

The hydrologic and hydraulic analyses affecting the City of Everett were performed by the U.S. Geological Survey (USGS) for FEMA, under Interagency Agreement No. IAA-H-17-75, Project Order No. 8. This work, which was completed in March 1976, covered the Snohomish River and Possession Sound. Additional hydraulic computations for the study were performed by the USACE.

The hydrologic and hydraulic analyses affecting the City of Lynnwood were performed by Northwest Hydraulic Consultants, Inc., and R.W. Beck and Associates, respectively. This work was completed in June 1990.

The hydrologic and hydraulic analyses affecting the City of Bothell for North Creek were performed by Northwest Hydraulic Consultants, Inc., for FEMA, under Contract No. EMW-90-C-3134. This work was completed in March 1992.

The hydrologic and hydraulic analyses for Swamp Creek were performed by the USACE, Seattle District, for FEMA, under Interagency Agreement No. EMW-89-E-2994, Project Order No. 9. This work was completed in February 1991.

The Special Flood Hazard Areas (SFHAs) in the Cities of Brier, Edmonds, Lake Stevens, and Mountlake Terrace were determined by approximate methods. The delineations of the approximate SFHAs were obtained from previously effective Flood Hazard Boundary Maps (FHBMs).

1.3 Coordination

The following entities were contacted for information pertinent to the individual Flood Insurance Studies: the Washington State Department of Ecology; USACE, Seattle District; USGS; and County and community governments.

During the preparation of the initial Flood Insurance Studies for the individual communities, Consultation Coordination Officer (CCO) meetings were held with representatives of FEMA and the study contractors, community officials, and other interested agencies and citizens. The meetings, referred to as the initial, intermediate, and final CCO meetings, were held at specified intervals during the preparation of the studies. The comments and issues raised at those meetings were addressed in the FIS for each community. The dates the meetings were held for each community are shown in Table 1, "CCO Meetings."

Swamp Creek was identified to be studied during a September 1989 meeting with representatives of the USACE, Seattle District; the study contractor; and FEMA. FEMA had coordinated previously with Snohomish County. During the course of the study, the study contractor coordinated extensively with the Snohomish County Department of Public Works, which agreed to provide field data including surveyed cross sections and topographic mapping for the study area. The study area covered the reach from the King-Snohomish County border upstream to the downstream end of the Swamp Creek culvert under Interstate Highway 5, a reach of approximately 5.5 miles.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Snohomish County, Washington, including the incorporated communities listed in Section 1.1. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction through September 2010.

Table 1. CCO Meetings

Community Name	Initial CCO and/or Coordination Meetings	Intermediate CCO Meetings	Final CCO Meetings
Arlington, City of	December 8, 1975	October 20, 1981	December 15, 1982
Bothell, City of	August 2, 1977 (Sammamish River) September 21, 1993 (North Creek)	--	June 8, 1981 (Sammamish River) June 27, 1997 (North Creek)
Darrington, Town of	June 3, 1975	October 20, 1981	September 21, 1984
Edmonds, City of	December 8, 1975	October 20, 1981	December 16, 1982
Everett, City of	February 19, 1975, and April 23, 1975	--	--
Gold Bar, Town of	December 10, 1975	October 20, 1981	December 16, 1982
Granite Falls, City of	December 8, 1975	--	--
Index, Town of	December 10, 1975	October 20, 1981	December 16, 1982
Lynnwood, City of	January 11, 1984	--	--
Marysville, City of	December 8, 1975	October 20, 1981	December 15, 1982
Mill Creek, City of	December 8, 1975	--	--
Monroe, City of	December 10, 1975	October 20, 1981	December 16, 1982
Mountlake Terrace, City of	December 10, 1975	October 20, 1981	December 16, 1982
Mukilteo, City of	January 11, 1984	--	March 19, 1985
Snohomish, City of	December 8, 1975	October 20, 1981	December 15, 1982
Snohomish County (Unincorporated Areas)	June 3, 1975	October 20, 1981	April 11, 1983

Table 1. CCO Meetings (cont'd)

Community Name	Initial CCO and/or Coordination Meetings	Intermediate CCO Meetings	Final CCO Meetings
Stanwood, City of	December 8, 1975	October 20, 1981	December 15, 1982
Sultan, City of	December 10, 1975	April 2, 1981	July 14, 1982
Woodway, Town of	--	--	June 27, 1985

Streams and tidal areas studied by detailed methods are shown in Table 2, "Streams and Tidal Areas Studied by Detailed Methods." Streams studied by approximate methods are shown in Table 3, "Streams Studied by Approximate Methods." Initial backwater calculations indicated that the Portage Creek 100-year (1-percent-annual-chance) floodplain would be submerged by the Stillaguamish 1-percent-annual-chance floodplain from Interstate Highway 5 to the City of Arlington in Snohomish County. Because of this, an agreement to delete Portage Creek from the study was reached between FEMA, the USACE, and county officials on January 19, 1979.

In addition to the streams listed in Table 3, "Streams Studied by Approximate Methods," a small marshy area west of Alverson Boulevard and east of the Burlington Northern Railroad (BNRR) in the City of Everett was studied by approximate methods.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon, by FEMA and the individual communities.

2.2 Community Description

Unincorporated Areas

Snohomish County is located in northwestern Washington. It is bordered by Skagit County to the north, Chelan County to the east, King County to the south, and Kitsap and Island Counties to the west. It is also bordered by Puget Sound to the west and the rugged Cascade Range, rising to 10,000 feet, to the east. Snohomish County is 2,098 square miles in area.

The first white settlement within Snohomish County was not formed until 1852 or 1853, when a saw mill was constructed at Tulalip Bay on Puget Sound. Logging was the main business of the early settlers of Snohomish County until removal of timber in the low-lying areas allowed diversified farming activities such as dairying and the raising of vegetable, fruit, and grain crops. Snohomish County was established in 1861. Its name was derived from the local Indian tribal word Sdohdohhohbsh, meaning "the men, the warriors, the braves" (Reference 100).

According to the U.S. Bureau of the Census, the population of Snohomish County in 2000 was estimated at 606,024 (Reference 56).

Snohomish County supports a variety of economic activities, including manufacturing, trade, agriculture, and forestry. Manufacturing, the largest sector of the county economy, is dominated by aircraft and wood-products industries. The largest single employer in Snohomish County is the Boeing Company, which operates an aircraft assembly plant near the City of Everett. Commercial agriculture and forestry are also important contributors to the county economy.

Floodplain soils consist of sands and gravelly sands in the upper reaches and become progressively finer textured to fine sandy loams, silt loams, loams, clay loams, and silty clay loams in the lower reaches. Peat and muck occur in many small drainage basins (Reference 41).

Vegetation in the mountainous areas of the eastern part of the county is predominantly conifers, except in logged areas where deciduous trees dominate. Moving westward,

Table 2. Streams and Tidal Areas Studied by Detailed Methods

Stream	Limit of Detailed Study
Canyon Creek	From confluence with the South Fork Stillaguamish River to River Mile (RM) 8.2.
Ebey Slough	Distributary channels studied through the City of Marysville.
Hat Slough	From mouth at Port Susan upstream to the Stillaguamish River at RM 2.7.
May Creek	From confluence with the Wallace River to RM 2.9 upstream from the City of Gold Bar.
North Creek	From the Snohomish-King County line at Northeast 205th Street to the City of Bothell corporate limit at 208th Street Southeast.
North Fork Skykomish River	From confluence with mouth to RM 4.1 above the Town of Index.
North Fork Stillaguamish River	From confluence with the South Fork Stillaguamish River to RM 34.4.
Pilchuck River	From mouth to RM 18.8 below the Town of Granite Falls.
Port Susan	Tidal flooding of shorelines.
Possession Sound	Tidal flooding of shorelines.
Puget Sound	Tidal flooding of shorelines.
Sammamish River	For its entire reach within the City of Bothell.
Sauk River	From Snohomish-Skagit County line, RM 17.0, upstream past the Town of Darrington to RM 24.8.
Scriber Creek	From approximately 2,400 feet downstream of 44th Avenue West to approximately 1,000 feet upstream of 196th Street Southwest through the City of Lynnwood.
Skagit Bay	Tidal flooding of shorelines.
Skykomish River	From confluence with the Snoqualmie River at RM 20.5 to RM 47.1 near the Town of Index.

Table 2. Streams and Tidal Areas Studied by Detailed Methods (Cont'd)

Stream	Limit of Detailed Study
Snohomish River	From mouth to confluence of the Skykomish and Snoqualmie Rivers at RM 20.5 (including Ebey, Steamboat, and Union Sloughs).
Snoqualmie River	From confluence with the Skykomish River to the Snohomish-King County line at RM 6.1.
South Fork Stillaguamish River	From confluence with the North Fork Stillaguamish River at RM 17.8 to RM 27.1, from RM 30.4 to RM 34.1, and from RM 41.3 to RM 48.7.
South-Cook Slough	South Slough from confluence with the Stillaguamish River to mouth of Portage Creek at RM 1.8, continues as Cook Slough from mouth of Portage Creek upstream to the Stillaguamish River at RM 3.4.
Steamboat Slough	Distributary channels studied through the City of Marysville.
Stillaguamish River	From mouth to confluence with the North and South Fork Stillaguamish Rivers at RM 17.8.
South Pass	From mouth at Port Susan upstream to the Stillaguamish River at RM 1.0.
West Pass	From mouth at Skagit Bay upstream to the Stillaguamish River at RM 1.0.
Sultan River	From confluence with the Skykomish River to RM 3.3.
Swamp Creek	From the King-Snohomish County line upstream to Interstate Highway 5.
Wallace River	From confluence with the Skykomish River to RM 7.3 upstream from the City of Gold Bar.

Table 3. Streams Studied by Approximate Methods

Stream	Limit of Approximate Study
Boulder River	From mouth to RM 3.0.
French Creek	From mouth to RM 2.7.
Hall Lake Areas	In the City of Lynnwood.
May Creek	From RM 2.9 to elevation of 560 feet (approximately 5 miles).
North Creek	From the City of Bothell corporate limit at 208th Street Southeast to Interstate Highway 5.
Quilceda Creek	From mouth to northeast corner of Section 9, T30N, R5E (approximately 5 miles).
Skykomish River	From RM 47.1 on the main stem to confluence with the North Fork Skykomish River (approximately 3 miles).
South Fork Stillaguamish River	From RM 27.1 to RM 30.4 and from RM 34.1 to RM 41.3.
West Fork Woods Creek	From confluence with Woods Creek to Bonneville Power transmission line (approximately 3 miles).
Woods Creek	From mouth to border between Sections 33 and 34, T8N, R7E (approximately 4 miles).

many different deciduous trees and shrubs are mixed with conifers. Along the floodplains are deciduous trees, cultivated land, pasture, and brush. Urban areas contain scattered conifers, deciduous trees, shrubs, and grasses. The dominant conifer species are Douglas fir, hemlock, and cedar, and the dominant deciduous species are alder, cottonwood, and maple (Reference 42).

Maritime air masses, prevailing westerly winds, and the Cascade Range in the eastern portion of the county influence both precipitation and temperatures in Snohomish County. Average annual precipitation varies from over 180 inches in the higher elevations of the Cascade Range to approximately 35 inches near the shoreline of Puget Sound. Approximately 75 percent of the precipitation generally occurs during the period from October through March. Temperature variations throughout the county are also dependent on elevation. Mean monthly temperatures during the coldest month range from 20°F to 40°F and during the warmest month from 55°F to 65°F. Average annual snowfall in the lowlands of Snohomish County ranges from 10 to 20 inches. The higher elevations of the Cascade Range receive in excess of 450 inches of snow annually (Reference 104).

Two principal river basins in Snohomish County are the Stillaguamish and the Snohomish. The Stillaguamish River rises in the Cascade Range at elevations of 4,000 to 6,000 feet and drains an area of 684 square miles. The main tributaries are the North and South Forks, which join near the City of Arlington. The North Fork heads near the Town of Darrington and flows westerly approximately 48 miles to its confluence with the South Fork. The South Fork heads near the community of Silverton and flows northwesterly approximately 53 miles to its confluence with the North Fork. From the confluence, the main stem flows westerly for approximately 18 miles to Puget Sound. The Stillaguamish River divides into three distributaries near the mouth: Hat Slough and South and West Passes. Stream valleys in the upper reaches of the basin are narrow and become progressively wider downstream. Below the City of Arlington, the valley widens to 1 to 1.5 miles until, 2 miles from the coast, it widens into a delta that merges with the coastal plain (Reference 42). Development in the floodplain of the Stillaguamish River includes primarily residential and farm structures. From the City of Arlington downstream there is some development in the floodplain based on agriculture and forest products (Reference 41).

The Snohomish Basin also rises in the Cascade Range and drains an area of 1,780 square miles. The Snohomish River begins at the confluence of the Skykomish and Snoqualmie Rivers and flows westerly approximately 20 miles to Puget Sound. Near its mouth, the Snohomish River divides into a main channel and three distributaries: Ebey, Steamboat, and Union Sloughs. Other than the Skykomish and Snoqualmie Rivers, the only other significant tributary to the Snohomish River is the Pilchuck River, which enters the Snohomish River upstream from the City of Snohomish. The main stem of the Skykomish River begins near the Town of Index, and flows westerly approximately 27 miles to its confluence with the Snoqualmie River. Tributaries to the Skykomish River include the Wallace River, near the community of Startup; the Sultan River, near the City of Sultan; and Woods Creek, near the City of Monroe. The main stem of the Snoqualmie River begins near the Town of North Bend in King County, approximately 4 miles upstream of Snoqualmie Falls. Below the falls, the river flows northwesterly approximately 36 miles to its confluence with the Skykomish River. The Snohomish River valley is from 1 to 3 miles wide and in the lower reaches are marshes and tidal lowlands (Reference 42). Development in the floodplains of the Snohomish Basin includes primarily residential and farm structures. Some industrial and commercial development also occurs in the floodplain adjacent to the Cities of Everett, Marysville, and Snohomish (Reference 41).

The other major rivers within Snohomish County are the Sauk River, including its North and South Forks, and the Suiattle River. Both of these rivers head in the Cascade Range and are part of the Skagit River Basin. Stream valleys along the Sauk River are narrow and heavily forested. Development in the floodplain of the Sauk River is very limited and consists of a limited number of residential and vacation cabins. The Suiattle River in Snohomish County is in a very remote mountainous area and was not studied.

City of Arlington

The City of Arlington is located in the northwestern portion of Snohomish County, approximately 12 miles north of the City of Everett, at the intersection of State Highways 9 and 530. The City of Arlington is served by the BNRR.

The City of Arlington was originally called Forks due to its position at the confluence of the North and South Forks of the Stillaguamish River. Forks was a natural trading place, and the community of Haller City was platted there in 1883. Haller City became the major trading center in the area until the building of the Seattle, Lakeshore and Eastern (SL&E) Railway (now the BNRR) in 1890. The depot for the SL&E was located on higher ground to the south of Haller City, and a new town site was platted there named Arlington. Haller City and Arlington were in fierce competition for growth and survival for many years, but eventually Arlington won out. The City includes the former site of Haller City (Reference 1).

The City of Arlington initially derived its principal support from the timber industry, but the depletion of this resource led to the development of other resources, chiefly farming. Today the City of Arlington area supports substantial dairy, beef, poultry, berry, pea, sweet corn, and forage crop production, as well as a frozen-food plant; sand-, gravel-, and concrete- products plants; and a wide variety of small manufacturing plants. A considerable number of residents of the City of Arlington are employed in business in the City of Everett (Reference 2). According to the U.S. Bureau of the Census, the 2000 population of the City of Arlington was estimated to be 11,713 (Reference 56). Development in the floodplain of the Stillaguamish and South Fork Stillaguamish Rivers consists of some industrial and commercial development based on agriculture and forest products (Reference 41).

The City of Arlington is located on a bluff at the confluence of the North Fork Stillaguamish, South Fork Stillaguamish, and Stillaguamish Rivers. Elevations in the City of Arlington range from approximately 50 feet next to the river to approximately 200 feet in the southeastern part of the City. Most of the City of Arlington is between 100 and 200 feet in elevation. To the east of the City of Arlington are the low foothills of the Cascade Range, rising to 500 feet, and to the west is the broad, low-lying floodplain of the Stillaguamish River. Underlying the City of Arlington are soils ranging from fine sandy loam to gravelly silt loam (Reference 54). Most of the land within the City limits of the City of Arlington is cleared or vegetated with grass or brush. In the few forested areas there are mixed deciduous species such as alder, cottonwood, and maple.

The Stillaguamish River to the northwest and South Fork Stillaguamish River to the north and east of the City of Arlington represent the major flooding sources of the community. The State Highway 9 bridge, near the northwestern limits of the City of Arlington, is approximately 18 miles from the mouth of the Stillaguamish River, and the drainage area above this point is 539 square miles (Reference 43).

City of Bothell

The City of Bothell lies approximately 3.5 miles northeast of the City of Seattle and is surrounded by the unincorporated areas of King and Snohomish Counties. In December 1991, the City of Bothell expanded its boundaries and incorporated certain areas of King and Snohomish Counties. According to the U.S. Bureau of the Census, the population of the City of Bothell was 30,150 in 2000 (Reference 56).

The topography of the City of Bothell area varies from flat stream valley bottomlands to steep rolling hillsides. Vegetation ranges from grassed pasturelands in the valley bottoms to hillsides covered with mature evergreen trees and dense brushy undergrowth.

North Creek originates in Snohomish County, just south of the City of Everett, and flows south to the Sammamish River. The contributing drainage area is approximately 30 square miles. The study reach, located approximately 0.5 mile east of the City of Bothell city center, lies within a flat, 0.5-mile-wide valley bordered by steep rolling hills.

Rapid development in the North Creek basin, upstream of the King-Snohomish County line, significantly altered the hydrology of the basin. An indicator of the development rate is the fact that the population within the North Creek catchment grew by approximately 22 percent between 1986 and 1990, according to Snohomish County officials.

Soils in the North Creek valley and adjacent to the Sammamish River are predominantly silt loam and silty clay loam. These soils are poorly drained and have layers of peat within a few feet of the surface. These areas have a seasonal high water table and are subject to localized flooding. Soils in the upland area north of the Sammamish River consist of gravelly, sandy loam underlain by sand and gravel.

The climate in the City of Bothell area is generally cool and mild and is moderated by maritime air from Puget Sound. Summers are characteristically dry, with high temperatures ranging in the 70s and low 80s and low temperatures in the 50s. The City of Bothell receives an average annual rainfall of approximately 39 inches, most of which occurs from October through March. Winters are moderate, with maximum temperatures in the 40s and 50s and minimum temperatures seldom dropping below 10°F (Reference 30).

Town of Darrington

The Town of Darrington is located in the Sauk River Valley in north-central Snohomish County and is bordered by the unincorporated areas of the county. The Town varies from 540 to 580 feet in elevation. The Town of Darrington is surrounded by Mt. Baker National Forest within the higher elevations of the Cascade Mountain range. According to the U.S. Bureau of the Census, the population of the Town of Darrington was estimated at 1,136 in 2000 (Reference 56).

The highest and lowest temperatures ever recorded in the Town of Darrington were 105°F and -14°F, respectively.

The Sauk River has its headwaters in the Cascade Range and flows northerly to its confluence with the Skagit River at the community of Rockport in Skagit County. The river flows east of the Town of Darrington and development within the Sauk River floodplain is minimal.

City of Everett

The City of Everett is located 29 miles north of the City of Seattle, in west-central Snohomish County on the east shore of Possession Sound. According to the U.S. Bureau of the Census, the population of the City of Everett was estimated at 91,488 in 2000 (Reference 56).

The floodplain within the City of Everett City limits contains some residential development but development has been developed primarily for commercial and industrial use.

City of Gold Bar

The City of Gold Bar is located in the south-central portion of Snohomish County, approximately 13 miles east of the City of Monroe. Transportation facilities include U.S. Highway 2 and the BNRR. According to the U.S. Bureau of the Census, the population of the City of Gold Bar was 2,014 in 2000 (Reference 56).

Prospectors searching for gold along the Skykomish River and its tributaries named the area near the present City of Gold Bar for traces of wealth found on a river bar. A prospector's camp was established in 1889, and the City was platted and formally named in 1900 by the Gold Bar Improvement Company. The City of Gold Bar later became a construction camp for the Great Northern Railroad (now the BNRR) and today is located in the center of an area of logging and small farming (Reference 103). The City is located along the Skykomish and Wallace Rivers and May Creek.

Elevations within the City of Gold Bar range from approximately 170 feet in the northern portion of the City to approximately 210 feet in the southeastern portion. The City of Gold Bar is situated in the western foothills of the Cascades, which rise to approximately 1,000 feet around the City. Underlying the City of Gold Bar are fine sandy loam soils (Reference 54). Most of the land within the City limits is cleared or vegetated with grass or shrubs. The few forested areas, particularly near May Creek and the Wallace River, are mixed deciduous and conifer species. Development in the floodplain of the Skykomish and Wallace Rivers and May Creek consists primarily of residential and farm structures.

The Skykomish and Wallace Rivers and May Creek are the major flooding sources in the City of Gold Bar. The Skykomish River gage near Gold Bar, approximately 3 miles upstream from the City, is approximately 23 miles from the mouth of the Skykomish River, and the drainage area above this point is 535 square miles. The Wallace River gage at Gold Bar is approximately 6 miles from the mouth of the Wallace River, and the drainage area above this point is 19 square miles (Reference 44).

Town of Index

The Town of Index is located near the mouth of the North Fork Skykomish River, in the southeastern portion of Snohomish County, situated approximately 23 miles east of the

City of Monroe. Transportation facilities include U.S. Highway 2, Index Avenue, and the BNRR. According to the U.S. Bureau of the Census, the population of the Town of Index was estimated to be 157 in 2000 (Reference 56).

Amos D. Gunn, the founder of the Town of Index, came to the area in 1890 and opened a way station for the benefit of travelers, miners, and claim seekers. The following year, he filed on seven placer claims near the forks of the river on which the Town of Index was platted in 1893. The railroad reached the Town of Index in 1892 and, with the opening of the Copper Bell and Sunset copper mines in 1898, there was a boom period for the Town. An estimated 800 to 1,000 prospectors and miners headquartered in the Town of Index during summer 1898 (Reference 37). The boom period continued into the early 1900s and the Town's economy was strong until the Great Depression of the 1930s (Reference 35). Today, the economy depends chiefly on the timber industry and trade generated by tourists and sportsmen who visit the Town.

