

## CHAPTER 7. ALTERNATIVE ANALYSIS APPROACH

### FLOODING ISSUE IDENTIFICATION

Flooding issues and concerns were identified by examining historical flooding patterns along the Yakima River, reviewing previous studies, and collecting information from Advisory Committee members and County staff. Advisory Committee members completed a flood problem questionnaire during the second committee meeting; members absent from the meeting were contacted by telephone for their input.

Each flooding issue was discussed further at Advisory Committee meetings to define the problem, evaluate related issues, and determine a range of solutions. Higher priority issues were discussed in greater detail. Specific flood hazard management options were then developed to address each flood issue.

### FLOOD HAZARD MANAGEMENT OPTIONS

A variety of options is available to address flooding concerns in the Yakima Valley, involving engineering, environmental protection and enhancement, and planning measures. Comprehensive flood hazard management emphasizes selecting the appropriate mix of approaches to minimize the impact of flooding on the community for the foreseeable future.

Flood hazard management measures are commonly classified as structural or nonstructural. Structural measures involve physical activities in or near the river, such as excavation, placement of bank protection materials, and other engineering and construction activities. Nonstructural measures can involve drainage and land use regulations, flood preparedness programs, public education, or maintenance programs. It is the policy of the current federal administration to encourage the use of cost-effective, long-term nonstructural alternatives.

The Advisory Committee examined potential structural and nonstructural solutions to the problems identified using summary sheets detailing various flood hazard management options. The summary sheets, included in the 1998 Upper Yakima River Comprehensive Flood Hazard Management Plan, can be used to analyze solutions to future flooding problems, or as educational material for private property owners addressing flood hazard issues. The options are categorized by their objective and briefly described below.

#### Nonstructural Measures

##### *Public Information*

Public information activities to advise people of the risks associated with flood hazards and about flood insurance and ways to reduce flood damage can include the following:

- Elevation certificates
- Map determinations
- Outreach projects
- Hazard disclosure
- A flood protection library

- Flood preparedness programs.

### ***Regulatory and Mapping***

Regulatory and mapping measures to provide protection for new development through land use regulation and the collection of accurate floodplain information can include the following:

- Higher regulatory standards
- Low density zoning
- Open space preservation
- Ordinance consistency
- Interagency agreements
- Additional flood data, including accurate floodplain and floodway mapping
- Flood data maintenance.

Most of the regulatory and land use recommendations were resolved through the 1999 adoption of *Plan 2015*, the Growth Management Act required Comprehensive Plan, and subsequent implementing regulations. See Appendix B for a description of those issues and how they were resolved.

### ***Flood Damage Reduction***

Flood damage reduction measures address flood damage to existing buildings, and the stability and safety of existing or new infrastructure through design and siting of these facilities in the context of the physical environment of the river. The physical environment include the existing topography of the floodplain and bathymetry of the river channel, as well as rates of change in sediment supply, energy to rework sediments or damage infrastructure, and rates of channel aggradation, degradation, and migration. Removing or reducing flood hazards can be accomplished through the following measures:

- Sharing information on physical characteristics of the river in the design and siting process for public and private infrastructure
- Acquiring or relocating flood-prone structures
- Floodproofing flood-prone structures
- Developing repetitive loss plans.

### ***Flood Preparedness***

Flood preparedness activities involve emergency management. Actions are taken to minimize the effects of flooding on people, property, and the contents of buildings. Flood preparedness measures include the following:

- Individual action plans
- Comprehensive planning
- Flood warning systems
- Flood facility maintenance programs
- Dam safety programs.

## Structural Measures

### *Alignment Control*

Alignment control alternatives, designed to accommodate discharge along a course that allows the channel to develop without eroding adjacent property, can include the following:

- Spur dikes
- Flow realignment
- Vane dikes
- Cutoff channels.

### *Bank Protection*

Bank protection measures, designed to produce a stable, durable streambank that can withstand floodwaters up to the predicted 100-year flood flow, can include the following:

- Re-establishing riparian vegetation (bioengineering)
- Cabling trees
- Constructing approach dikes
- Installing gabions
- Fencing
- Constructing windrow revetment
- Reducing bank slope
- Constructing standard trench fill revetment (riprap).

### *Conveyance Capacity*

Conveyance capacity is the amount of discharge that can occur in a river before water spills over the bank and floods adjacent areas. It is determined by such factors as channel bed slope, cross-sectional area, and channel roughness. Increasing the first two or decreasing the last increases conveyance capacity. Conveyance capacity alternatives include the following:

- Gravel bar scalping
- Construction of overflow channels
- Vegetation and debris removal
- Channel widening or deepening
- Improving sediment transport or reversing channel aggradation.

