KITTITAS COUNTY

COMPREHENSIVE FLOOD HAZARD MANAGEMENT PLAN

December 1996

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Section 1: Exectutive Summary

1.010 Statement of Purpose

The Kittitas County Comprehensive Flood Hazard Management Plan was created through joint funding from the Department of Ecology's Flood Control Assistance Account Program and Kittitas County. During the development of this plan, Kittitas County solicited assistance from county residents within identified flood prone areas, State and local agencies, the Yakama Indian Nation, and county citizens residing outside of identified flood prone areas. It is the purpose of this plan:

1) To protect human life, health, and safety;
2) To identify flood prone and repetitive loss areas within Kittitas County;
3) To identify alternative solutions for flood control mitigation in the identified flood prone and repetitive loss areas;
4) To evaluate potential flood control measures for their impact on critical areas;
5) To comply with the regulations in Chapter 173-145 WAC, RCW 86.26, the Growth Management Act, and integrate this ordinance into the Kittitas County Comprehensive Plan amendment in 1997;
6) To maintain County eligibility in the National Flood Insurance Program; and
7) To reduce repetitive losses.

1.020 Background

A. How Floodplains Work

Floodplains are a part of a system that has evolved to accommodate changing water levels during the course of each year. In a natural landscape, floodplains temporarily store floodwaters during spring runoff, reducing flood levels and slowing the river's flow. Those functions of floodplains can be impaired when a river is restricted by riprap or a bulkhead, or when the floodplain's natural characteristics are changed by development or by removal of native vegetation.

When a river is restricted by development and confined to a single channel, the velocity of the water increases and flood elevations increase. As the velocity increases, the water gains power and can erode its banks, scour the river bed, and damage structures.

Floodplain characteristics also affect the river's behavior during a flood event. Native vegetation helps slow flood waters, allowing it to soak into the ground or move gradually back into the stream channel. Established root systems of riparian vegetation help to control erosion by binding the soil. On the other hand, when

vegetation is removed, water runs off more quickly, often taking valuable topsoil with it. The overall effect of removing native vegetation can be an increase in debris, bank erosion, and bed load moved by a stream or river. Lawns and other non-native plantings do a better job than paved surfaces or bare soil, but they are not as effective as natural riparian and wetland vegetation.

Floodplains provide a number of other benefits. They are important habitat areas, especially in arid regions like the Yakima River Canyon. Wetlands and riparian zones support a great variety of plants and plant community structure. This diversity and the availability of water make floodplains attractive to many mammals, birds, amphibians, reptiles, and insects.

Floodplains also help maintain water quality by filtering surface water runoff before it reaches a stream or river. Natural floodplains help keep ground water recharged and summer low flows are often higher in streams with functioning floodplains because ground water recharge is higher. More water soaks into the ground because plant roots and soil-dwelling animals keep the soil porous.

B. Need for Plan

This plan has been developed to provide for sound floodplain management in Kittitas County. Engrossed Substitute Senate Bill 5411 (ESSB 5411), adopted in 1991 to coordinate flood hazard management activities state-wide, emphasizes the importance of comprehensive planning to effective flood hazard management. As development continues to occur in flood prone areas and more upland areas of the county are developed or otherwise altered, the need to address flood hazards grows. By providing comprehensive flood hazard management, the county hopes to address those hazards as they relate to other issues and values associated with floodplains.

Comprehensive flood hazard management is comprised of a number of principles related to balancing the range of issues related to floodplains. Those principles include:

- Respect the river's natural hydrologic process;
- Focus on the cause of the flood damage;
- Consideration of the entire watershed;
- Process-oriented examination of issues;
- Pursuit of other social and resource protection goals;
- Interagency and interdepartmental coordination;
- Incorporation of comprehensive planning solutions; and
- Public involvement in reducing hazards and vulnerability.

Those principles have been used to develop a plan that will protect lives, property, and a range of other resources in Kittitas County. In addition, this plan provides a link between various existing regulations that affect development in and use of the river corridors in Kittitas County, including KCC 14.08 Flood damage Prevention, KCC 17A Critical Areas, the Shoreline Master Program, and KCC 17

Zoning Code. These regulations and their relationships to flood hazards will be discussed later in the plan.

The National Flood Insurance Program (NFIP) requires local jurisdictions to regulate development through a permitting system using the mapped Federal Emergency Management Agency 100-year floodplain. In some cases these efforts are not necessarily adequate for preventing flood damage and may not assure good flood hazard management planning. State law requires local entities to go beyond the minimum requirements of the NFIP and RCW 86.16, by adopting Comprehensive Flood Hazard Management Plans. RCW 86.12, as amended by ESSB 5411, includes a list of elements that must be part of a county's comprehensive flood hazard management plan; they are as follows:

- Designation of areas that are susceptible to periodic flooding;
- Establishment of a comprehensive scheme of flood control protection and improvements;
- Establishing land use regulations that preclude the location of structures, works, or improvements in critical portions of such areas subject to periodic flooding;
- Establishing restrictions on construction activities in areas subject to periodic floods; and
- Establishing restrictions on land clearing activities and development practices that exacerbate flood problems by increasing the flow or accumulation of flood waters.

This plan fulfills those requirements, providing the technical foundation for future flood hazard management projects.

Finally, Washington state communities with approved Comprehensive Flood Hazard Management Plans are eligible for Flood Control Assistance Account Program (FCAAP) funds, which may be applied toward a variety of flood hazard management activities.

C. Description of FCAAP

The Flood Control Assistance Account Program (FCAAP) was established in 1984 under RCW 86.26, "State Participation in Flood Control Maintenance." The program is administered by the Washington State Department of Ecology and provides matching grants to local entities for development of flood control management plans, feasibility studies for new flood control projects, flood control maintenance projects, and emergency flood control projects. The flood hazard management activities of a local jurisdiction must be approved by the Department of Ecology, in consultation with the Department of Fish and Wildlife (DFW), in order for that jurisdiction to be eligible for FCAAP assistance. The state will only participate in flood control maintenance projects in areas for which flood control management plans have been or are being developed. To render a local jurisdiction eligible for grants for flood control maintenance, the subject jurisdiction's flood control management plan must:

- Determine the need for flood control work;

- Consider alternatives to instream flood control work;
- Identify and consider potential impacts of instream flood control work on the state's instream resources; and
- Identify the river's meander belt or floodway.

Finally, to be eligible for funding under FCAAP, local jurisdictions must participate in the National Flood Insurance Program (NFIP) and must restrict land use in meander belts or floodways of rivers to flood-compatible uses.

1.030 Planning Process and Methodology

This plan was prepared by County staff in cooperation with a Citizen's Advisory Group. The county's intention to form a Citizen's Advisory Group was advertised in the Ellensburg Daily Record and the Northern Kittitas County Tribune in February 1996 and by an informational brochure mailed to approximately 700 residents in flood prone areas. The sixteen (16) citizens which volunteered for the committee were appointed by the County Commissioners in March 1996. There was subsequently ten advertised public meetings at which time the goals, policies, and recommendations were drafted.

Section 2: Definitions

2.010 **Critical Areas** - "Critical Areas" are: (a) wetlands; (b) areas with a critical recharging effect on aquifers used for potable water; (c) fish and wildlife conservation areas; (d) frequently flooded areas; and (e) geological hazardous areas, as defined in KCC Title 17A.

2.020 **Drop Structures** - "Drop structures" are v-shaped weirs used primarily at bridge sites. .

2.030 **Federal Emergency Management Agency** - "FEMA" was created in 1979 to provide a single point of accountability for all Federal activities related to disaster mitigation, emergency preparedness, response, and recovery.

2.040 **Flood** - "Flood" or "flooding" is a general and temporary condition of partial or complete inundation of normally dry land areas from: (a) the overflow of inland or tidal waters; and/or (b) the unusual and rapid accumulation of runoff or surface water from any source.

2.050 **Flood Damage Prevention Ordinance** - The "Flood Damage Prevention Ordinance", adopted as Kittitas County Code (KCC) 14.08, is the governing regulations for development within frequently flooded areas.

2.060 **Flood Fringe** - "Flood fringe" is the area between the Floodway and the boundary of the 100-year Floodplain. The flood fringe encompasses the portion of the floodplain that could be completely obstructed without increasing water surface elevation of the 100-year floodplain more than one (1) foot at any time.

2.070 **Flood Insurance Rate Map (FIRM)** - The "Flood Insurance Rate Map" (FIRM) is the official map on which the Federal Insurance Administration has delineated both areas of special flood hazards and the risk premium zones applicable to the community.

2.080 **Floodway** - "Floodway" is any channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one (1) foot.

2.090 **Frequently Flooded Areas** - "Frequently Flooded Areas" is the 100-year floodplain, which are lands subject to a one percent (1%) or greater chance of flooding in any given year, as designated by the FEMA, FIRM panels for Kittitas County.

2.100 **National Flood Insurance Program (NFIP)** - The "NFIP", created by an act of Congress in 1968, makes flood insurance available in communities that enact satisfactory floodplain management regulations.

2.110 **National Wetlands Inventory (NWI)** - The "National Wetlands Inventory" (NWI) is a series of maps which show the approximate location of wetlands located within Kittitas County by means of aerial photography. This is not a complete inventory of all wetlands, as many were hidden from view by forest canopies.

2.120 **100-Year Floodplain** - The "100-Year Floodplain" are those lands or areas which are subject to a one percent (1%) or greater chance of flooding in any given year.

2.130 **Ordinary High Water Mark (OHWM)** - "Ordinary High Water Mark" is the mark that can be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual, and so long continued in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation as that condition exists, or as it may naturally change.

2.140 **Priority Habitats and Species (PHS)** - "Priority Habitats and Species" (PHS) are a series of maps published by the Washington State Department of Fish and Wildlife, that depict the locations of wetlands, steams, and habitat areas.

2.150 **Revegetating** - "Revegetating" is the replanting of native vegetation along a shoreline to stabilize and protect the bank from erosion.

2.160 **Riparian Habitat** - "Riparian Habitat" is an area adjacent to rivers, streams, or lakes that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other. The State of Washington has adopted a classification system for identifying riparian habitat, WAC 222-16-030, *Water Typing System, Forest Practices Rules*. Riparian habitat for purposes of this ordinance is deemed to be Type 1, 2, 3, and 4 waters under the state classification system.