Located on the right bank of the North Fork Skykomish River, the Town of Index is fairly level, with elevations ranging from approximately 515 feet on the western end of Town to approximately 540 feet on the eastern end of Town. Severe bluffs define the North Fork Skykomish River valley near the Town of Index. The area is part of the western foothills of the Cascade Range that rise approximately 1,500 feet in the immediate vicinity of the Town of Index. Underlying the Town of Index are soils consisting of gravelly loam (Reference 54). Most of the land within the Town limits is cleared or vegetated with grass or shrubs. The few forested areas are mixed deciduous and conifer species. Development in the floodplain of the North Fork Skykomish River consists primarily of residential and farm structures.

The North Fork Skykomish River along the southern corporate limits of the Town of Index represents the major flooding source in the Town. The North Fork Skykomish River gage at Index was located 1.5 miles from the mouth of the North Fork Skykomish River, and the drainage area above this point is approximately 147 square miles (Reference 44).

City of Lynnwood

The City of Lynnwood is located in the Puget Sound lowlands of southwestern Snohomish County, approximately 20 miles north of the City of Seattle and 10 miles south of the City of Everett. The City encompasses an area of approximately 6.9 square miles. Almost the entire area of the City of Lynnwood has been developed for residential and commercial purposes. However, some small pockets of forestland are found in the northern parts of the City and undeveloped wetland areas are found in several locations along the Scriber Creek stream corridor. According to the U.S. Bureau of the Census, the population of the City of Lynnwood was 33,847 in 2000 (Reference 56).

Scriber Creek is the principal drainage course within the City of Lynnwood City limits. It originates in several wetlands in the northern part of the City and flows in a generally southerly direction through residential and commercial areas to Scriber Lake. Development has occurred in many places within the original Scriber Creek floodplain and residential and commercial buildings are often found within a few feet of the stream.

City of Marysville

The City of Marysville is located in the west-central portion of Snohomish County, approximately 4 miles north of the City of Everett. Transportation facilities include Interstate Highway 5, old U.S. Highway 99, and the BNRR.

The City of Marysville was founded by James P. Comeford, who came to the area in 1872. Comeford served as Indian agent to the Tulalip Indian Reservation and, in 1877, erected a store, hotel, warehouse, and dock on Ebey Slough to be near the logging operations that provided his principal customers. The community was named "Marysville" at the request of two visiting friends of Comeford who resided in Marysville, California.

The City of Marysville boomed in its early years with the establishment of timber and shake mills located close to the forestlands and to water and rail transportation routes. With the clearing of nearby timberland, the land was gradually turned over to dairying and the raising of crops such as strawberries, raspberries, blueberries, and corn. Today, the City is primarily a residential area for people working in the City of Everett and a distribution point for the surrounding farm and dairy land. The City of Marysville also contains timber and wood-product mills and a boat factory (Reference 8). According to the U.S. Bureau of the Census, the estimated population of the City of Marysville was 25,315 in 2000 (Reference 56). According to the City, the population in April 2003 was 28,370.

Located on the northwestern edge of the low-lying Snohomish River delta, elevations within the City of Marysville range from sea level along Ebey and Steamboat Sloughs in the southern part of the City to approximately 45 feet in the northern part of the City (Reference 54). Underlying the City of Marysville are fine sandy loam soils. Most of the land within the City limits is either cleared or vegetated with grass or brush. In a few areas there are mixed deciduous species such as alder, cottonwood, and maple. Along Ebey and Steamboat Sloughs are cattails, sedges, rushes, grasses, and brush.

Development in the City of Marysville floodplain consists of residential, industrial, commercial, and farm structures (Reference 41). Ebey and Steamboat Sloughs, distributary channels of the Snohomish River to the south of the City of Marysville, represent the major flooding sources in the City.

City of Monroe

The City of Monroe is located in the southwestern portion of Snohomish County, approximately 15 miles southeast of the City of Everett. The City of Monroe is at the intersection of U.S. Highway 2 and State Highways 522 and 203 and is served by the BNRR.

The City of Monroe had its beginning in 1878 when Salem Wood began a settlement 1 mile from the present site and named the region Park Place. John Vanasdlen opened a store and post office in Park Place in 1890, but renamed the post office Monroe after postal authorities rejected the original name. The arrival of the Great Northern Railroad (now the BNRR) in 1891 and the location of its depot 1 mile from Park Place led Vanasdlen to plat a new town site near the station in 1892, which he named Tye City. A short time after Tye City was platted, a group of Everett and Tacoma capitalists known as the Monroe Land & Improvement Company filed the plat of Monroe nearby. This company had sufficient capital behind it to promote the growth of new enterprises and eventually Monroe became the favored business location. Present-day Monroe includes the former communities of Park Place, Tye City, and Monroe. The early economy of the

City of Monroe was based on the timber industry and agriculture, primarily dairying and berry farming. Today, the City of Monroe is the center of a rich farming community and has vegetable canneries and dairy- product plants (Reference 108). According to the U.S. Bureau of the Census, the population of the City of Monroe was 13,759 in 2000 (Reference 56).

Located primarily on the right bank of the Skykomish River, elevations within the City of Monroe range from approximately 40 feet near the mouth of Woods Creek in the southern portion of the City to approximately 210 feet in the eastern portion of the City. The City of Monroe is situated in the low-lying western foothills of the Cascade Range, which rise approximately 200 to 400 feet in the vicinity of the City of Monroe. Underlying the City of Monroe are silt loam soils (Reference 54). Most of the land within the City limits of the City of Monroe is cleared, vegetated with grass or shrubs, or in cropland. The few forested areas, particularly near the Skykomish River, are mixed deciduous and conifer species. Development in the Snohomish and Skykomish River floodplain consists primarily of residential and farm structures.

The Skykomish River and Woods Creek to the south and east, respectively, represent the major flooding sources in the City of Monroe. The State Highway 203 bridge at the City of Monroe is 5 miles from the mouth of the Skykomish River, and the drainage area above this point is 834 square miles. The Woods Creek gage near the City of Monroe is 3 miles from the mouth of Woods Creek, and the drainage area above this point is approximately 56 square miles (Reference 44).

City of Mukilteo

The City of Mukilteo is located in southwestern Snohomish County, approximately 15 miles north of the City of Seattle. The City of Mukilteo is bordered by the City of Everett, Paine Field Air Force Base, the unincorporated areas of Snohomish County, and Possession Sound to the east, southeast, south, and west, respectively.

Development in the City of Mukilteo is primarily residential. According to the U.S. Bureau of the Census, the population of the City of Mukilteo was 18,019 in 2000 (Reference 56). Little development exists along the shoreline, except in the northern area of the City of Mukilteo, due to a steep shoreline topography.

No major drainage system exists in the City of Mukilteo. Small gullies exist in steep canyons that drain the area of Mukilteo to Possession Sound.

Soils consist of sands to loams and silty clay loams. Vegetation includes deciduous trees, scattered conifers, shrubs, and grasses. The dominant deciduous species are alder, cottonwood, and maple.

City of Snohomish

The City of Snohomish is located in the southwestern portion of Snohomish County, approximately 6 miles southeast of the City of Everett. The City of Snohomish is at the intersection of U.S. Highway 2 and State Route 9 and is also served by the BNRR.

The City of Snohomish had its beginning in 1855 when Congress proposed a military road to be constructed between Fort Steilacoom and Fort Whatcom (now Bellingham). Two Steilacoom men, E. C. Ferguson and E. F. Cady, realized that the point where the road crossed the Snohomish River must become a trade center of importance. In 1859 Ferguson sent Cady and two other men to take up claims on opposite sides of the river where the ferry should cross. The road never became more than a blazed trail through Snohomish County but the City of Snohomish continued to prosper due to its strategic location to nearby timber lands and water-transportation routes. The City of Snohomish was the county seat from 1861 to 1894. During the period from 1860 to 1880, the City of Snohomish was the prime spot of Puget Sound, being as large if not larger than the City of Seattle and dwarfing Whatcom, which was later to become Bellingham (Reference 51).

Logging and lumbering were the economic backbone of early Snohomish, but with the depletion of this resource, the City of Snohomish turned to new resources and today is the center of a truck farming and dairy region. According to the U.S. Bureau of the Census, the estimated population of the City of Snohomish was 8,494 in 2000 (Reference 56).

Located at the confluence of the Snohomish and Pilchuck Rivers, elevations within the City of Snohomish range from approximately 15 feet in the southeast portion of the City next to the river to approximately 290 feet in the northeastern portion of the City. The City of Snohomish is situated in the low-lying western foothills of the Cascade Range, which rise approximately 200 to 400 feet in the vicinity. Underlying the City of Snohomish are gravelly loam soils (Reference 54). Most of the land within the City limits is cleared or vegetated with grass or brush. In the few forested areas, there are mixed deciduous species such as alder, cottonwood, and maple. Development in the Snohomish and Pilchuck River floodplain consists of residential, commercial, industrial, and farm structures (Reference 42).

The Snohomish and Pilchuck Rivers to the south and east, respectively, represent the major flooding sources in the City of Snohomish. The 99th Avenue Southeast bridge over the Snohomish River near the southwestern limits of the City of Snohomish is approximately 13 miles from the mouth of the Snohomish River, and the drainage area above this point is approximately 1,714 square miles. The U.S. Highway 2 bridge over the Pilchuck River near the southeastern limits of the City of Snohomish is approximately 2 miles from the mouth of the Pilchuck River, and the drainage area above this point is approximately 132 square miles (Reference 44).

City of Stanwood

The City of Stanwood is located in the northwestern corner of Snohomish County, approximately 13 miles west of the City of Arlington. The City of Stanwood is at the intersection of State Routes 530 and 532 and is served by the BNRR.

The first settlement in the vicinity of the City of Stanwood was a trading post and saloon established in 1866 on Davis Slough by Robert Fulton. A post office was created in the trading post and given the name Centerville before it was moved to just below the present City site prior to 1873. In 1877, D.O. Pearson was appointed postmaster and changed the name of Centerville to Stanwood in honor of his wife's maiden name (Reference 37). The location of the Seattle and Montana Railway (now the BNRR) station 0.75 mile east of the City of Stanwood led to the founding of East Stanwood in 1906 (Reference 108). The two communities consolidated in 1960 (Reference 3).

The City of Stanwood initially derived its principal support from lumber and agriculture, but with the depletion of nearby timber stands, the economy shifted primarily to vegetable farming. Today, the City of Stanwood supports a frozen food products plant, a vegetable packing plant, and a seed and grain company. According to the U.S. Bureau of the Census, the population of the City of Stanwood was 3,923 in 2000 (Reference 56).

Located on the right bank of the Stillaguamish River, elevations within the City of Stanwood range from 2 feet in the south-central portion of the City to approximately 190 feet in the extreme northeastern portion of the City. The City of Stanwood is located near the mouth of the low-lying Stillaguamish River valley. Underlying the City of Stanwood are primarily silt loam and clay soils (Reference 54). Most of the land within the city limits is cleared, vegetated with grass or shrubs, or in cropland. The few forested areas, particularly in the eastern part of the City, are mixed deciduous species.

Development in the Stillaguamish River floodplain is primarily residential and farm structures.

High tides in conjunction with high Stillaguamish River flows represent the major flooding source in the City of Stanwood. Floodwaters from the Skagit River can also reach the City by flowing south along the coastal plain.

<u>City of Sultan</u>

The City of Sultan is located in south-central Snohomish County, situated approximately 8 miles east of the City of Monroe. The City of Sultan is surrounded by unincorporated Snohomish County land. Transportation facilities include U.S. Highway 2 and the BNRR.

The first settlers in the area were prospectors who found “color” along the Sultan River in 1870. In 1880, John Nailor occupied a claim at the present site of the City of Sultan and his home became a way station for prospectors who still worked the small scattered gold claims. A post office was established in 1885, with Nailor as postmaster, and the name Sultan City was formally adopted. The name Sultan was derived from the Indian chief Tseultud, who headed a tribe living in the area. By 1887, mining operations had again become active in the Sultan area, not only in the rivers but also in mines of the Sultan River basin. Lead, zinc, silver, and gold discoveries created a mining boom in the City of Sultan, but the boom was short lived as very little ore was shipped to smelters in the City of Everett. The City of Sultan continued to flourish and, in 1891, the Great Northern Railroad made the City of Sultan a base for track work west of the Cascade Mountain range summit. The City of Sultan’s prominence as a mining center ended in 1897 as prospectors headed to the Yukon and the local economy turned primarily to the timber industry, supplemented by raspberry production and dairy products (Reference 108). According to the U.S. Bureau of the Census, the population of the City of Sultan was 3,344 in 2000 (Reference 56).

The Sultan and Skykomish Rivers to the west and south, respectively, represent the major flooding sources in the City of Sultan. The U.S. Highway 2 bridge over the Sultan River near the City of Sultan is 0.1 mile from the mouth of the Sultan River. The drainage area above this point is approximately 618 square miles (Reference 44).

Located in the foothills of the Cascade Mountain range at the confluence of the Sultan and Skykomish Rivers, elevations within the City of Sultan range from approximately 100 feet near the mouth of the Sultan River in the southwestern part of the City to approximately 320 feet in the northwestern part of the City. Underlying the City of

Sultan are soils ranging from silt loam to gravelly loam (Reference 54). Most of the land within the corporate limits of the City of Sultan is cleared. There are forested areas consisting of mixed deciduous and conifer species in the extreme eastern and western parts of the City and along the Sultan and Skykomish Rivers. Native vegetation has been essentially obliterated by agricultural operations and urbanization. Vegetation in the area consists of bushes, grasses, and shrubs.

The Sultan River floodplain consists of residential and business structures. The Skykomish and Wallace River floodplain consists of residential and business structures and some farmland.

Town of Woodway

The Town of Woodway is located in southwestern Snohomish County and is bordered by the City of Edmonds on the north, Puget Sound on the west, and the unincorporated areas of Snohomish County on the east and south. According to the U.S. Bureau of the Census, the population of the Town of Woodway was estimated at 936 in 2000 (Reference 56).

The Town of Woodway area supports a variety of economic activities including manufacturing, trade, agriculture, and forestry.

Floodplain soils consist of sands and loams. Peat and muck occur in small drainage basins.

Vegetation in the area consists of deciduous trees and shrubs mixed with conifers and grasses.

2.3 Principal Flood Problems

Flooding in Snohomish County may occur from high tide levels in Puget Sound or from floods on the various rivers and streams in the county.

Tidal flooding can occur when a high astronomical tide (gravitational effects of the sun and moon) is heightened by a large storm surge (rise in water levels due to wind stress and low atmospheric pressure). Wave run up is a significant factor when occurring during high-tide conditions in areas where the shorelines are not sheltered from local wind effects. During extremely high tides, some of the sea levees in the lower Stillaguamish area have been overtopped.

Major floods on rivers and streams in Snohomish County are caused by rainstorms between October and March. Though floodwaters are primarily from rainfall, they are often augmented by snowmelt. Snowmelt floods in spring and summer months are usually not as severe. Rain-runoff floods in the study basins are characterized by sharply rising riverflows, with high-magnitude peaks and flood durations ranging from a few hours on small streams to several days on larger rivers. The greatest threat from flooding occurs between late November and early February, when moisture-laden storms pass through the Puget Sound region. Characteristically, these storms are 24 hours in duration, with moderate and fairly constant precipitation seldom exceeding 1 inch per hour. Not uncommon are two or more storms in rapid succession, sometimes less than 24 hours apart.

The Snohomish River floodplain is subject to frequent inundation. Except for the

French Creek Drainage District, existing levees provide protection only from normal spring floods that would damage crops. Overtopping may be expected every 2 to 5 years on average, depending on height and condition of levees. Streamflow records are available from two gaging stations operated by the USGS on the Snohomish River. The gaging station on the Snohomish River near the City of Monroe is located approximately 0.1 mile downstream of the Skykomish and Snoqualmie River confluence and has operated since 1963. Records for the gage at the City of Snohomish included both stage and discharge between 1942 and 1965, but since 1965 only stages are available through the USGS.

From information published by the USGS, the largest floods known on the Snohomish River occurred in 1897, 1906, 1917, and 1921, prior to the installation of stream-gaging equipment. Based on correlations with nearby streams in the Skagit and Skykomish River basins, these historical peaks are estimated to have reached 206,000, 195,000, 165,000, and 180,000 cubic feet per second (cfs), respectively, at the gage near the City of Monroe. These discharges equate to approximately a 1-percent-annual-chance flood event.

The three largest floods of record on the Snohomish River occurred in February 1951, November 1959, and December 1975. Although the February 1951 flood was the largest flood, with a peak of 136,000 cfs at the Snohomish gage, the November 1959 flood reached a stage approximately 0.8 foot higher, with a maximum discharge of 113,300 cfs. The highest stage at the City of Snohomish was reached during the December 1975 flood, approximately 2.9 feet higher than occurred in February 1951. Discharge records are not available for the December 1975 flood at the City of Snohomish, but the peak is estimated to be approximately 130,000 cfs. Increasing flood stages over the past 25 years on the Snohomish River are attributed to constriction of the channel and overbank flow areas by levee construction and improvement after each significant flood event, based on flood routings from upstream gaging stations.

Because of the agricultural setting of the Snohomish River valley, most flood damage is to land, crops, livestock, and related improvements. During the December 1975 flood, approximately 18,500 acres of agricultural land were inundated, 237 homes damaged, and approximately 1,500 head of livestock lost

The Snoqualmie River floodplain within Snohomish County consists almost entirely of fertile farmlands, with the City of Monroe being the only nearby major population center. However, this low valley is inundated to some extent almost every winter.

Stream flows on the Snoqualmie River are recorded at the USGS stream-gaging station near the Town of Carnation in King County. This station is located approximately 24 miles from the confluence and has been in operation since 1930. Due to an extensive floodplain and lower channel slope, flood-discharge hydrographs near the Town of Carnation are characterized by somewhat slower runoff response, with less pronounced peaks and broader crests than at other major gage sites in the Snohomish River basin above the City of Monroe.

Although the February 1932 flood was the highest recorded flood on the Snoqualmie River, with a peak discharge of 59,500 cfs near the Town of Carnation, the largest runoff flood occurred in December 1975, when the highest average 1- through 10-day discharges were recorded and the river reached a maximum discharge of 52,000 cfs. Other major floods occurred in November 1932, when stream lows reached a maximum discharge of 59,000 cfs, and in February 1951, when river flow reached 52,200 cfs.

The largest recorded flood on the Skykomish River occurred in December 1980, when a peak discharge of 90,100 cfs was recorded at the stream gage near the City of Gold Bar approximately 23 miles above the confluence. Stream-gaging records for this site have been maintained since 1929. During the flood of December 1975, three crests were recorded near the City of Gold Bar during a period of less than 3 days and with a maximum peak discharge of 77,000 cfs.

Approximately 3,900 acres of agricultural land were inundated during the December 1975 flood along the Skykomish River, and 130 homes were damaged, mostly in the Cities of Monroe and Sultan.

Streamflow records for the Stillaguamish River have been reported at USGS stream-gaging stations on the South Fork Stillaguamish River near the Town of Granite Falls and North Fork Stillaguamish River near the City of Arlington since 1928. Streamflow records are not available for the main stem, but river stages are reported from a National Weather Service (NWS) non-recording gage on the Stillaguamish River at the City of Arlington. All major floods of record on the Stillaguamish River have occurred between November and February and were caused by high rates of precipitation with accompanying snowmelt. Discharges usually rise and fall rapidly, and two or more crests may occur in rapid succession as a series of storms move across the basin. The Stillaguamish River basin suffers damaging floods approximately every 3 to 5 years.

From the confluence of the North and South Fork Stillaguamish Rivers at the City of Arlington, the Stillaguamish River meanders westerly 23 miles through a fertile floodplain. In the vicinity of the community of Silvana, the stream flows through two channels, Cook Slough and the Stillaguamish River. The channels recombine near River Mile (RM) 11 and then divide again near RM 8. From this point, the main stream flows approximately 2 miles through Hat Slough and discharges into Port Susan. Below the head of Hat Slough, the old Stillaguamish River channel, via the City of Stanwood, has become aggraded to the extent that it carries little or no riverflow during the dry season. Below the City of Stanwood, flows in the old channel discharge into Port Susan through South Pass and into Skagit Bay through West Pass. The Stillaguamish River system is tidal for approximately 11.5 miles upstream from its mouth. The total range between mean higher-high water and mean lower-low water is approximately 11 feet.

The presence of a high tide will restrict the drainage capacity of Hat Slough and the old channel, causing an increased backwater effect. During the 67-year period from 1910 to 1977, Stillaguamish River floodflows have exceeded the zero-damage level more than 45 times. The only river gage below the confluence of the North and South Fork Stillaguamish Rivers is the stage gage at the City of Arlington. The cumulative peak discharge-frequency curve at the City of Arlington is based on estimates of discharge at the City of Arlington developed from the study of recorded discharges at upstream locations.

The largest flood of record along the Stillaguamish River occurred in February 1932, with a maximum discharge estimated to be 65,000 cfs at the City of Arlington, 32,400 cfs on the South Fork near the Town of Granite Falls, and 27,700 cfs on the North Fork near the City of Arlington. In February 1951, floodflows reached an estimated peak of 61,000 cfs at the City of Arlington, 27,600 cfs on the South Fork near the Town of

Granite Falls, and 30,600 cfs on the North Fork near the City of Arlington. Other extreme floods occurred in November 1958 and November and December 1959, with peak discharges at the City of Arlington estimated at 58,500, 59,600, and 54,800 cfs, respectively. Stream gradients of the North and South Fork Stillaguamish Rivers are relatively steep with well-defined channels. The primary flood problem is bank erosion with some agricultural land inundation. However, these valleys are sparsely populated and undeveloped, and flood damage is minor.

