Chelan County
Natural Resource
Program

Lake Wenatchee Water Storage Feasibility Study

June 2003

MWH
MONTGOMERY WATSON HARZA

in association with

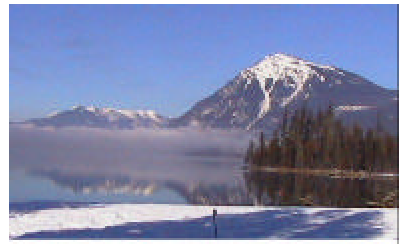
MONTGOMERY WATER GROUP, INC.

Jones & Stokes

R2

Executive Summary

Lake Wenatchee Water Storage Feasibility Study—June 2003



Executive Summary
Why is this study being done?

- The focus on reviewing all potential solutions to shortfalls in in-stream flow and water supply was sharpened in the drought year of 2001, when streamflows dropped to historic lows in late summer and many water users across the state had their water supply interrupted as a result.
- The Wenatchee River Watershed is listed as one of the State's sixteen "critical basins" because of the presence of Endangered Species Act (ESA) listed species, development pressures and the potential for future water shortages.
- Chelan County Natural Resources Department is leading the Wenatchee Watershed Planning effort, which is to identify and study solutions to watershed problems such as in-stream flow, water quantity, water quality and fish and wildlife habitat. The County is also the recipient of the water storage grant from the State and is administering the process of completing this feasibility study.
- A project team consisting of a diverse group of public, local agency (city and county), irrigation, conservation, state, federal and tribal interests was assembled to direct the content of this study. Meetings were held in 2001—2003 to prepare a scope of study, select a consultant and review study products.

This study results from a Washington State Legislature grant to study the feasibility of storing additional water in Lake Wenatchee. The Legislature acted upon recommendations of the State's Water Storage Task Force to study the issue of water storage across the State. Many other Watersheds throughout the State are also performing studies of the potential for increased water storage to meet the increasing competitive needs of fish, farms and people.

The Legislature appropriated funds for this study because of its location within the Wenatchee River Watershed, the history of past water storage studies and permits on Lake Wenatchee and ongoing efforts in Watershed Planning undertaken by the Wenatchee Watershed Planning Unit. Previous studies and planning on water storage in Lake Wenatchee were performed by the Wenatchee Reclamation District and Chelan County PUD. The Wenatchee Reclamation District initiated a water storage project in 1930 in response to drought conditions in the Wenatchee River Watershed. They obtained permits to construct a low dam near the mouth of the Lake which would impound water to the normal high water elevation. The project was not completed and Chelan County PUD acquired the permits from the District. The PUD envisioned a water storage project that was a component of a larger hydroelectric project. That project was dropped in the 1970's and the rights reassigned back to the District.

Five broad study areas were selected by the project team to cover the scope of the feasibility study. They are noted below as well as the objective they are intended to address:

Water Needs. Determine the water needs of the Wenatchee River watershed and how additional water supplies should be apportioned between fish and community interests.

Technical Feasibility. Evaluate the technical feasibility of constructing a dam on Lake Wenatchee that complies with current fish passage standards and provides storage to Ordinary High Water and other levels. Analyze wind-caused wave erosion and prepare construction and permitting cost estimates.

Legal Feasibility. Evaluate the legal feasibility of constructing the dam taking into account federal, state, and local laws, and Tribal Nations rights. A further objective is to establish the permitting requirements and the status of the existing storage permit.

Socioeconomic Impacts. Evaluate the impacts of the project on private lake front property and other private landowners, and state and federal lands. Assessment of impacts would include recreation, cultural resources, tourism, fishing, rafting, and other uses of the river. The assessment would include costs and benefits.

Environmental Impact. Determine the impacts of storing additional water on flood water levels, lands inundated for longer periods around the lake (including wetlands), and on the fishery resources of the lake and river with particular emphasis on endangered species. The beneficial impacts of releasing stored water later in the year would also be evaluated.

During the feasibility study, project team meetings were held on December 11, 2002; February 26; April 30 and June 4, 2003. Presentations of interim work products by the MWH team were made to the project team during those meetings and discussions held on a number of issues.

Lake Wenatchee Water Storage Feasibility Study—June 2003

Executive Summary
Water Needs Assessment

- **Water demands will increase with expected population growth in the Wenatchee Watershed. The increase in water demands for municipal and domestic purposes is predicted to be 7.3 cfs on a peak basis and 1,868 acre-feet annually.**
- **Industrial water demands outside of municipalities are not expected to increase as minimum instream flows limit the ability to obtain new water rights.**
- **An estimated 12,836 acres of irrigated agriculture exist in the Wenatchee Watershed. Most of the agricultural land is in orchards. The agricultural land base has been stable and water use for irrigation will likely not decline on a peak daily basis.**
- **Instream flows set by WAC 173-545 are not met on an average of 87 days per year. Water rights issued after 1984 are conditioned on those instream flows being met.**
- **The average shortfall in instream flow in the Wenatchee River is 17,500 acre-feet per year. In 2001, the shortfall was over 50,000 acre-feet.**
- **Water use to meet future municipal and domestic use is predicted to reduce streamflow by 5 cfs in summertime.**
- **Approval of current water right applications for irrigation would reduce streamflow an additional 5.6 cfs in summertime.**

The water stored in Lake Wenatchee could be used for several purposes: instream flow augmentation, water supply for future surface water users in the Wenatchee River Basin Watershed or as mitigation for future groundwater use either in the aquifers supplying the Wenatchee River or in tributaries to the Wenatchee River. The Water Needs assessment portion of this study summarizes the current and potential future use of water in the Wenatchee River Watershed (also referred to as Water Resources Inventory Area [WRIA] 45) for municipal, residential, commercial, industrial and agricultural needs and environmental uses.

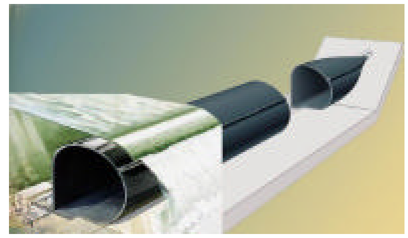
A review of potential population growth and growth in municipal, domestic, industrial and agricultural water needs was made. Chelan County is forecast to grow from 66,616 people to 101,860 people by 2025. Of that growth, an increase of 26,500 is forecast for the Wenatchee Watershed. The City of Wenatchee receives its water from wells located alongside the Columbia River and its future water use is not addressed in this study. The estimated increase in municipal and domestic water demands over the next 20 years is 7.3 cfs on a peak daily basis and 1,868 acre-feet annually. No growth in self-supplied industrial and commercial water use is forecast unless additional water is made available that would not be subject to interruption by minimum instream flows set by Chapter 173-545 WAC. The area of irrigated agriculture is estimated to be 12,863 acres and appears to be stable and not declining. There is a substantial area of land that is currently zoned for residential use that can be converted from agricultural use. Although annual water use may decline if that land is developed, peak water use may not change. The peak water demands are important as they have the most immediate effect on streamflow, especially during summer low flow periods.

Pending water right applications are requesting use of an additional 43 cfs from surface water and 10.9 cfs from ground water. The type of use requested on the applications is primarily municipal and domestic for surface water and irrigation for ground water. Most of the applications, if approved, would be subject to minimum instream flows and therefore interruptible during low streamflow periods. Some of the applications, such as those contained in the Peshastin Creek basin, would not likely be approved as the basin is closed for further appropriation from June 15 to October 15. It was estimated the increase in irrigation demand from approval of those applications to be 8 cfs; the estimated effect on streamflow is a reduction of 5.6 cfs. The estimated increase in municipal and domestic demand is 7.3 cfs and the estimated effect on streamflow is a reduction of about 5 cfs. The total estimated reduction in streamflow is estimated to be 10.6 cfs. That reduction would occur in the Wenatchee River.

The largest potential water need is for instream flow. Chapter 173-545 WAC has set minimum flows for the Wenatchee River and some tributaries. Hydrologic analyses have determined the average shortfall between Wenatchee River streamflow (measured at Plain) and the minimum flows is 17,500 acre-feet per year. In 2001, the shortfall was 50,400 acre-feet for the time period of July to October.

Lake Wenatchee Water Storage Feasibility Study—June 2003

Executive Summary
Technical Feasibility



To enable seasonal storage and release of water from Lake Wenatchee, an inflatable rubber dam was identified as the most suitable type of structure for the site. The dam would be located on the Wenatchee River approximately 1,600 feet downstream of the mouth of the lake where the river is narrowest. The flow stored and released would increase instream flow in the Wenatchee River in late summer, during the lowest flow period.

Two operating water levels were analyzed: 1) the Ordinary High Water (OHW), field surveyed and estimated to be 1870.3 ft., and 2) the spring high water level, estimated at 1872.4 feet, which occurs nine out of ten years. Five potential operating alternatives were analyzed with the model:

Alternative 1. Maximum lake level controlled by the rubber dam = 1872.4 ft. The dam would start storing water July 1 and releasing water August 23. Lake outflow would ramp up to 100 cfs in excess of historic outflows on September 1 and water released until storage is exhausted.

Alternative 2. Maximum lake level controlled by the rubber dam = 1872.4 ft. The dam would start storing water July 1 and releasing water August 23. Lake outflow would ramp up to 200 cfs in excess of historic outflows on September 1 and water released until storage is exhausted.

Alternative 3. Maximum lake level controlled by the rubber dam = 1872.4 ft. The dam would start storing water June 1 and releasing water July 1. Pulse flows would be released at a rate of 100 cfs for 4 hours per day until August 15. Lake outflow would be augmented by 100 cfs in excess of historic outflows starting August 16 and water released until storage is exhausted.

Alternative 4. Maximum lake level controlled by the rubber dam = 1870.3 ft. The dam would start storing water July 1 and releasing water August 23. Lake outflow would ramp up to 50 cfs in excess of historic outflows on September 1 and water released until storage is exhausted.

Alternative 5. Maximum lake level controlled by the rubber dam = 1870.3 ft. The dam would start storing water July 1 and releasing water August 23. Lake outflow would ramp up to 100 cfs in excess of historic outflows on September 1 and water released until storage is exhausted.

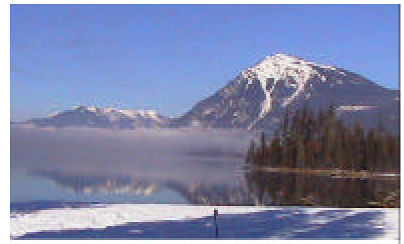
Alternative 2 provides the greatest flow augmentation, but for a shorter time period than Alternative 1, which can augment flow through much of October if needed. Alternative 3 has less water to store and release because it has different storage and release seasons in comparison to Alternatives 1 and 2. Alternatives 1 and 2 were found to provide a maximum storage of 12,300 af. The maximum increase in lake levels from historic levels is about 2.7 feet in July, 3.9 feet in August and 2.6 feet in September from Alternatives 1-3.

Alternative 5 can reliably provide a flow augmentation of 75 cfs in September. Alternative 4 can provide 50 cfs in September and for about one-half of October. Alternatives 4 and 5 would provide a maximum storage of 6,750 af. The increase in lake levels from historic for the two alternatives is about 0.6 feet in July, 2.0 feet in August and 1.0 feet in September.

- **Ordinary High Water (OHW) is the most important water level evaluated because it is the demarcation between private property and State-owned shorelands, except those second-class shorelands sold to property owners. The OHW elevation is 1,870.3 ft.**
- **A low rubber dam was studied that would impound water to two elevations: 1,872.4 ft. or 1,870.3 ft. (OHW).**
- **The rubber dam and concrete supports would be submerged and mostly hidden from view**
- **The estimated costs of designing, permitting and constructing a rubber dam to impound water to 1872.4 ft are $5.8M (excluding indirect costs such as financing, legal, interest, project mitigation, land purchase or easement, etc.)**
- **The estimated costs to construct a rubber dam to impound water to 1870.3 ft are $5.4M (excluding indirect costs)**
- **Wind analysis shows a large potential increase in wave energy (and erosion) if water levels are maintained at 1872.4 ft and a much smaller or no increase if water levels are maintained at 1870.3 ft.**

Lake Wenatchee Water Storage Feasibility Study—June 2003

Executive Summary
Legal and Permitting Requirements



- **The Wenatchee Reclamation District purchased an easement from the State of Washington in 1944 to overflow 2nd class shorelines in Lake Wenatchee.**
- **There exists 20,380 feet of 2nd class shoreline that is not subject to the easement. An easement to inundate those 2nd class shorelines would need to be acquired from adjacent property owners if a storage project was to be constructed to hold water to the Ordinary High Water level (1870.3 ft).**
- **If a storage project were to hold water to a level higher than the OHW, easements to inundate 70,000 lineal feet of shoreline on private property would be required.**
- **A number of permits that are required from Federal, State and local Agencies would be required. An EIS under SEPA or EA under NEPA would be required for the project. Because of the presence of endangered species, consultation with the U.S. Fish and Wildlife Service and NOAA Fisheries would be required. The permitting timeframe could stretch out over 3 years.**
- **Although no entity has proposed the project, a number of Federal, State and local agencies could construct and operate the project. The project would need to be operated with multiple objectives including instream flow augmentation, water supply and recreation.**

An assessment of legal and permitting requirements was made for construction and operation of a low dam at the outlet of Lake Wenatchee. The review covered existing permits to operate a reservoir and the requirements for acquiring new permits.

A reservoir permit was issued by the State of Washington in 1934 to the Wenatchee Reclamation District (WRD), which would have allowed the district to construct a dam at that time. The permit was transferred in 1963 to Chelan County PUD for their use in a potential water storage project. The PUD project did not proceed and the State cancelled the reservoir permit in 1976. In addition to the reservoir permit, the WRD obtained an easement in 1944 to overflow 2nd class shorelines around Lake Wenatchee. The easement is subject to the rights of previous purchasers of 2nd class shorelines around the lake. Second-class shorelands extend up to the line of Ordinary High Water (OHW). It was found that private property owners with a total of 10,950 feet and Washington State Parks and Recreation with 9,430 feet of waterfront own 2nd class shorelands that were purchased prior to the issuance of the overflow easement. An easement would need to be purchased or leased from those property owners to maintain water levels at the OHW level. A total of 70,000 feet of shoreline exists around Lake Wenatchee and overflow easements from all property owners on the lake would need to be obtained to maintain water levels at any water level higher than OHW, such as 1872.4 ft.

A review of the potential impact on Tribal fisheries was performed and the conclusion reached the project would have a negligible effect on Tribal fisheries in the Wenatchee River Watershed.

A review of permitting issues was performed and the types of permits that would be required from Federal, State and local agencies described. The typical timeframe for acquisition of those permits was also described. The project would likely be subject to the NEPA process and would require a Corps of Engineers permit, bringing in the need for consultation under ESA. Approaches to permitting and additional information needed for the permitting process are provided.

Because of the nature of the water storage project, it would be operated by a public entity. Although no entity has proposed the project, potential operators include the US Bureau of Reclamation, Washington State Department of Ecology, Chelan County PUD, and Wenatchee Reclamation District. The project would need to operate with multiple objectives including instream flow augmentation, water supply, recreation and other objectives.

- **Increase in water elevations could affect shoreline property values and potentially slow the rate of increase of property values, affect shoreline access, and affect shore facilities and improvements.**

- **Purchase of easements would be necessary for all alternatives and would range in cost from $1.4 to $3.5 million under Alts 4 and 5, to $6.1 to $15.3 million under Alts 1, 2, and 3.**

- **Impacts to lake-based recreation could include loss of shoreline access, and inundation of boat ramps and beaches.**

- **Estimated cost to retrofit the boat ramp at the State Park and to construct a new launch facility downstream of the dam would be approximately $171,000.**

- **More detailed socioeconomic and parcel studies will be necessary if the project proceeds. Those studies could include shoreline topographic surveys, property-by-property appraisals, property-by-property survey of facilities and improvements, and a study of decision factors when buying shoreline property.**

Lake Wenatchee Water Storage Feasibility Study—June 2003

Executive Summary
Socioeconomic Impact Assessment

The socioeconomic impact analysis of the Lake Wenatchee Water Storage Feasibility Study included a broad evaluation of property values, property improvements, lake-related recreation, river-related recreation, and potential effects on cultural resources. The analysis included a review of existing studies, acquisition and review of property assessments from the Chelan County Assessors Office, and field measurements and observations.

Land ownership on the lake includes U.S. Forest Service (45.3 percent), Washington State Parks and Recreation Commission (12.2 percent), County (0.5 percent) and private lands (42 percent). A review of Chelan County Assessor's records for 2002 indicates that there are 153 single-family residential parcels along the North Shore and 134 single-family residential parcels on the South Shore.

Recreation on the lake includes boating, fishing, wind surfing, camping and related activities, and beach recreation. Public access to the lake is provided at Lake Wenatchee State Park and from USFS land on the north and south sides of the lake. River-related recreation activities include whitewater rafting, kayaking, fishing, and access along the Wenatchee River. Two recorded archaeological sites occur on the north shore of the headwaters of the Wenatchee River; there are no recorded historic structures.

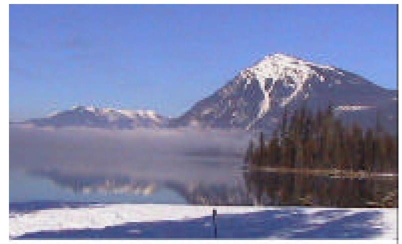
Increases in water elevations from the project could affect property values through 1) potentially slowing the rate of increase in property values, 2) perceived or real loss of property values, 3) affecting shoreline access or use, and 4) affecting shore facilities and improvements. The purchase of shoreline easements would be necessary and could range from a cost of $1.4 to $3.5 million under the OHW alternative (Alts. 4 and 5) to $6.1 to $15.3 million for elevation 1,872.4 ft. (Alts. 1,2, and 3). The impacts to shoreline improvements would be greatest under Alts.1, 2, and 3 and would vary on a parcel-by-parcel basis. Higher water elevations under Alts.1, 2, and 3 and wind-driven waves, could erode shorelines and lead to damage. These potential impacts were not quantified in this study and more detailed studies will be necessary in the future if the project proceeds.

Impacts to lake-based recreation would include the loss of shoreline access at various locations on the lake, particularly under Alts. 1, 2, and 3. Boat ramps at Lake Wenatchee State Park and at the Glacier View campground would be inundated, thereby making access more difficult. The dock at the State Park boat ramp would need to be modified (i.e., extended or rebuilt) to allow access from shore. That cost is $6,000. Beach recreation would be significantly affected by Alts.1 - 3 for all but the Lake Wenatchee State Park beach.

River-based recreation would not be adversely affected by changes in river flows by the proposed project, but construction and operation of the dam would disrupt boating access from the lake to the river. To ensure access to the river is maintained, a new launch facility would need to be constructed downstream of the dam. Construction costs for such a facility were estimated to be $165,000.

Cultural resources could be affected by the project by prolonging the saturation of artifact-bearing sediments and increasing the risk of erosion as a result of wave action. The magnitude of the impact would be greatest under Alts. 1, 2, and 3. A systematic survey of the dam site and other project elements should be conducted if future project studies are undertaken.

Lake Wenatchee Water Storage Feasibility Study—June 2003



Executive Summary Environmental Impact Assessment

- **The sockeye salmon population in Lake Wenatchee is one of only two runs still existing in the Columbia River Basin. A popular recreational fishery exists for sockeye and kokanee.**
- **Spring chinook salmon and steelhead in the Wenatchee River system are listed as endangered under the Endangered Species Act. Bull trout are listed as threatened. Different life-stages of these fish can be found in the river or lake throughout the year.**
- **Low instream flows in the Wenatchee River may result in summer water temperatures that stress bull trout and other salmonid fish. Low instream flows can also delay upstream migration of adult salmonids and reduce the summer carrying capacity of juvenile fish.**
- **During low water years, the release of increased flows from Lake Wenatchee in late-summer and early-fall may improve fisheries habitat in the mainstem Wenatchee River. Alts. 1 and 2 would provide the greatest opportunity for benefit; Alts. 4 and 5 would provide some benefit, especially under extreme low flow conditions. Alt. 3 would benefit adult upstream passage during low flow conditions.**
- **The extended storage of high water in Lake Wenatchee may result in some alteration of the wetland community along the shoreline of the lake and in the backwatered areas of the White and Little Wenatchee rivers. Alts. 1—3 have a high probability of altering the communities; Alts. 4 and 5 a moderate probability.**
- **Construction and operation of the dam will need to consider and accommodate both upstream and downstream passage of anadromous salmonids and bull trout into and from Lake Wenatchee.**

The storage of water in Lake Wenatchee and its release in late-summer and early-fall could have direct and indirect effects on the aquatic habitat and fish populations in the Wenatchee River system. This includes potential beneficial and negative effects on three fish species listed under the federal Endangered Species Act: spring chinook salmon, steelhead, and bull trout.

Lake Wenatchee is a cold, deep lake that is fed principally by the Little Wenatchee River and the White River. Extensive wetlands exist at the western end of the lake at the deltas of these two rivers. The lake drains to the Wenatchee River, which eventually empties into the Columbia River. Several populations of economically and culturally important fish species are found in the Wenatchee River system including chinook and sockeye salmon, kokanee, steelhead, bull trout, rainbow trout, westslope cutthroat trout, and Pacific lamprey. Coho salmon have recently been reintroduced to the basin. The Wenatchee River is an important migration corridor for many of these fish. In particular chinook, sockeye, steelhead, and Pacific lamprey mature in the ocean and then swim back upstream to spawn in the river, the smaller streams or along the shoreline of the lake. Bull trout are known to have a complex life history, where adult fish can spawn in the Chiwawa River and then return six miles upstream to feed in Lake Wenatchee. Their progeny may also migrate upstream as juveniles to rear in the lake. During the summer, low instream flow and associated warm water temperatures in the Wenatchee River have been identified as water quality concerns that can negatively affect many of these fish species.

The operation of the Lake Wenatchee Water Storage Project during low-flow water years could benefit anadromous salmonids in the Wenatchee River downstream of the lake outlet by providing added flows of cool water during the late-summer and early fall. This release of water could improve the quantity and quality of pool habitat used by adult fish for holding and passage conditions during their upstream migration, as well as result in more suitable areas to support spawning. Because of the greater volume of water that would be available for release, Alts.1 and 2 would have the greatest potential instream flow benefit for salmonids. Some instream flow benefits would also be provided by Alts.4 and 5 but these would be of lower magnitude and duration compared to Alts.1 and 2. Alt. 3 could benefit early passage of sockeye and spring Chinook into the upper watershed. Potential negative impacts identified during this analysis include the potential stranding of juvenile fish and the possibility of dewatering of incubating eggs if river flows are rapidly reduced (as the amount of stored water becomes depleted) prior to Fall rains. However, these potential impacts can be avoided or minimized if ramping rates are used and flows are adjusted to consider egg incubation. The extended storage of water in Lake Wenatchee may result in some alteration of the wetland community along the shoreline of the lake and in the backwatered areas of the White and Little Wenatchee Rivers. Alts.1—3 have a high probability of altering the communities; Alts.4 and 5 a moderate probability. In addition, the location of a dam at the lake outlet could affect the overall connectivity of the lake with the lower Wenatchee River. Construction and operation of the dam will need to consider and accommodate both upstream and downstream passage of anadromous salmonids and bull trout into and from Lake Wenatchee.