2.170 **Riprap** - "Riprap" is large, angular, quarried rocks placed along stream channels to protect the bank form erosion. Along stream reaches where real constraints will not permit bank slope reduction or where there is the potential for a vegetated slope to be undermined, the use of riprap may be acceptable. Riprap is placed in the critical erosion area and is sometimes combined with bioengineering techniques.

2.180 **Rock Barbs** - "Rock barbs" are riprap placed within a channel in such a manner so as to direct the flow away from the bank and to create a low velocity zone to minimize erosion. The size and spacing of rock barbs are based on the hydraulic conditions of the river over the affected reach to achieve particular results. The length of rock barbs are limited by the main channel conveyance required by the river and by effects on the opposite bank and downstream locations. The barbs usually exceed the normal river water surface elevation and are overtopped in moderate and severe flooding conditions.

2.190 **Shoreline Master Program** - The "Shoreline Master Program" is the governing regulations for development along shorelines of the state, in Kittitas County, adopted in May 1975.

2.200 **Shorelines** - "Shorelines" are all of the water areas of the state, including reservoirs and their associated wetlands, together with the lands underlying them. This includes those water bodies which are listed under (WAC) 173-18-230.

2.210 **Subdivision** - "Subdivision" is the division or redivision of land into five or more lots, tracts, parcels, sites, or divisions for the purpose of sale, lease, or transfer of ownership.

2.220 **Subdivision, Short** - "Short subdivision" or "short plat" is the division or redivision of land into four or fewer lots, tracts, parcels, sites, or divisions, for the purpose of sale, lease, or transfer of ownership.

2.230 **Substantial Improvement** - "Substantial improvement" is any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds fifty percent (50%) of the market value of the structure either: (a) before the improvement or repair is started; or (b) if the structure has been damaged and is being restored, to its before damaged state. For purposes of this definition "substantial improvement" is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of the building commences, whether or not that alteration affects the external dimensions of the structure; (c) the term does not include either any project for improvements of a structure to comply with

existing state and local health, sanitary, or safety code specifications which are solely necessary to assure safe living conditions, or any alteration of a structure listed on the National Register of Historical Places or a State Inventory of Historical Places.

2.240 **Wetlands** - "Wetlands" or "Wetland" are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marches, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from non-wetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities. However, wetlands may include nonwetland areas created to mitigate conversion of wetlands, if permitted by the county.

Section 3: Planning Area Characteristics

3.010 County Characteristics

A. EARTH

Geology

Alpine and continental glaciers were the sculptors of the geography of Kittitas County. Glaciers moved through this region shaping the mountains and depositing materials to create the geology and soils of the region. The primary types of glacial deposits found in the County are outwash and till. Outwash consists of unconsolidated sand, gravel, and rocks and results from runoff of melting glaciers. Outwash is usually loose and highly permeable. Glacial till or hardpan consists of unsorted clay, sand, gravel, or rock that has been compacted by the weight of the glacial ice into a highly impervious, concrete-like material.

The major geological features of Kittitas County are the Cascade and Wenatchee Mountains on the west and north portions, the south-central Yakima River Valley, and the Boylston and Saddle Mountains at the southeastern edge along the Columbia River. Within these elevations, slope, geologic and soil conditions vary dramatically including steep mountain peaks, foothills, broad rich valleys, and near-desert areas.

The county covers 2,315 square miles of highly varied terrain and climates. Beginning in the high Cascades the land slopes generally to the east and south to the Columbia River. Average annual rainfall ranges from over one-hundred (100) inches along the Cascade Range to six inches near the Columbia River. Within Kittitas County several zonal climates can be found as described in the Washington Environmental Atlas, Army Corp of Engineers. They include Alpine Zone, Sub-Alpine Zone, Forests East of the Cascade, and Steppes.

Seismic Areas

Seismic events could pose limited landslide and liquefaction hazards to the County in areas where steep or exposed slopes occur. Landslides occur when the structural integrity of a geological formation is damaged resulting in falling rocks or earth. Known areas of landslide activity (which may or may not have resulted from seismic events) occur along the Yakima River. Soil liquefaction occurs when soil loses its strength and bearing capacity during an earthquake. This is most likely to occur on noncohesive soils with high moisture content. These soils are poorly compacted and, in combination with moist conditions, are subject to liquefying during an earthquake. Structures built on liquefiable soils are subject to greater shaking and damage during an earthquake, but this damage can be

minimized by certain engineering and construction methods. Kittitas County has little potential for seismic events other than secondary affects of activity occurring to the west of the Cascades. Most of Kittitas County is within Seismic Zone Two as defined by the Uniform Building Code. The Snoqualmie Pass area is within Zone Three. The UBC rates seismic risk from One (low risk) to Four (high risk).

Soils

The soils of Kittitas County were formed by the forces of water, heat, time, vegetation and animal life, acting on the geologic parent material. The principal parent material consists of sands and gravels associated with glacial till and outwash. Highly organic soils were developed in a moist, climate under a rich covering of vegetation. Gravels associated with glacial till result in irregular soil patterns that cannot be accurately mapped. Consequently, unless soils are alluvial deposits, mapping must be interpreted very generally. There is currently no county soils map, although interim mapping by the Natural Resources Conservation Service is available.

The load-bearing capacity of soil, its hydric properties, erosion potential, and characteristics with respect to shrink-well potential all play a significant role in the development of land. Hydric properties in soils indicate the existence of wetlands and signal the potential for other environmental concerns. Soil suitability for structural support and stability is also important in determining the potential for development. Soil types vary considerably based on the *Soil Survey of Chelan Area, Washington, Parts of Chelan and Kittitas County Area, Washington,* prepared by the U.S. Department of Agriculture Soil Conservation Service (SCS) and the *Soil Interpretation Table for Kittitas County,* June, 1983.

While this analysis is useful for planning and is also helpful in determining general capacity of areas to support agricultural, residential, recreational, and other land uses, it cannot be used directly for assessing the actual use of any particular site. The glaciated character of the soils create too much variation within any particular soil type. Nonetheless, the soil maps are useful for determining general limitations and character of soils.

Soil profiles in western mountainous portion of Kittitas County differ from those in the Yakima Valley. Based on the U.S. Soil Conservation Service, soils in the western portion are more suited for growing forest products than food-crop farming. These soils are strongly acidic, gravelly or rocky, saturated most of the year, and occur in steep areas at high elevations. Soils in the foothill areas with streams are ideal for growing native trees. Soils in the Yakima River Valley are more suited to agriculture and those on the south slopes of the Valley are used for extensive fruit growing. Other areas have been designated as critical areas due to erosion and landslide potentials.

Knowledge of soil characteristics and capabilities can assist in wise public and private investments, and can be useful in determining suitability of land for various uses. Planning-level mapping should not to be substituted for specific on-site field inspections which may produce findings different from more general

accounts. It should also be noted that even some of the most severe soil limitations can be overcome by engineering techniques.

Suitability for Septic Tanks and Drainfields
For developments dependent on septic tank systems, soils are also important in determining the degree of development feasible without contaminating ground water and surface water supplies. This characteristic considers slope, permeability, drainage, depth of the water table, and the type of underlying geologic material. Areas well-suited for liquid waste disposal contain gravelly, sandy soils approximately four to six feet in depth sitting over an impermeable layer, such as till.

Several factors severely limit septic tank use in the County. First, shallow soils cover much of the western portion of the County. If soils are too shallow, the decomposition process of septic tank effluent does not proceed far enough to avoid contaminating the surface or ground water. Second, high water tables exist in river valley areas, rendering the underground reservoirs susceptible to contamination from failing septic systems. Third, rainfall varies widely from one end of the County to the other.

Depth-to-Seasonal Water Table
Depth to seasonal water table is a measurement from the surface to the water table during the wet months of the year. A shallow depth between the ground surface and the water table may cause both foundation and septic tank effluent disposal problems. A high seasonal water table may inhibit septic tank effluent from being properly treated in the soil. It may also cause foundations to "float" on their footings resulting in structural damage to buildings. Glacially cemented hardpan layers and shallow depth to bedrock account for portions of the County having a shallow depth-to-seasonal water table, (0 to 3 feet below the ground level.) These areas are not perched water tables. They can be either level or sloped areas with a hardpan layer underneath.

Aquifer Recharge Potential
Aquifer recharge potential is the relative ability of the soil and underlying geology to transport rainwater into underground aquifers. This classification considers the water-intake rate of the topsoils, the permeability of subsoils, and parent materials. While it is not known if water falling on these areas actually reaches the aquifers, it is not unreasonable to assume that these areas do play a role in recharging underground water reservoirs.

Aquifer recharge areas contain some of the most permeable soils. Conflicts can arise between the proper functioning of these soils and development. Roof tops, driveways, walkways, and frontage roads all reduce the amount of land surface available to receive rainwater. In areas of extreme permeability, septic tank effluent may percolate faster than the ability of soil microorganisms to purify it, thus increasing the chance of ground water contamination. Proper precautions should be taken when developing on areas considered to have aquifer recharge potential so that the function of these areas may be maintained without depleting or contaminating ground water supplies.

The ability of soils to allow replenishment of ground water reservoirs becomes an increasingly important consideration as more demand is placed on ground water for commercial and domestic use. Large areas of high aquifer recharge potential are found in the Yakima River Basin and its tributaries within Kittitas County. No critical aquifer recharge locations have identified in Kittitas County according to the *Interim Critical Areas Development Ordinance 94-22.*

Agricultural Suitability
The suitability of soils for agricultural production has been classified by the Soil Conservation Service into eight categories or classes. These categories are determined by expected crop yields and soil management techniques required. Generally speaking, Class 1 through Class 4 soils produce the highest yields with the least amount of soil management. Class 5 through Class 8 soils will require more costly soil management and lower yields can be expected. Kittitas County contains a considerable diversity of soils with varying agricultural properties for growing crops and trees.

Topography
Kittitas County possesses a diverse topography that is dominated by the Cascade and Wenatchee Mountains which occupy considerable areas of the County. East County consists of low, rolling to moderately steep glacial terraces and long, narrow valleys. The southeast section of the County is characterized by moderately steep to steep glacial terraces and steep, rough, broken mountain foothills. Figure 3.1 illustrates the County's topography.

