

5.0 SOCIOECONOMIC IMPACT

This section presents the analysis of the socioeconomic effects of constructing and operating a water storage project in Lake Wenatchee and the mainstem Wenatchee River. The objective of this analysis is to determine the effects on land use, lake-related recreation, river-related recreation, and cultural resources that would be expected to occur if the water storage project is placed in operation.

The chapter begins with a definition of study methods used for each of the subjects, followed by descriptions of existing conditions. These descriptions are followed by assessments of impacts to land use, recreation, and cultural resources. We conclude the chapter with conclusions and recommendations addressing specific findings, issues or concerns.

5.1 STUDY METHODOLOGY AND EXISTING CONDITIONS

5.1.1 Land Use

The objectives of the land use analysis include:

- Evaluating short-term and long-term impacts to lakefront property;
- Identifying land ownership patterns and improvements;
- Assessing the “sensitivity” of land uses and improvements to changes in Lake hydrology; and
- Preparing a generalized assessment of changes in private property values resulting from increasing water storage during the summer months.

This analysis was based on review of existing studies; review of the technical feasibility analysis and alternatives defined for this study; acquisition and review of property assessments from the Chelan County Assessors Office; discussions with Chelan County staff, realtors, the Chelan County PUD, and construction contractors; and field measurements and observations. The field measurements and observations conducted on May 14, 2003, provided information on shoreline conditions at Ordinary High Water (OHW) elevation (determined to be 1870.3 ft based on Montgomery Water Group February 19, 2003 memorandum), and an estimation of shoreline conditions at El. 1872.4. Elevation 1872.4 ft represents the water storage elevation for Alternatives 1, 2, and 3, while elevation 1870.3 ft represents the water storage elevation for Alternatives 4 and 5.

To estimate the effects of operating the water storage project on uses of the land occurring at Lake Wenatchee, impacts on current activities resulting from changes in the surface elevation were evaluated in a generalized fashion (a parcel by parcel evaluation was not undertaken). The estimation of impacts to lakefront properties was based on the findings of the literature review, frequency and duration of the new surface elevations for the key lake-use months of July, August, and September (with a return to “normal” levels occurring during the months of September or October, depending on the alternative). The results of hydrologic modeling were used to determine how frequently lake elevations would inundate or potentially limit use of facilities when compared to historic conditions.

The study team conducted a review of economic studies that assessed the relationship between the surface elevation of lakes and reservoirs and property values. Most of these studies were conducted entirely or in

part to help estimate the effect on property values as a result of modifying the hydrologic regime of a certain lake or reservoir. (Benson et al. 1998; Big Bear Municipal Water District. 1993; Feather, T.D. et al. 1992; Khatri-Chhetir, J.B et al. 1999; Langsford N.H., et al 1995; Monterey County Water Resources Agency unpublished; U.S. Fish and Wildlife Service, et al. 1999).

5.1.1.1 Land Ownership and Improvements

Land ownership of shoreline properties around Lake Wenatchee falls into five general categories: federal lands, state lands, county lands, private lands – residential, and private lands – other (According to County Assessor files, there are a least seventeen parcels on the South shore and one parcel on the North shore that is owned by the County), as shown on Figure 5-1, Land Ownership Lake Wenatchee. Of the property with a shoreline on Lake Wenatchee, 45.3 percent of the shoreline is in Federal ownership, 12.2 percent is in State ownership, 0.5 percent is in County ownership, and 42.0 percent is in private ownership, the majority of which is for residential use.

5.1.1.1.1 Federal Lands

According to the Chelan County Assessors' files, Federal lands ownership on Lake Wenatchee is categorized as follows:

- United States Department of Agriculture;
- United States Forest Service (USFS)
- Wenatchee National Forest
- Mt. Baker – Snoqualmie National Forest
- Entiat Ranger District
- Additionally, there is one parcel on the Little Wenatchee River owned by the United States Federal Housing Administration (FHA).

Facilities

Shoreline areas of Lake Wenatchee administered by the USFS include Glacier View Campground, summer cottages on the north (Crescent Beach) and south shores (approximately 30 cottages), the Campfire Girls' Camp Zenika on the South shore of the lake, and University Beach on the North shore.

Glacier View Campground has 23 campsites, of which 16 are classified as walk-in sites. There is also an unimproved boat launch site. (USFS Wenatchee National Forest web page, <http://www.fs.fed.us/r6/wenatchee/recreate/recremain.html>).

5.1.1.1.2 State Lands

As described on the Washington State Parks and Recreation website, “Lake Wenatchee State Park is a 489-acre camping park with 12,623 feet of waterfront on glacier-fed Lake Wenatchee and the Wenatchee River. The park is bisected by the Wenatchee River, creating two distinct areas -- South Park, with areas for camping, swimming and horseback riding; and North Park, in a less developed, forested section...” (Washington State Parks and Recreation Commission web page, <http://www.parks.wa.gov/parkpage>.)

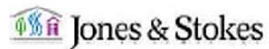
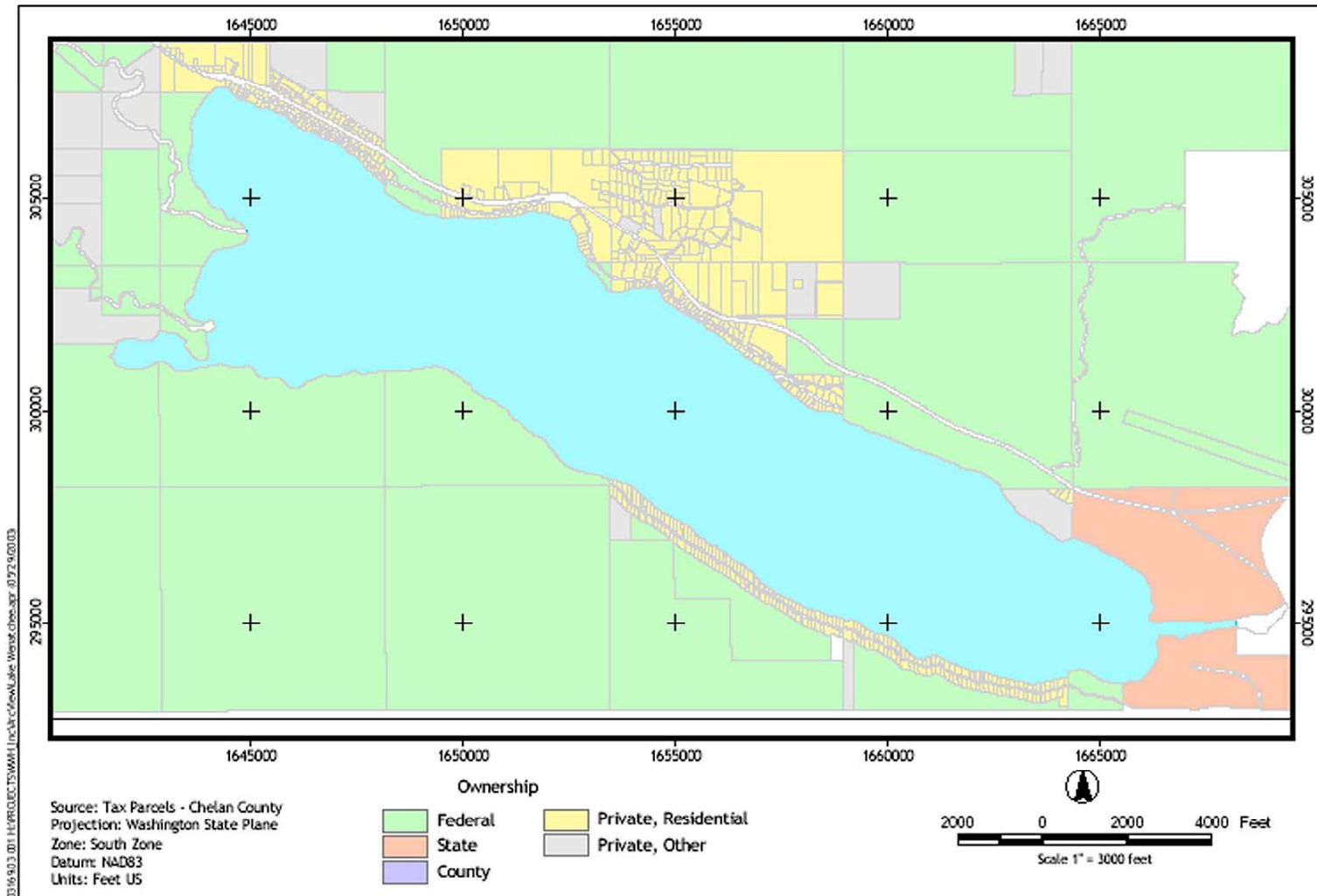


Figure 5-1
Land Ownership, Lake Wenatchee

Figure 5.1-1. Land ownership, Lake Wenatchee.