Between the City of Arlington and the community of Silvana, low intermittent levees provide some protection to agricultural lands. Below Silvana, flood damages are aggravated by high tides that increase flood stages. A levee system protects most of this area from spring floods; however, the levees are low, with narrow cross sections, and are incapable of withstanding floodflows in excess of approximately 45,000 cfs or approximately a 3-year event. Floods caused frequent and extensive damage to pasture and croplands, bridges, highways, and utilities. In the December 1975 flood, the Stillaguamish River peaked at approximately 57,000 cfs on the Arlington gage, which is estimated at approximately an 8-year-recurrence-interval flood. A total of 7,900 acres was flooded, causing an estimated $1,474,000 in damages, the highest in 16 years in the basin. Flooding in Snohomish County resulted in the declaration of the county as a Federal disaster area on December 13, 1975. The December 1977 flood was less severe, although it also resulted in the declaration of Snohomish County as a Federal disaster area on December 10, 1977. The river peaked at approximately 46,500 cfs at the City of Arlington, which is estimated at a 3-year-recurrence-interval flood. Farmlands south of the City of Stanwood were flooded, as well as some low-lying areas in the communities of Florence and Silvana east of the City. Damage within the City of Stanwood was minor, mostly because of a successful flood fight. The following account from the December 10, 1975, *Stanwood News* describes the December 3, 1975, flood in the City of Stanwood:

> "Stanwood residents awoke Wednesday morning of last week to find many of their upriver neighbors already flooded by the rampaging Stillaguamish, and water pouring into town at two points. Main source of flooding in the east side of town was where Florence Road goes beneath the railroad overpass. Floodwater lapping over the dike near the Twin City Foods' Diner ... poured into the west end of town to cause at least minor flooding in several places of business."

Nearly all of the City of Arlington is situated on a bluff, and the estimated 1-percent-annual-chance flood will only inundate 5 to 10 acres near the southwestern side of the State Route 9 bridge over the Stillaguamish River and 10 to 15 acres in the extreme northeastern part of the City.

The natural channel of North Creek lies on the opposite side of the valley from where the stream now flows. The creek was relocated to the high side of the valley to improve its capacity. Flooding on North Creek occurred in March 1950, when the flow reached 680 cfs. Because land use in the valley at that time was agricultural, the flooding had minimal impact. High water in December 1975 was reportedly contained within the North Creek channel. There are no gage records of this event. Localized ponding areas developed every winter because of the poorly drained soils in the valley.

Since the mid-1980s, only one event has significantly inundated portions of the North Creek floodplain. On January 18, 1986, a peak flow of 914 cfs was recorded at the

Snohomish County North Creek stream gage located just upstream of the limits of detailed study reach.

During this event, a berm located along the county line gave way and floodwaters inundated the floodplain between the North Creek west levee and Interstate 405. No buildings existed at the time and no significant flood damage was reported.

The Skagit Basin, lying directly in the storm path of cyclonic disturbances from the Pacific Ocean, is subject to numerous storms, which are frequently quite severe. Not uncommon are two or more storms in rapid succession, sometimes less than 24 hours apart. Floods usually occur in November or December, but may occur as early as October or as late as February. These floods are characterized by sharply rising riverflows, high-magnitude peaks, and flood durations of several days. Often, heavy rainfall is accompanied by snowmelt, which increases the runoff. On the mountain slopes, storm precipitation is heavy and almost continuous as a result of combined frontal and orographic effects.

Springs floods also occur on the Skagit River and its tributaries and are due primarily to snowmelt runoff. However, these events are not of sufficient magnitude to be a serious flood threat.

Flooding of the City of Everett may occur from high tide levels in Puget Sound or from floods on the various rivers and streams in the county. High tides alone do not usually cause flooding but, when combined with high winds, can cause flooding along the coastline.

Tidal flooding within the City of Everett along the coastal industrial area has occurred three times in the last 25 years, as reported by local residents. Coincidence of the annual highest tide level with a river peak can enlarge the extent of river flooding, but over the 30 years during which records have been kept, the magnitude of such coincident tides has not exceeded that having a 3-year recurrence interval.

The major problem associated with floods within the City of Everett has been inundation of the low-lying agricultural lands, resulting in loss of crops and, in some cases, failure of dikes and blocked roads.

The estimated 1-percent-annual-chance flood will not affect the major portion of the City of Gold Bar, but some land and scattered residences on both sides of May Creek and the Wallace River on the northern and western portions of the Town will be inundated.

A flood occurred in the Town of Index on December 26, 1980. This flood had a recurrence interval of approximately 20 years for the peak discharge of 90,100 cfs at the stream gage on the Skykomish River at the City of Gold Bar, and did major damage in the Town of Index. The following account from the *Seattle Post Intelligencer* describes the December 26, 1980, flood in the Town of Index:

> "The flooding began in Index, a community of about 200 persons, shortly before 2 am and the swift current of the North Fork of the Skykomish quickly washed out a portion of A Street along the river bank (to the west of the BNRR bridge). Eight houses in Index or downstream of the community were washed away and at least 15 homes were damaged, but all persons living in them fled to safety.

> Index Fire Chief Barbara McDonald said the pipeline that supplies water to the town was washed out in one area but the water collecting system above town was not damaged.
>
> The fire chief also said about half the town was without power because flood waters had shorted out transformers."

Scriber Creek in the City of Lynnwood is typical of many small urban streams. Its hydrologic regime has been greatly altered by extensive urban development, loss of wetland storage, and channelization of the creek. A comprehensive survey and review of flooding problems was recently carried out for development of the Scriber Creek Watershed Management Plan (Reference 49).

Intermittent flooding has been reported at several locations along Scriber Creek. Problems have largely been confined to roadway flooding, with little damage to private property. Flooding occurred during the storms of January 17-18, 1986, and January 9, 1990. The estimated January 1986 peak flow had a return period of approximately 20 years. The return period for the January 1990 event has not been determined.

The principal flooding problems along Scriber Creek, as abstracted from the Scriber Creek Watershed Management Plan, are as follows:

- Scriber Creek at 196th Street Southwest -- Flooding occurs periodically across a low stretch of old 196th Street Southwest, which provides access to a number of small businesses. Flooding also occurs several hundred feet upstream from this point where Scriber Creek enters two 42-inch culverts. The hydraulic conditions in this reach are complicated and several factors appear to contribute to the problems. These include the limited capacity of culverts or bridges at several bridge crossings (which impose high tailwaters on upstream culverts), heavy siltation, and extremely poor hydraulic conditions in the 42-inch culverts. These have an abrupt 90-degree turn halfway down their length, where there is a change from concrete pipe to corrugated metal.

- Scriber Creek at 50th Avenue West and 200th Street Southwest and Edenbrook Apartments -- Flooding across 50th Avenue West and 200th Street Southwest has occurred during high-intensity storms. At this intersection, Scriber Creek crosses the roadway diagonally through two 65- by 40-inch corrugated metal culverts. Several factors contribute to local flooding, including poor entrance conditions, siltation, and downstream backwater effects. The stream channel downstream of this intersection has a very low gradient. During moderately high flows of 75 cfs or more, the outlets are submerged.

  Flooding problems also occur in the Edenbrook Apartments and several commercial buildings upstream from where Scriber Creek crosses 200th Street Southwest.

- 44th Avenue West -- Scriber Creek crosses under 44th Avenue West in two 42-inch culverts and one 66-inch culvert. Prior to mid-September 1989, flooding across 44th Avenue West occurred several times a year during moderate flows on Scriber Creek. The flooding was caused by insufficient culvert capacity due to silt and debris obstructing approximately 90 percent of the three culverts. The limited capacity of the culverts caused stormwaters to back up and temporarily store upstream of the culverts and then to spill over the roadway.

In September 1989, the 44th Avenue West flooding problem was partially corrected when the 66-inch corrugated metal culvert under 44th Avenue West was cleaned. This pipe can now pass approximately 170 cfs before the roadway is overtopped. However, roadway flooding occurred during the event of January 9, 1990.

Flooding conditions in the City of Marysville are aggravated if high tidal levels on Possession Sound occur simultaneously with high flows on Ebey and Steamboat Sloughs. The estimated 1-percent-annual-chance flood will inundate timber mills located on the right bank of Ebey Slough in the southwestern part of the City, 80 acres of undeveloped land in the southwestern part of the City, and 120 acres of developed agricultural land in the southeastern part of the City.

Localized flooding damages were reported along Swamp Creek for the January 1986 flood of record on Swamp Creek and were primarily related to channel-bank erosion, overtopping of roadways and resulting damages (including culvert washouts), and limited damages to residential structures.

Within the City of Monroe, the estimated 1-percent-annual-chance flood from the Skykomish River will inundate approximately 80 acres of undeveloped land in the south and southeastern parts of the City. The estimated 1-percent-annual-chance flood from the Snohomish River will inundate approximately 100 acres of developed agricultural land in the extreme northwestern part of the City. The Woods Creek floodplain in the City of Monroe is dominated by floodwaters backing up from the Skykomish River.

Flooding in the City of Mukilteo may occur from high-tide levels and storm surge accompanied by winds in Possession Sound. Very little flood-damage potential exists in the City of Mukilteo area.

Flooding in the City of Snohomish by the Snohomish and Pilchuck Rivers is confined primarily to the southeastern part of the City where there are scattered residences and undeveloped land.

Flooding in the City of Sultan is caused by major floods on the Sultan and Skykomish Rivers. The Wallace River is not a major flooding factor because areas subject to flooding from the Wallace River are more significantly affected by backwater from the Skykomish River.

Flooding occurs in the City of Sultan when high flows on the Sultan and Skykomish Rivers go over the banks on the western and southern sides of the City. Floodwaters also enter the City of Sultan when high flows on the Skykomish River back up into the Sultan River and go over banks on both sides of the lower Sultan River.

The following account from the *Everett Herald* describes the December 1-4, 1975, flood in the City of Sultan:

> "At 4 a.m. Tuesday (2 December), evacuation efforts began at Sultan .... Two dozen homes in the flood plain were threatened by fast rising waters, and soon more than a foot of water flowed through the town's main streets .... Residents of the Sky View River Tract and the Twin Rivers Park were evacuated via boat by volunteer search and rescue personnel and deputy sheriffs .... The Sultan state

liquor store, a tavern, and a restaurant were among the buildings threatened in the City .... Floods there were not unusual, but it is not usual for the water to rise as rapidly, as far, and to stay as long as it did."

Information on major floods in the City of Sultan is shown below.

Table 4. Peak Discharges

Flood Dates	Peak Discharges (cfs)	
	Sultan River Below Chaplain Creek, Near City of Sultan	Skykomish River, Near City of Gold Bar
November 1959	23,500[1]	78,800
December 1975	24,600	76,600
December 1977	18,600	62,800
December 1980	26,600	90,100

[1]November 1959 flood at gage near the community of Startup

2.4 Flood Protection Measures

Levees exist in the study area that provides the county with some degree of protection against flooding. However, it has been ascertained that some of these levees may not protect the community from rare events such as the 1-percent-annual-chance flood. The criteria used to evaluate protection against the 1-percent-annual-chance flood are 1) adequate design, including freeboard, 2) structural stability, and 3) proper operation and maintenance. Levees that do not protect against the 1-percent-annual-chance flood are not considered in the hydraulic analysis of the 1-percent-annual-chance floodplain.

Nine diking districts maintain approximately 42 miles of levees along the Snohomish River and its three distributary channels: Ebey, Steamboat, and Union Sloughs. One diking district maintains sea dikes along Port Susan, South and West Passes, and Skagit Bay, and levees along Hat Slough and the main stem Stillaguamish River near the City of Stanwood. Small, scattered private levees exist elsewhere in the county. Most of these levees are not adequate to protect against a 10-year (10-percent-annual-chance) tidal or riverine flood.

A USACE levee between the City of Gold Bar and the community of Startup extends approximately 7,000 feet along the right bank of the Skykomish River and prevents the Skykomish River from overflowing into the Wallace River. Although designed for a 50-year (2-percent-annual-chance) flood on the Skykomish River, it has been estimated that the levee would withstand a 1-percent-annual-chance flood.

Snohomish County Public Utility District No. 1 operates and maintains a dam and water-supply reservoir project on the Sultan River, and the City of Seattle operates and maintains a dam and water-supply reservoir project on the South Fork of the Tolt River, a tributary to the Snoqualmie River in King County. Neither of these projects is licensed to provide flood-control storage. Both projects have some regulatory effect at low flows and have reduced some flood peaks. However, because of limited outlet capacity, the availability of storage to control large floods is uncertain.

In the mid-1980s, portions of the North Creek channel were realigned and confined between levees to allow development of the floodplain. Downstream of Interstate 405, levees were constructed adjacent to the North Creek channel. The east levee extends from State Route 522 to Interstate 405. The west levee extends from Interstate 405 approximately 1,500 feet downstream and ties into high ground. Both levees are approximately 5 feet high. Upstream of Interstate 405 to Northeast 195th Street, a 2- to 3-foot-high levee protects the east floodplain. Upstream of Northeast 195th Street, the North Creek channel is confined between levees that range from 4 to 12 feet high. At the King-Snohomish County line, berms have been constructed across both left and right floodplains to direct all upstream floodplain flow into the North Creek channel.

The City of Bothell zoning code prohibits development within the shoreline management areas of North Creek and the Sammamish River. The City's drainage-control ordinance requires peak flow reduction of stormwater flows to protect against flooding and erosion as a result of development of the watershed.

Existing flood-control measures within the Snohomish River basin consist of two small upstream storage reservoirs, floodplain levees, and channel improvements. Channel improvements within the City of Everett consist of dredging and bank protection. Levees constructed along the lower reaches of the river also protect the waterfront industries against the high tides of Puget Sound, except during extreme river floods. Existing levees of the Marshland Control District provide protection along the left bank of the Snohomish River (RM 9 to RM 17.6) from a flood of approximately 63,000 cfs, which has been exceeded at least once annually in 33 percent of the years during which records have been kept, or once on the average in every 3 years (Reference 40). This project provides limited flood protection within the upper reaches of the study.

Due to the flat stream gradient (1 foot per mile) and river-basin runoff characteristics, the lower Snohomish River valley is subject to a zero-damage flow or more, at an average of twice a year. Zero-damage flow is defined as "the maximum flow a stream can carry without causing overbank flow and damages" (Reference 41). Because of this, Snohomish County implemented land-use controls and floodplain regulations in 1968.

A 2.3-mile-long jetty (breakwater) and Jetty Island affords some protection to the Port of Everett and the coastal industrial area. This island is periodically raised but, at present, would be overtopped by the 1-percent-annual-chance base flood.

The BNRR embankment at the City of Gold Bar acts as a levee, protecting the City against major floods on the Skykomish River.

Levees exist in the City of Marysville along portions of the left and right banks of Ebey Slough and along the western City limits south of Ebey Slough; however, the levees will not protect the City from a 1-percent-annual-chance tidal or Snohomish River flood.

A levee system protects the City of Stanwood from tidal flooding directly from Puget Sound, but the interior levees are low, have narrow cross sections, and are incapable of withstanding unusually high tides in combination with Stillaguamish River flows in excess of 45,000 cfs or approximately a 3-year event.

No specific flood-protection structures have been constructed within the Cities of Arlington and Lynnwood or the Towns of Darrington, Index, and Woodway.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood-hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

Coastal areas of Snohomish County are also subject to tidal flooding. An analysis of tidal flooding was conducted for the coastal areas of Snohomish County to determine tidal flooding stages for 10- and 1-percent-annual-chance recurrence intervals and wave-runup factors for use in exposed reaches. The use of these methods was confirmed by a FEMA letter dated June 10, 1980.

Discharge records published by the USGS for the stations listed in Table 5, "Stream Gaging Stations Operated by the USGS and Periods of Record Analyzed for Detailed Studies," were analyzed statistically following procedures described in U.S. Water Resources Council Bulletin No. 17A, "Guidelines for Determining Flood Flow Frequencies" (Reference 99). Statistical analyses were conducted to determine discharge-frequency relationships of the specified recurrence intervals for each stream studied in detail in the county. Floodflows at ungaged locations were derived from discharge-frequency relationships by adjusting for drainage areas, rainfall intensity, and significant retention areas.

Special hydrologic procedures were used to determine floodflow frequencies at USGS gaging stations on the Snohomish River near the City of Monroe and at the City of Snohomish.

Table 5. Stream Gaging Stations Operated by the USGS and Periods of Record Analyzed for Detailed Studies

Name	USGS Gage No.	Location	Period of Record	Drainage Area (Square Miles)
Beckler River	12131000	Near Town of Skykomish	1930-1933 1947-1970	
Deer Creek	12166500	Near community of Oso	1918-1930 (Discontinuous)	
Issaquah Creek	12121600	Near City of Issaquah	1964-1988	56.60
Jim Creek	12164000	Near City of Arlington	1938-1969	
Juanita Creek	12120500	Near City of Kirkland	1964-1988	6.69
Mercer Creek	12120000	Near City of Bellevue	1956-1990	12.00
North Creek	12125900 12126000 12126100	Below Penny Creek Near City of Bothell (196th Street Southeast) Near City of Woodinville (240th Street Southeast)	1985-1986 1946-1974 1985-1986 1989-1990	14.2 24.6 27.6
North Fork Skykomish River	12134000	At Town of Index	1911-1922 1930-1938 1947-1948	
North Fork Stillaguamish River	12167000	Near City of Arlington At City of Arlington	1928-1975 1928-1976[1]	
Penny Creek	12125800	Near City of Everett	1985-1986 1989-1990	5.6
Pilchuck River	12152500	Near Town of Granite Falls	1944-1971	
Raging River	2145500	Near City of Fall City	1946-1988	30.60
Skykomish River	12134500	Near City of Gold Bar	1929-1976	

[1]Gage is a U.S. Weather Bureau manually operated wire-weight gage. Records are discontinuous and only stages are reported.

Table 5. Stream Gaging Stations Operated by the USGS and Periods of Record Analyzed for Detailed Studies (Cont'd)

Name	USGS Gage No.	Location	Period of Record	Drainage Area (Square Miles)
Snohomish River		At City of Snohomish Near City of Monroe	1942-1965 1930-1963 1964-1975 1976 (Computed)	
Snoqualmie River	12149000	Near Town of Carnation	1930-1976	
South Fork Skykomish River	12133000 12130500	Near Town of Index Near Town of Skykomish	1914-1976 1930-1931 1947-1970	
South Fork Stillaguamish River	12161000	Near Town of Granite Falls Above Jim Creek	1928-1976 1937-1957	
Squire Creek	12165000	Near Town of Darrington	1951-1969	
Stillaguamish River		At City of Arlington	1928-1976[1]	
Sultan River	12137500	Near community of Startup Near City of Sultan	1935-1974 1912 1917-1927 1930-1932	
Swamp Creek	12127100	At community of Kenmore	1964-1990	23.10
Wallace River	12135000	At City of Gold Bar	1959-1976	

[1]Gage is a U.S. Weather Bureau manually operated wire-weight gage. Records are discontinuous and only stages are reported.

Because floodflows on the Snohomish River are dependent on timing and magnitude of coincident events on the Skykomish and Snoqualmie Rivers, the 13 years of record at the gaging station near the City of Monroe (1964 to 1976) was considered too short a period for determining a representative frequency curve. Therefore, the effective period of record for the Snohomish River near the City of Monroe gage was extended to 47 years by reconstituting major flood events from 1930 to 1963 using the Streamflow Synthesis and Reservoir Regulation computer model (Reference 70). The model routed streamflows from the gages on the Skykomish River near the City of Gold Bar and the Snoqualmie River near the Town of Carnation in King County to the confluence at the City of Monroe. Local inflow between these locations was estimated by adjusting streamflows on the South Fork Stillaguamish River near the Town of Granite Falls to simulate tributary response and volume. The model was calibrated by adjusting routing coefficients to assure acceptable reproduction of 15 flood events.

Except for the December 1975 flood, the computed peaks were within 5 percent of the published flows. Further studies of the December 1975 flood event involving comparisons of runoff volume and an analysis of the rating curve for the gaging station indicated that the flood was much greater than the published peak of 115,000 cfs and was subsequently increased to 140,000 cfs for the study. This revision of the published peak was discussed with the USGS.

Determining a representative frequency curve for the Snohomish River at the City of Snohomish is complicated by the fact that the floodplain has undergone considerable hydrologic changes due to levee raising and construction. The last major floods in the Snohomish River valley, gaged at the Snohomish River at the City of Snohomish gage, occurred in November and December 1959; however, the present floodplain development was not completed until the French Creek levees were constructed and the Marshland levees raised in the early 1960s. For this reason, a standard statistical analysis of the published discharge records would not be appropriate because they do not reflect existing floodplain effects on peak discharge at the City of Snohomish. The significance of these improvements on peak flows was evaluated by means of a Simulated Open-Channel Hydraulics, Multiple Junction unsteady flow model (Reference 87). The unsteady model was calibrated to the December 1975 and January 1974 floods and used to determine stream retention and peak attenuation with present floodplain conditions. Floodflow frequencies were determined by routing hypothetical floods from the gages near the City of Monroe to the City of Snohomish, with coincident local inflow from the Pilchuck River and other small drainageways.

The water-supply reservoirs on the Sultan and Tolt Rivers provide regulatory effect at low flows and have reduced some flood peaks. However, because of limited outlet capacity, the availability of storage to control large floods is uncertain; therefore, no flood reduction was attributed to these reservoirs in development of discharge-frequency relationships.

More intensive land use, limited to lower, flatter portions of the basins, is considered to have had negligible effect on basin storm-runoff response. Levee construction and floodplain development in the Snohomish River valley affect stage-discharge relationships and peak flows, and these changes were evaluated by appropriate mathematical models.

The Snohomish River discharge-frequency relationship for the City of Everett FIS was based on statistical analyses of 23 years of record (1942 to 1965) at the Snohomish River at the City of Snohomish gage. In 1973, when the analyses were completed, it was believed that this record represented existing Snohomish River conditions; however, the December 1975 flood indicated a discrepancy between the City of Monroe and the City of Snohomish gage readings. Further analyses of the 1975 flood and other floods led to the conclusion that levee construction after the 1959 floods had increased the bankfull capacity upstream from the City of Snohomish gage from approximately 60,000 cfs to approximately 125,000 cfs. The higher levees restrict overflow into the Marshland and French Creek areas, which reduces the attenuating effect of valley storage, leading to higher peak discharges. Because the Snohomish gage record does not reflect present overflow conditions, it was decided to use the gage record at the City of Monroe, which is upstream from the City of Snohomish gage and not as affected by the changed valley storage conditions downstream. A discharge-frequency curve was developed for the City of Monroe gage by the statistical analyses of both observed (1964 to the present) and computed (1930 to 1963) peak discharges. The frequency statistics were adjusted for historical peak discharges occurring in 1897, 1906, 1918, and 1921 to increase the effective period of the data base to over 80 years.

