

# LAKE CHELAN



## Subbasin Plan

Prepared for the Northwest Power & Conservation Council

Draft

# Lake Chelan Subbasin Plan

5/28/2004

Prepared for the Northwest Power and  
Conservation Council

# **1 Introduction**

## **1.1 Contributors**

### **1.1.1 Lead Organization**

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### **1.1.6 Reviewers**

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## **1.2 Subbasin Plan Approach and Public Involvement**

### **1.2.1 Description of Board or Planning Unit**

The Upper Columbia Salmon Recovery Board (UCSRB) is made up of representatives from Chelan, Douglas and Okanogan counties, the Yakama Nation and the Colville Tribes that are working on regional fish and wildlife recovery efforts. The UCSRB has been involved with both subbasin summaries and subbasin plans and has provided oversight for these planning efforts. The UCSRB has a board of directors that meets monthly and a regional recovery staff that also meets monthly. The staff has been working directly on planning efforts with the board providing oversight of work products as they are developed. The board is relying on staff from the Chelan County PUD for detailed review of draft work products for the Lake Chelan subbasin.

### **1.2.2 Public Involvement**

Chelan County and the Washington State Department of Fish and Wildlife are relying heavily on the extensive public outreach efforts conducted by the Chelan County PUD during the Lake Chelan FERC alternative relicensing process for FERC No. 637. As the subbasin plan is based on information and studies from the relicensing process, the public is already familiar with this information. The alternative relicensing process engaged the public early on and included participation by property owners, private businesses, agriculture, tourism and recreation industries, resource agencies, environmental groups, government officials, Indian tribes and citizens of Chelan County. Public outreach conducted by the Chelan County PUD included newsletters, presentations, meetings and many working groups. The relicensing process began in 1998 in order to submit the final license application to FERC by June 2004.

Chelan County has been providing draft products to the Chelan County PUD relicensing team in order to assure thorough review of subbasin planning products as they are developed. The final subbasin plan will be reviewed by the relicensing team and will be distributed to the stakeholder list used for the relicensing efforts. In addition, the Northwest Power and Conservation Council will be conducting a six-week public review period which will be advertised locally by Chelan County.

### **1.2.3 Mission Statement**

The Lake Chelan subbasin plan is a model through which human and natural economies can begin to co-exist in more mutually inclusive ways than they have over the past 150 years. The plan acknowledges that as environmental integrity has been compromised, so have populations of salmon and other fish and wildlife species. In order to redress current situations, the plan focuses on understanding how human activities interact with the natural world, particularly the processes that sustain fish and wildlife.

A major goal of the subbasin plan is to restore conditions to a more natural state. Thus, the plan emphasizes ecosystem-based perspectives that consider multiple species, their life histories, and their inter-relationships. Finally, the plan considers the subbasin's position within the larger context of the Columbia River basin, particularly with regard to anadromous fish populations.

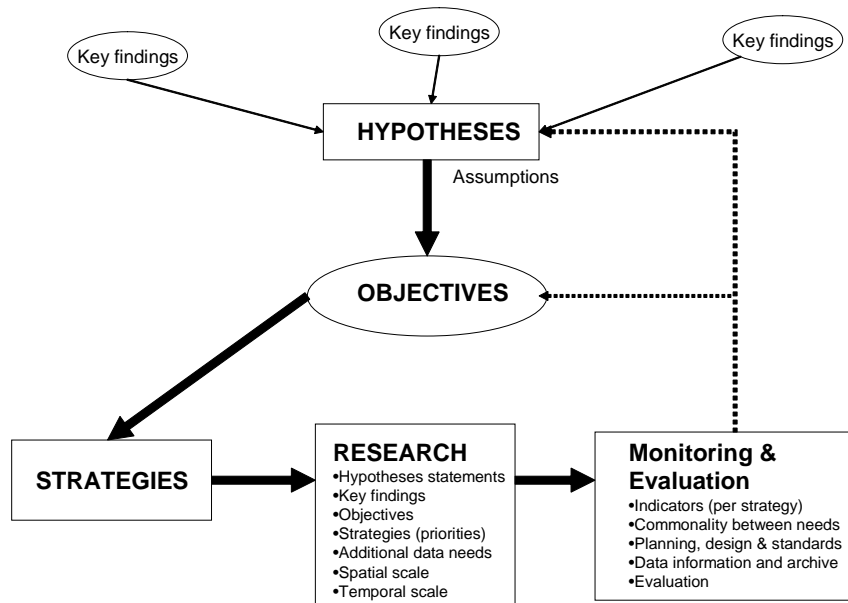
The Lake Chelan subbasin plan is focused on restoring and maintaining indigenous fish and wildlife populations and their ecosystems to support sustainable harvest, cultural values, and non-consumptive benefits through a local, state, tribal, and federal partnership. Management

decisions related to conclusions arrived at in the subbasin plan will be made in an open and cooperative coordinated process that respect different points of view and adhere to varied rights and statutory responsibilities.

### 1.2.4 Approach

Of primary interest to the Lake Chelan Subbasin Plan is the logic, or rationale that supports the recommendations of the Management Plan. The fundamental premise in the development of this Plan is to identify 1) what habitat conditions have been most effected by developments in the last 200 years, 2) how have important species responded to these changes, and 3) what can local resource managers and citizens can do to maintain and enhance these and other important terrestrial and aquatic populations and ecosystems (Figure 1).

**Figure 1.** Logic diagram



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## 2 Executive Summary

### 2.1.1 Purpose and Scope

The Lake Chelan Subbasin management plan – along with the supporting assessment and inventory -- is one of nearly 60 management plans currently being developed throughout the Columbia River Basin for the Northwest Power and Conservation Council (NPCC). This subbasin plan was crafted by the same team that is currently working on the Upper Middle Mainstem and Entiat subbasins, and thus shares many elements in common with those plans. The plans will be reviewed and adopted as part of the NPCC's Columbia River Basin Fish and Wildlife Program. Conclusions reached in the subbasin plans will help prioritize the spending of Bonneville Power Administration (BPA) funding for projects that protect, mitigate and enhance fish and wildlife that have been adversely impacted by the development and operation of the Columbia River hydropower system.

The primary goal of subbasin planning in the Columbia Basin is to respond to the Independent Scientific Group's Return to the River report to the NPCC. Notable conclusions from that report were:

“Our review constitutes the first independent scientific review of the Fish and Wildlife Program...”

“The Program's...lack of a process for prioritization provides little guidance for annual implementation...”

“We recommend incorporation of an integrated approach based on an overall, scientifically credible conceptual foundation...”

The NPCC responded to the ISG by creating the subbasin planning process, within the context of the 2000 Fish and Wildlife program. Subbasin plans provide the first basin-wide approach to developing locally informed fish and wildlife protection and restoration priorities.

Another important goal of the subbasin planning process is to bring people together in a collaborative setting to improve communication, reduce conflicts, address problems, and where ever possible, reach consensus on biological objectives and strategies that will improve coordinated natural resource management on private and public lands.

The plan could potentially have a significant effect on fish and wildlife resources in the subbasins and economic impact on the communities within the subbasins. For these reasons, public involvement is considered a critical component in the development of the subbasin plans.

An important objective of this subbasin plan is to identify management actions that promote compliance of the federal Endangered Species and the Clean Water acts. None of the recommended management strategies are intended nor envisioned to compromise or violate any federal, state or local laws or regulations. The intent of these management strategies is to provide local solutions that will enhance the intent and benefit of these laws and regulations. The NPCC, BPA, NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS) intend to use adopted subbasin plans to help meet requirements of the 2000 Federal Columbia River Power System Biological Opinion. NOAA Fisheries and the USFWS have stated their intent to use subbasin plans as a foundation for recovery planning for threatened and endangered species.

The Lake Chelan management plan's purposes include providing benefits to fish and wildlife where that help is most needed. The broad purposes of the plan and of the NPCC program mesh regarding fish and wildlife species.

From the Columbia River Basin Fish and Wildlife Program (NPPC 1994):

The development of the hydropower system in the Columbia River Basin has affected many species of wildlife as well as fish. Some floodplain and riparian habitats important to wildlife were inundated when reservoirs were filled. In some cases, fluctuating water levels caused by dam operations have created barren vegetation zones, which expose wildlife to increased predation. In addition to these reservoir-related effects, a number of other activities associated with hydroelectric development have altered land and stream areas in ways that affect wildlife. These activities include construction of roads and facilities, draining and filling of wetlands, stream channelization and shoreline riprapping (using large rocks or boulders to reduce erosion along streambanks). In some cases, the construction and maintenance of power transmission corridors altered vegetation, increased access to and harassment of wildlife, and increased erosion and sedimentation in the Columbia River and its tributaries.

The habitat that was lost because of the hydropower system was not just land, it was home to many different, interdependent species. In responding to the system's impacts, we should respect the importance of natural ecosystems and species diversity.”

Some species, such as some waterfowl species, have seemed to benefit from reservoirs and other hydropower development effects, but for many species, these initial population increases have not been sustained.

### **2.1.2 Subbasin Vision Statement**

The Vision Statement for the Lake Chelan Subbasin is largely based on the Chelan County Watershed Planning Association Goal Statements for water resources. These goals are based on a sustainable future for the landscape, the economy, and the people in the subbasin.

The vision for the landscape is to balance habitat conservation with human uses to ensure the long-term health of plant, fish, wildlife and human communities.

The vision for the economy is based on efficient management and use of natural resources including reliable water supplies, fish and wildlife populations, and aquatic and terrestrial habitats.

The vision for the people is to manage natural resources to promote social and economic well-being and to improve or maintain our quality of life. Stake holders and interest groups will work together to foster increased understanding of the importance of natural resource conservation.

### **2.1.3 Goals and Biological Objectives**

Biological objectives describe physical and biological changes within the subbasin needed to achieve the vision and address factors affecting focal habitats. Biological objectives for all ecoregion subbasins are habitat based and describe priority areas and environmental conditions needed to achieve functional focal habitat types. Where possible, biological objectives are empirically measurable and based on an explicit scientific rationale (the working hypothesis). Biological objectives are: consistent with subbasin-level visions and strategies, developed from a

group of potential objectives based on the subbasin assessment and resulting working hypotheses, realistic and attainable within the subbasin, consistent with legal rights and obligations of fish and wildlife agencies and tribes with jurisdiction over fish and wildlife in the subbasin. The biological objectives are agreed upon by co-managers in the subbasin and are complementary to programs of tribal, state and federal land or water quality management agencies in the subbasin. Finally, the subbasin plans have quantitative and have measurable outcomes where practical.

### **Shrubsteppe**

Goal: Provide sufficient quantity and quality shrubsteppe habitat to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing sagebrush-dominated shrub-steppe toward conditions 1, 2 and 3 identified in 3.1.7.2.3 (Inventory and Assessment).