TABLE OF CONTENTS

1.0 INTRODUCTION 1-1

2.0 WATER NEEDS 2-1

2.1 CURRENT AND PROJECTED WATER USE 2-1
2.1.1 Municipal and Domestic Water Use 2-1
2.1.2 Self-Supplied Commercial/ Industrial Water Use 2-8
2.1.3 Agricultural Water Use 2-10

2.2 INSTREAM FLOW NEEDS 2-21

2.3 WATER CONSERVATION OPPORTUNITIES 2-25
2.3.1 Municipal and Domestic 2-25
2.3.2 Agricultural Water Conservation 2-25

2.4 WATER RIGHTS 2-27
2.4.1 Surface Water Rights Summary 2-28
2.4.2 Ground Water Rights Summary 2-31
2.4.3 Summary of All Water Rights in WRIA 45 2-34

2.5 ALLOCATION OF NEW WATER RIGHTS 2-34

2.6 SUMMARY OF WATER NEEDS 2-36

2.7 USE OF STORED WATER 2-37

3.0 TECHNICAL FEASIBILITY 3-1

3.1 INTRODUCTION 3-1

3.2 DELINEATION OF ORDINARY HIGH WATER 3-1
3.2.1 Definition of Ordinary High Water 3-1
3.2.2 Fieldwork Performed to Interpret OHW 3-2

3.3 HYDROLOGY 3-6
3.3.1 Lake Wenatchee Historic Water Levels 3-6
3.3.2 Storage Operation Model 3-11
3.3.3 Operating Scenarios 3-28
3.3.4 Flood Operation 3-48

3.4 WIND AND WAVE EROSION ASSESSMENT 3-50
3.4.1 Wind Data 3-50
3.4.2 Wind Analysis 3-51
3.4.3 Wave-Height Analysis 3-52
3.4.4 Wave-Energy Analysis 3-53

3.5 IMPOUNDMENT STRUCTURE 3-56
3.5.1 Background 3-56
3.5.2 Field Reconnaissance 3-56
3.5.3 Rubber Dam Impoundment Structure 3-58

3.6 ADDITIONAL STUDY NEEDS 3-69

4.0 LEGAL AND PERMITTING REQUIREMENTS 4-1

4.1 STATUS OF PREVIOUS PERMIT AND EASEMENTS 4-1
4.1.1 Status of Reservoir Permit 4-1
4.1.2 Status of Overflow Easement 4-3

4.2 COMPLIANCE WITH TRIBAL NATION RIGHTS 4-4
4.2.1 Tribal Fishing Rights 4-4
4.2.2 Government-to-Government Consultation 4-5
4.2.3 PROJECT Effects on tribal fisheries 4-6
4.2.4 Recommendations... 4-7

4.3 REGULATORY AUTHORITY 4-7

4.4 PERMITTING REQUIREMENTS.. 4-8
4.4.1 List of Permits.. 4-8

4.5 POTENTIAL ISSUES, APPROACHES AND MITIGATION REQUIREMENTS.......... 4-15
4.5.1 Legal and Permitting Issues.. 4-15
4.5.2 Socioeconomic Impacts 4-16
4.5.3 Environmental Impacts... 4-16
4.5.4 Mitigation Requirements 4-17

4.6 REQUIRED EASEMENTS 4-17

4.7 ADDITIONAL STUDY NEEDS... 4-17

5.0 SOCIOECONOMIC IMPACT 5-1

5.1 STUDY METHODOLOGY AND EXISTING CONDITIONS 5-1
5.1.1 Land Use 5-1
5.1.2 Lake-related Recreation.. 5-10
5.1.3 River-related Recreation... 5-13
5.1.4 Cultural Resources.. 5-14

5.2 EFFECTS OF PROPOSED PROJECT OPERATIONS... 5-17
5.2.1 Land Use 5-17
5.2.2 Lake-related Recreation.. 5-19
5.2.3 River-related Recreation... 5-23
5.2.4 Cultural Resources.. 5-27

5.3 CONCLUSIONS AND RECOMMENDATIONS 5-28
5.3.1 Land Use 5-28
5.3.2 Lake-related Recreation.. 5-29
5.3.3 River-related recreation 5-29
5.3.4 Cultural Resources.. 5-30

6.0 ENVIRONMENTAL IMPACT 6-1

6.1 WATER AVAILABILITY 6-1

6.2 OPERATIONAL ALTERNATIVES.. 6-1

6.3 ENVIRONMENTAL BASELINE OF THE AQUATIC RESOURCES 6-4
6.3.1 Areas Influenced by Lake Wenatchee Rubber Dam.. 6-4
6.3.2 Aquatic Species.. 6-8

6.3.3 Wetlands 6-19
6.3.4 Water Quality 6-20
6.3.5 Sediment Quality 6-26

6.4 ENVIRONMENTAL IMPACTS AND BENEFITS OF RUBBER DAM OPERATIONS 6-27
6.4.1 Effects of Rubber Dam Operations on Fish Habitat and Fish Use 6-28
6.4.2 Effects f Rubber Dam Operations On Riverine And Lacustrine Ecosystem Processes6-40
6.4.3 Effects Of Rubber Dam Operations On Water Quality Conditions 6-47

6.5 CONCLUSIONS REGARDING POTENTIAL ENVIRONMENTAL IMPACTS AND BENEFITS 6-50

6.7 POTENTIAL ADDITIONAL STUDIES 6-50

7.0 SUMMARY AND CONCLUSIONS 7-1

7.1 SUMMARY 7-1
7.1.1 Summary of Water Needs 7-2
7.1.2 Summary of Technical Feasibility 7-3
7.1.3 Summary of Legal and Permitting Issues 7-5
7.1.4 Summary of Environmental Effects and Recommended Additional Studies 7-5
7.1.5 Summary of Socioeconomic Impacts 7-7

7.2 CONCLUSIONS 7-9
7.2.1 If Water Is Stored To El. 1870.3 Ft 7-9
7.2.2 If Water is Stored To El. 1872.4 Ft 7-10

8.0 REFERENCES 8-1

9.0 PUBLIC COMMENTS 9-1

TABLES

Table 2.1-1. Estimate of Current Population and Municipal/Domestic Water Use, by Water Use Category 2-3
Table 2.1-2. Forecasted Population Growth in Chelan County........ 2-6
Table 2.1-3. Forecasted Population Growth in Wenatchee River Watershed......... 2-7
Table 2.1-4. Wenatchee River Watershed Projected Municipal and Domestic Water Use in 2025. 2-8
Table 2.1-5. Estimate of Current Self-Supplied Commercial/Industrial Water Use......... 2-9
Table 2.1-6. Pattern and Quantity of Diversions for Wenatchee Reclamation District, 2002. 2-11
Table 2.1-7. Monthly Diversions Icicle and Peshastin Irrigation Districts - Average of 1990 and 1991 2-12
Table 2.1-8. Average Crop Irrigation Requirements......... 2-14
Table 2.1-9. Expected Field Application Efficiencies in Washington. 2-14
Table 2.1-10. Summary of Potentially Irrigated Lands Based Upon 1992 Land Cover Database (acres). 2-17
Table 2.1-11. Estimated Irrigation Water Demand for Consumptive Use Based Upon 1992 Land Cover Data (acre-feet). 2-17
Table 2.1-12. Tree Fruit Acreage in Wenatchee Fruit Reporting District........ 2-18
Table 2.1-13. Irrigated Farmland in Chelan County. 2-18
Table 2.1-15. Estimates of Land Area and Zoning within Wenatchee River Watershed. 2-19
Table 2.2-1. WAC Stream Management Units in Wenatchee River Watershed........ 2-21
Table 2.2-1. WAC Instream Flow Requirements in Wenatchee River Watershed......... 2-22
Table 2.4-1. Surface Water Rights by Subbasin. 2-30
Table 2.4-2. Ground Water Rights by Subbasin. 2-33
Table 2.4-3. Surface and Ground Water Rights by Subbasin. 2-35
Table 3.2-1. Ordinary High Water Marks Interpreted and Surveyed......... 3-2
Table 3.3-1. Frequency data for historic Lake Wenatchee level (feet NGVD29)......... 3-9
Table 3.3-2. Lake Wenatchee annual instantaneous peak lake level data for USGS Gage 12455000. 3-10
Table 3.3-3. Historic flow (cfs) at USGS Gage 12455000, Wenatchee River below Lake Wenatchee. 3-14
Table 3.3-4. Historic flow (cfs) Frequency at USGS Gage 12455000, Wenatchee River below Lake Wenatchee........ 3-14
Table 3.3-5. Historic flow (cfs) at USGS Gage 12457000, Wenatchee River at Plain......... 3-15
Table 3.3-6. Historic flow (cfs) Frequency at USGS Gage 12457000, Wenatchee River at Plain. 3-15
Table 3.3-7. Historic flow (cfs) at USGS Gage 12459000, Wenatchee River at Peshastin......... 3-16
Table 3.3-8. Historic flow (cfs) Frequency at USGS Gage 12459000, Wenatchee River at Peshastin. 3-16
Table 3.3-9. Lake Wenatchee elevation-area-storage. 3-19
Table 3.3-10. Simulated Lake Wenatchee level (feet NGVD29) frequency data – Historic Operation. 3-20
Table 3.3-11. Simulated flow (cfs) frequency at USGS Gage 12455000, Wenatchee River below Lake Wenatchee – Historic Operation......... 3-21
Table 3.3-12. Instream flows (cfs) for the Wenatchee River (Ref: WAC 173-545-030, last update 6/9/88) 3-22
Table 3.3-13. Number of days with flow less than instream flow requirement at USGS Gage 12457000, Wenatchee River at Plain – Historic Operation........ 3-23

Table 3.3-14. Number of days with flow less than instream flow requirement at USGS Gage 12459000, Wenatchee River at Peshastin – Historic Operation. 3-24
Table 3.3-15. Number of days with flow less than instream flow requirement at the Peshastin or Plain USGS Gages – Historic Operation. 3-25
Table 3.3-16. Storage (acre-feet) necessary to be impounded by the rubber dam to meet instream flow requirements at Plain or at Plain and Peshastin 3-26
Table 3.3-17. Lake Wenatchee inflow (acre-feet) potentially available for storage with rubber dam. 3-27
Table 3.3-18. Comparison of lake levels to potential storage. 3-29
Table 3.3-19. Alternative 1 Lake Wenatchee Elevation-Frequency Difference (feet) from Historic. 3-34
Table 3.3-20. Alternative 2 Lake Wenatchee elevation-frequency difference (feet) from historic. 3-35
Table 3.3-21. Alternative 3 Lake Wenatchee elevation-frequency difference (feet) from historic. 3-35
Table 3.3-22. Alternative 4 Lake Wenatchee elevation-frequency difference (feet) from historic. 3-36
Table 3.3-23. Alternative 5 Lake Wenatchee elevation-frequency difference (feet) from historic. 3-37
Table 3.3-24. Alternative 1 Lake Wenatchee outflow-frequency difference (cfs) from historic. 3-42
Table 3.3-25. Alternative 2 Lake Wenatchee outflow-frequency difference (cfs) from historic. 3-43
Table 3.3-26. Alternative 3 Lake Wenatchee outflow-frequency difference (feet) from historic. 3-43
Table 3.3-27. Alternative 4 Lake Wenatchee outflow-frequency difference (cfs) from historic. 3-44
Table 3.3-28. Alternative 5 Lake Wenatchee outflow-frequency difference (cfs) from historic. 3-44
Table 3.3-29. Average number of days with flow less than instream flow requirement at USGS Gage 12457000, Wenatchee River at Plain – Historic and Alternative Operation. 3-47
Table 3.5-1. Lake Wenatchee Impoundment Structure - Feasibility Cost Estimate*. 3-68
Table 5.1-1. Comparison of Assessed Value of Single-Family Parcels on Lake Wenatchee, 1997 & 2002. 5-6
Table 5.1-2. Representative Improvements on Lands Adjacent to Lake Wenatchee. 5-7
Table 5.1-3. Assumed Easement Costs, Sample Scenario 5-10
Table 6.2-1. Description of five alternatives and their resource targets considered in the environmental impact analysis of the Lake Wenatchee Water Storage Feasibility Study. 6-4
Table 6.3-1. USEPA recommended temperature water quality guidelines for Pacific Northwest salmonid fish. 6-21
Table 6.3-2. Lake Wenatchee depth profiles of temperature, dissolved oxygen and pH (from Sylvester and Ruggles 1957). 6-26
Table 6.4-1. Aquatic and fisheries impact evaluation matrix for three segments of the Wenatchee Watershed potentially influenced by project operations under Alternative 1 of the Lake Wenatchee Water Storage Feasibility Study. 6-32

Table 6.4-2. Aquatic and fisheries impact evaluation matrix for three segments of the Wenatchee Watershed potentially influenced by project operations under Alternative 2 of the Lake Wenatchee Water Storage Feasibility Study. 6-33
Table 6.4-3. Aquatic and fisheries impact evaluation matrix for three segments of the Wenatchee Watershed potentially influenced by project operations under Alternative 3 of the Lake Wenatchee Water Storage Feasibility Study. 6-34
Table 6.4-4. Aquatic and fisheries impact evaluation matrix for three segments of the Wenatchee Watershed potentially influenced by project operations under Alternative 4 of the Lake Wenatchee Water Storage Feasibility Study. 6-35
Table 6.4-5. Aquatic and fisheries impact evaluation matrix for three segments of the Wenatchee Watershed potentially influenced by project operations under Alternative 5 of the Lake Wenatchee Water Storage Feasibility Study. 6-36
Table 6.4-6. Predicted change in hydroperiod components as a result of five alternative rubber dam scenarios, Lake Wenatchee, WA. 6-46

FIGURES

Figure 2.1-1. Census County Divisions in Wenatchee Watershed. 2-5
Figure 2.1-2. Forecasted Population Growth in Chelan County. 2-7
Figure 2.1-3. Wenatchee Reclamation District Diversions – 2002 2-12
Figure 2.1-4. Sub-basins in Wenatchee River Watershed. 2-16
Figure 2.2-1. Comparison of Wenatchee River at Plain Flow to IRPP Flows. 2-23
Figure 2.2-2. Comparison of Wenatchee River at Monitor Flow to IRPP Flows. 2-23
Figure 2.2-3. Comparison of Wenatchee River at Plain Flow to IRPP Flows for 2001 and 2002. 2-24
Figure 2.2-4. Comparison of Wenatchee River at Monitor Flow to IRPP Flows for 2001 and 2002.2- 24
Figure 3.3-1. Representative wet, dry, and average year lake levels. 3-7
Figure 3.3-2. Lake Wenatchee level duration curve. 3-7
Figure 3.3-3. Lake Wenatchee monthly lake level frequency curves. 3-8
Figure 3.3-4. Peak annual flows at USGS Gage 12457000, Wenatchee River at Plain. 3-11
Figure 3.3-5. Annual average flow (cfs) at USGS Gage 12457000, Wenatchee River at Plain. 3-12
Figure 3.3-6. Monthly average flow (cfs) at USGS Gage 12457000, Wenatchee River at Plain. 3-13
Figure 3.3-7. Lake Wenatchee outflow rating curve. 3-17
Figure 3.3-8. Rating curve for USGS Gage 12457000, Wenatchee River at Plain. 3-17
Figure 3.3-9. Rating curve for USGS Gage 12459000, Wenatchee River at Peshastin. 3-18
Figure 3.3-10. Illustration of Water Levels at Kane Boathouse 3-29
Figure 3.3-11. Alternatives 1, 2, and 3, and historic lake levels for an average water year – 1949. 3-32
Figure 3.3-12. Alternatives 4 and 5, and historic lake levels for an average water year – 1949. 3-32
Figure 3.3-13. Alternatives 1, 2, and 3, and historic lake levels for a dry water year – 1941. 3-33
Figure 3.3-14. Alternatives 4 and 5, and historic lake levels for a dry water year – 1941. 3-33
Figure 3.3-15. Alternatives 1, 2, and 3, and historic lake outflows for an average water year – 1949. 3-38
Figure 3.3-16. Alternatives 1, 2, and 3, and historic lake outflows for the 1949 augmentation season. 3-38
Figure 3.3-17. Alternatives 4, and 5, and historic lake outflows for an average water year – 1949. 3-39
Figure 3.3-18. Alternatives 4, and 5, and historic lake outflows for the 1949 augmentation season. 3-39
Figure 3.3-19. Alternatives 1, 2, and 3, and historic lake outflows for a dry water year – 1941. 3-40
Figure 3.3-20. Alternatives 1, 2, and 3, and historic lake outflows for the 1941 augmentation season. 3-40
Figure 3.3-21. Alternatives 4 and 5, and historic lake outflows for a dry water year – 1941. 3-41
Figure 3.3-22. Alternatives 4 and 5, and historic lake outflows for the 1941 augmentation season. 3-41
Figure 3.3-23. Alternatives 1, 2, and 3, and historic flows at Plain for the 1949 augmentation season. 3-45
Figure 3.3-24. Alternatives 4 and 5, and historic flows at Plain for the 1949 augmentation season. 3-46
Figure 3.3-25. Alternatives 1, 2, and 3, and historic flows at Plain for the 1941 augmentation season. 3-46

Figure 3.3-26. Alternatives 4 and 5, and historic flows at Plain for the 1941 augmentation season. 3-47
Figure 3.3-27. Lake levels during maximum floods having continuous records. 3-48
Figure 3.4-1. Prevailing Wind Velocity Occurance, RAWS Dry Creek Station, July-October, 2002. 3-51
Figure 3.4-2. Monthly Average Wind Speed 3-52
Figure 3.4-3. Wave Height Contours for 25 mph Wind Speed from WNW Direction 3-53
Figure 3.4-4. Comparison of Wave Energy at Site on South Shore Drive between Existing Conditions and the Operational Scenario that Impounds Water at El. 1872.4. 3-54
Figure 3.4-5. Comparison of Wave Energy at Site on South Shore Drive between Existing Conditions and the Operational Scenario Which Impounds Water at El. 1870.3. .. 3-55
Figure 3.5-1. Lake Wenatchee Impoundment Structure – Construction Schedule. 3-66
Figure 4.1-1. Second Class Shorelands, Lake Wenatchee, WA. 4-2
Figure 5.1-1. Land ownership, Lake Wenatchee. 5-3
Figure 6.1-2. Temporal distribution of adult and juvenile salmonid habitat utilization in the Wenatchee River basin, Washington. Darker areas indicate times of peak occurrence at the mouth of the Wenatchee River. Data adapted from NMFS et al. 1998, Beery and Kelly 1982 and USFWS 1999. 6-11
Figure 6.3-3. WRIA 45 Sockeye distribution map. 6-13
Figure 6.3-4. WRIA 45 steelhead distribution map. 6-15
Figure 6.3-5. WRIA 45 map of bull trout. 6-17
Figure 6.3-6. WRIA 45 bull trout distribution map 6-18
Figure 6.3-7. Map of the Wenatchee River basin indicating stream reaches that were included on the 1998 303(d) list of impaired waters (from NPPC 2002). 6-23
Figure 6.4-1. Average lake level elevations under different rubber dam operational models, Lake Wenatchee Water Storage Feasibility Study. 6-47

PHOTOGRAPHS

Photograph 3.2-1. Approximately 300 yards south of YMCA Camp, El. 1870.5. 3-3
Photograph 3.2-2. Approximately 300 yards south of YMCA Camp, El. 1870.4. 3-3
Photograph 3.2-3. Approximately 300 yards south of YMCA Camp, El. 1870.2. 3-3
Photograph 3.2-4. Halfway between YMCA Camp and State Park, El. 1870.2. 3-4
Photograph 3.2-5. Near USGS BM at State Park, El. 1870.4 – 1870.2. 3-4
Photograph 3.2-6. Kane beach, El. 1870.8. 3-4
Photograph 3.2-7. Hoyt beach, El. 1870.7. 3-5
Photograph 3.2-8. Aspiri beach, El. 1869.8. 3-5
Photograph 3.2-9. South of Aspiri beach, El. 1869.6. 3-5
Photograph 3.2-10. Starr beach, El. 1870.1 3-6
Photograph 3.5-1. Wenatchee River, looking upstream (westward), immediately downstream of Lake Wenatchee and upstream of the State Highway 207 Bridge. 3-57
Photograph 3.5-2. Potential location of impoundment structure on Wenatchee River, looking upstream. 3-57
Photograph 3.5-3. North shore overbank. 3-58
Photograph 3.5-4. South shore overbank. 3-58
Photograph 3.5-5. Week Falls rubber dam; inflated with water over crest 3-59
Photograph 3.5-6. Weeks Falls rubber dam; deflated 3-59
Photograph 3.5-7 Typical Portadam river crossing. (Photo courtesy Portadam, Inc.) 3-64
Photograph 3.5-8. Portadam at MWH Wynoochee Hydro Project on the Wynoochee River near Montesano, WA 3-64
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. 5-7
Photograph 5.1-2. Site 45CH208 upstream from proposed impoundment structure. 5-15
Photograph 5.1-3. View south of abandoned Wenatchee River Bridge pilings from the north bank of the Wenatchee River. 5-16
Photograph 5.2-1. Estimated 1872.4 ft. Water Elevation a the Glacier View Campground Boat Launch. 5-20
Photograph 5.2-2. Estimated 1872.4 ft. Water Elevation at the Lake Wenatchee State Park Campground Boat Launch. 5-20
Photograph 5.2-3. Water line at Camp Zanika Beach approximates OHW Alternative while base of survey rod depicts approximate El. 1872.4. 5-22
Photograph 5.2-4. Base of survey rod depicts approximate water elevation for the 1872.4 Alternative at Lake Wenatchee State Park Beach. 5-23
Photograph 6-3.1. Little Wenatchee River near upper extent of lake backwater effect; the river contains extensive amounts of spawning gravel. Photos taken during November 2002 field reconnaissance. 6-5
Photograph 6.3-2. White River at FS Road 6500, looking downstream (left photo) and White River above lake influence zone. Photos taken during November 2002 field reconnaissance. 6-6
Photograph 6.3-3. Lake Wenatchee looking upstream within outlet channel near proposed site of rubber weir (upper photo) and upstream view of Wenatchee River just below lake outlet at control riffle, from Highway 207 bridge (right photo). Photos taken during November 2002 field reconnaissance. 6-6

Photograph 6.3-4. Wenatchee River at Plain, looking downstream of Highway 209, and within Tumwater Canyon section above Leavenworth, Washington. Photos taken during November 2002 field reconnaissance. 6-7
Photograph 6.3-5. Upstream (left photo) and downstream (right photo) views of Wenatchee River near Peshastin, Washington. Photos taken during November 2002 field reconnaissance. 6-7

APPENDICES

Appendix A – Project Team Members / Scope of Work

1.0 INTRODUCTION

This report results from a Washington State Legislature appropriation to study the feasibility of storing additional water in Lake Wenatchee. The appropriation was provided to the Department of Ecology to administer the study. The Legislature acted upon recommendations of the State's Water Storage Task Force to study the issue of water storage across the State. Many other Watersheds throughout the State are also performing studies of the potential for increased water storage to meet the increasing competitive needs of fish, farms and people. The focus on reviewing all potential solutions to shortfalls in instream flow and water supply was sharpened in the drought year of 2001, when streamflows dropped to historic lows in late summer and many water users across the state had their water supply interrupted as a result.

The Legislature appropriated funds for this study because of its location within the Wenatchee River Watershed (see Figure 1.0-1), the history of past water storage studies and permits on Lake Wenatchee and ongoing efforts in Watershed Planning undertaken by the Wenatchee Watershed Planning Unit. The Wenatchee River Watershed is listed as one of the State's sixteen "critical basins" because of the presence of Endangered Species Act (ESA) listed species, development pressures and the potential for future water shortages. Previous studies and planning on water storage in Lake Wenatchee were performed by the Wenatchee Reclamation District and Chelan County PUD. The Wenatchee Reclamation District initiated a water storage project in 1930 in response to drought conditions in the Wenatchee River Watershed. They obtained permits to construct a low dam near the mouth of the Lake which would impound water to the normal high water elevation. The project was not completed and Chelan County PUD acquired the permits from the District. The PUD envisioned a water storage project that was a component of a larger hydroelectric project. That project was dropped in the 1970's and the rights reassigned back to the District.

Chelan County Natural Resources Department is leading the Wenatchee Watershed Planning effort, which purpose is to identify and study solutions to watershed problems such as instream flow, water quantity, water quality and fish and wildlife habitat. The County is also the recipient of the water storage grant from the Department of Ecology and is administering the process of completing this feasibility study.

After receiving the grant, the County started a process of assembling a project team to oversee the scope of the feasibility study and obtain public comment on the scope. An initial public meeting was held on September 13, 2001 to obtain input on the scope. The project team was then assembled from a diverse group of public, local agency (city and county), irrigation, conservation, state, federal and tribal interests. The project team is listed in Appendix A. Project team meetings were then held on March 27; April 30 and June 27, 2002 to refine a scope of work for the feasibility study. The final scope of work that was agreed to by the project team is contained in Appendix A. Chelan County then advertised for consultant services to prepare the feasibility study. MWH was selected for the project in September 2002 and began work shortly thereafter.

Five broad study areas were selected by the project team to cover the scope of the feasibility study. They are noted below as well as the objective they are intended to address:

- **Water Needs.** The objective is to determine the water needs of the Wenatchee River watershed and how additional water supplies should be apportioned between fish and community interests.
- **Technical Feasibility.** The objective is to evaluate the technical feasibility of constructing a dam on Lake Wenatchee that will comply with current fish passage standards, will not result in storage above the normal High Water Mark, or result in increased damaged to private, state, or federal property on the lake and downriver.
- **Legal Feasibility.** The objective is to evaluate the legal feasibility of constructing the dam taking into account federal, state, and local laws, and Tribal Nations rights. A further objective is to establish the permitting requirements and the status of the existing storage permit.
- **Socioeconomic Impacts.** The objective is to evaluate the impacts of the project on private lake front property and other private landowners, and state and federal lands. Assessment of impacts would include recreation, cultural resources, tourism, fishing, rafting, and other uses of the river. The assessment would include costs and benefits.
- **Environmental Impact.** The objective is to determine the impacts of storing additional water on flood water levels, lands inundated for longer periods around the lake (including wetlands), and on the fishery resources of the lake and river with particular emphasis on endangered species. The beneficial impacts of releasing stored water later in the year would also be evaluated.

During the feasibility study, project team meetings were held on December 11, 2002; February 26; April 30 and June 4, 2003. Presentations of interim work products by the MWH team were made to the project team during those meetings and discussions held on a number of issues. A draft report was issued on June 4 for a review by the project team. Comments from the project team were received and incorporated as much as possible within the scope of work. Following the project team meetings, a public workshop was held on June 19, 2003 to present the report. Comments received at and subsequent to that meeting were compiled by Chelan County and are included in this report as a separate chapter (Chapter 9).

The following chapters contain our analysis and findings for those study areas. A summary of this feasibility study is contained in Chapter 7.

2.0 WATER NEEDS

The purpose of this section is to summarize the current and potential future use of water in the Wenatchee River Watershed (also referred to as Water Resource Inventory Area [WRIA] 45) for municipal, residential, commercial, industrial and agricultural needs and environmental uses. Water use estimates are derived by reviewing water rights records and available water use records from municipal and irrigation water users. A comparison of the potential effect on streamflow in the Wenatchee River Watershed is made from the future increase in water demands. Instream flow needs, as defined by minimum flows set by Chapter 173-545 WAC, are described and compared to flows in the Wenatchee River.

2.1 CURRENT AND PROJECTED WATER USE

This section provides estimates of current and projected water use for various types of water users in the Wenatchee River Watershed. These estimates were made using existing and readily available information. This information is also summarized in the *Wenatchee River Basin Watershed Technical Assessment* (Montgomery Water Group, 2003).

2.1.1 Municipal and Domestic Water Use

The section addresses water provided by public water systems, individual household wells and industry. The Department of Health (DOH) regulates public water systems under two main categories. Group A systems are those systems regulated under the federal Safe Drinking Water Act (SDWA). Group B systems are regulated under state law, but are not regulated under SDWA. Group A systems are further divided into two categories, as described below.

- Group A, Community Water Systems, provide water to 15 or more service connections used by year-round residents for 180 days or more in a year, or provide water to less than 15 connections that serve at least 25 year-round residents. These systems serve cities, subdivisions, mobile home parks, and other types of communities.
- Group A, Non-Community Water Systems, provide water to the public but not to residential communities. DOH regulates two sub-categories: transient and non-transient. Examples include campgrounds, restaurants, motels, day-care centers, and some businesses.
- Group B systems are those that meet the definition of a public water system under state law, but do not fall into one of the categories listed above. These include systems serving smaller communities and subdivisions ranging from 2 to 14 residential service connections.

For the portion of the population not receiving water from a public water system, it is assumed that water for domestic use is obtained via individual household wells. These wells are exempt from the requirement to obtain permits from Ecology. As such, there is limited information available on the number of these wells and their associated production.

Table 2.1-1 presents the estimate of population and the number of connections or equivalent residential units[1] (ERUs) served by the various categories of water supply and delivery for Year 2002. Estimated average day and maximum day demands are also provided. Average day demand is equal to the total annual demand allocated evenly to each day of the year. Maximum day demand is the day of the year having the highest water demand. The following subsections describe the methodology used to determine the populations served by the various types of municipal and domestic water supplies, and summarize the estimates of Year 2002 water production by these supplies.

2.1.1.1 Estimate of Year 2002 Population

An estimate of population served by the various types of municipal and domestic water supplies is necessary in order to calculate the number of exempt household wells located within the Wenatchee River Watershed. The following approach was used in analyzing population data:

1. Estimates of population for 2000 and 2025 were obtained from Chelan County Department of Long Range Planning staff. The Year 2000 population estimates are based on results of Census 2000 and are organized by US Census Bureau Census County Divisions (CCDs). Three Chelan County CCDs comprise the Wenatchee River Watershed: the Wenatchee, Cashmere, and Leavenworth-Lake Wenatchee CCDs. Figure 2.1-1 depicts the boundaries of these CCDs. The Year 2025 population estimates are forecasts generated by County staff, based upon Office of Financial Management projections. Year 2002 population estimates were derived via interpolation between the 2000 population estimate and 2025 population forecast for each CCD. In total, the 2002 population for the Wenatchee River Watershed is estimated to be 53,181.

2. Estimates of the portion of Wenatchee River Watershed population served by the largest public water systems were obtained directly from water purveyors. This approach was followed with the Cities of Wenatchee, Cashmere, and Leavenworth, as well as Chelan County PUD No. 1, which serves portions of the City of Wenatchee as well as rural areas to the west. This information was organized by CCD.

3. Estimates of the population served by other public water systems were obtained from the Department of Health (DOH) Drinking Water Automated Information Network (DWAIN) database, as updated January 2003. This information was organized by CCD.

4. Estimates of the population served by exempt wells were calculated for each CCD by subtracting the population served by public water systems from the total CCD population.