The discharge frequencies at the City of Snohomish were determined by routing hypothetical floods from the City of Monroe using an unsteady flow model to reflect the changed floodplain conditions. As a result of this analysis, the 1-percent-annual-chance flood discharge at the City of Everett increased from 144,000 to 170,000 cfs, which resulted in a stage increase from 17.7 to 20 feet. Although the increase is primarily due to the changed flow conditions, some of the increase is probably due to the extended base period developed for the City of Monroe gage.

Recorded streamflow data are available from a number of gages in the North Creek catchment, as shown in Table 5, "Stream Gaging Stations Operated by the USGS and Periods of Record Analyzed for Detailed Studies." The upstream limit of the North Creek study reach is the King-Snohomish County line, which is approximately 1,500 feet and 3.5 miles downstream from Gage Nos. 12126100 and 12126000, respectively.

Previous analyses of the magnitude and frequency of flows have been based largely on the record of flows collected between 1946 and 1974 at Gage No. 12126000. The 1-percent-annual-chance flow has been estimated from this record as approximately 630 cfs (Reference 92). A limited record is available for Gage No. 12126100, but it is too short to provide a direct basis for frequency analysis.

Up until the closure of Gage No. 12126000 in 1974, land use within the North Creek catchment was primarily agriculture and forestry. Since that time, considerable urban and suburban development has significantly changed the hydrologic regime of the basin. As a result, the available discharge record collected prior to 1974 at Gage No. 12126000 is no longer suitable for characterizing the existing magnitude and frequency of flows.

A detailed hydrologic study has been completed on North and Scriber Creeks using the Environmental Protection Agency (EPA) Hydrologic Simulation Program FORTRAN (HSPF) (Reference 98). HSPF is a continuous deterministic hydrologic simulation program that transforms long-time series of rainfall and evaporation data into corresponding streamflow time series. The model is particularly useful for assessing the impacts of land-use change on the hydrologic regime of streams. The model has seen extensive use by governmental agencies in western Washington. Of particular interest in this regard is the research effort undertaken by the USGS to develop regional parameter estimates for HSPF for western King and Snohomish Counties (Reference 96).

The HSPF model of North Creek was initially calibrated against streamflow data collected during water years 1985 to 1986 at several gage sites, including Gage No. 12126100. Land-use data for the calibration period were obtained from aerial photographs taken in 1985. The calibration period included the severe event of January 18, 1986, in which approximately 2.6 inches of rain fell in 18 hours (approximately a 25-year rainfall event). This event produced a recorded peak flow of 914 cfs at Gage No. 12126100.

The calibration model was based on 1985 land-use data. Rapid development continued to take place within the North Creek basin after 1985, and the land-use data used in the calibration model did not accurately represent current basin characteristics. The effects of continued rapid development were accounted for by verifying the model against streamflow data collected by Snohomish County in 1989 and 1990. The model, using 1989 to 1990 rainfall data with 1985 land-use data, consistently undersimulated peak flows recorded in 1989 and 1990. Therefore, the 1985 land-use data were adjusted to allow reasonable simulation of 1989 to 1990 streamflow data. The adjusted model was used to represent existing hydrologic conditions.

To develop flood-frequency curves, the North Creek HSPF model was run with 39 years of 15-minute rainfall and daily-evaporation data (1949 through 1987). The rainfall data were collected at the NWS Seattle-Tacoma Airport station and evaporation data at the NWS Puyallup 2W station. These data were adjusted to represent conditions in the North Creek basin. The resulting 39-year time series of simulated North Creek streamflows at 240th Street Southeast were then subjected to frequency analysis. A log-Pearson Type III distribution was fitted to the annual maxima of the simulated streamflow data using procedures from Water Resources Council Bulletin No. 17B, "Guidelines for Determining Flood Flow Frequencies" (Reference 99), and the magnitudes of flows with return periods of 10, 50, 100, and 500 years were determined.

There are no gaging stations on the Sauk River near the study area at the Town of Darrington. Floodflows were derived from discharge-frequency relationships by adjusting for drainage area, rainfall intensity, and significant retention areas.

Hourly rainfall data for hydrologic modeling were obtained from Sea-Tac Airport for the period of October 1961 through September 1989, for a total of 28 water years. The Sea-Tac gage is the closest hourly rainfall gage to North and Scriber Creeks with a long, high-quality record. Other long-term records available within the City of Lynnwood vicinity are limited to daily observations. Daily rainfall data are available from the City of Everett, for the approximate period of 1949 to the present. Comparison of daily rainfall data from the City of Everett and Sea-Tac suggests that the relationship between rainfall at Sea-Tac and at the City of Everett is quite complex and not well correlated. Although the average annual rainfall for the two stations is similar, the City of Everett experiences wetter summer months and drier winter months than Sea-Tac. Examination of daily records also shows that, on a daily basis, Sea-Tac experiences greater rainfall amounts in severe rainstorms than the City of Everett. Frequency analyses were performed on the annual maximum daily rainfall data from these two stations for water years 1961 to 1986. On the basis of these results, the hourly rainfall data from Sea-Tac were transposed to the City of Lynnwood by multiplying by a factor of 0.85. This produces annual maximum daily rainfall depths intermediate between Sea-Tac and the City of Everett (as desired), but probably results in underestimation of summer rainfall amounts.

A hydrologic analysis for Swamp Creek was performed by the USACE, Seattle District (Reference 71), based on an analysis of 27 years of USGS streamflow records at a gage site located on the Bothell Way Bridge at the community of Kenmore (Gage No. 12127100). This gage is located 0.5 mile above the confluence with the Sammamish River and measures runoff from a drainage area of 23.1 square miles (Reference 95).

The USACE HEC-WRC Floodflow Frequency Analysis Computer Program (Reference 67) was used to determine the discharge-frequency relationships for the Swamp Creek peaks. This program applies log-Pearson Type III analysis techniques in accordance with methods presented in Water Resources Council Bulletin No. 17B, "Guidelines for Determining Flood Flow Frequencies" (Reference 99).

The hydrologic analysis for Scriber Creek, from approximately 2,400 feet downstream of 44th Avenue West to the City of Lynnwood corporate limits, was performed using the EPA HSPF (Reference 98).

Stillwater elevations in coastal areas were developed using 76 years of annual peak tides as recorded at the Seattle Tidal Station (Reference 57) and analyzed using the log-Pearson Type III method, with +0.2 skew. These values were then transferred to other coastal areas of Snohomish County by using tide-prediction tables (Reference 58). Wave runup was determined by comparing the high-water-mark elevations of two storms against the record high-tide levels as transferred from Seattle.

Elevations for floods of the selected recurrence intervals on all tidal areas are shown in Table 6, "Summary of Elevations."

A review of tsunami studies and data indicated that tsunamis are not a significant factor in coastal flooding of Snohomish County.

Peak discharge-drainage area relationships for the flooding sources studied by detailed methods are shown in Table 7, "Summary of Discharges."

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data table in this FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

Hydraulic analyses of the shoreline characteristics of the flooding sources studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the shorelines.

A detailed wave-runup analysis was conducted for the City of Everett only. No detailed wave-runup analysis was conducted for the remaining Snohomish County coastal areas, but previous studies indicated an average wave runup of 1.5 feet for moderately exposed reaches in northern Puget Sound.

The Snohomish County shoreline was divided into exposed or sheltered reaches, and 1.5 feet were added to the 1-percent-annual-chance tidal stage for the exposed reaches. In sheltered reaches no runup factor was added. The methods used for tidal flooding were approved by FEMA.

Water-surface elevations (WSELs) for floods of the selected recurrence intervals along Canyon Creek; Hat Slough; May Creek; North Fork Skykomish, North Fork Stillaguamish, Pilchuck, Sauk, Skykomish, and Snoqualmie Rivers; South-Cook Slough; South Fork Stillaguamish, Stillaguamish, and Sultan Rivers; Swamp Creek; and Wallace River were computed by step-backwater computations using a computer program (722-K5-G311) developed by the USACE, Seattle District, that computes both natural and floodway WSELs using the principles of Method II in USACE Engineering Manual 1110-2-1409, "Engineering and Design - Backwater Curves in River Channels" (Reference 65).

Flood elevations for the Stillaguamish River, from RM 0.0 to RM 11.1, and for the Snohomish River were calculated using the multiple-junction unsteady flow model that simulates complex unsteady flow conditions using a hydraulic routing procedure based on the St. Venant equations, the basic differential equations of unsteady flow. The program requires time-dependent input of stage or discharge at the outer model boundaries to calculate the resultant stage, discharge, and velocity hydrographs at the interior computational nodes. For the Snohomish River, the 1-percent-annual-chance flood profile developed by the "unsteady state" method was used to calibrate a step-backwater model that was used to calculate the floodway profile.

For flood profile calculations, channel and overbank roughness factors (Manning's "n" values) were initially based on empirical methods, then adjusted as necessary during model calibration. Field inspections and photographs aided the "n" value determination. Roughness values for the flooding sources studied by detailed methods are shown in Table 8, "Manning's "n" Values."

Table 6. Summary of Elevations

Flooding Source and Location	Water Surface Elevations (Feet NAVD[3]) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Port Susan				
At City of Stanwood	11.8	_[1]	12.7	_[1]
At Hat Slough	12.4	_[1]	13.2	_[1]
Possession Sound				
At Port Gardner Bay	11.7	_[1]	12.3	_[1]
At City of Everett	11.7	12.1	12.2	12.5
At mouth of the Snohomish River and U.S. Interstate 99	11.7[2]	12.2[2]	12.3[2]	12.6[2]
At intersection of Everett Avenue and West Marine View Drive, at City of Everett	11.7[2]	12.0[2]	12.2[2]	12.5[2]
Approximately 400 feet north of intersection of North Park Drive and Olympic Boulevard, at City of Everett	11.8[2]	12.2[2]	12.3[2]	12.6[2]
At the corporate limits of City of Everett	12.1[2]	12.4[2]	12.6[2]	12.8[2]
At City of Mukilteo	13.2	_[1]	13.8	_[1]
Puget Sound				
At City of Edmonds	13	_[1]	13.6	_[1]
Skagit Bay				
At West Pass	11.9	_[1]	12.7	_[1]
At Douglas Slough	12.9	_[1]	13.7	_[1]
At Tom Moore Slough	13.9	_[1]	14.7	_[1]
Snohomish River				
At Ebey and Steamboat Sloughs	11.6	11.9	12.2	_[1]
Stillaguamish River				
Near 84th Avenue Northwest, at City of Stanwood	12.4	12.7	13.2	13.5

[1] Data not available

[2] Includes effects of wave runup

[3] North American Vertical Datum of 1988

Table 7. Summary of Discharges

Flooding Source and Location	Drainage Area (Sq. Mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Canyon Creek					
At mouth	62.4	9,550	12,400	13,700	16,300
Below Mud Lake Outlet	52.5	8,500	11,000	12,200	14,500
Above Mud Lake Outlet	47.0	7,540	9,800	10,800	12,900
At RM 8	43.5	7,260	9,420	10,400	12,400
May Creek					
At mouth	9.8	1,870	2,430	2,660	3,210
At RM 3.66	7.2	1,370	1,820	2,010	2,550
North Creek					
At 240th Street Southeast (Gage No. 12126100)	27.6	958	1,290	1,440	1,810
Upstream of confluence of Palm Creek	--[1]	840	1,130	1,260	1,580
At 220th Street Southeast	--[1]	750	1,020	1,140	1,420
Upstream of 214th Street Southeast	--[1]	710	960	1,060	1,310
North Fork Skykomish River					
RM 0-4	147	25,300	36,700	42,000	54,700
RM 4-8	--[1]	--[3]	--[3]	42,000	--[3]
North Fork Stillaguamish River					
At mouth	284	28,100	30,300[2]	31,100[2]	32,100[2]
At Gage No. 1670, near City of Arlington	262	28,100	0,300[2]	31,100[2]	32,100[2]
Below Deer Creek	239	27,300	31,900	33,800	37,300
Above Deer Creek	172	21,400	24,800[2]	26,400[2]	28,900[2]
Below Boulder River	139	20,800	27,900	31,000	37,800
Above Boulder River	113	17,600	23,400	26,200	31,500
Below Squire Creek	83.0	17,100	24,800	27,500	35,400
Above Squire Creek	58.0	14,000	20,400	22,800	29,600
At RM 34.7	49.0	13,000	19,300	21,500	28,000
Pilchuck River					
At mouth	135	8,900[2]	12,100[2]	13,300[2]	17,200[2]
Below tributaries (RM 8.98)	116	9,500	12,500	13,700	17,100
At gage near City of Granite Falls	54.5	7,900	10,500	11,700	14,600

[1]Data not available
[2]Decrease in discharge due to overbank storage
[3]100-Year only, limited detailed study

Table 7. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Sq. Mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Sammamish River					
At mouth	240.0	2,300	3,300	4,300	5,600
Sauk River					
Near community of Sauk	714	52,500	81,000	94,000	129,000
At Town of Darrington	--[1]	--[1]	--[1]	70,000	--[1]
Scriber Creek					
At 196th Street Southwest	1.8	139	171	184	212
At outlet from Scriber Lake	2.4	175	206	216	233
At Interstate Highway 5	3.0	168	190	197	212
Below 44th Avenue West	3.5	222	258	270	292
Skykomish River					
Below Sultan River	724	97,900	139,200	156,900	197,900
Below Wallace River	618	82,900	119,200	133,700	171,900
At gage near City of Gold Bar	535	77,700	113,000	128,000	166,000
At confluence with North and South Fork Skykomish Rivers	509	64,900	95,500	109,800	142,300
At North Fork Skykomish River at mouth	147	20,900	34,500	39,500	51,500
At North Fork Skykomish River at RM 4.00	—[1]	20,900	34,500	39,500	51,500
Snohomish River					
At City of Snohomish	1,729	125,000	141,000[2]	174,000[2]	243,000[2]
Near City of Monroe	1,537	120,700	174,400	196,800	242,900
At City of Everett	—[1]	--[1]	--[1]	170,000	--[1]

[1]Data not available
[2]Decrease in discharge due to overbank storage
[3]100-Year only, limited detailed study

Table 7. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Sq. Mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Snoqualmie River					
Near Snoqualmie	681	51,700	71,100	79,100	95,200
Near Carnation	603	58,200	82,400	91,800	113,300
South Fork Skykomish River					
At Mouth	--[1]	--[3]	--[3]	76,000	--[3]
South Fork Stillaguamish River					
At mouth	256	33,100	41,600[2]	45,000[2]	52,700[2]
Below Jim Creek	250	33,100	42,600	46,000	54,700
Above Jim Creek	203	30,700	39,500	42,700[2]	50,800[2]
At RM 26	196	30,700	39,500	42,700[2]	50,800[2]
Below Canyon Creek	182	30,700	39,900	43,500	52,800
Above Canyon Creek	128	25,200	32,800	36,000	43,500
At Gage No. 1610 near City of Granite Falls	119	25,200	32,800	36,000	43,500
At RM 41	107	25,200	32,800	36,000	43,500
At RM 49	82	19,300	25,100	27,600	33,400
Stillaguamish River					
At mouth	684	58,500	70,000	75,000	82,000
At City of Arlington	539	58,500	70,000	75,000	82,000
Sultan River					
At mouth	106	35,100	51,300	59,100	77,900
At RM 3.28	98	29,000	42,000	48,000	62,000
Swamp Creek					
At Swamp Creek gage at community of Kenmore, at RM 0.5 23.1	23.1	720	980	1,100	1,400
At Snohomish-King County line, at RM 2.3	20.9	660	900	1,010	1,290
Below Scriber Creek, at RM 4.5	18.2	590	800	900	1,140
Above Scriber Creek, at RM 4.5	13.0	440	600	670	850
At County Road No. 459 (Larch Way), at RM 5.4	11.7	400	540	610	780
At Interstate Highway 5 bridge, at RM 7.7	8.4	310	410	460	580

[1]Data not available
[2]Decrease in discharge due to overbank storage
[3]100-Year only, limited detailed study

Table 7. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Sq. Mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Wallace River					
At mouth	58.4	7,470	9,560	10,450	12,600
Below Bear Creek	55.7	9,990	13,200	14,600	18,600
Below May Creek	50.4	9,290	12,300	13,600	17,300
Below Olney Creek	40.6	7,470	9,890	10,900	13,900
At gage near City of Gold Bar	19.0	3,550	5,050	5,580	7,090
At RM 7.24	17.5	3,350	4,440	4,910	6,240
Wagleys Creek					
At Mouth	--[1]	--[3]	--[3]	320	--[3]
Woods Creek					
RM 0-1	--[1]	2,390	3,150	3,470	4,290
RM 1-2	--[1]	--[3]	--[3]	3,470	--[3]

[1]Data not available
[2]Decrease in discharge due to overbank storage
[3]100-Year only, limited detailed study

Table 8. Manning's "n" Values

Flooding Source	Roughness Coefficients Channel	Roughness Coefficients Overbanks
Canyon Creek	0.020 to 0.067	0.040 to 0.150
Ebey Slough	0.036 to 0.070	0.036 to 0.070
Ebey Steamboat Connector	0.036 to 0.070	0.036 to 0.070
Hat Slough	0.020 to 0.067	0.040 to 0.150
Marshland	0.036 to 0.070	0.050 to 0.070
May Creek	0.020 to 0.067	0.040 to 0.150
North Creek	0.035 to 0.070	0.045 to 0.150
North Fork Skykomish River	0.020 to 0.067	0.040 to 0.150
North Fork Stillaguamish River	0.020 to 0.067	0.040 to 0.150
Pilchuck River	0.020 to 0.067	0.040 to 0.150
Sammamish River	0.035 to 0.045	0.040 to 0.150
Sauk River	0.020 to 0.067	0.040 to 0.150
Scriber Creek	0.040 to 0.060	0.040 to 0.110
Skykomish River	0.020 to 0.067	0.040 to 0.150
Snohomish River	0.035 to 0.045	0.050 to 0.070
Snoqualmie River	0.020 to 0.067	0.040 to 0.150
South Fork Stillaguamish River	0.020 to 0.067	0.040 to 0.150
South-Cook Slough	0.020 to 0.067	0.040 to 0.150
Steamboat Slough	0.036 to 0.070	0.036 to 0.070
Stillaguamish River	0.020 to 0.067	0.040 to 0.150
Sultan River	0.020 to 0.055	0.050 to 0.090
Swamp Creek	0.030 to 0.086	0.068 to 0.099
Wallace River	0.020 to 0.067	0.040 to 0.150

Numerical models for the rivers identified above were calibrated to the following conditions:

1. Snohomish River reach from RM 0.0 to RM 20.5 -- 93 percent of the observed WSELs of the December 4, 1975, flood (126,000 cfs at mouth, 20-year recurrence interval) were reproduced within approximately 0.8 foot.

2. Snoqualmie River reach from RM 0.0 to RM 6.1 -- all four of the observed WSELs of the December 4, 1975, flood were reproduced within approximately 0.5 foot. However, backwater from the Snohomish River caused stages of approximately a 1-percent-annual-chance magnitude on the Snoqualmie River from RM 0.0 to approximately RM 7.0.

3. Skykomish River reach from RM 20.51 to RM 47.1 -- 20 observed WSELs of the December 3, 1975, flood (76,000 cfs near the City of Gold Bar, 10-percent-annual-chance recurrence interval) were reproduced as follows: 28 percent within approximately 0.1 foot, 28 percent within approximately 1 foot, 22 percent within approximately 1.5 feet, 12 percent within approximately 2 feet, and 10 percent within approximately 3.1 feet.

   The failure to reproduce many of the 1975 high-water marks is considered to be the result of channel changes between the 1975 flood and 1977, when the cross sections were taken and localized buildup during the 1975 flood. The Skykomish River is very prone to channel shifting.

   4.Pilchuck River reach from RM 0.0 to RM 19.0 -- all of the observed WSELs of the January 1972 and December 1972 floods (4,000 and 5,400 cfs at confluence with the Snohomish River, 2-year recurrence intervals) were reproduced within approximately 0.5 foot.

5. Stillaguamish River reach from RM 0.0 to RM 11.1 -- all 15 observed WSELs of the December 2, 1975, flood (approximately 62,000 cfs at the City of Arlington, 15-year recurrence interval) were reproduced within approximately 0.7 foot, of which the majority were within approximately 0.2 foot.

6. Stillaguamish River reach from RM 11.1 to RM 17.8 -- all of the observed WSELs of the January 1961 flood (47,000 cfs near the City of Arlington, 3-year recurrence interval) were reproduced within approximately 0.2 foot.

7. South Fork Stillaguamish River reaches from RM 0.0 to RM 27.1, from RM 30.4 to RM 34.1, and from RM 41.3 to RM 48.7 -- all of the observed WSELs of the December 2, 1977, flood (24,500 cfs at confluence with the main stem, 3-year recurrence interval) were reduced within approximately 0.5 foot.

8. Sultan River reach from RM 0.0 to RM 3.3 -- six of the seven observed WSELs of the December 4, 1977, flood (18,600 cfs at confluence with the Skykomish River, 3-year recurrence interval) were reproduced within 0.8 foot; the seventh observed WSEL was classified as not reliable.

9. Wallace River reach from RM 0.0 to RM 7.3 -- all of the observed WSELs of the December 1977 flood (3,500 cfs at the USGS gaging station at RM 5.79 and 9,500 cfs at the mouth, 9-year recurrence interval) were reproduced within approximately 1 foot.

10. Sauk River reach from RM 17.0 to RM 24.7 -- all seven of the observed WSELs of the December 4, 1975, flood (30,000 cfs at confluence with the Skagit River, 2-year recurrence interval) were reproduced within approximately 0.5 foot.

11. North Fork Skykomish River and May and Canyon Creeks.

Because there are no observed high-water marks for these streams, the models were calibrated with low and full-bank flows to obtain a reasonable and smooth water-surface profile.