- Determine the necessary amount, quality, and juxtaposition of shrubsteppe by the year 2008
- Identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010
- Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving agricultural practices, fire management, weed control, livestock grazing practices, and road management on existing shrubsteppe
- Determine population status of Brewer's sparrow by 2008
- Within the framework of the Brewer's sparrow population status determination, inventory other shrub-steppe obligate populations to test assumption of the umbrella species concept for conservation of other shrub-steppe obligates
- Maintain and enhance mule deer populations consistent with state/tribal herd management objectives

### **Ponderosa Pine**

Goal: Provide sufficient quantity and quality ponderosa pine habitats to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing ponderosa pine toward conditions 1a, 1b, 2 and 3 identified in 3.1.7.1.3 (Inventory and Assessment).

- Determine the necessary amount, quality, and juxtaposition of ponderosa pine habitats by the year 2008
- Provide biological and social conservation measures to sustain focal species populations and habitats by 2010
- Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silvicultural practices, fire management, weed control, livestock grazing practices, and road management in existing and restored ponderosa pine habitat
- Determine population status of white-headed woodpecker, flammulated owl, and pygmy nuthatch by 2008

- Within the framework of the focal species population status determinations, inventory other ponderosa pine obligate populations to test assumption of the umbrella species concept for conservation of other ponderosa pine obligates

### **Riparian Wetlands**

Goal: Provide sufficient quantity and quality riparian wetlands to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing riparian wetland habitats toward conditions 1a, 1b, and 2 identified in 3.1.7.3.3 (Inventory and Assessment).

- Determine the necessary amount, quality, and connectivity of riparian wetlands by the year 2008.
- Provide biological and social conservation measures to sustain focal species populations and habitats by 2010.
- Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture, agricultural practices, fire management, weed control, livestock grazing practices, and road construction and maintenance on and adjacent to existing riparian wetlands.
- Determine population status of beaver and red-eyed vireo chat by 2008.
- Within the framework of the focal species population status determinations, inventory other riparian wetlands obligate populations to test assumption of the umbrella species concept for conservation of other riparian wetlands obligates.
- Maintain and enhance beaver populations where appropriate and consistent with state/tribal management objectives.

### **Westslope Cutthroat Trout**

- Make historic spawning grounds available to westslope cutthroat trout (WSCT) earlier by removal of tributary barriers or lake level management by 2008 (assuming new license is issued to Chelan PUD)
- Eliminate the introductions of non-native species that have negative impacts on WSCT by 2010
- Decrease the abundance or remove key exogenous species by 2015
- Reduce direct harvest impacts on naturally produced WSCT by 2010

### **Bull Trout**

- Determine if bull trout exist in the basin by 2008
- If bull trout are found, attain self sustaining non-migratory populations of bull trout (if feasible) by 2025
- Reduce abundance of exogenous stocks that may hinder reintroduction by 2010

- Ensure historic habitat remains in tact by 2008

### **Kokanee**

- Reduce negative interactions with mysids by 2015
- Increase juvenile survival and increase abundance of adults in lake by 2010
- Ensure self-sustaining populations by 2015

## **2.1.4 Synopsis of Major Findings and Conclusions**

The assessment and management plan identify strategies that benefit focal wildlife species that inhabit the subbasin's terrain and focal fish species that utilize Lake Chelan and its tributaries. Seven wildlife species were chosen as focal species to represent three focal habitat types within the Lake Chelan Subbasin: Shrubsteppe- mule deer and Brewer's sparrow; Ponderosa Pine – pygmy nuthatch, white-headed woodpecker and flammulated owl; and Riparian Wetlands - American beaver and red-eyed vireo. Focal species' current viability was evaluated and biological objectives and strategies devised, based on the condition, availability, and potential for restoration of focal habitat types on which these species depend.

### **Terrestrial**

Numerous strategies identified during the subbasin planning process and outlined in the management plan attempt to contribute beneficially to several limiting factors in the Lake Chelan Subbasin. A general theme identified across the subbasin is a reduction in the quantity and quality of all types of wildlife habitat that focal and other species need to flourish. Among the causes of the diminution and fragmentation of shrubsteppe habitat are grazing, invasion of exotic plant species, fire management regimes and wildfires, and human disturbance. The invasion of crested wheatgrass and other introduced plant species and the loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe/grassland communities, has reduced shrubsteppe habitat quality and/or availability.

Ponderosa pine habitat has been degraded or lost due to timber harvest, fire reduction (and subsequent intensive wildfires), mixed forest encroachment, overgrazing, invasion of exotic plants, fragmentation, and development. Timber harvesting has reduced the amount of old growth forest and associated large diameter trees and snags, while invasion by exotic plants and fire reduction has altered understory conditions and increased fuel loads. Loss of habitat and habitat diversity/function has resulted in extirpation or reduction of ponderosa pine obligate species and these species are at increased risk of parasitism, competition with non-native species, predation by domestic animals (i.e. cats), and high levels of human disturbance.

Riparian wetland habitat has also been affected by livestock overgrazing and invasion of exotic vegetation. Grazing can widen channels, raise water temperature, and reduce understory cover. Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and be subject to high levels of human disturbance.

## **Aquatic**

Westslope cutthroat trout currently appear to be reduced from historic abundance. Factors limiting the productivity of WSCT are related primarily to overharvest in the 19th century, historic and current hatchery practices, introduction of exogenous species, and barriers at the mouth of most of the spawning streams (excluding First, Twenty-five Mile Creek and the Stehekin River) to Lake Chelan. Spawning and rearing competition occurs with native bridgelip suckers and introduced rainbow trout and brook trout. Rainbow trout may also breed with WSCT, affecting genetic integrity. Predation by chinook salmon and lake trout may decrease spawner recruits.

Bull trout have not been documented within the Chelan Basin since the 1950s. It is not clear why they may be extinct, but potential reasons are: over harvest, loss of spawning grounds due to high floods in 1948 and 1949; or a catastrophic disease outbreak, or a combination of above factors.

Current spawning and rearing areas within the Stehekin, and other tributaries (except Railroad Creek) are functioning near pristine levels. However, re-introduction of bull trout may be inhibited by native kokanee and introduced rainbow trout, lake trout, and brook trout through competition during rearing, foraging, or spawning phases. Redd imposition by kokanee may decrease the viability of bull trout eggs and brook trout are also known to reduce genetic integrity of bull trout when they interbreed (and are sterile).

Kokanee were introduced in 1917 and have provided a large recreational fishery ever since. Kokanee populations have been volatile, which could be related to predator abundance, competition with native and exotic species for forage, and general lake productivity. Predation by lake trout and Chinook salmon significantly reduces the number of spawners in a given year, and competition with mysids, juvenile WSCT and Chinook salmon, and other native species may limit production of kokanee. Spawning habitat is not limiting.

### **2.1.5 Summary of Restoration and Conservation Measures**

#### **Terrestrial**

Habitat quantity and quality can be improved by emphasizing conservation, protection, and connectivity of large blocks of high quality focal habitat. Strategies to achieve this goal include promoting local planning and zoning, utilizing governmental plans and programs, implementing habitat stewardship projects with private landowners, and protecting lands through acquisition, conservation easements, and cooperative agreements. The plan also promotes the development and implementation of fire management protocols (protection and prescribed burning), and weed control and road management plans.

Two strategies directed specifically at wildlife focal species pertain to all wildlife focal species within the subbasin, while other strategies are directed at individual focal species. Survey protocol will be selected and abundance, diversity, and richness of focal species will be measured. In addition, methodology, alternative to IBIS or GAP, will be selected and implemented to accurately characterize focal habitats in the Lake Chelan subbasin.

Both the fish and wildlife portions of this management plan provide strategies to protect and restore beaver habitat and, where possible, to prepare for reintroduction into suitable habitat where natural recolonization may not occur. The restored habitat would benefit beaver, whose



activities would in turn benefit the salmon and steelhead that use the watershed for a portion of their life history. Natural and reintroduced beaver populations would be protected through state harvest restrictions. The plan also provides for the maintenance of mule deer populations and ensures their habitat needs are met.

### **Aquatic**

Populations of WSCT can be increased by reducing direct harvest impacts and eliminating introductions of, and/or removing, non-native species. Subbasin planners encourage the production of a comprehensive fish stocking plan that considers all impacts to all species from introduced fish, and will determine the types of fish introduced, best release locations, and timing. Harvest limits on brook trout and rainbow trout should also be removed and harvest rates on Chinook salmon and lake trout increased to reduce competition and enhance spawning and productivity of WSCT. Further, fishing near tributary mouths should be delayed until after the spawning season to avoid taking WSCT that are either staging for spawning, or returning to Lake Chelan following spawning. Reducing direct harvest on vulnerable adults will increase the number of adult fish surviving, and since WSCT are iteroparous, more adults surviving after spawning means more adults will spawn again, thus increasing productivity.

All life histories of bull trout can be successfully reintroduced into the Chelan Basin, but because of established species assemblages, founding adfluvial forms of bull trout is not possible. First, it must be determined if bull trout exist in the basin by exploring likely places that may hold reserves of non-migratory bull trout. If bull trout are found, self sustaining non-migratory populations of bull trout need to be attained. If not found, a pilot reintroduction program for non-migratory populations should be developed.

Introduction of bull trout will depend on available broodstock, feasibility of using hatcheries, and whether there is a high likelihood that they can maintain a self-sustaining population. Restoration measures should also reduce abundance of exogenous stocks that may hinder reintroduction, ensure historic habitat remains in tact, determine predator-prey relationships in Lake Chelan and potential interactions with established populations, increase harvest on Chinook salmon and lake trout, remove harvest limit on brook trout, preserve (or restore) geo-fluvial processes in all tributaries, and reintroduce bull trout into historic habitat, if feasible.

A number of actions can be taken to increase the abundance and productivity of Kokanee: Increase harvest on Chinook salmon and lake trout, reduce the abundance of, and negative interactions with, mysids; develop planting schedule of hatchery fish that meets native fish production goals and ensures satisfactory harvest rate. Implementing these actions will help increase juvenile survival and abundance of adults and ensure self-sustaining populations.

#### **2.1.6 Summary of Monitoring and Evaluation Needs**

There is significant need for ongoing monitoring and evaluation within the Lake Chelan watershed. Although there is a high level of certainty with several key findings and strategies, without concerted monitoring and evaluation there is a margin of uncertainty that the best strategies will achieve the most benefit possible. Therefore, along with the actions suggested in the management plan, an extensive monitoring and evaluation effort within Lake Chelan is considered a high priority.