Facilities

The Lake Wenatchee State Park offers: two picnic shelters without electricity; 54 unsheltered picnic tables; a kitchen shelter that accommodates 20 to 80 people and includes six picnic tables; 200 fire pits; a second kitchen shelter that accommodates eight to 12 people and includes one picnic table, a fireplace and two cooking grills; one boat ramp; a 16-foot boat dock; 8-miles of hiking trails; 7-miles of bike trails; 5-miles of horse trails, including a horse concession offering guided rides; an amphitheater; beach for swimming; a volleyball field; 197 tent spaces; one dump station; seven restrooms and 16 showers; 100 campground parking pads in the south campground; and 197 campground parking pads in the north campground.

5.1.1.1.3 Private Lands, Residential

Residential development around Lake Wenatchee is separated into two separate zones, the North shore and the South shore. There are approximately 153 single-family residential parcels along the North shore, including one owned by Chelan County. There are approximately 134 single-family residential parcels along the South shore, including sixteen owned by Chelan County (see Figure 5.1-1). Most, if not all, of the County owned parcels are very narrow and appear to provide publically owned access points to the lake. As shown in Table 5.1-1, land values, improvement values, lot size and their respective averages vary substantially from lot to lot and from the North shore to the South shore. These data are based on 1997 and 2002 values. (Chelan County Assessors Office pers com).

While the data presented in Table 5.1-1 are suitable for an evaluation of this detail, a careful, parcel-by-parcel analysis should be completed to eliminate unbuildable lots. For example, based on the Assessor's files, there are 24 parcels on the North Shore and 46 parcels on the South Shore showing zero building value. Some percentage of these lots/parcels may not be buildable.

Additionally, there are six parcels on the North Shore and three parcels on the South Shore with buildings that are valued at less than \$10,000 per parcel.

Table 5.1-1. Comparison of Assessed Value of Single-Family Parcels on Lake Wenatchee, 1997 & 2002.

	North Shore			South Shore		
	1997	2002	% Change	1997	2002	% Change
Lot Size (sq. feet)						
Largest	195,955			42,220		
Average	16,047			16,815		
Median	10,277			1,752		
Smallest	2,871			1,899		
Assessed Value Land						
Highest	\$492,200	\$733,750	49.08%	\$285,000	\$340,000	19.30%
Average	\$269,552	\$339,466	25.94%	\$101,544	\$147,566	45.32%
Median	\$262,500	\$320,000	21.90%	\$100,000	\$150,000	50.00%
Lowest	\$1,500	\$20,000	1233.33%	\$18,200	\$27,300	50.00%
Assessed Value Building						
Highest	\$457,277	\$462,686	1.18%	\$259,152	\$357,106	37.80%
Average	\$74,936	\$151,550	102.24%	\$45,717	\$42,962	-6.03%
Median	\$51,848	\$63,926	23.30%	\$27,224	\$23,801	-12.57%
Lowest	\$500	\$700	40.00%	\$420	\$420	0.00%
Square Foot (land) Assessed Value						
Highest	\$64.95	\$89.08	37.15%	\$17.11	\$17.63	3.04%
Average	\$13.87	\$17.47	25.96%	\$5.83	\$8.47	45.28%
Median	\$20.78	\$25.50	22.71%	\$5.97	\$8.69	45.56%
Lowest	\$0.93	\$1.42	52.69%	\$1.95	\$2.00	2.56%
Shoreline (land) Assessed Value Per Lineal Foot***						
Highest	\$11,045	\$14,025	26.98%	\$1,364	\$5,170	279.03%
Average	\$2,784	\$3,506	25.94%	\$1,069	\$1,554	45.32%
Median	\$3,363	\$4,057	20.64%	\$1,187	\$1,605	35.21%
Lowest	\$271	\$444	63.84%	\$422	\$227	-46.21%

Costs listed in Table 5.1-2 were derived from contractors familiar with facility replacement and repair costs at Lake Wenatchee, and from the P.U.D. The costs represent actual construction costs only and do not include planning, design and permitting costs. Ultimately a parcel-by-parcel evaluation should be completed to assess property impacts and mitigations for any alternative considered for further evaluation.

Table 5.1-2. Representative Improvements on Lands Adjacent to Lake Wenatchee.

Improvement	Estimated Range of Value (not including permits)	
	Low	High
STEP Sewage System (PUD) ¹	\$1,250	\$17,000
On-site Sewage System –Lateral Field	\$1,750	\$3,500
Wells ²	\$750	\$8,000
Float – Swimming	\$600 ³	\$14,400
Dock	\$600 ⁴	\$14,400
Boat Launch	\$1,200	\$6,000
Bulkhead ⁵ (70 foot lot)	\$1,750	\$8,750
Trails (6' trail/lineal foot)	\$2.00	\$5.00
Drives (10' drive/lineal foot) High Cost Assume Asphalt	\$40.00	\$130

¹ Values range from a minor modification to the system, up to complete replacement including out of the ordinary trenching costs (based upon local contractor and PUD estimates). Costs for slope stabilization are not included but would be a part of the parcel-by-parcel assessments.

² The range of costs for wells could be as minor as raising the “riser” to complete well replacement. One estimate is that up to one-half of the residences along Lake Wenatchee are on wells and about one third of those wells are relatively near the shore. The Department of Ecology can provide more detailed information for a case-by-case analysis.

^{3,4} According to County staff, docks and floats require a Shoreline Substantial Use Permit exception and cannot exceed 450 square feet or \$10,000 in value. For the purpose of this project, we have assumed any replacement will be a floating dock. The lower value represents adjustments to the anchoring mechanism of a current dock/float. We have also noted that some docks, in the past, have exceeded the maximum allowed value and have therefore presented the higher value.

⁵ Bulkheads are not permitted in Lake Wenatchee. However, anecdotal information and field observations indicates there are bulkheads present and the cost included represents repair/improvement to an existing bulkhead based upon a local contractors estimate ranging from minor repairs to complete replacement. Complete replacement of bulkheads is estimated at \$125 per linear foot.



Photograph 5.1-1. Shows septic tank that is located very close to the shoreline and could be impacted by any of the five alternatives.

5.1.1.1.4 Private Lands, Other

There are two parcels in private ownership other than residential. Both are located along the North shore – the YMCA Camp and Blue Grouse Lodge. The YMCA has operated a 26-acre camp on the North shore of Lake Wenatchee since 1928. The camp includes approximately one-half mile of waterfront.

The Blue Grouse Lodge includes four rooms and is located on the northwest end of Lake Wenatchee.

Facilities

The Lake Wenatchee YMCA Camp includes: the Larry Handy Lodge (10,000 useable square feet with dining capacity for 150); a paved game court; a campfire area with capacity for 145 people, including a stage; a chapel; an archery range; 18 cabins; a swimming beach and dock.

5.1.1.2 Property Values

5.1.1.2.1 Property Value – Reservoir/Lake Elevation Studies

As mentioned in section 5.1.1, the study team conducted a review of economic studies of the relationship of surface water elevations of lakes and reservoirs and property values. It was found that the case studies analyzed the effects on property values of cases where the surface elevation of a subject lake or reservoir would be lower, would fluctuate within a wider range of elevations, or be held more stable compared to current conditions. No studies were found that assessed the expected change in property value as a result of increasing water elevation and storage in a natural lake such as Lake Wenatchee.

The studies revealed the following general relationships between the surface elevations of lakes and reservoirs and the value of adjacent properties:

- Lake or reservoir elevations that remain stable result in property values that are higher than those with fluctuating lake elevations. Property values were higher when lake levels are held at their long-term average as opposed to being below that average (Lansford and Jones 1995).
- Fluctuating reservoir levels may result in a substantial economic cost to surrounding property owners (Khatri-Chhetir, et al. 1990). A recent study assessed changes in operation of a reservoir with residential properties along the shoreline, estimated a decrease in property values of just over 4 percent attributable to reservoir levels fluctuating more than current conditions (Monterey County Water Resources Agency, unpublished).
- The aesthetic character of a property can substantially enhance value. As an example, quality ocean views were found to increase the market value of a comparable property by nearly 60 percent (Benson et al. 1998).
- The value of properties near the shore of a lake or reservoir are less sensitive to the surface elevation of the lake or reservoir than properties that front on the shore (U.S. Fish and Wildlife Service, et al. 1999).