### *Floodplain Protection*

Floodplain protection measures reduce flood hazards for property, structures, and occupants in the 100-year floodplain. Protection from inundation, floating debris, sediments, and the force of water flowing in the floodplain may be achieved through the following alternatives:

- Setback levees
- Low dikes (floodplain levees)
- Ring levees
- Cutoff levees
- Storage reservoirs

- Floodproofing of structures.

#### ***Streambed Controls***

Streambed controls prevent streambed degradation and upstream headcutting, and control bed slope, bed elevation, and water surface elevation by dissipating river energy that would otherwise alter the characteristics of the streambed. Streambed controls include the following:

- Stabilizers
- Drop structures.

### **ALTERNATIVE ANALYSIS AND SELECTION**

Potential flood hazard management solutions were developed for each issue identified in this study. The potential solutions include construction projects, new policy decisions, land use modifications, additional development standards, and options for retrofitting existing structures. Several criteria were considered in selecting the alternatives. The alternative that best met the goals and objectives of the CFHMP and that received support from the Advisory Committee was selected for recommendation.

#### **Considerations for Evaluating Alternatives**

Evaluating any flood hazard management alternative requires an understanding of existing floodplain use, a clear community vision of future floodplain use, and a review of current floodplain management practices, both within the community and across the nation. The alternative evaluation must also take into consideration the following:

- Ease of implementation
- Cost effectiveness
- Potential for success in solving the issue and providing public benefit
- Environmental considerations
- Applicable policies and regulations.

Cost-effectiveness was evaluated by comparing planning-level cost estimates to potential public benefits. Cost estimates were also used to approximate overall funding requirements for the CFHMP. Preliminary cost estimates were based on unit cost data compiled from several sources and verified with County staff. Unit costs were obtained from recent County and COE projects, WSDOT bid tabulation summaries, cost guides (e.g. Means), contact with construction contractors, and KCM data. Markups for contingencies, engineering, and other indirect costs are commonly accepted values.

Potential for success was determined by conducting a reconnaissance-level engineering analysis, in which options were investigated without too much time being dedicated to any specific design. Such an analysis evaluates if the flooding issue is specifically addressed, considers the public benefit derived, reviews the existing regulatory environment, and considers funding possibilities, environmental impact, and community values. If appropriate, computer analysis tools are used to assess potential changes in river hydraulics and to perform floodplain overlay analysis. Such tools include HEC-2, a river conveyance capacity computer model, and ARCVIEW, GIS analysis software. The goal of the reconnaissance-level analysis is to determine the feasibility of a solution.

Due to the possible far-reaching effects of flood events, solving flooding problems sometimes requires the implementation of a variety of structural and nonstructural measures; a selected solution may include both short- and long-term alternatives.

Flood hazard management measures that involve structural modification of the floodplain produce unavoidable environmental impact through changes forced on natural processes. The impact on fisheries and wildlife; on scenic, aesthetic, and historic resources; on water quality; and on hydrology were considered in evaluating alternatives. A table of effects associated with various flood hazard management alternatives (Table 7-1) was provided to Advisory Committee members during the alternative selection process. Upon completion of the CFHMP, environmental assessment documentation—a SEPA checklist—will be prepared.

Applicable policies and regulations were also considered in the alternatives analysis and selection. Alternatives were evaluated for consistency with the goals and objectives developed in this CFHMP, policies currently under development or already developed in the local GMA process, and applicable federal and state regulations. Only alternatives consistent with existing regulations and policies were selected for recommendation.

