

## **ATTACHMENT A**

### **SOUTH FORK SNOQUALMIE RIVER CORRIDOR PLAN FRAMEWORK**

#### **FLOODPLAIN MANAGEMENT GOALS, OBJECTIVES, AND CONCEPTUAL APPROACHES**

**NOVEMBER 24, 2014**

#### **Overview**

This document establishes a framework for completing a comprehensive floodplain management plan for the South Fork Snoqualmie River as part of the King County Flood Control District's capital improvement program. The scope of the South Fork Snoqualmie River Corridor Plan is focused on the lower six miles of the South Fork, where flooding problems are most significant and where the County maintains a system of flood containment levees. The Plan will recommend a suite of actions within the river corridor, comprised of its levees, floodplain, channel migration zone, and riparian areas to achieve the goals and objectives outlined in this framework.

In order to evaluate flooding, levee stability, channel migration, and ecological conditions, a characterization of existing and projected future conditions has been completed. This characterization has included extensive data collection, computer modeling, technical analysis, and consultation with local residents and interested stakeholders; together this information forms a basis for describing existing and future conditions and recommending goals and objectives for corridor management.

#### **Background**

The South Fork Snoqualmie River flows through unincorporated King County and the City of North Bend on its journey from the Cascade Mountains near Snoqualmie Pass to its confluence with the Middle Fork Snoqualmie River. Levees along the river through North Bend provide inadequate and uneven flood protection, containing flood flows only up to about 12,900 cubic feet per second (about a 25-year event) on the west bank, and 15,150 cubic feet per second (a 100-year event) on the east bank. (These containment levels are without freeboard.) The levees were constructed in the 1960s and do not meet current standards for levee stability; as such, they are prone to seepage and are at risk of damages from scour, overtopping, and potentially internal erosion or breaching. All of these instabilities potentially threaten adjacent communities.

Flooding in recent years, most notably in 2006, 2008, and 2009, has resulted in overtopping of portions of the levee system with impacts to homes, roadways, and communities. This flooding has also damaged County flood protection facilities, and in response, King County has completed seven flood damage repair projects, acquired five at-risk homes, and provided cost-sharing assistance to elevate fifteen homes above flood levels.

Downstream of the South Fork's levees, the Circle River Ranch neighborhood is at risk from bank erosion, flooding, and channel migration which could be amplified by actions taken to contain flows upstream. Additionally, the City of Snoqualmie lies just downstream of the river's confluence, and is potentially affected by any actions taken to contain flows or otherwise manage flood hazards in the leveed segment of the South Fork. These potential downstream impacts need to be assessed and mitigated as part of this Plan.

Further complicating the management of the corridor are five aging bridges with inadequate capacity to convey floodwaters, and tributary inflows from Clough, Ribary, and Gardiner Creeks which contribute to flooding landward of the levees. Without action, future flooding conditions are likely to worsen, as continued gravel accumulation (aggradation) within the levees will reduce hydraulic capacity.

South Fork flooding creates considerable public safety risks and impacts to both local and regional economies. A 100-year flood event (1% annual likelihood) would likely inundate more than 130 structures and properties, over five miles of roadway including a portion of Interstate 90, and critical facilities including North Bend's wastewater treatment plant. A 500-year event would create significantly more risk, inundating an estimated 500 structures, over 15 miles of roads, and additional critical facilities.

The South Fork corridor supports important ecological resources including native trout populations as well as elk herds that use the river corridor for migration. However its ecological functions are greatly impaired due to the loss of connection between the river and its floodplain, and the presence of flood containment levees which fragment the remnant riparian forest. The South Fork is valued for its open space and natural functions, and trails on the levees are used by the community for access to the river environment immediately adjacent to the developed areas of North Bend. All of these ecological and open space functions can be improved through the King County Flood Control District's floodplain management actions.

