

2.3.6 Floodplains

2.3.6 FLOODPLAINS

2.3.6.1 Status of Floodplains in the Clean Water District

The purpose of the Stillaguamish Clean Water District includes preservation of surface water and river management, as well as controlling, accommodating, and discharging storm runoff; rehabilitating drainage corridors for hydraulics, aesthetics, and fisheries benefits, as described and provided for in the Snohomish County Code (25A.05.010 (3)).

Floodplains are low lying areas adjacent to rivers that are formed chiefly of river sediment and are subject to flooding. Flooding is a natural process that results in inundation and bank erosion. Floodwaters rise above the natural containment levels in rivers and streams as a result of periods of intense rainfall and/or snowmelt. Bank erosion is the process whereby river and stream banks are scoured or undermined by high velocity erosive flow. Ongoing bank erosion can result in movement or shifting of the channel, called channel migration. Both flooding and channel migration are natural processes that exacerbate the risk of damage to developed properties. At the same time, these processes are important for creating and maintaining healthy aquatic and riparian habitats.

This section deals primarily with the effects of floods on people and property. More detailed discussion on the ecological role of riparian corridors, which includes floodplains, is given in Section 2.3.4 Aquatic Habitat/Riparian Corridors of this report.

Locations and Extents

The 100-year floodplain has been mapped for large rivers in the Stillaguamish Watershed, including all or portions of the Mainstem, North and South Forks, Pilchuck Creek and Canyon Creek. There are many additional miles of floodplain in the upper reaches of these streams and smaller ones that are not mapped. Generally flood hazards along these smaller systems are less extensive, so the existing mapped floodplain encompasses the majority of the flood hazard area within the watershed. The extents of mapped floodplains are shown in Figure 2.3.6-1.

Land Use

Table 2.3.6-1 shows the current use of all floodplain properties in the Stillaguamish Watershed. This data was calculated by grouping the number of parcels and total acreage for each use code by watershed. Currently almost 58 percent of the Stillaguamish floodplain is in agricultural use. Agricultural land, actively managed forests, and vacant rural residential lots make up more than 78 percent of the floodplain.

Jurisdictions

The vast majority of mapped floodplain lands are under Snohomish County's jurisdiction. Only in the upper reaches a small amount of private, federal or state timberlands occur in the floodplain – less than five percent of the total Stillaguamish floodplain. Stanwood is the only city with any significant area in the floodplain, although Arlington has been purchasing floodplain lands for parks and utilities usage.

County land use zoning in the floodplain is predominately agriculture on the Mainstem and lower forks, with rural residential in the upper valleys.

Table 2.3.6-1. Floodplain Properties in the Stillaguamish Watershed

Existing Use Designation	Data	Main-stem	North Fork	South Fork	Canyon Creek	Pilchuck Creek	*Skagit Floodplain	Grand Total
Agricultural	Number of Parcels	413	98	19	0	8	87	625
	Floodplain acres	9537	1530	438	0	93	1998	13,597
Commercial	Number of Parcels	58	13	9	3	0	149	232
	Floodplain acres	180	11	58	10	0	115	374
Timber/Forest	Number of Parcels	6	52	30	17	6	0	111
	Floodplain acres	21	671	187	202	93	0	1174
Rural	Number of Parcels	318	333	554	181	24	250	1660
Residential	Floodplain acres	1539	1102	464	107	54	290	3556
Vacant	Number of Parcels	195	371	391	186	21	92	1256
	Floodplain acres	939	1086	989	98	162	415	3689
Other	Number of Parcels	41	54	46	15	8	14	178
	Floodplain acres	454	444	135	6	75	154	1268
Total Number of Parcels		1031	921	1049	402	67	592	4062
Total Floodplain Acres		12,669	4844	2272	423	478	2972	23,658

*Skagit Floodplain refers to the coastal plain north of Stanwood within Snohomish County

Floodplain Functions

The recognized benefits of a naturally functioning floodplain include the storage and conveyance of flood waters, the recharging of groundwater, the maintenance of surface water quality, and the provision of habitats for fish and wildlife. Unconstrained floodplains provide some of the most productive habitats for anadromous salmonids (Sommer et al. 2001). Off-channel habitats in the floodplains of larger rivers are important refuge habitats for salmonids. Floodplains are also a source of nutrients and organic matter for the food web. These areas filter floodwaters and provide depositional areas for fine sediment. (Wissmar and Timm 2003). Along the Stillaguamish River, floodplains have been modified and disconnected in places from their rivers due to human activities and development.

