

# Coastal and River Flooding Events

*A Discussion Paper about Community Resilience*

*January 2016*

**Brief:** *Warmer temperatures are reducing winter snow accumulations at higher elevations, increasing storm intensity and flood risks throughout the State. Sea levels are expected to rise, slower in the NW than in other areas. Washington communities have successfully applied adaptive approaches and tools to reduce flood damage and can increase the delivery of these adaptive measures to become more resilient to our changing environment.*

## Problem

Flooding is both one of the most common natural hazards in Washington State, and a supplier of a host of ecosystem services. Flooding affects every county and cost over \$40 million in damages in just 2012 alone. Since 1956, there have been 32 Presidential Disaster Declarations for flooding in Washington with Western Washington experiencing a higher risk for flooding<sup>1</sup>.

We experience two different types of flooding; overflow of riverbanks due to increased storms and coastal flooding from storm surge and high tides. As our climate changes, both types of flooding are expected to increase as winter storms increase and less moisture is stored as snow.

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<sup>1</sup> Washington Emergency Management Division, Flood Hazard Profile, Washington State Enhanced Hazard Mitigation Plan, 2013

**Flooding** causes damage to buildings, structures, crops, flood control structures, and transportation infrastructure, such as roads and bridges and utilities. Planning efforts can significantly influence the degree of impact from flooding through the implementation of adaptation measures. We have an arsenal of approaches and tools available to reduce flood risk.

## Introduction

Flooding in Washington State typically occurs on a seasonal basis from:

- Rainfall on frozen ground in early fall or winter
- Rainfall combined with snow melt causing winter and early spring flooding
- Late spring flooding from snow pack melt, particularly in Eastern Washington (this will diminish with global warming)
- Thunderstorms causing flash floods, mainly in Eastern Washington, with some winter storms causing flash flooding in Western Washington.
- Winter storms, accompanying storm surges and high tides.

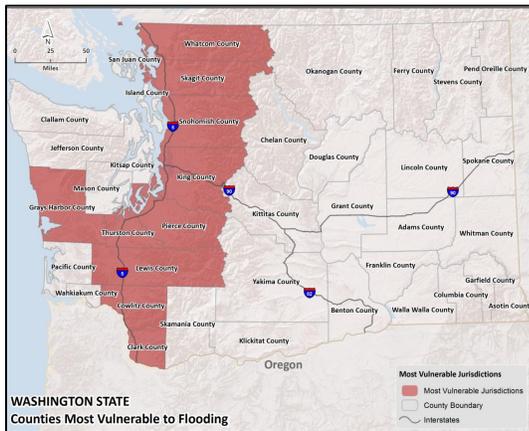
Floods can be caused by:

- Overbank flooding from rivers and streams
- Coastal storm surge flooding
- High tides
- Local stormwater drainage flooding

- Flooding from failures of dams, reservoirs or levees
- Other sources such as subsidence, tsunamis and seiches

The ten counties in Washington State that have realized the highest flood losses are coastal and located west of the Cascade Mountains. (See map)

With a changing climate each of these types of flooding are predicted to increase. According to the National Climate Assessment (2014), climate change will increase flood risk in most Western Washington river basins. There are two principal reasons for this: (1) warmer winters causing less snow accumulation, resulting in increased winter flood discharges, and (2) heavier precipitation events.



Source: Washington Enhanced Hazard Mitigation Plan

Future flooding is expected to become more frequent, exceeding risk tolerances, and the capacity and protective abilities of existing flood protection measures. Such changes will threaten infrastructure, lives, property, major transportation corridors, communities and regional economic centers, and habitat.

As hydrology changes, what is currently considered a 100-year flood will strike

more often, leaving many communities at greater risk. For example, the historical 100-year flood is modeled to become a 30-year flood by the 2080s.

Climate change is impacting storm patterns and increasing the probability of more frequent, intense storms. Increases in temperature are affecting snowpack and its ability to hold and store water. Warming temperatures increase the occurrence and duration of summer droughts, raising the probability of wildfires. Along with the human cost of homes and livelihoods destroyed, wildfires also make soil less permeable and reduce the vegetative land cover, contributing to landslide and further flooding.