## **3 Subbasin Overview**

### **3.1.1 Introduction**

The Subbasin Overview has two main sections. The first, Subbasin in Regional Context, describes the Lake Chelan subbasin and its place within the Columbia Cascade Province or eco-region as defined by the Northwest Power and Conservation Council (NPCC). The second, the Subbasin Description, summarizes the Lake Chelan subbasin's geological, climatic, biological, and hydrological characteristics; gives an overview of its fish and wildlife resources; and describes the human population and activities that occur in the subbasin.

### **3.2 Subbasin in Regional Context**

For planning purposes, the Northwest Power and Conservation Council divided the Columbia River Basin south of the Canadian border and its more than 50 subbasins into 11 eco-regions. NPCC is responsible for implementing the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P.L. 96-501) and the Fish and Wildlife Program mandated by the Act.

The 11 provinces, beginning at the mouth of the Columbia River and moving inland, are: Columbia Estuary; Lower Columbia; Columbia Gorge; Columbia Plateau; Columbia Cascade; Inter-Mountain; Mountain Columbia; Blue Mountain; Mountain Snake; Middle Snake; Upper Snake. These 11 eco-regions include the entire Columbia River basin in the United States, and together cover approximately 25,000 sq. mi. in Washington, Oregon, Idaho and Montana.

Each of the 11 provinces will develop its own vision, biological objectives, and strategies consistent with those adopted at the subbasin level. NPCC's intent is to adopt these elements into the 2000 Fish and Wildlife Program during later rulemaking. The biological objectives at the province scale will then guide development of the program at the subbasin scale.

The provinces are made up of adjoining groups of ecologically related subbasins, each province distinguished by similar geology, hydrology, and climate. Because physical patterns relate to biological population patterns, fish and wildlife populations within a province are also likely to share life history and other characteristics (NPCC 2000). The Lake Chelan basin or subbasin is in the Columbia Cascade Province.

#### **3.2.1 Columbia Cascade Province**

The Columbia Cascade Province is the fourth smallest of the ecological provinces and covers an area of approximately 9,407 sq. mi. It is defined as the Columbia River and all tributaries downstream from, but not including, Chief Joseph Dam to Wanapum Dam. This area includes much of north-central Washington. The province is divided into six subbasins: Chelan, Okanogan, Methow, Lake Entiat, Wenatchee, and Columbia Upper Middle Mainstem (CBFWA 2004).

The Cascade Mountains form the western border of the province, and the U.S./Canada border forms the northern edge. The northeastern corner of the province passes through the Okanogan National Forest and the Colville Indian Reservation, while the southeastern boundary is bordered by Banks Lake, Lake Lenore State Wildlife Recreation area, and the towns of Ephrata and Quincy. Wanapum Dam lies at the southern tip of the province.

The province overlies two significantly different physiographic regions and topography varies widely (10,000 ft. at Glacier Peak to 600 ft. at the Columbia River). The Cascade Mountains, to the north and west, consists primarily of metamorphosed sedimentary, volcanic and granitic rock, while the Columbia Plateau, to the east and south, features vast thick layers of basaltic bedrock. Temperatures and precipitation vary widely, usually depending on elevation, with cooler and wetter climates in the mountainous areas in the western and northern sections of the Province, and arid to semi-arid climates in the eastern and southern portions of the Province. The uppermost elevations along the Columbia Crest support subalpine fir communities, which in turn give way at the highest elevations to subalpine and alpine meadow grasses and forb species. Increased moisture in the basin's mid-elevations support a transition from the dominant ponderosa pine forests along the subbasin's lower slopes and valleys to Douglas-fir communities, while lower elevations are characterized by a more arid continental climate and shrubsteppe and steppe plant communities (shrubs, perennial bunch grasses, lichens, and mosses). High water table or seasonal flooding conditions found near/along lakes, streams and rivers support development of deciduous riparian communities.

The Confederated Tribes of the Colville Reservation, a federally recognized tribe, is located on 1.4 million acres in north central Washington in the Columbia Cascade Province. Many of the names of Colville's 12 aboriginal tribes indicate the geographic range and interest of today's Colville confederation. They include the Nespelem, the San Poil, the Lake, the Palus, the Wenatchi (Wenatchee), the Chelan, the Entiat, the Methow, the southern Okanogan, the Moses Columbia, and others.

Federal lands, including the Okanogan and Wenatchee National Forests make up most of the Western section and small portions of the northeastern section of the province (**Table 3**). The western one-third (341,051 acres) of the Colville Indian Reservation is also located within the Province (southeast portion of the Okanogan subbasin) and much of remaining Province lands are in private ownership. The western portion of the Province is predominately coniferous forest, while the eastern portion is comprised primarily of agricultural lands and Shrubsteppe / Steppe habitat (**Table 5**).

The Columbia Cascade is an important agricultural and grazing area and also encompasses several urban areas. Orchards and small areas of irrigated cropland are found along the Columbia River corridor between Chief Joseph and Rock Island dams. Most of the south-eastern portion of the Province (Columbia Upper Middle subbasin) is a sandy plateau where dryland farming and rangelands are the dominant agricultural practices. The area within much of Grant County is part of the Columbia Reclamation Irrigation Project and has extensive irrigated agriculture. Significant urban centers within the Province include Wenatchee, East Wenatchee, Entiat, Chelan, Pateros, Brewster, Winthrop, Leavenworth, Cashmere, Waterville, Bridgeport, and Okanogan/Omak, Washington. The western one-third (341,051 acres) of the Colville Indian Reservation is also located within the Province (southeast portion of the Okanogan subbasin).

The Columbia Cascade is also a significant source of hydroelectric power. Three major Columbia River dams are located within the Province: Rock Island Dam downstream and Rocky Reach Dam upstream of the Wenatchee-Columbia confluence, and Wells Dam downstream of the Methow-Columbia confluence. The Chief Joseph dam lies on the Columbia River, just outside the Province, east of Bridgeport, WA. Six more dams lie downstream of the Province on the mainstem Columbia which must be traversed by anadromous fish migrating to and from the

province's subbasins: Wanapum, Priest Rapids, McNary, John Day, The Dalles, and Bonneville dams.

### **3.2.2 Terrestrial / Wildlife Relationships**

The mule deer Chelan PMU (Population Management Unit) is located within this subbasin.

### **3.2.3 Aquatic / Fish Relationships**

No hatcheries or rearing ponds are located in the Lake Chelan subbasin. Hatcheries are located, however, in all of the other subbasins within the Columbia Cascade Ecoprovince to address natural production of salmon and steelhead and to mitigate for fish and wildlife lost due to hydroelectric and irrigation development throughout the Columbia River Basin (CBFWA 2004).

Three federally listed threatened and endangered fish species are known to occur in the Project area. These are the upper Columbia River bull trout (listed as threatened by the USFWS), and the upper Columbia River summer steelhead and spring chinook (listed as endangered by the NMFS).

#### **Spring Chinook within the ESU**

The Upper Columbia River Spring Chinook were listed as an endangered species on March 24, 1999 and critical habitat for the ESU was designated on February 16, 2000. The listed ESU includes all naturally spawned populations of spring Chinook in accessible reaches of Columbia River tributaries between Rock Island and Chief Joseph dams, excluding the Okanogan River. Critical habitat covers this same geographic area. Several hatchery populations from the Methow and Wenatchee rivers were included in the listed ESU (Fisher and Talayco 2002).

Adult spring chinook salmon are not currently known to use the Okanogan River. The temperature regime, at the time spring chinook salmon spawn in the mainstem Okanogan River, is too high for successful spawning and rearing due to irrigation water withdrawals (K. Williams and J. Spotts, personal communication). In addition, spring chinook adults are collected as they migrate upstream at Wells Dam on the Columbia River, approximately 20 miles downstream of the confluence of the Okanogan River, and are transported to the Winthrop National Hatchery in Winthrop, Washington (U.S. Federal Register 1999)

#### **Steelhead within the ESU**

Upper Columbia River Steelhead was listed as an endangered species on August 18, 1977, and critical habitat for the ESU was designated on February 16, 2000. The ESU includes all naturally-spawned populations of steelhead in tributaries of the Columbia River between the Yakima River and Chief Joseph Dam. The Wells Hatchery stock steelhead were included in the listed ESU because they are considered essential for the recovery of the natural population. Critical habitat includes the same geographic area (Fisher and Talayco 2002).

This ESU has been greatly homogenized by the widespread planting of the Wells hatchery stock and concurrent poor survival of natural-origin fish. Each year approximately 100,000 Wells stock steelhead yearlings are outplanted into the Okanogan River and its tributaries, Omak and Salmon creeks, and the Similkameen River. This is an integrated recovery program designed to help recover endangered Upper Columbia River Steelhead (Fisher and Talayco 2002).

## **Bull Trout within the DPS**

The 'distinct population segment' (DPS) for bull trout, incorporating the entire Columbia (i.e., upper and lower), was listed as threatened on June 20, 1999. An assessment of bull trout stock status on a watershed basis is currently under preparation, however, no such a