Slope Stability
Slope stability refers to the potential of land slippage due to factors such as steepness, composition of materials, and water content within soils. Slopes that have been landscaped and altered from their natural vegetated state or saturated by septic tanks are also subject to sliding. Slumping can also occur when water infiltrates the soil and comes in contact with an impermeable layer. Although the upper layers of soil may not become saturated, water perches on the impermeable layer and causes a slippery interface resulting in the downward and outward movement of weak rock or unconsolidated material. Much of the western and northern portions of the County contain slopes of 15 percent or greater. Slopes less than 15 percent are generally found in the river basins in the eastern portions of the County.

B. CLIMATE

Climate in eastern Washington is a function of both maritime and continental influences. The Yakima River basin's location just east of the Cascade Crest, places it in the rain shadow, with hotter summers, colder winters, a shorter growing season, and less precipitation that areas of similar latitude west of the Cascades. Within the basin, topography and elevation strongly influence climate. Temperatures generally increase and precipitation generally decreases from northwest to southeast, and from high to low elevation.

Temperatures
Because of the variation in elevation, temperatures vary greatly in the Yakima River basin. In the Kittitas Valley summers tend to be hot, with wide divergent fluctuations, and mild to severe winters. Data is scarce for higher elevations; however, those areas are generally characterized by cool summers and cold winters. For example, in the Subalpine Fir forest zone, which extends from approximately 2,000 feet to the timberline, mean July temperatures in the range of 55° to 65° can be expected.

Temperature affects snowmelt rates in the basin and plays a critical role in flooding. In years with warm spring temperatures, snowmelt will occur over a shorter period than in cooler years. Cool spring temperatures will likely increase peak stream flows. Snow that has remained in the mountains throughout the early spring will melt and runoff more quickly when temperatures increase in later spring or early summer. When large amounts of water runoff at one time, high flows occur. Higher peak flows increase the possibility of flooding.

Precipitation
As is typical of areas in the lee of large coastal mountain ranges, the Yakima River basin is generally arid, with average annual precipitation estimated at 35 inches. Spatial distribution is extremely uneven, varying with elevation and distance from the Cascades. Rates range from 150 inches annually at the Cascade crest and 10 inches at the Columbia River.

Precipitation rates vary from one sub-basin to another. Average annual precipitation over the Yakima River drainage ranges from 60-10 inches and over the Teanaway River drainage from 50-25 inches annually. Disparities in precipitation rates from one sub-basin to another affect runoff rates and the character of the rivers in the different drainages, which influence flooding and land-use potential.

Summers in Kittitas County tend to be dry; approximately two-thirds of the of the county's precipitation occurs between October and April, with much in the form of snow. In the winter, considerable snow often accumulates in the higher elevations. In the Kittitas Valley, snow season dates generally range from November-February, with significant variation from one season to the next.

Relationship of climate and flooding
Temperatures and the amount of precipitation the county receives shape the flood hazard potential in Kittitas County. The amount of snow fall and snow melt runoff rates are critical in determining flood potentials. The majority of flooding in the Yakima and Teanaway River basins follows periods in which large amounts of wet snow accumulate, and is associated with rain-on-snow events during which

runoff cannot percolate into the soil, either because the soil has been saturated (typically during a wet fall) or because the ground is still frozen.

C. HYDROLOGY AND GEOMORPHOLOGY

Hydrology

Understanding the basin's hydrology helps planners to estimate the likely frequency and magnitude of flooding and to locate sites where erosion may be a hazard. The hydrology of the basin is in large part of climate, topography, and the region's geology and glacial history. In Kittitas County, the Yakima River basin measures approximately 1,594 square miles.

In Kittitas County, the Yakima River is the basin's principle hydraulic feature. Its major tributaries include the two rivers, the Cle Elum and Teanaway (all forks) and many creeks including, but not limited to, Silver, Manastash, Taneum, Naneum, Wilson, Reecer, Mercer, Big, and Little.

Surface Water

Watershed areas receive millions of gallons of snow melt from the Cascade Mountain Range and runoff from precipitation, requiring preparation and planning during storm and flood events. Surface water flows result in a complex system of rivers, lakes, streams, and wetlands. Sound management of these waters can mitigate the impacts of flooding events and water contamination and protect water supply and fish habitat. Major surface water bodies of Kittitas County include Lake Keechelus, Cabin Creek, Log Creek, Big Creek, Lake Kachess, Lake Cle Elum, Yakima River, Kachess River, Lake Easton, Teanaway River (all forks), Swauk Creek, Taneum Creek, Manastash Creek, and Naneum Creek.

Wetlands

Wetlands are a critical issue in that they serve important ecological functions including recharging ground water, excess storage during flood events, floodwater conveyance, habitat for fish and wildlife, sediment control, pollution control, surface water supply, and aquifer recharge. It is helpful to understand the definition of wetlands to identify and develop appropriate policies. This can be difficult, however, as the State and local definition differ from the federal definition. Kittitas County's Critical Areas Ordinance uses the Washington State Department of Ecology's *Tier Wetlands Rating System* for evaluating wetlands. The wetland classifications used in this system range from Category I having very high quality or containing threatened or endangered species to Category IV which are very small or have limited species.

Floodplains

Flooding occurs when a spring, stream, or river overruns its channels. The area most frequently flooded is called the 100-year floodplain. The Federal Emergency Management Agency (FEMA) has mapped floodplains in the County. These

maps are available for most streams in the County and have been compiled into the County's mapping system.

Ponding occurs when the seasonal water table rises above the surface of the land. Areas of ponding are found in low-lying areas, such as the Yakima River Valley, or in depressions in the land profile surrounding lakes and ponds. Small areas of ponding are located intermittently about the County. Floodplains serve to store and convey precipitation as ground or surface water. When rain falls too fast or too frequently, streams and rivers overflow their banks. Frequently flooded areas are subject to inundation during periods of high rainfall. Numerous areas of shallow soils and perched water tables exist where localized drainage problems occur.

Development on floodplains poses a danger to property owners, may aggravate flood conditions on neighboring land, and compound damage to the natural environment. Stream and shoreline habitat can be lost. Water quality can be impaired and degraded by increased sedimentation, contamination from urban runoff, or saturation of septic sewage system drainfields. Floods have deposited fertile agricultural soils in the floodplain along stream corridors. Due to the danger inherent in building in frequently flooded areas, floodplains are often better suited for farmland, parks, trails, and fish and wildlife habitat.

Surface water resources include streams, rivers, lakes, and wetlands. Impacts of land use activities on surface water resources can be direct and indirect, and vary in intensity depending on the type of land use, time of year, and specific location. Surface water runoff generally increases with additional impervious surface area (e.g., streets, rooftops) which results from development. Typical adverse impacts to surface water resources include sedimentation from erosion during construction, loss of riparian vegetation, loss of the floodplain storage capabilities, and alteration of natural drainage patterns.

Another impact includes the disruption of natural water flow patterns leading to dry streams in the summer, excessive flooding in winter, and impacts to habitat areas in receiving water bodies. Other impacts are pollution of streams due to runoff from roads and parking lots; industrial discharges; sedimentation from abandoned forest roads; and increases in water temperature from clearcut streamside riparian areas. Although rural developments tend to have short-term and less direct impacts due to their smaller scale, they are less regulated and occur over broad areas. Despite this, impacts to surface water resources from urban land uses, such as stormwater runoff, may be more significant than the impacts of rural land uses, such as hobby farming or low density residential development.

Existing environmental standards and programs, including the Shoreline Master Program and KCC 14.08 Flood Damage Prevention will continue to assist in mitigating potential impacts as the area grows. The County could establish additional floodplain protection to protect areas against future flooding.

rock in the mountains may flow downward and then move laterally into confined aquifers.

Water in confined aquifers often becomes pressurized. In some cases, the pressure is sufficient for a well to spout water several feet above the ground. Such wells are called **flowing artesian wells**. Confined aquifers are also sometimes called **artesian aquifers.**

The water level of a well drilled into an unconfined aquifer is generally at the same level as the upper surface of the aquifer. In most cases, this is the water table level. The **water table** is the boundary between the unsaturated and saturated zones. It represents the upper surface of the ground water or the level at which the hydraulic pressure is equal to atmospheric pressure. The water level found in unused wells is often at the same level as the water table. In Kittitas County, the water table may vary from one adjacent lot to another.

By contrast, when a well is drilled into a confined aquifer, its water level will be at some height above the top of the aquifer. If a number of wells are drilled into a confined aquifer, the water level will rise in each well to a certain level. These well levels form an imaginary surface called the **potentiometric surface.** The potentiometric surface is to a confined aquifer what the water table is to an unconfined aquifer. It describes at what level the upper surface of a confined aquifer would occur if the confining bed were removed.

Aquifer Recharge and Discharge
Recharge is the process by which ground water is replenished. An **aquifer recharge area** identifies where water from precipitation is transmitted downward to an aquifer. Most areas, unless composed of solid rock or covered by development, allow a certain percentage of total precipitation to reach the water table. More precipitation will infiltrate in some areas than others. Areas which transmit the most precipitation are often referred to as "high" or "critical" recharge areas.

How much water infiltrates depends on vegetation cover, slope, soil composition, depth to the water table, the presence or absence of confining beds and other factors. Recharge is promoted by natural vegetation cover, flat topography, permeable soils, a deep water table and the absence of confining beds. Soil materials in much of the County are unsorted and generally shallow in depth, which are poor groundwater collection conditions. Discharge areas are the opposite of recharge areas. They are the locations at which ground water leaves the aquifer and flows to the surface. Ground water discharge occurs where the water table or potentiometric surface intersects the land surface. Where this happens, springs or seeps are found. Springs and seeps may flow into fresh water bodies, such as lakes, streams, or wetlands.

Under the force of gravity, ground water generally flows from high areas to low areas. Consequently, high areas--hills or plateaus--are typically where aquifers are

recharged and low areas--river valleys--are where they discharge. In some instances aquifers occur beneath river valleys making them important recharge areas as well.

Water Supply Wells
Wells are a major source of drinking water for County residents. Ground water resources have been quite unpredictable in location, quantity, and quality. How aquifers respond when withdrawn through a well is important in ground water hydrology. Withdrawing water can explain (1) how a well gets its water, (2) how it can deplete adjacent wells, or (3) how it can induce contamination.