More discussion on the ecological role of floodplains and riparian system in general can be found in Section 2.3.4 Aquatic Habitat/Riparian Corridors of this report. The remaining discussion in this section will deal primarily with the infrastructure aspects of floodplains, and will be focused on flood hazards, risks and floodplain development.

2.3.6.2 Floodplain Programs in the Stillaguamish Watershed County Programs

Like all rivers, the Stillaguamish River is subject to regular flooding. While a natural occurrence that benefits the environment, flooding poses a potential hazard to county residents who live on the floodplain and lowlands. In recent years, Snohomish County experienced several devastating floods in 1990, 1995, 1996, 1997, 2003, and 2006. Snohomish County has flood management programs, plans and regulations to manage and reduce the damaging effects of flooding while

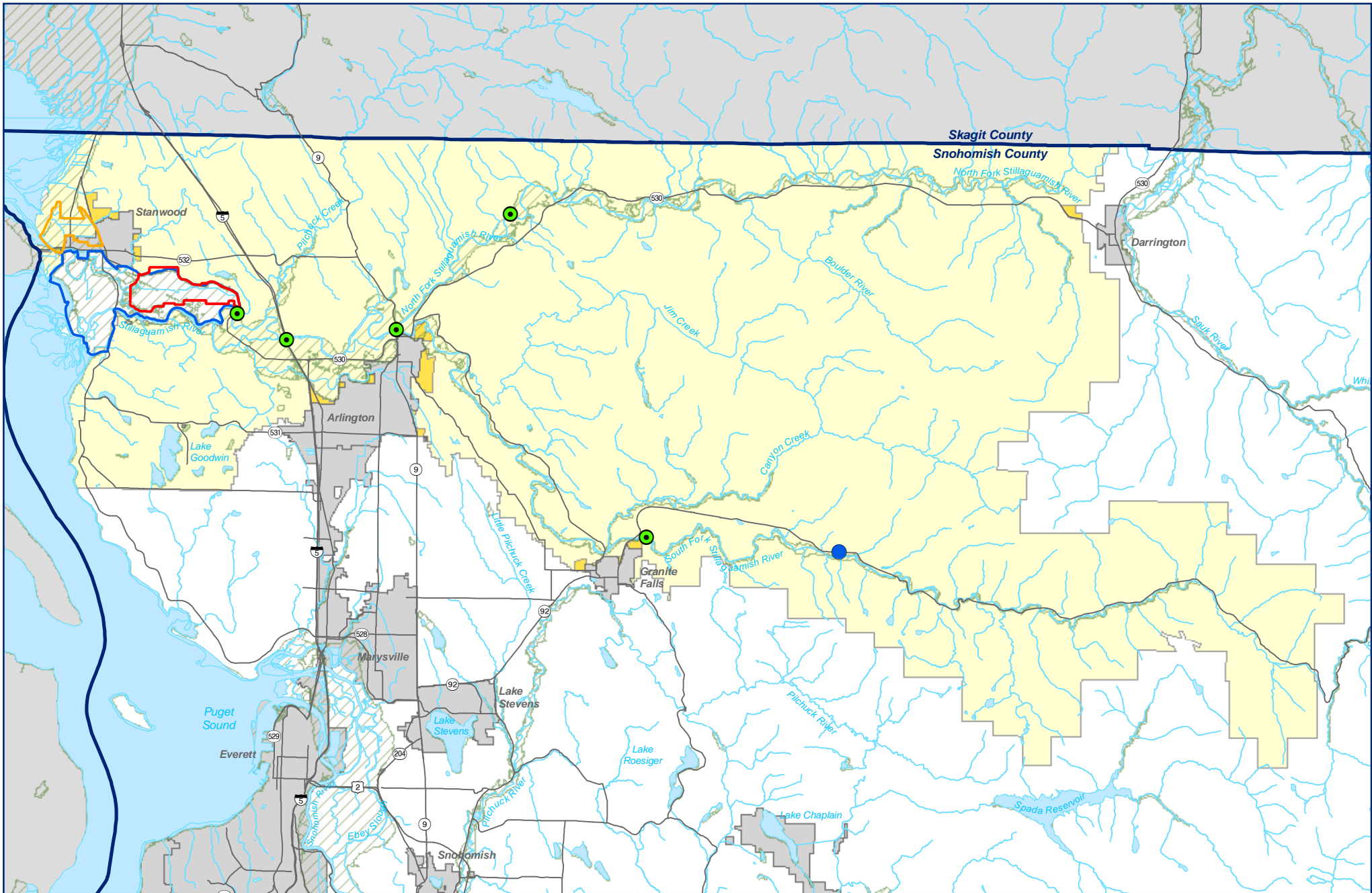


Figure 2.3.6-1 Flood Related Features in the CWD

- Flood Warning Gage
- Robe Valley Flood Control District
- 100 Year Floodplain
- Drainage District 7
- Drainage District 12
- Stillaguamish Flood Control District
- Major Roads
- Rivers & Streams
- Lakes & Bays
- Cities
- Stillaguamish CWD
- Stillaguamish CWD UGA



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preserving the positive environmental benefits (Snohomish County Public Works 2004). County and other flood-related programs are described below.

Capital Improvements

Entirely new flood control structures are rarely built anymore. In most cases, repair and replacement of existing projects are what normally occurs. However, emergency conditions and unexpected flood damage can lead to building new structures. Two large structures recently constructed in the Stillaguamish Watershed include the Robe Valley Flood Control District project on the South Fork and the Steelhead Drive project on the North Fork. In the latter case, the County and U.S. Corps of Engineers performed emergency bank stabilization work after the Hazel slide. The next summer the Stillaguamish Tribe constructed a long log revetment on the opposite bank to keep the river from migrating back into the slide area.

Flood Control Structure Maintenance

Snohomish County Public Works operates and maintains flood control structures throughout the Stillaguamish Watershed (see Figure 2.3.6-1). The Oso levee on the North Fork, Schloman Road Dike, Dike Road Dike Berm, and Hevly Road Berm are some of the longer structures actively maintained. These structures are inspected annually. Most are also mowed regularly, and damages repaired as needed.