Starting WSELs for the rivers studied in detail were established by a rating curve for the coincident discharge of the main stem associated with the event being analyzed on the tributary, with the following exceptions:

1. The Skykomish, Upper Stillaguamish, and Sauk Rivers starting elevations were obtained from backwater runs for the downstream reach of each river.

2. Snohomish River starting elevations were based on a mean higher high-tide elevation of 5 feet.

3. South Fork Stillaguamish River starting elevations at RM 30.4 and RM 41.3 were computed by the slope-area method.

4. North Fork Skykomish River starting elevations were computed by the slope-area method and a rating curve.

5. Stillaguamish River from RM 0.0 to RM 11.1 -- with the unsteady state method, hydrographs are used instead of single starting elevations as in the step-backwater method. Water-surface profiles for tidal flooding were computed from stage hydrographs of selected recurrence interval tides, with a coincident river hydrograph for a 2-year event. Profiles for river flooding were computed from discharge hydrographs of the selected recurrence interval river flood with stage hydrographs of the most probable coincident tide. A review of flood profiles from tidal river floods showed that tidal flooding produced the most extensive flood conditions downstream from RM 5.6 and from Hat Slough RM 0.0 to RM 0.75, and river flooding dominates upstream from RM 5.6. This combination of flood profiles described the most extensive flooding conditions for the Stillaguamish River between RM 0.0 and RM 11.1.

Examination of the backwater analyses for Canyon Creek showed that flow conditions are unstable. High velocities and numerous supercritical flow conditions were encountered. To determine stable WSELs in this reach, a factor of 0.4 of the velocity head was added to the computed critical depth (Dc) WSELs. This is based on the theory that flow must be greater than 1.1 Dc to be stable (Reference 66).

Flow on the main stem of the Stillaguamish River in excess of 66,000 cfs will overtop the right bank near RM 17.2 and spill back into the main channel near RM 14.2. This is the

Stillaguamish River Split Flow. The overtopping flow for the 1-percent-annual-chance flood was computed, and the water-surface profiles and floodplain reflect these reductions and increases of flow near RM 17.2 and RM 14.2, respectively.

WSELs along Scriber Creek were computed using the USACE HEC-2 computer program (Reference 68), while the various culverts along the study reach were modeled using the Federal Highway Administration (FHA) HY8 culvert analysis program (Reference 97).

Cross-section data for the backwater analyses of Scriber Creek were obtained from field surveys performed by Lovell-Sauerland & Associates in May 1990. The survey crews obtained data at 30 channel and floodplain cross sections throughout the study reach. Cross-section data for the extremities of the floodplain for a few sections were taken from detailed topographic maps of the area.

Starting WSELs for Scriber Creek at the downstream boundary of the study reach were determined based on normal-depth computations. Surveys just downstream of 44th Avenue West indicated a very flat or, for a small distance, adverse channel bottom slope. Thus, to ensure normal depth at the beginning of the computations, the downstream limit was extended approximately 2,400 feet downstream of 44th Avenue West, where the channel slope is steeper.

Much of the Scriber Creek floodplain is heavily wooded wetlands, particularly from the downstream limit to 200th Street Southwest. Upstream of 44th Avenue West, the WSELs are relatively insensitive to channel or overbank roughness, because it is controlled primarily by culvert characteristics and top-of-road elevations.

Scriber Creek contains one bridge (old 196th Street Southwest) and seven culvert crossings. WSELs at the bridge were computed using the special bridge routine of the USACE HEC-2 computer program. This bridge is low, and pressure flow occurs. The culverts were analyzed using the FHA HY8 culvert analysis program. Given the culvert properties, the roadway profile for overtopping, and the tailwater conditions, a rating curve was developed for each culvert giving the headwater elevations. The HEC-2 computer model and HY8 culvert analysis program were integrated to determine the water-surface profile in the following manner. Given the normal depth at the downstream boundary, the water depths were computed upstream to the first culvert (44th Avenue West) using HEC-2. The HY8 culvert analysis program was then used to compute the headwater rating curve at the culvert using the last HEC-2 computed depth as the tailwater condition. The headwater rating curve was then used to begin the HEC-2 computations for the next length of creek (to next culvert). This process was repeated throughout the entire study reach for each recurrence interval flow. Data needed for each culvert include the inlet type, culvert dimensions, entrance and exit invert elevations, and roadway profiles above the culverts. Inlet types were determined by field inspections. Inlet elevations downstream of Scriber Lake and all culvert dimensions were obtained from a study by R.W. Beck and Associates (Reference 49). Inlet elevations upstream of Scriber Lake and all roadway profiles were surveyed by Lovell-Sauerland & Associates.

The hydraulic analysis of North Creek has detailed and approximate components. The USACE HEC-2 computer program (Reference 68) was used to determine if existing levees meet FEMA freeboard requirements, and to estimate floodplain and floodway boundaries downstream of Interstate 405. Complex hydraulic conditions exist upstream of Interstate 405 and, as a result, only approximate analyses of portions of the east overbank were completed.

The physical geometry of the North Creek channel was represented by cross sections surveyed between November 1990 and January 1992. Only the channel itself (i.e., between levees) was surveyed. Channel overbank geometry (i.e., landward of levees) was estimated from 2-foot contour mapping provided by the City of Bothell Department of Public Works (Reference 6).

Eight bridges are modeled in the North Creek hydraulic analysis. The data used to define these structures were obtained from field surveys and/or from information provided by private developers and FEMA.

Roughness coefficients (Manning' "n" values) used in the North Creek HEC-2 model were initially determined by calibrating the model to conditions observed in the field on January 28, 1992. These values were then adjusted using engineering judgment and reference to classical publications (Reference 5) to represent conditions that would be expected during a 1-percent-annual-chance flood.

To determine if the existing levees that confine North Creek meet FEMA freeboard requirements, the 1-percent-annual-chance water-surface profile was calculated using the HEC-2 model (Reference 68). FEMA requires levees to provide a minimum of 3 feet of freeboard (defined as levee height above the 1-percent-annual-chance profile), and 4 feet of freeboard within 100 feet of a bridge.

The calibrated HEC-2 model for North Creek was used to compute the 1-percent-annual-chance water-surface profile corresponding to a discharge of 1,440 cfs, assuming the flow was confined between levees. This revealed that flow could overtop the levees at several locations. The model was then modified to employ the HEC-2 split-flow option so that the quantity of flow lost at each overtopping site could be estimated and the channel flow adjusted accordingly. Upon completion of this analysis, which showed that the levees do not meet FEMA freeboard requirements, the following two analyses were performed:

1. Remove the entire west levee from the HEC-2 model and compute the 1-percent-annual-chance profile and floodplain boundary (leaving the east levee in place).

2. Remove the entire east levee from the HEC-2 model and compute the 1-percent-annual-chance profile and floodplain boundary (leaving the west levee in place).

For the condition along North Creek with an ineffective east levee, several methods were used to evaluate flooding. For the area downstream of Interstate 405, the HEC-2 model was used to calculate the 1-percent-annual-chance profile. Prior to this analysis, a separate HEC-2 analysis was required to estimate the 1-percent-annual-chance discharge entering this reach. Using the split-flow option of the HEC-2 model, this discharge was estimated assuming both levees upstream of Interstate 405 would remain in place and would withstand levee overtopping.

The North Creek east levee upstream from Interstate 405 is expected to overtop near Cross Section P and fail during a 1-percent-annual-chance flood event. This would allow nearly all flow to leave the channel and flow to the south, where it would collect and pond in the area confined by State Route 522 to the south, Interstate 405 to the west, and high terrain to the east. To determine an approximate maximum ponding elevation in this area for a 1-percent-annual-chance event, an approximate analysis of ponding was performed with the USACE HEC-1 model (Reference 69). The HEC-1 model was based on the following data: 1) a 1-percent-annual-chance flood hydrograph, 2) pond outflow rating curve, and 3) pond storage/elevation data. The 1-percent-annual-chance flood hydrograph is an approximation of that determined by the HSPF simulation (Reference 98). The outflow rating curve was estimated by combining rating curves for four culverts, which drain the pond area, with a rating curve for the North Creek channel at the North Creek Parkway south bridge (at this location, flow would be likely to re-enter the creek channel as the water level rises in the pond area). Storage/elevation data were estimated from the City of Bothell topographic maps. HEC-1 ponding simulations used the modified-Puls routing procedure. The 1-percent-annual-chance water-surface profile east of the channel upstream of Cross Section P was calculated using the HEC-2 model. The starting WSEL for this study reach just downstream of Cross Section P was assumed to be the maximum level of ponding determined by the HEC-1 analysis.

For all streams having detailed study reaches, all channel cross sections were field surveyed, and most overbank sections were developed photogrammetrically. Most of the cross sections were taken between 1971 and 1980, except on the Snoqualmie River, where all eight cross sections were taken in 1961; on the Skykomish River, where 26 of 57 cross sections were taken in 1961; on the Stillaguamish River between RM 11.1 and RM 17.75, where 6 of 15 cross sections were taken in 1962; and on the South Fork Stillaguamish River, where 9 of 65 cross sections were taken in 1963. All bridges were field surveyed to obtain elevation data and structural geometry.

RM stationing shown on tables and profiles in this study was established by interpolating between key landmarks, such as bridges, for which RM stationing is specified in the RM index (References 43 and 8). Because of channel changes and the extreme meandering nature of some streams since the index was established, the published distances between index stations do not always scale out on the maps. In such cases, the measured flow-line distances between cross sections were used in the backwater computations, rather than the stationing distances.

Flood profiles were drawn showing computed WSELs to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

Floodplain boundaries for some areas studied by approximate methods were taken from previously published FHBMs (References 60,through 63) and revised when necessary after field examinations and conversations with local residents.

The approximate 1-percent-annual-chance flood elevations for the Boulder River and French Creek were computed using the USACE HEC-2 computer program (Reference 68).

Floodplain boundaries for areas determined by approximate methods within the City of Everett were determined from historical references.

The approximate hydraulic analysis for an overflow area of the Sultan River was based on field investigations, in conjunction with topographic data (Reference 72).

For the approximate studies of Horse Creek, 96th Avenue Northeast drainage, and overflow from North Creek, 1-percent-annual-chance flood boundaries within the City of Bothell were determined on the basis of limited field inspections. Localized flooding on Horse Creek results from backwater at inadequate culverts or pipes (Reference 7).

WSELs of floods of the selected recurrence intervals along Swamp Creek were computed using the USACE HEC-2 computer program (Reference 68). Flood profiles were drawn showing computed WSELs for floods of the selected recurrence intervals.

Starting WSELs for Swamp Creek, beginning at the Snohomish-King County boundary, were obtained from the FIS for King County, Washington, dated September 29, 1989 (Reference 19), which ended at this location.

Roughness coefficients (Manning's "n" values) used in the hydraulic computations for Swamp Creek were chosen using engineering judgment and based on field observations of Swamp Creek and the floodplain areas.

The detailed hydraulic analysis of Scriber Creek was prepared by Northwest Hydraulic Consultants, Inc. The USACE HEC-2 computer program (Reference 68) was used to develop the hydraulic analyses, and culverts along the study reach were analyzed using the FHA HY8 culvert analysis program (Reference 97).

Locations of selected cross sections used in the hydraulic analyses for all streams, with the exception of the Stillaguamish River Split Flow, are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (FIRM) (Exhibit 2).

The Stillaguamish River Split Flow 1-percent-annual-chance floodplain is inundated by the Stillaguamish River floodplain; therefore, it was decided by FEMA to delete the Stillaguamish River Split Flow profile from the Stillaguamish River hydraulic analysis and profiles.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs, including are being prepared using NAVD88 as the referenced vertical datum.

All elevations for the flooding sources within Snohomish County and Incorporated Areas in this FIS report and on the FIRM have been converted from the NGVD29 and are referenced to the NAVD88. The Conversion Factors are shown in Table 9, "Conversion Factors for Flooding Sources" to illustrate the values of the Vertical Datum Change.

Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data and Density Fringe Data tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the NGVD29 and NAVD88, or to obtain current elevation, description, and/or location information for bench marks, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
(301) 713-4172 (fax)

Table 9. Conversion Factors for Flooding Sources

Flooding Source	Elevation (feet NAVD above NGVD)
Riverine Studies	
Canyon Creek	+3.8
Ebey Slough	+3.7
Ebey-Steamboat Slough Connector	+3.7
Hat Slough	+3.7
Marshland	+3.7
May Creek	+3.8
North Creek	+3.7
North Fork Skykomish River	+3.9
North Fork Stillaguamish River	+3.8
Pilchuck River	+3.7
Sauk River	+3.8
Scriber Creek	+3.6
Skykomish River	+3.7
Snohomish River	+3.7
Snoqualmie River	+3.6
South-Cook Slough	+3.7
South Fork Stillaguamish River	+3.8
Steamboat Slough	+3.7
Stillaguamish River/Lower Stillaguamish River	+3.7
Sultan River	+3.7
Swamp Creek	+3.6
Union Slough	+3.7
Wallace River	+3.7
Tidal Areas	
Port Susan	+3.7
Possession Sound	+3.8
Puget Sound	+3.6
Skagit Bay	+3.7
Snohomish River	
At Ebey and Steamboat Sloughs	+3.7
Stillaguamish River	
Near 84th Avenue NW, at City of Stanwood	+3.7

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this county. Interested individuals may contact FEMA to access these data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides 1-percent-annual-chance (100-Year) flood elevations and delineations of the 1- and 0.2-percent-annual-chance (500-Year) floodplain boundaries and 1-percent-annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, Floodway Data Table, and Summary of Stillwater Elevations Table. Users should reference the data presented in the FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at scales of 1:1,200, 1:2,400, 1:4,800, 1:12,000, and 1:24,000, with contour intervals of 2, 5, 10, 20, 40, and 80 feet (References 4,36,38, 73, 88,89,74,75,101 and 102,).

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH and AO), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM (Exhibit 2).

Approximate tidal flooding boundaries in unleveed areas were derived from inundation maps published in the "Coastal Zone Atlas of Washington" (Reference 52), which were based on field observations following an extremely high tide in December 1977. In leveed areas, where the upland areas are subject to flooding from the Stillaguamish River, the levee was used as the boundary between tidal and riverine flooding and rate zones.

Approximate 1-percent-annual-chance floodplain boundaries in the Hall Lake area were taken directly from the previous FIRM for the City of Lynnwood, which used the boundaries from the previous FHBM for the City of Lynnwood.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 8, "Floodway Data"). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the WSEL of the 1-percent-annual-chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

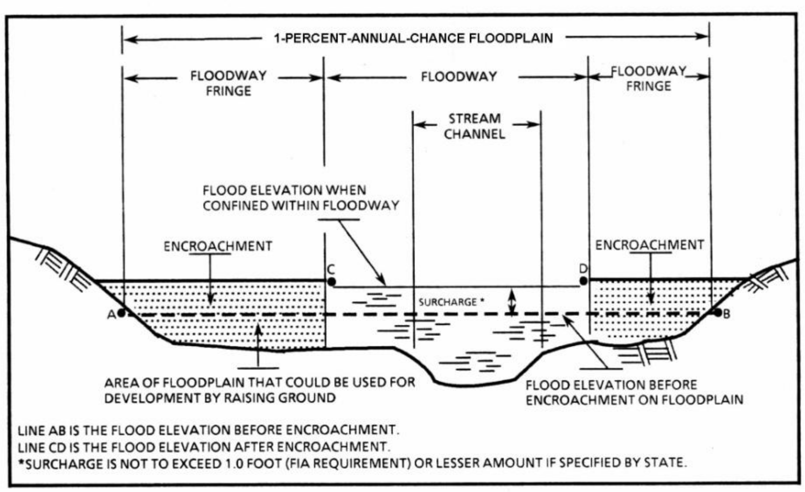

Figure 1. Floodway Schematic

Except for the lower Snohomish and Sauk Rivers, the floodways presented in this study were computed on the basis of equal-conveyance reduction from each side of the floodplain.

No floodway was developed for Hat or South-Cook Sloughs or the Stillaguamish River between RM 0.0 and RM 11.1 because of the complex system of split-river channels and overland flow.

Examination of the Canyon Creek floodway and 1-percent-annual-chance floodplain computations indicates that high velocities (12 to 20 feet per second) and severe bank erosion should be expected along the entire reach. Therefore, the entire Canyon Creek floodplain is considered "extremely hazardous," with the floodway designated as the area inundated by the base flood.

No floodway has been delineated along the Snohomish River from RM 0.00 to RM 16.62. Through agreements made with FEMA, Snohomish County is regulating this reach through methods that do not require a floodway.

The Snohomish County Planning Department, in a letter dated July 21, 1980, requested additional study of the Pilchuck River to narrow the floodway at a subdivision called the Pilchuck 26 tract, between Cross Sections J and L. More detailed definition of the topography in this area resulted in the narrowing of the floodway. The new floodway satisfies the FEMA criteria for an equal-conveyance floodway.

Similar revisions that meet the equal-conveyance-floodway criteria were made on the Skykomish River at Ironhead Park and at Twin Rivers in the City of Sultan.

The Snohomish County Planning Department, in a letter dated April 3, 1978, requested additional study of the Sultan River to narrow the floodway at the Ironhead Park subdivision, between Cross Sections E and F. The narrowing of the floodway between these two cross sections was accomplished by widening the floodway for approximately 1 mile downstream. Because the widening of the floodway downstream included a portion of the City of Sultan, approval from Sultan officials was sought and received. The new floodway can be classified as an equal-conveyance floodway under FEMA criteria because the conveyance on opposite banks has been adjusted by an equal percentage. However, the new floodway includes more varied upstream and downstream percentages and generates a more significant increase in velocity than the previous floodway.

The Sauk River equal-conveyance floodway was modified at Cross Sections A, B, E, H, and L to create a smooth and more realistic floodway delineation and to encompass high-water channels that are considered too dangerous to be developed.

The concept of floodways is based on conveyance losses in the floodplains. Flow along Scriber Creek is predominantly controlled by the culvert characteristics and top-of-road elevations, not by conveyance. At flood levels, ponding is significant and water levels are rather insensitive to channel and floodplain roughness. Therefore, no floodways were computed along Scriber Creek.

Floodways are not applicable in areas inundated by tidal flooding; therefore, no floodways were delineated in coastal areas.

The Density Fringe area is an area of high flood damage potential where conventional floodway areas cannot be established. In order to foster the continued agricultural use of prime farmlands in these flood plain areas, and maintain an acceptable level of flood hazard protection, special development criteria shall be utilized to prevent a cumulative increase in the base flood elevation of more than one foot.

The density fringe area shall consist of the following: Areas designated on the Floor Insurance Study (FIS) for Snohomish County and Incorporated Areas, and the Flood Insurance Rate Maps (FIRMS)* and the Stillaguamish River special flood hazard area (1% Annual-Chance flood plain) located between the mouth of said river and river mile 11.1.(Reference 110)

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH [2] (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
Canyon Creek								
A	0.35	150	896	15.3	235.2	235.2	235.2	0.0
B	0.61	160	739	18.5	263.5	263.5	263.5	0.0
C	0.83	140	633	21.6	306.7	306.7	306.7	0.0
D	1.04	90	1,309	10.5	338.7	338.7	338.7	0.0
E	1.36	340	1,338	10.2	355.0	355.0	355.0	0.0
F	1.72	400	1,758	7.8	373.7	373.7	373.7	0.0
G	2.15	750	984	13.9	393.0	393.0	393.0	0.0
H	2.59	360	1,853	7.4	417.7	417.7	417.7	0.0
I	2.89	220	1,092	12.5	433.5	433.5	433.5	0.0
J	3.25	377	1,375	10.0	453.5	453.5	453.5	0.0
K	3.66	387/492	1,424	9.6	472.3	472.3	472.3	0.0
L	3.97	470	2,319	5.9	486.7	486.7	486.7	0.0
M	4.20	161/622	1,124	12.2	495.5	495.5	495.5	0.0
N	4.42	1880	1,613	8.5	504.8	504.8	504.8	0.0
O	4.67	580	1,406	9.7	513.8	513.8	513.8	0.0
P	5.00	160	1,171	11.7	525.1	525.1	525.1	0.0
Q	5.28	180	1,952	6.3	537.8	537.8	537.8	0.0
R	5.53	497	1204	9.0	547.5	547.5	547.5	0.0
S	5.91	650	1451	7.4	564.5	564.5	564.5	0.0
T	6.16	200	1098	9.8	572.9	572.9	572.9	0.0
U	6.57	810	943	11.5	593.5	593.5	593.5	0.0
V	7.00	300	1522	7.1	608.9	608.9	608.9	0.0
W	7.21	230	899	12	617.1	617.1	617.1	0.0
X	7.54	324	1,109	9.7	640.3	640.3	640.3	0.0
Y	7.90	150	940	11.5	656.0	656.0	656.0	0.0
Z	8.20	947	739	14.6	679.1	679.1	679.1	0.0

(1) Stream Distance in Miles above Mouth
(2) Width/width including split flow

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SNOHOMISH COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

CANYON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
May Creek								
A	0.65	436	1,369	1.9	173.8	173.8	174.1	0.3
B	0.79	375	1,064	2.5	174.8	174.8	175.1	0.3
C	1.00	168	802	3.3	176.7	176.7	177.2	0.5
D	1.16	115	362	7.3	178.9	178.9	179.2	0.3
E	1.32	233	666	4.0	182.3	182.3	182.3	0.0
F	1.58	42	653	4.1	186.9	186.9	187.6	0.7
G	1.83	231	1,496	1.8	188.6	188.6	189.6	1.0
H	2.07	194	814	3.3	190.2	190.2	191.0	0.8
I	2.37	225	455	5.8	195.6	195.6	196.1	0.5
J	2.63	134	714	3.7	203.5	203.5	204.2	0.7
K	2.92	166	495	5.4	212.0	212.0	213.0	1.0
L	3.26	91	384	6.9	239.3	239.3	239.3	0.0
M	3.65	118	195	10.3	259.6	259.6	260.3	0.7
N	3.78	132	331	6.1	272.5	272.5	272.7	0.2
O	3.87	162	246	8.2	280.8	280.8	280.9	0.1
P	4.02	204	412	4.9	295.1	295.1	295.3	0.2