Water withdrawn from a well results in a drop in water level. The movement of water from an aquifer into a well alters the surface of the aquifer around the well, forming a **cone of depression.** A cone of depression is a funnel-shaped drop in the aquifer's surface. The well itself penetrates the bottom of the cone. All ground water flows to the well within a cone of depression. The outer limits of the cone define the well's **area of influence.**

The size of a cone of depression depends on the rate at which water is withdrawn from a well. A well from which a high volume of water is withdrawn will generally have a larger cone of depression than a well from which smaller quantities are taken, if both wells tap the same aquifer and are at the same depth. Also, all other factors being equal, pumping from an unconfined aquifer usually results in a larger cone of depression than pumping from a confined aquifer.

At times, the cone of depression formed around one well will overlap that of a nearby well. When this happens, the well with the wider and deeper cone of depression can draw water away from the smaller well, eventually causing the water level to drop in the smaller well. If contaminants are discharged or migrate into a cone of depression, they are likely to be drawn into a well. Contaminants can also be drawn into a well if the cone of depression enlarges and intercepts contaminated ground water.

Geomorphology
Geomorphology refers to the relationship between the shape and other physical characteristics of the river and the rocks and sediments of the valley in which it flows. The river creates its channel, which reflects the force of the flowing water and the material of which the bed and banks are made. Changes in watershed condition can affect the amount of runoff, the amount and size of sediment that enters the river, or both. Changes in runoff and sediment loading affect the river's behavior, including flood characteristics.

The Yakima River's character changes in response to the County's geology as it flows downstream. Much of the river is braided, with interlaced channels and gravel bars, with an active channel area; however, there are areas where basalt flows constrict the lateral movement of the river. The Teanaway River (all forks) generally are constrained in their upper reaches. Moving downstream to the Teanaway River valley, the river is fairly channelized, but has free lateral movement.

Streamflow
Two factors, runoff and hydraulic exchange, affect flow rates in the County. During ordinary years much of the precipitation remains as snowpack for several months after it falls, providing for higher flows during the spring thaw; however, much of the runoff is stored in one of the three reservoirs for irrigation purposes later in the year. In high precipitation years, rain-on-snow events will decrease the snowpack and increase stream flow to the point of flood events. This was most apparent during the 1990, 1995, and 1996 flood events.

Exchanges between surface and groundwater are the second factor driving stream flow in the Yakima River basin, but the relationships between the two are complex. Permeable glacial sediments are thought to provide for a high degree of hydraulic continuity between surface and groundwater in most parts of the basin. Where surface and groundwater are in continuity, the condition of the river corridor will have strong impact on groundwater resources as well as on flooding. Riparian vegetation both slows flows and helps water percolate to the zone from which it can recharge the aquifer. Similarly, changes in land use that affect groundwater quantity and quality and aquifer recharge potential will be reflected in the river.

D. BIOLOGICAL RESOURCES

Plants
The natural vegetation of the Yakima River Basin varies in response to temperature, moisture availability, and soil characteristics. The highly-varied geography of Kittitas County provides a wealth of ecosystems supporting many different types of habitats and species. The Alpine Zone, Sub-Alpine Zone, and Forest East of the Cascades can be generally described as high altitude with ground cover ranging from stony fell fields to lush timberline. Primary species types include lichens, shrubs and sub-alpine forests. Western white pine and western larch are the prevailing seral trees. The major climax dominants are segregated with western hemlock in the most moist situations, western red cedar in less moist places (a transitory tree on hemlock sites) and grand fir on soils tending to be droughty. Swamps with western red cedar also occur. Passing from the grand fir areas, one enters into land where the soils regularly dry deeper. There, drought-tolerant ecotypes of Douglas-fir, which can play only a transitory role in wetter areas, remain as climax dominants for lack of competition from fir, cedar or hemlock. Forest in the Douglas-fir belt have undergrowth dominated by mallow ninebark, common snowberry or pinegrass. Ponderosa pine invades the sites after logging or fire, but it cannot retain its place for more than a single generation in the face of competition from Douglas-fir.

As the severity of soil drought intensifies, Douglas-fir drops out of the zonal sequence leaving ponderosa pine dominant for lack of any competitor. Ecologically distinctive segments of pine forest are recognizable by differences in the undergrowth dominants which may be any of bitterbrush, mallow ninebark, common snowberry, Idaho fescue, rough fescue, bluebunch wheatgrass, needle

The following are listed as endangered or threatened vascular plants located in Kittitas County: Columbia milk-vetch, Clustered lady's slipper, Wenatchee larkspur, Basalt daisy, Hoover's desert-parsley, Adder's tongue, Oregon checker-mallow, Seely's silene, Hoover's tauschia (Federal Candidate), Pine broomrape, Green-fruited sedge, Swamp saxifrage, and Victoria's grape-fern.

There is a possibility that the following endangered, threatened, sensitive, or high quality native plants may be located within Kittitas County: Buxbaum's sedge, Gray cryptantha, Bitterbush/Indian ricegrass community, Longsepal globemallow, Henderson's ricegrass, Three-tip sagebrush/Idaho fescue community,and Pauper milk-vetch.

Animals

Fish

The Yakima River basin watercourses support both anadromous and resident fish, including spring and fall Chinook, rainbow/steelhead trout, bull trout, whitefish, and squawfish. The Yakima River is regulated on a catch-and-release basis and is closed to salmon and steelhead fishing. Some of the tributaries are open for keeping taken fish, with a daily-catch limit of two (2) fish over twelve (12) inches in length. Attempts to rebuild steelhead and salmon runs have begun in the basin, with the planning of a fish hatchery located near the city of Cle Elum.

Land use practices have been the cause of some of the decline in habitat. Salmon and trout have fairly precise habitat requirements, and changes in the watershed condition (whether natural or human-caused) may have a negative effect on the survival rates and population density.

Animals

The Washington State Department of Fish and Wildlife designates Priority Habitats and Species, maps areas of critical importance to them, and develops management recommendations for them. Priority habitats are those with unique or significant value to many species. Priority species are those that have been listed by the State as endangered, threatened, or sensitive, or are candidates for such listing; vulnerable species that are susceptible to significant population declines; and species of recreational importance.

The following lists include, but are not limited to, known animals in Kittitas County:

Birds

Great Blue Heron, Goshawk, Northern Goshawk, Cooper's and Sharp-shinned Hawks, Golden Eagle, Bald Eagle, Marsh Hawk, Osprey, American Peregrine Falcon, Merlin, American Kestrel, Blue Grouse, Spruce Grouse, Ruffed Grouse, White-tailed Ptarmigan, California Quail, Merriam's Turkey, Chucker, Common Snipe, Band-tailed Pigeon, Mourning Dove, Spotted Owl, Flammulated Owl, Great Gray Owl, Mountain Bluebird, Loggerhead Shrike, Western Meadowlark,

Blackbacked Woodpecker, Vaux's Swift, Western Bluebird, White-headed Woodpecker, Common Loon, and Purple Martin.

Mammals
Black Bear, Grizzly Bear, Gray Wolf, Marten, Pacific Fisher, Wolverine, Cascade Red Fox, Cougar, Lynx, Rocky Mountain Elk, Mule Deer, Mountain Goat, and Bighorn Sheep.

Amphibians
Cascades Frog, Spotted Frog

Threatened and Endangered Animal Species
Bald Eagle (Federally listed, State threatened), Black-backed Woodpecker (State monitor), Cascades Frog (Federal Candidate), Common Loon (State candidate), Fisher (State candidate), Flammulated Owl (State candidate), Golden Eagle (State Candidate), Gray Wolf (Federal endangered), Great Blue Heron, (State monitor), Grizzly Bear (Federally listed), Harlequin Duck (Federal candidate), Lewis' Woodpecker (State candidate), Mountain Sucker (State monitor), Northern Goshawk (Federal and State candidate), Osprey (State monitor), Pacific Fisher (Federal candidate), American Peregrine Falcon (Federal and State Endangered), Pileated Woodpecker (State Candidate), Purple Martin, (State candidate), Pygmy Whitefish (State monitor), Spotted Owl (Federal threatened, State endangered), Vaux's Swift (State candidate), Western Bluebird (State candidate), White-headed Woodpecker (State Candidate).

Habitat, Wildlife, and Unique Species: Wildlife habitats in the County include shorelines, rivers, streams, wetlands, lake riparian vegetation zones, forest land, desert and known nesting sites. Wildlife habitat is critical to the survival of species in the County, particularly those dependent on unique habitats such as the Spotted Owl, and salmon. Land clearing, alteration of wetlands and riparian vegetation, pollution of surface waters, and the establishment of roadways and urban development can have adverse impacts on habitat. Urban development permanently alters habitats by removing native vegetation, and can lead to the introduction of non-native species. Most native wildlife species cannot exist in urban areas. Urban development can also alter wetlands through filling and can increase water runoff from impervious surfaces such as roads and buildings.

Agricultural land uses can also impact habitat as agriculture tends to maintain large areas of land in a single type of vegetation. This land management technique favors some species over others and can lead to increases in numbers of species such as crows, coyotes, and seagulls.

Rural land uses result in a mix of field and pasture habitat that can support a wide variety of native wildlife. However, the presence of humans, even in low densities, may drive off many native forest species such as black bear and cougar. Continued loss of habitat areas may bring about increased confrontations between humans and displaced animals. Deer, coyote, and many other native northwest animals have adapted to exist in rural areas despite the presence of humans and

fragmented habitat. Others, such as the Blue Heron, are very sensitive to human activity and can abandon nest sites if disturbed.

Forestry management creates intense, short-term impacts for some wildlife species while permanently removing habitat from those species that depend on large, old-growth environments. Clearcutting threatens prime forest habitat and leads to erosion and landslides.

E. WETLANDS AND RIPARIAN AREAS

Wetlands and riparian areas are transitional areas between open water and the adjacent dry land. They typically share some characteristics of both aquatic and terrestrial ecosystems. Both wetlands and riparian zones are ecologically complex areas that perform a variety of functions, including water quality protection, flood storage and conveyance, bank stabilization, and streamflow maintenance. In addition, these areas are also important contributors to wildlife and fisheries habitat. Kittitas County Code 17A, Critical Areas, protects both wetlands and riparian areas from encroachment by development.