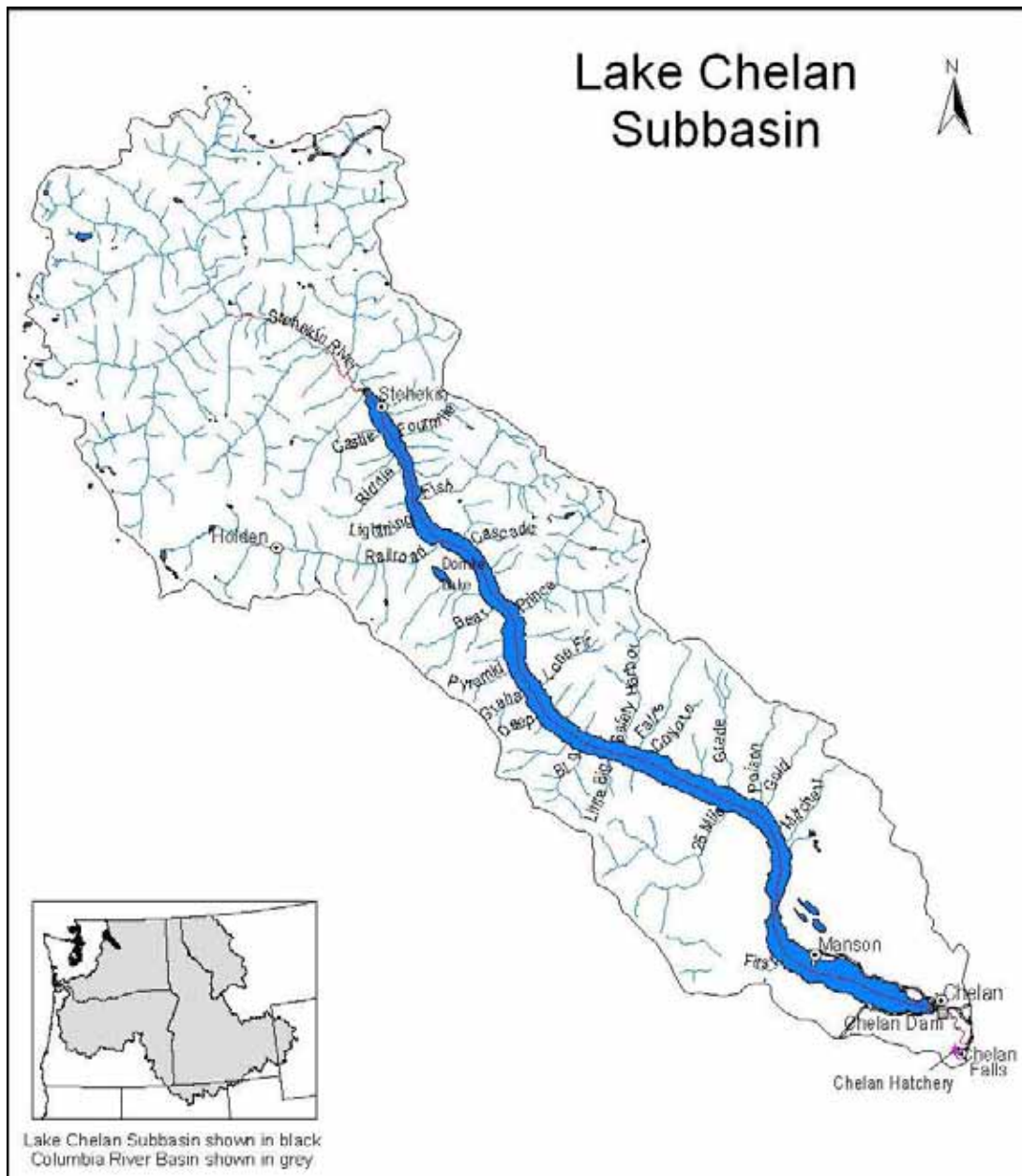
### **3.3 Subbasin Description**

#### **Introduction**

The Lake Chelan subbasin is located in north central Washington and lies entirely within Chelan County. The subbasin comprises 6.5% of the Columbia Cascade Province and consists of 599,905 acres (937 sq. mi.).

The upper portion of the Chelan subbasin is within the North Cascades National Park and the Lake Chelan National Recreation Area. The middle part of the basin is in the Wenatchee National Forest. Most of the lower basin, which contains the majority of the development, is privately owned (Beck 1991). Lake Chelan, which comprises approximately 50.4 miles of the 75-mile-long basin, is the third deepest freshwater lake in the nation (FERC 2002) and the largest and deepest natural lake in Washington. The subbasin lies within an elongated, steeply sloped fjord basin formed by two glaciers. The Lake has an average width of 1.5 miles, a maximum depth of 1,486 feet, and it drains 2,393 sq. km (Beck 1991). It is bordered on the north by the Sawtooth Mountains and on the south by the Entiat and Chelan Mountains and the Glacier Peak Complex. Water from Lake Chelan flows from its southern end into the shortest river in Washington, the 4.1-mile-long Chelan River. This river falls 400 feet in its descent through a steep, rocky gorge to the Columbia River (FERC 2002).

**Figure 2.** Lake Chelan subbasin



### 3.3.1 Topographic/Physio-geographic Environment

#### Geology/Topography

The Lake Chelan basin is located between two significantly different physiographic provinces in north-central Washington. The Cascade Mountains, to the west, consist primarily of metamorphosed sedimentary, volcanic and granitic rock, and the Columbia Plateau, to the east, features vast thick layers of basaltic bedrock. Topographic elevations in the project vicinity range from over 9,000 feet above sea level at the crest of the Cascade Mountains to 700 feet on the Columbia River (FERC 2001). From Twentyfive Mile Creek uplake, the terrain is mountainous and rugged with glacial features such as cirques, truncated spurs, moraines, horns, and U-shaped valleys. In many cases, the steep slopes run directly into Lake Chelan with no flat beaches or

shoreline. The terrain of the lower end of the lake is much less severe, mainly arid or semi-arid, and soils consist of alluvial deposits and glacial drift (Beck 1991, FERC 2002).

Lake Chelan and its immediate surroundings are the result of the complex interaction between two glacial masses. The lake was formed approximately 18,000 years ago during the Wisconsin glacial period. During this time, the Chelan Glacier moved down the valley from the north and the Okanogan-Columbia Valley lobe of the Cordilleran ice sheet extended upward from the south. The two glaciers approached each other and nearly met at Wapato Point and at a constriction known as “The Narrows” (a shallow sill 135 feet below the surface of the lake at its narrowest part). The approach and recession of these two glaciers caused erosion in the mid and upper portion of the lake, and geologic moraine deposits at the lower end of the lake. Together these effects created Lake Chelan (Kendra and Singleton 1987, and Hillman and Giorgi 1999 in Viola and Foster 2000). The lake now consists of two basins: the Lucerne basin, which is deep and fjord-like and extends north from The Narrows for 38 miles; and the Wapato basin, which is relatively wide and shallow in comparison (max. depth of 400 feet) and extends for 12 miles south of The Narrows (Hillman and Giorgi 1999 in Viola and Foster 2000).

### **Climate**

The climate of the area is semi-arid and is characterized by hot, dry summers and mild to severe winters. The average summer maximum temperature for July is 86.4°F, and the average winter maximum is 19.8° F (Beck 1991). Precipitation and temperature vary widely depending on the elevation and proximity to the Cascade Crest. Winds typically are funneled down the lake valley in an easterly direction towards the Columbia River basin, where warm air masses are rising. This pattern causes increased wind speeds in the evenings, especially on the north shore of Lake Chelan (USFS 1998).

Average annual precipitation in the area ranges from a high of 150 inches near the crest of the Cascade Mountains to a low of 11 inches in the City of Chelan, near the Columbia River (Beck 1991). Total annual precipitation at Stehekin at the head of the lake averages 35 inches, the majority of which is snowfall from November through March (FERC, 2001).

### **Vegetation**

The Lake Chelan Basin includes a diversity of life zones and plant and animal species. The upper two-thirds of the basin is mixed coniferous forest. The lower third is characterized by ponderosa pine, shrubsteppe (sage/bitter brush), and grassland plant communities. Within the lower basin, species typical of the Northern Cascades tend to prevail along tributaries on north-facing slopes, whereas Columbia Basin species generally dominate the south-facing slopes. The relatively mesic and sheltered conditions within riparian habitats obscure these vegetative differences (FERC 2002).

The basin is characterized by six primary vegetation zones: Ponderosa Pine (*Pinus ponderosa*), Douglas Fir *Pseudotsuga menziesii*, Grand Fir *Abies grandis*, Lodgepole Pine *Pinus contorta*, Subalpine Fir *Abies lasiocarpa*, and big sagebrush/bluebunch wheatgrass *Artemisia tridentata/Agropyron spicatum* (Franklin and Dyrness, 1973). The Douglas fir zone dominates most of the project area, extending from lakeshore to about the 4,000 foot elevation, where it blends into the grand fir and subalpine forest zones. The Douglas fir zone occurs along the upper 3/4 of the lake and along the Stehekin Valley. The major tree species in the zone are Douglas fir,

ponderosa pine, lodgepole pine, and larch. Any of these four tree species may dominate forest stands in the Douglas fir zone. Snowberry, spirea, and rose are dominant shrubs in the Douglas fir zone understory, and bluebunch wheatgrass and fescue are dominant grasses.

The southeastern portion of Lake Chelan is bordered by a mixture of ponderosa pine and steppe zones with agricultural crops intermingled. The ponderosa pine zone typically lies between the higher Douglas fir zone and the lower steppe zone. The ponderosa pine zone has a short growing season, minimal summer precipitation, summers with hot days and cool nights, and low winter temperatures, resulting in heavy snow accumulations. Within the Lake Chelan area, this zone is vegetated by ponderosa pine, Douglas fir, and in riparian bottoms, aspen and cottonwood. Common shrubs include bitterbrush, sagebrush, rose, ceanothus, and serviceberry. Dominant forbs and grasses are arrowleaf balsamroot, eriogonum, bluebunch wheatgrass, needle and thread, and recently, cheatgrass (Chelan PUD 1998).

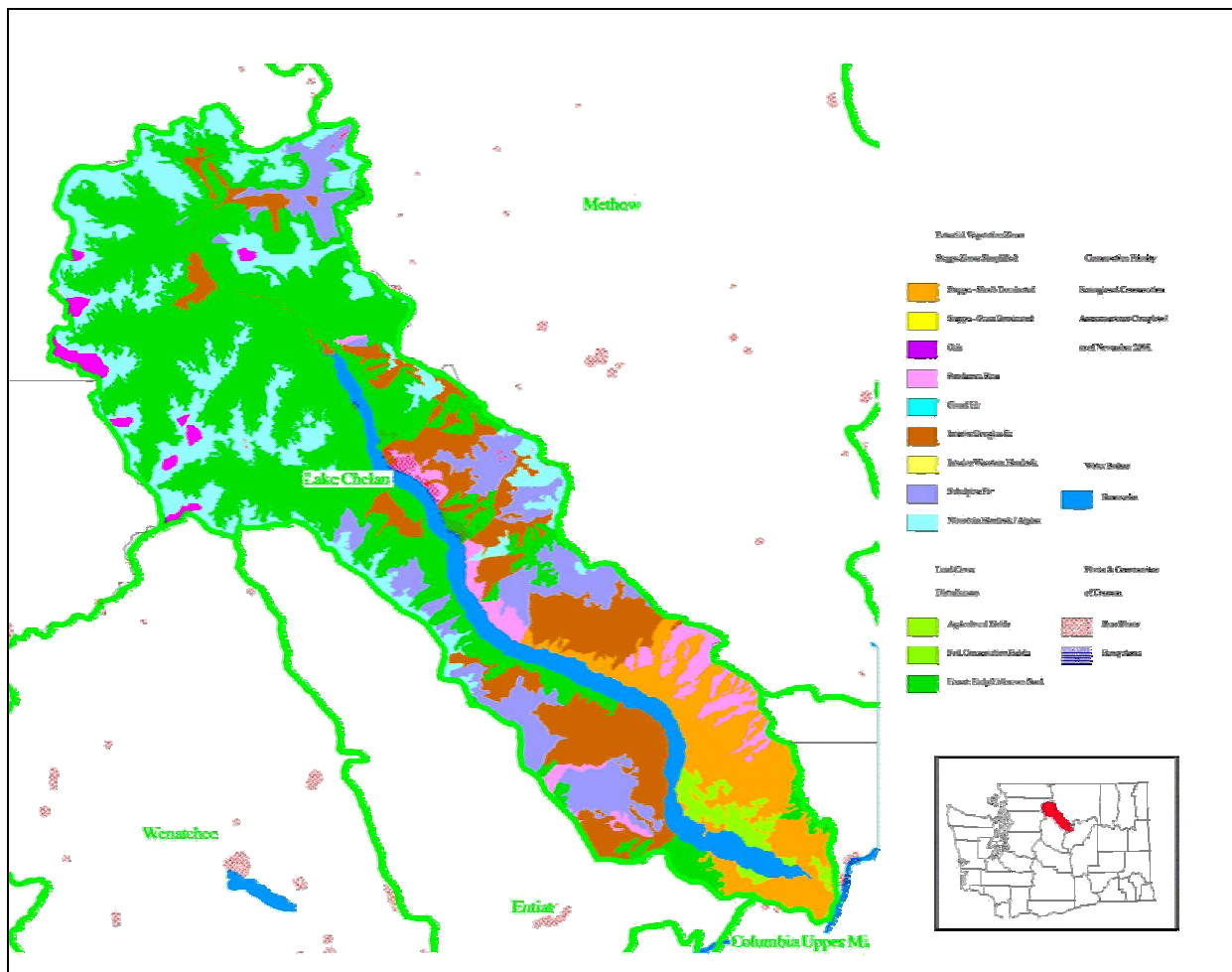
The steppe zone, at the foot of Lake Chelan to the Columbia River, is occupied by the *Artemisia tridentata/Agropyron spicatum* (big sagebrush/bluebunch wheatgrass) association. This association is generally composed of four vegetation layers: 1) shrub layer of principally big sagebrush, bitterbrush, and rabbitbrush, 2) a layer of perennial grasses dominated by bluebunch wheatgrass, 3) a layer of low growing grasses such as Sandberg bluegrass and cheatgrass, and 4) a surface crust of crustose lichens and mosses (Chelan PUD 1998).