(1) Stream Distance in Miles above Mouth

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

MAY CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
Haskel Slough								
A	18,216	4,528	28,000	5.3	55.8	55.8	56.3	0.5
B	20,909	1,347	12,714	11.4	58.7	58.4	58.8	0.4
C	21,067	1,300	13,245	11.0	59.8	58.6	59.1	0.5
D	21,701	3,381	31,981	4.6	61.4	60.9	61.7	0.8
E	22,757	4,450	36,336	4.0	62.5	62.1	63.1	1.0
F	25,080	4,982	41,309	3.6	64.5	65.0	65.7	0.7
G	25,608	4,981	41,036	3.6	65.1	65.2	65.9	0.7
H	27,614	4,185	28,252	2.6	66.7	66.9	67.4	0.5

(1) Stream distance in feet above confluence with Snoqualmie River.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

HASKEL SLOUGH

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
North Creek								
A-S [2]								
T	9,182	318	1,161	1.2	43.8	43.8	43.8	0.0
U	9,692	117	307	4.7	44.1	44.1	44.4	0.3
V	9,825	59	273	5.3	44.4	44.4	44.9	0.5
W	10,001	49	205	7.0	45.1	45.1	45.2	0.1
X	10,351	55	254	5.7	45.8	45.8	46.7	0.9
Y	10,423	28	151	9.5	46.7	46.7	47.6	0.9
Z	10,523	62	224	6.4	48.6	48.6	48.8	0.2
AA	11,228	71	267	5.4	50.9	50.9	51.7	0.8
AB	12,368	128	184	7.8	56.2	56.2	57.2	1.0
AC	12,978	29	177	8.1	59.4	59.4	60.3	0.9
AD	13,078	30	143	10.1	60.0	60.0	60.6	0.6
AE	13,798	28	179	8.0	66.2	66.2	66.8	0.6
AF	14,698	33	173	8.3	70.6	70.6	71.4	0.8
AG	14,978	28	152	9.5	72.8	72.8	73.0	0.2
AH	15,588	41	165	7.7	77.1	77.1	77.7	0.6
AI	16,168	35	165	7.6	81.6	81.6	81.6	0.0
AJ	16,208	51	138	9.1	81.6	81.6	81.6	0.0
AK	16,283	71	301	4.2	83.1	83.1	83.1	0.0
AL	16,978	160	748	1.7	83.6	83.6	84.3	0.7
AM	17,638	253	853	1.5	83.9	83.9	84.8	0.9
AN	18,774	57	196	6.4	88.3	88.3	89.0	0.7
AO	19,404	70	289	4.4	92.6	92.6	92.7	0.1
AP	20,320	55	197	5.8	96.7	96.7	96.9	0.2
AQ	21,116	48	198	5.8	100.2	100.2	101.2	1.0
AR	21,141	36	203	5.6	100.9	100.9	101.5	0.6

(1) Stream distance in feet above confluence with Sammamish River

(2) Located entirely within King County

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

NORTH CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
North Creek (Cont'd)								
AS	21,246	44	193	5.9	101.2	101.2	102.1	0.9
AT	21,751	55	238	4.8	104.3	104.3	104.3	0.0
AU	22,006	47	148	7.7	106.7	106.7	106.8	0.1
AV	22,206	45	311	3.7	108.1	108.1	108.4	0.3
AW	22,416	40	235	4.8	108.3	108.3	108.8	0.5
AX	22,921	33	192	5.9	110.5	110.5	111.0	0.5
AY	22,988	37	224	5.1	113.2	113.2	113.7	0.5
AZ	23,418	30	198	5.7	114.8	114.8	115.2	0.4
BA	23,458	30	222	5.1	114.9	114.9	115.7	0.8
BB	23,527	35	233	4.9	115.8	115.8	116.0	0.2
BC	24,397	341	1,281	0.8	117.0	117.0	117.9	0.9
BD	25,822	44	164	6.5	126.2	126.2	127.1	0.9

(1) Stream distance in feet above confluence with Sammamish River

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SNOHOMISH COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

NORTH CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE** [1]	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
North Fork Skykomish River								
A	426	305	3,231	12.9	461.4	461.4	461.4	0.0
B	800	340	2,944	14.2	464.5	464.5	464.5	0.0
C	1,645	601	5,098	8.2	473.0	473.0	473.2	0.2
D	2,476	557	3,686	11.3	478.2	478.2	478.4	0.2
E	3,297	458	3,672	11.4	486.0	486.0	486.1	0.1
F	3,934	248	2,628	15.9	492.2	492.2	492.4	0.2
G	4,800	424	3,146	13.3	505.1	505.1	505.5	0.4
H	5,617	383	3,395	12.3	514.2	514.2	514.3	0.1
I	5,888	469	3,347	12.5	518.0	518.0	518.5	0.5
J	6,249	485	3,771	11.1	521.9	521.9	522.3	0.4
K	6,512	425	3,284	13.3	525.0	525.0	525.0	0.0
L	6,934	314	3,060	13.7	527.9	527.9	528.8	0.9
M	7,138	316	2,683	15.6	529.5	529.5	529.7	0.2
N	7,380	260	2,392	17.5	531.6	531.6	531.6	0.0
O	7,503	389	3,333	12.6	535.2	535.2	535.2	0.0
P	7,600	364	3,427	12.2	535.4	535.4	535.4	0.0
Q	7,696	292	2,840	15.0	535.1	535.1	535.1	0.0
R	7,865	319	3,375	12.9	538.0	538.0	538.0	0.0
S	8,114	348	3,597	11.6	539.6	539.6	539.6	0.0
T	8,256	357	3,690	11.3	540.5	540.5	540.5	0.0
U	8,395	373	3,350	12.5	541.2	541.2	541.2	0.0
V	8,575	437	3,003	13.9	542.3	542.3	542.3	0.0
W	8,841	406	3,534	11.8	546.3	546.3	546.3	0.0
X	9,250	350	3,341	12.5	548.5	548.5	548.5	0.0
Y	9,549	346	3,269	12.8	550.0	550.0	550.0	0.0
Z	9,761	341	3,069	13.6	550.6	550.6	550.6	0.0

(1) Stream distance in feet above confluence with Skykomish River.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

NORTH FORK SKYKOMISH RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
North Fork Skykomish River (Cont'd)								
AA	10,381	523	3,052	13.7	555.8	555.8	555.8	0.0
AB	11,093	272	2,455	17.0	564.2	564.2	564.2	0.0
AC	12,474	664	4,348	9.6	575.8	575.8	575.8	0.0
AD	13,003	575	3,203	13.0	579.1	579.1	579.1	0.0
AE	13,897	685	3,674	11.4	588.4	588.4	588.4	0.0
AF	14,535	969	4,562	9.2	595.4	595.4	595.4	0.0
AG	15,249	916	3,649	11.3	604.1	604.1	604.1	0.0
AH	15,902	954	4,959	8.3	612.3	612.3	612.3	0.0
AI	16,594	428	2,807	14.7	617.9	617.9	617.9	0.0
AJ	17,987	968	4,133	10.5	636.4	636.4	636.8	0.4
AK	18,166	770	7,588	5.5	639.1	639.1	639.5	0.4
AL	19,133	686	3,778	10.9	643.4	643.4	643.4	0.0
AM	19,681	405	3,544	11.7	649.8	649.8	649.8	0.0
AN	22,220	378	2,764	15.0	672.6	672.6	672.6	0.0

(1) Stream distance in feet above confluence with Skykomish River.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

NORTH FORK SKYKOMISH RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
North Fork Stillaguamish River								
A	0.73	379	5,118	6.1	76.8 [2]	73.5	74.2	0.7
B	2.30	365	4,148	7.5	82.2	82.2	82.5	0.3
C	2.65	520	4,975	6.3	84.8	84.8	84.9	0.1
D	2.84	502	4,869	6.4	85.6	85.6	85.6	0.0
E	2.90	279	4,859	6.4	86.0	86.0	86.3	0.3
F	3.01	1,110	11,097	2.8	86.7	86.7	86.9	0.2
G	3.40	1,124	6,273	5.0	87.4	87.4	87.8	0.4
H	3.80	588	5,568	5.6	89.2	89.2	89.8	0.6
I	4.23	500	4,501	6.9	91.4	91.4	92.2	0.8
J	4.53	1,621	9,433	3.3	93.8	93.8	94.8	1.0
K	4.94	611	4,783	6.5	96.8	96.8	97.4	0.6
L	5.32	381	4,089	7.6	99.5	99.5	99.9	0.4
M	5.85	1,763	10,740	2.9	103.1	103.1	103.7	0.6
N	6.13	1,200	6,411	4.9	105.3	105.3	106.2	0.9
O	6.55	645	4,465	7.0	108.4	108.4	109.1	0.7
P	7.01	1,919	8,516	3.7	111.8	111.8	112.3	0.5
Q	7.44	2,127	10,974	2.8	113.9	113.9	114.9	1.0
R	7.90	1,551	7,297	4.3	116.6	116.6	117.5	0.9
S	8.26	1,637	6,459	4.8	119.4	119.4	120.3	0.9
T	8.65	1,185	7,803	4.0	122.9	122.9	123.8	0.9
U	9.08	450	3,450	9.0	126.1	126.1	126.8	0.7
V	9.34	736	5,865	5.3	129.4	129.4	129.8	0.4
W	9.78	561	4,717	6.6	133.8	133.8	133.9	0.1
X	10.06	394	4,498	6.9	136.1	136.1	136.8	0.7
Y	10.55	343	3,423	9.1	139.5	139.5	140.0	0.5
Z	10.80	356	3,634	8.6	142.7	142.7	142.9	0.2

(1) Stream distance in miles above mouth
(2) Backwater from South Fork Stillaguamish River

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SNOHOMISH COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

NORTH FORK STILLAGUAMISH RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
North Fork Stillaguamish River (cont'd)								
AA	11.12	573	3,971	7.8	145.1	145.1	145.5	0.4
AB	11.47	591	4,062	7.7	148.3	148.3	148.9	0.6
AC	11.85	805	4,576	6.8	152.2	152.2	152.6	0.4
AD	12.16	1,266	5,016	6.2	155.2	155.2	155.5	0.3
AE	12.67	1,245	4,430	7.0	160.8	160.8	161.3	0.5
AF	13.26	1,733	9,656	3.2	167.3	167.3	167.8	0.5
AG	13.65	1,190	7,447	4.2	169.8	169.8	170.6	0.8
AH	14.11	240	3,762	9.0	177.7	177.7	178.4	0.7
AI	14.60	899	3,363	7.9	185.5	185.5	185.7	0.2
AJ	15.27	1,384	4,927	5.4	194.3	194.3	194.3	0.0
AK	15.55	719	3,877	6.8	197.3	197.3	197.6	0.3
AL	15.66	615	3,083	8.6	198.5	198.5	199.0	0.5
AM	15.80	250	1,937	13.6	202.6	202.6	202.9	0.3
AN	15.82	280	2,965	8.9	205.5	205.5	205.5	0.0
AO	16.05	933	7,163	3.7	207.8	207.8	207.8	0.0
AP	16.44	557	3,694	7.1	210.1	210.1	210.3	0.2
AQ	16.84	426	2,589	10.2	214.9	214.9	215.0	0.1
AR	17.38	1,898	7,606	3.5	222.5	222.5	222.7	0.2
AS	17.60	230	1,925	13.7	224.9	224.9	225.1	0.2
AT	17.82	323	3,025	8.7	230.8	230.8	230.8	0.0
AU	18.26	549	4,151	6.4	238.0	238.0	238.4	0.4
AV	18.66	199	2,626	10.1	243.5	243.5	244.0	0.5
AW	19.12	200	2,254	11.7	253.3	253.3	253.3	0.0
AX	19.56	281	2,774	9.5	259.2	259.2	259.2	0.0
AY	19.87	524	3,299	8.0	264.0	264.0	264.2	0.2
AZ	20.25	627	3,803	6.9	270.1	270.1	270.8	0.7

(1) Stream distance in miles above mouth

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

NORTH FORK STILLAGUAMISH RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
North Fork Stillaguamish River (cont'd)								
BA	20.60	819	3,975	6.6	275.2	275.2	275.2	0.0
BB[2]	21.08	760	3,786	7.0	281.0	281.0	281.3	0.3
BC	21.14	276	2,306	11.4	282.0	282.0	282.3	0.3
BD	21.43	1,520	5,721	4.6	287.9	287.9	287.9	0.0
BE	21.84	485	4,084	6.5	292.5	292.5	293.1	0.6
BF	22.15	869	5,984	4.4	296.6	296.6	297.2	0.6
BG	22.50	1,084	5,185	5.1	300.6	300.6	301.3	0.7
BH	22.96	1,874	8,321	3.2	306.1	306.1	307.1	1.0
BI	23.38	644	3,485	7.6	314.1	314.1	314.6	0.5
BJ	23.96	1,061	7,559	3.5	321.7	321.7	322.1	0.4
BK	24.33	1,350	4,129	7.5	325.3	325.3	325.9	0.6
BL	24.78	500	3,624	7.2	332.7	332.7	333.7	1.0
BM	25.12	750	2,740	9.6	338.6	338.6	339.3	0.7
BN	25.59	1,137	6,102	4.3	348.3	348.3	349.2	0.9
BO	26.00	585	3,113	8.4	355.0	355.0	355.7	0.7
BP	26.34	710	2,742	9.6	360.0	360.0	360.2	0.2
BQ	26.64	1,500	3,129	8.4	365.0	365.0	365.6	0.6
BR	26.99	1,310	8,156	3.2	370.7	370.7	371.2	0.5
BS	27.36	1,292	5,207	5.0	375.8	375.8	375.8	0.0
BT	27.71	930	6,525	4.0	381.9	381.9	382.6	0.7
BU	27.97	541	3,073	8.5	387.4	387.4	388.0	0.6
BV	28.41	345	2,540	10.3	396.6	396.6	397.1	0.5
BW	28.73	704	4,919	5.3	402.8	402.8	403.5	0.7
BX	29.18	393	2,574	10.2	409.0	409.0	409.7	0.7
BY	29.57	417	3,736	7.0	416.8	416.8	417.5	0.7
BZ	29.83	468	3,009	8.7	419.6	419.6	420.6	1.0

(1) Stream distance in miles above mouth

(2) Values based on appropriate hydraulic model output without regard to the new base map adjustments

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

NORTH FORK STILLAGUAMISH RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
North Fork Stillaguamish River (cont'd)								
CA	30.00	374	2,515	10.4	423.7	423.7	424.2	0.5
CB	30.42	1,330	5,343	4.9	428.1	428.1	428.6	0.5
CC	30.70	586	3,325	7.9	433.2	433.2	433.7	0.5
CD	31.10	484	3,406	8.1	441.2	441.2	441.7	0.5
CE	31.62	836	5,892	3.9	448.9	448.9	449.2	0.3
CF[2]	31.87	360	3,103	7.3	453.1	453.1	453.6	0.5
CG[2]	32.20	529	4,099	5.6	459.4	459.4	460.4	1.0
CH	32.54	359	3,248	7.0	465.5	465.5	466.5	1.0
CI	33.03	297	2,661	8.6	474.4	474.4	474.7	0.3
CJ	33.35	672	5,036	4.5	480.3	480.3	480.9	0.6
CK	33.72	702	4,791	4.8	483.9	483.9	484.5	0.6
CL	34.02	250	5,992	3.8	488.2	488.2	488.8	0.6

(1) Stream distance in miles above mouth

(2) Values based on appropriate hydraulic model output without regard to the new base map adjustments

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

NORTH FORK STILLAGUAMISH RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
Pilchuck River								
A	1.51	191	1,640	8.1	33.9	33.9	34.0	0.1
B	1.90	206	2,089	6.4	38.2	38.2	38.8	0.6
C	2.30	259	2,185	6.1	41.5	41.5	41.7	0.2
D	2.72	515	4,539	2.9	44.6	44.6	45.0	0.4
E	2.88	435	2,336	5.7	45.4	45.4	45.9	0.5
F	3.00	680	2,580	5.2	46.5	46.5	47.2	0.7
G	3.17	400	2,949	4.5	48.5	48.5	49.2	0.7
H	3.25	689	3,012	4.4	49.5	49.5	50.3	0.8
I	3.36	313	2,980	4.5	50.9	50.9	51.9	1.0
J	3.60	226	1,728	7.7	55.4	55.4	56.0	0.6
K	3.75	317	1,847	7.2	58.1	58.1	58.1	0.0
L	3.94	530	3,849	3.5	60.3	60.3	60.7	0.4
M	4.24	540	2,755	4.8	62.5	62.5	63.2	0.7
N	4.68	374	2,061	6.5	67.7	67.7	68.7	1.0
O	5.07	452	2,763	4.9	73.3	73.3	74.3	1.0
P	5.62	351	1,604	8.4	81.1	81.1	81.6	0.5
Q	5.90	398	1,924	7.0	85.6	85.6	85.7	0.1
R	6.28	550	3,393	4.0	89.7	89.7	89.9	0.2
S	6.52	384	2,432	5.6	91.7	91.7	92.2	0.5
T	6.77	415	1,982	6.9	95.7	95.7	96.5	0.8
U	6.99	226	1,814	7.5	100.5	100.5	101.3	0.8
V	7.24	198	1,632	8.3	105.2	105.2	105.5	0.3
W	7.63	500	2,304	5.9	112.8	112.8	113.4	0.6
X	7.88	660	2,218	6.1	116.6	116.6	117.6	1.0
Y	8.05	336	2,164	6.3	119.3	119.3	120.3	1.0
Z	8.30	241	1,849	7.4	123.4	123.4	124.2	0.8

(1) Stream distance in miles above mouth.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

PILCHUCK RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Pilchuck River (Cont'd)								
AA	8.56	299	1,822	7.5	127.3	127.3	127.9	0.6
AB	8.71	330	2,844	4.8	129.6	129.6	130.3	0.7
AC	8.80	166	1,527	8.9	130.4	130.4	131.1	0.7
AD	8.91	156	1,326	10.3	132.6	132.6	133.0	0.4
AE	9.23	638	3,532	3.9	138.7	138.7	138.9	0.2
AF	9.62	635	2,640	4.7	142.1	142.1	143.0	0.9
AG	9.86	298	1,830	6.8	146.3	146.3	147.2	0.9
AH	10.17	230	1,391	9.0	153.0	153.0	153.8	0.8
AI[2]	10.30	360	2,220	5.7	156.1	156.1	156.6	0.5
AJ	10.70	201	1,491	8.5	164.1	164.1	164.3	0.2
AK	10.92	438	2,564	5.0	167.8	167.8	167.8	0.0
AL	11.15	506	2,593	4.9	170.2	170.2	170.6	0.4
AM[2]	11.54	410	2,499	5.1	175.8	175.8	176.7	0.9
AN	11.75	264	1,743	7.3	180.1	180.1	180.8	0.7
AO	12.08	514	3,254	3.8	186.0	186.0	186.4	0.4
AP	12.28	332	2,138	5.8	188.1	188.1	188.5	0.4
AQ	12.44	365	2,168	5.8	190.5	190.5	190.8	0.3
AR	12.77	530	2,578	4.8	195.8	195.8	196.4	0.6
AS	13.08	511	2,373	5.2	201.3	201.3	201.7	0.4
AT	13.27	507	1,843	6.7	205.1	205.1	205.5	0.4
AU	13.52	530	2,696	4.6	209.1	209.1	209.5	0.4
AV	13.75	810	3,133	4.0	212.1	212.1	212.6	0.5
AW	13.94	632	3,173	3;9	215.3	215.3	215.9	0.6
AX	14.22	674	3,258	3.8	218.9	218.9	219.9	1.0
AY	14.43	500	2,957	4.2	222.4	222.4	223.2	0.8
AZ	14.75	691	3,189	3.9	227.0	227.0	227.6	0.6

(1) Stream distance in miles above mouth

(2) Values based on appropriate hydraulic model output without regard to the new base map adjustments

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

PILCHUCK RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Pilchuck River (Cont'd)								
BA	15.03	701	3,238	3.8	230.8	230.8	231.7	0.9
BB	15.29	553	3,380	3.7	235.7	235.7	235.7	0.0
BC	15.50	269	1,807	6.9	239.5	239.5	240.4	0.9
BD	15.76	348	1,607	7.7	244.5	244.5	245.3	0.8
BE	16.06	261	2,177	5.7	249.9	249.9	250.5	0.6
BF	16.26	204	1,666	7.3	252.7	252.7	253.1	0.4
BG	16.61	186	1,539	7.9	258.7	258.7	258.9	0.2
BH	16.82	220	1,984	6.1	262.2	262.2	262.7	0.5
BI	17.08	586	2,793	4.2	265.8	265.8	266.2	0.4
BJ	17.29	284	1,584	7.4	268.8	268.8	269.4	0.6
BK	17.52	280	2,254	5.2	273.1	273.1	273.7	0.6
BL	17.84	288	1,697	6.9	277.9	277.9	278.2	0.3
BM	18.11	637	3,930	3.0	283.7	283.7	283.7	0.0
BN	18.46	178	1,674	7.0	289.2	289.2	289.9	0.7
BO	18.79	233	2,256	5.2	292.7	292.7	293.1	0.4
BP	19.05	103	1,354	8.6	295.2	295.2	295.5	0.3

(1) Stream distance in miles above mouth

(2) Values based on appropriate hydraulic model output without regard to the new base map adjustments

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

PILCHUCK RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
Riley Slough								
A	10,085	5,247	38,464	3.1	49.0	49.1	49.7	0.6
B	10,930	5,203	36,600	3.3	49.3	49.4	50.2	0.8
C	12,250	5,325	27,454	4.5	49.8	50.0	50.8	0.8
D	13,517	5,142	30,804	5.1	53.1	52.4	52.7	0.3
E	14,784	4,758	34,784	3.9	54.1	54.4	55.0	0.6
F	16,315	4,876	35,588	3.9	57.2	55.5	56.1	0.6
G	17,054	3,939	24,210	6.1	59.4	55.8	56.3	0.5
H	18,216	4,528	28,000	5.3	60.2	55.8	56.3	0.5
I	21,701	3,381	31,981	4.6	62.5	60.9	61.7	0.8
J	22,757	4,450	36,336	4.0	63.5	62.1	63.1	1.0
K	25,080	4,982	41,309	3.6	64.5	65.0	65.7	0.7
L	25,608	4,981	41,036	3.6	65.4	65.2	65.9	0.7
M	27,614	4,185	28,252	2.6	65.8	66.9	67.4	0.5
N	31,733	3,291	20,800	7.1	68.3	70.4	70.6	0.2
O	32,261	2,759	19,947	7.4	70.5	71.3	71.7	0.4
P	33,106	2,630	20,267	7.3	72.3	73.0	73.7	0.7