Of the total watershed population of 53,181, approximately 67 percent (35,895) reside within the Wenatchee CCD. Twenty-one percent of the population (11,217) resides within the Cashmere CCD, and 11 percent (6,068) live in the Leavenworth CCD. Within the entire watershed, 80 percent of the population obtains water from public water systems, with the other 20 percent utilizing exempt wells.

---

[1] An equivalent residential unit (ERU) is a measure of water use equal to the amount consumed by an average single-family household, and is often used in water system planning. One single-family residential connection equals one ERU, while one multi-family residential connection or a commercial connection may equal more than one ERU.

Table 2.1-1. Estimate of Current Population and Municipal/Domestic Water Use, by Water Use Category.

				2002 Water Use			2002 Water Use (AF/yr), by Type of Source (14)	
Water Use Category	Notes	2002 Population (1)	Number of Connections or ERUs (2)	ADD (mgd)	MDD (mgd)	Annual (AF/yr) (3)	Ground Water	Surface Water
Wenatchee CCD								
PWS Serving > 100 People								
City of Wenatchee	(4), (15)	24,057	7,250	NA	NA	NA	NA	NA
Chelan County PUD No. 1 - Wenatchee	(5), (15)	8,542	3,726	NA	NA	NA	NA	NA
Other Community & Group B PWS	(6)	40	14	0.005	0.013	6	6	0
Non-Community PWS	(7)	NA	82	0.008	0.019	9	9	0
Households with Exempt Well	(8)	3,256	1,252	0.476	1.190	534	534	0
Wenatchee CCD Sub-Total	(9)	35,895	12,324	0.489	1.223	548	548	0
Cashmere CCD								
PWS Serving > 100 People								
City of Cashmere	(10)	3,045	1,860	0.697	1.255	781	195	586
Peshastin Water District	(6)	445	202	0.077	0.192	86	86	0
Valley Hi Community Club	(6)	219	98	0.037	0.093	42	42	0
Chelan County PUD No. 1 - Dryden	(5)	125	64	0.017	0.044	20	20	0
Peshastin Domestic Water Assoc.	(6)	117	52	0.020	0.049	22	22	0
Other Community & Group B PWS	(6)	1,353	512	0.195	0.486	218	218	0
Non-Community PWS	(7)	NA	285	0.027	0.068	30	30	0
Households with Exempt Well	(8)	5,913	2,274	0.864	2.161	969	969	0
Cashmere CCD Sub-Total	(9)	11,217	5,347	1.934	4.347	2,168	1,582	586
Leavenworth CCD								
PWS Serving > 100 People								
City of Leavenworth	(11)	3,269	2,170	1.011	2.629	1,133	397	737
Ponderosa Community Club	(6)	330	111	0.042	0.105	47	47	0
Chiwawa Communities Association	(12)	150	60	0.055	0.138	62	62	0
Other Community & Group B PWS	(6)	775	299	0.114	0.284	127	112	15
Non-Community PWS	(7)	NA	657	0.062	0.156	70	55	15
Households with Exempt Well	(8)	1,545	594	0.226	0.564	253	253	0
Leavenworth CCD Sub-Total	(9)	6,068	3,891	1.510	3.876	1,693	926	767
WRIA 45 Total								
Community & Group B PWS	(13)	42,466	16,418	2.270	5.288	2,544	1,207	1,338
Non-Community PWS		NA	1,024	0.097	0.243	109	94	15
Households with Exempt Well		10,714	4,121	1.566	3.915	1,755	1,755	0
WRIA 45 Total		53,181	21,563	3.933	9.446	4,409	3,056	1,353

Notes:
CCD = Census County Division; PWS = Public Water System; ADD = Average Day Demand; MDD = Maximum Day Demand
mgd = million gallons per day; AF/yr = acre-feet per year
(1) Estimated population served by each water supplier and water supply category in 2002. See further notes below for sources of estimates.
(2) Where public water systems use equivalent residential units (ERUs) for planning purposes, ERUs are listed. Otherwise, the number of connections served is listed.
(3) Average day demand converted to AF/yr by multiplying by 1,121.
(4) Population data obtained from City of Wenatchee planning staff. Connections data obtained from Department of Health (DOH) Drinking Water Automated Information Network (DWAIN) database, January 2003.
(5) Population data obtained from DWAIN. ERU and water demand data obtained from Chelan County PUD No. 1 Water and Wastewater Utility Plan, September 2001.
(6) Population and connections (residential) data obtained from DWAIN. ADD calculated as number of connections times 380 gpd/connection (averag water production factor for WRIA 45). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45).
(7) Assumed no population served year-round by Non-Community PWS. Connections (total) data obtained from DWAIN. ADD calculated as number c connections times 95 gpd/connection (i.e., 380/4, assuming use occurs only half of the year and at half the rate of average residential water product MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45).
(8) Population calculated as total CCD population minus population served by PWS. Number of connections calculated as population served divided b (average number of persons per household in Chelan County, as obtained from Census 2000 data). ADD calculated as number of connections tim 380 gpd/connection (average water production factor for WRIA 45). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45).
(9) CCD total population for 2000 and 2025 obtained from Chelan County planning staff. Year 2002 population determined via interpolation.
(10) Information obtained from City of Cashmere Water System Plan Update, to be finalized May 2003.
(11) Information obtained from City of Leavenworth Water System Plan - Final Draft, November 2002.
(12) Population and connections (residential) data obtained from DWAIN. ADD obtained from water system operator, personal comm.; includes usage b owners in addition to those listed in DWAIN and who are not present full year. MDD calculated as ADD times 2.5 (average peaking factor for WRIA
(13) Total of all Community and Group B PWS.
(14) Based upon data obtained from PWS and DWAIN.
(15) Source of water supply located outside of WRIA 45; therefore, no estimate of demand is provided.

2.1.1.2 Estimate of Year 2002 Municipal and Domestic Water Use

Table 2.1-1 summarizes the estimate of 2002 municipal and domestic water use throughout the Wenatchee River Watershed. Information for specific public water systems serving more than 100 people is shown in detail. Data pertaining to other public water systems and household wells are shown in totals for these categories. The following approach was used in developing the water use information in Table 2.1-1:

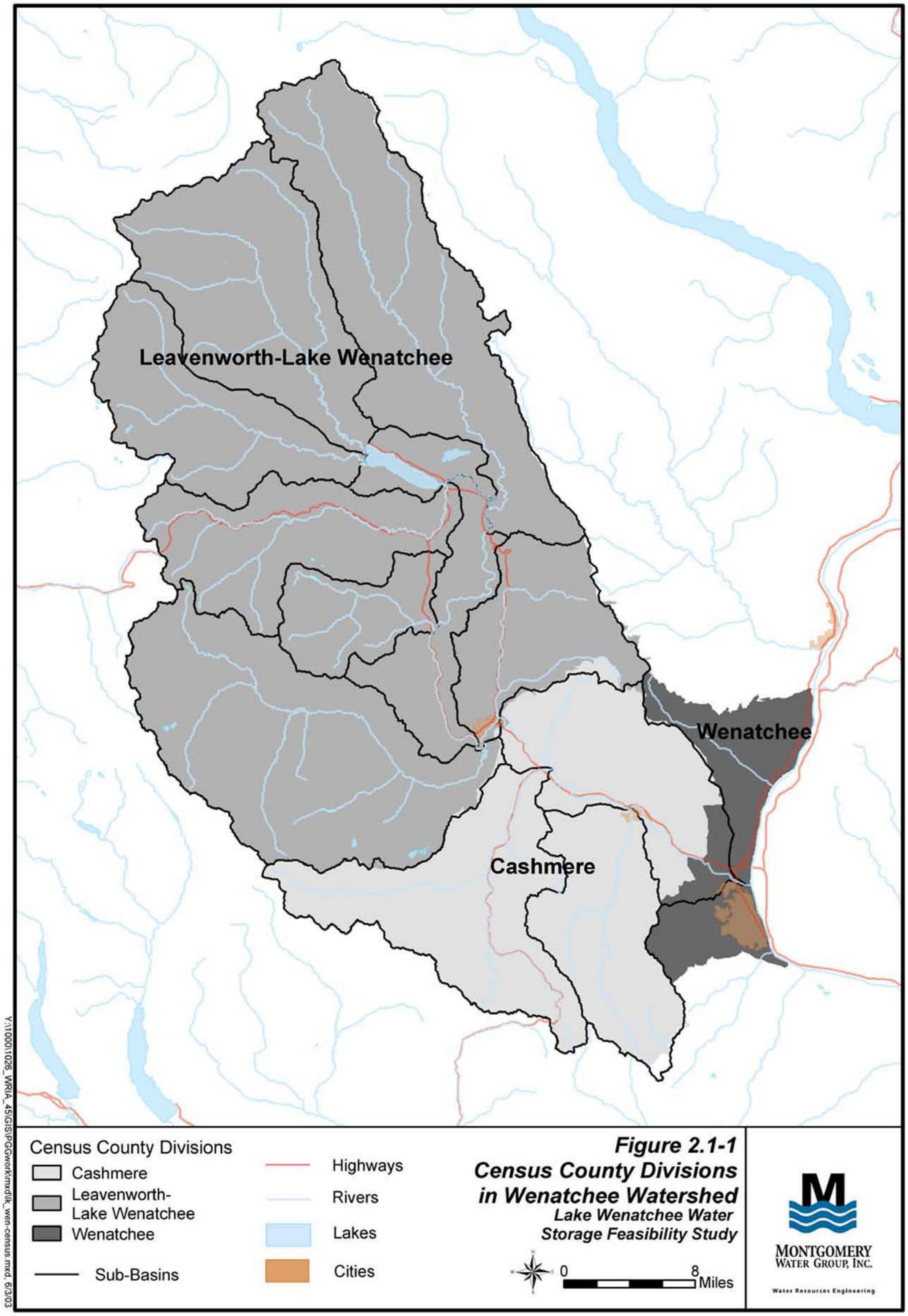
1. Analysis of current water use associated with public water systems was performed using data obtained from water system plans and DOH's DWAIN database. Large Group A public water systems are required to submit water system plans to DOH, which include water use estimates and projections. For large communities such as Cashmere and Leavenworth, these plans are the most reliable source of usage information. These cities were contacted and current water use information was obtained from city staff. Such information was also directly obtained from the Chelan County PUD No.1 for its Dryden Water System, and from the Chiwawa Communities Association. The other large systems (i.e., those serving more than 100 people) did not respond to requests for water use data. Average day and maximum day demands were tabulated, as well as the annual amount of water used, in acre-feet per year (afy). The average daily water use factor for these systems was calculated to be 380 gallons per day (gpd) per residential connection, based upon usage and connections data. The average peaking factor (i.e., ratio of maximum day to average day usage) was determined to be 2.5.

2. Although the City of Wenatchee and Chelan County PUD No.1 – Wenatchee Area are listed in Table 2.1-1 for population estimation purposes, no water use information is provided, since these two purveyors share a regional source of supply located outside of the Wenatchee River Watershed (the Rocky Reach Dam Aquifer).

3. Estimates of water use for the other systems listed individually in Table 2.1-2, as well as all other Community and Group B public water systems, were developed using connections information in DWAIN, in conjunction with the average water use and peaking factors mentioned above. Average daily demand was calculated as the number of residential connections listed in DWAIN multiplied by the average daily water use factor (380 gpd). Maximum day demand was calculated as the average day demand multiplied by the average peaking factor (2.5).

4. There is little readily available data pertaining to water use by Non-Community public water systems. Therefore, an estimate was made, based upon the average water use and peaking factors described above. However, it is noted that there is a high degree of uncertainty associated with these estimates, as they are predicated on multiple assumptions. For the purposes of this analysis, water use by Non-Community public water systems is assumed to occur for only half of the year, and at half of the average daily rate of a typical residence, given that most such systems are campgrounds, parks, etc. Therefore, estimates of water use by Non-Community public water systems were calculated as the number of total connections listed in DWAIN multiplied by 95 gpd per connection (i.e., 380 gpd/4). A peaking factor of 2.5 was used to generate maximum day demands.

5. Water use estimates for households with exempt wells were developed using the same method used for the smaller Community and Group B public water systems, applying average daily water use and peaking factors.


Leavenworth-Lake Wenatchee
Wenatchee
Cashmere
Y:\1000\1026_WRIA_45\GIS\PGGwork\mxd\lk_wen-census.mxd, 6/3/03
Census County Divisions
Cashmere
Leavenworth-
Lake Wenatchee
Wenatchee
Sub-Basins
Highways
Rivers
Lakes
Cities
Figure 2.1-1
Census County Divisions
in Wenatchee Watershed
Lake Wenatchee Water
Storage Feasibility Study
0
8
Miles
MONTGOMERY
WATER GROUP, INC.
Water Resources Engineering

6. Also provided in Table 2.1-1 is an estimate of the amount of municipal and domestic water use obtained from groundwater versus surface water sources. This distinction is based upon information provided by water purveyors and type of source data available from DWAIN.

Based on this approach, total municipal and domestic water use for WRIA 45 is estimated to be approximately 3.9 million gallons per day (mgd) on an average daily basis and 9.4 mgd on a maximum daily basis. This equates to 6.0 cfs on an average day and 14.6 cfs on a maximum day. The total annual amount used is 4,400 afy. The Cashmere CCD contains the highest water use, at 2,170 afy annually. Of this amount, 45% is associated with exempt well use. In the Leavenworth CCD, the majority of water usage is accounted for by the City of Leavenworth, with less than 15 percent of total usage associated with individual household wells. As noted earlier, the majority of the population residing within the Wenatchee CCD receives water from outside the watershed. However, 548 afy is produced from within the watershed, the majority of which is associated with exempt wells.

Considering the entire watershed, public water systems comprise 58% of the total municipal and domestic water use, with 42% of usage accounted for by exempt wells.

2.1.1.3 Estimate of 2025 Population

The Washington State Office of Financial Management (OFM) prepares forecasts of future population that are used for growth management planning by cities and counties in Washington State. The forecasts are provided at five-year intervals between 2000 and 2010 and single-year intervals between 2010 and 2025. The projections provide high, intermediate, and low growth expectations for each county. The high and low projected population forecasts generally reflect assumptions as to the uncertainty regarding growth over the next 25 years. These assumptions are based on the historical high and low decade migration patterns for each county and on current factors affecting the economic base and attractiveness of specific areas in the state. The alternative forecasts are a means of taking the fundamental unpredictability of long-range projections into account. The OFM population forecasts for Chelan County are summarized in Table 2.1-2 and illustrated in Figure 2.1-2.

Table 2.1-2. Forecasted Population Growth in Chelan County.

Projection	Year			
	2000	2010	2020	2025
High	66,616	81,009	94,966	101,859
Medium	66,616	75,993	85,864	90,461
Low	66,616	71,015	76,848	79,176

Counties may select a growth management planning target within the high and low projections. Chelan County Planning Department has adopted the high growth projection for use in growth management planning. For 2025, the population forecast for Chelan County is 101,859, an increase of 35,243 from the population found in the 2000 Census.

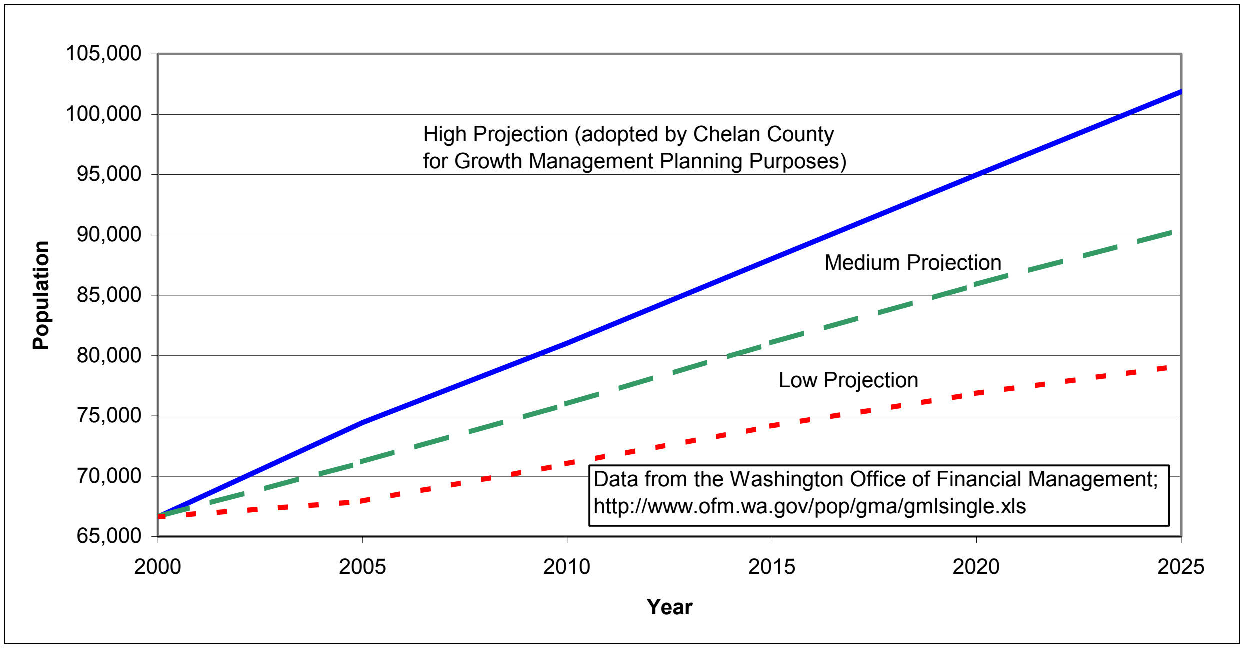


Figure 2.1-2. Forecasted Population Growth in Chelan County.

The projected 2025 population within each County Census Division was obtained from Chelan County Planning and is summarized in Table 2.1-3 along with 2000 Census results and 2002 estimates. The population within the Wenatchee River Watershed is projected to grow from 53,180 in 2002 to about 79,600 in 2025, an increase of about 26,500. Most of the growth will occur in the Wenatchee CCD, with a population increase of about 18,200. The population increase in the Cashmere CCD is projected at about 5,900 and the population increase in the Leavenworth-Lake Wenatchee CCD is projected at about 2,550.

Table 2.1-3. Forecasted Population Growth in Wenatchee River Watershed.

Census County Divisions	2000 Census	2002	2025
Cashmere	10,824	11,217	17,092
Leavenworth - Lake Wenatchee	5,902	6,068	8,453
Wenatchee	34,678	35,895	54,061
Total Population of C.C.D.'s located in Wenatchee River Watershed	**51,404**	**53,180**	**79,606**

2.1.1.4 Estimate of Year 2025 Municipal and Domestic Water Use

Future Municipal and Domestic Water Use was estimated using the population growth estimates contained in the previous sections as well as estimates contained in Water System Plans for the Cities of Leavenworth and Cashmere. Table 2.1-4 summarizes those estimates. The Average Daily Demand is forecast to increase 1.7 mgd (2.6 cfs) by 2025. The Maximum Daily Demand, which occurs in summertime, is forecast to increase 4.7 mgd (7.3 cfs) by 2025. The annual volume of water use is forecast to increase by about 1,900 acre-feet by 2025.

The future water demands include both surface water and groundwater. An estimate of the split of use between surface water and groundwater was not attempted however most of the additional demand will likely be obtained from groundwater sources. The exception may be the Cities of Leavenworth and Cashmere, who currently use surface water for a portion of their supply and may use additional surface water if they have adequate surface water rights.

Table 2.1-4. Wenatchee River Watershed Projected Municipal and Domestic Water Use in 2025.

		Estimated 2002 Population	Estimated 2025 Population	Est. No. of Connections or ERUs	ADD (mgd)	MDD (mgd)	Annual (afy)
Wenatchee CCD	City of Wenatchee, PUD and other community systems	32,639	47,925	n/a	n/a	n/a	n/a
	Households with exempt wells	3,256	5,404	2,078	0.790	1.975	885
	Wenatchee CCD sub-total supplied with water from WRIA 45	3,256	5,404	2,078	0.790	1.975	885
Cashmere CCD	City of Cashmere	3,045	10,225	6,391	1.592	3.980	1,785
	Others including Community and Exempt wells	8,172	6,867	2,641	1.004	2.509	1,125
	Cashmere CCD sub-total	11,217	17,092	9,032	2.596	6.489	2,910
Leavenworth CCD	City of Leavenworth	3,269	6,012	3,989	1.857	4.817	2,082
	Others including Community and Exempt wells	2,800	2,441	939	0.357	0.892	400
	Leavenworth CCD sub-total	6,068	8,453	4,928	2.214	5.709	2,482
WRIA 45 Total (Does not include population served by Wenatchee)		20,541	30,949	16,038	5.599	14.173	6,277
Estimated 2002 Totals					**3.933**	**9.446**	**4,409**
Estimated Increase in Demand 2002-2025 in mgd and acre-feet					**1.666**	**4.727**	**1,868**
Estimated Increase in Demand 2002-2025 in cfs and acre-feet					**2.6**	**7.3**	**1,868**

2.1.2 Self-Supplied Commercial/ Industrial Water Use

Some industries have their own water rights and sources of supply, which are considered here separately from municipal usage. For the purposes of this analysis, annual water usage for such users was assumed to equal the annual amount of their commercial/industrial water rights. This approach does not identify the actual water use by such users; rather, it identifies the maximum authorized use by each user. In the case of commercial/industrial surface water rights, no annual quantity is provided in the State's water right database. The only information provided for these rights is instantaneous quantity. Therefore, annual water usage by commercial/industrial surface water right holders is considered unknown. Estimation of annual use based upon instantaneous water rights (i.e., assuming constant use of the instantaneous quantity) is not a viable approach, as most such users do not use water constantly throughout the year.

Table 2.1-5 summarizes the water usage associated with self-supplied commercial/industrial users. The points of withdrawal and diversion of all Wenatchee River Watershed commercial/industrial water right holders listed in Table 2.1-5 are located within the Cashmere CCD, near the Cities of Cashmere and Peshastin. These users are fruit grower associations or unions, with the exception of one lumber company. In most cases, fruit grower associations and packers use water for non-consumptive purposes such as fruit washing, process transport, and water-cooled refrigeration. In total, the amount of ground water used for self-supplied commercial/industrial purposes is estimated to be 933 afy.

Not included in Table 2.1-5 are industries around the City of Wenatchee, which obtain surface water from the Columbia River and ground water from outside of any of the sub-basins directly tributary to the Wenatchee River. These industries include Pacific Pulp Molding, Columbia Concrete Pipe Company, Spring Builders Inc., Keyes Fibre Company, Western Cold Storage Company, JM Smucker Company, Wenatchee Wenoka Growers, Glico Apple Corporation, and Stemilt Growers, Inc.

Table 2.1-5. Estimate of Current Self-Supplied Commercial/Industrial Water Use.

	2002 Water Use (1				
	Annual (afy), by Type of Source				
Water Right Holder	ADD (3) (mgd/cfs)	MDD (4) (mgd/cfs)	Ground Water	Surface Water	Total
Wenatchee CCD - Subtotal	0/0	0/0	0	0	0
Cashmere CCD - Subtotal	0.833/1.29	2.806/4.35	933	Unknown (2)	933
Peshastin Fruit Growers Assoc.	0.357/0.55	0.361/0.56	400	0	400
Central Packers	0.225/0.35	0.258/0.4	252	0	252
Peshastin Cooperative Growers	0.206/0.32	0.323/0.5	231	0	231
Cashmere Fruit Growers Union	0.045/0.07	0.574/0.89	50	Unknown (2)	50
Schmitten Lumber Co.	Unknown (2)	1.290/2.0	0	Unknown (2)	Unknown
Leavenworth CCD - Subtotal	0/0	0/0	0	0	0
TOTAL-WRIA 45	0.833/1.29	2.806/4.35	933	Unknown (2)	933

Notes:

(1) Based on water right information presented in Section 2.4.

(2) No annual quantities are associated with the two surface water commercial/industrial water rights (Cashmere Fruit Growers Union and Schmitten Lumber Co.).

(3) Calculated as annual water right (Q_a) divided by 365 days/year.

(4) Instantaneous water right (Q_i).

2.1.2.1 Estimate of Future Self-Supplied Commercial/Industrial Water Use

The growth in self-supplied commercial and industrial water use is limited because of difficulty in obtaining new water rights and the potential for interruptions in supply when instream flows are not met if water rights are obtained. These types of water users will locate where a reliable water supply is available. This sector may increase water use in the Wenatchee River Watershed but would likely need to purchase the water from another user, such as an irrigator or municipality. No change in total diversions or streamflow would likely result from that scenario.

2.1.3 Agricultural Water Use

This section presents estimates of water diverted for irrigation use and water applied to crops in the study area.

2.1.3.1 Records of Water Diverted for Irrigation Use

Section 2.4, Water Rights, summarizes the volume of Water Right Permits, Certificates and Claims for various purposes including irrigation. The volume of water rights stated in those tables may overstate the volume of water diverted and used for irrigation purposes because supplemental rights are included, limitations to use of the water rights are not described and the quantities associated with claims have not been reviewed or adjudicated. The totals should be considered to be an upper bound, or maximum potential irrigation use. To verify those totals and obtain a more accurate estimate of water diversions, water measurement data is used.

Most of the irrigation water users in the Wenatchee watershed are located within the Wenatchee Reclamation District and the Icicle and Peshastin Irrigation District. Approximately 12,000 acres are irrigated in the Wenatchee watershed with water delivered by those districts. Water diversion records for those irrigation water users were requested and obtained. The data from the Wenatchee Reclamation District is for 2002 (Smith, pers. comm) while the Icicle and Peshastin Irrigation Districts requested that data published in Water Conservation Plans for the Districts be used in this report. That data is from 1990 and 1991, however they stated the water diversion patterns have not changed significantly since that time (Teeley, pers. comm).

Table 2.1-6 lists the average weekly diversions by the Wenatchee Reclamation District for 2002. The diversions listed in the table should not be construed to be long-term averages as diversions change both annually and seasonally due to weather conditions, cropping patterns, acreage irrigated and other factors. Figure 2.1-3 illustrates the weekly diversions. The District starts diversions in early April and stops in mid-October. At the beginning and end of the irrigation season the District typically diverts about one-half of their water right of 200 cfs. Peak diversions occur during July and August in response to hot weather and peak crop irrigation requirements.

Water use records are not available for smaller water users, although their water use is limited to their water right. The diversion patterns that occur for the Wenatchee Reclamation District are probably typical for smaller irrigation water users in the Wenatchee River Watershed.

Table 2.1-6. Pattern and Quantity of Diversions for Wenatchee Reclamation District, 2002.