The planning horizon and anticipated design life of any constructed facilities is 50 years or more, and the Corridor Plan will create a comprehensive strategy for managing flood risks over this time frame. The overall strategy will address flooding problems and enhance river processes and functions, while implementing more sustainable and cost effective floodplain management actions. The current Flood Control District 6-year CIP includes an early action project to address Interstate 90 flooding. The adopted Plan will augment this with additional recommended projects and commensurate funding in the 6-year CIP, along with a 10- to 20-year implementation strategy and sequence.

### **Goals and Provisional Objectives**

The following goals and provisional objectives are intended to provide clarity about desired outcomes for the Corridor Plan and its recommendations. The goals are consistent with adopted County floodplain management goals and related policies, and the provisional objectives provide targets for the South Fork, against which approaches and alternatives can be evaluated. The final Plan may not be able to fully meet every objective, but it should include an evaluation of tradeoffs among the various objectives in order to recommend an alternative that meets them to the maximum extent possible.

## **Goal 1: Reduce risks from flood and channel migration hazards**

(Goal from FCD-adopted Countywide Flood Hazard Management Plan)

### Objectives

- Provide 500-year flood protection in consideration of future sediment aggradation and uncertainties due to climate change
- Eliminate high and moderate geotechnical deficiencies in the levee system
- Mitigate potential for channel migration within 50 years in areas with homes and infrastructure

### Rationale

A 500-year flood event is projected to impact significantly more homes and infrastructure than a 100-year event, yet preliminary cost estimates suggest the increased cost of providing 500-year compared to 100-year flood protection may be marginal (see Attachment A for details.) In addition, a 500-year objective would better accommodate future increases in flooding due to sediment aggradation and potential uncertainties due to climate change. Risk reduction should also address high and moderate geotechnical deficiencies that create levee instabilities, which in a worst case could create a levee failure with substantial risks to adjacent communities. Channel migration hazards are also present, and a 50-year time frame is recommended for considering their potential impacts, consistent with the overall corridor planning time horizon.

## **Goal 2: Reduce the long-term costs of flood hazard management**

(Goal from FCD-adopted Countywide Flood Hazard Management Plan)

### Objectives

- Implement sustainable cost-effective floodplain management solutions
- Reduce long-term maintenance and repair costs by 30%

### Rationale

Floodplain management solutions should be evaluated for both their short- and long-term cost effectiveness to reduce life-cycle floodplain management costs over time. Costs should be a strong consideration when comparing among alternative approaches and this comparison should include an evaluation of the additional benefits accruing to progressively more robust floodplain management solutions. A 30% cost-reduction objective is recommended as a potentially feasible target for long-term maintenance and repair costs.

### **Goal 3: Improve the natural environment through sound and sustainable flood hazard management**

(Goal from FCD-adopted Countywide Flood Hazard Management Plan)

#### Objectives

- Improve instream aquatic habitat area quality and quantity
- Improve riparian habitat quality and quantity

#### Rationale

Along the South Fork, both the quality and quantity of habitat is significantly degraded, in large part due to the levees disconnecting the river from its floodplain and riparian areas. Primary problems include simplification of aquatic habitat due to levee construction immediately adjacent to the river channel, and disconnection of the floodplain and riparian area from the river. As a result, slow water habitats are exceedingly rare, and the riparian area is fragmented and degraded in its scale and functions. There are many opportunities to achieve meaningful improvements in habitat area and quality in the corridor through more environmentally sustainable floodplain management actions. Any resulting enhancements to aquatic and riparian habitat would benefit native cutthroat and rainbow trout, resident and migrating elk, and other fish and wildlife.

### **Goal 4: Incorporate stakeholder and community values into the Corridor Planning process.**

#### Objectives

- Consider Equity and Social Justice in corridor planning decisions; provide equitable outcomes to the degree practicable
- Incorporate multiple objectives into the Corridor Plan through community and stakeholder involvement

#### Rationale

The South Fork flows through diverse communities with a wide range of interests and demographic characteristics. In addition, many organizations and individuals are affected by floodplain management decisions for the river, including community organizations, local and regional non-governmental organizations, state and federal agencies, two cities and unincorporated King County. It is essential that these diverse community and stakeholder interests are considered as the Corridor Plan is developed, and that King County's Equity and Social Justice Initiative is met so that all communities receive equitable floodplain management outcomes to the maximum extent possible, regardless of their demographic characteristics. This goal is also consistent with the Flood Control District's adopted policy G-1, which prioritizes threats to public safety over impacts to the economy or damage to private structures.