The climate of the upper portion of Lake Chelan has a strong maritime influence, which has created a greater diversity of species, many of which are more characteristic of the western Cascades (Taylor, 1985).

Changes in biodiversity have been closely associated with changes in land use. Grazing, agriculture, and accidents have introduced a variety of exotic plants, many of which are vigorous enough to earn the title "noxious weed." Twenty-six species of noxious weeds occur in the Lake Chelan subbasin (**Table 1**). The Lake Chelan subbasin contains 22 rare plant communities. Table XX) Doc does not like Rare Plant Table; currently in separate file. [I'm assuming we've either got this some where or are not using it. Approximately 32% of the rare plant communities are associated with shrubsteppe habitat, and 68% with upland forest habitat. Rare/high-quality plant occurrences and communities are illustrated in **Figure 3**.



**Figure 3.** GAP Lake Chelan subbasin vegetation zones, including rare plants



Source: Cassidy 1997

**Table 1.** Noxious weeds in the Lake Chelan subbasin and their origin

<b>Common Name</b>	<b>Scientific Name</b>	<b>Origin</b>
Feld bindweed	<i>Convolvulus arvensis</i>	Eurasia
Scotchbroom	<i>Cytisus scoparius</i>	Europe
Buffalobur nightshade	<i>Solanum rostratum</i>	Native to the Great Plains of the U.S
Pepperweed whitetop	<i>Cardaria draba</i>	Europe
Common crupina	<i>Crupina vulgaris</i>	Eastern Mediterranean region
Jointed goatgrass	<i>Aegilops cylindrica</i>	Southern Europe and western Asia
Meadow hawkweed	<i>Hieracium caespitosum</i>	Europe
Orange hawkweed	<i>Hieracium aurantiacum</i>	Europe
Poison hemlock	<i>Conium maculatum</i>	Europe
Johnsongrass	<i>Sorghum halepense</i>	Mediterranean
White knapweed	<i>Centaurea diffusa</i>	Eurasia
Russian knapweed	<i>Acroptilon repens</i>	Southern Russia and Asia
Spotted knapweed	<i>Centaurea biebersteinii</i>	Europe
Purple loosestrife	<i>Lythrum salicaria</i>	Europe
Mat nardusgrass	<i>Nardus stricta</i>	Eastern Europe
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>	Central United States
Puncturevine	<i>Tribulus terrestris</i>	Europe
Tansy ragwort	<i>Senecio jacobaea</i>	Eurasia
Rush skeletonweed	<i>Chondrilla juncea</i>	Eurasia
Wolf's milk	<i>Euphorbia esula</i>	Eurasia
Yellow star thistle	<i>Centaurea solstitialis</i>	Mediterranean and Asia
Canadian thistle	<i>Cirsium arvense</i>	Eurasia
Musk thistle	<i>Carduus nutans</i>	Eurasia
Scotch cottonthistle	<i>Onopordum acanthium</i>	Europe
Dalmatian toadflax	<i>Linaria dalmatica</i>	Mediterranean
Yellow toadflax	<i>Linaria vulgaris</i>	Europe

Source: Callihan and Miller 1994

A rare plant survey of the Lake Chelan Hydroelectric Project area (Chelan PUD, 2000c), based on 1998-1999 fieldwork (**Table 2**), showed no federally listed plant species, but identified 14

populations of five rare plant species within the Project area and a total of 452 plant taxa (Alverson and Arnett 1986, Taylor 1985, Chelan PUD, 2000c).

**Table 2.** Rare plant populations for Lake Chelan Hydroelectric Project

Common Name	Scientific Name	Status		Number of Populations
		WA	USFS	
Giant helleborine	<i>Epipactis gigantea</i>	S		1
Common bluecup	<i>Githopsis specularioides</i>	S		4
Sierra cliffbrake	<i>Pellaea brachyptera</i>	S	S	2
Seely's silene	<i>Silene seelyi</i>	T	S	1
Western ladies-tresses	<i>Spiranthes porrifolia</i>	S	S	6
Total number of populations within the Lake Chelan Hydroelectric Project Area				14
T = Threatened, S = Sensitive				

Source: Chelan PUD, 2000c

In addition to the Washington Natural Heritage Program (WNHP) state-listed rare plant species, two other species of interest were also found within the Lake Chelan Hydroelectric Project area and one species listed as threatened by the USFWS, Ute ladies-tresses (*Spiranthes diluvialis*), has been documented as potentially occurring in the Project area. *Pectocarya pusilla*, a small native annual in the borage family, was found in the Prince Creek area. This species is only known in Washington from a few collections in Klickitat County. The north shore also supports a population of unusually large shrubs in the manzanita genus. The USGS Biological Resources Division believes that these plants are *Arctostaphylos patula*, which is not widely distributed in Washington. Potential habitat for Ute ladies-tresses exists in the Lake Chelan Hydroelectric Project area; however, no populations were recorded during the rare plant survey (Chelan PUD, 2000c).

### Soils

Throughout much of the subbasin, the soils consist of alluvial deposits and glacial drift. Volcanic pumice and ash from the Glacier Peak region are also present in many areas and deposits are relatively deep on north-facing slopes, whereas erosion has removed much of this material from south-facing slopes (Beck 1991, USFS 1998). The mountainous terrain consists mainly of large rock outcroppings and shallow soils (Beck 1991). Shoreline slopes are relatively steep and rocky, with most of the shoreline characterized by bedrock outcrops or glacial till. The glacial till

materials are variable in texture and source but generally consist of gravel and cobbles in a matrix of silty sand (FERC 2002).

More recent colluvial and alluvial deposits are also common. Some colluvial deposits, derived from bedrock rather than till, are rockier with less silty sand. Alluvial deposits found at tributary mouths range from sand to cobbles and boulders; they are generally less dense and include more rounded particles than tills and colluvial soils. Outwash deposits found around the lower end of the lake and along the bypassed reach range from silty sands to sandy gravel and cobbles. These soils are often slightly cemented (FERC 2002).

Susceptibility of the various soils to erosion varies widely. Some of the tills are resistant to erosion, while the colluvial and alluvial deposits erode more easily. In many parts of the drawdown zone around the lake, colluvial deposits and the finer particles that form the matrix of the tills have been removed from the near-surface soils by wave action, leaving behind coarse gravels, cobbles, and boulders. Alternatively, where slopes are flatter and sandy soils more predominant, the drawdown zone is characterized by sand or sandy gravel (FERC 2002).

### **3.3.2 Jurisdictions and Land Ownership**

The Lake Chelan subbasin is the historic lands of the Chelan tribe, now one of the 12 Confederated Tribes of the Colville Reservation. Their aboriginal territories were grouped primarily around waterways, including those in the Lake Chelan subbasin as well as many other Columbia Basin watersheds. These watersheds, including the Lake Chelan, contain traditional fishing, hunting and food gathering places still used today by tribal members for subsistence and ceremonial purposes. In 1879 the United States government by executive order created the Moses Columbia Reservation engulfing the Lake Chelan drainage. The forming of this reservation was for the purpose of relocating the Moses Columbia, Chelan, Entiat and Wenatchi tribes. The Moses Columbia Reservation is located east of the Okanogan and Columbia Rivers, north of the south shore of Lake Chelan, east of the Cascade Crest and south of the Canadian Border. Members of these tribes were later relocated onto the present Colville Reservation, but many families and allotments still exist along lake, river and stream corridors.

Over 90% of the Lake Chelan subbasin, primarily the upper portion, is in public ownership, with the WNF comprising approximately 70% and the North Cascades National Park (505,000 acres) accounting for another 23%. The upper nine miles of the lake and the Stehekin River are located within the Lake Chelan NRA (63,000 acres), a unit of the North Cascades NPS. The middle 27 miles of the lake are within the Chelan Ranger District (422,073 acres) of the WNF. Most of the lower basin, which contains the majority of the development, is privately owned. The BLM also manages parcels scattered throughout the basin. In 1988, 635,000 acres of North Cascades National Park, Lake Chelan NRA, and Ross Lake NRA (118,000) were designated by Congress as the Stephen Mather Wilderness Area (FERC 2002). The subbasin consists of 599,905 acres (937 mi<sup>2</sup>) and is the second smallest in the Columbia Cascade Province, comprising just 6.5% of the land area. Lake Chelan lies within a 589,000 acre (924 mi<sup>2</sup>) drainage basin (**Figure 2**) located along the eastern slopes of the Cascade Mountains in Chelan County in north-central Washington (FERC 2002). Approximately 87% of the Lake Chelan subbasin is in federal, state, and local government ownership. The remaining 13% of the lands in the Subbasin is in private ownership.

The WNF includes a net area of 2,164,180 acres, more than half of which is designated wilderness. The WNF is 140 miles long and 25 to 55 miles wide, stretching from Lake Chelan in the north through the rugged Goat Rocks Wilderness in the south. Included within the Chelan Ranger District are the 141,361-acre Glacier Peak Wilderness and the 54,802-acre Lake Chelan-Sawtooth Wilderness (FERC 2002).