Date	Flowrate (cfs)	Weekly Volume (ac-ft)
4/8/02	91.6	1,272
4/15/02	94.3	1,309
4/22/02	92.9	1,290
4/29/02	98.3	1,364
5/6/02	96.9	1,346
5/13/02	91.6	1,272
5/20/02	118.3	1,643
5/27/02	119.6	1,661
6/3/02	119.6	1,661
6/10/02	143.7	1,995
6/17/02	151.7	2,106
6/24/02	149.0	2,069
7/1/02	155.7	2,162
7/8/02	181.1	2,514
7/15/02	167.7	2,329
7/22/02	169.1	2,347
7/29/02	167.7	2,329
8/5/02	165.1	2,292
8/12/02	157.0	2,180
8/19/02	163.7	2,273
8/26/02	155.7	2,162
9/2/02	146.4	2,032
9/9/02	129.0	1,791
9/16/02	114.3	1,587
9/23/02	114.3	1,587
9/30/02	113.0	1,568
10/7/02	113.0	1,568
10/14/02	92.9	1,290
Total Diversions		51,000

Data from the Icicle and Peshastin Irrigation Districts is summarized in Table 2.1-7. Their records show the peak diversions occurring in the period of June through August with water use increasing to a peak in April and May and declining in September towards the end of the irrigation season.

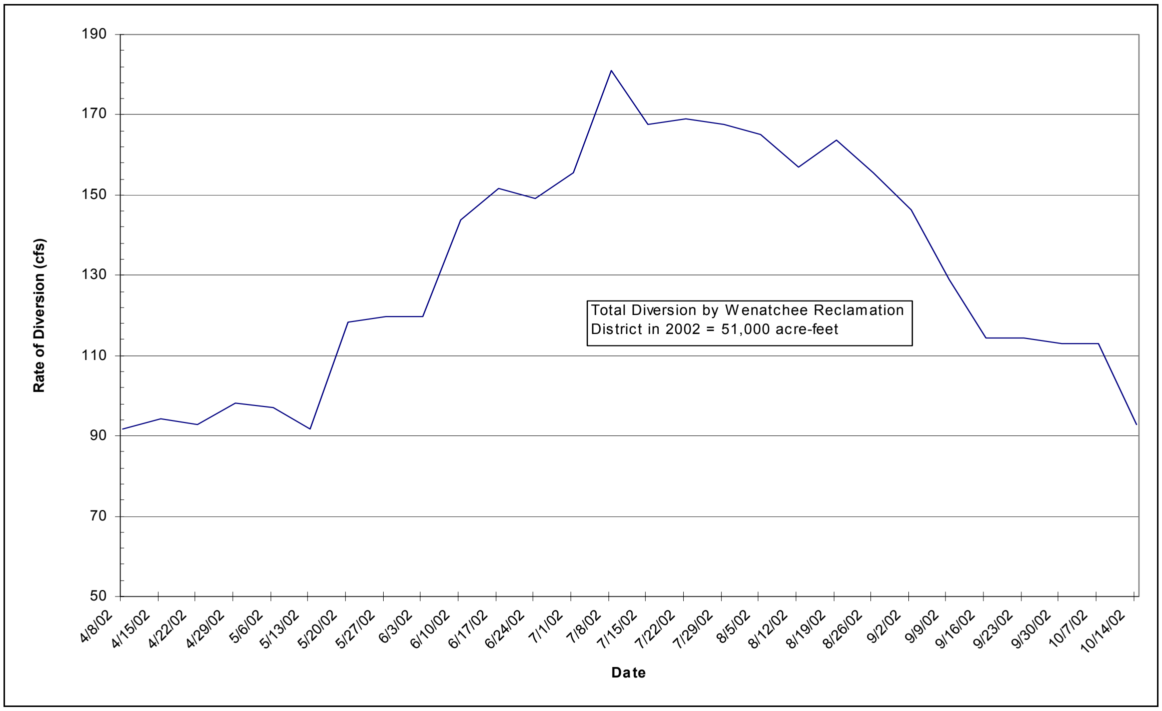


Figure 2.1-3. Wenatchee Reclamation District Diversions – 2002

Table 2.1-7. Monthly Diversions Icicle and Peshastin Irrigation Districts - Average of 1990 and 1991

Month	Icicle Creek Diversion		Peshastin Creek Diversion	
	Rate (cfs)	Volume (acre-feet)	Rate (cfs)	Volume (acre-feet)
April	69	4,106	30.5	1,812
May	88.5	5,443	35.0	2,154
June	96.5	5,742	37.0	2,199
July	99.5	6,120	39.5	2,427
August	98.5	6,058	36.6	2,248
Sept	78.5	4,671	28.0	1,666
Totals		**32,139**		**12,505**

It is likely that additional data will be available in the future for analyzing irrigation diversions with the implementation in 2003 of WAC 173-173, *Requirements for Measuring and Reporting Water Use.* The WAC contains new requirements for the measurement and reporting of water diversions. In the future, water users will be required to record diversions using standard measuring devices and report annually the rate and volume of water diverted to the Department of Ecology.

2.1.3.1.1 Volume of Water Needed to Meet Crop Irrigation Requirements

An indirect method of estimating water use for irrigation is to count the acreage irrigated and estimate the amount of water needed to productively grow crops. This method will not provide an estimate of the amount of water diverted or pumped but will provide an estimate of the volume of water consumptively used for irrigation in the watershed.

Crop Irrigation Requirements (CIRs) for representative crops grown in the Wenatchee River Basin are listed in Table 2.1-8. The CIRs were obtained from the Washington Irrigation Guide (WSU, SCS 1985) and represent average annual consumptive water use for different crops and locations in the basin. The actual crop water demands can vary substantially depending on weather conditions, soil type, location, and other factors. Two locations are documented in Table 2.1-8; Leavenworth and Wenatchee. The CIR for Leavenworth is a fair representation of the upper watershed while the CIR for Wenatchee represents the lower watershed. For each location, CIRs for different crop types representing the types of crops grown in the area. The CIRs are provided in inches per month and annually in inches per year and feet per year.

In addition to average CIRs from the Washington Irrigation Guide, data from the WSU Tree Fruit Research Extension Center is available for apple trees with cover. The Research Center is located in Wenatchee. The average CIR measured at the Research Center for the period of 1972-2000 was 35 inches. That corresponds to and confirms the CIR contained in the Washington Irrigation Guide.

The CIR is one component of the on-farm irrigation water requirement. The other component is the efficiency of irrigation, called the field application efficiency. The field application efficiency varies with the type of irrigation practiced (surface or pressurized), the field configuration, size, slope, soils, and other factors. The Washington Irrigation Guide published approximate field application efficiencies for various types of irrigation practiced, which are listed in Table 2.1-9.

The irrigation method most used in the Wenatchee River Watershed is solid set sprinklers with varying emitter sizes from Rainbird-type sprinklers to micro-spray nozzles. The average field application efficiency in the Wenatchee River Watershed is likely about 70 percent.

The volume of water required by a grower for a particular crop type, when considering their method of irrigation, is equal to the CIR for the crop type divided by the field application efficiency for their method of irrigation. For example, an apple grower in the lower Wenatchee Valley that uses solid set sprinklers may require 4.19 acre-feet of water per acre (2.93 ft CIR/0.70 field application efficiency) to meet the CIR during an average year.

Table 2.1-8. Average Crop Irrigation Requirements.

Location / Crop Type	Typical Crop Irrigation Period	Monthly Water Demand (inches)							Seasonal Water Demand (inches)	Seasonal Water Demand (feet)
		April	May	Jun	July	Aug.	Sept.	Oct.		
Leavenworth										
Alfalfa	6/3-10/7	0	0	3.37	6.42	4.77	2.56	0	17.12	1.43
Pasture/Turf	6/3-10/7	0	0	3.58	6.78	5.05	2.77	0	18.18	1.52
Apples w/Cover	6/3-10/7	0	0	4.52	8.54	6.44	3.6	0	23.10	1.93
Pears & Plums w/Cover	5/24-10/7	0	0.47	4.53	7.83	5.89	3.19	0	21.91	1.83
Winter Wheat	4/22-10/7	0.11	3.44	5.01	7.78	2.78	0	0	19.12	1.59
Wenatchee										
Alfalfa	5/7-10/10		3.82	6.71	7.98	5.59	3.91	0.47	28.48	2.37
Pasture/Turf	5/7-10/10		4.04	7.09	8.41	5.91	4.12	0.51	30.08	2.51
Apples w/Cover	5/7-10/10		3.37	8.23	10.55	7.52	5.00	0.47	35.14	2.93
Pears & Plums w/Cover	5/7-10/10		3.97	7.47	9.69	6.88	4.56	0.4	32.97	2.75
Winter Wheat	4/2-10/10	2.21	6.33	8.23	7.53	0.57	0.31	0.7	25.88	2.16

Table 2.1-9. Expected Field Application Efficiencies in Washington.

Irrigation Method	Efficiency (percent)
Level Border	75
Graded Border	70
Flood Irrigation	50
Contour Ditch	50
Level furrow	65
Graded Straight furrow	60
Graded Contour Furrow	60
Trickle - Point Source Emitter	90
Trickle - Spray Emitter	85
Trickle - Continuous Tape	90
Handline/Wheel Line	65
Big Gun (Fixed Place)	60
Traveling Gun	65
Solid Set (Above Canopy)	65
Solid Set (Below Canopy)	70
Center Pivot	70
Linear Move	70

Growers may also require additional water to make up for conveyance losses in irrigation canals or ditches used to convey water to farms. The magnitude of conveyance loss depends on the type of canal or ditch (lined or unlined), their length, the degree of maintenance and other factors. In our experience in North Central Washington, we have found conveyance losses to range from zero (for piped systems) to more than 50 percent. The only data on efficiency found in the Wenatchee River Watershed was from the Icicle Irrigation District Comprehensive Water Conservation Plan and Peshastin Irrigation District Comprehensive Water Conservation Plan (Klohn Leonoff, 1993). Those reports indicate conveyance losses averaging 10-15%.

2.1.3.1.2 Estimated Consumptive Use of Water for Irrigation

To estimate the total consumptive water use for irrigation in the Wenatchee River Basin, irrigated land cover area and types were determined and average CIRs applied to those crop types. Irrigation areas and land cover types were estimated from the National Land Cover Dataset (NLCD) for 1992. The analysis was performed for each sub-basin delineated in the *Wenatchee River Basin Watershed Technical Assessment*. Those sub-basins are shown in Figure 2.1-4. Table 2.1-10 shows the area of potentially irrigated land types in each sub-basin and the entire Wenatchee River Basin. Five sub-basins, White, Little Wenatchee, Nason, Chiwaukum, and Lake Wenatchee showed no irrigated land use types in the NLCD. The total irrigated area estimated using the 1992 NLCD data is 12,836 acres; of that 11,573 acres were classified as orchards. A shortcoming of the NLCD data is that irrigated area (lawns, landscaping) is also contained within urbanized or developed area. Because the predominant land cover within an area classified as urban may be housing or streets the irrigated area within those areas is not accounted for. If the urban area water supply is solely from a municipal supplier, such as the City of Cashmere, that water use is accounted for in Section 2.1.1 Municipal and Domestic Use. If they are served by an irrigation district or company, that consumptive use of water is not accounted for in this analysis.

The number and type of irrigated acreage was then multiplied by the corresponding CIR value for the land use type. The area of orchards was multiplied by the CIR for apples, because it is a more conservative number than the CIR for pears. The area of pasture and hay was multiplied by the CIR for alfalfa. The area of small grains was multiplied by the CIR of winter wheat. The remaining irrigated areas were multiplied by the CIR for pasture/turf. Table 2.1-11 shows the estimated irrigation water demand for each sub-basin and the Wenatchee River Watershed. The total estimated consumptive use of water for irrigation purposes is 35,000 acre-feet per year. The on-farm demand, including field application efficiency, would likely be 30-40% greater. Most of the additional water used will seep into shallow groundwater aquifers and may be a source of water supply for groundwater users or may return to surface water via a stream or wetland.

The 1992 data set is the most recent land coverage data set from the NLCD although additional color infrared photos were taken in 2002. The 2002 photos have not yet been analyzed by the USGS.

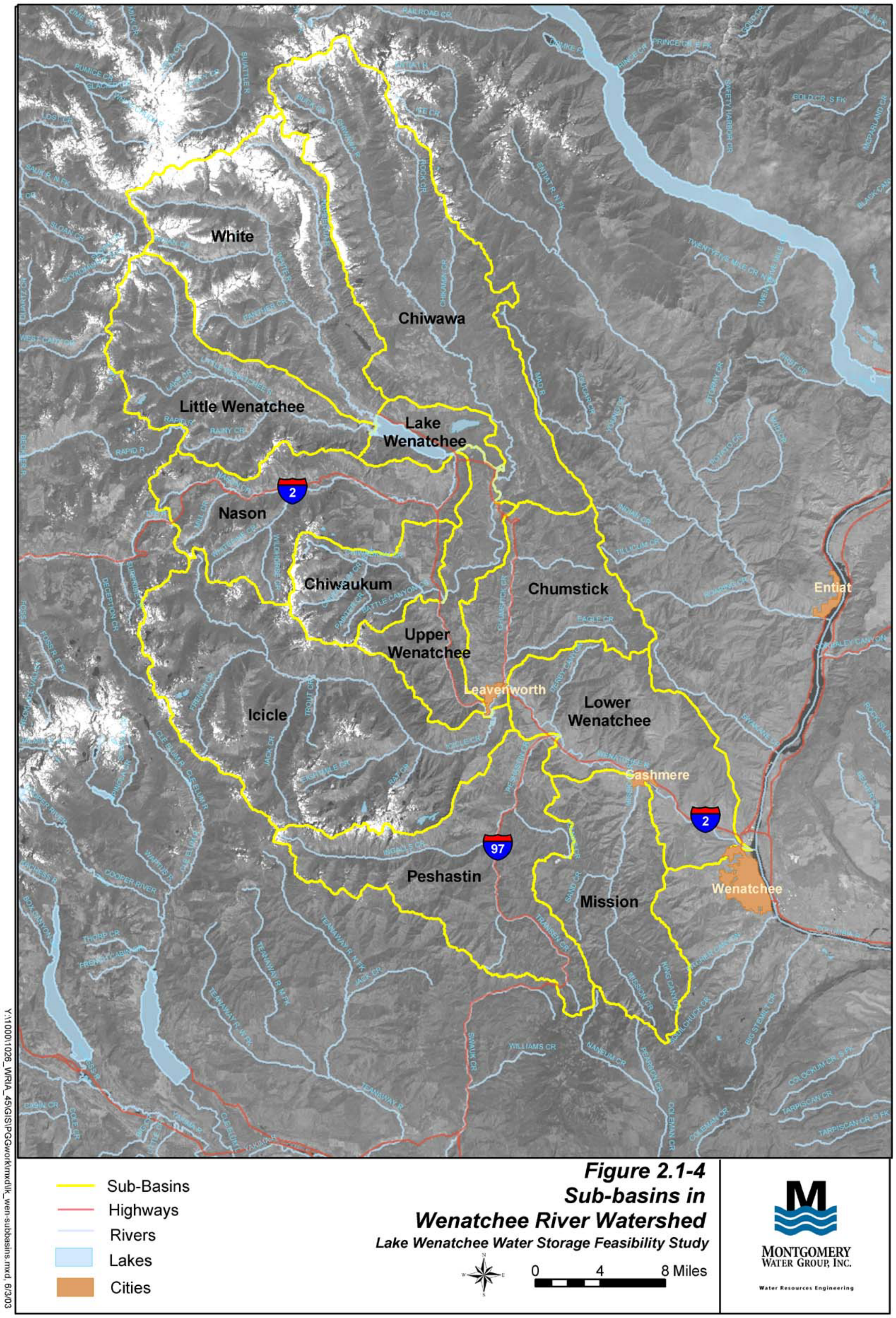


Figure 2.1-4
Sub-basins in Wenatchee River Watershed
Lake Wenatchee Water Storage Feasibility Study

Table 2.1-10. Summary of Potentially Irrigated Lands Based Upon 1992 Land Cover Database (acres).

Land Cover Type	Chiwawa	Upper Wenatchee	Chumstick	Icicle	Peshastin	Mission	Lower Wenatchee	Wenatchee River Watershed
Orchards, Vineyards, Other	49	278	652	216	645	1,807	7,926	11,573
Pasture, Hay	93	320	118	86	17	0	299	933
Row Crops	0	0	0	0	1	0	27	28
Small Grains	0	0	3	0	1	0	253	257
Fallow	0	0	0	0	0	0	8	8
Urban, Recreational Grasses	0	0	37	0	0	0	1	37
Potentially Irrigated Land	**142**	**598**	**810**	**302**	**664**	**1,807**	**8,513**	**12,836**

Table 2.1-11. Estimated Irrigation Water Demand for Consumptive Use Based Upon 1992 Land Cover Data (acre-feet).

Land Cover Type	Chiwawa	Upper Wenatchee	Chumstick	Icicle	Peshastin	Mission	Lower Wenatchee	Wenatchee River Watershed
Orchards, Vineyards, Other	94	536	1,255	416	1,889	5,290	23,210	32,690
Pasture, Hay	133	457	168	122	42	0	709	1,631
Row Crops	0	0	0	0	2	0	69	71
Small Grains	0	0	5	0	2	0	545	552
Fallow	0	0	0	0	0	0	20	20
Urban, Recreational Grasses	0	0	56	0	0	0	1	57
Total Consumptive Use	**227**	**992**	**1,485**	**538**	**1,934**	**5,290**	**24,554**	**35,020**

2.1.3.1.3 Summary of Agricultural Census of Irrigated Acreage

Although the 1992 land cover data set is the most recent comprehensive data found agricultural census data is available to review changes in irrigated acreage that have occurred since that time. The *2001 Washington Fruit Survey* (Washington Agricultural Statistics Service, 2001) was consulted to estimate the trend in tree fruit acreage in recent years. The Washington Agricultural Statistics Service is part of the Washington State Department of Agriculture and conducts periodic statewide fruit acreage surveys. The most recent survey completed was in 2001. Data is also available from the National Agricultural Statistics Service (NASS) for previous years, such as 1982, 1987, 1992 and 1997. The results of the tree fruit survey are compiled and reported by Fruit Reporting District (FRD). The Wenatchee FRD, which comprises Chelan, Douglas and Okanogan Counties, contains the Wenatchee River Watershed. Table 2.1-12 presents a comparison of fruit acreage in the Wenatchee FRD since 1982.

Table 2.1-12. Tree Fruit Acreage in Wenatchee Fruit Reporting District.

Year	Apple Acreage	Pear Acreage	Cherry Acreage
1982	58,865	8,733	3,716
1987	59,022	10,694	3,991
1992	57,346	11,684	4,923
1997	55,643	12,682	6,533
2001	54,000	14,650	9,500

Source: 2001 Washington Fruit Survey (Washington Agricultural Statistics Service, 2001)

The total acreage of apples, pears and cherries planted in the Wenatchee FRD increased by 4,197 acres in the period of 1992 to 2001. A decline in the acreage planted in apples has been offset by increases in pear and cherry acreage. Additional data on the acreage with different varieties of fruit is also available but is not presented in this report.

The tree fruit acreage by County or Watershed within the Wenatchee FRD was not available from the *2001 Washington Fruit Survey*. However estimates of irrigated orchards and irrigated farmland located in Chelan County were published in the 1997 *Census of Agriculture* (NASS, 1999). Those estimates are summarized in Table 2.1-13.

Table 2.1-13. Irrigated Farmland in Chelan County.

Year	Irrigated Orchard Acreage	Other Irrigated Acreage	Total Irrigated Acreage
1987	28,923	2,356	31,279
1992	28,775	1,233	30,008
1997	28,603	1,959	30,562

Source: 1997 Census of Agriculture (NASS, 1999)

An overall decrease of about 700 irrigated acres has occurred since 1987 but an increase of about 550 acres occurred from 1992 to 1997. The agricultural statistics for both the Wenatchee FRD and Chelan County indicate that tree fruit acreage has increased since 1992. The change within the Wenatchee River Watershed is not available from those publications. The Washington State Department of Agriculture (WSDA) was consulted and it was found they performed mapping of crops in Chelan County in 2002 (pers. communication with Perry Beale). The data was obtained from the WSDA and analyzed for the Wenatchee River Watershed. Table 2.1-14 presents that data. That data estimates the area of orchard in the Wenatchee Watershed at 16,169 acres. The WSDA mapping did not include irrigated area beyond crops, such as parks and landscaping. Although there are differences between the 1992 NLCD and the 2002 WSDA mapping, a comparison of these data sources and the agricultural census indicates irrigated orchard acreage has not decreased in the Wenatchee River watershed. The consumptive use estimate presented in the previous section is likely representative of current conditions also.

Table 2.1-14. Estimates of Land Area and Zoning within Wenatchee River Watershed.

	Area within each Subbasin (acres)												
Land Use Classification	**Chiwaukum**	**Chiwawa**	**Chumstick**	**Icicle**	**Lake Wenatchee**	**Little Wenatchee**	**Lower Wenatchee**	**Mission**	**Nason**	**Peshastin**	**Upper Wenatchee**	**White**	**Totals**
Commercial Agricultural	0	0	0	0	0	0	6,161	1,412	0	622	0	0	8,195
Commercial Forest	30,243	123,758	39,454	131,586	10,322	64,146	16,079	46,288	63,407	81,923	30,104	94,899	732,209
Public	0	0	4	171	801	0	179	0	71	0	0	0	1,226
Rural Residential / Resource 2.5	42	324	199	371	112	0	1,578	372	220	397	774	22	4,411
Rural Residential / Resource 5	706	732	4,749	854	149	0	5,039	2,122	1,417	1,627	1,717	115	19,227
Rural Residential / Resource 10	433	534	1,666	447	294	0	6,480	1,928	1,137	873	400	426	14,619
Rural Residential / Resource 20	474	1,527	5,309	3,763	982	816	29,705	6,935	2,565	604	2,458	4,438	59,576
Total Rural Residential / Resource	1,655	3,118	11,924	5,436	1,536	816	42,802	11,356	5,339	3,501	5,349	5,001	97,833
Rural Village	0	0	100	1	59	0	1,628	71	0	0	0	0	1,860
Rural Commercial	0	0	0	0	3	0	83	0	105	34	10	0	236
Rural Industrial	155	0	0	0	0	0	221	0	0	0	0	0	376
Rural Recreational / Resource	0	183	20	0	212	0	0	0	322	108	8	0	853
Rural Waterfront	0	387	57	11	402	0	32	0	0	0	581	15	1,484
Urban Residential 1	0	0	0	0	0	0	8	0	0	0	0	0	8
Urban Residential 2	0	0	0	0	0	0	0	0	0	0	0	0	0

2.1.3.1.4 Future Agricultural Water Use

The potential for change in irrigated agriculture exists due to market conditions for fruit and the proximity of farmland to desirable areas to live. A review of the long-term potential change in land use was performed by analyzing zoning data and comparing the area zoned agriculture to that currently used for farming. Table 2.1-14 presents estimates of land area zoned for agriculture and residential uses in the Wenatchee River Watershed.

A large difference in land area exists between the current agricultural land use and the area zoned for agriculture. The area zoned for agriculture is in the range of 4-6000 acres less than current irrigated area. However the availability of the land for residential use does not mean that it will be converted from agricultural use; the conversion will depend on the value of the land for residential property and the economics of continuing to farm. The previous section reviewed the changes in irrigated acreage that has occurred since 1982 and found the agricultural land base in Chelan County to be fairly stable and not declining. Most of the growth in the watersheds will occur in or near urban growth areas such as Cashmere and Leavenworth. Farms in the vicinity of those towns are most susceptible to development pressure.

When farms are converted to residential uses, the water rights associated with their properties are still owned by the property owner and can be used to irrigate lawns and landscaping as those water uses are defined as a beneficial use in the State Water Code. If the property is within an irrigation district, the district is obligated to deliver the same quantity of water as previously delivered to the property. The rate of delivery is fixed by the water rights appurtenant to the property and usually varies from 5 to about 10 gallons per minute per acre. Since irrigation districts are obligated to deliver that rate of flow even to a residential water user, the peak rate of diversion by the irrigation district from a stream will often not change. The total volume of water may be reduced because of less land area to irrigate or less interest in maintaining fields properly irrigated. An example is the Greater Wenatchee Irrigation District, which has units in East Wenatchee, Brays Landing and at Howard Flat near Chelan. The East Wenatchee unit has experienced the conversion of agricultural land to residential purposes. The Brays Landing and Howard Flat units are almost entirely agricultural. The district estimated the percentage of residential land to be 7% as of 2000 (Montgomery Water Group, 2000). The water demand in the Brays Landing unit is approximately 4% higher per acre than in the East Wenatchee unit. The water demand in the Howard Flat unit is approximately 8% higher per acre than in the Brays Landing unit and 13% higher per acre than in the East Wenatchee unit. However the demands at peak periods have not declined and therefore reductions in peak diversions have not occurred.

It is our opinion the peak rate of water use for agricultural use may not change significantly for the reasons described above. However the overall volume of water used for irrigation may be slightly reduced.

Although there is agricultural land that is converting to residential land, there are still some areas where additional water supply could be used to irrigate acreage that may be contiguous with an existing orchard but does not currently have water rights. That occurs in the Wenatchee River valley as most irrigation water supplies were developed a century ago using gravity delivery systems. Lands lying above the canals or lands with poor drainage could not be irrigated. With pumping systems and more advanced sprinkler systems, more land can be irrigated. In the Water Rights section (2.4) the review of Water Right Applications shows that a number of applications have been made for additional irrigation. It is not known how much of the water applied for would be used for agricultural use or for landscaping purposes. A number of applicants in the Lower Wenatchee sub-basin are fruit growers, which indicates the desire to plant additional acreage. The information available in the water rights database does not indicate the acreage applied for. The Water Right Applications would need to be reviewed individually to glean that information. A limitation to the use of water from new Water Rights is the interruptibility of those rights when stream flow is less than regulatory minimum flow. Most agricultural enterprises such as orchards cannot economically operate unless an alternate source is available (through a lease or temporary transfer of water). Landscape irrigation can withstand interruption without significant economic losses.

2.2 INSTREAM FLOW NEEDS

Instream flows were established by rule in 1983 for three reaches on the Wenatchee River, one reach on Icicle Creek and one reach on Mission Creek. The instream flows are set in Chapter 173-545 WAC Instream Resource Protection Program (IRPP) for the Wenatchee River Basin. Future consumptive water rights for diversion of surface water from the main stem of the Wenatchee River and perennial tributaries are subject to these instream flows as measured at the appropriate stream gauge, preferably the nearest one downstream. Chapter 173-545 WAC also stipulates that Peshastin Creek is subject to a June 15 to October 15 closure for protection of instream values. These instream flows do not affect water rights that were in existence prior to 1983. Single domestic and stockwater use are exempt, and nonconsumptive uses that are compatible with the purposes of the instream flows may be approved.

Table 2.2-1 lists the five stream reaches (called stream management units) affected by the instream flow criteria set in Chapter 173-545 WAC. Control stations are USGS streamflow gauging stations. Instream flow rates for each reach are tabulated in Table 2.1-17.

Table 2.2-1. WAC Stream Management Units in Wenatchee River Watershed.