5.1.1.2.2 Property Values – Lake Wenatchee

Based upon conversations with the County Assessors' office, lakeshore property around Lake Wenatchee is in "high demand" and the assessed value of the each lot is more dependent on the frontage width than

the overall size of the parcel. The Assessors' office reported (pers comm) lot values ranging from \$4,000 to \$6,500 per lineal foot, with an average cost of \$5,000 per shoreline lineal foot. Because of high market demand, the Assessors' office indicated that lot depth has less impact on lot value than does length of shoreline, unless the depth is reduced such that the lot is rendered marginal or unusable for development. The Assessor's office did not distinguish this value between north and south shores. A review of the 2002 Chelan County Property Valuation data presented slightly lower averages than those stated by the Assessor's office. Table 5.1-1 shows the range of data derived from this report. Based upon the sample information presented in Table 5.1-1, the value of shoreline property on Lake Wenatchee has an average value of \$3,506 per lineal foot on the North shore. The South shore has an average value of \$1,554 per lineal foot. These values are less than those communicated by the Assessor's office by telephone. For the purposes of this report, costs and values are derived from the 1997 and 2002 data received from the Chelan County's Tax Assessment office.

Per square foot assessed value variations of land appear to be dramatic, based upon the single-family lots included in Table 5.1-1. The highest value land was appraised at \$89.08 per square foot (in 2002) on the North Shore and \$17.63 on the South Shore. The lowest value land was appraised at on the North Shore was \$1.42 per square foot, and \$2.00 per square foot on the South Shore. Land was appraised at an average value of \$17.47 on the North Shore and \$8.47 on the South Shore, during this period. Average property values have increased over 25 percent on the North Shore and over 45 percent on the South Shore over the past five-year period between valuations.

Based upon information gathered from lakefront landowners and project team participants at a team meeting on April 30, 2003 and an Open House held on June 19, 2003, much of the value owners place on their property is attributed to beach accessibility during the summer. None of the examples found in the literature search identified a comparable condition to Lake Wenatchee. Consequently, more detailed analysis will be required in further studies on the relationship between property values with seasonal use. The costs of purchasing easements for inundation could be substantial. The following scenario provides an example of a range of possibilities, exclusive of the impacts to site improvements.

- Assume water level is stabilized two feet above ordinary high water mark with slopes between 4 to 10 percent.
- Assume an easement would have to be purchased from the property owners for inundation easements above OHW.
- Assume the easement purchases would include lands two feet below OHW for owners who hold deeds to Second Class Shorelands that are not subject to the current overflow easement (Note: A detailed title search and topographic survey should be completed prior to accepting value assessments of easement purchases).

Table 5.1-3 presents an estimated range of easement costs based on this sample scenario.

Table 5.1-3. Assumed Easement Costs, Sample Scenario ^{1/}

	4% Slope 50 ft length	Average	10% Slope 20 ft length
Second Class shorelands below OWH (20,380 lf) ^{3/}	\$3,454,000	\$2,418,000 ^{2/}	\$1,382,000
Total Shorelands above OHW (70,000 lf)	\$11,865,000	\$8,306,000	\$4,746,000
Total (DNR 25%) ^{4/}	\$15,319,000	\$10,724,000	\$6,128,000

^{1/} Example included at request for property owners and should not be used for actual easement purchase estimates.

^{2/} Value, for this purpose, is a combined average of the upland land. Values were \$13.56 per square foot. However, property owners may perceive a greater loss given the loss of access to beaches during the summer months.

^{3/} Includes 9,430 ft of State-owned shorelands at Lake Wenatchee State Park.

^{4/} Totals were calculated using the Washington Department of Natural Resources' (DNR) method for calculating lease value of lands. This method calculates lease fees based on a percentage of the yearly assessed value. For example, if a property assessed at \$100,000 was used for 10% of the year, the lease fee would be \$10,000. For the purposes of this scenario, it was estimated the overflow of the property would be for a total of 3 months, or 25% of the year.

Table 5.1-3 shows a potentially dramatic range of values for easement purchases (values not based upon parcel-by-parcel appraisals and should only be used as a discussion example). Once final alternatives are determined, a detailed parcel-by-parcel appraisal should be conducted that includes a topographic survey to establish the actual inundation area of each property, title searches to ascertain current ownership and easement lines, as well as appraisals. A parcel-by-parcel survey would allow for any special conditions unique to a particular parcel to be taken into consideration of its valuation for compensation purposes.

5.1.2 Lake-related Recreation

The objective of the lake-related analysis is to determine the magnitude of changes in lake-related recreation opportunities and the associated effects that would be expected to occur if the water storage project is placed in operation.

To estimate the effect on recreation occurring on Lake Wenatchee, changes in recreation opportunities resulting from changes in lake surface elevations were evaluated. The analysis of change in opportunities focused on two criteria: continued use of the Lake for the activity and access to the Lake for the activity.

This analysis was based on review of existing studies; review of the technical feasibility analysis and alternatives defined for this study; discussions with the Washington State Parks and Recreation and U.S. Forest Service personnel; and field measurements and observations. The field measurements and observations conducted on May 14, 2003, provided information on shoreline conditions at Ordinary High Water (OHW) elevation (determined to be 1870.3 ft based on Montgomery Water Group February 19, 2003 memorandum), and an estimation of shoreline conditions at El. 1872.4. El. 1872.4 represents the water storage elevation for Alternatives 1, 2, and 3, while elevation 1870.3 ft represents the water storage elevation for Alternatives 4 and 5.

To estimate the effects of operating the water storage project on recreation activities and opportunities occurring at Lake Wenatchee, impacts on current activities resulting from changes in the surface elevation were evaluated in a generalized fashion (a parcel by parcel evaluation was not undertaken). The

estimation of impacts was based on the findings of the literature review, frequency and duration of the new surface elevations for the key recreation months of July, August, and September. The results of hydrologic modeling effort for the project were used to determine how frequently lake elevations would affect when compared to historic conditions.

5.1.2.1 Chelan County Recreation

In 2002, Chelan County had a total population of approximately 66,600 (US Census 2003a). Median household income was \$37,300 and per capita income was estimated as \$19,300 (US Census 2003b). The county fell below the average median household income of \$45,800 and per capita income of \$23,000 for all Washington counties.

Recreation, visitation, and other leisure-type activities are an important component of the Chelan County economy. Approximately 3,100 persons were employed within the arts, entertainment, recreation, and accommodation and food services sector in 2000, or about 11 percent of the total number of persons employed within the county (US Census 2003c). This employment sector was the second largest in the county, following the educational, health and social services sector.

The State of Washington estimated that employment related to travel (recreation, business, etc.) occurring within Chelan County directly resulted in 4,230 jobs in 2001 (Washington State Business and Tourism Department 2002a). Of these jobs, 1,140 were directly related to recreation occurring within the county. This represents an increase in 160 jobs from 1991 levels, although a decrease of 40 jobs from 1999 and 2000 levels.

Travel related spending in Chelan County totaled \$223 million in 2001 an increase of \$87 million from 1991 levels (Washington State Business and Tourism Department 2002a). Nearly 57 percent of this spending was for overnight indoor accommodations, followed by day travel at 23 percent. Travel related spending also represents an important source of local and state lodging and sales tax revenue. Travel spending generated \$4.8 million in local taxes and \$13.1 million in state taxes.

5.1.2.2. Lake-related Recreation

5.1.2.1.1 Boating

Boating, one of the more popular recreation activities on Lake Wenatchee, occurs primarily during mid-June through early fall. Boats are launched from public boat ramps located at Lake Wenatchee State Park at the south end of the lake, or from an unimproved ramp at the U.S. Forest Service (USFS) Glacier View Campground on the southwest side of the lake (Thayer pers com; McMillin pers com; Bolser pers com). Launching boats during summer low water conditions can be problematic due to shallow water and rocks (McMillin pers com).

Limited boat launching occurs from private properties and USFS lease properties (e.g., summer cabins and Camp Zanika), however summer residents often use low-water beach areas as pull up areas for boats and canoes.

Boating includes outboard motor-driven boats, sailboats, sailboards, jet skis, and canoes, rafts, rowboats, and kayaks. There are opportunities for access to the lake for car-top watercraft. For example, wind

surfers, canoeists, and kayakers access the lake from USFS property on the north shore (e.g., Crescent and University Beaches). Some kayakers also enter the White River west of the lake, floating the river and then paddling the lake to Glacier View Campground or the State Park. Residents on the lake also launch from private docks or shorelines.

5.1.2.1.2 Fishing

Fishing on Lake Wenatchee is limited because of closures to protect the federally-listed endangered species of chinook salmon, steelhead, bull trout, kokanee, and sockeye salmon. Trout fishing is legal; however, the lake does not provide a significant fishery since the lake is no longer stocked (Washington Department of Fish and Wildlife, 2002). See Section 6 of this report for specific information.