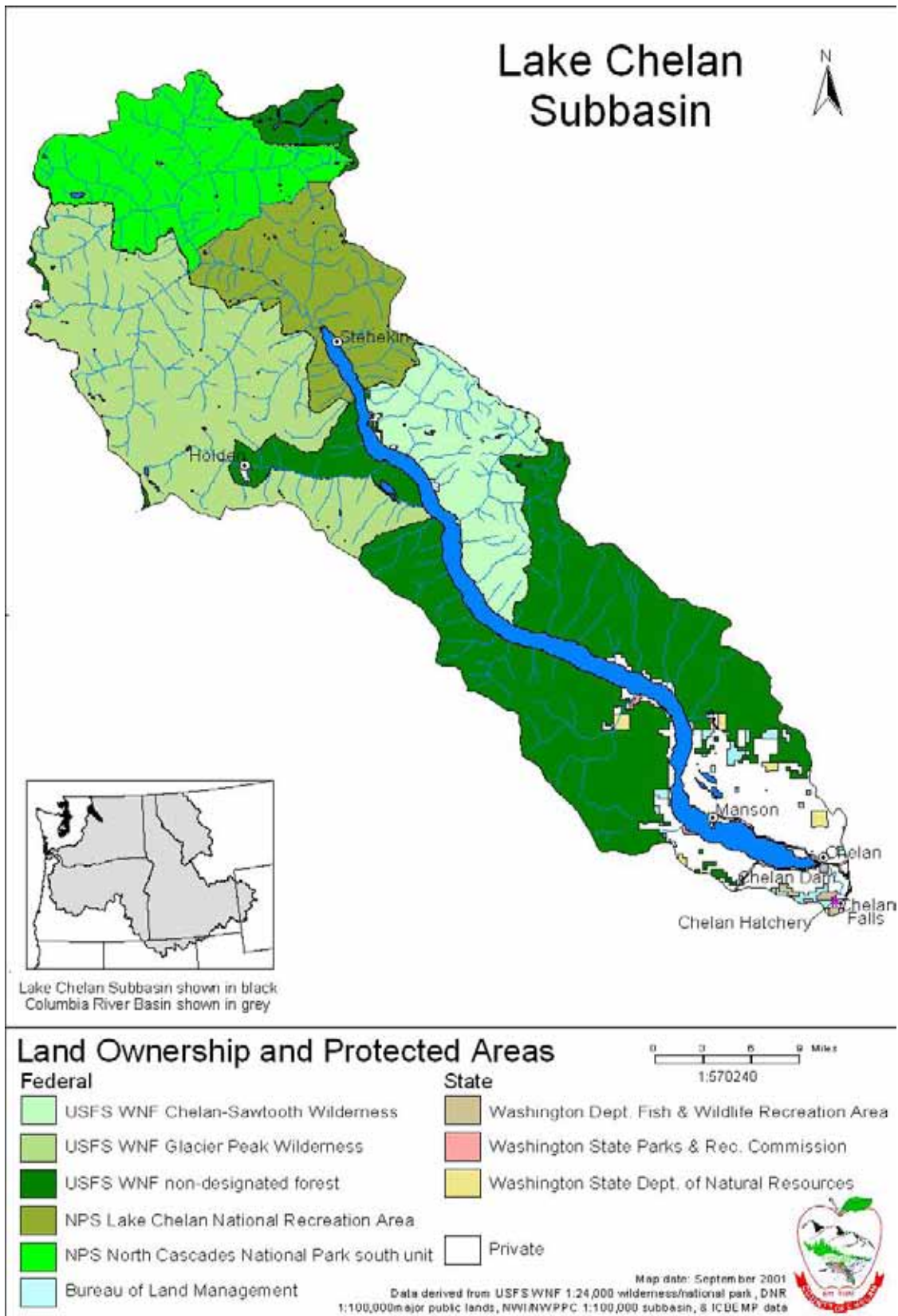
The Washington State Parks and Recreation Commission operates two state parks on the south shore of Lake Chelan. Lake Chelan State Park is located on the west side of the lake and occupies 126 acres. It features 6,454 feet of waterfront on Lake Chelan and 1,640 feet of stream frontage on First Creek. Twentyfive Mile Creek State Park occupies 235 acres on the south shore of the lake and has 1,500 feet of lakefront (FERC 2002).

Although Lake Chelan is a natural lake, its levels and outfall (the Chelan River—called the “bypassed reach” because its flow is diverted much of the year), are controlled as part of the Lake Chelan Hydroelectric Project, owned and operated by Chelan County Public Utility District No. 1. The PUD's license to operate the facility expires in 2006 (Kaputa and Woodward 2002).

**Table 3.** Land ownership in the Lake Chelan subbasin

<b>Owner</b>	<b>Acres</b>	<b>Percent</b>
Private	78,493	13%
Tribal	0	
Federal	517,883	86%
State	3,549	0.6%
Total	599,925	

**Figure 4.** Land ownership and protected status of lands in the subbasin



### 3.3.3 Land Use and Demographics

Land use within Lake Chelan subbasin is varied and includes conservation, recreation, primary and secondary (vacation and second homes) residential, resorts and agriculture (**Table 3**).

Tourism is a significant part of the local economy. Consequently a substantial portion of the subbasin is protected for recreation and the enjoyment of the environment.

An estimated 277,480 acres (46%) are permanently protected in the Subbasin. These lands have permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events of natural type are allowed to proceed without interference or are mimicked through management (high protection).

Approximately 10.5% (63,069 acres) of the Subbasin has permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state (medium protection status). Approximately 195,607 acres (33%) has permanent protection from conversion of natural land cover for the majority of the area, but is subjected to uses of either a broad, low intensity type or localized intense type (low protection status). Approximately 10.6% (63,769 acres) of the lands within the Subbasin lack irrevocable easements or mandates to prevent conversion of natural habitat types to anthropogenic habitat types (no protection).

The lake is also used for power production, irrigation, and commercial navigation. Recreation on land and water is an important part of the economy of the basin. While timber harvest occurred in the past, little timber is harvested now. Mineralized formations producing copper, gold, zinc and silver were mined at the Holden Mine on Railroad Creek from 1938 through 1957 (Beck 1991). Mining currently is a minor activity in the basin; however, in addition to the large claim at Holden, patented mining claims exist in private inholdings throughout the basin. Under current mining laws they could be proposed for development (Kaputa and Woodward 2002).

The upper two-thirds of the subbasin is quite remote and can be accessed only by water, foot, horseback or air (floatplane). The majority of land in this area is in public ownership and is managed for conservation objectives and/or recreation. With the exception of the Stehekin and Lucerne areas, there is very little development. Shoreline development in this portion of the lake is largely confined to small, primitive shoreline campgrounds administered by the USFS and the NPS. Several roads and trails in the upper basin provide access into the Lake Chelan National Recreation Area (NRA) and the Wenatchee National Forest (WNF) (FERC 2002).

The community of Stehekin is located at the head of the lake and has the most privately owned and developed land in the upper basin (primarily in the Stehekin Valley area). Land uses in Stehekin are primarily residential but also include a resort and several small commercial enterprises. Lucerne, located about eight miles down lake from Stehekin, has a number of private cabins adjacent to the lake, is served by commercial boat service, and is the primary access point to the small community of Holden (FERC 2002).

Because the lower one-third of the lake is primarily privately owned and the terrain is not as steep, it has received the most development. The City of Chelan (population 3,000 – 6,000)

contains the most concentrated development in the subbasin. It is located at the lower end of Lake Chelan and is the only incorporated community on the lake. The Community of Manson (population 2,000 – 4,000) is located approximately eight miles up lake from Chelan on the north shore. Population decreases significantly in winter months (FERC 2002, Kaputa and Woodward 2002).

**Table 4.** Population of Chelan County 1990-2000

County	1990 Population	2000 Population	Area (sq. mi.)	People/sq. mi.
Chelan	52,250	66,616	2,291	22.8

Source: U.S. Census Bureau, 2000

Land uses in the lower basin include primary and secondary residences, agriculture, resorts and public recreation. Agriculture is the predominant land use, with nearly 9,500 acres of orchards (primarily apples). However, as the area becomes more popular as a recreation and second home destination, non-agricultural development has become a significant land use. Docks are common at lakeside residences, and resorts have features such as boat ramps, docks, marinas, beaches and swimming areas. These residential areas are located on both sides of the lake, within and outside of the boundaries of the Community of Manson and the City of Chelan (FERC 2002).

Between the dam at the end of the lake and the Columbia River is the 3.9-mile long bypassed reach. Most of the bypassed reach is owned by Chelan PUD and is undeveloped. Privately-owned parcels (primarily orchard) adjoin the north side of the Chelan River in Reaches 1 and 2 (FERC 2002).

**Table 5.** Existing land use within Lake Chelan subbasin

Land Use	Area (km2)	Percentage
Lake Chelan	135	5.6
Other Water Bodies	4	0.2
Forested Public Lands	2,000	83.6
Forested Private Lands	163	6.8
Agriculture - Orchard	47	2.3
Agriculture - Non-Orchard	31	1.3
Residential	6	0.2
Roadways	6	0.2
Commercial and Public Buildings	1	0.0
TOTAL	2,393	100.0

Source: Patmont et al. 1989

### 3.3.4 Chelan County Comprehensive Plan 2000

A comprehensive plan is required by the 1990 Growth Management Act (GMA). In response to increased pressures from unprecedented population growth in Washington State, the State Legislature passed the GMA. The GMA requires all cities and counties in the state to do



planning. The fastest growing counties are required to adopt new comprehensive land use plans in compliance with the new law and to address the following 13 goals (City of Woodinville Comp Plan 2002):

Goal (1) Urban Growth – Encourage development in urban areas where adequate public facilities and services exist or can be provided in an efficient manner.

Goal (2) Reduce Sprawl – Reduce the inappropriate conversion of undeveloped land into sprawling, low-density development.

Goal (3) Transportation – Encourage efficient multimodal transportation systems that are based on regional priorities and coordinated with county and city comprehensive plans.

Goal (4) Housing - Encourage the availability of affordable housing to all economic segments of the population of the state, promote a variety of residential densities and housing types, and encourage preservation of existing housing.

Goal (5) Economic Development - Encourage economic development throughout the state that is consistent with adopted comprehensive plans; promote economic opportunity for all citizens of the state, especially for unemployed and disadvantaged persons; and encourage growth, all within the capacities of the state's natural resources, public services, and public facilities.

Goal (6) Property rights - Private property shall not be taken for public use without just compensation having been made. The property rights of landowners shall be protected from arbitrary and discriminatory actions.

Goal (7) Permits - Applications for both state and local government permits shall be processed in a timely and fair manner to ensure predictability.

Goal (8) Natural Resource Industries – Maintain and enhance natural resource-based industries, including productive timber, agricultural, and fisheries industries. Encourage the conservation of productive forest lands and productive agricultural lands, and discourage incompatible uses.