Wetlands are areas in which water has affected the soil characteristics and vegetation types. Many of the wetlands in Kittitas County are associated with rivers and creeks, but wetlands may also be located in areas far from flowing water. The U.S. Fish and Wildlife Service used photographic interpretation to map wetlands in the basin as part of the National Wetland Inventory (NWI) survey for Kittitas County. The NWI generally does not show all of the wetlands, for example, small wetlands and those hidden by dense vegetation may not be apparent in aerial photographs. Conversely, the maps may incorrectly identify areas as wetlands, when in fact they are not. In addition, there is no information as to the storage capacity or flood attentuation value of the basin's wetlands. However, some areas can be defined as seasonal wetlands (over flow channels) that do act as relief valves for flood flows.

Riparian areas are those located adjacent to rivers and creeks, where there is enough water to support vegetation that would not grow farther from water. They are an important link between aquatic and upland ecosystems. Riparian areas provide food, cover, movement corridors, and access to water for a variety of animals. These areas also provide vital habitat areas for amphibians and migratory birds. Although riparian areas occupy only a small percentage of the entire watershed, a majority of the wildlife species use them. Riparian areas also serve as a source of fine litter and coarse woody debris, which are vital components of instream habitat. In addition, riparian vegetation plays an important role in bank

stabilization and trapping sediments that would otherwise be washed into the water.

In many of the basin's wetlands and riparian areas, function has been affected by land use and development activities. Removal of wetland and riparian vegetation, compaction of soils, and alteration of the natural hydrology (fill is added or areas drained) diminish the capacity of the system.

Wetlands and riparian areas are often located with floodplains. Riparian areas adjacent to headwaters and tributary streams may not be within mapped floodplain areas, but they are likely to be subject to inundation during periods of high water.

F. LAND USE

The existing land use pattern within Kittitas County is characterized as predominantly undeveloped. Of the total 2,315 square miles, 72% is owned by federal and state agencies or private timber companies and is virtually undeveloped. Fifty-four percent of the County is forest land, 30% is range-land, and about nine percent is cultivated farmland. Only about two percent of the County land area is "urban". Most of the population lives in Ellensburg, Cle Elum, or the other cities.

The County is characterized as rural, forested and range-land with some significant densely populated areas. Settlers originally came to this area to take advantage of the opportunities for logging, sawmills, farming, and for services for the resource industries. Today, traditional economic sectors such as logging and other forest-related industries are in decline due to restrictions on logging and the transition of land to conservation and parks. A large part of the growing economy is based on tourism and recreational activities. Much of the developed landscape reflects this and consists of vacation/recreational housing, single family units, highway-oriented service/retail commercial development, and recreational uses such as golf courses and parks. The majority of remaining nonfederal and non-state land is privately held forest and some agricultural land.

In the Snoqualmie Pass area timber harvesting is the dominant land use with limited areas used for recreational purposes. Resource extraction is also predominant in the mid-elevations, however, residential development has become significant land use in recent years. In the lower elevations of the County agricultural activities are the primary land use intermixed with residential development. The Yakima Training Center, located in the southwestern portion of the county, makes up a large percentage of the ownership in the lower Kittitas Valley, comprising nearly 164,000 acres.

Existing Density

The 1994 Comprehensive Plan relies on the underlying zoning for assigning density. Under current zoning, densities range from one dwelling unit per acre to one unit per 80 acres. The Suburban Zone allows a density of one unit per acre, while the Rural-3, Agricultural-3, Agricultural-20, and Forest and Range Zones

habitat is not likely to be incorporated into development decisions without external requirements.

G. RECREATION AND TOURISM

The Yakima River basin offers a wide range of opportunities for both active and passive recreation throughout the year, and tourism has been an important component of the area's economy over the years. Many visitors are attracted to the area by its natural beauty and scenic setting; others come to use wilderness areas and forest recreation facilities.

Within the basin, camping, hiking, fishing, hunting, horseback riding, river rafting and mountain biking are popular activities. From spring through fall hunting and fishing opportunities draw a variety of outdoor enthusiasts to Kittitas County. In addition, river rafting, camping, and hiking are popular summer activities for tourists.

Access to the basin's rivers and streams are limited in many parts of the county. However, there are several public access areas on the Yakima River for boat launching and fishing and many streams flow through public lands making them accessible for public use.

H. SUMMARY

The characteristics of the Yakima river basin and its associated sub-basins, provide both problems and opportunities with regard to river corridor and flood hazard management. Rivers and their corridors are important economically, as a source of irrigation water and recreational resource, and so their management is critical to many local residents and landowners. The most important factor is the diversity of conditions found in various parts of the basin, which means that different approaches will be needed in different places.

Alluvial fans and other areas subject to erosion stand out as problems related to the geomorphology of the basin. The condition of riparian areas is another area of concern and the condition of the river corridors has a strong impact on flooding. Native vegetation has been disturbed in many places, affecting the river's ability to handle floods and also diminishes habitat quality.

Finally, land use patterns present a variety of problems in the basin. Much of the land adjacent to the assorted rivers and creeks is in private ownership and some areas have high density "urban" type development. As land use in the county shifts from forestry and agricultural uses to residential, there will likely be changes in the management of those lands that will influence the river corridors and floodplain storage.

3.020 Description of Drainage

The Yakima River drainage is made up of a variety of different streams, creeks, and rivers that flow from the higher elevations to the main-stem of the Yakima River. The majority of past developments have been located in flood prone areas (100-year floodplain/floodway) along the Yakima, Cle Elum and Teanaway Rivers, prior to floodplain management in Kittitas County. This development has tended to be high density, residential development, which created city sized lots located in flood prone areas. Since the adoption of the Flood Damage Prevention Ordinance, Critical Areas, and the Shoreline Master Program, development of this kind has substantially decreased. The flood prone and/or repetitive loss areas generally lie within a variety of zoning classifications, ranging from 1 to twenty acre minimum lot sizes. This includes: Agricultural-3 (Ag-3), Agricultural-20 (Ag-20), Rural-3 (R-3), and Suburban zones. Under current zoning classifications, future development densities should continue to remain lower, as the minimum lot sizes should remain the same.

3.030 Hydrologic Analysis

The hydrologic analysis is taken from the Flood Insurance Study of Kittitas County, dated 1978. Although this study was completed in 1978, the information contained in the study, is the best available data found to date.

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream flooding source studied in detail.

Gaging stations on the Yakima River (operated since 1906 at cross-section KI and since 1941 at cross-section SI), the Teanaway River (operated from 1968 to 1974 at cross-section EF), the Cle Elum River (operated since 1903 at cross-section CQ), the Kachees River (operated since 1903 at cross-section L), and twenty-one (21) other adjacent hydrologically similar sites, were the principle sources of data for defining the peak discharge-frequency relationships for each stream studied. Values of the 10-, 50-, 100-, and 500-year peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data at these sites in accordance with the guidelines set forth in Water Resources Bulletin 17. Peak discharges for sites on the Yakima, Cle Elum, and Kachees Rivers are affected by regulation and only non-regulated flows were used to develop these frequency curves.

Regional relationships in existing publications did not produce satisfactory results for the 10-, 50-, 100-, and 500-year peak discharges in comparison with those obtained for the gaged sites by the log-Pearson Type III distribution. Therefore, new regional relationships relating basin characteristics (drainage area and precipitation) to streamflow characteristics (10-, 50-, 100-, and 500-year peak discharges) were developed for determining peak discharges at all sites in the study area. These values were adjusted to fit present day (1978) regulated conditions on the Yakima, Cle Elum, and Kachees rivers. A summary of drainage area and peak discharges for each stream studied in detail are shown in Table 3.1. These discharges were coordinated with the Army Corps of Engineers, the Soil Conservation Service, and Tudor Engineers, the study contractor doing the adjacent Yakima County FIA study. (FIS, K.C., 17-18)

Table 3.1
Summary of Discharges

Flooding source and location	Drainage area (sq miles)	Peak discharges (cfs) 10-yr	50-yr	100-yr	500-yr
Yakima River					
Downstream study limit, section A	1594	20,000	29,300	33,900	45,400
Upstream of Wilson Creek, section D	1190	19,000	28,000	32,300	43,600
Confluence with Manastash Creek, section CB	1177	18,900	27,700	32,000	43,200
Confluence with Dry Creek, section DC	1037	18,500	27,100	31,400	42,400
Section GN	948	18,200	26,700	30,900	41,900
Confluence with Teanaway River, section GZ	740	17,100	25,100	29,100	39,600
Upstream of confluence with Teanaway River, section HA	533	14,700	21,700	25,200	34,300
Upstream of confluence with Crystal Creek, section KR	495	14,500	21,400	24,700	33,800
Confluence with Cle Elum River, section LO	485	14,200	21,000	24,300	33,200
Upstream of confluence with Cle Elum River, section LP	263	7,990	11,700	13,500	18,400
Upstream of confluence with Big Creek, section PS	229	7,220	10,600	12,200	16,600
At gauging station at Easton, section SI	188	6,580	9,660	11,200	15,200
Upstream of confluence with Cabin Creek with Kachees River, section SP	122	4,900	7,180	8,290	11,300
Upstream of confluence with Cabin Creek, section TG	82.1	3,740	5,480	6,300	8,600
Upstream study limit, section UG	74.8	3,460	5,060	5,840	7,900
Kachees River					

at Mouth, section A	64.0	2,300	3,360	3,860	5,180
Silver Creek					
at Mouth, section A	6.1	260	370	425	560
Cle Elum River					
at Mouth, section A	222	8,020	11,800	13,600	18,600
Upstream study limit, section CR	203	7,540	11,100	121,800	17,400
Manastash Creek					
Downstream limit of study, section A	87	1,400	2,000	2,010	2,700
Downstream of Diversion Channel, section BB[1]	--	1,400	2,030	2,060	2,780
Downstream of Diversion Channel, section BO[1]	--	1,400	2,030	2,180	2,900
At section BR	--	1,400	2,030	2.310	3,030
At section BT	--	1,320	1,900	2,200	2,850
At confluence of Manastash and N.F. Manastash Creeks, section DO	69.7	1,240	1,780	2,040	2,670
Upstream limit of study, section FB	42.8	967	1,400	1,590	2,100
Crystal Creek					
at Mouth, section A	7.71	150	220	250	320
Naneum Creek					
at Mouth, section A	--	920	1,310	1,480	1,890
Section I	--	290	420	470	600
Left channel					
section A	--	625	890	1,000	1,300
section I	--	290	420	470	600
Wilson Creek					
at Mouth, section A[2]	396	3,100	4,250	4,750	5,900
Upstream of confluence with Cherry Creek, section N	--	2,050	2,750	3,000	3,700
Upstream of confluence with Naneum Creek, section AB[2]	--	1,550	2,170	2,360	2,950
Upstream of left channel, section BQ[2]	--	1,260	1,610	1,725	2,045