Control Station	Stream Gauge	River Mile	Stream Management Reach
Wenatchee River at Plain	12-457000	46.2	From Plain Road Bridge RM 46.2, to headwaters
Icicle Creek near Leavenworth	12-458500	1.5	From headwaters to Icicle Creek to its mouth
Wenatchee River at Peshastin	12-459000	21.5	From confluence of Derby Creek to Plain Road Bridge, RM 46.2 excluding Derby Creek and Icicle Creek
Wenatchee River at Monitor	12-462500	7.0	From mouth to confluence of Derby Creek, including Derby Creek and excluding Mission Creek
Mission Creek near Cashmere	12-462000	1.5	From Mission Creek headwaters to its mouth

The Wenatchee Watershed Planning Unit has started a process to recommend new instream flows as part of the watershed planning process. That process will take several years to complete and is contingent on receipt of adequate funding to complete the instream flow setting process.

Table 2.2-1. WAC Instream Flow Requirements in Wenatchee River Watershed.

Month	Day	Instream Flow from WAC (cfs)				
		12-457000 Wenatchee River at Plain	12-458000 Icicle Creek near Leavenworth	12-459000 Wenatchee River at Peshastin	12-462000 Mission Creek near Cashmere	12-462500 Wenatchee River at Monitor
Jan	1	550	120	700	6	820
	15	550	120	700	6	820
Feb	1	550	120	700	6	820
	15	550	120	700	6	800
Mar	1	550	150	750	6	800
	15	700	170	940	11	1040
Apr	1	910	200	1300	22	1350
	15	1150	300	1750	40	1750
May	1	1500	450	2200	40	2200
	15	2000	660	2800	40	2800
Jun	1	2500	1000	3500	28	3500
	15	2000	660	2600	20	2400
Jul	1	1500	450	1900	14	1700
	15	1200	300	1400	10	1200
Aug	1	880	200	1000	7	800
	15	700	170	840	5	700
Sep	1	660	130	820	4	700
	15	620	130	780	4	700
Oct	1	580	130	750	4	700
	15	520	130	700	5	700
Nov	1	550	150	750	6	800
	15	550	150	750	6	800
Dec	1	550	150	750	6	800
	15	550	150	750	6	800

Figures 2.2-1 and 2.2-2 present a statistical analysis of streamflow compared to the IRPP flows for two Wenatchee River gauging stations; at Plain and at Monitor. The IRPP flows generally fall between the 50% and 90% exceedance values for streamflow on the affected streams except in September when the IRPP flows exceed the 50% exceedance flow values.

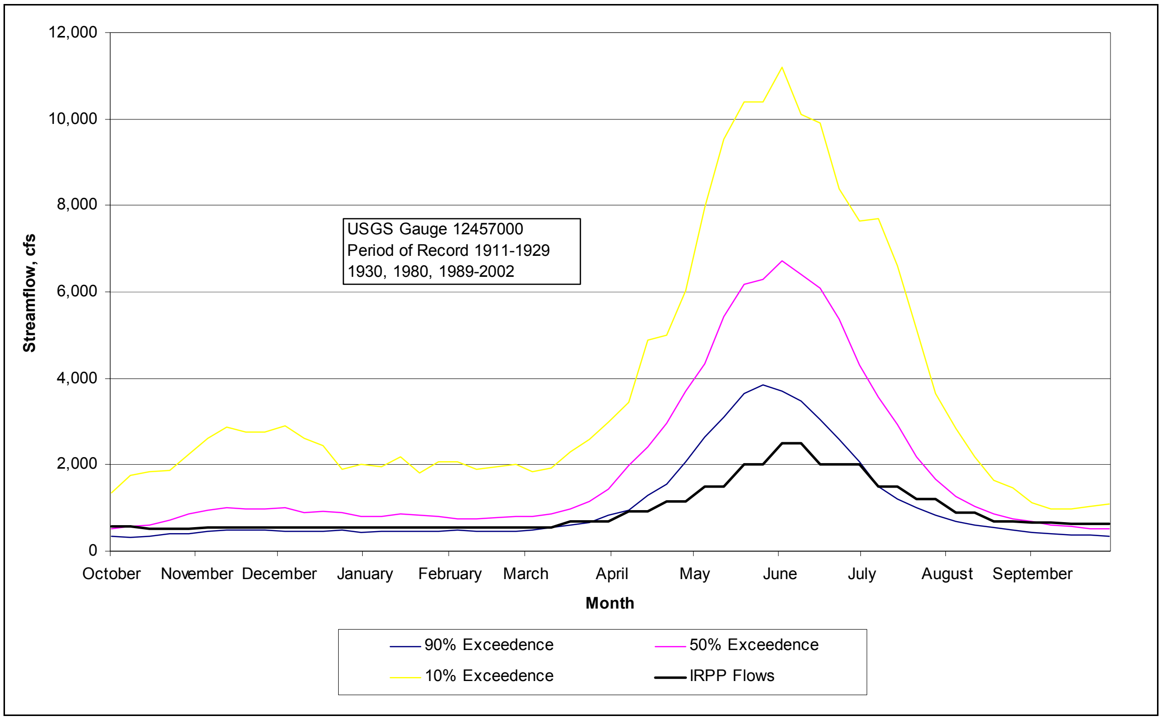


Figure 2.2-1. Comparison of Wenatchee River at Plain Flow to IRPP Flows.

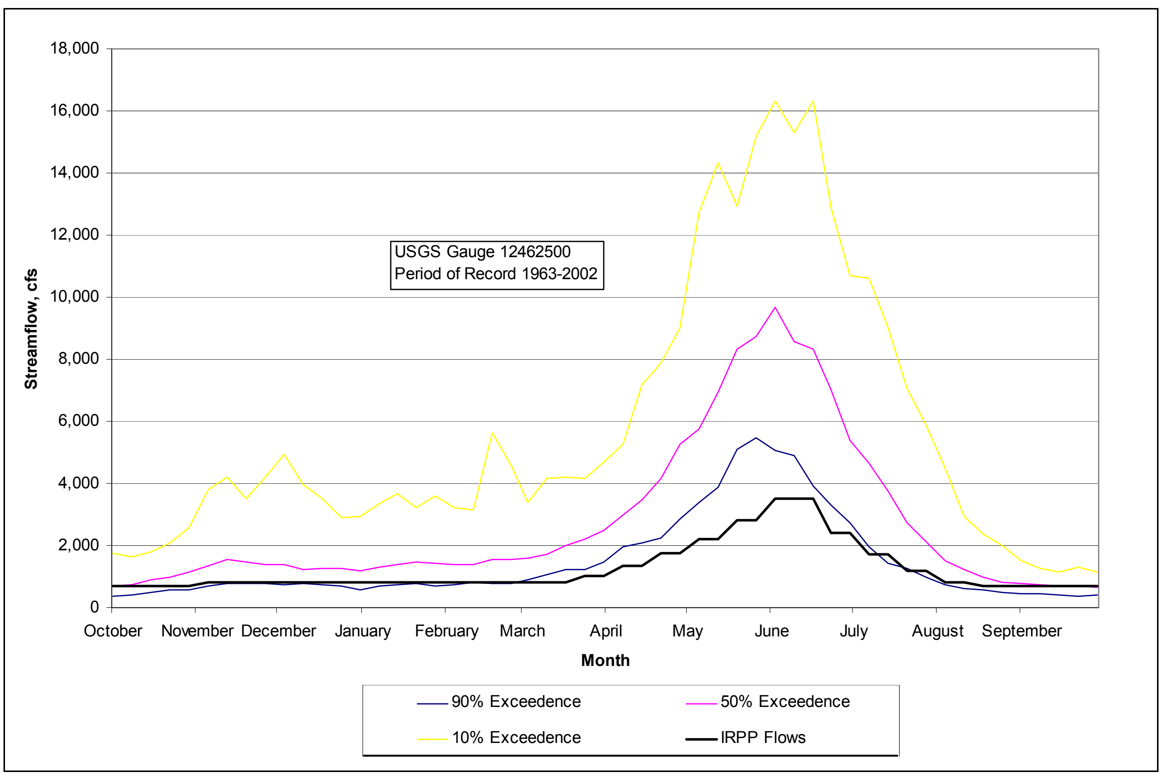


Figure 2.2-2. Comparison of Wenatchee River at Monitor Flow to IRPP Flows.

Figures 2.2-3 and 2.2-4 show a comparison of Wenatchee River flow at Plain and Monitor to IRPP flows for the last two July-October time periods. The flow volume which Wenatchee River flows are less than IRPP flows are listed in the figures. In 2002, the Wenatchee River flows were 15,700 – 24,700 ac-ft below IRPP flows. In 2001, the Wenatchee River flows were 46,100 – 50,400 ac-ft below the IRPP flows. 2001 was a drought year with an extended period of low streamflow. In 2002, the annual runoff was average but a late summer dry period caused streamflow to decline to 2001 levels.

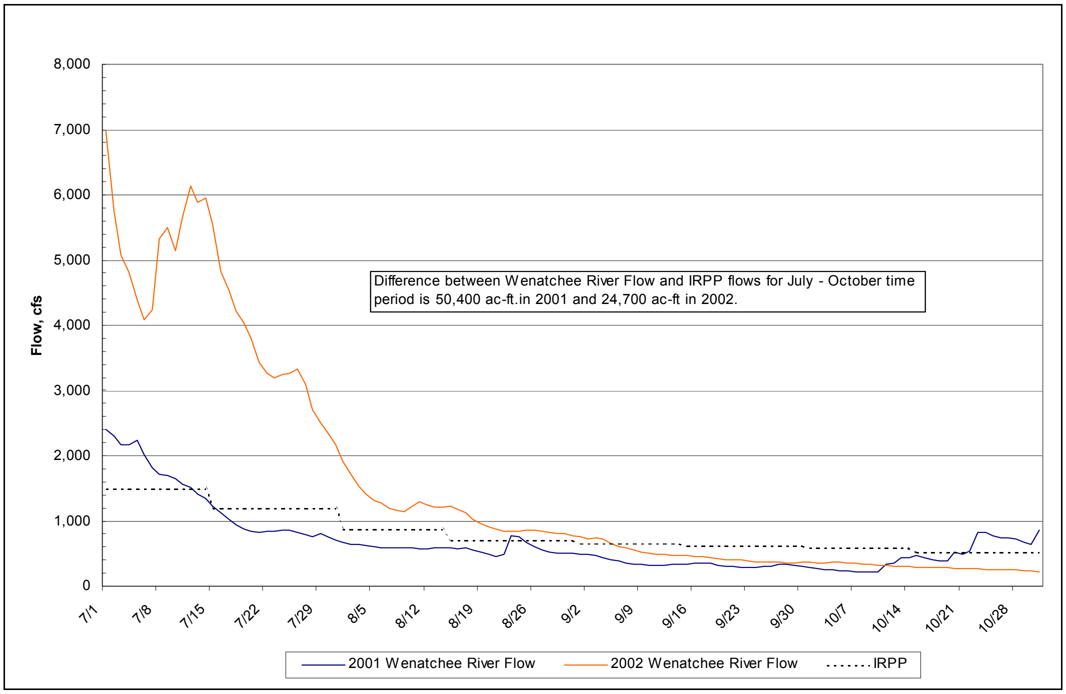


Figure 2.2-3. Comparison of Wenatchee River at Plain Flow to IRPP Flows for 2001 and 2002.

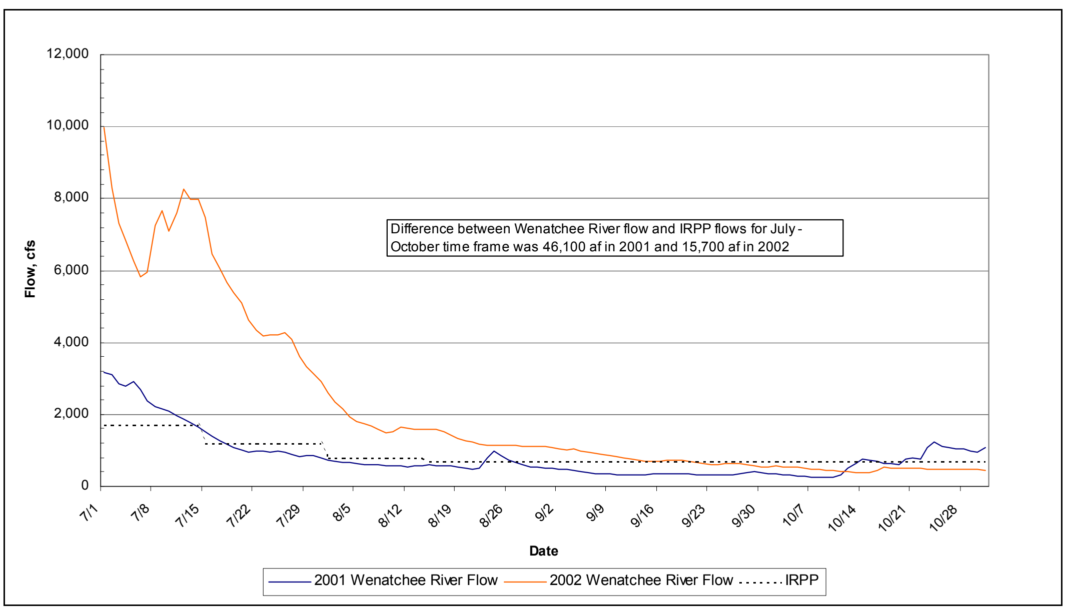


Figure 2.2-4. Comparison of Wenatchee River at Monitor Flow to IRPP Flows for 2001 and 2002.

Additional discussion of the quantity of water needed to meet IRPP targets is contained in Section 3. Analyses provided in that section show that, on average, there are 87 days per year that the IRPP flows are not met at the Wenatchee River at Plain gauging station. The average annual quantity of water needed to meet IRPP flows at Plain for the June – October time period is 17,500 acre-feet. These analyses show that a large volume of flow would be required to increase Wenatchee River flow to meet IRPP levels.

2.3 WATER CONSERVATION OPPORTUNITIES

2.3.1 Municipal and Domestic

Water conservation planning is a required element of Water System Plans prepared for the Washington Department of Health (DOH). Water System Plans are required for Group A systems and smaller systems that are expanding. There are minimum requirements for water conservation depending on the size of the water system. The minimum requirements are easy to meet as they contain requirements such as metering at the well source, metering at deliveries and public education. From those basic requirements water systems can implement a number of different strategies to conserve water. Those strategies include leak detection, meter installation or replacement, indoor plumbing retrofits, peak demand management, progressive rate structures, outdoor landscaping water demand management and many other strategies. The information obtained in our review of public water systems with written water conservation plan elements of their Water System Plans showed an estimated reduction of 5-10% of the peak and annual demand with implementation of water conservation programs. The water savings would accrue over a long time period as water conservation projects are implemented. If those types of water savings could be achieved for all municipal and domestic water users, the peak demand (current and future) could be reduced by about 3.5 cfs and the average annual demand reduced by approximately 600 afy by 2025.

2.3.2 Agricultural Water Conservation

The only water conservation plans found for irrigation entities in the Wenatchee River Watershed are the Icicle Irrigation District Comprehensive Water Conservation Plan and the Peshastin Irrigation District Comprehensive Water Conservation Plan (Klohn Leonoff, 1993). Those plans were prepared to meet the requirements of The Washington State Department of Ecology's Referendum 38 Program. The plans allowed the Districts to obtain grants and low-interest loans from Ecology for projects that conserve water and improve the operations of their canal systems. Although they may be the only water Conservation Plans written, water conservation activities have been on-going for other water users such as the Wenatchee Reclamation District, who have been constructing canal linings to reduce seepage and replacing water delivery boxes to better measure and control deliveries.

The types of projects reviewed in those plans include canal lining and piping, upgrading turnouts, reconstructing flumes and other hydraulic structures, increasing maintenance on open canals, constructing reregulating reservoirs and on-farm water conservation measures. Costs and potential water savings were presented for each.

The projects reviewed would reduce seepage losses and spills from irrigation canals and seepage losses that occur on-farm. They would not reduce the consumptive use of water needed for crops. The seepage from canals and farms contributes to groundwater aquifers and either flows back to surface water bodies or wetlands or is pumped from aquifers by groundwater users such as domestic exempt well owners.

There is typically a delay in the time seepage occurs to when the flow reenters a surface water body. That delay depends on subsurface geological conditions and the distance from the point of seepage to a surface water body. In work performed in the upper Yakima River basin, it has been found the overall delay from when seepage occurs in canals and farms in the Kittitas Valley to when it reenters the Yakima River is 1-2 months (U.S. Bureau of Reclamation 1998). With about one-half of the total return flow from a diversion returning in the same month it is diverted.

The plans concluded that with implementation of priority projects (upgrading turnouts, canal lining, increasing maintenance, and upgrading structures) the water savings would be 7-10% of diversions. Those types of projects can be implemented by irrigation entities without substantially changing the mode of operation of the irrigation delivery systems, which are primarily open canals. The cost in 1993 for those measures was estimated to be $1.8M, or about $230/acre.

An estimate of the total effect on streamflow in Icicle Creek, Peshastin Creek or the Wenatchee River was not made that accounts for seepage and return flow back to those streams. Because of return flow, the full water savings would not likely be realized as improvements in instream flow. For this review, we are assuming that one-half of the water savings from water conservation would result in instream flow improvements. Table 2.1-7 presented the diversions from the districts throughout the irrigation season. In September, the time of lowest flow, the total diversions from the districts average 106.5 cfs. The potential water savings from implementing water conservation measures would then be about 7.5 cfs to 10.6 cfs and the improvement in instream flow likely in the range of 4-5 cfs during September.

An estimate of the improvement in instream flow if all irrigation entities implemented water conservation measures can be made by scaling the effect of the Icicle and Peshastin Irrigation District improvements. The plans estimated the total amount of irrigated acreage in both districts to be 7,636 acres in 1991. Of that total acreage, 7,097 acres were in orchards. The total orchard acreage in the watershed was estimated to be 11,573 acres in 1992 (Section 2.1). A scaling factor of 1.6 (11,573/7,097) can be applied to the water savings estimated in the Icicle and Peshastin Irrigation District plans. The estimate of water savings in terms of improvements in instream flow would be on the order of 6-8 cfs. Additional water savings may result from water conservation measures implemented on the portions of the WRD that convey water diverted from the Wenatchee River to area within the Cities of Wenatchee and East Wenatchee. Since those areas are not tributary to the Wenatchee River, their irrigated farmland was not counted in Section 2.1.3. Approximately 8,115 acres of the 12,500-acre WRD is located in the Cities of Wenatchee and East Wenatchee. Applying the same water conservation factors to that area, the water savings are estimated to be 8-12 cfs. Since seepage that occurs in those areas does not return to the Wenatchee River a return flow factor is not applied to the water savings. The improvement in instream flow in the Wenatchee River would be equal to those water savings. The estimated total water conservation savings, measured in terms of improvements in instream flow, is 14-20 cfs for improvements to irrigation delivery systems.

Additional water savings could be accomplished through improvements in on-farm irrigation efficiencies. Irrigation districts and companies don’t control the application of water on-farm (their responsibility is to deliver a set quantity of water to a farm headgate) and therefore are not active in on-farm water conservation activities. The promotion of on-farm water conservation occurs through the Conservation Districts, the WSU Cooperative Extension and National Resources Conservation Service (NRCS). Section 2.1.3 contained a discussion of typical irrigation methods in the Wenatchee River Watershed. Most all orchards use solid set sprinklers. The average field application efficiency is not known but estimated to be about 70%. Some improvement in field application efficiency is possible through irrigation audits, conversion to micro sprinklers and through irrigation scheduling. Assuming an efficiency improvement of 10%, the water savings would be roughly equal to those calculated above for improvements to irrigation systems, or 14-20 cfs. The costs would be higher though, in the range of $500-$1000 per acre depending on the improvements required to implement the conservation activities.

The total water savings, measured in terms of improvements to instream flow from water conservation in the agricultural sector could be in the range of 30-40 cfs. This estimate is based upon simplified assumptions of irrigation system conveyance and on-farm efficiencies. Many of the irrigation entities and farmers are continuously upgrading their systems to conserve water and improve their operations. A more detailed review of the current operations of irrigation districts and companies would be required to obtain better estimates of potential water savings. In addition, analysis of the location where seepage occurs would be required to better estimate the timing of return flow and the overall effect on instream flows. The costs of upgrading canals and on-farm irrigation systems would be high, approximately $750 to $1,250 per acre. The total cost would be applied to at least the 11,573 acres of orchard irrigated in the Wenatchee River Watershed and additional 8,115 acres irrigated with water diverted by WRD from the Wenatchee River.

2.4 WATER RIGHTS

This section addresses water rights in WRIA 45. It identifies the sources of information available for estimating the quantity of surface and ground water represented by water rights under the State Surface Water Code (RCW 90.03) and the State Groundwater Code (RCW 90.44). Water claims and applications are also summarized.

Water rights in the State of Washington fall into two major categories. One category consists of "claims" for water based on the filing of water right claims during the time periods specified in State law for filing such claims. The other category is water rights obtained through the application process specified in the State Water Code.

The Washington State Department of Ecology (Ecology) has the responsibility for administering water rights in the State, via the application and review process set forth in the State Water Code. Ecology maintains paper files for each water right application submitted. These paper files serve as the complete record for each water right. Information from these files has also been entered into a digital database, the Water Rights Application Tracking System (WRATS). Ecology's Central Regional Office, within which jurisdiction WRIA 45 lies, has combined the WRATS data with information from other sources in developing a Geographic Information System (GIS) – based database containing water right information for the entire Central Region. Information from this product, the Geographic Water Information System (GWIS), was used in developing the WRIA 45 water rights summary for permits, certificates, and claims presented herein. Data extracted from this product were updated in August, 2002. The GWIS database has been provided to Chelan County for use in watershed planning activities.

Additional data pertaining to water right applications were obtained from Ecology's website. These data were updated in September, 2002. An application indicates an applicant has requested water, but a decision approving, modifying, or denying the application for a water right has not been made by Ecology. The date an application is filed with Ecology is the priority date for the application and any water right issued under the application. Water rights are based on "first in time is first in right," which means that earlier water rights have priority over later ones, if regulation between uses is necessary.

The GWIS information includes approximately 925 records for permits and certificates for WRIA 45. The database also includes approximately 1,700 claims for surface and ground water in the watershed. As of September 2002, there were 134 water right applications for the watershed awaiting an Ecology decision.

Information from GWIS that was used in this summary includes the following:

- **Type of Record -** A "record" is simply one entry in the database. A record may represent a permit to develop a water right, a certificate indicating that the water right has been perfected (i.e., put to use); or a claim documenting water uses that existed prior to adoption of the State Water Code. In general terms, a record for an "active permit" or "active certificate" indicates the holder has the right to put the water to use. Therefore, these records offer a convenient tool for estimating the total amount of water that has been authorized for appropriation in WRIA 45.

  The validity and extent of each claim registered in accordance with the Claims Registration Act (RCW 90.14) lies with the Superior Court through the adjudication process. Since only a portion of the claims within the Wenatchee Watershed have undergone adjudication, the accuracy of the claims data is unknown. However, the information in GWIS does document this information.

- **Instantaneous and Annual Quantities -** The GWIS database indicates both the instantaneous quantity (Q_i) and the maximum annual quantity of water (Q_a). Q_i is expressed in cubic feet per second (cfs) for surface water and gallons per minute (gpm) for ground water. Q_a is expressed in acre-feet per year (afy). In order to facilitate comparison between surface and ground water quantities, ground water instantaneous quantities have been converted to cfs. For purposes of analyzing total amounts of water rights in the watershed, the annual quantity is the most useful measure.

- **Location -** The "point of withdrawal" or "point of diversion" associated with a water right is a specifically-defined location from where the water is obtained. This is different than the "place of use", which is a specifically-defined land area where the water can be used. GWIS includes the Township, Range, and Section of the well location, point of withdrawal, or point of diversion. The Township, Range and Section identifies a single, one-square-mile area within WRIA 45. Water rights have been organized geographically in this summary, based upon points of withdrawal and diversion.

- **Purpose of Use -** Each water right is granted for a specific purpose, such as irrigation, stock watering, domestic use, municipal use, industrial use, etc. In many cases, a single water right is granted for multiple uses. For example a water right may permit use of the water for irrigation, stock watering, and domestic use.

2.4.1 Surface Water Rights Summary

This section provides a summary of the surface water data found in GWIS for WRIA 45.

2.4.1.1 Surface Water Permits and Certificates

Table 2.4-1 provides a summary of the surface water rights information contained in the GWIS database for WRIA 45. Certificate and permit data is sorted by purpose of use and by sub-basin (according to location of point of diversion). Pertinent information regarding the number of records, and instantaneous and annual quantities, is provided. In the Wenatchee Watershed there are a total of 544 surface water right permits and certificates. The total annual quantity associated with surface water rights for the watershed is 73,099 afy, while the total instantaneous quantity of appropriated surface water is 811 cfs. The instantaneous quantity includes supplemental water rights; therefore, the maximum amount of water allowed to be diverted at any given time may be much less than 811 cfs.

The purpose of use categories having the greatest watershed-wide instantaneous quantity are irrigation. Approximately 567 cfs (70%) is appropriated for the irrigation of more than 30,000 acres. Icicle Creek is the sub-basin with the largest irrigation instantaneous quantity (261 cfs) and annual quantity (29,286 afy). These totals include supplemental rights.

Other purpose of use category having substantial watershed-wide annual quantities is fish propagation and municipal. However, it should be noted that the fish propagation water rights (totaling 17,800 afy) apply to a non-consumptive use of water (i.e., water is diverted from a stream for use in fish hatcheries, with the majority of water returned downstream after its use).

It is also noted that the two largest municipal water purveyors in the watershed (City of Wenatchee and Chelan County PUD No. 1) obtain their water from a source located outside of the watershed (Rocky Reach Dam Aquifer) and thus do not have significant water rights within the watershed that are exercised.

In total, 40% of the annual quantity associated with surface water rights in the watershed is diverted within the Icicle sub-basin. Another 40% is associated with rights in three sub-basins: Chiwawa, Chumstick, and Lower Wenatchee. Together, the Icicle and Lower Wenatchee sub-basins account for 75% of the total instantaneous quantity appropriated within the watershed.

2.4.1.2 Surface Water Claims

Similar to permits and certificates, surface water claims in the watershed are organized in Table 2-18 according to sub-basin. In the Wenatchee Watershed there are a total of 709 surface water claims. The total annual quantity associated with surface water claims is 22,204 afy, while the total instantaneous quantity of surface water claims is 307 cfs. Lower Wenatchee is the sub-basin with the largest instantaneous quantity (134 cfs). The Peshastin sub-basin has the largest annual quantity (7,319 afy).

2.4.1.3 Surface Water Applications

There are a total of 81 surface water right applications currently pending in the Wenatchee Watershed. The total instantaneous quantity associated with these applications is 43 cfs. No annual quantities are provided with the application data. The Lake Wenatchee sub-basin has the highest number of applications (30), while the Peshastin sub-basin has the largest total instantaneous quantity (18.8 cfs). Purpose of use information is not provided in the applications data used for this analysis; however, the majority of applications having this information are for irrigation and domestic use.

See Section 2.4.3 for a discussion of primary versus supplemental water rights.