The lake was last open to sockeye salmon fishing in August 2001, and prior to that in 1997. According to Thayer (pers com), Glacier View Campground was the preferred boat launch since a majority of the fishing took place at the west end of the lake. According to USFS records, 18,328 visits occurred to the campground during 2001, over 3,000 more than the previous year when the sockeye fishery was closed (Thayer pers com).

Both the White River, located above the lake, and the Wenatchee River located downstream of the lake, are closed to fishing (note: WDFW held a special winter whitefish-only season on the Wenatchee River during 2002, according to the Washington Department of Fish and Wildlife 2002).

5.1.2.1.3 Wind Surfing

During the summer months (primarily July and August), wind-surfers launch from USFS property and private property on the north shore of Lake Wenatchee, and to a lesser extent from the Glacier View Campground. Windsurfing is limited primarily by the lack of easy access and parking (Bolser pers com; Thayer pers com). For example, there is room for approximately six vehicles along the road at University Beach (Thayer pers com).

5.1.2.1.4 Camping and Related Activities

Lake Wenatchee State Park Camping occurs at Lake Wenatchee State Park. See Section 5.1.1.1 for descriptions of facilities.

U.S. Forest Service

The USFS provides camping at Glacier View Campground (23 campsites) and at Nason Creek Campground at the south of the lake (73 campsites). Nason Creek campground has no shoreline on Lake Wenatchee. See Section 5.1.1.1 for further description. Additional shore-related recreation activities on USFS land include hiking along portions of the south shore (Glacier View Campground, leased summer homes, and Camp Zanika). This trail is extensively used by Camp Zanika and cottagers (McMillin pers com).

5.1.2.1.5 Beach Recreation

The southeast shore of Lake Wenatchee State Park provides the best and most expansive public beach on the lake. Small “pocket” beaches occur at the Glacier View Campground and at some lease summer homes on USFS south shore land. A beach area is also present at Camp Zanika.

Beach areas also occur on private properties on the North Shore of the lake, primarily west of University Beach, and at the west end of the lake near the confluence of the White River, but also on the South Shore. Beach recreation is at its highest during the months inundation is proposed. Depending on the alternative, impacts could be dramatic.

5.1.3 River-related Recreation

The objective of this analysis is to determine the magnitude of changes in river-related recreation opportunities and the associated socioeconomic effects that would be expected to occur if the water storage project is placed in operation.

To estimate the effect on recreation occurring on the Wenatchee River, changes in recreation opportunities resulting from changes in river flows and the potential disruption of access to the upper reach of the Wenatchee River as a result of constructing the dam were evaluated. In addition, the analysis considered changes in fishing opportunities on the Wenatchee River as a result of altering the hydrologic characteristics of the Wenatchee River.

The prediction of changes in recreation opportunities was based on the frequency and duration with which recreation quality thresholds were exceeded. A complete discussion of the hydrologic conditions that are expected to occur if the water storage project is placed in operation is included in Section 3 of this report. Recreation quality thresholds developed for this assessment are expressed as the minimum flows required for rafting, kayaking, or participating in other boating activities on the Wenatchee River. The results of hydrologic modeling for the project were applied to determine how frequently river flows would be below or above quality thresholds for the project alternatives compared to frequency these historic conditions.

5.1.3.1 Chelan County

See Section 5.1.2.1 for description of Chelan County recreation.

The following section provides background information on boating and fishing, the two primary recreation activities that could be affected as a result of modifying flows in the Wenatchee River.

5.1.3.2 Boating

5.1.3.2.1 Lake Wenatchee to Plain

Commercial rafting operators and State Parks staff indicated that private and commercial rafting, kayaking, and tubing are the most common boating activities occurring on the Lake Wenatchee to Plain reach of the river (Halsted pers. comm.). The peak period for use on this segment of the river extends from Memorial Day through Labor Day. Most boaters using this reach of the river launch from the boat ramp at Lake Wenatchee State Park (Halsted pers. comm.). Because of the wide variety of boating activities that occur on this reach of the river, no minimum flow threshold was identified or applied in the analysis of effects on recreation opportunities.

5.1.3.2.2 Leavenworth-Downstream

Most commercial white-water boating on the Wenatchee River occurs on the reach downstream of Leavenworth. Most boating activity occurs during the summer months (May through September). June

is typically the peak month (Martin pers. comm.) approximately 12 commercial whitewater boating companies operate in this reach (McMillin pers. comm.)

Although, no official recreation use data is available for this reach of the river, during weekend days over the peak month of June, it is estimated that over 1,000 persons may be rafting on the river per day (Martin pers. comm.). A recent study estimates that per person per trip expenditures for non-motorized boating within the interior Columbia River basin was \$44.63 (US Forest Service 1999). Expenditures made by persons participating in commercial and private boating activities on the Wenatchee River include goods and services such as lodging, food, equipment, and fuel. Based on peak weekend use estimate for the lower reach of the river of 1,000 persons per day, expenditures on this reach could total \$44,600/day. This high level of use suggests boaters on this reach of the river make a substantial contribution to the recreation sector of Chelan County's economy.

Whitewater boating can be accommodated within a wide range of flows in this reach of the river. Because this reach of the river is relatively safe, some boaters will raft or kayak the river during flow events as high as 18,000 cfs (Martin pers. comm.). Based on interviews with whitewater guides, the following minimum flow thresholds for the Leavenworth-downstream reach were developed:

- Whitewater rafting: 3,000 cfs (Moore pers. comm.)
- Rafting: 1,500 cfs (Martin pers. comm.)
- Kayaking: 1,000 cfs (Martin pers. comm.)

5.1.3.3 Fishing

In 1997, the National Marine Fisheries Services designated steelhead runs in the upper Columbia River Basin as in danger of becoming extinct. Because of listing, the river is closed to all fishing, except for a winter whitefish from December through March (Washington Department of Fish and Wildlife, 2002). Because of these restrictions, the river does not support an extensive sport-fishery.

A detailed description of project effects on aquatic habitat is provided in Section 6. As indicated in that section, the quality of aquatic habitat in the Wenatchee River is not expected to substantially change as a result of the water supply project. Because no change in aquatic habitat is expected, the existing quality of the sport-fishery is not expected to change.

5.1.4 Cultural Resources

The topics covered in the cultural resource analysis include descriptions of previously recorded archaeological sites and historic properties within the project area; findings from field reconnaissance; a list of potential cooperating state, federal, and Tribal entities that could be involved on the project; and an analysis of the potential impacts to cultural resources.

Study methodology included review of existing resource records, communications with the Washington State Office of Archaeology and Historic Preservation (OAHP) (pers. comm. Rob Whitlam), the U.S. Forest Service (USFS) (pers. comm. Powys Gadd), the Washington State Department of Parks and Recreation (pers. comm. Dan Meatte), and field reconnaissance surveys.

On April 21, 2003, a Jones & Stokes' cultural resource specialists inspected the Area of Potential Effect (APE) (a term used in evaluating the effect of a proposed action on cultural resources), for the proposed impoundment structure. For this project, the cultural resources APE would consist of the entire shoreline around Lake Wenatchee and both the north and south banks of the Wenatchee River from the lake outlet to the proposed impoundment structure. The APE would include the ordinary high water elevation (OHW, elevation 1870.3 feet) and an elevation of 1872.4 feet (NGVD29).

Due to the sensitive nature of the information gathered, Chelan County has elected to exclude the cultural resources report compiled by Jones & Stokes from the final report. The County will maintain this information on file in its Natural Resource Program. Excluding this information from the final report is in accordance with RCW 42.17.310(1) (K), the Public Disclosure Act, which exempts from disclosure "records, maps, or other information identifying the location of archaeological sites in order to avoid the looting or depredation of such sites."

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5.2 EFFECTS OF PROPOSED PROJECT OPERATIONS

5.2.1 Land Use

The impact to any given parcel requires a case-by-case evaluation, a level of effort beyond the scope of this project. Other anecdotal information indicated the lowest finished floor level of buildings around Lake Wenatchee to be 1876 feet, or 3.6 feet above the highest level proposed for increased summer-time water storage.

5.2.1.1 Changes in Property Value

5.2.1.1.1 Alternatives 1,2 and 3

Under these alternatives the water elevations in the lake would be held during the mid-July through mid-October period at an elevation approximately two feet higher than the OHW (El. 1870.3 ft). Water elevations in the lake would not be controlled during the remaining months - mid-October through early July. Based on 26 years of data, water elevations equal to or greater than 1872.4 occur 4.6 percent of the time. Under these alternatives, water elevations equal to or greater than 1872.4 would occur 12.3 percent of the time.