Section BT[3]	--	290	440	475	655
Upstream study limit	--	475	680	770	986
Reecer Creek					
Downstream detailed study limit, section A	40.0	280	400	450	560
Section E	--	100	140	160	200
Currier Creek					
Downstream detailed study limit, section A[4]	40.0	280	400	450	560
Dry Creek Connection Road	26.6	180	255	290	360
Whiskey Creek					
At 5th Street	--	75	105	175[5]	275[5]
Upstream study limit	10.3	75	105	118	147
Mercer Creek					
Mouth	15.6	110	150	220[5]	310[5]
At Railroad Ave.	--	110	150	170	210
Caribou Creek					
Downstream study limit	36.7	294	417	471	595
Teanaway River					
At mouth, section A	207	5,300	6,700	7,350	8,700
At section EF	172	4,600	5,950	6,450	7,650
Upstream of confluence with North Fork Teanaway River, section EU	69.0	2,400	3,000	3,300	3,900
North Fork Teanaway					
River at Mouth, section A	95.0	2,900	3,700	4,000	4,750
Middle Fork Teanaway					
River at Mouth, section A	30.0	1,250	1,570	1,700	2,020
West Fork Teanaway					
River at Mouth, section A	39.3	1,300	1,640	1,780	2,080
Upstream study limit	19.2	790	1,000	1,080	1,260

1 - Loss of approximately 125 cfs due to diversion channel upstream of section.
2 - Includes overflow from Yakima River, Reecer, and Currier Creeks.
3 - Includes overflow from Reecer and Currier Creeks.

4 - Combined values Reecer and Currier Creeks.
5 - Includes overflow from Reecer Creek.

3.040 Flood Damage History

According to the Flood Insurance Study for Kittitas County, the most damaging floods along in the Yakima, Teanaway, and Cle Elum Rivers occur during November and December, as a result of heavy rains and snow melt. Floods also occur during the spring and early summer months as a result of run-off of snow melt from the higher elevations. Spring floods are generally characterized by a slow rise and long duration of flows. The winter floods generally rise rapidly, but are shorter in duration. In addition, river stages may be increased by ice and log debris jams.

The winter floods have historically had their crests reduced by reservoir storage, as flooding occurs after the irrigation season when storage is available. However, these reservoirs control only a small part of the runoff and storage may not be available if a second winter flood occurs. The three reservoirs have a combined storage capacity of 833,700 acre-feet (Keechelus Lake, 157,800 A.F.; Kachess Lake, 239,000 A.F.; Cle Elum Lake, 436,900 A.F.). These reservoirs were constructed for irrigation purposes, but are also operated for flood control on the basis of runoff forecasts.

Since 1862, approximately twenty major floods have occurred on the Yakima River and its tributaries, five of the most severe taking place in November 1906 (41,000 cfs), December 1933 (32,200 cfs), May 1948 (27,700 cfs), December 1975 (16,600 cfs), and December 1977 (21,500 cfs). These peak discharges were observed at the USGS gauging station on the Yakima River at Umptanum, station number 12484500. This site is ten miles south of Ellensburg.

The most recent floods were in the November 1990, November 1995, and February 1996. During these floods many of the developments located adjacent to the Yakima and Teanaway Rivers had to be evacuated due to the level of the floods. In November 1995, the estimated peak of the Yakima River was at thirty-four (34) feet. This flood threatened bridges over the Teanaway River (SR970 and Lambert Road) and broke through dikes located on both rivers, which caused damage to both private and public property. The estimated peak of the February 1996 flood is not available to date. However, the damaged sustained by this flood was not limited to the Upper County. Private property and county roads and bridges were damaged throughout the valley, including, but not limited to, the Manastash, Swauk, Taneum, and lower Badger Pocket areas. A total of twenty-two (22) bridges sustained damage in the county, in addition to approximately 120 road damage sites.

3.050 Potential Future Damage

As new developments continue to be cited in flood prone areas, the potential for flood damage will increase. This plan will eliminate all new subdivisions, both short and long plats, within frequently flooded areas (see Section 4.4). In addition, Kittitas County will follow KCC 14.08, Flood Damage, and the FEMA rules and

regulations for allowing reconstruction and/or restoration of residential structures located in frequently flooded areas.

This plan will also address alternative measures for flood control work, as outlined in Section 5. Many land uses, including bank armoring, dikes, land clearing activities, etc, alter the pattern of runoff by decreasing the ability of upstream lands to store water and increase the rate of runoff and downstream impacts.

Once this plan is implemented the potential flood damage should remain the same as is currently occurring and eventually lessen the potential future damage to public and private lands and structures.

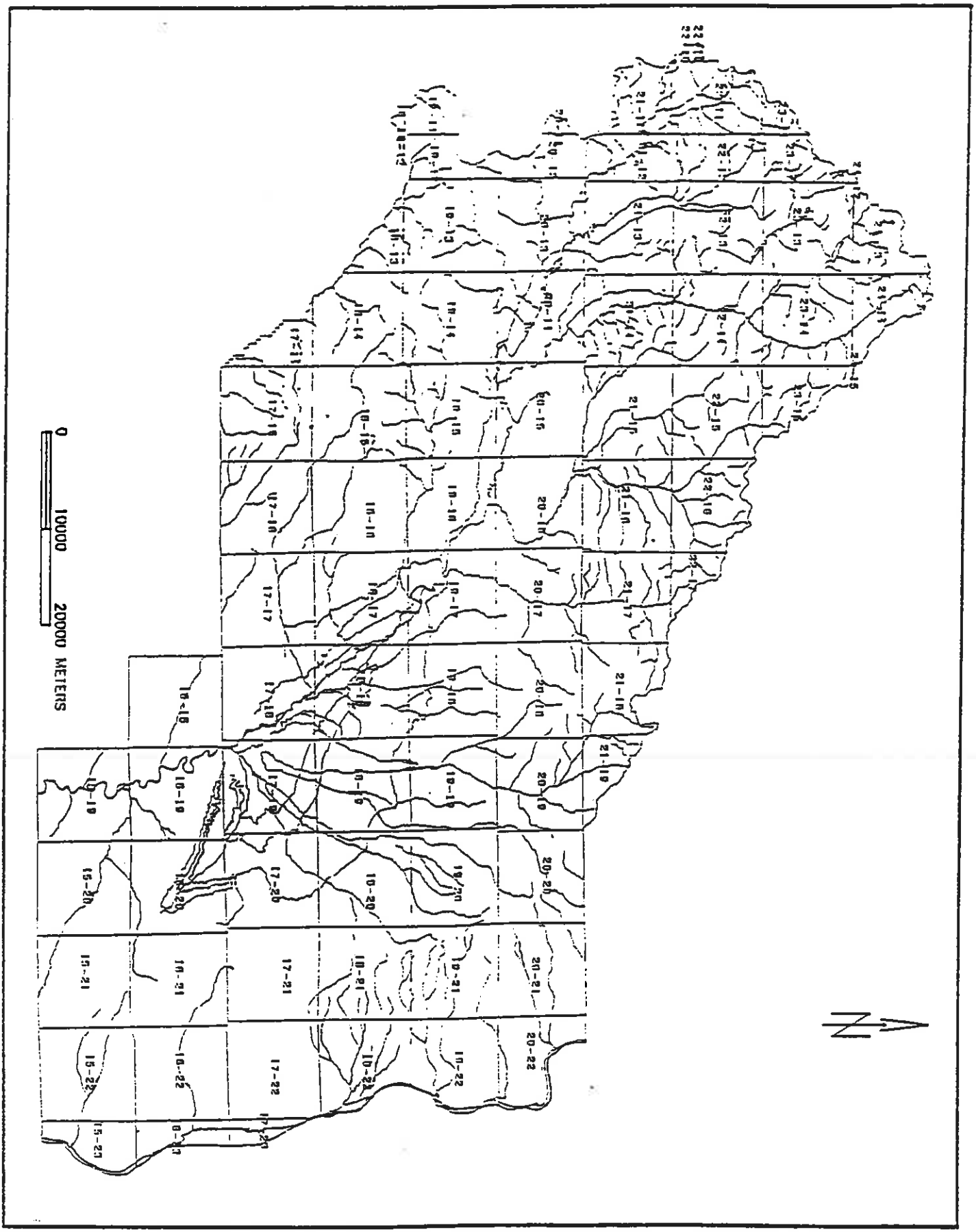
3.060 Location and Description of Specific Problem Areas

There are many flood problem areas within Kittitas County. Large scale developments with urban densities, have historically been located adjacent to the Yakima and Teanaway Rivers. Specifically, Elk Meadows, Elk Meadows Park, Pine Glen, Sun Island, Sun Country, Teanaway Acres, and the Teanaway Wagon Wheel have had substantial flood damage. In addition to these areas, there are streams which have large and unpredictable floodplains and tremendous flood capacities. This includes, but is not limited to, the Cabin, Cole, Big, Little, Silver, Gold, Manastash, Taneum, Wilson, And Reecer Creeks.

According to the Federal Emergency Management Agency (FEMA) there are only four repetitive loss structures located in Kittitas County. The first repetitive loss structure is located in the Elk Meadows Subdivision on the Yakima River. According to the FEMA Floodway Panel (530095 0229B) the entire lot is located within the 100-year floodplain. The second repetitive loss structure is also located on the Yakima River and according to the FEMA Floodway Panel (530095 0241B) approximately ninety percent (90%) of the parcel is located in the regulatory floodway with the remainder located in the 100-year floodplain. The third site is located on the middle fork of the Teanaway River, however the parcels proximity to the regulatory floodway/100-year floodplain has not been determined. The location of the last site has not been determined at this time.

The low number of repetitive loss structures in Kittitas County can be attributed to the NFIP rules and regulations governing secondary homes. Many of the subdivisions located on the Yakima and Teanaway Rivers are made up of recreational homes (secondary homes) which are not covered by the NFIP.

Map 3-1
Hydrology Map of Kittitas County



Section 4: Provisions for Flood Damage Reduction

4.010 Shoreline Master Program Regulations

The Kittitas County Shoreline Master Program was adopted in 1975 in accordance with SMA. The county issues permits for substantial development, conditional uses, and variances in accordance with the SMP and the Department of Ecology's guidelines.