Table 2.4-1
Surface Water Rights, By Subbasin (1)
Wenatchee River Watershed (WRIA 45)

		White	Chiwawa	Little Wenatchee	Lake Wenatchee	Nason	Chiwaukum	Upper Wenatchee	Chumstick (4)	Icicle (5)	Lower Wenatchee	Peshastin	Mission
Permits and Certificates													
Purpose of Use (2)													
Domestic	# of Records	5	4	1	149	13	1	8	15	6	35	11	3
	Qa (AF/yr)	4	331	0	263	26	0	6	46	10	66	136	4
	Qi (cfs)	0.1	3.6	0.1	6.4	0.3	0.0	0.3	0.6	0.1	0.7	0.5	0.1
Irrigation (6)	# of Records	2	5		15	11	1	10	49	23	92	6	18
	Qa (AF/yr)	11	4,775		139	587	0	150	1,291	29,286	2,314	129	219
	Qi (cfs)	0.6	34.2		1.0	2.4	0.3	2.9	12.4	260.9	243.5	4.6	3.0
Municipal	# of Records									3	7		
	Qa (AF/yr)									636	3,584		
	Qi (cfs)									6.2	5.4		
Fish Propagation	# of Records		2						1	1	3		
	Qa (AF/yr)		13,000						0	0	4,812		
	Qi (cfs)		33.0						0.5	42.0	37.5		
Comm./Ind.	# of Records										1		1
	Qa (AF/yr)										0		0
	Qi (cfs)										2.0		0.8
Other	# of Records	2	3	2	1	5	1		2	1	3	1	
	Qa (AF/yr)	0	45	4	6	5	0		6	1	18	0	
	Qi (cfs)	1.3	33.0	1.0	0.1	4.1	0.2		0.0	3.0	2.3	1.3	
Subtotal, Permits & Certificates	# of Records	9	14	3	165	29	3	18	67	34	141	18	22
	Qa (AF/yr)	14	18,150	4	407	617	0	156	1,342	29,933	10,794	264	223
	Qi (cfs)	1.9	103.7	1.1	7.5	6.8	0.5	3.2	13.6	312.3	291.4	6.4	3.9
	Acres Irrigated	32	1,432		50	241	14	145	440	14,926	13,568	22	117
Claims	# of Records	7	18		99	39	4	60	16	25	228	51	135
	Qa (AF/yr)	393	4,734		288	941	46	176	336	4	3,171	7,319	3,495
	Qi (cfs)	24.4	33.2		2.8	4.6	0.0	1.5	2.5	0.1	134.1	53.1	46.2
	Acres Irrigated	172	1,501		29	287	13	7	106	427	5,671	4,103	392
Applications (3)	# of Records	1	4		30	3		2	5	6	16	9	2
	Qi (cfs)	0.1	0.1		15.6	1.1		0.0	0.0	1.0	6.3	18.8	0.0

Notes:
Qa = Annual Quantity; Qi = Instantaneous Quantity; AF/yr = acre-feet per year; cfs = cubic feet per second
(1) Summary of water rights data obtained from Department of Ecology's Geographic Water Information System (GWIS), except for Applications data (see Note 3). Revision date of information used in t 2002. Data are organized geographically by point of diversion (POD) according to twelve defined subbasins. Those rights having a POD in the southeastern-most portion of WRIA 45 (i.e., the area drain River) are categorized as "Drainage to Columbia River." This summary does not include Reservoir water rights, of which there are four in WRIA 45 with a total Qa of 19,000 AF/yr.
(2) Some water rights have multiple purposes of use. For such rights in this analysis, the purpose listed first in the GWIS database was assumed to be the primary use. For example, if "Irrigation" and "I listed in this order as purposes of use for a given right, then that right is classified as an Irrigation water right in this table.
(3) Obtained from Ecology's website. Data current as of September 5, 2002.
(4) Includes the following revision of GWIS data: Irrigation Qi for document S4-29191C was changed from 30 (appears to be an entry error) to 3 cfs.
(5) Includes the following revision of GWIS data: Acres Irrigated for documents SWC01227, SWC01228, SWC01229, and SWC01591 are shown as 7,000 for each right in the database; however, it is k total irrigated area for all rights combined. Therefore, only 7,000 acres is included to account for these rights in the total for the sub-basin.
(6) Some water right records in the GWIS database do not provide annual quantities for irrigation rights. This is reflected most prominently in the Lower Wenatchee sub-basin, where Irrigation Qi is shov

2.4.2 Ground Water Rights Summary

This section provides a summary of the ground water data found in GWIS for the Wenatchee River Watershed.

2.4.2.1 Ground Water Permits and Certificates

Table 2.4-2 provides a summary of the ground water rights information contained in the GWIS database for WRIA 45. Certificate and permit data is sorted by purpose of use and by sub-basin (according to location of point of withdrawal). Pertinent information regarding the number of records, and instantaneous and annual quantities, is provided. In the Wenatchee Watershed there are a total of 381 ground water right permits and certificates. The total annual quantity associated with ground water rights is 23,277 afy, while the total instantaneous quantity of appropriated ground water is 73.6 cfs (33,046 gpm). These totals include supplemental water rights.

The purpose of use category having the greatest watershed-wide instantaneous quantity is irrigation. Approximately 30.3 cfs (13,605 gpm) is appropriated for the irrigation of more than 2,000 acres. Lower Wenatchee is the sub-basin with the largest irrigation instantaneous quantity (14.5 cfs) and the largest irrigation annual quantity (3,003 afy).

The purpose of use categories having the greatest watershed-wide annual quantities are fish propagation and irrigation. However, it should be noted that the fish propagation water rights (totaling 6,377 afy) apply to a non-consumptive use of water (i.e., water is diverted from wells for use in fish hatcheries, with the majority of water returned to a receiving body after its use).

In total, 64% of the annual quantity associated with ground water rights in the watershed is withdrawn in three sub-basins: Chumstick, Icicle, and Lower Wenatchee. These same three sub-basins also account for 62% of the total ground water instantaneous quantity appropriated throughout the watershed.

2.4.2.2 Ground Water Claims

Similar to permits and certificates, ground water claims in WRIA 45 are organized in Table 2.4-2 according to sub-basin. In the Wenatchee Watershed there are a total of 986 ground water claims. The total annual quantity associated with ground water claims for WRIA 45 is 23,573 afy, while the total instantaneous quantity of ground water claims is 131 cfs. Lower Wenatchee is the sub-basin with the largest instantaneous quantity (42.3 cfs). The Mission sub-basin also has many claims (31.6 cfs on an instantaneous basis and 5,185 afy on an annual basis).

2.4.2.3 Ground Water Applications

There are a total of 53 ground water right applications currently pending in the Wenatchee Watershed. The total instantaneous quantity associated with these applications is 10.9 cfs. No annual quantities are provided with the application data. The Lower Wenatchee sub-basin has the highest number of applications (25), while the Lake Wenatchee sub-basin has the largest total instantaneous quantity (2.8 cfs).

2.4.2.4 Exempt Wells

Under the State Ground Water Code, ground water cannot be withdrawn unless the user files an application and obtains a permit from Ecology. However, certain types of use are exempted from this requirement, and a valid right to use water can be established without applying for a permit under certain conditions (RCW 90.44.050). Uses exempted from the requirement to apply for a permit are:

- Stock-watering;
- Watering a lawn or non-commercial garden up to one-half-acre in size;
- Domestic uses (single or group domestic) up to 5,000 gallons per day; and
- Industrial purposes up to 5,000 gallons per day.

The law indicates that Ecology may, from time to time, require the water user to provide information regarding the means for withdrawal and the quantity of the withdrawal.

Wells installed under this provision of the law are known as "exempt wells," because they are exempt from the requirement to obtain a permit. Because no permit is issued, Ecology does not have comprehensive data on the number and size of such wells. Therefore, different methods must be applied to estimate the number of wells and the quantity of ground water withdrawals associated with those wells. This topic is discussed in greater detail in Section 2.1.1.

Table 2.4-2
Ground Water Rights, By Subbasin [(1)]
Wenatchee River Watershed (WRIA 45)

		White	Chiwawa	Little Wenatchee	Lake Wenatchee	Nason	Chiwaukum	Upper Wenatchee	Chumstick	Icicle	Lower Wenatchee	Peshastin	Mission
Permits and Certificates													
Purpose of Use [(2)]													
Domestic	# of Records		2		5	7	1	8	74	1	36	2	11
	Qa (AF/yr)		40		124	116	1	80	196	1	758	156	172
	Qi (cfs)		0.2		0.4	0.8	0.1	0.5	2.0	0.0	2.5	0.5	0.7
Irrigation	# of Records	2	1		2	5	1	4	54	7	75		49
	Qa (AF/yr)	139	45		23	306	9	68	1,132	106	3,003		1,368
	Qi (cfs)	1.0	0.2		0.1	1.1	0.1	0.3	5.0	0.4	14.5		5.8
Municipal	# of Records								2		3	1	4
	Qa (AF/yr)								2,000		553	75	1,227
	Qi (cfs)								6.7		1.5	0.2	3.1
Fish Propagation	# of Records									2			
	Qa (AF/yr)									6,377			
	Qi (cfs)									11.4			
Comm./Ind.	# of Records										4		1
	Qa (AF/yr)										883		70
	Qi (cfs)										1.5		0.1
Other	# of Records					1		2					
	Qa (AF/yr)					8		516					
	Qi (cfs)					0.2		0.7					
Subtotal, Permits & Certificates	# of Records	2	3	0	7	13	2	14	130	10	118	3	65
	Qa (AF/yr)	139	85	0	147	430	10	664	3,328	6,484	5,197	231	2,837
	Qi (cfs)	1.0	0.4	0.0	0.6	2.1	0.2	1.4	13.6	11.8	19.9	0.7	9.7
	Acres Irrigated	40	10		9	245	4	17	453	35	758		380
Claims	# of Records	1	14		48	23	2	58	15	19	391	59	312
	Qa (AF/yr)	1	150		140	209	4	234	116	1,836	6,235	394	5,185
	Qi (cfs)	0.0	0.9		0.9	3.0	0.0	4.3	1.4	11.7	42.3	10.6	31.6
	Acres Irrigated	0	30		2	23	11	54	18	69	1,064	30	956
Applications [(3)]	# of Records	1			6			2	9		25		3
	Qi (cfs)	0.0			2.8			0.0	6.7		0.9		0.1

Notes:
Qa = Annual Quantity; Qi = Instantaneous Quantity; AF/yr = acre-feet per year; cfs = cubic feet per second
(1) Summary of water rights data obtained from Department of Ecology's Geographic Water Information System (GWIS), except for Applications data (see Note 3). Revision date of information used
2002. Data are organized geographically by point of withdrawal (POW) according to twelve defined subbasins. Those rights having a POW in the southeastern-most portion of WRIA 45 (i.e., the area
Columbia River) are categorized as "Drainage to Columbia River." Qi converted from gallons per minute (gpm) to cubic feet per second (cfs) for ease of comparison with surface water rights.
(2) Some water rights have multiple purposes of use. For such rights in this analysis, the purpose listed first in the GWIS database was assumed to be the primary use. For example, if "Irrigation" an
listed in this order as purposes of use for a given right, then that right is classified as an Irrigation water right in this table.
(3) Obtained from Ecology's website. Data current as of September 5, 2002.

2.4.3 Summary of All Water Rights in WRIA 45

Table 2.4-3 provides a summary of all surface and ground water rights in WRIA 45. In total, there are 924 permits and certificates, 1,695 claims, and 134 applications for new water rights. The Lower Wenatchee sub-basin has the highest number of water right records (259 permits/certificates, 619 claims, and 41 applications).

This analysis does not distinguish between "primary" and "supplemental" water rights, as such information is not provided in GWIS. A primary right can stand alone; but a supplemental right is always associated with a primary right. The supplemental right can only be used to the extent that the primary right cannot be exercised. As an example, in a dry year, a stream, which is a primary right, may not be available, but the right-holder can pump a well with a supplemental right to replace that water. Because of this relationship, supplemental rights are not additive to primary rights. Therefore, the totals provided in Tables 2-18 through 2-19 may overstate the amount of water appropriated for use under "normal" conditions. Some rights may only be exercised under certain conditions. These totals should be considered as an upper bound, or maximum, to the amount of water appropriated throughout the watershed.

2.5 ALLOCATION OF NEW WATER RIGHTS

The previous section described the applications for surface and ground water withdrawal permits. There are 81 surface water applications requesting a total of 43 cfs. The Peshastin sub-basin (18.8 cfs) has the largest quantity of surface water applied for. Ten cfs of that quantity is for a non-consumptive use while the other uses are for domestic use and highway use. That sub-basin is closed by Chapter 173-545 for further withdrawals from June 15 to October 15 so most of those applications would not likely be approved. The Lake Wenatchee sub-basin has the second highest quantity applied for (15.6 cfs). Most all of those applications are for domestic use. The Lower Wenatchee sub-basin has applications for 6.3 cfs; 5.4 cfs is for the City of Cashmere and the remainder mostly for domestic use. All of the surface water applications, if approved, would be subject to interruption when instream flows set forth in Chapter 173-545 are not met unless exempted by Ecology because of an overriding public interest. In some cases Ecology will write permits for domestic use with conditions that only indoor uses and limited outdoor uses are allowed during periods when instream flows are not being met. In the case of municipal uses, permits are usually written accounting for return flow from a wastewater treatment plant along with some mitigation for reduced streamflow.

There are 53 ground water applications requesting 10.9 cfs. The largest requested uses are in the Chumstick sub-basin (6.7 cfs) and the Lake Wenatchee sub-basin (2.8 cfs). The Chumstick applications are primarily for irrigation while the largest requested use in the Lake Wenatchee sub-basin is for fisheries, which is a non-consumptive use. The Lower Wenatchee sub-basin has the greatest number of applications (25) but many of them did not have quantities listed in the database. Therefore the requested quantity (0.9 cfs) is likely low. Most of the applications in that sub-basin are for domestic use. The total estimated quantity of ground water applications for domestic use is about 1 cfs while the estimated quantity of ground water applications for irrigation use is about 8 cfs.

Table 2.4-3
Surface and Ground Water Rights, By Subbasin [1]
Wenatchee River Watershed (WRIA 45)

		White	Chiwawa	Little Wenatchee	Lake Wenatchee	Nason	Chiwaukum	Upper Wenatchee	Chumstick	Icicle	Lower Wenatchee	Peshastin	Mission
Permits and Certificates													
Purpose of Use													
Domestic	# of Records	5	6	1	154	20	2	16	89	7	71	13	14
	Qa (AF/yr)	4	371	0	387	142	1	86	241	11	824	292	176
	Qi (cfs)	0.1	3.7	0.1	6.8	1.0	0.1	0.8	2.6	0.1	3.2	1.0	0.8
Irrigation	# of Records	4	6		17	16	2	14	103	30	167	6	67
	Qa (AF/yr)	150	4,819		161	893	9	218	2,423	29,391	5,317	129	1,587
	Qi (cfs)	1.6	34.3		1.1	3.6	0.4	3.1	17.4	261.4	258.1	4.6	8.8
Municipal	# of Records								2	3	10		4
	Qa (AF/yr)								2,000	636	4,137		1,227
	Qi (cfs)								6.7	6.2	6.9		3.1
Fish Propagation	# of Records		2						1	3	3		
	Qa (AF/yr)		13,000						0	6,377	4,812		
	Qi (cfs)		33.0						0.5	53.4	37.5		
Comm./Ind.	# of Records										5		2
	Qa (AF/yr)										883		70
	Qi (cfs)										3.5		0.9
Other	# of Records	2	3	2	1	6	1	2	2	1	3	1	
	Qa (AF/yr)	0	45	4	6	13	0	516	6	1	18	0	
	Qi (cfs)	1.3	33.0	1.0	0.1	4.3	0.2	0.7	0.0	3.0	2.3	1.3	
Subtotal, Permits & Certificates	# of Records	11	17	3	172	42	5	32	197	44	259	20	87
	Qa (AF/yr)	153	18,235	4	554	1,047	10	820	4,670	36,417	15,991	420	3,061
	Qi (cfs)	2.9	104.0	1.1	8.0	8.9	0.7	4.6	27.2	324.1	311.3	6.8	13.6
	Acres Irrigated	72	1,442	0	59	486	18	162	892	14,961	14,326	22	497
Claims	# of Records	8	32		147	62	6	118	31	44	619	110	447
	Qa (AF/yr)	394	4,884		427	1,149	50	409	452	1,840	9,406	7,712	8,680
	Qi (cfs)	24.4	34.1		3.7	7.6	0.1	5.9	3.9	11.7	176.4	63.7	77.8
	Acres Irrigated	172	1,531		31	309	24	61	124	496	6,735	4,133	1,348
Applications	# of Records	2	4		36	3		4	14	6	41	9	5
	Qi (cfs)	0.1	0.1		18.4	1.1		0.0	6.7	1.0	7.2	18.8	0.1

Notes:
Qa = Annual Quantity; Qi = Instantaneous Quantity; AF/yr = acre-feet per year; cfs = cubic feet per second
(1) Total of Surface Water Rights (see Table 5-1) and Ground Water Rights (see Table 5-2).

Section 2.1.1 presented an estimate of future municipal and domestic water needs. The estimated peak daily needs are forecast to increase by 7.3 cfs. Those demands are based upon population forecasts and are less than the total of surface and ground water applications pending. The forecast peak daily demands are also averaged over a peak day. The quantity of water requested on applications is typically higher than the peak daily demand as pumping equipment is sized larger to provide a factor of safety during operation and to ensure the pumping equipment does not have to operate all day to meet demands.

The effect on streamflow for surface water applications with consumptive uses and no immediate return flow will be a direct reduction in flow. Those types of uses with no immediate return flow are domestic multiple which typically have septic tank drainfields to dispose of indoor water used. A typical return flow factor (for water use discharged through drainfields from indoor water use) is 50%. The peaking factor (maximum/average daily demands) for domestic use is estimated to be 2.5 (Section 2.1.1) during the summertime. During summer, only about one-third of the water diverted may return to groundwater (counting both drainfields and return flow from outdoor irrigation). As described in Section 2.3 there is a delay between seepage into ground water and its return to surface water. That delay depends on the subsurface geology and the proximity of the seepage to a surface water body.

The effect on surface water from greater ground water extraction will vary depending on the aquifer properties and proximity to surface water. The effect cannot be stated with certainty because each well location will have a different effect on surface water. However it appears that most of the larger ground water applications are located in alluvial aquifers that are in continuity with surface water bodies such as the Wenatchee River. Those applications, if approved, would likely be subject to interruption when instream flows are not met. The return flow factor described in the previous paragraph would also apply for ground water use.

Of the total future municipal and domestic water use, approximately one-third may return to a surface water body, leaving two-thirds as a direct reduction in streamflow. That reduction is estimated to be about 5 cfs. That effect may be reduced if restrictions on water use are applied to the surface and ground water permits to minimize effects on streamflow during the periods instream flows are not met.

If the applications for irrigation use are approved, an increase in use of about 8 cfs would occur. Most of those permits, if approved, would likely be subject to interruption when instream flows are not met. The maximum effect on streamflow would be the consumptive use, which would be about 5.6 cfs for those applications.

2.6 SUMMARY OF WATER NEEDS

A review of potential population growth and growth in municipal, domestic, industrial and agricultural water use was made. From the perspective of population growth and growth in forecasted municipal demands, the estimated increase in water demands over the next 20 years is 7.3 cfs on a peak basis and 1,868 acre-feet annually. No growth in self-supplied industrial and commercial water use is forecast unless additional water is made available that would not be subject to interruption from low streamflow levels and minimum instream flows set by Chapter 173-545 WAC. A review of agricultural water use was made and an estimate of 68,000 acre-feet of consumptive use (either water consumptively used by crops or exported outside the Wenatchee River Watershed) made. The area of irrigated agriculture appears to be stable and not declining. There is a substantial area of land that is currently zoned for residential use that can be converted from agricultural use. However our experience with conversion from agricultural to urban use is that although annual water use may decline, peak water use may not change. The peak water demands are important as they have the most immediate effect on streamflow.

A review of water right applications was made to compare to the predicted future water demands. The current applications are requesting 43 cfs from surface water and 10.9 cfs from ground water. The type of use requested on the applications are primarily municipal and domestic for surface water and irrigation for ground water. Most of the applications, if approved, would be subject to minimum instream flows and therefore interruptible during low streamflow periods. Some of the applications, such as those contained in the Peshastin Creek basin, would not likely be approved as the basin is closed from June 15 to October 15. The difference between the forecast future water needs and the quantity applied for is large and mostly due to applications for irrigation. It appears those applications are primarily for landscape or lawn irrigation and not commercial agriculture. It was estimated the increase in irrigation demand from approval of those applications to be 8 cfs; the estimated effect on streamflow is a reduction of 5.6 cfs. The estimated increase in municipal and domestic demand is 7.3 cfs and the estimated effect on streamflow is a reduction of about 5 cfs.

The estimated effect on streamflow from future municipal and domestic demand and from approval of pending water right applications for irrigation is a reduction of about 10.6 cfs.

2.7 USE OF STORED WATER

The water stored in Lake Wenatchee could be used for several purposes; those being instream flow augmentation, supply to future surface water users in the Wenatchee River Basin Watershed or as mitigation for future groundwater use either in the aquifers supplying the Wenatchee River or in tributaries to the Wenatchee River. Section 3 describes the volume of water that is potentially available from implementation of this project and the time frame during which the water could be discharged from the project to meet future water needs.

3.0 TECHNICAL FEASIBILITY

3.1 INTRODUCTION

To enable seasonal storage and release of water from Lake Wenatchee, an impoundment structure would need to be constructed on the lake outlet channel. The structure would span from the north shore to the south shore as indicated in Exhibits 3.5-1 and 3.5-2 and would have the ability to be manipulated to allow storage of water during the late spring and summer, allow gradual release of stored water during the late summer and early fall, and to be completely invisible to lake outflow during the non-storage season such that lake outflows can pass unimpeded.

Section 3.2 presents the definition of the term “Ordinary High Water” (OHW) used for lakes and the results of a field survey to interpret the OHW elevation on Lake Wenatchee. Section 3.3 presents some perspective on historical hydrological data collected at various gages on the Wenatchee River and the results of computer modeling of the impoundment structure and beneficial seasonal water releases from Lake Wenatchee. This study investigates the use of an air-inflatable / deflatable rubber dam to be used as an impoundment structure to control the lake level. Section 3.4 makes an assessment of the change in potential wave energy as a result of a raised lake level. Section 3.5 addresses considerations for an impoundment structure and proposes a potential layout of such a structure.

3.2 DELINEATION OF ORDINARY HIGH WATER

The purpose of this section is to present the definition of the term “Ordinary High Water” (OHW) used for lakes and the results of a field survey to interpret the OHW elevation on Lake Wenatchee.

3.2.1 Definition of Ordinary High Water

A search for the commonly used definitions of OHW was made. The OHW is generally interpreted as the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil destruction on terrestrial vegetation, or the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding area. It is usually marked as the lowest limit of perennial vegetation.

The legal definition of OHW used by the Department of Fish and Wildlife and defined in WAC (220-110-020(57)) is:

> "*Ordinary high water line means the mark on the shores of all waters that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual and so long continued in ordinary years, as to mark upon the soil or vegetation a character distinct from that of the abutting upland: Provided, That in any area where the ordinary high water line cannot be found the ordinary high water line adjoining saltwater shall be the line of mean higher high water and the ordinary high water line adjoining freshwater shall be the elevation of the mean annual flood*".

Considerable judgment is required to identify representative OHW marks. It may be difficult to identify the mark on cut or rocky banks. A biologist experienced in vegetation typing typically performs the interpretation of OHW.

3.2.2 Fieldwork Performed to Interpret OHW

On February 14, 2003 Scott Stoneman, P.E. and Bob Montgomery, P.E. of Montgomery Water Group and Tom Kahler of The Watershed Company surveyed lake level, ordinary high water (OHW) marks, and other high water marks at various locations on Lake Wenatchee. Tom is a biologist experienced in vegetation surveys. Surveyed elevations are based on the USGS benchmark located at the outlet end of the lake. The USGS benchmark is stamped "1880 T" and is 1878.47 feet NGVD 1929 datum.

The work began by a survey of the lake level near the benchmark. The lake level was 1868.69 feet at 11:00 am that day. Ordinary High Water marks were interpreted and surveyed near Lake Wenatchee State Park and at several locations on both the north and south sides of the lake. Published benchmarks at other locations adjacent to the lake were not located so the lake level was used as the benchmark for the day. It is our opinion that the interpretation of OHW is subject to more uncertainty than the use of the lake as a benchmark so our methodology should be acceptable for this level of study. We also reviewed stream gaging records from the Department of Ecology (DOE) station on Wenatchee River below Lake Wenatchee and found the river stage fluctuated between 2.62 and 2.65 feet during the time of our surveys. Since the fluctuation in the DOE stage measurements was only 0.03 feet during the time of the survey, water level fluctuations should not be a factor in the use of the Lake as a benchmark.

Table 3.2-1 presents the elevations and locations of the OHW marks interpreted and surveyed. The quality of the sites varied as some of the sites were heavily disturbed from shoreline development and were very rocky. The best sites to interpret the OHW, in our opinion, are those near the State Park. Those OHW's were interpreted and surveyed to be 1870.2 to 1870.4 feet.

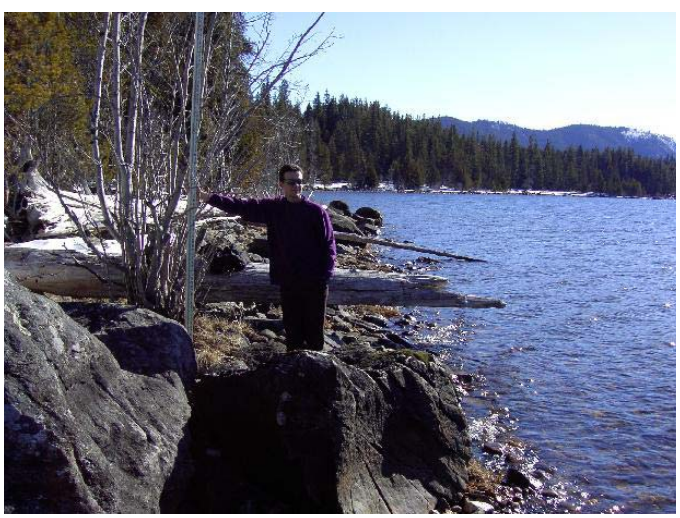
Table 3.2-1. Ordinary High Water Marks Interpreted and Surveyed.

Ordinary High Water Mark Location	Elevation
300 yds South of YMCA Camp	1870.5
300 yds South of YMCA Camp	1870.4
300 yds South of YMCA Camp	1870.2
Halfway between YMCA Camp and State Park	1870.2
Near USGS BM in State Park	1870.4
Near USGS BM in State Park	1870.2
Kane Beach - 18045 North Shore Drive	1870.8
Hoyt Beach – 16181 North Shore Drive	1870.7
Aspiri Beach – 16925 North Shore Drive	1869.8
South of Aspiri Beach	1869.6
Starr Beach – 15300 South Shore Road	1870.1
Average	***1870.3***
95% Confidence (2 x Std. Dev.)	***0.7***

The average OHW mark of all the sites reviewed is El. 1870.3 feet, which is also within the range of the sites interpreted and surveyed near the State Park. The 95% confidence interval for the OHW marks is 0.7 feet. The following photographs show the site and shoreline characteristics of the OHW marks interpreted and surveyed.