**Sea level rise** has begun to impact some Washington coastal areas. A number of factors reduce the rate of sea level rise in Washington as compared to other places along the West Coast. However, we will experience an increase in the sea level and also greater impacts from more frequent coastal storm events. These will have numerous indirect impacts such as increasing the salinity of coastal marshes, stresses to existing agricultural production, and impacts to port and railroad infrastructure.<sup>2</sup>

Flooding is also natural and beneficial. The flooding of normally dry lands provides an army of ecosystem services along with significant **and often unappreciated** flood protection values downstream. Floodwaters can be stored to help protect against future drought. “The open space service value along riparian areas is quite large, representing their ability to attenuate flows and store storm water and reduce the frequency and extent of residential and commercial

<sup>2</sup><http://www.ecy.wa.gov/climatechange/2012ccrs/coasts.htm>

flooding. Riparian areas also provide an important service in filtering waste and nutrients before it can reach a river.”<sup>3</sup>

We can expect impacts on Washington's river and coastal communities from flooding due to changes in climate. These impacts will include increased annual temperatures, rising sea level, increased sea surface temperatures, more intense storms, and greater river flooding. Climate change will likely increase the occurrence and intensity of natural disasters, potentially leading to additional loss of life and significant economic losses.<sup>4</sup>

## How to Adapt to a Changing Landscape

Risk is typically defined as being a function of the frequency of a damaging event and the resulting consequences. With respect to flooding, risk can be lowered by either addressing those characteristics contributing to higher incidence of flooding or by designing facilities to better adapt to flooding.

Levees are often the first damage reduction measure considered for rivers in attempts to reduce flooding by protective measures. While levees can reduce short term flooding, they often do not reduce risk over the long term. For example, with climate change, a 50-year levee will only offer such protection over a shorter term and with every subsequent year, safety will diminish and risks to “protected” development will increase.

<sup>3</sup> “Open Space Valuation for Central Puget Sound”, by Earth Economics, May 2015, Report Version 1.1

<sup>4</sup> Washington Emergency Management Division, Flood Hazard Profile, Washington State Enhanced Hazard Mitigation Plan, 2013

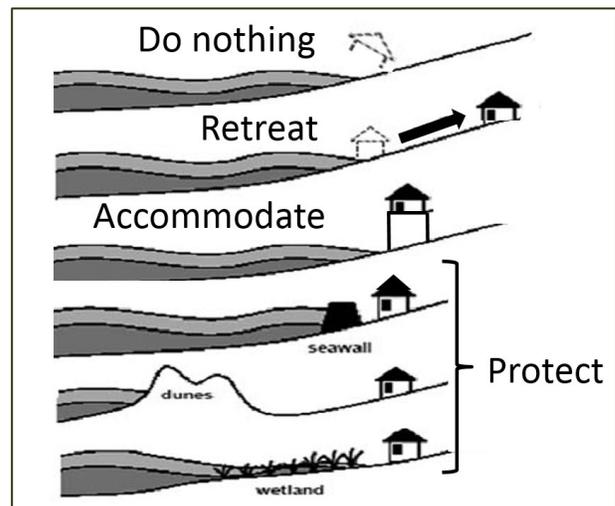
An example of controlling flood characteristics might include allowing the storage of water on upper reach floodplains. This would allow floodwaters to spill on to existing and historic floodplains.

## Approaches

The consequences of flooding can be lowered by three approaches:

- Retreating from flood prone areas,
- Accommodating the flooding by designing safer structures, or
- Protecting vulnerabilities from floodwaters by creating barriers. The key is to identify the proper approach for each situation.

These three approaches are not mutually exclusive. Several approaches may work for a given situation and provide a tolerable level of risk for a time. However, as our climate continues to change and the hazard increases, the approach may require reassessment.



As oceans rise and rivers flood with greater regularity it might suffice to “protect” coastal and river development by building seawalls and levees to extend the

useful life. It may also be reasonable to “accommodate” flooding by elevating structures on land that is occasionally flooded -- until the shoreline or riverbank moves landward of the development. The long term solution or preferred approach may be relocating the use (“retreat”).

Suggested elements to these approaches for Washington communities include:<sup>5</sup>

### Data Gathering

- Prepare detailed inventories and climate vulnerability assessments to identify critical and vulnerable infrastructure within their jurisdictions.

### Assessment

- Encourage owners and operators of critical energy infrastructure to evaluate vulnerability to the impacts of climate change, including risks of damage and the potential for disruptions and outages from flooding, sea level rise, extreme heat, erosion, and extreme weather events.
- Identify and protect critical evacuation routes. Coordinate emergency evacuation planning among adjacent cities and counties.