Under these alternatives, summer time water levels would be held at an elevation up to 3.9 feet higher than the water levels that occur under current conditions. Based on review of the water level duration curve (see Section 3 for discussion), this alternative would result in the establishment of a water elevation for a two-month time frame (17 percent of each year) that, under current conditions, occurs less than 4 percent of the time each year. This elevation currently occurs as a series of short-time events, primarily during May and June rather than as a long-duration event.

Observations made during the May 14th field visit, indicated that an elevation of 1872.4 would result in a loss of beach and shallow water shoreline on much of the lake. There would also likely be shoreline erosion and vegetation mortality associated with the higher lake level. Over time substrate in the higher shoreline will stabilize and become devoid of vegetation. Additionally, damage due to erosion and wind-wave action could be substantial.

5.2.1.1.2 Alternatives 4 and 5

These alternatives would result in the maintenance of Ordinary High Water (El. 1870.3 ft) in the lake from mid-July through mid-October (see hydrology discussion in Section 3). Water elevations in the lake would not be controlled during the remaining months - mid-October through early July. Based on 26 years of data, water elevations equal to or greater than 1870.3 occur 17 percent of the time annually, and 40 percent of the time during the proposed storage period for this project. Under these alternatives, water elevations equal to or greater than 1870.3 would occur 75 percent of the time.

By their very locations, shoreline properties on Lake Wenatchee are subject to the range and variability of seasonal lake water elevations, wind-generated waves and to the less frequent major flood events. As previously mentioned, water elevations greater than or equal to OHW occur on Lake Wenatchee approximately 17 percent of the time each year (see Hydrology section of this study). According to County staff, some lots and structures are located at lower elevations thereby making them more

susceptible to flooding and potential property damage during the higher water events. Several of these properties were observed during May 14th field visits.

Property values of shoreline properties currently reflect the locations of the properties on the lake (north or south shores). Table 5-1 depicts the differences in values. Under these alternatives, the OHW elevation would be maintained during the mid-July through mid-October. During the same timeframe, under current conditions, the lake elevation gradually lowers to approximately 2.2 feet below OHW in mid-September.

Based on the literature review, discussions with the Chelan County Assessors Office regarding property values, the assessed value of property on Lake Wenatchee relates only to linear frontage of shoreline as opposed to total square footage of shoreline area. Based upon these findings, the OHW elevation under this alternative would impact only those landowners holding rights to second class shorelands. In addition, this taking may impact individual owners' sense of value where their properties about public second-class shorelands, due to restriction of access to existing seasonal beaches in the public domain exposed when the water is below OHW. There is no information regarding the discriminating factors potential property buyers use when considering the purchase of shoreline property on the lake and the role of the appearance of the lake at OHW as a factor in deciding whether to purchase property is not known.. Although not a part of this study, a well-framed survey of potential property buyers and property sellers around the lake would provide insight as to the importance of such factors and should be combined with a survey of current owners and residents.

5.2.1.2 Effect on Property Improvements

5.2.1.2.1 Alternatives 1, 2, and 3

As previously mentioned, under these alternatives, summer time water levels would be held at an elevation ranging from 2.7 to 3.9 feet higher than the water levels that occur under current conditions. At this higher elevation, some existing shoreline improvements may be impacted by the higher sustained water elevation and wind-driven waves. As examples, the higher elevation could result in saturated soil conditions that could affect footings, septic tanks and STEP (Septic Tank Effluent Pump) sewer system connections, fixed docks and boathouses, and other improvements as presented in Table 5.1-2.

According to the wind and wave erosion assessment conducted and presented in Section 3, there is likely to be more wave erosion if the lake is maintained at 1872.4 feet since that elevation would more deeply submerge structures and portions of the shoreline that are not usually submerged.

The actual effect on individual properties on the lake was not a part of this study, but would be needed in the event this alternative was brought forward to the next level of study.

5.2.1.2.2 Alternatives 4 and 5

As mentioned above, shoreline properties on Lake Wenatchee are subject to the range and variability of seasonal lake water elevations, wind-generated waves, and flooding under current conditions. Because of such exposure, properties have developed to account for the risks of high or variable water elevation conditions. Homes and associated improvements have been set back from OHW while others have been protected through the use of revetments and bulkheads. Other structures such as boat houses and fixed docks have been constructed with the knowledge that, during times of the year, those structures or

portions of those structures may be submerged or partially submerged as a result of seasonally high water. Other structures, such as floating docks and diving floats, have been constructed, through the use of adjustable anchoring devices, to accommodate the annual variability in water elevations.

According to the wind and wave erosion assessment conducted and presented in Section 3, it is likely that very little additional erosion would occur if the lake were maintained at 1870.3 feet. The threshold elevation where increased wave energy will cause erosion is not known, but it is likely higher than OHW.

Based on review of the lake elevation data, a hydrographs and field observations, there would be little or no impact of this alternative on property improvements. The change in water elevations under this alternative would not result in a change in shoreline conditions that would vary significantly from current conditions.

5.2.2 Lake-related Recreation

5.2.1.1 Boating

5.2.2.1.1 Alternatives 1, 2, and 3

Under these alternatives the water elevations in the lake would be held during the mid-July through mid-October period at an elevation approximately two feet higher than the El 1870.3 alternative. Water elevations in the lake would not be controlled during the remaining months - mid-October through early July. Under an average water year, water elevations equal to or greater than 1872.4 occur 4.6 percent of the time. Under this alternative, water elevations equal to or greater than 1872.4 would occur 12.3 percent of the time.

Maintenance of a water elevation of 1872.4 feet would result in greater usable lake surface area over a longer summer period than currently occurs. At the Glacier View Campground, this higher elevation would reduce the area available to launch boats (Photograph 5.2-1), while at Lake Wenatchee State Park at majority of the concrete boat ramp would be under water (Photograph 5.2-2). The higher water conditions would also affect access to the dock adjacent to the park ramp (Photograph 5.2-2). Boaters would need to wade through water to reach the dock. Ultimately the dock would need to be modified (i.e., extended or rebuilt) to allow access from the shore.



Photograph 5.2-1. Estimated 1872.4 feet Water Elevation at the Glacier View Campground Boat Launch.



Photograph 5.2-2. Estimated 1872.4 t Water Elevation at the Lake Wenatchee State Park Campground Boat Launch.

Cost to extend the concrete boat ramp at Lake Wenatchee State Park is estimated to be approximately \$1,800. Cost for an extension of access to the boat launch is estimated to be \$3,000.

5.2.2.1.2 Alternatives 4 and 5

As previously mentioned, OHW water elevation conditions commonly occur on the lake under current conditions. Based on review of the lake elevation data and hydrographs and field observations, there would be little or no negative impact of these alternatives on boating.

Beneficial impacts of the higher water elevation will include greater ease in launching boats at the boat ramps and the reduced risk of damage to boats and motors caused by shallow-water conditions around the lake that now occur late in the summer.

5.2.2.2 Fishing

5.2.2.2.1 Alternatives 1, 2, and 3

Based on review of the lake-elevation data and hydrographs and field observations, there would be little or no impact of these alternatives on lake fishing. Overall, there may be some reduction in fishing opportunities from the shore, but an increase in fishable water within the lake.

The impact on fish resources is presented in the Section 6 Environmental Impacts section of this report.

5.2.2.2.2 Alternatives 4, and 5

The impact of these alternatives on fishing would be similar to the impacts defined for Alternatives 1,2, and 3 above.

5.2.2.3 Wind Surfing

5.2.2.3.1 Alternatives 1, 2, and 3

The impacts of these alternatives on wind surfing would be similar to those defined for boating beach access.

5.2.2.3.2 Alternatives 4 and 5

With the exception of reduced beach area for access and egress, there would be little or no impact of these alternatives on wind surfing.

5.2.2.4 Camping and Related Activities

5.2.2.4.1 Alternatives 1, 2 and 3

Under these alternatives, the lake water elevation would be held during the mid July through mid-October period at an elevation approximately two feet higher than under Alternatives 4 and 5.

As previously mentioned, maintenance of that water elevation would result in the loss of beach and open shoreline on the lake. Based on field observations and estimates of elevations conducted in mid-May, this alternative would impact portions of the Glacier View Campground and USFS south shore trail from Glacier View Campground south to Camp Zanika. An elevation of 1872.4 would affect firepits at several campsites at Glacier View, and inundate low-elevation sections of the south shore trail. Shoreline trails at Lake Wenatchee State Park may also be affected. Additionally, hiking on the shoreline below OHW would be completely eliminated around the lake.