Photograph 3.2-1. Approximately 300 yards south of YMCA Camp, El. 1870.5.

Photograph 3.2-2. Approximately 300 yards south of YMCA Camp, El. 1870.4.



Photograph 3.2-3. Approximately 300 yards south of YMCA Camp, El. 1870.2.

Photograph 3.2-4. Halfway between YMCA Camp and State Park, El. 1870.2.

Photograph 3.2-5. Near USGS BM at State Park, El. 1870.4 – 1870.2.

Photograph 3.2-6. Kane beach, El. 1870.8.

Photograph 3.2-7. Hoyt beach, El. 1870.7.

Photograph 3.2-8. Aspiri beach, El. 1869.8.

Photograph 3.2-9. South of Aspiri beach, El. 1869.6.

Photograph 3.2-10. Starr beach, El. 1870.1.

3.3 HYDROLOGY

3.3.1 Lake Wenatchee Historic Water Levels

This section provides statistical input to Task 2.1.D, the determination of the ordinary high water level for Lake Wenatchee. Results in this section also serve other purposes including providing general familiarity with historic lake levels, baseline data to compare historic and potential future lake levels, and information to assist development of reservoir operation scenarios for the rubber dam impoundment structure described in Section 3.5.

USGS continuous daily flow data are available for Lake Wenatchee from January 1932 through September 1958. Instantaneous annual peak lake levels are available through water year 1979. Some additional daily lake levels are available, but because there are no corresponding additional flow values, they were not used in the current study. Many graphs and data tables are organized herein on a water year basis from October 1 through September 30. For example, water year 1933 would begin on October 1, 1932 and run through September 30, 1933. Water years are the standard way of presenting hydrologic data. The USGS flow records at Lake Wenatchee provide a continuous period of record for 26 complete water years from 1933 through 1958.

As an introduction, historic daily lake levels are presented for three years having varying hydrologic conditions. Figure 3.3-1 presents daily average Lake Wenatchee levels for selected representative wet, dry, and average years. The representative years were selected on the basis of average annual outflow from the lake. Figure 3.3-1 indicates the day-to-day variability of the lake level and also shows that lake levels during dry years can occasionally be higher than during wet years for the corresponding period. An El. 1870.3 line has been added to the figure as a reference to ordinary high water (OHW) as determined by the vegetation method.

Lake Wenatchee levels as measured and published by the USGS are based on the datum of 1912. Benchmarks near Lake Wenatchee and USGS quad sheets for the vicinity of Lake Wenatchee are based on the National Geodetic Vertical Datum of 1929 (NGVD29). NGVD29 is based on mean sea level, which means that mean sea level has an elevation of 0.0 feet. Because the datum of 1912 is no longer in use, all Lake Wenatchee levels as included herein have been converted to the NGVD29 datum. To convert datum of 1912 values to NGVD29 values, subtract 1.73 feet. In equation form, the datum conversion would be:

Lake level elevations on NGVD29 = lake level elevations on datum of 1912 – 1.73 feet

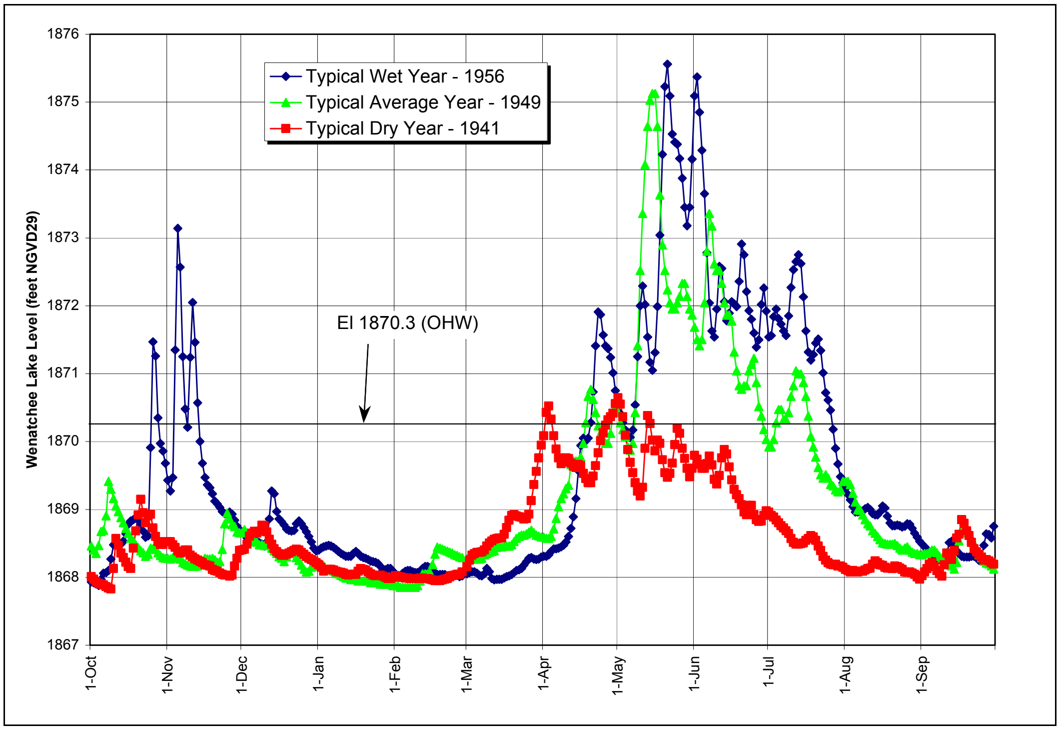


Figure 3.3-1. Representative wet, dry, and average year lake levels.

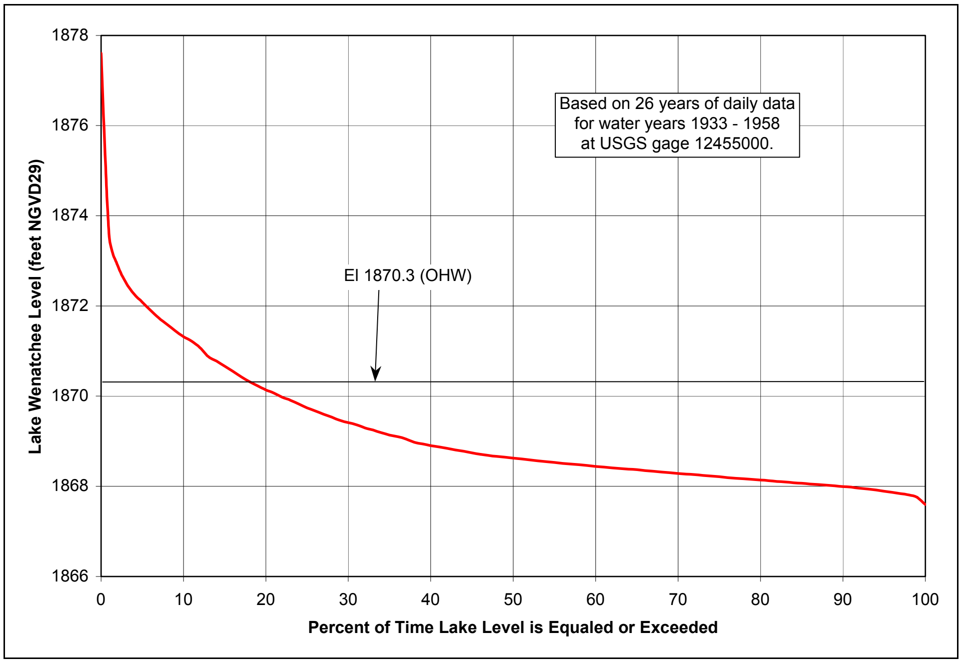


Figure 3.3-2. Lake Wenatchee level duration curve.

Figure 3.3-2 provides the Lake Wenatchee level duration curve based on daily data for the 26 years of record. The lake level duration curve indicates the percent of time that the lake level was less than or equal to the indicated level. The median lake level, which is exceeded 50% if the time, is at El. 1868.6. Figure 3.3-2 also indicates that daily water levels above El. 1871.3 occur about 10% of the time.

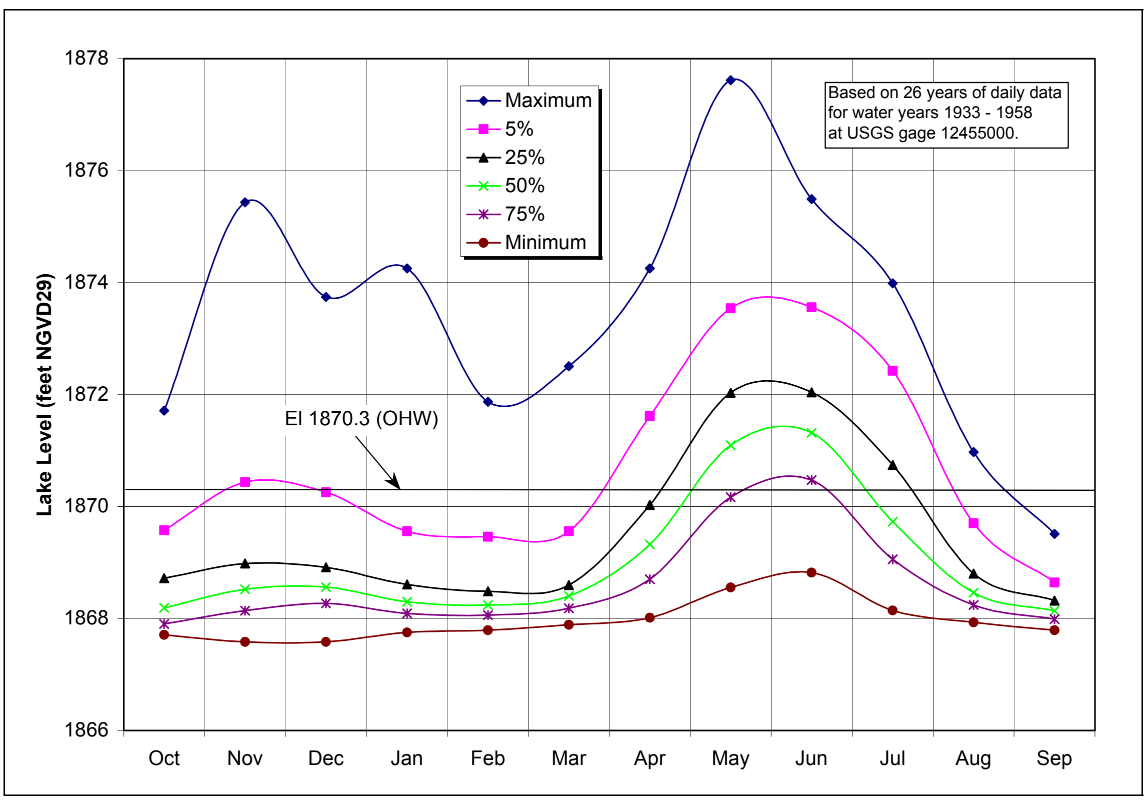


Figure 3.3-3. Lake Wenatchee monthly lake level frequency curves.

Figure 3.3-3 provides monthly lake level frequency data, based on the available daily data within each month. The information on Figure 3.3-3 includes the maximum and minimum daily lake levels recorded for each month during the 26-year period of record. The additional information is equivalent to a lake level duration curve for each month, in a manner similar to the lake level duration curve for the entire year that was presented on Figure 3.3-2.

Table 3.3-1 provides the detailed lake level frequency data by month from which the curves on Figure 3.3-3 were plotted. Daily data for the available 26-year period were used to develop the information in Table 3.3-1. The higher lake levels have typically occurred during the April through July period, but can occasionally occur in the late fall to early winter period.

Annual maximum recorded lake levels and outflows are available for a 48-year period from 1932 through 1979 at USGS gage 12455000, a much longer period than the continuous daily period of record. The complete series of annual instantaneous maximum lake levels is presented in Table 3.3-2. The data is sorted in two ways, both by chronological order and rank ordered by maximum lake level. The data in Table 3.3-2 indicates that the maximum lake level that can be expected with a frequency of about 1 in 2 years (the median high water level) would be at about El. 1873.8. The maximum water level in this period of record was at El. 1877.92 on May 29, 1948.

Table 3.3-1. Frequency data for historic Lake Wenatchee level (feet NGVD29).

% of Time Lake Level is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	1871.7	1875.4	1873.7	1874.3	1871.9	1872.5	1874.3	1877.6	1875.5	1874.0	1871.0	1869.5
5	1869.6	1870.4	1870.3	1869.6	1869.5	1869.6	1871.6	1873.5	1873.6	1872.4	1869.7	1868.6
10	1869.2	1869.6	1869.5	1869.2	1869.1	1868.9	1870.9	1873.0	1872.7	1871.7	1869.4	1868.5
15	1869.0	1869.3	1869.2	1868.8	1868.9	1868.8	1870.5	1872.5	1872.5	1871.3	1869.1	1868.4
20	1868.9	1869.2	1869.1	1868.7	1868.6	1868.7	1870.2	1872.2	1872.2	1871.0	1869.0	1868.4
25	1868.7	1869.0	1868.9	1868.6	1868.5	1868.6	1870.0	1872.0	1872.0	1870.7	1868.8	1868.3
30	1868.6	1868.9	1868.8	1868.5	1868.4	1868.6	1869.8	1871.9	1871.9	1870.4	1868.7	1868.3
35	1868.5	1868.8	1868.7	1868.5	1868.4	1868.5	1869.7	1871.6	1871.7	1870.2	1868.6	1868.3
40	1868.4	1868.7	1868.7	1868.4	1868.3	1868.5	1869.5	1871.4	1871.6	1870.0	1868.6	1868.2
45	1868.3	1868.6	1868.6	1868.4	1868.3	1868.4	1869.4	1871.3	1871.4	1869.9	1868.5	1868.2
50	1868.2	1868.5	1868.6	1868.3	1868.2	1868.4	1869.3	1871.1	1871.3	1869.7	1868.5	1868.1
55	1868.1	1868.5	1868.5	1868.3	1868.2	1868.4	1869.2	1870.9	1871.2	1869.6	1868.4	1868.1
60	1868.0	1868.4	1868.5	1868.2	1868.2	1868.3	1869.1	1870.7	1871.0	1869.4	1868.4	1868.1
65	1868.0	1868.3	1868.4	1868.2	1868.1	1868.3	1868.9	1870.5	1870.8	1869.3	1868.3	1868.0
70	1867.9	1868.2	1868.3	1868.1	1868.1	1868.2	1868.8	1870.3	1870.7	1869.2	1868.3	1868.0
75	1867.9	1868.1	1868.3	1868.1	1868.1	1868.2	1868.7	1870.2	1870.5	1869.1	1868.2	1868.0
80	1867.9	1868.1	1868.2	1868.0	1868.0	1868.2	1868.6	1870.0	1870.3	1868.9	1868.2	1868.0
85	1867.8	1868.0	1868.1	1868.0	1868.0	1868.1	1868.6	1869.9	1870.1	1868.8	1868.1	1867.9
90	1867.8	1867.9	1868.0	1868.0	1868.0	1868.0	1868.5	1869.7	1869.9	1868.7	1868.1	1867.9
95	1867.8	1867.7	1867.8	1867.9	1867.8	1868.0	1868.4	1869.3	1869.7	1868.5	1868.0	1867.9
Minimum	1867.7	1867.6	1867.6	1867.8	1867.8	1867.9	1868.0	1868.6	1868.8	1868.1	1867.9	1867.8

Records at the Kane Boathouse, a stationary structure built on Lake Wenatchee in November 1938, indicate that the 48-year period from 1932 through 1979 does not contain the maximum water level events that have occurred more recently. Boathouse records show two flood levels higher than in 1948, one on November 24, 1990, and an even higher flood level on November 30, 1995. To corroborate the boathouse records, peak flow data was gathered at a gage downstream from Lake Wenatchee, USGS gage 12457000, Wenatchee River at Plain. The Wenatchee River at Plain has a 591 square mile drainage area, compared to the 273 square mile drainage area for the Wenatchee River at the outlet of Lake Wenatchee. The record for the USGS gage at Plain is unusually long, encompassing 79 years of data with only a few years missing during the period between 1911 and 2001.

Peak annual flows for the Wenatchee River at Plain are plotted chronologically on Figure 3.3-4. This figure shows that the flows on November 25, 1990 (water year 1991) and November 30, 1995 (water year 1996) were remarkably higher than the third largest flow that occurred in 1948. Most of the annual flood peaks in the record occur in the May-June period and are probably dominated by snowmelt. The maximum recent floods occurring in November are probably rain on snow events that are dominated by the rainfall component. Figure 3.3-4 confirms that the lake levels in November 1990 and November 1995 would undoubtedly have been higher than any that occurred in the period up to 1979.

Table 3.3-2. Lake Wenatchee annual instantaneous peak lake level data for USGS Gage 12455000.

Chronological Order			Rank Ordered		
Date of Annual Maximum Level	Lake Level (feet NGVD29)		Rank	Date of Annual Maximum Level	Lake Level (feet NGVD29)
February 28, 1932	1874.41		1	May 29, 1948	1877.92
June 16, 1933	1874.84		2	December 4, 1975	1877.57
April 24, 1934	1874.35		3	November 27, 1949	1876.59
January 27, 1935	1874.46		4	June 17, 1974	1876.02
June 3, 1936	1873.82		5	June 11, 1972	1875.81
June 3, 1937	1873.62		6	June 13, 1955	1875.55
May 26, 1938	1873.86		7	May 16, 1949	1875.48
May 16, 1939	1872.89		8	May 21, 1956	1875.40
May 24, 1940	1872.73		9	June 5, 1961	1875.01
May 1, 1941	1870.79		10	June 16, 1933	1874.84
May 26, 1942	1872.66		11	May 12, 1951	1874.73
May 26, 1943	1873.80		12	May 26, 1958	1874.73
May 16, 1944	1871.43		13	June 6, 1969	1874.68
May 31, 1945	1873.18		14	June 21, 1967	1874.53
May 27, 1946	1873.82		15	November 25, 1959	1874.47
May 28, 1947	1873.36		16	January 27, 1935	1874.46
May 29, 1948	1877.92		17	February 28, 1932	1874.41
May 16, 1949	1875.48		18	April 24, 1934	1874.35
November 27, 1949	1876.59		19	June 3, 1968	1874.14
May 12, 1951	1874.73		20	June 2, 1975	1874.11
May 19, 1952	1872.46		21	June 5, 1970	1874.00
July 9, 1953	1872.37		22	May 26, 1938	1873.86
May 20, 1954	1873.86		23	May 20, 1954	1873.86
June 13, 1955	1875.55		24	June 8, 1977	1873.85
May 21, 1956	1875.40		25	May 1, 1959	1873.83
May 9, 1957	1873.74		26	June 3, 1936	1873.82
May 26, 1958	1874.73		27	May 27, 1946	1873.82
May 1, 1959	1873.83		28	May 26, 1943	1873.80
November 25, 1959	1874.47		29	May 9, 1957	1873.74
June 5, 1961	1875.01		30	June 2, 1964	1873.69
June 17, 1962	1871.94		31	June 6, 1978	1873.65
November 20, 1962	1873.01		32	June 3, 1937	1873.62
June 2, 1964	1873.69		33	June 24, 1971	1873.37
June 11, 1965	1872.76		34	May 28, 1947	1873.36
May 7, 1966	1873.18		35	May 31, 1945	1873.18
June 21, 1967	1874.53		36	May 7, 1966	1873.18
June 3, 1968	1874.14		37	November 20, 1962	1873.01
June 6, 1969	1874.68		38	May 16, 1939	1872.89
June 5, 1970	1874.00		39	June 11, 1965	1872.76
June 24, 1971	1873.37		40	May 24, 1940	1872.73
June 11, 1972	1875.81		41	May 26, 1942	1872.66
May 18, 1973	1872.36		42	May 19, 1952	1872.46
June 17, 1974	1876.02		43	July 9, 1953	1872.37
June 2, 1975	1874.11		44	May 18, 1973	1872.36
December 4, 1975	1877.57		45	June 6, 1979	1872.05
June 8, 1977	1873.85		46	June 17, 1962	1871.94
June 6, 1978	1873.65		47	May 16, 1944	1871.43
June 6, 1979	1872.05		48	May 1, 1941	1870.79

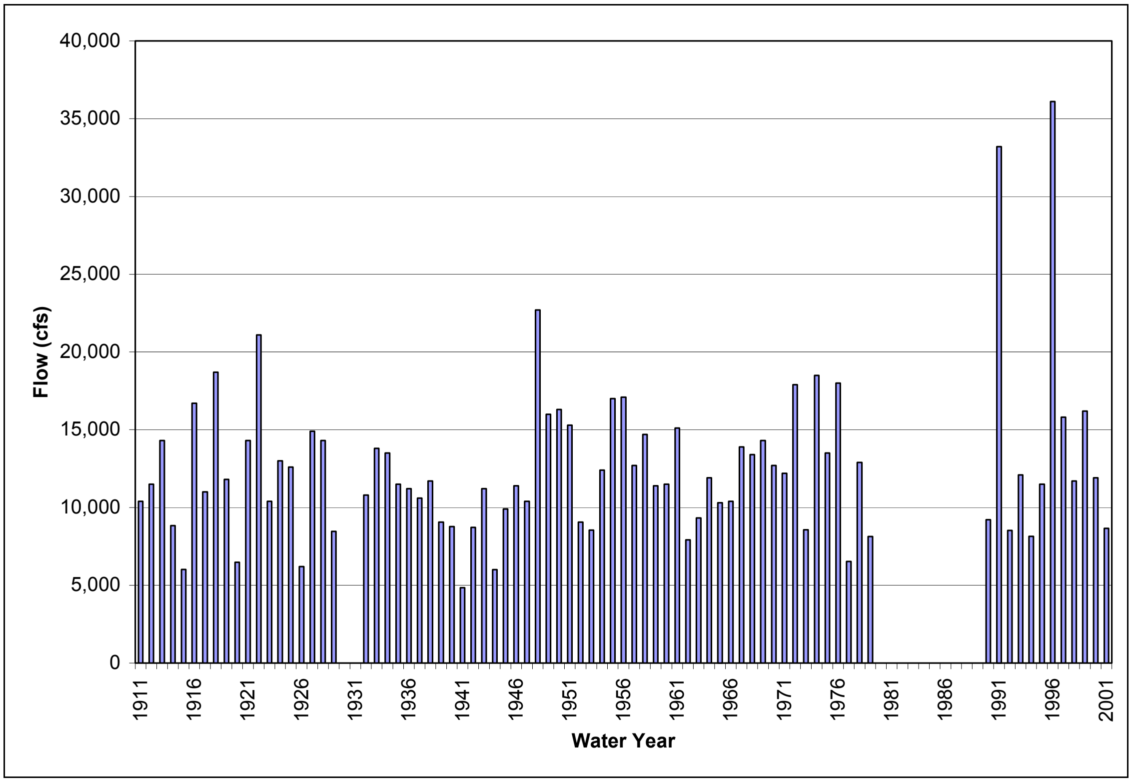


Figure 3.3-4. Peak annual flows at USGS Gage 12457000, Wenatchee River at Plain.

3.3.2 Storage Operation Model

A daily storage operation model was developed for Lake Wenatchee for Task 2.1.B. The purpose of the daily storage operation model is to determine the amount of flow that could be stored with a rubber dam impoundment structure during periods of high spring to early summer runoff for later release during the low flow periods of late summer to early fall. The model would also determine the effects of a rubber dam on lake levels and the downstream flow regime. The model would operate on a continuous record of daily data for a long-term period of years.

3.3.2.1 Historic Flow Data

Daily flow data is available on the Wenatchee River at the following USGS gages:

- USGS gage 12455000, Wenatchee River below Wenatchee Lake. Period of record is from January 1932 through September 1958. Drainage area is 273 square miles.
- USGS gage 12457000, Wenatchee River at Plain. Period of record is from October 1910 through September 1979 (monthly flows only for some periods), and October 1989 through September 2001. Drainage area is 591 square miles.
- USGS gage 12459000, Wenatchee River at Peshastin. Period of record is March 1929 through September 2001. Drainage area is 1,000 square miles, approximately.
- USGS gage 12462500, Wenatchee River at Monitor. Period of record is October 1962 through September 2001. Drainage area is 1,301 square miles.

The period of record to be used in the operation model was selected as the 26 water years 1933 through 1958, which is the period of record of full water years at gage 12455000 at Lake Wenatchee. Daily flow data at Plain and Peshastin for the common period of record with the gage below Lake Wenatchee was also included in the operation model. The gage at Monitor does not have a common period of record with the gage below Lake Wenatchee and was not included in the operation model, but the flows are only about 7% greater than the flows at Peshastin.

3.3.2.1.1 Comparison of Selected Period of Operation to Longer Term Data

It is generally desirable to use the longest period of data that is available for the operation model to ensure that the average and range of operating conditions are adequately represented. Because flow data is available on the Wenatchee River for a period much longer than water years 1933 through 1958, a comparison was made with the longer-term data.

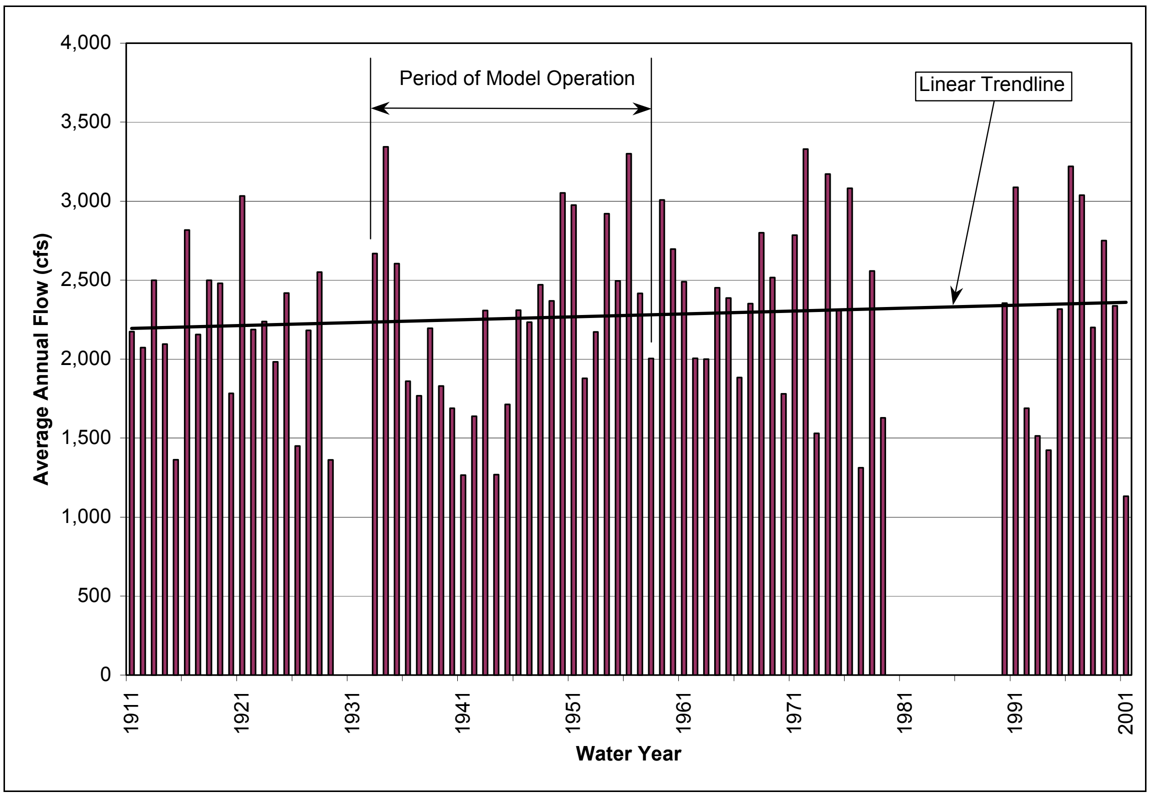


Figure 3.3-5. Annual average flow (cfs) at USGS Gage 12457000, Wenatchee River at Plain.