Flood Hazard Regulations

One of the most important long term actions to reduce flood damage is to develop and enforce regulations that keep people and property out of harms way. Snohomish County has a flood hazard code as part of its Critical Areas Regulation. The code follows the standards mandated by the National Flood Insurance Program under the Federal Emergency Management Agency, plus additional requirements under state law. Having this code is a requirement for membership in the National Flood Insurance Program, which allows federal flood insurance to be sold in the community.

The intent of the flood hazard code is to ensure floodplain development occurs in locations and in ways that minimize the risk of flood damage to the permitted structure or project. The 100-yr flood (a flood that has a one percent chance of occurring in any given year) is the national standard for which the code is written. Most floodplains have had detailed mapping performed, where floodplain limits and flood elevations are calculated. In Snohomish County, new residential and other structural construction must be built so that the first floor and all utilities are one foot above the base flood elevation (equivalent to the 100-yr flood elevation).

The flood hazard code also divides the Stillaguamish floodplain into one of three zones, with varying degrees of restriction in each. In all cases, the standard is that the net effect of development cumulatively cannot cause the 100-yr flood to increase by more than one foot from existing conditions. Upstream of Interstate-5, the floodplain is mapped into “floodway” and “flood fringe” zones. The floodway is the main channel and adjacent area that must be reserved to convey the 100-yr flood with less than a one-foot rise, should the flood fringe area be entirely developed. The floodway has very stringent requirements, including a ban on all new residential construction.

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Downstream of Interstate-5, the flood areas use “density fringe floodway” zoning. Here allowable development is spread across the floodplain rather than being contained to the flood fringe, but only a small percentage of each lot can be developed, rather than the entire parcel as would be allowed in the flood fringe. The result, in either case, is to ensure that no more than a one-foot rise occurs in the 100-yr flood should the floodplain be fully developed as allowed.