Kittitas County's shoreline jurisdiction extends 200 feet landward from the ordinary high water mark (OHWM) and building setbacks from shorelines of the state are 100 feet from the OHWM. The Shoreline Master Program also establishes four (4) shoreline designations: Urban, Rural, Conservancy, and Natural environments.

In 1995, State Legislature revised the Shoreline Management Act to allow for fish enhancement projects, within the shoreline jurisdictional boundaries of streams, lakes, and rivers, to be exempt from the local permitting process. In order to qualify for this new exemption under RCW 90.58.147, (1) the project has been approved by the Washington State Department of Fish and Wildlife; (2) the project has received hydraulic project approval by the Washington State Department of Fish and Wildlife, pursuant to RCW 75.20; and (3) the local government has determined that the project is substantially consistent with the local shoreline master program. The local government shall make such determination in a timely manner and provide it by letter to the project proponent.

4.020 Flood Damage Prevention Ordinance

The Kittitas County Flood Damage Prevention Ordinance was adopted in 1979 and has been included under Kittitas County Code 14.08, Flood Damage Prevention. KCC 14.08 was amended in 1981, 1982, and 1989 as new requirements came into effect. The State requires counties to adopt floodplain management ordinances that comply with the minimum standards of the NFIP and with additional requirements developed by W.S. Department of Ecology.

4.030 Critical Areas

In 1994, Kittitas County adopted the Critical Areas Policies and Development Regulations to comply with the mandates of the Washington State Growth Management Act of 1990. KCC 17A, Critical Areas, requires certain land use and development activities to be reviewed for potential impacts to a critical area. Specifically, frequently flooded areas, wetlands, riparian areas, geologic hazard areas, and aquifer recharge areas are protected under this code.

KCC 17A, Critical Areas, requires that buffers be established to protect wetlands in Kittitas County. Table 4.1 outlines the required buffers for wetlands in Kittitas County.

Table 4.1

Wetland Type	Buffer
Type 1	50-200 feet
Type 2	25-100 feet
Type 3	20-80 feet
Type 4	Structural setback determined by underlying zoning

KCC 17A, Critical Areas also requires protective buffers to be placed on riparian corridors. Specifically, the required buffers are included in Table 4.2.

Table 4.2

Riparian Type	Buffer
Type 1	40-200 feet
Type 2	40-100 feet
Type 3	20-50 feet
Type 4	10-20 feet*
Type 5	15 foot structural setback from OHWM

* The buffer begins at the intersection with type 1, 2, and 3 streams for 40-500 feet and a 15 foot structural setback from end of buffer.

The Kittitas County Planning Department has both digital and "hard copy" maps showing the locations of designated critical areas. The maps include, FEMA FIRM and Floodway panels, NWI maps, Priority Habitats and Species maps, and the DNR Hazardous Slopes map.

4.040 Subdivisions

The Revised Code of Washington 58.17.120, *Disapproval due to flood, inundation, or swamp conditions - Improvements - Approval conditions,* states:

> The city, town, or county legislative body shall consider the physical characteristics of a proposed subdivision site and may disapprove a proposed plat because of flood, inundation, or swamp conditions. Construction of protective improvements may be

required as a condition of approval, and such improvements shall be noted on the final plat.

No plat shall be approved by any city, town, or county legislative authority covering lands situated in a flood control zone as provided in Chapter 86.16 RCW without the prior written approval of the Department of Ecology of the state of Washington.

Under state law, the county can deny all subdivisions located in frequently flooded areas. The majority of the land divisions in the county are short plats and because they are not included in 58.17.120 RCW, short subdivisions can still be located in these areas. By disallowing future short plats in frequently flooded areas, it may allow the county to come into further compliance with the NFIP and may decrease flood insurance premiums for county residents.

4.050 Other Programs

A number of existing regulatory, planning, and capital improvement programs are relevant to river corridor management in Kittitas County.

Unified National Program for Floodplain Management

The Water Resources Planning Act of 1965 created the U.S. Water Resources Council, an independent executive agency that encourages the conservation, development, and use of water and related land resources on a comprehensive and coordinated basis. The chief tool in carrying out that mission is the Unified National Program for Floodplain Management. First issued in 1976, and revised and reissued in 1979, the program analyzes the basic principles of flooding and relates floodplains to the natural and social systems of which they are a part. Based on that analysis, it outlines a series of management strategies, implementation techniques, and recommendations for an effective response to flooding.

NFIP

The National Flood Insurance Program (NFIP) was established with the passage of the National Flood Insurance Act in 1968 to enable property owners to buy insurance against flood losses. However, to be eligible for insurance, an individual must live in a jurisdiction with an approved floodplain ordinance in conjunction with a floodplain management program. This shifted part of the flood damage reduction responsibility to local governments and gave an incentive for floodplain regulation. The program is administered by the Federal Insurance Administration of the Federal Emergency Management Agency (FEMA). Kittitas County participates in the NFIP, thus residents of the county are eligible to purchase flood insurance.

The Federal Disaster Protection Act of 1973 changed the NFIP from a voluntary to a mandatory program by requiring the purchase of flood insurance for any federal project and more significantly, any project in a flood-prone area that relies on federal mortgage guarantees. Thus flood insurance was tied to any building that was financed with assistance from the Federal Housing Administration and Veterans Housing Administration loans, or for which a loan was guaranteed by the

Federal Deposit Insurance Corporation or the Federal Savings and Loan Insurance Corporation.

Participating communities must adopt and enforce certain minimum floodplain management standards, including requiring permits for all development within the 100-year floodplain, requiring development activities to minimize future flood damage, and maintaining construction documentation for buildings within the 100-year floodplain.

Disaster Relief Acts

The 1970 Disaster Relief Act set up a disaster relief program to assist areas that have received major damage in conjunction with a natural disaster. The program is managed by the Disaster Response and Recovery Office, which is a part of FEMA. The 1974 Disaster Relief Act supplemented the 1970 Act by requiring hazard mitigation actions, either before or after a disaster, as a condition for receipt of disaster relief funds.

Section 5: Alternatives for Flood Control

5.010 In-Stream Work

As an alternative to normal flood proofing of structures located within flood prone areas, the County will develop standards, through consultation with the Departments' of Ecology and Fish and Wildlife, for in-stream work as flood control measures. Except for those activities outlined in Appendix C, *Kittitas County Bio-Engineering Standards*, in-steam projects will be required to provide an analysis showing the accumulative effects of the project on up- and down-stream areas and modeling data, to Kittitas County at the time of application.

5.020 Rock Barbs

One such alternative is the placement of rock barbs within the ordinary high water level. Such barbs shall be placed only through direct consultation with the Department of Fish and Wildlife and the Department of Ecology. The County Planning Department will provide handouts that outline the standards for placement and that contain diagrams which show the effects rock barbs have on stream flow. In some instances, properly constructed barbs will protect property and enhance fish habitat.

5.030 Drop Structures

Another alternative is the placement of drop structures. These structures are also used as flood control measures and enhance fish habitat. Such structures will only be placed through direct consultation with the Departments' of Fish and Wildlife and Ecology.

5.040 Bank Stabilization

Bank stabilization is another alternative for mitigating potential flood damage for a specific site. Bank armoring and bioengineering methods (as outlined in section 5.050 and 5.060) are two possible actions which may be used for bank stabilization.

5.050 Bank Armoring

Riprap is one alternative to bank stabilization. When placed correctly, the riprap will protect the bank from erosion and help to channelize the water. However, because riprap works to channelize a stream or river the velocity of the water may actually increase. Although this alternative may protect the bank at a specific site, riprap can actually cause more prolific flood damage to up-stream and down-stream properties.

5.060 Bioengineering Methods

Another option to bank stabilization is the revegetating of the bank. By planting trees and other native vegetation along the bank, deep root systems develop. The root systems protect the bank from further erosion. The vegetation also helps to decrease the velocity of the water during a flood event.

5.070 Land Use Alternatives

Kittitas County has established a variety of land use controls for development within frequently flooded areas, including, but not limited to, Kittitas County Codes (KCC) 17A *Critical Areas Development Ordinance* and 14.08 *Flood Damage Prevention, Kittitas County Critical Areas Policy Document* and the *Shoreline Master Program.* KCC 17A protects critical areas from encroachment by development; however, in some cases, critical areas protection is not available. This plan should address those activities which do not break the threshold for critical areas protection.

5.080 Riparian Corridors/Areas

Riparian corridors/areas are very important for mitigating potential flood damage. The vegetation in these areas decrease the velocity of flood waters and are natural flood storage areas.

5.090 Geological Hazard Areas

The Washington State Department of Natural Resources, Geologic Hazards map designate areas as one of three types of hazard. This includes:

1. Slopes less than twenty-five percent (25%) are designated as low risk;
2. Areas with a slope between twenty-five and fifty percent (25-50%) are designated as moderate risk; and
3. Slopes greater than fifty percent (50%) are designated as high risk.

For purposes of this plan, both moderate and high risk areas will be regulated for flood hazard management, due to the potential for run-off from these steep slopes. Moderate and high risk slopes can contribute to bank erosion by a sliding or slumping effect. As vegetation is cleared and/or soil is disturbed, the possibility of a slide or slump increases. For development activities located on moderate to high risk slopes, the applicant shall be responsible for demonstrating, to the county, that stormwater run-off will not increase from such development.

5.100 Septic Tanks

KCC 13.04.080 (e) prohibits the placement of septic systems in areas where surface water will accumulate and areas subject to flooding. 13.04.080 (f) prohibits the installation of septic systems in flood control zones.

5.110 Subdivisions (see section 4.040)

KCC 13.04.080 (e) and (f) limit the placement of septic tanks within designated floodplains. In addition, RCW 58.17.120 allows local governments to prohibit subdivisions within the regulatory floodplain. Because of these two statutes as well as the reoccurring flooding the county has received, it is in the best interest of public health, safety, and welfare to prohibit new subdivisions (short and long) within frequently flooded areas.

Section 6: Potential Impacts

6.010 Fish resources
6.020 Wildlife resources
6.030 Water quality
6.040 Hydrology
6.050 Existing and future recreation
6.060 Fishing
6.070 Hunting
6.080 River floats

6.010 Fish Resources

Section 5 of this plan discusses flood management alternatives for in-stream work and bank stabilization measures. Specifically, bank barbs, drop structures, riprap, and bank revegetating are discussed in this section. When placed correctly in locations approved by the Department of Fish and Wildlife, bank barbs can enhance fish habitat while protecting the bank from erosion. Drop structures can also provide fish habitat while protecting the bank from erosion.