TABLE 7-1  
PROBLEM ADDRESSED AND ENVIRONMENTAL IMPACT ASSOCIATED WITH FLOOD HAZARD MANAGEMENT MEASURES

Alternative (a)	Problem Solved							Impact					
	Channel Migration	Bank Erosion	Conveyance Capacity	Property Protection	Streambed Degradation / Aggregation	Public Knowledge	Long-term Flood Control Expenditures	Fisheries	Wildlife	Scenic/Aesthetic /Historic	Water Quality	Hydrology	Recreation
<b>Non-Structural</b>													
Public Information Program	0	0	0	+	0	+	+	+	0	0	+	+	0
Regulatory Measures	+	0	+	+	0	0	+	+	+	+	+	+	+
Flood Damage Reduction of Existing Structures	0	0	0	+	0	0	+	+	+	+	+	+	+
Improved design and siting of new infrastructure	+	0	0 to +	+	+	+	+	+	+	+	+	+	+
Flood Preparedness/ Emergency Management	0	0	0	+	0	+	-	0	0	0	0	0	0
<b>Alignment Control</b>													
Spur Dikes	+	+	-	+	-	0	-	+	0	0	0	0	0
Flow Realignment	+	+	-	+	-	0	-	-	-	-	-	-	-
Vane Dikes	+	+	-	+	-	0	-	-	-	+	-	0	0
Cutoff channels	+	+	-	+	-	0	-	-	-	-	-	-	-
<b>Bank Protection</b>													
Bioengineering	+	+	0	+	0	0	+	+	+	+	0	0	0
Cabling Trees	+	+	-	+	0	0	0	+	+	+	0	0	0
Approach Dikes	+	+	-	+	0	0	-	-	-	-	-	0	0
Gabions	+	+	-	+	0	0	-	-	-	0	0	0	0
Fencing	+	+	-	+	0	0	-	+	0	0	0	0	0
Window Revetment	+	+	-	+	0	0	-	0	0	+	0	0	0
Reducing Bank Slope	+	+	+	0	0	0	0	0	0	0	0	0	0
Standard Riprap	+	+	-	+	0	0	-	-	-	+	0	0	0
<b>Conveyance Capacity</b>													
Gravel Bar Scalping	0	+	+	+	+	0	-	-	-	0	-	0	0
Overflow Channels	+	+	+	+	0	0	-	+	0 to +	0	0	0	0
Vegetation & Debris Removal	0	-	0	0	- or +	0	-	-	-	-	0	- to 0	0
Channel Widening or Deepening	+	+	+	+	+	0	-	-	-	0	- to 0	0	- to 0
<b>Floodplain Protection</b>													
Setback Levees	+	0	-	+	0	0	-	+	+	+	0	+	+
Low Dikes (Floodplain Levees)	+	0	-	+	-	0	-	-	-	- to 0	-	-	-
Ring Levees	+	-	-	+	-	0	-	0	0	- to 0	-	0	0
Cutoff Levees	+	-	-	+	0	0	-	-	-	- to 0	0	0	0
Storage Reservoirs	+	+	0	+	0	0	-	-	-	- to 0	- to 0	+	0 to +
Floodproofing of Structures	0	0	0	+	0	0	+	0	0	0	0	0	0
<b>Streambed Control</b>													
Stabilizers	+	+	-	0	+	0	-	-	-	-	+	0	0
Drop Structures	+	+	-	0	+	0	-	-	-	-	+	0	0

a. See Appendix G for further information on flood hazard reduction alternatives

## **Alternative Selection**

In the original 1998 CFHMP, recommended alternatives were selected according to ratings given by the Advisory Committee. Advisory Committee members rated each alternative on a scale from one to three. A rating of one meant that the member considered the alternative unacceptable; two meant acceptable, and three meant preferred. The ratings were totaled for each alternative, and the alternative receiving the highest rating was recommended. Advisory Committee voting results are tabulated in Appendix E. A full discussion of these recommendations is contained in chapter 8 of the 1998 plan.

The following table (Table 7-2) contains the status of the recommended actions from the 1998 plan. Actions recommended in the current update, including those that are continuations of the 1998 plan, are presented in Chapter 8.