(1) Stream distance in feet above confluence with Snoqualmie River.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SNOHOMISH COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

RILEY SLOUGH

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Sauk River								
A	17.10	1,925	11,754	6.0	437.0	437.0	437.0	0.0
B	17.84	1,951	9,471	7.4	445.3	445.3	445.4	0.1
C	18.25	2,212	17,332	4.0	453.8	453.8	454.5	0.7
D	18.66	2,990	8,245	8.5	458.7	458.7	459.2	0.5
E	18.99	2,436	14,815	4.7	468.3	468.3	469.2	0.9
F	19.34	2,000	7,500	9.3	473.4	473.4	473.7	0.3
G	19.59	2,172	9,300	7.5	479.7	479.7	480.0	0.3
H	19.88	2,400	14,150	5.0	484.4	484.4	485.4	1.0
I	20.24	2,000	11,300	6.2	491.1	491.1	491.6	0.5
J	20.43	1,778	10,180	6.9	497.6	497.6	498.0	0.4
K	20.81	2,250	18,500	3.8	505.3	505.3	505.9	0.6
L	21.06	2,125	11,000	6.4	508.3	508.3	509.1	0.8
M	21.40	349	5,100	13.7	517.9	517.9	518.2	0.3
N	21.74	1,121	9,234	7.6	527.7	527.7	528.4	0.7
O	21.95	1,730	12,376	5.7	533.5	533.5	533.9	0.4
P	22.28	1,098	10,318	6.8	538.7	538.7	539.4	0.7
Q	22.51	1,012	10,258	6.8	544.1	544.1	545.1	1.0
R	22.91	900	7,820	9.0	551.0	551.0	551.8	0.8
S	23.15	831	9,090	7.7	560.5	560.5	560.8	0.3
T	23.50	841	7,521	9.3	571.0	571.0	571.5	0.5
U	23.80	460	5,242	13.4	579.7	579.7	580.6	0.9
V	24.18	405	6,454	10.8	595.8	595.8	596.4	0.6
W	24.75	493	5,954	11.8	612.3	612.3	613.1	0.8

(1) Stream distance in miles above mouth

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SNOHOMISH COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

SAUK RIVER

FLOODING SOURCE			FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
SKYKOMISH RIVER		DISTANCE [1]	WIDTH (SQUARE FEET)	SECTION AREA (FEET PER SECOND)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY [2] (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
MAIN CHANNEL CROSS SECTIONS	OVERFLOW CROSS SECTIONS								
A	A[3]	845	2,854	58,465	3.5	46.6 / 46.6	46.6	47.3	0.7
B	B[3]	1,109	3,011	60,876	3.3	46.7 / 46.7	46.7	47.4	0.7
C	C[3]	2,059	3,559	58,756	3.5	46.9 / 46.9	46.9	47.5	0.6
D	D[3]	3,274	4,440	70,101	2.9	47.2 / 47.2	47.2	47.9	0.7
E	E[3]	4,699	4,858	66,634	3.1	47.5 / 47.6	47.5	48.1	0.6
F	F[3]	6,019	4,971	74,139	2.7	48.0 / 48.0	48.0	48.6	0.6
G	G[3]	7,022	5,276	76,550	2.7	48.3 / 48.4	48.3	48.9	0.6
H	H[3]	8,078	6,724	87,358	2.3	48.7 / 48.6	48.7	49.3	0.6
I	I[3]	8,712	7,908	94,968	1.9	48.8 / 48.9	48.8	49.4	0.6
J		10,085	5,247	38,464	3.1	49.1	49.1	49.7	0.6
K		10,930	5,203	36,600	3.3	49.4	49.4	50.2	0.8
L		12,250	5,325	27,454	4.5	50.0	50.0	50.8	0.8
M		13,517	5,142	30,804	5.1	52.4	52.4	52.7	0.3
N		14,784	4,758	34,784	3.9	54.4	54.4	55.0	0.6
O		16,315	4,876	35,588	3.9	55.5	55.5	56.1	0.6
P		17,054	3,939	24,210	6.1	55.8	55.8	56.3	0.5
Q		18,216	4,528	28,000	5.3	55.8	55.8	56.3	0.5
R		20,909	1,347	12,714	11.4	58.4	58.4	58.8	0.4
S		21,067	1,300	13,245	11.0	58.6	58.6	59.1	0.5
T		21,701	3,381	31,981	4.6	60.9	60.9	61.7	0.8
U		22,757	4,450	36,336	4.0	62.1	62.1	63.1	1.0
V		25,080	4,982	41,309	3.6	65.0	65.0	65.7	0.7
W		25,608	4,981	41,036	3.6	65.2	65.2	65.9	0.7
X		27,614	4,185	28,252	2.6	66.9	66.9	67.4	0.5
Y		31,733	3,291	20,800	7.1	70.4	70.4	70.6	0.2
Z		32,261	2,759	19,947	7.4	71.3	71.3	71.7	0.4

(1) Stream distance in feet above confluence with Snoqualmie River.
(2) Where there are overflow reaches, the order is main channel first and then overflow reaches.
(3) Snoqualmie River portion of overflow.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SNOHOMISH COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

SKYKOMISH RIVER

FLOODING SOURCE			FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
SKYKOMISH RIVER		**DISTANCE [1]**	**WIDTH (SQUARE FEET)**	**SECTION AREA (FEET PER SECOND)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY [2] (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
MAIN CHANNEL CROSS SECTIONS (continued)	OVERFLOW CROSS SECTIONS (continued)								
AA		33,106	2,630	20,267	7.3	73.0	73.0	73.7	0.7
AB		34,320	2,445	29,091	5.1	76.0	76.0	76.7	0.7
AC		35,270	2,847	26,118	5.6	76.8	76.8	77.5	0.7
AD		36,432	3,298	29,989	4.9	78.3	78.3	79.0	0.7
AE		37,594	2,557	35,655	4.1	79.6	79.6	80.4	0.8
AF		38,491	2,577	27,305	5.4	80.0	80.0	80.8	0.8
AG		39,811	3,114	32,605	4.5	81.3	81.3	82.0	0.7
AH		40,709	3,214	30,664	4.8	82.2	82.2	82.8	0.6
AI		41,870	3,553	26,980	5.5	83.1	83.1	83.9	0.8
AJ		43,032	3,508	28,155	5.2	84.7	84.7	85.7	1.0
AK		44,352	3,491	36,911	4.0	86.6	86.6	87.6	1.0
AL		45,302	3,408	38,164	3.9	87.6	87.6	88.5	0.9
AM		46,042	3,125	30,689	4.8	88.2	88.2	89.2	1.0
AN	[2]	47,256	3,000	30,445	5.2	89.7 / 89.3	89.7	90.3	0.6
AO	[2]	48,338	1,948	19,368	8.1	90.6 / 90.0	90.6	91.0	0.4
AP	[2]	49,344	1,782	19,484	8.1	92.2 / 91.8	92.2	93.1	0.9
AQ	[2]	50,121	1,541	19,422	8.1	93.6 / 93.1	93.6	94.5	0.9
AR	[2]	51,236	1,391	21,250	7.4	95.9 / 95.5	95.9	96.8	0.9
AS	[2]	52,499	1,560	22,099	7.1	97.6 / 97.2	97.6	98.5	0.9
AT		53,562	1,599	23,717	6.6	98.9	98.9	99.9	1.0
AU		54,477	3,038	31,703	5.0	100.1	100.1	101.0	0.9
AV		56,417	4,073	42,872	3.7	101.4	101.4	102.4	1.0
AW		57,294	3,598	36,403	4.3	101.9	101.9	102.9	1.0
AX		57,827	3,544	32,293	4.9	102.2	102.2	103.2	1.0
AY		58,887	3,092	29,727	5.3	103.0	103.0	104.0	1.0
AZ		60,127	2,774	27,702	5.7	104.2	104.2	105.1	0.9

(1) Stream distance in feet above confluence with Snoqualmie River.

(2) Where there are overflow reaches, the order is main channel first and then overflow reaches.

FLOODING SOURCE			FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
SKYKOMISH RIVER		**DISTANCE [1]**	**WIDTH (SQUARE FEET)**	**SECTION AREA (FEET PER SECOND)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY [2] (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
MAIN CHANNEL CROSS SECTIONS (continued)	OVERFLOW CROSS SECTIONS (continued)								
BA		61,093	2,140	25,641	6.1	105.4	105.4	106.3	0.9
BB		61,746	1,749	20,476	7.7	106.2	106.2	107.0	0.8
BC		63,187	1,853	25,612	6.1	108.8	108.8	109.7	0.9
BD		64,507	2,438	29,250	5.4	110.5	110.5	111.4	0.9
BE		66,039	3,734	43,516	3.6	112.0	112.0	113.0	1.0
BF		67,182	3,713	36,330	4.3	112.7	112.7	113.7	1.0
BG		68,160	4,666	41,602	4.0	113.7	113.7	114.6	0.9
BH		69,037	4,366	43,292	3.9	115.6	115.6	116.2	0.6
BI		69,495	4,324	41,708	3.9	115.9	115.9	116.6	0.7
BJ		70,047	4,147	38,017	4.4	116.8	116.8	117.5	0.7
BK	[2]	70,861	4,023	39,144	3.4	117.4 / 117.4	117.4	118.3	0.9
BL	[2]	71,361	3,794	36,167	3.7	117.5 / 117.5	117.5	118.4	0.9
BM	[2]	71,568	4,071	35,777	4.5	117.5 / 117.5	117.5	118.5	1.0
BN	[2]	71,669	4,161	34,499	4.4	117.6 / 117.7	117.6	118.6	1.0
BO	[2]	71,952	4,113	36,427	3.7	118.0 / 118.0	118.0	119.0	1.0
BP	[2]	72,690	3,959	38,175	3.5	118.7 / 118.7	118.7	119.5	0.8
BQ	[2]	74,054	3,487	30,499	4.4	119.7 / 119.7	119.7	120.4	0.7
BR	[2]	74,914	3,493	31,005	4.3	120.9 / 120.9	120.9	121.3	0.4
BS	[2]	75,705	2,972	25,516	5.2	121.9 / 121.9	121.9	122.3	0.4
BT	[2]	76,477	3,087	26,350	5.1	122.8 / 122.8	122.8	123.4	0.6
BU	[2]	77,119	3,028	23,589	5.7	123.7 / 123.7	123.7	124.3	0.6
BV	[2]	77,932	3,675	31,320	4.3	125.5 / 125.5	125.5	126.1	0.6
BW	[2]	78,577	3,728	25,512	5.2	126.4 / 126.4	126.4	127.0	0.6
BX	[2]	79,375	3,829	27,123	4.7	128.4 / 127.8	128.4	128.9	0.5
BY	[2]	80,594	3,435	23,092	5.5	131.4 / 130.2	131.4	131.7	0.3
BZ	[2]	81,530	3,488	27,028	4.7	133.7 / 132.6	133.7	133.9	0.2

(1) Stream distance in feet above confluence with Snohomish River.

(2) Where there are overflow reaches, the order is main channel first and then overflow reaches.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SKYKOMISH RIVER

FLOODING SOURCE			FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
SKYKOMISH RIVER		**DISTANCE [1]**	**WIDTH (SQUARE FEET)**	**SECTION AREA (FEET PER SECOND)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY [2] (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
MAIN CHANNEL CROSS SECTIONS (continued)	OVERFLOW CROSS SECTIONS (continued)								
CA	2	82,442	3,731	25,625	5.0	135.5 / 134.6	135.5	135.7	0.2
CB	2	83,006	4,025	32,700	3.9	137.0 / 135.8	137.0	137.1	0.1
CC	2	83,581	4,193	25,988	4.9	137.8 / 136.7	137.8	137.8	0.0
CD	2, 3	84,505	4,765	35,287	3.6	139.2 / 138.2 / 138.2	139.2	139.4	0.2
CE	2, 3	86,043	4,560	30,603	4.2	141.1 / 139.8 / 139.6	141.1	141.2	0.1
CF	2, 3	86,635	3,877	24,434	5.2	141.9 / 140.9 / 140.5	141.9	142.1	0.2
CG	2, 3	87,052	3,632	21,783	5.9	143.0 / 142.3 / 141.7	143.0	143.1	0.1
CH	2, 3	87,735	3,252	20,945	6.1	144.5 / 143.9 / 143.1	144.5	144.6	0.1
CI	2, 3	88,481	2,391	15,999	8.0	146.4 / 145.7 / 144.7	146.4	146.4	0.0
CJ	2, 3	89,286	2,020	16,607	7.7	148.8 / 147.9 / 146.8	148.8	149.0	0.2
CK	2, 3	89,770	2,082	16,728	7.7	149.9 / 148.0 / 147.9	149.9	150.2	0.3
CL	2, 3	90,285	1,853	14,180	9.0	151.3 / 150.9 / 149.4	151.3	151.7	0.4
CM	2, 3	90,770	1,845	15,370	8.3	152.8 / 152.7 / 150.9	152.8	153.6	0.8
CN		91,532	2,025	19,693	6.5	154.4	154.4	155.2	0.8
CO		92,043	2,040	14,492	8.8	155.0	155.0	155.4	0.4
CP		92,619	2,299	15,876	8.1	156.8	156.8	157.4	0.6
CQ		93,119	2,622	19,197	6.7	159.5	159.5	159.7	0.2
CR		93,768	2,886	22,817	5.6	160.7	160.7	160.9	0.2
CS		94,641	3,388	22,126	5.8	161.8	161.8	162.1	0.3
CT		95,127	3,186	15,104	8.5	162.2	162.2	162.5	0.3
CU		95,788	3,202	18,216	7.0	165.0	165.0	165.2	0.2
CV		96,713	3,267	20,454	6.3	167.2	167.2	167.3	0.1
CW		97,292	3,511	19,945	6.4	168.3	168.3	168.6	0.3
CX		98,194	3,955	20,944	6.1	170.5	170.5	170.7	0.2
CY		98,725	3,722	13,487	9.5	171.0	171.0	171.1	0.1
CZ		99,305	3,130	13,455	9.5	173.1	173.1	173.6	0.5

(1) Stream distance in feet above confluence with Snohomish River.

(2) Where there are overflow reaches, the order is main channel first and then overflow reaches.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SKYKOMISH RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
Skykomish River (Cont'd)								
DA	99,608	2,661	15,978	8.0	175.1	175.1	175.3	0.2
DB	100,534	1,850	8,917	14.4	176.4	176.4	176.4	0.0
DC	100,870	1,568	9,135	14.0	179.2	179.2	179.2	0.0
DD	102,212	3,462	18,158	7.1	187.2	187.2	187.2	0.0
DE	103,388	2,935	12,055	10.6	189.6	189.6	189.6	0.0
DF	104,190	2,626	12,643	10.1	193.1	193.1	193.1	0.0
DG	105,060	2,694	14,196	9.0	195.5	195.5	195.5	0.0
DH	105,590	2,768	11,673	11.0	197.1	197.1	197.1	0.0
DI	107,006	2,647	17,784	7.2	203.1	203.1	203.1	0.0
DJ	108,182	2,016	12,922	9.9	205.8	205.8	205.8	0.0
DK	109,615	1,518	14,137	9.1	211.7	211.7	211.7	0.0
DL	110,596	1,302	15,204	8.4	215.3	215.3	215.6	0.3
DM	111,416	906	10,726	11.9	217.0	217.0	217.5	0.5
DN	111,787	734	7,478	17.1	217.2	217.2	217.5	0.3
DO	112,918	1,271	14,692	8.7	224.1	224.1	225.1	1.0
DP	113,900	920	11,535	11.1	225.5	225.5	226.5	1.0
DQ	114,886	486	6,761	18.9	227.4	227.4	227.9	0.5
DR	116,315	422	8,118	15.8	234.6	234.6	235.6	1.0
DS	117,818	319	7,040	18.2	239.4	239.4	240.1	0.7
DT	118,758	330	7,730	15.3	244.7	244.7	245.6	0.9
DU	119,079	497	12,498	9.4	247.9	247.9	248.5	0.6
DV	119,463	424	9,189	12.8	247.9	247.9	248.1	0.2
DW	119,536	388	8,314	14.2	247.9	247.5	248.1	0.6
DX	119,597	395	8,454	14.0	248.6	248.6	249.1	0.5
DY	119,736	497	9,423	12.5	249.9	249.9	249.9	0.0
DZ	120,052	479	11,236	10.5	251.4	251.4	251.5	0.1

(1) Stream distance in feet above confluence with Snoqualmie River.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SKYKOMISH RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
Skykomish River (Cont'd)								
EA	120,425	435	9,578	12.3	251.4	251.4	251.6	0.2
EB	120,582	360	7,338	16.1	251.4	250.7	251.1	0.4
EC	120,636	349	7,471	15.8	251.9	251.9	252.2	0.3
ED	120,662	420	8,093	14.6	252.8	252.8	252.9	0.1
EE	121,140	539	9,699	12.2	255.2	255.2	255.4	0.2
EF	122,035	578	7,405	15.9	257.1	257.1	257.3	0.2
EG	122,480	519	7,048	16.7	259.7	259.7	259.7	0.0
EH	123,018	274	4,905	24.1	261.8	261.8	261.8	0.0
EI	124,667	887	10,227	11.5	277.6	277.6	277.9	0.3
EJ	125,481	800	11,263	10.5	280.0	280.0	280.6	0.6
EK	126,014	935	7,227	16.3	282.1	282.1	282.1	0.0
EL	127,547	842	8,362	14.1	292.9	292.9	292.9	0.0
EM	127,956	617	6,747	17.5	294.6	294.6	294.6	0.0
EN	128,886	813	8,986	13.1	301.8	301.8	301.8	0.0
EO	129,628	534	7,490	15.8	304.3	304.3	304.3	0.0
EP	130,656	590	8,250	14.3	309.1	309.1	309.1	0.0
EQ	130,983	536	7,469	15.8	309.8	309.8	309.8	0.0
ER	131,705	318	5,389	21.9	311.2	311.2	311.2	0.0
ES	133,320	530	8,192	14.4	321.7	321.7	321.7	0.0
ET	134,432	638	6,848	17.2	325.2	325.2	325.2	0.0
EU	134,988	426	6,052	19.5	328.7	328.7	328.7	0.0
EV	135,909	381	6,187	19.1	336.7	336.7	336.7	0.0
EW	136,702	362	5,743	20.6	342.0	342.0	342.0	0.0
EX	137,812	333	7,358	16.0	349.8	349.8	349.8	0.0
EY	138,281	344	6,625	17.8	350.9	350.9	350.9	0.0

(1) Stream distance in feet above confluence with Snoqualmie River.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SNOHOMISH COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

SKYKOMISH RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
Snohomish River								
A[2]								
B-AH[3]								
AI	16.01	2,171	27,190	6.5	36.8	36.8	36.8	0.0
AJ	16.53	3,942	45,232	4.5	38.1	38.1	38.0	-0.1
AK	16.86	3,567	63,610	3.2	38.3	38.3	38.6	0.3
AL	17.5	3,660	33,818	6.0	38.9	38.9	39.3	0.4
AM	18.02	4,024	47,800	4.3	39.7	39.7	40.2	0.5
AN	18.3	4,500	44,568	4.6	40.0	40.0	40.5	0.5
AO	18.5	4,205	43,529	4.7	40.2	40.2	40.7	0.5
AP	19.04	3,032	42,024	4.9	40.8	40.8	41.5	0.7
AQ	19.51	2,766	33,206	6.1	41.6	41.6	42.3	0.7
AR	19.85	3,165	40,383	5.1	42.5	42.5	43.2	0.7
AS	20.18	1,322	20,878	9.8	42.9	42.9	43.4	0.5
AT	20.44	1,031	25,015	10.1	42.9	42.9	43.4	0.5
AU[4]	20.46	1,024	25,415	8.0	42.9	42.9	43.4	0.5
AV[4]	20.74	1,489	31,916	6.4	44.4	44.4	45.0	0.6
AW[4]	20.98	1,988	36,038	5.7	45.5	45.5	46.2	0.7
AX[4]	21.28	2,598	55,133	5.7	46.6	46.6	47.3	0.7

(1) Stream distance in miles above mouth
(2) No floodway or density fringe computed.
(3) See Table 13, Density Fringe Area Data Table and Hydraulic analyses in Section 10.2 in the FIS.
(4) Cross Sections within the new study reach