Floodplain Mapping

An integral part of the flood hazard code is the flood insurance rate maps published by the Federal Emergency Management Agency (FEMA). These are used both by the county to apply the regulations and also by FEMA to rate and sell flood insurance policies. These maps show the extent of the floodplain, floodway boundaries and base flood elevations. The maps for the Stillaguamish Watershed were developed in the early 1980s by the U.S. Army Corps of Engineers. FEMA has made updating outdated flood insurance rate maps a priority, as inaccurate maps can lead to counties permitting homes in dangerous locations and FEMA paying high flood insurance claim amounts.

Nationally, around 30 percent of all current flood insurance claims come from areas outside of mapped flood hazard zones. Snohomish County is a Cooperating Technical Partner for FEMA, meaning it has been certified as having the necessary technical resources to perform its own flood mapping updates. Currently the county is working on the upper Skykomish River. The Stillaguamish River is the next priority to remap. In the meantime, when errors in the existing flood maps are found, the Snohomish County Planning and Development Services Department is notified and will use new data, such as high water marks in lieu of known mapping errors.

Community Rating System

Snohomish County is a member of the Community Rating System, a voluntary program administered by FEMA that rewards communities that go beyond federal minimum requirements in their flood hazard management programs by giving reduced premiums to flood insurance policy holders within the County. The county holds a class 5 rating, which results in a 25 percent reduction in flood insurance premiums for county residents. Numerous county programs and policies contribute to this rating, including floodplain resident outreach programs, having low-density floodplain zoning and higher regulatory standards.

Flood Hazard Mitigation

Planning

SWM completed the Stillaguamish River Comprehensive Flood Hazard Management Plan in 2004. The plan evaluated flood hazards in the watershed and recommended a suite of 35 actions including capital projects; planning; forest practices; emergency response; and maintenance. This plan was developed with stakeholders in the watershed, including the cities of Arlington and Stanwood. Its recommendations were folded into the Snohomish County Natural Hazards Mitigation Plan, adopted in 2005. These two plans serve as the guidance documents for developing mitigation projects in the Stillaguamish Watershed, and make any projects eligible for state and federal mitigation funding, such as those listed in the next section.

Projects

SWM executes flood hazard mitigation projects, typically using grant funds from federal and state sources. Recent projects include the Chatham Acres acquisition, a \$1.9 million buyout of a community on the North Fork threatened by stream channel change in 2003; a home elevation project on a historic residence near Stanwood (underway); and the Robe Valley Flood Control District formation and bank stabilization project (2005). SWM also assisted the Stillaguamish Flood Control District in successfully applying for a grant to construct a flood drainage structure near Stanwood.

Flood Warning System

SWM operates an automated flood warning system to allow emergency responders and floodplain residents advanced warning and monitoring of floods. Snohomish County operates three telemetered gages on the Mainstem, the USGS operates two gages, one on each fork, and the Department of Ecology will upgrade four or five of their gages in 2007 to be used as flood warning instruments. The county gages transmit data to a base station in Everett, where it is processed and sent to a web page updated every 15 minutes. The data is also transmitted to the National Weather Service for their use. The Department of Emergency Management uses this data and also maintains a recorded flood information line that is updated frequently during flood events.

State Programs

Washington Department of Transportation

The Washington State Department of Transportation maintains three highways that are located in the Stillaguamish River floodplain. Each highway has some effect on flood behavior, and requires maintenance to protect it from flood damage.

Interstate 5 crosses the Mainstem between Silvana and Arlington. The freeway is elevated above grade, with bridge openings for Portage Creek and the Stillaguamish River. The highway has been nearly overtopped in the large floods of the last 15 years. SWM modeling predicts it will overtop in a 100-yr event while causing increased flood stages upstream due to backwater effects.

State Route 532 runs across the floodplain at Stanwood. This highway functions as a levee to protect Stanwood from any Stillaguamish River flooding. The City built an emergency floodwall along a portion of the highway in the 1990 flood; SWM modeling predicts long lengths of it may overtop in a 100-yr flood.

State Route 530 runs from I-5 up the Mainstem to Arlington and then up the North Fork to Darrington. The highway is overtopped in numerous places during floods, including at Island Crossing, along the South Fork just out of Arlington and at Cicero. When closed the town of Darrington must use a long detour through Skagit County to reach the rest of Snohomish County.