Under these alternatives, private docks and launches elsewhere on the lake may need to be modified to account for the increased water elevation. The impacts to property improvements such as docks and launches is presented in the Land Use section.

In addition to the impacts on structures, these alternatives would also reduce boater access to the shoreline because of the loss of beach areas that are used as defacto launch locations during the summer. For some properties, the water line at the 1872.4 elevation would be at the tree line, an area that is generally rocky or covered with logs, downed trees, and other debris drifted on the shoreline from the White River or other shoreline areas of the lake (based on field observations made during the May 14, 2003 site visit). Other properties may be clear of vegetation and logs.

5.2.2.4.2 Alternatives 4 and 5

Based on review of the lake elevation data, hydrographs and field observations, there would be little or no impact of this alternative on camping and related activities, with the exception of beach related activities.

5.2.2.5 Beach Recreation

5.2.2.5.1 Alternatives 1, 2, and 3

Under each of the Elevation 1872.4 Alternatives, all but the largest beach areas would be under water. Based on field measurements and observations taken on May 14th, the beach at Lake Wenatchee State Park would be the one remaining beach at this elevation having exposed sand. The base of the survey rod

shown in Photograph 5.2-3 depicts the estimated 1872.4 elevation at Camp Zanika, while Photograph 5.2-4 shows the beach area that would be impacted at Lake Wenatchee State Park. Opportunities for beach recreation on the lake would be curtailed for all but the Lake Wenatchee State Park beach.



Photograph 5.2-3. Water line at Camp Zanika Beach approximates OHW Alternative while base of survey rod depicts approximate El. 1872.4. Water elevation on this date were approximately at OHW 1870.3.



Photograph 5.2-4. Base of survey rod depicts approximate water elevation for the 1872.4 Alternative at Lake Wenatchee State Park Beach.

5.2.2.5.2 Alternatives 4 and 5

The impact of the OHW Alternatives on beach recreation would be a reduction in the amount of exposed beach around the lake from mid-July through the end of summer. Under current conditions, the amount of exposed beach varies during the summer months, particularly during the first half of July when water elevations are typically above OHW (see Hydrology section for a discussion of seasonal water levels). Lake water elevations typically fall below OHW from mid-July until November, thereby exposing more beach for recreation.

The impact would be more noticeable along those portions of the shoreline that have limited beach at OWH or higher, but rely on the declining water elevations to provide greater beach area. This reduction in beach area could limit such uses as picnicking, shore fishing and sunbathing. Photograph 5.2-4 shows a portion of the beach at Camp Zanika. The water elevation at the time of the photograph was within several tenths of a foot of OWH and is a reasonable representation of water conditions would be at this beach under the OWH alternative.

5.2.3 River-related Recreation

This section describes the effects on boating as a result of operating the water storage project. As described above, the project is expected to have no affect on the Wenatchee River sport fishery.

5.2.3.1 Lake Wenatchee to Plain

Tables 5.2-1 and 5.2-2 show the change in outflow from Lake Wenatchee estimated for Alternative 2 (200 cfs discharge) and Alternative 5 (100 cfs discharge).

Table 5.2-1. Changes in outflow from Lake Wenatchee under Alternative 2 Compared to Historic Conditions.

YEAR	Cubic Feet / Second											
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1933	1	-2	2	0	0	0	-2	0	5	-107	-14	120
1934	10	24	-1	-1	-1	-7	24	-10	-6	-153	14	145
1935	2	-1	-2	13	-14	-1	-3	1	3	-141	2	143
1936	-1	-1	-1	0	0	0	2	-4	6	-169	16	155
1937	0	-1	0	-1	0	-1	0	5	-9	-151	9	152
1938	2	-2	-4	2	0	0	-7	17	-7	-166	11	157
1939	0	-1	-3	3	-1	-1	-4	11	-15	-134	-4	153
1940	0	-4	2	0	0	0	3	-8	-126	-44	19	159
1941	0	-3	2	0	0	-3	1	2	-150	-33	30	154
1942	1	-3	2	0	0	0	2	2	-8	-159	18	149
1943	1	-1	-1	1	0	-1	2	5	-14	-106	-16	137
1944	0	0	0	0	-1	0	-4	2	-130	-45	16	163
1945	-1	-1	0	1	0	-1	2	-9	12	-169	12	159
1946	4	-5	-1	1	0	0	2	6	-8	-131	-3	140
1947	3	-4	1	2	-3	-2	1	6	0	-154	1	153
1948	1	-2	0	-1	1	-1	2	24	-28	-137	7	137
1949	1	0	-1	0	0	1	-3	5	1	-131	-10	142
1950	1	21	-24	1	-1	0	0	1	-15	-91	-5	114
1951	1	1	2	-3	0	-1	1	6	-5	-144	4	142
1952	2	-1	-1	-1	1	0	7	1	-4	-151	8	146
1953	1	-1	0	-5	6	-1	3	-3	-2	-120	-6	133
1954	-4	4	0	0	0	0	1	0	-1	-70	-6	81
1955	-1	5	-5	0	0	1	0	-2	4	-97	-25	125
1956	5	-4	0	-1	0	-1	6	-15	15	-131	3	127
1957	2	-1	2	-2	-3	2	-15	9	8	-161	17	147
1958	-6	6	0	-1	1	-1	-2	16	-10	-165	16	151
Average	1	1	-1	0	-1	-1	1	3	-19	-125	4	142

YEAR	Percent Difference											
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1933	0%	0%	0%	0%	0%	0%	0%	0%	0%	-3%	-1%	21%
1934	1%	1%	0%	0%	0%	0%	1%	0%	0%	-14%	3%	51%
1935	0%	0%	0%	1%	-1%	0%	0%	0%	0%	-6%	0%	33%
1936	0%	-1%	-1%	0%	0%	0%	0%	0%	0%	-17%	4%	54%
1937	0%	-1%	0%	0%	0%	0%	0%	0%	0%	-7%	2%	53%
1938	1%	0%	-1%	0%	0%	0%	0%	0%	0%	-11%	3%	60%
1939	0%	0%	-1%	0%	0%	0%	0%	0%	-1%	-8%	-1%	61%
1940	0%	-1%	0%	0%	0%	0%	0%	0%	-5%	-6%	6%	60%
1941	0%	-1%	0%	0%	0%	0%	0%	0%	-11%	-6%	9%	34%
1942	0%	0%	0%	0%	0%	0%	0%	0%	0%	-12%	4%	65%
1943	1%	0%	0%	0%	0%	0%	0%	0%	0%	-3%	-2%	38%
1944	0%	0%	0%	0%	0%	0%	0%	0%	-6%	-6%	5%	46%
1945	0%	0%	0%	0%	0%	0%	0%	0%	0%	-14%	3%	51%
1946	1%	-1%	0%	0%	0%	0%	0%	0%	0%	-6%	0%	45%
1947	1%	-1%	0%	0%	0%	0%	0%	0%	0%	-10%	0%	49%
1948	0%	0%	0%	0%	0%	0%	0%	1%	0%	-8%	1%	31%
1949	0%	0%	0%	0%	0%	0%	0%	0%	0%	-6%	-1%	30%
1950	0%	1%	-2%	0%	0%	0%	0%	0%	0%	-2%	0%	25%
1951	0%	0%	0%	0%	0%	0%	0%	0%	0%	-7%	1%	41%
1952	0%	0%	0%	0%	0%	0%	0%	0%	0%	-9%	1%	56%
1953	1%	-1%	0%	0%	0%	0%	0%	0%	0%	-4%	-1%	35%
1954	-1%	0%	0%	0%	0%	0%	0%	0%	0%	-2%	0%	9%
1955	0%	0%	-1%	0%	0%	0%	0%	0%	0%	-3%	-2%	27%
1956	1%	0%	0%	0%	0%	0%	0%	0%	0%	-4%	0%	26%
1957	0%	0%	0%	0%	-1%	0%	-1%	0%	0%	-14%	3%	47%
1958	-2%	2%	0%	0%	0%	0%	0%	0%	0%	-17%	4%	44%
Average	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-8%	2%	42%

Table 5-2-2. Changes in outflow from Lake Wenatchee Outflow Alternative 5 Compared to Historic Conditions