6.020 Wildlife Resources

Section 5 of this plan discusses the importance of riparian corridors/areas. Not only are riparian areas important for flood damage reduction, but they also provide habitat for a wide variety of wildlife. KCC 17A, *Critical Areas*, protects riparian areas from encroachment by development. Through the implementation of this plan, as well as the continued enforcement of KCC 17A, riparian areas should continue to improve.

6.030 Water Quality

Because rock barbs, drop structures, and riprap can only be placed through direct consultation with the County Planning Department and the Department of Fish and Wildlife, long-term impacts to water quality should be negligible.

6.040 Hydrology

Through implementation of this plan, the hydrology of the basin should continue in its current state and potentially improve. All flood prevention measures will still require an HPA, when applicable, and will be reviewed by the county for conformance with other county, state, and federal regulations.

6.050 Existing and Future Recreation

There are numerous streams and rivers located within Kittitas County, which offer a number of recreational activities. These activities include, but are not limited to, fishing, hunting, and river floats.

6.060 Fishing

A number of streams and creeks provide great fishing potential for county residents and tourists. The News Tribune of Tacoma has rated a number of streams and rivers in the county, one (1) being poor and four (4) being excellent, for the quality of fishing. Table 6.1 shows the names of the water bodies, rating,

and species of fish. It should be noted that all of the water bodies listed below, are designated as shorelines of the state, per WAC 173-18-230.

Table 6.1
Fisheries Ratings

Water Body	Rating*	Species of Fish
Cle Elum River	2	Rainbow trout
Manastash Creek	2	Rainbow trout Cutthroat trout
Naneum Creek	2	Rainbow trout Cutthroat trout
Taneum Creek	2	Rainbow trout
Teanaway River	2	Rainbow trout
Yakima River	4	Rainbow trout

* cites News Tribune rating system

This plan, once implemented, should increase the fish habitat along the streams listed above, as well as other streams in the county. Flood protection measures will be designed to provide and/or enhance fish habitat.

6.070 Hunting

Large portions of Kittitas County, provide excellent hunting opportunities for area residents as well as out of area hunters. The Washington State Department of Fish and Wildlife has designated many Game Management Units (GMU's), used in conjunction with the deer season, within Kittitas County. In addition, a portion of both the Yakima and Colockum unit elk hunts are located in the county. Upland bird hunting is also a popular fall and winter recreational activity. Quail, chucker, and grouse populations seem to have increased over the past five to ten years, while pheasant populations are down. However, through local efforts, release programs have improved the pheasant populations in the county.

Once implemented, this plan may improve habitat for a wide variety of wildlife in Kittitas County. The riparian areas should improve in overall habitat value and provide wildlife with corridors for movement.

6.080 River floats

During the late spring, summer, and early fall months, the rivers in Kittitas County provide recreational opportunities in the form of river floats. Although all of the rivers are used for recreation, the Yakima River is the most popular and widely used river for such floats.

Section 7: Goals and Policies

7.010 Goals and Policies

7.010 Comprehensive Flood Hazard Management Plan Goals and Policies
The purpose of the goals and policies of this plan are to minimize the risk to human life and property, reduce public expenditure related to flooding, and to conserve the natural functions of streams within Kittitas County.

G-1 Avoid short term flood protection measures in favor of long term solutions and promote practices that will reduce public expenditures related to flooding.

P-1 Kittitas County shall continue to enforce Kittitas County Codes 14.08 (Flood Damage Prevention) and 17A (Critical Areas) and the Kittitas County Shoreline Master Program.

P-2 Kittitas County should implement appropriate means to remain eligible for involvement in the National Flood Insurance Program (NFIP) and the PI-99 program administered by the Army Corp of Engineers, and implement practices that are eligible for flood insurance premium reductions through the NFIP, Community Rating System.

G-2 Develop a system to educate the public on flood risks and mitigation measures for future flood damage.

P-3 Kittitas County should update and digitize existing FEMA Floodway and FIRM maps and integrate it with existing parcel information on the County Geographic Information System (GIS).

P-4 Kittitas County may develop and implement procedures for providing prospective buyers with flood risk information and require flood history information be placed on the real estate disclosure and on title reports.

P-5 Kittitas County should develop a county wide emergency response office that would, as part of its mission, deal with flood situations.

P-6 Kittitas County should conduct pre and post-flood event seminars for the residents within flood hazard areas.

P-7 Kittitas County should investigate appropriate means to inform county residents of potential natural hazard mitigation.

P-8 Kittitas County should develop and update a procedure to document flood flow history for frequently flooded areas.

P-9 Kittitas County should provide for the maintenance of pre-existing essential public facilities within the floodplain when legally and economically feasible.

P-10 Kittitas County should develop a scheme for establishing an early flood warning system in flood hazard areas.

G-3 Encourage the County to investigate Flood Control Districts, pursuant to RCW 86.15.

P-11 Kittitas County shall identify areas that may benefit from establishing Flood Control Districts.

G-4 Encourage development activities which serve the private property rights of an individual as well as being beneficial to habitat.

P-12 Kittitas County shall encourage development which serves the rights of private individuals as well as the environment.

P-13 Kittitas County shall discourage floodplain developments, which are incompatible with natural floodplain functions, put life or property at risk, or reduce flood storage.

P-14 Kittitas County should encourage development to avoid degradation of public trust resources (such as ground water, flood storage, surface water, wildlife, etc.) and maintain the existing ecological functions wherever possible.

G-5 Encourage the development of a basin wide model for flood hazard reduction.

P-15 Kittitas County should create and implement a model which establishes safe post-flood event flows below the Easton reservoir.

P-16 Kittitas County shall prevent or prohibit new development in hazardous areas or ensure that it is built in such a way that on-site, up-stream, and down-stream risks are minimized.

P-17 Kittitas County should adopt measures which hold the developer, contractor, or land owner accountable for damages to up and down-stream properties caused by unpermitted or improperly built structures and work within the regulatory floodplain.

P-18 Kittitas County shall, to the extent practical, eliminate the need for emergency measures by employing a combination of planning, structural, and non-structural flood hazard reduction measures.

P-19 Provide for the modeling of proposals in terms of effects on the affected river or stream corridors functions and values.

G-6 Minimize the environmental impacts of flood hazard management. Maintain and improve the health of the stream corridors in Kittitas County to support their natural functions, including: flood attenuation, fisheries and wildlife habitat support, water quality protection, and aquifer recharge. To the extent practical, maintain or restore the full range of hydrologic characteristics of the natural watershed.

P-20 Kittitas County shall encourage the appropriate agencies to repair or replace damaged and inaccurate gauging stations on the Yakima River.

P-21 Kittitas County shall continue to involve the appropriate local, state, and federal agencies on development proposals to ensure habitat preservation.

P-22 Kittitas County should require chronically flooded structures to be elevated to current local, state, and/or federal standards.

P-23 Kittitas County should provide for appropriate stormwater management by encouraging Best Management Practices.

P-24 Kittitas County should develop a plan to track and consider the cumulative effects of system wide floodplain management.

P-25 Encourage habitat friendly floodplain uses, as in open space community areas.

P-26 Encourage appropriate agencies to provide for improvement of recreational opportunities where consistent with flood hazard reduction and natural resource preservation goals.

P-27 Kittitas County should encourage the Bureau of Reclamation, Corps of Engineers, property owners, Dept. of Fish and Wildlife, the Yakama Indian Nation, and other appropriate agencies to work together to regulate the flows on the Yakima River during post-flood event periods at manageable levels.

P-28 Floodplain modifications will not be completed until an analysis has been done of short and long-term impacts to up-stream and down-stream areas, except those activities outlined in the Kittitas County Bio-engineering Standards (see Appendix C).

P-29 Flood profile modeling should be performed prior to implementing floodplain modifications, except those activities outlined in the Kittitas County Bio-engineering Standards (see Appendix C).

G-7 Identify and mitigate for factors that increase the destructive force of flood waters.

P-30 Kittitas County shall develop procedures, through direct consultation with the appropriate agencies, for removing unnecessary debris from a river or stream systems.

P-31 Kittitas County shall, where appropriate, encourage bank stabilization for protection of public and private property. Bank stabilization activities shall include, but not be limited to, bio-engineering techniques, and will only be allowed through direct consultation with the Department of Fish and Wildlife, Department of Ecology, and/or any other agency with knowledge in best management practices.

70232	Stevens Road - Johnson Creek	.03 South I-90	23	17	20	1968
70141	Stevens Road Culverts	3.32 from Parke Creek	14	17	20	1974
04281	Storie Lane - Little Creek	.07 South Nelson Siding	28	20	14	1984
87051	East Taneum Road - Taneum Creek	.43 East I-90	5	18	17	1957
06061	Teanaway Road - Teanaway River	7.09 North US-970	6	20	16	1960
99325	Thomas Road - Naneum Creek	.57 West Naneum Road	32	19	19	1955
87053	Thorp Cemetery Road - Taneum Creek	.49 Southeast West Taneum Road	5	18	17	1965
97341	Dudley Bridge	.82 Southeast SR-10	34	19	17	1936
88333	South Thorp Hwy - Yakima River	.30 Southwest I-90	33	18	18	1967
79291	Thrall Road - Cherry Creek	.05 East No. 6 Road	29	17	19	1969
78131	Tjossem Road - Wilson Creek	.08 East SR-503	13	17	18	1962
78111	Umptanum Road - Wilson Creek	.41 East I-90	11	17	18	1966
78102	Lower River Bridge	.37 West I-90	10	17	18	1955
05011	West Fork Teanaway Road - Middle Fork Teanaway River	.11 West Middle Fork Teanaway	1	20	15	1962
03031	Sparks Road - Kachess River	.85 West Sparks Road	3	20	13	1974

Table 8.2
Dike and Levees on PL-99 Program

Dike/Levee	Year Built
Schaake Dike	1960
Jeffries Dike	1948-52
Jensen Dike	Unknown
Klocke Dike	Unknown

3) Affected agencies should provide visual inspections of the dikes and levees twice yearly (late Fall and Late spring) to identify possible structural damage before the failure of the structure.