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SNOHOMISH RIVER

FLOODING SOURCE			FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
SNOQUALMIE RIVER		DISTANCE [1]	WIDTH (SQUARE FEET)	SECTION AREA (FEET PER SECOND)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY [2] (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
MAIN CHANNEL CROSS SECTIONS	OVERFLOW CROSS SECTIONS								
A	A[3]	898	2,854	58,465	3.5	46.6/ 46.6	46.6	47.3	0.7
B	B[3]	1,162	3,011	60,876	3.3	46.7/ 46.7	46.7	47.4	0.7
C	C[3]	2,165	3,559	58,756	3.5	46.9/ 46.9	46.9	47.5	0.6
D	D[3]	3,643	4,440	70,101	2.9	47.2/ 47.2	47.2	47.9	0.7
E	E[3]	4,699	4,858	66,634	3.1	47.5/ 47.5	47.6	48.1	0.5
F	F[3]	5,702	4,971	74,139	2.7	48.0/ 48.0	48.0	48.6	0.6
G	G[3]	6,917	5,276	76,550	2.7	48.3/ 48.3	48.4	48.9	0.5
H	H[3]	7,973	6,724	87,358	2.3	48.7/ 48.7	48.6	49.3	0.7
I	I[3]	8,765	8,188	94,968	1.9	48.8/ 48.8	48.9	49.4	0.5
J		9,398	5,247	64,973	1.6	48.9	48.9	49.5	0.6
K		10,190	3,671	58,838	1.5	49.0	49.0	49.6	0.6
L		11,458	3,410	59,078	1.5	49.1	49.1	49.7	0.6
M		11,510	3,572	58,645	1.5	49.1	49.1	49.7	0.6
N		12,250	3,500	67,909	1.3	49.1	49.1	49.8	0.7
O		13,411	3,255	65,784	1.3	49.1	49.1	49.8	0.7
P		14,414	3,668	77,212	1.1	49.2	49.2	49.9	0.7
Q		15,523	3,922	75,837	1.1	49.2	49.2	50.0	0.8
R	A[4]	17,266	4,187	76,029	1.1	49.2/ 49.2	49.2	50.0	0.8
S	B[4]	18,427	4,756	77,343	1.1	49.2/ 49.3	49.2	50.0	0.8
T	C[4]	20,117	4,961	92,162	0.9	49.3/ 49.3	49.3	50.1	0.8
U	D[4]	21,278	5,235	99,556	0.9	49.4/ 49.4	49.4	50.2	0.8
V	E[4]	22,598	5,480	110,739	0.8	49.4/ 49.4	49.4	50.2	0.8
W	F[4]	23,813	6,204	125,890	0.7	49.4/ 49.4	49.4	50.2	0.8
X	G[4]	24,605	7,070	135,928	0.6	49.5/ 49.5	49.5	50.3	0.8
Y	H[4]	25,766	7,788	156,260	0.6	49.5/ 49.5	49.5	50.3	0.8
Z	I[4]	27,350	8,551	162,192	0.5	49.5/ 49.5	49.5	50.3	0.8
AA	J[4]	29,093	8,349/750[5]	154,290	0.6	49.5/ 49.5	49.5	50.3	0.8

(1) Main stream distance in feet above confluence with Skykomish river.
(2) Where there are overflow reaches, the order is main channel first and then overflow reaches.
(3) Skykomish River portion of overflow.
(4) Overflow 1 portion of overflow.
(5) Total floodway width/Floodway width in the Snohomish County

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SNOHOMISH COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

SNOQUALMIE RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
South Fork Stillaguamish River								
A	18.20	1,116	7,002	6.4	74.7	74.7	75.2	0.5
B	18.56	962	9,130	4.9	76.5	76.5	77.3	0.8
C	18.78	852	6,177	7.3	77.0	77.0	77.7	0.7
D	19.23	1,178	13,317	3.4	78.9	78.9	79.9	1.0
E[2]	19.92	428	4,494	10.2	82.9	82.9	83.5	0.6
F	20.15	436	3,923	11.7	85.6	85.6	86.0	0.4
G	20.48	703	6,756	6.8	90.0	90.0	90.1	0.1
H	20.88	847	9,363	4.9	91.8	91.8	92.1	0.3
I	21.13	962	7,912	5.8	93.0	93.0	93.4	0.4
J	21.33	941	7,604	6.0	94.4	94.4	94.9	0.5
K	21.56	1,071	7,656	6.0	96.0	96.0	97.0	1.0
L	21.88	344	3,484	12.3	99.3	99.3	100.0	0.7
M	22.25	628	5,797	7.4	104.1	104.1	105.0	0.9
N	22.61	514	5,364	8.0	106.5	106.5	107.3	0.8
O	22.82	288	4,482	9.5	107.9	107.9	108.6	0.7
P	23.09	256	4,470	9.6	109.9	109.9	110.4	0.5
Q	23.37	224	2,977	14.3	112.8	112.8	113.1	0.3
R	23.84	230	4,128	10.3	117.8	117.8	117.8	0.0
S	24.28	382	7,657	5.6	120.5	120.5	120.9	0.4
T	24.89	297	4,054	10.5	122.6	122.6	123.0	0.4
U	25.60	300	5,416	7.9	128.7	128.7	128.8	0.1
V	25.74	262	5,300	8.1	129.2	129.2	129.3	0.1
W	26.10	220	4,130	10.3	132.1	132.1	132.3	0.2
X	26.30	250	4,655	9.2	134.5	134.5	134.6	0.1
Y	26.74	350	4,485	9.5	138.3	138.3	138.5	0.2
Z	27.13	290	4,328	9.9	141.7	141.7	142.2	0.5

(1) Stream distance in miles above mouth of Stillaguamish River.

(2) Values based on appropriate hydraulic model output without regard to the new aerial base map adjustments

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SOUTH FORK STILLAGUAMISH RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
South Fork Stillaguamish River (Cont'd)								
AA	30.35	300	4,100	10.4	170.5	170.5	171.1	0.6
AB	30.70	340	5,282	8.1	175.6	175.6	175.8	0.2
AC	31.22	266	4,702	9.3	182.4	182.4	183.1	0.7
AD	31.51	293	5,241	8.3	186.3	186.3	186.8	0.5
AE	31.92	263	4,606	9.4	191.8	191.8	192.8	1.0
AF	32.40	294	5,092	8.5	198.0	198.0	198.8	0.8
AG	32.66	240	3,929	11.1	201.8	201.8	202.6	0.8
AH	32.93	380	5,513	7.9	207.0	207.0	207.6	0.6
AI	33.10	609	7,354	5.9	209.4	209.4	210.3	0.9
AJ	33.29	291	4,149	10.5	212.6	212.6	213.2	0.6
AK	33.43	258	4,541	9.6	216.1	216.1	216.4	0.3
AL	33.77	416	3,768	9.6	222.6	222.6	223.1	0.5
AM	33.87	260	3,197	11.3	228.4	228.4	229.3	0.9
AN	34.10	187	2,407	15.0	236.9	236.9	237.2	0.3
AO	41.32	150	1,881	19.1	847.3	847.3	847.5	0.2
AP	41.63	541	5,269	6.8	857.8	857.8	857.8	0.0
AO[2]	41.98	148	2,235	15.6	861.7	861.7	861.9	0.2
AR[2]	42.27	477	4,182	8.4	868.7	868.7	869.0	0.3
AS[2]	42.56	272	2,963	11.8	871.3	871.3	871.6	0.3
AT	42.86	611	5,222	6.5	876.4	876.4	876.9	0.5
AU	43.30	282	3,009	11.3	881.5	881.5	881.9	0.4
AV	43.54	700	6,124	5.5	886.5	886.5	887.1	0.6
AW	43.94	401	3,184	10.3	891.8	891.8	892.4	0.6
AX	44.26	250	2,413	13.6	898.5	898.5	898.9	0.4
AY	44.47	205	2,454	13.4	903.7	903.7	903.9	0.2
AZ	44.76	267	2,903	11.0	911.5	911.5	912.0	0.5

(1) Stream distance in miles above mouth of Stillaguamish River.

(2) Values based on appropriate hydraulic model output without regard to the new base map adjustments

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SOUTH FORK STILLAGUAMISH RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
South Fork Stillaguamish River (Cont'd)								
BA	45.06	506	5,315	6.0	917.6	917.6	918.4	0.8
BB	45.37	431	3,731	8.5	922.7	922.7	923.3	0.6
BC	45.66	403	3,449	8.9	930.4	930.4	930.7	0.3
BD	45.98	223	2,395	12.8	939.6	939.6	940.2	0.6
BE	46.14	449	4,903	6.3	945.5	945.5	946.4	0.9
BF	46.44	159	1,936	15.3	952.6	952.6	953.1	0.5
BG	46.68	129	1,647	18.0	961.9	961.9	962.2	0.3
BH	46.96	219	2,542	11.7	973.2	973.2	974.1	0.9
BI	47.20	180	1,706	16.8	982.0	982.0	982.1	0.1
BJ	47.56	176	2,260	12.7	1,007.2	1,007.2	1,007.3	0.1
BK	47.95	243	1,894	15.1	1,028.2	1,028.2	1,028.8	0.6
BL	48.29	208	3,346	8.2	1,045.9	1,045.9	1,046.1	0.2
BM	48.55	239	1,865	14.8	1,057.6	1,057.6	1,058.4	0.8
BN	48.74	230	2,489	11.1	1,069.0	1,069.0	1,069.9	0.9

[1] Stream distance in miles above mouth of Stillaguamish River.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SNOHOMISH COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

SOUTH FORK STILLAGUAMISH RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
Stillaguamish River								
A-Z [2]								
AA	11.10	629	8,764	8.2	45.1	45.1	45.9	0.8
AB	11.11	552	8,778	8.2	45.2	45.2	45.9	0.7
AC	11.12	523	7,784	9.3	45.2	45.2	45.9	0.7
AD	11.50	970	9,076	7.9	46.3	46.3	46.8	0.5
AE	12.24	1,001	8,633	8.7	48.0	48.0	48.6	0.6
AF	13.19	776	8,988	8.3	51.8	51.8	52.3	0.5
AG	14.14	1,050	10,120	6.5	56.0	56.0	57.0	1.0
AH	15.14	664	10,271	6.4	60.4	60.4	61.3	0.9
AI	15.69	713	8,582	7.7	62.4	62.4	63.0	0.6
AJ	16.92	2,546	18,133	3.6	67.5	67.5	67.8	0.3
AK	17.22	2,700	31,516	2.4	68.3	68.3	69.2	0.9
AL	17.73	512	6,478	11.6	71.2	71.2	71.8	0.6
AM	17.74	451	7,093	6.3	71.3	71.3	71.9	0.6
Stillaguamish River Split Flow								
A	14.11	584	4,334	2.1	56.0	56.0	57.0	1.0
B	16.94	1,285	5,402	1.7	58.2	58.2	58.2	0.0

(1) Stream distance in miles above mouth of Hat Slough

(2) No floodway computed

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

STILLAGUAMISH RIVER - STILLAGUAMISH RIVER SPLIT FLOW

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
Sultan River								
A	474	520	6,330	9.3	116.8 [2]	116.1	116.9	0.8
B	585	480	5,986	9.9	117.0	117.0	117.5	0.5
C	1,188	1,079	10,961	5.4	119.1	119.1	119.7	0.6
D	2,341	1,604	17,617	3.4	120.1	120.1	120.9	0.8
E	2,982	1,645	17,632	3.4	120.3	120.3	121.2	0.9
F	3,460	1,648	15,497	3.8	120.6	120.6	121.5	0.9
G	4,275	1,536	9,735	6.1	122.1	122.1	122.9	0.8
H	5,059	1,708	13,381	4.4	124.2	124.2	125.2	1.0
I	5,537	1,889	13,184	4.5	125.1	125.1	126.0	0.9
J	5,842	1,807	11,259	5.3	126.1	126.1	126.7	0.6
K	6,457	1,874	11,590	5.1	128.3	128.3	128.9	0.6
L	6,813	1,797	10,437	5.7	129.2	129.2	130.2	1.0
M	7,275	1,512	12,229	4.8	131.1	131.1	132.1	1.0
N	7,808	1,325	11,040	5.4	132.6	132.6	133.3	0.7
O	8,682	1,372	8,965	6.6	134.9	134.9	135.7	0.8
P	8,927	1087	6,721	8.8	135.6	135.6	136.5	0.9
Q	9,493	909	5,358	11.0	139.7	139.7	140.4	0.7
R	9,793	742	8,073	7.3	143.2	143.2	144.2	1.0
S	10,347	819	8,516	6.9	144.7	144.7	145.7	1.0
T	10,869	970	6,382	9.3	146.3	146.3	146.9	0.6
U	10,969	1030	7,211	8.2	147.7	147.7	147.8	0.1
V	11,769	539	5,545	10.7	152.3	152.3	152.4	0.1
W	12,289	672	5,602	10.6	154.9	154.9	155.6	0.7
X	12,465	682	6,425	9.2	156.4	156.4	157.3	0.9
Y	12,850	678	6,440	9.2	158.0	158.0	159.0	1.0
Z	13,600	615	6,465	9.1	161.4	161.4	162.4	1.0

(1) Stream distance in feet above confluence with Skykomish River.

(2) Elevation controlled by Skykomish River.

TABLE 10	FEDERAL EMERGENCY MANAGEMENT AGENCY **SNOHOMISH COUNTY, WA** **AND INCORPORATED AREAS**	**FLOODWAY DATA** **SULTAN RIVER**

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Sultan River (Cont'd)								
AA	14,187	417	5,384	11.0	163.9	163.9	164.9	1.0
AB	14,892	269	4,308	13.7	167.3	167.3	168.3	1.0
AC	15,998	329	4,853	12.2	173.5	173.5	174.2	0.7
AD	17,377	151	2,578	22.9	182.6	182.6	182.7	0.1

(1) Stream distance in feet above confluence with Skykomish River.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SNOHOMISH COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

SULTAN RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Swamp Creek								
A	92	45	195	5.2	88.8	88.8	88.8	0.0
B	1,212	36	187	5.4	100.3	100.3	100.3	0.0
C	2,552	36	120	8.4	111.6	111.6	111.9	0.3
D[2]	4,381	55	205	4.9	131.7	131.7	131.8	0.1
E[2]	4,799	39	124	8.1	136.1	136.1	136.1	0.0
F	5,139	24	117	8.6	140.1	140.1	140.1	0.0
G	5,349	54	134	7.5	142.6	142.6	142.6	0.0
H	6,203	38	180	5.6	148.5	148.5	148.9	0.4
I	7,378	52	144	7.0	158.3	158.3	158.5	0.2
J	8,572	37	200	3.3	167.9	167.9	168.6	0.7
K	10,042	31	109	6.1	180.2	180.2	181.1	0.9
L	12,058	49	151	4.0	199.2	199.2	199.2	0.0
M[2]	12,821	31	78	7.8	207.1	207.1	207.3	0.2
N	13,677	48	112	5.5	214.7	214.7	215.2	0.5
O	14,439	60	170	3.6	221.8	221.8	222.2	0.4
P	17,381	40	100	6.1	247.2	247.2	247.3	0.1
Q	18,983	42	103	5.9	257.1	257.1	257.1	0.0
R	20,408	43	148	4.1	270.8	270.8	271.7	0.9
S	21,971	44	89	6.9	285.0	285.0	285.9	0.9
T	23,566	36	69	7.5	298.3	298.3	298.4	0.1
U	25,033	21	81	6.4	307.6	307.6	307.6	0.0
V[2]	25,358	28	108	4.8	309.4	309.4	309.8	0.4
W	25,521	36	105	5.0	310.4	310.4	310.8	0.4
X	25,940	18	62	8.4	315.9	315.9	315.9	0.0
Y	26,267	26	75	7.0	316.7	316.7	316.7	0.0
Z	27,708	30	75	6.9	334.1	334.1	334.1	0.0
AA	28,510	63	206	2.5	337.1	337.1	337.4	0.3
AB	29,758	40	153	3.4	345.6	345.6	346.1	0.5

(1) Stream distance in feet above King-Snohomish County line.

(2) Values based on appropriate hydraulic model output without regard to the new base map adjustments.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SWAMP CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE [1]**	**WIDTH (FEET)**	**SECTION AREA (SQUARE FEET)**	**MEAN VELOCITY (FEET PER SECOND)**	**REGULATORY (FEET NAVD)**	**WITHOUT FLOODWAY (FEET NAVD)**	**WITH FLOODWAY (FEET NAVD)**	**INCREASE (FEET)**
Wallace River								
A	0.52	641	4,079	3.7	*	125.5	125.9	0.4
B	0.70	580	3,473	4.3	*	126.2	127.0	0.8
C	1.02	487	2,529	5.9	*	129.4	129.7	0.3
D	1.31	395	2,634	5.7	*	133.2	133.4	0.2
E	1.92	527	3,805	3.9	*	141.1	141.8	0.7
F	2.33	700	3,219	4.6	*	146.7	147.1	0.4
G	2.70	219	2,067	7.2	*	151.9	152.0	0.1
H	2.80	225	3,280	4.5	152.7	152.7	152.8	0.1
I	3.08	196	1,745	8.5	154.8	154.8	154.9	0.1
J	3.53	327	2,008	7.4	162.4	162.4	162.6	0.2
K	3.69	250	2,274	6.6	164.9	164.9	165.1	0.2
L	3.70	224	2,217	6.9	164.9	164.9	165.2	0.3
M	3.87	680	4,005	3.5	166.6	166.6	166.7	0.1
N	4.05	317	2,273	6.2	168.7	168.7	169.2	0.5
O	4.32	364	3,184	3.4	172.1	172.1	173.0	0.9
P	4.94	250	1,231	4.5	176.5	176.5	177.3	0.8
Q	5.42	464	2,020	2.8	181.7	181.7	182.6	0.9
R	5.80	80	871	6.0	188.2	188.2	188.6	0.4
S	6.00	158	740	7.0	191.1	191.1	191.5	0.4
T	6.44	191	769	6.8	204.6	204.6	205.1	0.5
U	6.60	100	500	10.4	215.8	215.8	215.8	0.0
V	6.91	102	612	8.5	234.4	234.4	234.9	0.5
W	7.30	241	686	7.2	273.2	273.2	273.4	0.2

(1) Stream distance in miles above confluence with Skykomish River.
(*) Elevations controlled by Skykomish River.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SNOHOMISH COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

WALLACE RIVER

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base (1-percent-annual-chance) Flood Elevations (BFEs) or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by detailed methods. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by levees. No BFEs or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The countywide FIRM presents flooding information for the entire geographic area of Snohomish County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the county identified as floodprone. This countywide FIRM also includes flood-hazard information that was presented separately on Flood Boundary and Floodway Maps, where applicable. Historical data relating to the maps prepared for each community are presented in Table 11, "Community Map History."

7.0 OTHER STUDIES

This study revises and updates the previous Flood Insurance Studies and FIRMs for the unincorporated areas of Snohomish County and the incorporated communities within Snohomish County (References 9,10,11,12,13,14,15,16,17,22,,23,24,25,26 and27,).

In June 1971, the USACE, Seattle District, under contract to FEMA, completed a FIS for the unincorporated areas of Snohomish County (Reference 76). This study was not formally released by FEMA, but limited distribution was made to cognizant State and local officials for interim use in floodplain management.

The USACE, Seattle District, has published several reports and studies for Snohomish County, including: "Sauk River Suggested Hydraulic Floodway" June 1976; "Stillaguamish River Flood Plain Information Studies" February and November 1963; "Stillaguamish River Review of Reports on Flood Control" January 1967 ; "Snohomish River Flood Plain Information Studies" June 1966 and May 1967; "Snohomish River Suggested Hydraulic Floodway" April 1975; "Pilchuck River Special Flood Hazard Information Study" March 1973; "Snoqualmie River Flood Control and Other Improvements Study" March 1968; and "Reconnaissance Report on Mediated Plan for Snohomish River Basin," November 1976 (References 77 through 84 respectively).

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATES	FIRM EFFECTIVE DATES	FIRM REVISIONS DATES
Arlington, City of	June 27, 1975	N/A	November 16, 1983	September 16, 2005
Bothell, City of	May 24, 1974	November 12, 1976	June 1, 1982	March 2, 2004 September 16, 2005
Brier, City of	January 24, 1975	N/A	September 24, 1984	September 6, 2005
Darrington, Town of	July 11, 1975	N/A	August 19, 1985	September 16, 2005
Edmonds, City of	July 26, 1974	January 16, 1976	August 8, 1978	December 7, 1982 February 19, 1986 September 16, 2005
Everett, City of	June 21, 1974	N/A	April 3, 1978	September 5, 1990 September 16, 2005
Gold Bar, City of	September 19, 1975	N/A	December 1, 1983	September 16, 2005
Granite Falls, Town of	November 8, 1999	N/A	November 8, 1999	September 16, 2005
Index, Town of	December 27, 1974	N/A	December 1, 1983	September 16, 2005
Lake Stevens, City of	April 17, 1989	N/A	April 17, 1989	September 16, 2005
Lynnwood, City of	June 28, 1974	December 28, 1975	June 5, 1985	September 17, 1992 September 16, 2005
Marysville, City of	March 15, 1974	April 2, 1976	February 15, 1984	September 16, 2005
Mill Creek, City of	November 8, 1999	N/A	November 8, 1999	September 16, 2005
Monroe, City of	November 5, 1976	January 16, 1979	December 1, 1983	September 16, 2005

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

COMMUNITY NAME (continued)	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATES	FIRM EFFECTIVE DATES	FIRM REVISIONS DATES
Mountlake Terrace, City of	June 28, 1974	September 26, 1975	August 19, 1985	September 30, 1987 September 16, 2005
Mukilteo, City of	July 11, 1975	N/A	February 19, 1986	November 5, 1986 September 16, 2005
Snohomish, City of	March 8, 1974	May 28, 1976	November 16, 1983	September 16, 2005
Snohomish County Unincorporated Areas	December 23, 1971	December 13, 1977	March 15, 1984	September 30, 1992 September 16, 2005
Stanwood, City of	June 28, 1974	April 2, 1976	November 16, 1983	September 16, 2005
Sultan, City of	September 7, 1974	N/A	September 30, 1983	September 16, 2005
Gold Bar, City of	September 19, 1975	N/A	July 3, 1986	September 16, 2005
Granite Falls, Town of				

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

SNOHOMISH COUNTY, WA
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

Additional studies in Snohomish County include the 1970 "Puget Sound and Adjacent Waters" study and the "Snohomish River Basin Resource Management Program Main Report," dated June 1981 (References 47 and 48).

The FIS reports for the City of Everett, dated October 1977, and King County, Washington and Incorporated Areas, dated May 16, 1995, were affected by the above-mentioned reports (References 11 and 20, respectively). Water-surface profiles shown in those studies for the Snohomish and Snoqualmie Rivers, respectively, are significantly lower than presently calculated. The differences in stage are primarily due to revised hydrologic analyses.

The 1-percent-annual-chance flood discharge for the Snoqualmie River at the Snohomish-King County line was increased from 56,000 cfs in the King County FIS to 73,000 cfs, primarily due to the additional records available after 1973. The increase in stage at the county line from 43.0 feet to 46.0 feet was caused not only by the higher discharge but by backwater effects from a higher coincident stage in the Snohomish River.

This study does not agree with the Flood Insurance Studies prepared for Island and Kitsap Counties, Washington (References 18 and 21), because it contains a more detailed analysis of the tidal area.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Federal Insurance and Mitigation Division, Federal Regional Center, 130 228th Street, Southwest, Bothell, Washington 98021-9796.

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