YEAR	Cubic Feet / Second											
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1933	0	-2	2	0	0	0	-2	0	5	-17	-28	40
1934	10	26	-1	-1	-1	-7	24	-10	-6	-63	-1	67
1935	1	0	-2	13	-14	-1	-3	1	3	-51	-13	64
1936	-1	-1	-1	0	0	0	2	-4	6	-79	2	77
1937	0	0	0	-1	0	-1	0	5	-9	-61	-6	74
1938	1	0	-4	2	0	0	-7	17	-7	-76	-4	78
1939	0	-1	-3	3	-1	-1	-4	11	-15	-44	-16	72
1940	0	-4	2	0	0	0	3	-8	8	-83	5	80
1941	0	-3	2	0	0	-3	1	2	-57	-33	15	76
1942	0	-2	2	0	0	0	2	2	-8	-68	4	71
1943	0	0	-1	1	0	-1	2	5	-14	-16	-31	58
1944	0	0	0	0	-1	0	-4	2	-37	-45	2	85
1945	0	-1	0	1	0	-1	2	-9	12	-79	-3	81
1946	2	-4	-1	1	0	0	2	6	-8	-41	-17	61
1947	3	-3	1	2	-3	-2	1	6	0	-64	-13	75
1948	1	-2	0	-1	1	-1	2	24	-28	-47	-7	59
1949	1	0	-1	0	0	1	-3	5	1	-40	-24	64
1950	0	23	-24	1	-1	0	0	1	-15	-1	-19	36
1951	1	1	2	-3	0	-1	1	6	-5	-54	-11	62
1952	4	0	-1	-1	1	0	7	1	-4	-61	-10	71
1953	0	-1	0	-5	6	-1	3	-3	-2	-30	-21	54
1954	-5	6	0	0	0	0	1	0	-1	2	-5	6
1955	-1	5	-5	0	0	1	0	-2	4	-10	-37	46
1956	4	-4	0	-1	0	-1	6	-15	15	-41	-11	48
1957	3	-1	2	-2	-3	2	-15	9	8	-71	3	69
1958	-9	8	0	-1	1	-1	-2	16	-10	-74	4	70
Average	1	2	-1	0	-1	-1	1	3	-6	-48	-9	63

YEAR	Percent Difference											
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1933	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-2%	7%
1934	1%	1%	0%	0%	0%	0%	1%	0%	0%	-6%	0%	23%
1935	0%	0%	0%	1%	-1%	0%	0%	0%	0%	-2%	-2%	15%
1936	0%	-1%	-1%	0%	0%	0%	0%	0%	0%	-8%	1%	27%
1937	0%	0%	0%	0%	0%	0%	0%	0%	0%	-3%	-1%	26%
1938	0%	0%	-1%	0%	0%	0%	0%	0%	0%	-5%	-1%	30%
1939	0%	0%	-1%	0%	0%	0%	0%	0%	-1%	-3%	-3%	29%
1940	0%	-1%	0%	0%	0%	0%	0%	0%	0%	-11%	1%	30%
1941	0%	-1%	0%	0%	0%	0%	0%	0%	-4%	-6%	5%	17%
1942	0%	0%	0%	0%	0%	0%	0%	0%	0%	-5%	1%	31%
1943	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-3%	16%
1944	0%	0%	0%	0%	0%	0%	0%	0%	-2%	-6%	1%	24%
1945	0%	0%	0%	0%	0%	0%	0%	0%	0%	-6%	-1%	26%
1946	0%	-1%	0%	0%	0%	0%	0%	0%	0%	-2%	-2%	20%
1947	1%	-1%	0%	0%	0%	0%	0%	0%	0%	-4%	-2%	24%
1948	0%	0%	0%	0%	0%	0%	0%	1%	0%	-3%	-1%	13%
1949	0%	0%	0%	0%	0%	0%	0%	0%	0%	-2%	-3%	14%
1950	0%	1%	-2%	0%	0%	0%	0%	0%	0%	0%	-1%	8%
1951	0%	0%	0%	0%	0%	0%	0%	0%	0%	-3%	-2%	18%
1952	0%	0%	0%	0%	0%	0%	0%	0%	0%	-4%	-2%	27%
1953	0%	-1%	0%	0%	0%	0%	0%	0%	0%	-1%	-2%	14%
1954	-1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
1955	0%	0%	-1%	0%	0%	0%	0%	0%	0%	0%	-3%	10%
1956	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	10%
1957	0%	0%	0%	0%	-1%	0%	-1%	0%	0%	-6%	1%	22%
1958	-4%	2%	0%	0%	0%	0%	0%	0%	0%	-8%	1%	20%
Average	0%	0%	0%	0%	0%	0%	0%	0%	0%	-4%	-1%	19%

5.2.3.1.1 Alternatives 1, 2, and 3

Using Alternative 2 as a proxy, Table 5.2-1 shows there would be no substantial change in outflow from Lake Wenatchee over the October-July period. The largest change would occur during July, with an average decrease of 130 cfs from historic outflow. This decrease in flows represents a change of approximately 8 percent of historic flow. Flows would then increase during August-September, peaking in September with an average increase of 130 cfs or 39 percent of the historic flow. Because operation of

the project would result in only a small decrease in river flows during most peak-season months and a small increase during September, no change in boating opportunities on the Lake Wenatchee to Plain reach of the river are expected.

The dam would result in a barrier to access to the upper reach of the Wenatchee River for boaters launching craft from Lake Wenatchee State Park. The boat ramp at the State Park is the primary launch site for this reach of the river. Presently, no formal river access sites suitable for launching watercraft occur downstream of the proposed dam. Constructing the dam at the proposed location would adversely affect access to the river because boaters would be required to portage around the dam or carry watercraft downstream from the State Park parking area and launch at undesignated sites downstream of the dam. Additionally, requiring a portage so close to the launch site could adversely impact the quality of the boating experience. In addition, the presence of the dam immediately downstream of the launch could pose an unnecessary safety hazard.

In the absence of a formal survey of boaters, the magnitude in the reduction in boating on this segment of the river cannot be quantified. However, because the State Park boat ramp is the primary river access point, use on this reach of the river will decrease because of difficulty of portaging around the dam or accessing the river below the dam. This would result in a reduction in expenditures in the local and regional economy made by persons boating this reach of the river. In addition, fees collected by the State Park may decrease as a result of a decrease in the demand for parking and launching facilities.

5.2.3.1.2 Alternatives 4 and 5

Using Alternative 5 as a proxy, Table 5.2-2, shows that there would be no substantial change in outflow from Wenatchee over the October-June period. The largest change would occur during July, with an average decrease of 49 cfs from historic outflow. This decrease in flows represents a change of approximately 4 percent of historic flow. Flows would then increase during August-September, peaking in September with an average increase of 130 cfs or 39 percent of the historic flow. As indicated above, no minimum flows were identified for this reach of the river, however, because operation of the project would result in small decrease in river flows during most peak-season months and a small increase during September, no change in boating opportunities are expected.

The effects on recreation associated with construction of the dam would be the same as described for Alternatives 1, 2, and 3.

5.2.3.2 Leavenworth-Downstream

Tables 5.2-1 and 5.2-2 show the average monthly changes in river flow downstream of the USGS Peshastin gage (Gage 12459000) for Alternatives 2 and Alternative 5. These flows were used as a proxy for the change in flows for all alternatives expected on the reach of the Wenatchee downstream of Leavenworth.

5.2.3.2.1 Alternatives 1, 2, and 3

As shown in Table 5.2-1, under Alternative 2 there would be no substantial change in river flows during the October-June period. The largest change would occur during July, with an average decrease of 130 cfs from historic outflow. This decrease in flows represents a change of approximately 4 percent of

historic flow. Flows would then increase during August and September. Flows would increase in September by approximately 131 cfs or 18 percent increase relative to historic flow.

Table 5.2-2 presents the results of the flow threshold analysis. During the peak season there would be no change in the frequency minimum whitewater rafting are met. Minimum flows required for whitewater rafting would be met in two fewer months over the 26-year modeling period, or a 1.5 percent change compared to historic conditions. However, minimum flows for kayaking would be met in two additional months during the peak season. There would be no change in the frequency minimum boating flows occur during the off-season recreation period. The small change in flows would not affect boating opportunities occurring on the reach of Wenatchee River downstream of Leavenworth.

5.2.3.2.2 Alternatives 4 and 5

As shown in Table 5.2-2, under Alternative 5 there would be no substantial change in river flows during the October-June period. The largest change would occur during July, with an average decrease of 50 cfs from historic outflow, representing a decrease of approximately 2 percent compared to historic flow. Flows would then increase during September by approximately 61 cfs or a 9 percent increase relative to historic flow.

Table 5.2-2 presents the results of the flow threshold analysis for Alternative 5. During the peak season there would be no change in the frequency minimum flows for kayaking and whitewater rafting are met. Minimum flows required for whitewater rafting would be met in two fewer months over the 26-year modeling period, or a 1.5 percent change compared to historic conditions. However, minimum flows for kayaking would be met in two additional months during the peak season. There would be no change in the frequency minimum flows for boating is met during the off-season recreation period. The operation of the project is not expected to result in small change in flows would not affect boating activities occurring on the reach of Wenatchee River downstream of Leavenworth.