### Planning Actions

- Develop an inventory of dikes, levees, tide gates, clean-up sites, nearshore fuel storage facilities, and other facilities.
- Use this information to plan for and adapt to rising sea levels and coastal hazards and to aid investment decisions in coastal areas. Ensure that the inventory products and maps are

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<sup>5</sup> These are best practices drawn from a number of sources including Sustainable Washington, the Washington Integrated Climate Response Plan and the Washington Climate Change Plan.

widely available to planners, agencies, tribes, and other users.

- Strengthen and increase the capacity of natural systems to respond to droughts, stream flow changes, and flooding
- Use a watershed-based framework for planning.
- Incorporate information about climate impacts into state and local emergency planning efforts into the Growth Management Act process, including integrating the recommendations of the Hazards Mitigation Plans.
- Adjust routine operations, maintenance and inspection, and capital budget expenses to prepare for more frequent and intense storms, floods, landslides, wildfires, and extreme heat events.
- Encourage partnerships with federal, tribal, and local government, private landowners, and conservation organizations to implement landscape planning and foster adaptation strategies and actions that protect and restore habitat corridors across jurisdictional and land ownership boundaries.
- Guide development away from floodplains and barrier beaches.

### Regulatory Actions

- Optimize flood control and stormwater codes to reflect expected changes in flood events frequency, volume and duration.
- Realign shorelines and critical areas protections to protect riparian areas and maximize their flood management capacity.
- Identify priority conservation and restoration areas that can increase

natural resiliency and protect vulnerable communities.

- Limit non-resource dependent development in floodplains and coastal areas vulnerable to sea level rise and changes in riverine flood return intervals. Consider returning flood-prone areas to natural conditions.

### Conservation Actions

- Increase the quantity, quality, and size of conservation areas, buffers, and connectivity corridors using the full range of conservation tools available.
- Restore riparian zones, estuaries, wetlands, and floodplains by implementing appropriate conservation, restoration, and other land stewardship actions and practices, such as mitigation banking.
- Protect existing trees and encourage the planting of new trees.

### Tools

Tools to achieve the approaches listed above (retreat, accommodate and protect) include:

- Use of Local Revenue
- Regulation (Police Powers)
- Grants (opportunity based)
- Warning (hazard disclosure)

### Use of Local Revenue

King County is an example of local revenues being used to reduce flood risk. King County has created a flood-taxing district that has paid for over 100 million dollars in flood prevention structures including buying homes, providing flood storage, armoring riverbanks through the

use of large woody debris (<http://www.kingcounty.gov/services/environment/water-and-land/flooding/flood-control-zone-district.aspx>).

Other examples of revenue tools include:

- Acquisition (fee simple) to create open space
- Acquisition (life estate) may create open space while accommodating needs of current owner
- Developer Extractions/impact fees provide funds to offset adverse consequences of developments
- Development Impact Tax/Improvement Tax for stormwater management
- Differential Assessment/Taxation (user fees) for development in flood prone areas and those areas not subject to flooding
- Internalizing Externalities (taxes or credits) for development likely to exacerbate flooding in other areas
- Land Gains Taxation (user fees)
- Transfer or Development Taxes dedicated to protecting open space
- Property Tax
- Purchase of Development Rights/Easements for riparian and coastal floodplains
- Purchase Option (Right of First Refusal)
- Purchase Sellback/Leaseback
- Sales Tax
- Service Areas Fees
- Special Assessments Districts (Local Improvement Districts) for stormwater management

### Develop Regulation (Police Powers)

As an example; in the mid-1980s after a series of presidential flood-related disaster declarations, the City of Snoqualmie adopted regulations (Chapter 15.12 Snoqualmie Municipal Code,

<http://www.codepublishing.com/WA/Snoqualmie/>)

that required homes to be elevated above the base flood level if the home was substantially damaged (the threshold for substantial damage was set at 15% damage or greater). This demonstrated the seriousness for which the City considered flood risk reduction. This action also increases their eligibility for federal assistance.

Other examples regulatory tools includes:

- Agricultural zoning for flood prone areas
- Bonus and Incentive Zoning to transfer development away from flood plains
- Building codes that ensure development in flood plains can resist the maximum expected flood
- Coastal Construction Control Line (CCCL)
- Conditional use permits for development in flood plains
- Contract or Conditional Zoning where the landowner agrees to previously unstated conditions) in exchange for some government action
- Cumulative Substantial Improvement requirement to limit abuse from multiple improvements with each being below a triggering permit threshold.
- Density Transfers/Average Density/Cluster development ordinances to allow development to occur but outside flood prone areas
- Eminent Domain to acquire critical flood prone areas
- Freeboard (increased level of safety)