Goal (9) Open Space and Recreation – Encourage the retention of open space and development of recreational opportunities, conserve fish and wildlife habitat, increase access to natural resource lands, and discourage incompatible uses.

Goal (10) Environment – Protect the environment and enhance the state's high quality of life, including air and water quality, and the availability of water.

Goal (11) Citizen Participation and Coordination - Encourage the involvement of citizens in the planning process and ensure coordination between communities and jurisdictions to reconcile conflicts.

Goal (12) Public Facilities and Services – Ensure that those public facilities and services necessary to support development shall be adequate to serve the development at the time the development is available for occupancy and use without decreasing current service levels below locally established minimum standards.

Goal (13) Historic Preservation – Identify and encourage the preservation of lands, sites, and structures that have historical or archaeological significance.

The Chelan County Comprehensive Plan (Plan) (Hunter, Lynch and Stefaniw 2000) is a legal document adopted by local elected officials establishing policies that will guide the future development, growth, and land use within Chelan County through the year 2017. The plan strives to maintain and enhance the existing quality of life that includes: culture, customs, economy, agricultural economy, sense of community, water quality, and recreational opportunities. This is a plan to promote the development of a 12 month economy utilizing the abundant natural resources of the area. This plan should provide for expansion of these opportunities, while maintaining an adequate infrastructure to accommodate this growth. Continuous public participation is warranted, with decision making and implementation at the local level. This plan will ensure the protection of individual property rights, and provide for the right to farm according to historic and recommended practices.

The Chelan County Comprehensive Plan is divided into eight study areas of which the Chelan – Manson (Chelan subbasin) area is one. The plan is also broken down into elements: land use, transportation, capital facilities, economic development, utilities, and rural. The following is a summary of the plan’s goals and policies for each of these elements.

### **Land Use Element**

The majority of land in the County is in federal and state ownership. The County as a whole is not currently constrained on the availability of land to meet current and projected needs; however, it is constrained by funding resources for public utilities. Coordination between the Land Use Element and the Capital Facilities Element was essential in producing a plan with accurate projections for residential and economic development.

### ***Natural Systems / Critical Areas***

The Plan provides for the protection of critical areas, which include the following areas and ecosystems: (a) wetlands; (b) groundwater resources and aquifer recharge areas; (c) fish and wildlife habitat conservation areas; (d) frequently flooded areas known to be critical parts of the natural drainage system; and (e) geologically hazardous areas. The land use element is also required by the GMA to review; where applicable, drainage, flooding, and storm water run-off and to provide guidance for corrective actions to mitigate or cleanse those discharges that pollute waters of the state.

Plan goals help to identify and protect critical areas, and provide for reasonable use of private property while mitigating adverse environmental impacts. This includes protecting the quality and quantity of ground water used for public water supplies, protecting and maintaining air quality, preserving frequently flooded areas by limiting and controlling potential alterations and / or obstructions to those areas, and avoiding or mitigating significant risks that are posed by geologic hazard areas to property (public & private), health, and safety. They also ensure that development minimizes impacts upon significant natural, historic, and cultural features and preserves their integrity.

### ***Resource Lands***

County goals assure conservation and continued use of agricultural, forest, mineral, and rural resource lands that have long-term significance for commercial production. The Plan provides for reasonable, limited use of designated resource lands that are compatible with the long-term production of natural resource products. They also allow for short term mineral resource

extraction opportunities in unincorporated areas (where appropriate), facilitate a healthy, diverse, and competitive agricultural industry, control encroachment of incompatible uses and ensure public health and safety. Chelan County calls for the mitigation of conflicts between resource and non-resource land uses in designated resource lands.

### ***Residential Development***

While recognizing that residential development is important and necessary to the sustainability of the communities, housing goals were developed to ensure that future development is compatible with surrounding land uses and can be efficiently and effectively served by public facilities and services. In addition, residential designations shall provide for an adequate supply of land to accommodate housing needs, and a variety of residential opportunities to serve a full range of income levels.

### ***Urban Growth Areas (UGAs)***

The GMA stipulates that UGAs are to include areas and densities sufficient to permit the urban growth that is projected to occur in the County over a twenty year planning period. Urban growth is encouraged within designated UGAs (areas already characterized by urban development where existing public facility and service capacity is available). Otherwise, in areas where public or private facilities or services are planned or could be provided and utilized in an efficient manner.

### ***Commercial and Industrial Development***

Similar goals apply to commercial and industrial development. Commercial and industrial development are limited to areas zoned for these activities within the UGAs (areas with the infrastructure and services to support such development) and in rural lands when consistent with the GMA. The existing commercial and industrial base is maintained and further diversification is promoted, while maintaining compatibility with surrounding land uses. The Plan also calls for the designation of adequate areas, which will allow for a range of opportunities and the diversification of area economies. Mitigation of impacts on other land uses and the community are required, where appropriate. Finally, the Plan retains docking facilities at the Stehekin Landing for both commercial and private use.

### ***Open Space / Recreation***

Plan goals encourage the retention of open space (underdeveloped land that helps define the rural character of the County), the development and maintenance of recreational facilities to meet the needs of residents and tourists, and the coordination of federal, state, local, and private planning. Park and recreation planning and development activities are required take into consideration impacts to surrounding land uses, critical areas, and significant natural, scenic, historic, and cultural features. The Plan also provides for public access to recreation sites and the reasonable, limited use of privately-owned land within the Open Space designation, provided that such development is reasonably compatible with open space recreation and fish and wildlife habitat conservation.

### ***Master Planned Resorts***

Another objective of the plan is to provide opportunities for Master Planned Resorts (MPRs: destination resort facilities that may be located outside of the UGA) consistent with the provisions of RCW 36.70A.360. These opportunities include encouraging and enhancing a

diversity of recreational, lodging, and economic opportunities, and providing resorts (in existence as of July 1, 1990), which match the definition of an MPR, a means to be classified as such. The plan also requires that development regulations governing the review of MPRs shall incorporate appropriate environmental and design standards.

### **Transportation Element**

Transportation goals provide for the efficient use of existing and future transit facilities for all citizens through a systematic approach of monitoring and maintaining the transport systems. The goals integrate many types of transportation systems and facilities (i.e. road, rail, air, bike, pedestrian, etc.) and establish levels of service, by coordinating transportation planning with other elements of the comprehensive plan (i.e. land use and rural areas), and coordination with other jurisdictions and transportation providers to meet shared needs. They also promote safe, efficient access to land, while maintaining the integrity and minimizing impacts of the transportation systems, and providing for the health and economic well-being of county citizens. Transportation improvements and development are provided through a fiscally sound approach that stays within the counties funding capacity. Further, the Plan provides for a systematic process for reviewing and updating the Transportation Improvement Program.

### **Capital Facilities Element**

Plan goals ensure that adequate public facilities and services (i.e. fire, police, water, sanitary sewer, storm water, schools, hospitals, parks, etc.) are planned, located, designed and maintained in a timely, economical, efficient, and equitable manner, according to future development of the county and in coordination with other elements of the comprehensive plan (i.e. Land use and transportation) and other jurisdictions. This includes: establishing and achieving levels of service standards; encouraging compatible, multiple uses of public facilities; maximizing use, including rehabilitation, of existing facilities and replacing worn out or obsolete facilities, when and where feasible; ensuring funding for facilities and services that's within the counties capacity; and encouraging land use patterns that minimize (make reasonable) the cost of providing facilities and services. The Plan also encourages participation in, and the establishment of, a regional forum to address area wide public facility and service and utility needs as they arise.

With regards to environmental protections, the Plan ensures that public services and facilities are adequately planned and designed to prevent significant negative environmental impact, to assure access, and to protect public health, safety and welfare. Specifically, the county supports and encourages water conservation education and measures, energy conservation design strategies, and the design of facilities and services that are in keeping with the rural and scenic character of the county. Also, fire provisions provide for proper disposal of vegetative debris associated with capital development.

### **Economic Development Element**

County goals are designed to increase efforts to support, retain, and expand the existing agricultural industry (includes expanding value-added agricultural products) and other local business, while diversifying the economy by promoting other opportunities for economic development throughout the County that provide diverse work opportunities, job security, and ensure a healthy, stable, growing economy. The plan seeks to attract businesses and industries that complement and build upon existing enterprises and those that conserve natural resources

and open spaces, maintain environmental quality and rural character, and enhance the overall quality of life. Development of tourism and recreation is a key goal.

The Plan also encourages economic growth through other means. It proposes to involve citizens and other jurisdictions in the creation of decisions/direction for future growth in economic development including educational partnerships that provide the technically skilled labor force to attract and retain good paying industries. It also encourages economic growth through planning and development of the region's public services and facilities' capacity, and by pursuing legislative changes (including tax increment financing) and providing regulatory incentives to foster public/private partnerships and economic development.

Chelan County recognizes the need to be proactive in addressing ESA listings and entering into watershed planning efforts due to their potential impact on economic development efforts and the ability to pursue sustainable economic development. They will also work to retain and develop their site limited industrial sector and to diversify the local economy by strengthening manufacturing and promoting producer services and other basic industries.

### **Housing Element**

Chelan County's primary housing goal is to provide affordable housing to all economic segments of the population of the county. This includes promoting a variety of residential densities and housing types, providing an adequate supply of land zoned for residential use, and encouraging the appropriate preservation of existing housing stock.

### **Utilities Element**

County utility goals promote increased efficiencies and quality service, multi-jurisdictional cooperation, coordination with other elements of the comprehensive plan (i.e. land use and transportation), and the provision of adequate, timely, safe, and cost effective utilities (power, water, sewer, telecommunications and, in some areas, irrigation) to support current and future development. This includes identifying the proper location of utilities, minimizing cost and disruption of normal activities, increasing effectiveness of the resource, and protecting the public and environment from negative impacts associated with the siting, development, and operation of utility services and facilities. The county will also promote the continued use, maintenance, development and revitalization of existing utilities whenever possible. Utility development regulations should be flexible, receptive to innovations, and based on specific situations.

To protect the environment and quality of life, the Plan calls for utilities to provided in such a way as to minimize negative visual and noise impacts. Where facilities may have negative impacts, regulations shall provide for adequate buffering and screening of facilities. Energy conservation, including new construction, and the use of cost effective alternative energy sources (i.e. solar and wind power) is also encouraged.