5.2.4 Cultural Resources

5.2.4.1 Alternatives 1, 2, and 3

Under these alternatives the water elevations in the lake would be held during the mid-July through mid-October period at an elevation approximately two feet higher than OHW. Water elevations in the lake would not be controlled during the remaining months - mid-October through early July. Based on 26 years of data, water elevations equal to or greater than 1872.4 occur 4.6 percent of the time. Under this alternative, water elevations equal to or greater than 1872.4 would occur 12.3 percent of the time.

As would occur under Alternatives 4 and 5, this increase in duration could impact archaeological deposits of the Headwaters site by prolonging the saturation of artifact-bearing sediment and increasing the risk of erosion as a result of wave action. The magnitude of this impact could be greater than under Alternatives 4 and 5 because of the prolonged exposure of soil and vegetation to inundation and saturation during the summer months, a time of the year when shoreline vegetation and soils are not inundated. Prolonged flooding would result in mortality and/or reduced vigor of shoreline vegetation and roots. Loss of roots would result in reduced soil binding and subsequent increases in soil erosion. The loss of root mass and soil could further expose the Headwater site and undiscovered archaeological materials elsewhere along the shoreline of the lake.

5.2.4.2 Alternatives 4 and 5

These alternatives would result in the maintenance of the Elevation 1870.3 water elevation in the lake from mid-July through mid-October (a complete discussion of this alternative is included in Section 3.0 Technical Feasibility). Water elevations in the lake would not be controlled during the remaining months - mid-October through early July.

This increase in duration could impact archaeological deposits of the Headwaters site by prolonging the saturation of artifact-bearing sediment and increasing the risk of erosion as a result of wave action.

Construction of the inflatable dam along the north bank of the Wenatchee River could potentially impact the Headwaters site and potentially expose previously undiscovered sites.

The south bank of the Wenatchee River, from the proposed dam site to the outlet of Lake Wenatchee, maintains a high probability for unknown cultural resources due to the existence of site 45CH208 across the river, limited development of the shoreline, and the ethnographic data detailing tribal use of the area.

The Lucky Break site would not be impacted as a result of the construction of the proposed impoundment facility.

No historic structures or resources would be subject to effect from the construction and maintenance / operation of the proposed impoundment facility.

5.3 CONCLUSIONS AND RECOMMENDATIONS

5.3.1 Land Use

Impact of the Lake Wenatchee Water Storage Project on property values and property improvements would vary with alternative.

Under Alternatives 1, 2, and 3, increase in water elevations could affect shoreline property values and potentially slow the rate of increase in property values, affect shoreline access, and affect facilities and improvements located near the shoreline. Purchase of overflow easements for both second-class shorelands and lands above the OHWM would be necessary and, for the scenario presented, would range in cost from \$6.1 to \$15.3 million.

This alternative could impact improvements located near the shoreline because of the higher sustained water elevations. Improvements and facilities such as footings, septic tanks, fixed docks, and boathouses could be damaged and require relocation or renovation. The level of risk for each property would vary based on such factors as slope, shoreline material (e.g., cobble, sand), elevations of structures, and property location on the lake. For example, shorelines would be more susceptible to higher wave heights and energy (and associated shoreline erosion).

At present, there are no studies or data outlining the discriminating factors potential property buyers consider when searching for lake front property to buy. A well-framed survey of potential property buyers and sellers around the lake would provide insight as to the importance of such factors. Such a study should be undertaken in the event this alternative is considered further. Additionally, if the El 1872.4

Alternative is to be evaluated further, a detailed study should be initiated to determine specific impacts to properties.

Under the OHW alternatives (Alternatives 4 and 5), there would be less effect on property values as a whole. For some properties, there would be a loss or reduction of access to beaches inundated up to the OHW. The value of the loss of use of these public lands adjacent to private land has not been quantified as part of this study. This relationship should be studied further at the time valuation of individual properties takes place in order to determine if this value can be included in determining compensation to the landowner. Purchase of overflow easements for privately-owned second-class shorelands only would be necessary and, for the scenario presented, would range in cost from \$1.4 to \$3.5 million.

5.3.2 Lake-related Recreation

As indicated above, operation of the Lake Wenatchee Water Storage Project would result in variable impacts to lake-related recreation based on the activity and the alternative water elevation.

Under Alternatives 4 and 5 (OHW alternative), the greatest definable impact would be on beach recreation, with little or no adverse impact to boating (except for a reduction in beach access), fishing, wind surfing, or camping. Some benefits would include greater ease in launching boats at boat ramps and may reduce risk of damage to boats and motors caused by shallow-water conditions.

Under Alternatives 1, 2, and 3 (Elevation 1872.4), the most significant effects would be to beach recreation and camping and related activities (shoreline hiking, sun bathing, e.g.). Launch ramps at Glacier View Campground and at the Lake Wenatchee State Park would be inundated, as would the access to the dock adjacent to the Park's boat ramp. Under each of these three alternatives, the dock would need to be modified (extended or rebuilt) to allow access from the shore. Estimated costs of modifications for the boat ramp and launch access is \$4,800.

The proposed location of the dam could have an adverse impact on boater's safety. Due to its proximity to the boat launch, the dam could be a safety hazard for boats that stall and drift towards the dam with the river current.

5.3.3 River-related recreation

As indicated above, operation of the Lake Wenatchee Water Storage Project should result in no adverse effect on whitewater boating and rafting as a result of the proposed changes in flows. The operation of the project is not expected to result in either a beneficial or adverse effect on the regional economy because use associated with river flows is not expected to change.

The proposed location of the dam between the north and south banks of the State Park and downstream of the present boat launching facility for down-river users would have an adverse effect. Constructing the dam at the outlet of Lake Wenatchee would disrupt boating access to the upper reach of the Wenatchee River. Because Wenatchee State Park is the only suitable launch site to the upper reach of the river, the dam would act as a barrier and potential safety hazard for boaters floating the segment between Lake Wenatchee and Plain.

To ensure access to the river is maintained, the project sponsors should ensure the dam includes a portage or a replacement launch facility is constructed downstream of the dam. Because a portage facility would require boaters to exit the river soon after launching from the existing State Park boat ramp, a new launch ramp would better facilitate access to the river. Site visits indicated a replacement launch ramp could be constructed on state property located on the south side of the river just downstream of the dam site. To reduce costs, this facility could utilize access roads and staging areas that will be needed to facilitate construction of the dam.

An order of magnitude cost estimate for constructing a launch for rafts, kayaks, and other non-motorized watercraft was conducted. Elements of the launch ramp facility would include constructing an access road, parking lot, boat launch, rest room, and signage. Construction costs were estimated to total \$165,000.

5.3.4 Cultural Resources

The findings from the cultural resource analysis identified a component of a previously recorded Headwaters archaeological site (45CH208). The 1990 floods experienced in the upper Wenatchee River watershed exposed and destroyed a large portion of the site.

Consultation (government to government) with all affected Native American Tribes, USFS/Wenatchee National Forest, Lake Wenatchee State Parks, and Washington State Office of Archaeology and Historic Preservation is recommended in the event this project moves forward. A Memorandum of Agreement between the state and federal agencies would need to be entered into to mitigate for effects to site 45CH208 and other potential resources. Government-to-government dialogue should be early, often, and continuous throughout the duration of the project.

During project planning, a professional archaeologist should conduct a systematic survey of site 45CH208, the dam site and other project elements such as access roads. A series of shovel test probes should be excavated near the footprint of the impoundment structure to establish the extent of the archaeological deposits in the area. The margin around Lake Wenatchee and the upper Wenatchee River watershed maintain a high probability for unknown archaeological resources (pers. comm. Powys Gadd 2003). A professional archaeologist should systematically survey all high probability locations along the lake and river's margin. This survey and shovel probe series should follow the established guidelines and standards of the Wenatchee National Forest and Washington State Parks.

Cultural resources located on federal property and on other lands involved in projects utilizing federal funding or requiring federal permits are protected by Section 106 of the National Historic Preservation Act of 1966, as amended. Washington law makes it unlawful on private or state lands to knowingly damage, deface or destroy any prehistoric or historic archaeological resource or site. Under Washington State law (RCW 27.53), no subsurface disturbance can legally be conducted inside the boundaries of an area determined to represent an archaeological site or resource locale without first being issued an excavation permit from the Washington State Office of Archaeology and Historic Preservation in Olympia.