## **Conceptual Floodplain Management Approaches for Evaluation**

In order to develop a preferred set of floodplain management actions to optimally meet the corridor goals and objectives, it is necessary to establish a range of floodplain management approaches and applicable tools for evaluation. These approaches are intended to set boundaries for the alternatives analysis, allowing an evaluation of the benefits and drawbacks of potential solutions within the river corridor that may be effective at meeting the goals and objectives of the Plan. It is anticipated that the preferred alternative in the Plan will likely be comprised of a combination of these approaches and tools applied at different sites throughout the river corridor.

### **Corridor-wide floodplain management approaches include:**

1. **Levee setbacks.** Reconstruct levees away from the immediate river channel to provide more room for natural river processes to convey and store floodwaters and sediment and to provide for enhanced natural river functions by reconnecting the river to its floodplain.
2. **Raise levees in place.** Reconstruct levees in approximately their current locations, but in a more stable configuration and to a higher flow containment standard.
3. **Continue existing management practices.** Continue to repair levees when they are damaged. Continue to buy the most at-risk properties and to provide cost-sharing assistance for home elevations.
4. **Use of additional complementary tools as appropriate, including:**
  - a) In-stream structures
  - b) Road and bridge modifications
  - c) Gravel management
  - d) Home elevations
  - e) Home buyouts

### **Rationale**

These approaches are intended to reflect the feasible range of floodplain management capital actions that can be undertaken within the river corridor under the auspices of the King County Flood Control District. Approaches not being evaluated include those focused on flow control or broader watershed management, such as potential large dams and flood storage reservoirs, changes to stormwater management regulations or forestry practices, etc. Land use and zoning recommendations are also not included as they are outside the jurisdiction of the Flood Control District. Development of the South Fork River Corridor Plan should include coordination with organizations responsible for watershed management and land use decisions to assure that the final Plan is compatible with approaches being undertaken by others.

## EXHIBIT A: COMPARISON OF 100-YEAR AND 500-YEAR FLOODING

A 500-year flood event would put significantly more homes and infrastructure at risk along the South Fork Snoqualmie River than a 100-year flood event. Levees on both banks would overtop, creating widespread flooding in both North Bend and unincorporated King County. Table 1 provides a summary of these impacts, based on hydraulic modeling completed during the river corridor characterization.

Table 1. Comparison of impacts from simulated 100-year and 500-year flood events.

<b>Impacts</b>	<b>100-year</b>	<b>500-year</b>	<b>% Difference</b>
Flow (cfs)	15,150	18,968	+25%
Structures inundated	135	514	+281%
Assessed value inundated (\$ million)	53.5	116.1	+117%
Roadways inundated (miles)	5.5	14.5	+164%
Acres inundated	339	716	+111%

The differential costs of constructing levees to a higher 500-year flood containment standard may not be that great compared to a lower 100-year standard. Depending on the approach utilized throughout the river corridor, the cost increase of a 500-year standard instead of a 100-year standard appears to be 10% or less. This is due to the relatively minor costs of the increase in levee height and material volume compared to the costs of design, construction, and acquisition of necessary real estate for any alternative. Costs are summarized in Table 2 based on preliminary modeling and estimates conducted during the corridor planning process. These costs do not reflect a final alternative, but do provide a meaningful comparison between the costs of achieving a 100-year versus a 500-year standard.

Table 2. Preliminary estimates of corridor-wide floodplain management approaches.

<b>Corridor Approach</b>	<b>(Cost in \$ million)</b>		<b>% Cost difference</b>
	<b>100-year protection</b>	<b>500-year protection</b>	
Levee setbacks	76.1	78.7	+3%
Raise levees in place	51.4	56.0	+9%