Chelan County has also set guidelines specific to the Stehekin area. These goals encourage the continued use and maintenance of hydroelectric facilities and the enhancement of hydroelectric power capabilities through system efficiency and the protection of facilities from erosion and flooding. Further, they seek to decrease future reliance upon diesel powered electricity by encouraging the use of alternative energy

## **Rural Element**

Rural areas are those areas not designated for urban growth, agriculture, forest, or mineral resources. However, agriculture, farming/ranching, forestry, mineral, recreation and other similar activities are inherent within this designation. Plan goals take into consideration both human uses and the natural environment. They encourage rural development that maintains the rural character and visual integrity of the land and protects and restores the land and water environments required by natural resource-based economic activities, fish and wildlife habitats, rural lifestyles, outdoor recreation, and other open space. Other primary stipulations for rural development include developing at low levels of intensity, ensuring that the provision of public facilities and services are consistent with rural character and lifestyle, reducing the inappropriate conversion of rural lands to sprawling low-density development, and promoting coordination with other jurisdictions and sections of the plan.

The comprehensive plan provides for a variety of rural densities and designations, while striking a balance between maintaining the existing pattern of uses (i.e. residential, small-scale commercial, cottage and resource industries, tourism, recreation, agricultural, light industrial and limited natural resource processing, sales, and support services) and providing opportunities for future, compatible development. To accomplish this, the county promotes the continuation and enhancement of clustering (i.e. MPRs, designated rural service centers fully contained communities), density transfer, design guidelines, conservation easements, and other innovative techniques. Open space will be part of the development in order to protect rural values and buffer adjacent resource use/critical areas. Also, whenever feasible, rural developments will be encouraged to utilize community systems for domestic water and sewage disposal to increase efficiency, lower costs of providing these services, and to cause fewer impacts to the environment (i.e. aquifer recharge areas, water quality and quantity). Development and recreational opportunities in rural shoreline and other rural areas shall minimize potential adverse impacts to water quality, slope stability, vegetation, wildlife and aquatic life.

### **3.3.5 Hydrology**

Lake Chelan is oriented generally in a northwest-to-southeast direction within a deeply glaciated valley and occupies approximately 50 miles of the 75-mile-long basin. The majority of inflow to Lake Chelan is from two major tributaries: the Stehekin River, which feeds into the lake from the west, provides 65%; Railroad Creek provides 10%. Approximately 50 small streams provide the remaining 25% of the inflow. Due to the shape of the valley, most tributaries are relatively steep and short (FERC 2001).

The lake consists of two distinct basins separated by a relatively shallow sill 135 feet below the surface of the lake at its narrowest part. The larger Lucerne Basin (upper 38.4 miles of the lake), has a maximum depth of 1,486 feet and contains over 92% of the total lake volume. The Wapato Basin is relatively broad and shallow, with a length of 12 miles and a maximum depth of 400 feet. Water entering the Lucerne Basin has an average residence time of approximately 10 years, however, the residence time of water within the smaller Wapato Basin is much shorter, ranging from approximately 0.2 to 1 year, depending on climatic factors (FERC 2001).

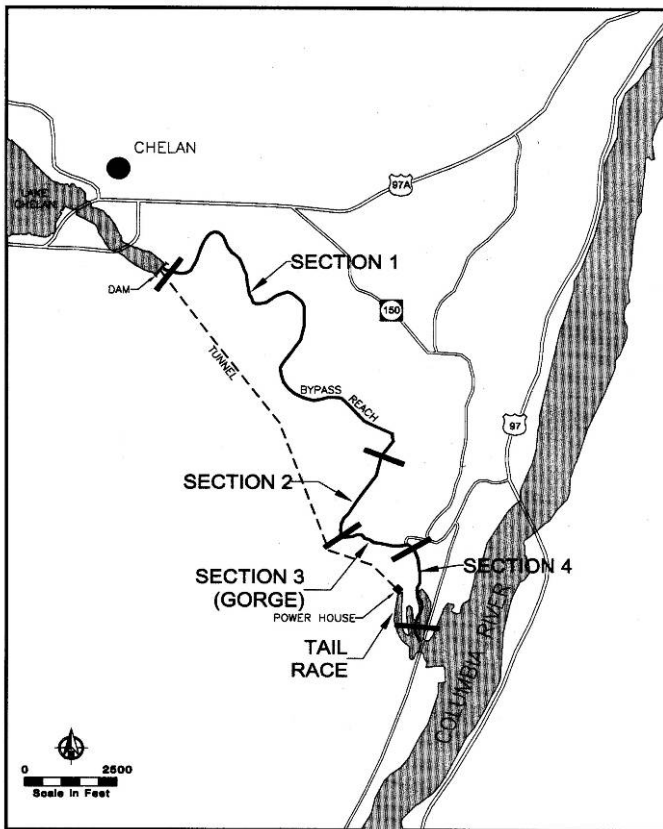
Nearly the entire Lake Chelan outflow, averaging approximately 2,000 cfs, is diverted through a 2.2-mile-long power tunnel (penstock; vertical drop of 401 feet), which passes the water through the powerhouse for hydroelectric generation and into the tailrace, which empties into the

Columbia River. The 3.9-mile bypassed reach (original Chelan River channel) is without flow during most of the year; normally, the only flow in the bypassed reach comes during the spring and early summer when snow melt raises the lake to levels requiring spill for flood control (Chelan PUD 1998, FERC 2001).

The powerhouse tailrace is a 1,700-foot-long channel adjacent to the lower end of the bypassed reach. The tailrace has a variable, near-zero gradient due to the backwater from the downstream Rocky Reach Project on the Columbia River. At the time of construction of the Lake Chelan Hydroelectric Project, the tailrace was excavated from the powerhouse to the Columbia River, and an earthen dike (now vegetated) was established between the tailrace and the bypassed reach (FERC 2002).

As shown in **Figure 5**, the bypassed reach is comprised of four distinct sections (Chelan PUD, 1999). The upper two sections, Sections 1 and 2, are relatively low gradient areas (approximately 55 ft/mi) extending a length of 3.0 miles. Section 3, referred to as the gorge, is 0.4-mile long with steep and narrow canyon walls. The gradient in this part of the channel is very steep, approximately 480 ft/mi. Waterfalls, from 5 to 20 feet high, numerous cascades, bedrock chutes, and large, deep pools characterize the stream channel in the gorge reach. Finally, Section 4 is 0.5-mile long and characterized by a wide floodplain. This section of the bypassed reach has a relatively low gradient (22 ft/mi) and a substrate comprised of gravel, cobble, and boulders. Section 4 extends from the bottom of the gorge section downstream to the confluence with the tailrace and Columbia River (Anchor, 2000).

**Figure 5.** Chelan River (bypassed reach) by section and Lake Chelan hydroelectric project



### **Impoundments and Irrigation Projects**

Lake Chelan is a natural lake, but its levels are affected and controlled by the Lake Chelan Hydroelectric Project (Project), a dam and powerhouse owned and operated by Chelan County Public Utility District, which is located at the mouth of the lake on the Chelan River. The Project, constructed in 1927, is a 40-foot-high concrete gravity dam that raised the elevation of the lake by 21 feet above normal high water levels. The project reservoir, Lake Chelan, is operated between elevations of 1,079 feet and 1,100 feet to ensure optimum use of the reservoir for power generation, fish and wildlife conservation, recreation, water supply, and flood control. The annual drawdown of the lake begins in early October, with the lowest lake elevation normally occurring in April. The average annual drawdown is 15.8 feet, to elevation 1,084.2 feet. The lake refills during May and June and is maintained at or above elevation 1,098 feet from June 30 through September 30 each year, the peak recreation season. The upper 21 feet of the reservoir is allocated as storage (677,400 acre-feet), usable by the project for hydroelectric generation and other purposes. (FERC 2001, Anchor 2000).

Surface water is pumped from the lake to serve domestic water supplies for the towns of Chelan and Manson. In Chelan, the average winter use (February) is about 500,000 gallons per day; the average summer (August) use is 2,600,000 gallons per day (Bill Greenway, City of Chelan). The city of Manson consumes 325,000,000 gallons a year. Manson also has a large pumping station which supplies irrigation water through an underground system to 6,500 acres of farms (Paul Cross, Lake Chelan Reclamation District manager). Residents on private land at places like First



Creek, Twentyfive Mile Creek, Fish Creek and Canoe Creek withdraw minor amounts of water for domestic use as well.

The 76-year-old Lake Chelan Project is currently up for relicensing by FERC. As part of the relicensing process, Chelan PUD agreed to return water to a portion of the Chelan River that had been dry most of the year since the project's inception. Water temperatures in Lake Chelan, however, are potentially high enough to exceed Washington state's numeric standard for riverine water temperatures. Although Columbia River Inter-Tribal Fish Commission lost a court challenge to the agreement, to date Chelan PUD has not released a plan that indicates how it intends to address the possibility of exceedences in water temperatures.

### **3.3.6 Wildlife Resources**

There are an estimated 341 wildlife species that occur in the Lake Chelan subbasin. Of these species, 105 (31% ) are closely associated with riparian and wetland habitat and 75 (22% ) consume salmonids during some portion of their life cycle. Seventeen wildlife species are non-native. Eight wildlife species that occur in the Subbasin are listed federally and 42 species are listed in Washington and Idaho as Threatened, Endangered, or Candidate species. A total of 98 bird species are listed as Washington or Idaho State Partners in Flight priority and focal species. A total of 57 wildlife species are managed as game species in Washington (Appendix A). The most abundant big game species present in the Lake Chelan vicinity include: mule deer, mountain goats, black bears and cougars. Lesser numbers of white-tailed deer, Rocky Mountain elk and moose are reported. The WDFW manages these species. Mountain goats, considered a Priority Species by WDFW, were observed near Bear Creek (FERC 2002).

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### **3.3.7 Fish Resources**

Lake Chelan and its tributaries support a variety of fish species. Appendix B lists fish species historically and currently present in the Lake Chelan subbasin and whether they are native or introduced (FERC 2001). The predominant salmonid species native to the Lake Chelan subbasin are westslope cutthroat trout. Bulltrout are believed to have been extirpated (Cavender, 1978; Pratt, 1992). Lake Chelan does not contain anadromous fish species because of the steep gorge in the Chelan River at the mouth of the lake (Hillman and Giorgi, 2000). However, fish populations from the Columbia River, including migrating salmonids, have been found in the Lake Chelan Project tailrace and in the lower part of the Chelan River (FERC, 2001).

Lake Chelan supports an important sport fishery consisting of kokanee (landlocked sockeye salmon), landlocked chinook salmon, rainbow trout, cutthroat trout, lake trout and burbot. Other fish found in Lake Chelan include smallmouth bass, pygmy and mountain whitefish, a variety of panfish/sunfish, northern pikeminnow, suckers, minnows and sculpins (FERC 2002). Brown (1984) provides an overview of the Lake Chelan fishery resource, based on intensive creel,

limnological and tributary surveys done in 1981 and 1982. Relicensing studies conducted on Lake Chelan in 1999 and 2000 provide comparative data to those collected by Brown (1984) (DES, 2000a). During summer, fish biomass in the lower basin is most likely greater than 90% coarse fish (Brown 1984).