Washington Department of Ecology

Stream Gaging

The Washington State Department of Ecology installed a network of stream gages in the watershed several years ago. SWM is working with this agency in 2007 to upgrade their gages

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so they will function as flood warning gages, with hourly real-time data updates. Gages selected for upgrade include sites on the South Fork Stillaguamish, upper North Fork Stillaguamish, Deer Creek and Canyon Creek.

Flood Control Account and Assistance Program

The Department of Ecology operates the Flood Control Account and Assistance Program (FCAAP), a grant program that funds flood hazard planning and projects. Grants are available on the two year state budget cycle. SWM has used to these grants to fund flood hazard plan development, flood warning system upgrades and floodplain mapping efforts.

Federal Programs

U.S. Army Corps of Engineers

The Corps operates a flood control project on the Mainstem consisting of 26 bank revetments and the Cook Slough weir. The project dates from the 1930s. Typically the revetments are mowed every other year and repaired as necessary. Two of the revetments have county roads and berms on top of them.

Federal Emergency Management Agency (FEMA)

This agency provides several important roles in flood hazard management for Snohomish County, including operating the National Flood Insurance Program; funding map update efforts; funding hazard mitigation grants; funding disaster recovery efforts after large floods; and providing input on County regulatory changes impacting the flood hazard code.

Other Programs

Stillaguamish Flood Control District

The Stillaguamish Flood Control District was formed in the early 1990s and services the lower Mainstem floodplain below Silvana to Port Susan. The district operates and maintains many miles of dikes and levees, drainage ditches and tidegates.

Robe Valley Flood Control District

The Robe Valley Flood Control District was created after the devastating floods of 2003 washed several homes in the community away. Snohomish County assisted in the formation of the district, as well as directing the construction of a large bank stabilization project using Natural Resource Conservation Service funds in 2005.

2.3.6.3 Trends

Changes in either the hazard (i.e. the size of floods) or the exposure (the amount of property and number of people at risk) can lead to increased flood damages over time. Issues with flood flow trends are described in the water quantity section of this report. Floodplain development will increase over time. Zoning in the floodplain is primarily low density agriculture and rural residential, which will minimize the numbers of new homes, but significant numbers of homes can still be built in the floodplain.

Table 2.3.6-2 is taken from the Stillaguamish Comprehensive Flood Hazard Management Plan. It was developed using 2001 data from the county assessor's office, and represents an upper

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bound on the amount of new homes that could be built in the floodplain, assuming all lots are subdivided to the minimum allowable – typically five or ten acres. Actual numbers of new homes are expected to be substantially less due to constraints not accounted for, such as riparian area and wetland buffers

Table 2.3.6-2. Potential Home Construction in Floodplain Areas

Land Use	Data	¹ Main Stem	¹ North Fork	¹ South Fork	¹ Canyon Creek	¹ Pilchuck Creek	^{1,2} Skagit Floodplain	Grand Total
Agriculture	Existing Homes	365	159	5	0	1	31	561
	New Homes Possible	793	147	29	0	1	193	1,163
	Total Future Homes	1158	306	34	0	2	224	1,724
Land use within City Limits								
Land use within City Limits	Existing Homes	48	0	8	0	0	357	413
	New Homes Possible	0	0	0	0	0	0	0
	Total Future Homes	48	0	8	0	0	357	413
Forest								
Forest	Existing Homes	0	10	19	12	0	0	41
	New Homes Possible	0	16	7	3	0	0	26
	Total Future Homes	0	26	26	15	0	0	67
Rural Residential								
Rural Residential	Existing Homes	117	225	430	175	25	10	982
	New Homes Possible	134	175	104	4	70	23	510
	Total Future Homes	251	400	534	179	95	33	1,492
Other								
Other	Existing Homes	16	2	119	0	0	0	137
	New Homes Possible	11	11	0	0	0	0	22
	Total Future Homes	27	13	119	0	0	0	159
Total Existing Homes		546	396	581	187	26	398	2,134
Total New Homes Possible		938	349	140	7	71	216	1,721
Total Future Homes		1484	745	721	194	97	614	3,855

¹This information is for analysis only and is not intended to reflect actual development potential of individual parcels.
²Skagit Floodplain refers to the coastal plain north of Stanwood within Snohomish County.