**TABLE 7-2.**  
**STATUS OF RECOMMENDED ACTIONS FROM 1998 STUDY**

Recommendation <sup>b</sup>	Implementation Priority <sup>a</sup>	Status	Lead Agency	Issues Addressed
<b>REGULATORY</b>				
Expand Flood Overlay Zone	High	On-Going will be Resolved in Plan 2015	County	UR2, LR4, RW11
Modify ordinances	High/Medium	Completed On-Going	County	UR2, LR4, MR5, RW4 <sup>c</sup> , RW5 <sup>c</sup>
Adopt or develop flood hazard management policies	High	Completed No Change	County	RW14, RW8 <sup>c</sup> , RW16 <sup>c</sup>
<b>LAND USE</b>				
Modify land use plans and development regulations	High	Completed No Change	County	UR2, MR5, LR4, RW11 RW6 <sup>c</sup>
Promote open space in the floodplain	High/Medium	No Change	County	RW10 <sup>c</sup>
<b>PUBLIC EDUCATION AND AWARENESS</b>				
Staff additional flood hazard management personnel	High	Completed	County	RW6 <sup>c</sup> , RW7 <sup>c</sup> , RW17 <sup>c</sup> , RW18 <sup>c</sup>
Enroll in the Community Rating System	Medium	On-Going	County	RW7 <sup>c</sup> , RW18 <sup>c</sup>
Perform a detailed flood audit of floodplain structures	Medium/Low	No Change	County COE	UR2, UR3 <sup>c</sup> , UR4, MR5, MR6, MR7 <sup>c</sup> , LR4, RW10 <sup>c</sup>
Disseminate floodplain information	Medium	On-Going	County, FEMA	RW6 <sup>c</sup> , RW7 <sup>c</sup> , RW19 <sup>c</sup>
Provide guidance on private bank protection projects	Low	No Change	County	UR1 <sup>c</sup> , LR1 <sup>c</sup> , LR2, RW3 <sup>c</sup>
<b>PLANNING, EVALUATION, AND DATA COLLECTION</b>				
Develop a long-term gravel management plan	High/Medium	On-going	County, DNR	UR5 <sup>c</sup> , MR2 <sup>c</sup> , LR2, LR5 <sup>c</sup> , RW2 <sup>c</sup>
Pursue obtaining accurate floodplain maps	High	On-Going	County, FEMA	RW1 <sup>c</sup> , RW3 <sup>c</sup> , RW15 <sup>c</sup>
Expand the CFHMP to include the entire county	High/Medium	Completed	County	LR6 <sup>c</sup> , RW9 <sup>c</sup> , OSA
Gather and maintain flood hazard data	High/Medium	No Change	County	LR3, RW1 <sup>c</sup> , RW15 <sup>c</sup> , RW16 <sup>c</sup> , RW19 <sup>c</sup> , OSA1 <sup>c</sup>
Consolidate flood facility maintenance requirements	Medium	No Change	County	RW16
Enhance flood warning and emergency response	Medium	On-Going	County	UR3 <sup>c</sup> , UR4 <sup>c</sup> , MR7, RW19 <sup>c</sup>
Promote fish habitat enhancement	High	Modified	County, WDFW	MR8 <sup>c</sup> ,
		No-Change	County, WDFW	RW2 <sup>c</sup>

TABLE 7-2 (*continued*).  
STATUS OF RECOMMENDED ACTIONS FROM 1998 STUDY

Recommendation <sup>b</sup>	Implementation Priority <sup>a</sup>	Status	Lead Agency	Issues Addressed
<b>ENHANCEMENTS TO FLOOD CONTROL STRUCTURES &amp; ROADS</b>				
Reinforce the East Riverbank levee and restore floodplain function downstream of SR 24	High/Medium	No-Change	County, Diking District #1, DNR	LR2, LR5 <sup>c</sup> , RW2 <sup>c</sup>
Restore floodplain function near East Selah gravel pit following gravel extraction	Medium/Low	No Change	County, DNR, owner	UR5 <sup>c</sup> , RW2
Raise Gordon Lake levee to COE standards	Medium	Completed	County, City of Yakima	MR1, RW2 <sup>c</sup>
Reinforce KOA Campground levee	Low	Completed	Diking District #1	MR3
<b>MITIGATE DAMAGE TO ROADS WITHIN CFHMP STUDY AREA</b>				
I-82 at Selah Interchange	Medium/Low	Completed	WSDOT	RW12 <sup>c</sup> ,
I-82 at Union Gap Interchange	Medium/Low	No Change	WSDOT	RW12 <sup>c</sup> ,
I-82 South of Union Gap	Medium/Low	Outside Study Area	WSDOT	RW12 <sup>c</sup>
SR 823 near Elks Golf Course	Medium/Low	No Change	WSDOT	RW12 <sup>c</sup>
SR 12 near 16th Avenue	Medium/Low	No Change	WSDOT	RW12 <sup>c</sup> ,
Thorp Road	Low	No Change	County	RW12 <sup>c</sup>
SR 24 East of Yakima River	Medium	No Change	WSDOT	LR5 <sup>c</sup>
<b>FUNDING</b>				
Develop a county-wide flood control district or flood control districts for high priority basins and continue to actively pursue outside federal and state grants	High	Completed	County	RW13 <sup>c</sup>

- a. Low priority items will be implemented when funding becomes available or future plan amendments change their priority.
- b. The groupings (Regulatory, Land Use etc ) are not utilized in the 2007 update.
- c. Refer to Chapter 8 for discussion of these continuing issues.

**Definitions used in status column**

**Completed:** Completely addressed issue, no on-going work needed.

**Modified:** Issue is still relevant, but new studies cause modifications in approach

**On-Going:** Issue has been partially or completely addressed with on-going work needed.

**No Change:** Still an issue, little or no change in approach and work not started.