- Large Lot Zoning can be problematic – tends to increase impermeability do to extensive infrastructure required
- Moratoria to allow time to develop or implement regulations
- NFIP (Claim and ICC payments) can be used to retrofit at risk properties.
- Overlay Zones could apply regulation to hazard or resource areas
- Rate Allocation Systems, Growth Phasing
- Retrofitting and Design Triggers
- Setback, Buffers
- Subdivision Regulations (Cluster, Planned Unit Development) to allow development to be built outside of hazard and resource area.
- Transfer of Development Rights (TDR)

### **Apply for Grants (opportunity based)**

Many of our Washington Counties and Cities have received grants to reduce flood risks. These include moving, elevating and purchasing at-risk structures. For example, the City Snoqualmie has applied for and received FEMA post disaster Hazards Mitigation Grant Program funding to elevate many dozens of flood prone properties (<http://www.ci.snoqualmie.wa.us/PlanningProjects/HomeElevationProgram.aspx>)

Grant Programs that are most often available include:

- FEMA (Five Mitigation Grant Programs)
- FEMA (Public Assistance Program)
- The Nature Conservancy (TNC) “Floodplains by Design” initiative.
- Washington Department of Ecology “Floodplain Management Assistance Program”

### **Warning (hazard disclosure)**

One of the most advanced warning systems in the world is located along our coast. This is system referred to as the *All Hazard Alert Broadcast System* (AHAB). The AHAB system is a single unit or network of warning sirens strategically placed to warn those who are outside or who are in close proximity to a siren.

Other examples include:

- Community Awareness Programs
- Disaster Warning (AHAB)
- Disclosure Requirements on subdivision maps and titles to reveal the risk of flooding
- Mapping Hazard Areas (FIRM, Risk Map)
- Monitoring Hazard Areas

### Planning

Planning has a long history within the State with a key tool being the Growth Management Act (GMA). The GMA was designed to guide growth and protect our environment. Comprehensive planning under GMA provides communities a way to begin to address hazard situations through land use planning. The GMA plans and corresponding Critical Areas Ordinances (CAO) are being updated and are incorporating risk reduction strategies as critical drivers.

Communities also have their Shoreline Master Programs authorized under the state Shoreline Management Act, an important planning and regulatory tool available to address flooding along both coastal and riverine environments.

Most Washington communities have adopted Hazards Mitigating Plans (HMP) that provides risk reduction action recommendations.

The Snohomish County HMP recommends that growth be designated within areas having lower risk or where risks can be mitigated. Accordingly, the HMP provides guidance for future non- resource-based development to be discouraged on floodplain “resource” lands and development rights be allowed to be transferred to safer growth areas.

(<http://snohomishcountywa.gov/2429/Hazard-Mitigation-Plan>).

Community master planning plays an important role for relocating all or a portion of a community. The Quinault Indian Nation’s (QIN) largest community Taholah, Washington, located at the confluence of the Quinault River and the Pacific Ocean, is particularly vulnerable to impacts from tsunamis and increased flooding. The QIN made the difficult decision to relocate the village to higher ground. Development of a Relocation Master Plan was initiated in the spring of 2014 with support from a Social and Economic Development Strategies Grant from the Administration for Native Americans (<http://quinaultindiannation.com/planning/masterplan.html>).

Other planning examples include:

- Basin Wide Organizations (Utilities, Flood Districts)
- Biological Opinion (Puget Sound)
- Capital Improvement Plan (CIP)
- Community Rating System (CRS)
- Comprehensive Plans
- Contingency Planning (and Continuity of Operations Plans COOP)
- Focused Public Investment Plan (FPIP)
- Forest Harvesting Management Plans
- Hazards Mitigation Plans
- Levee Breaching (flood channel corridor) Emergency Plans
- National Flood Insurance Program (NFIP) regulations

- Post-storm Reconstruction Plans
- Reconstruction Triage
- Shoreline Master Programs
- Special Area Management Plans (CZM / SAMPs)
- Specific Development Plans; Shadow Platting
- Stormwater Management Plan

Snohomish County Hazards Mitigation Plan 2015.

Washington Emergency Management Division, Flood Hazard Profile, Washington State Enhanced Hazard Mitigation Plan, 2013

## References

"Capabilities Inventories Tool" was prepared by Bob Freitag CFM with funds provided through the National Disaster Preparedness Training Center (NDPTC) by the Federal Emergency Management Agency (FEMA) to be used in delivering the Coastal Risk Reduction performance level Course.

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