This table shows the importance of the agriculturally-zoned lands in future development scenarios in unincorporated Snohomish County since more than 67 percent of future new home construction can occur in this zone. This is due to the large percentage of the floodplain being zoned agriculture, and the lack of a regulatory floodway in much of the Mainstem that would prevent new development.

This calculation does not take into consideration the restrictions placed on development in the density fringe area, which provides significant limitations on growth west of I-5.

2.3.6.4 Problems and Gaps

Explained below are the existing problems regarding floodplains, as well as any gaps in data or analysis, and gaps in SWM’s programs regarding floodplain management.

Outdated Flood Maps

The flood insurance rate maps currently used to regulate floodplain development in the Stillaguamish basin are more than 20 years old. Errors in predicted flood levels in multiple locations and of up to four feet have been identified. Where identified, the county uses updated information for permits, but until all the floodplains are re-mapped, the number of areas with erroneous information is unknown. SWM is re-mapping all the county's floodplains, and is currently working on the Skykomish River. While the Stillaguamish Watershed is the next priority, completing it will depend on receiving further FEMA funding.

Future Flood Risk Increasing

Flood hazard regulations follow the FEMA standard, which is based on current risk levels. In fact, future flood risk is known to be generally increasing due to both development and climate change. The impacts of development on peak flows are well known.

The Pacific Northwest has seen increasingly warmer and wetter conditions in the last century (Mote 2001). Climate change predictions for western North America (Intergovernmental Panel on Climate Control 2001) and the Pacific Northwest region (Mote 2001) indicate continued warming at rates greater than the global average. Moderate increases in precipitation are also predicted (Mote 2001). More severe weather extremes, including larger precipitation events, are expected worldwide (Intergovernmental Panel on Climate Control 2001). Sea level is also expected to continue to rise.

These factors indicate that in the coming decades, the severity of flooding is likely to increase on the rivers in Snohomish County. The consequence is that structures, most of which will last 50 or more years, will be subject to greater damages over their life than what would be predicted by the current risk. By evaluating likely future conditions in inundation mapping efforts, the true risk and consequent expected damages over the life of the structure can be more accurately determined.

Channel Migration Regulations Needed

Channel migration is the natural movement of a stream or river across its floodplain due to erosion, deposition or a change in stream volume. Currently there are no county regulations that address channel migration. In the upper valleys, channel migration is often a greater risk than flood inundation, which is what the current flood hazard regulations target. Channel migration regulations are proposed in the new Critical Areas Regulation regulations.

Tsunami Analysis and Mapping Needed

The lower floodplain and estuary of the Stillaguamish River, including Stanwood, may be at risk of a tsunami. Puget Sound has a record of tsunamis occurring over the last several thousand years. Earthquakes can directly cause tsunamis by the rapid uplift or subsidence of the seabed along fault zones. An earthquake of magnitude 7 or more is known to have occurred around A.D. 900-930 on the Seattle Fault Zone (National Oceanic and Atmospheric Administration 2003). Tsunami deposits attributed to this earthquake have been mapped in the Snohomish River delta, along with additional tsunami deposits dated to around A.D. 130-530 and A.D. 420-640 (Bourgeois and Johnson 2001). Shipman (2001) documents the historic accounts of the Snohomish people of a large landslide from Camano Head in the 1820s that initiated a tsunami.

The tsunami washed over the low lying areas of Hat Island, drowning some tribal members. Other potential nearby tsunami generators include the South Whidbey fault and the Snohomish River delta (National Oceanic and Atmospheric Administration 2003).

Detailed tsunami analysis and mapping have been performed for several areas of Puget Sound, including Seattle and Bellingham. SWM and the Department of Emergency Management have had some informal discussions about this, but there is no active work currently ongoing to address this risk.

Evaluation of Flood Control Structures Needed

In addition to the above, the Stillaguamish flood control structures, including revetment and levees, can have a detrimental effect on riparian habitat. These structures also need evaluation to assess the potential for abandonment or modification to improve their habitat function.

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