Figure 3.3-5 presents the annual average flow for the Wenatchee River at Plain. A linear trendline fitted to the annual flows indicates that there has not been a significant trend in the annual flows. The period of model operation from 1933 through 1958 appears to reasonably represent the average and variability of flow in the longer-term period. Only water year 2001 had a lower average flow than water year 1941and water year 1934 had the highest annual average flow on record.

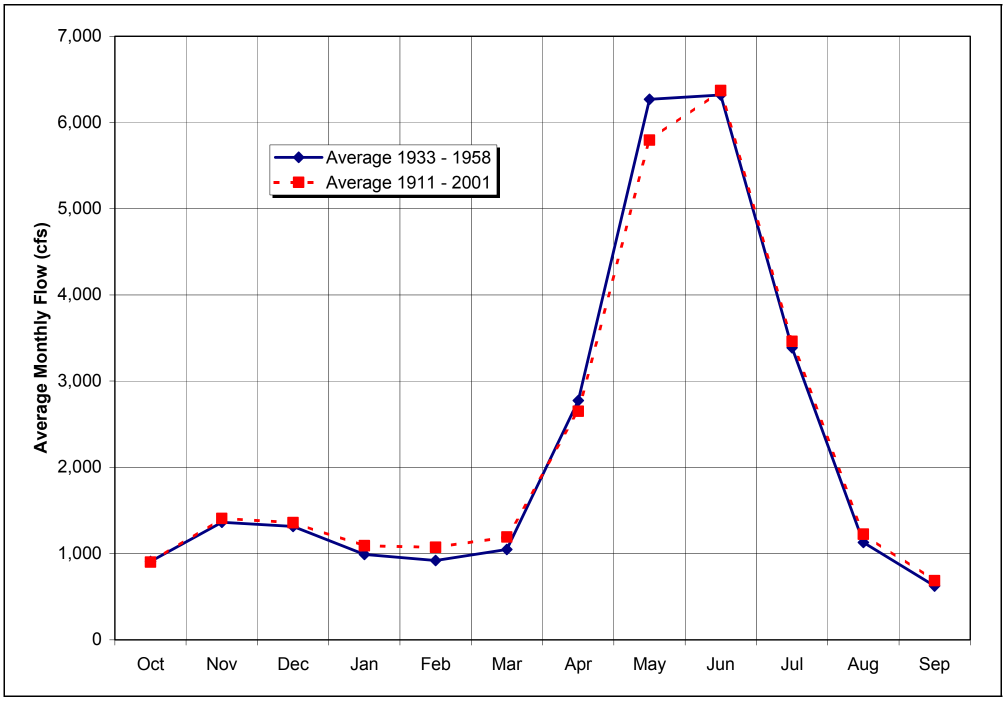


Figure 3.3-6. Monthly average flow (cfs) at USGS Gage 12457000, Wenatchee River at Plain.

Figure 3.3-6 presents the average monthly flows for the Wenatchee River at Plain for both the period of model operation, 1933 through 1958, as well as the average monthly flows for the entire period of record. The results on Figure 3.3-6 indicate that there is no significant difference between the two periods. From these comparisons it is concluded that water years 1933 through 1958 are an adequate period to represent the average and range of operating conditions for the rubber dam.

3.3.2.1.2 Historic Flow Data Summaries

This section provides a summary of historic flow data at the three USGS gages on the Wenatchee River that are included in the model, which are at Lake Wenatchee, at Plain, and at Peshastin. The data summaries are based on daily flow data for the common period of record of water years 1933 through 1958. The data in the tables provides the baseline historic conditions to which the potential future conditions with the rubber dam can be compared.

The following data summaries are of two types for each gauging station, monthly flow data and monthly flow frequency data. The flow frequency data essentially presents a daily flow duration curve for each month at each gauging station.

Table 3.3-3. Historic flow (cfs) at USGS Gage 12455000, Wenatchee River below Lake Wenatchee.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1933	402	2,128	1,149	620	461	529	1,054	1,873	4,508	3,659	1,255	572	1,520
1934	1,565	1,821	2,237	1,549	1,185	2,113	4,715	3,312	2,444	1,117	506	287	1,906
1935	475	1,656	717	1,528	1,209	741	925	3,061	3,983	2,181	655	428	1,462
1936	241	198	197	222	186	369	1,986	4,467	3,783	1,014	398	289	1,115
1937	204	147	317	222	200	303	766	2,803	4,901	2,057	440	289	1,056
1938	318	812	737	605	331	424	1,844	3,803	3,908	1,500	367	260	1,245
1939	260	355	588	887	367	537	1,813	3,381	2,545	1,732	496	251	1,105
1940	343	711	970	384	415	818	1,948	3,385	2,356	759	335	265	1,060
1941	516	400	532	298	262	804	1,907	1,840	1,338	588	323	457	773
1942	1,087	759	1,036	358	300	363	1,535	2,291	2,274	1,291	432	230	1,000
1943	171	321	464	466	364	461	2,355	2,919	4,208	3,502	932	356	1,380
1944	256	288	695	274	273	482	1,095	2,332	2,128	702	293	355	766
1945	337	392	613	926	776	453	689	3,076	2,813	1,241	391	312	1,003
1946	515	566	347	360	295	418	1,349	4,935	3,995	2,344	684	309	1,349
1947	408	359	875	657	844	1,194	2,173	4,102	2,970	1,540	550	312	1,335
1948	1,045	947	634	459	419	395	1,039	3,834	5,773	1,807	747	442	1,464
1949	665	487	480	265	336	540	1,709	4,807	3,811	2,082	731	468	1,371
1950	606	1,936	1,383	651	438	812	971	2,913	5,806	4,171	1,303	464	1,793
1951	1,124	1,350	1,608	902	1,598	599	1,926	4,162	3,733	2,004	597	346	1,661
1952	837	784	400	274	309	334	1,631	3,378	2,924	1,674	557	259	1,117
1953	184	153	168	1,077	1,376	614	1,220	3,191	3,225	2,975	944	385	1,292
1954	506	891	1,057	697	504	533	1,108	3,827	4,218	4,556	1,971	887	1,739
1955	618	1,457	779	425	494	324	647	2,043	5,137	3,338	1,218	470	1,414
1956	965	2,020	725	435	298	318	1,848	5,125	5,066	3,584	911	495	1,822
1957	924	876	1,717	507	390	564	1,319	4,788	3,211	1,185	500	312	1,365
1958	253	384	439	357	515	628	1,237	5,017	3,236	955	424	342	1,152
Average	570	854	802	593	544	603	1,570	3,487	3,627	2,060	691	379	1,318

Table 3.3-4. Historic flow (cfs) Frequency at USGS Gage 12455000, Wenatchee River below Lake Wenatchee.

% of Time Flow is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	3,990	9,350	6,800	7,550	4,200	5,060	7,550	13,000	9,440	7,160	3,020	1,490
5	1,560	2,490	2,290	1,540	1,440	1,540	3,860	6,510	6,540	4,950	1,690	676
10	1,180	1,580	1,490	1,180	1,040	952	2,990	5,730	5,390	3,970	1,330	584
15	1,020	1,310	1,180	852	874	786	2,560	5,080	5,040	3,460	1,080	507
20	868	1,130	1,050	718	672	691	2,260	4,690	4,630	3,110	962	470
25	744	989	928	648	550	639	2,040	4,420	4,430	2,840	820	438
30	641	916	830	580	479	608	1,800	4,180	4,250	2,480	736	419
35	564	829	755	537	460	572	1,650	3,900	3,990	2,250	676	396
40	498	736	698	500	436	532	1,530	3,640	3,800	2,040	604	373
45	420	657	648	462	408	511	1,410	3,420	3,600	1,890	567	350
50	362	579	608	426	390	491	1,300	3,180	3,470	1,720	533	333
55	304	525	577	401	362	467	1,190	2,970	3,280	1,560	506	314
60	264	460	539	376	344	442	1,060	2,760	3,080	1,400	473	302
65	247	403	486	349	329	414	938	2,610	2,920	1,290	445	289
70	232	364	449	324	314	386	825	2,390	2,750	1,130	410	274
75	222	335	408	309	295	359	727	2,190	2,530	1,030	391	261
80	208	306	359	287	281	344	672	2,060	2,330	916	370	252
85	197	268	328	272	270	319	609	1,880	2,170	817	338	242
90	183	206	281	247	243	287	545	1,710	1,910	699	314	231
95	170	155	194	220	194	268	493	1,310	1,640	584	289	217
Minimum	143	100	100	160	175	215	273	604	838	338	235	175

Table 3.3-5. Historic flow (cfs) at USGS Gage 12457000, Wenatchee River at Plain.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1933	651	3,156	1,962	1233	680	656	2,043	4,319	8,038	6,086	2,123	988	2,668
1934	2,527	3,066	3,720	2,537	1,994	3,719	8,162	6,516	4,434	1,953	918	538	3,344
1935	785	2,716	1269	2,399	2,162	1433	1920	5,941	7,007	3,749	1168	716	2,604
1936	470	401	392	426	387	688	3,279	7,480	5,986	1,625	651	471	1,859
1937	344	236	571	352	332	595	1395	4,628	8,075	3,315	819	521	1,768
1938	544	1340	1240	1059	630	838	3,272	6,838	6,899	2,494	692	452	2,196
1939	462	635	1011	1421	659	946	3,055	5,632	4,129	2,671	827	424	1,830
1940	465	857	1446	643	676	1328	3,260	5,521	3,847	1258	523	400	1,689
1941	807	617	828	499	444	1313	3,240	3,174	2,236	886	456	671	1,266
1942	1,528	1243	1,654	631	519	635	2,614	3,972	3,817	2,029	644	313	1,638
1943	251	526	765	805	635	800	3,857	5,064	7,276	5,627	1435	582	2,307
1944	458	502	1093	476	491	826	1,823	3,876	3,461	1154	468	557	1,268
1945	562	636	905	1625	1292	766	1231	5,344	4,956	2,060	643	506	1,713
1946	786	1080	611	619	486	746	2,309	8,640	6,893	3,759	1120	542	2,310
1947	663	599	1348	1010	1272	1,945	3,835	7,266	5,033	2,389	878	504	2,233
1948	1,600	1529	1064	715	668	643	1,744	6,615	10,080	3,000	1235	712	2,470
1949	1072	832	798	469	575	869	3,154	8,736	6,570	3,307	1174	756	2,369
1950	966	2,869	2,149	1090	760	1325	1779	5,413	10,330	6,968	2,071	798	3,052
1951	1,678	2,113	2,544	1531	2,805	1192	3,719	8,119	6,943	3,426	1036	627	2,975
1952	1296	1223	713	525	573	656	2,781	5,956	4,906	2,535	870	427	1,877
1953	300	271	296	1,532	2,064	1071	2,057	5,656	5,798	4,891	1472	645	2,172
1954	810	1301	1,593	1054	817	901	1,995	6,868	7,549	7,540	3,045	1383	2,920
1955	1026	2,232	1308	768	852	628	1196	3,945	9,442	5,733	1,974	791	2,495
1956	1593	3,316	1379	800	584	636	3,654	9,771	9,198	6,094	1618	825	3,301
1957	1462	1424	2,801	888	687	998	2,566	8,855	5,769	2,006	851	527	2,415
1958	480	689	750	636	889	1089	2,214	8,843	5,621	1535	687	533	2,003
Average	907	1,362	1,316	990	921	1,048	2,775	6,269	6,319	3,388	1,131	623	2,259

Table 3.3-6. Historic flow (cfs) Frequency at USGS Gage 12457000, Wenatchee River at Plain.

% of Time Flow is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	5,840	13,600	9,880	10,100	8,720	7,710	13,200	21,900	16,800	12,200	4,740	2,560
5	2,330	3,960	3,580	2,450	2,390	2,650	6,480	11,800	11,500	8,110	2,680	1,100
10	1,820	2,640	2,390	1,900	1,770	1,670	5,230	10,100	9,420	6,680	2,080	941
15	1,550	2,140	1,900	1,430	1,410	1,340	4,540	9,020	8,750	5,720	1,780	838
20	1,350	1,840	1,660	1,230	1,110	1,210	4,030	8,490	8,140	5,070	1,560	772
25	1,180	1,610	1,510	1,120	950	1,120	3,640	7,940	7,790	4,720	1,360	726
30	1,030	1,440	1,390	1,010	800	1,080	3,210	7,410	7,490	4,100	1,230	690
35	908	1,320	1,290	930	748	1,010	2,920	6,970	7,120	3,660	1,120	652
40	800	1,160	1,190	868	724	938	2,740	6,590	6,790	3,280	1,040	622
45	698	1,050	1,100	813	689	893	2,500	6,190	6,430	3,040	960	590
50	615	978	1,040	740	658	842	2,310	5,840	6,150	2,760	914	561
55	520	873	970	684	634	789	2,140	5,430	5,810	2,530	853	542
60	481	761	898	635	607	743	1,920	5,070	5,430	2,310	818	517
65	446	691	813	590	583	694	1,710	4,720	5,020	2,070	755	490
70	419	642	757	560	563	667	1,490	4,430	4,660	1,850	695	462
75	390	575	701	540	544	648	1,340	4,000	4,270	1,670	644	441
80	365	508	625	514	508	628	1,250	3,670	3,970	1,480	600	420
85	340	468	568	484	457	598	1,120	3,420	3,630	1,330	547	400
90	320	386	474	450	420	559	1,010	3,000	3,240	1,170	496	370
95	271	271	379	390	370	507	875	2,520	2,740	928	452	344
Minimum	226	186	196	283	300	385	495	1,240	1,350	512	358	262

Table 3.3-7. Historic flow (cfs) at USGS Gage 12459000, Wenatchee River at Peshastin.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1933	867	4,459	2,710	1680	962	971	2,898	5,920	11,710	8,584	2,817	1254	3,744
1934	3,640	4,546	5,648	3,696	3,043	5,172	11,250	8,911	6,079	2,644	1119	683	4,706
1935	1086	3,897	1888	3,505	3,131	2095	2780	8,208	9,941	4,945	1447	854	3,644
1936	612	525	497	550	486	1018	4,693	11,090	8,934	2,257	790	588	2,677
1937	475	339	728	493	476	839	1923	6,602	11,440	4,481	1071	637	2,463
1938	720	1778	1697	1445	872	1293	4,696	9,777	10,070	3,345	816	522	3,091
1939	622	845	1310	1841	901	1372	4,234	7,447	5,516	3,481	981	495	2,429
1940	611	1151	2037	883	923	1855	4,385	7,773	5,214	1586	660	543	2,307
1941	1045	778	1072	643	618	1867	4,334	4,414	3,191	1164	587	953	1,725
1942	2,089	1761	2,308	887	705	880	3,661	5,770	5,499	2,801	789	426	2,305
1943	336	782	1122	1190	972	1239	5,501	6,854	10,070	7,572	1835	689	3,186
1944	627	647	1444	616	651	1126	2,518	5,677	5,062	1576	577	767	1,778
1945	780	846	1293	2125	1855	1090	1712	7,403	6,808	2,667	785	682	2,339
1946	1044	1452	820	849	657	1113	3,418	12,110	9,592	4,993	1394	683	3,191
1947	930	849	1863	1457	1823	2,884	5,250	10,140	7,097	3,265	1125	733	3,125
1948	2,306	2288	1576	1050	979	972	2,441	9,433	14,750	4,234	1639	933	3,554
1949	1507	1161	1175	689	989	1450	4,572	12,410	9,379	4,560	1533	1046	3,385
1950	1455	4,001	2,965	1495	1121	1843	2539	7,448	14,650	9,491	2,687	1017	4,237
1951	2,255	2,893	3,563	2194	3,943	1862	5,379	11,250	9,754	4,651	1356	802	4,154
1952	1848	1765	1081	809	830	948	3,978	8,314	6,723	3,367	1081	615	2,621
1953	463	384	421	2,076	2,917	1588	2,883	7,955	8,183	6,888	1967	802	3,045
1954	979	1558	2,043	1371	1143	1325	2,728	9,400	10,230	10,350	4,003	1746	3,927
1955	1329	2,889	1732	1019	1140	880	1706	5,305	13,320	7,695	2,420	942	3,368
1956	2034	4,511	2107	1213	906	1001	5,719	13,800	13,030	8,358	2149	1105	4,676
1957	1901	1853	3,794	1199	932	1474	3,348	12,430	7,723	2,577	1069	699	3,267
1958	655	903	992	873	1330	1593	3,009	12,390	7,734	2019	808	653	2,755
Average	1,239	1,879	1,842	1,379	1,319	1,529	3,906	8,778	8,912	4,598	1,443	803	3,142

Table 3.3-8. Historic flow (cfs) Frequency at USGS Gage 12459000, Wenatchee River at Peshastin.

% of Time Flow is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	7,700	18,300	15,700	14,200	11,900	10,200	18,400	30,900	23,800	17,200	6,220	3,350
5	3,120	5,290	5,100	3,520	3,560	3,800	9,260	16,800	16,400	11,400	3,480	1,450
10	2,520	3,600	3,360	2,570	2,620	2,440	7,520	14,300	13,400	9,470	2,760	1,210
15	2,100	3,000	2,640	2,020	2,020	2,000	6,360	12,900	12,400	7,830	2,330	1,070
20	1,830	2,500	2,340	1,700	1,590	1,770	5,550	12,000	11,700	6,830	1,990	998
25	1,620	2,210	2,140	1,510	1,380	1,690	5,010	11,300	11,200	6,260	1,780	942
30	1,370	1,990	1,960	1,400	1,200	1,620	4,450	10,500	10,600	5,540	1,560	892
35	1,210	1,770	1,780	1,300	1,070	1,500	4,040	9,780	10,000	4,910	1,430	840
40	1,070	1,590	1,660	1,230	1,010	1,420	3,710	9,260	9,520	4,450	1,310	798
45	958	1,450	1,560	1,110	977	1,330	3,490	8,660	9,010	4,080	1,220	750
50	822	1,300	1,450	1,030	940	1,240	3,240	8,020	8,550	3,740	1,110	718
55	712	1,160	1,350	976	900	1,160	3,050	7,520	8,000	3,380	1,050	686
60	646	1,010	1,240	911	878	1,070	2,720	6,990	7,500	3,050	998	660
65	598	932	1,110	850	840	1,030	2,470	6,530	7,030	2,780	918	634
70	569	862	1,040	794	798	990	2,160	6,030	6,520	2,480	855	608
75	542	770	942	750	755	945	1,960	5,420	5,960	2,240	777	582
80	520	686	876	712	686	911	1,800	5,010	5,430	1,960	724	536
85	486	598	775	640	624	865	1,630	4,610	4,980	1,740	672	503
90	454	520	630	604	590	797	1,510	4,150	4,400	1,480	604	481
95	395	390	486	520	460	705	1,270	3,460	3,820	1,200	576	435
Minimum	276	270	270	400	430	525	757	1,660	1,940	636	460	347

3.3.2.1.3 Rating Curves

Rating curves provide a graphical presentation of the relationship between flow rate and water level at a given location. The rating curve for outflow from Lake Wenatchee under historic conditions (no rubber dam or rubber dam fully down) as used in the operation model is presented on Figure 3.3-7.

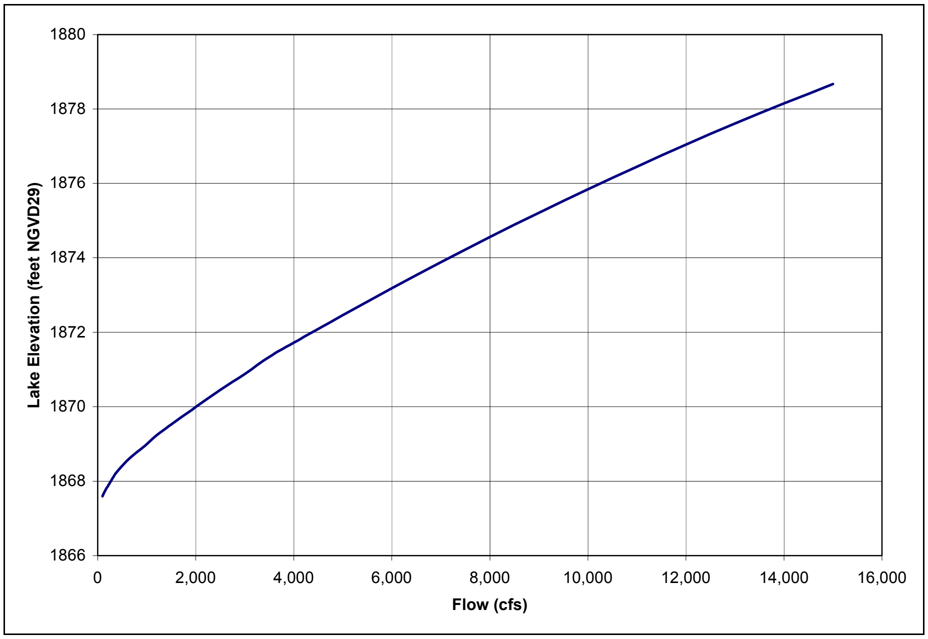


Figure 3.3-7. Lake Wenatchee outflow rating curve.

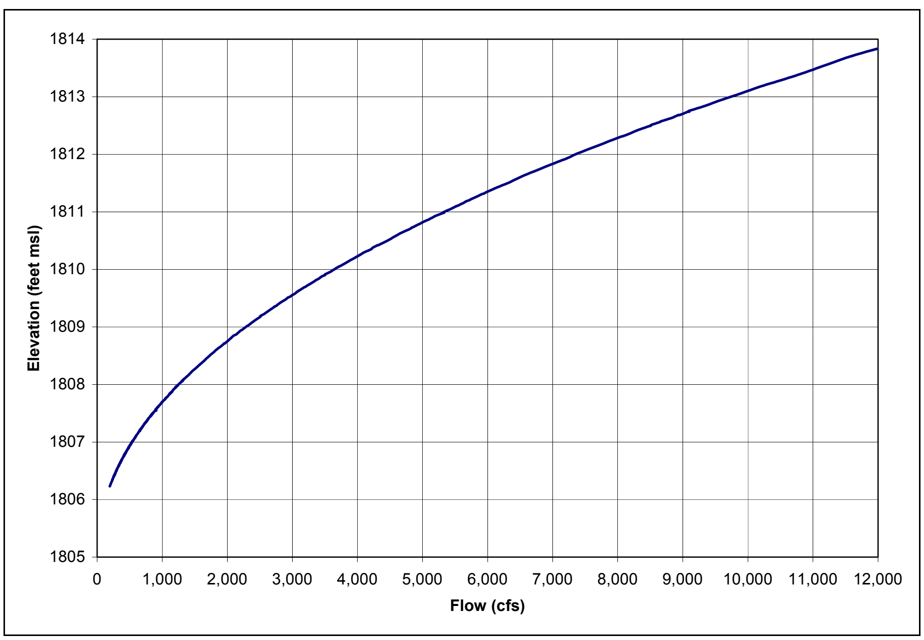


Figure 3.3-8. Rating curve for USGS Gage 12457000, Wenatchee River at Plain.

The downstream variation of water level with flow is a consideration for fishery issues and could have some impact on future operation of the rubber dam. To provide an indication of how water levels vary with flow rates at downstream locations, a rating curve for the Wenatchee River at Plain is provided on Figure 3.3-8. In a similar manner, the rating curve for the Wenatchee River at Peshastin is provided on Figure 3.3-9.

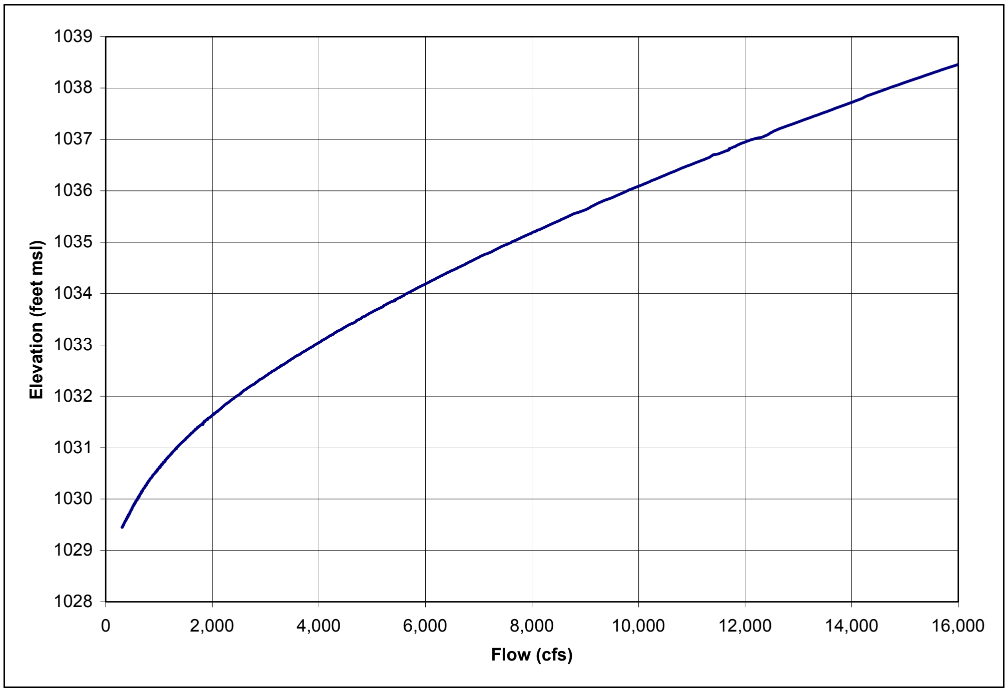


Figure 3.3-9. Rating curve for USGS Gage 12459000, Wenatchee River at Peshastin.

3.3.2.2 Operation Model Description

This section provides a general description of the storage operation model input and output. A basic input to any storage operation model is the inflow to the lake or reservoir. For Lake Wenatchee, the available flow data is lake outflow, not the required lake inflow. Lake inflow was developed by a process called reverse routing. The basic storage equation for the lake can be written as:

lake inflow – lake outflow = change in lake storage

Lake inflow can be calculated by rearranging the terms as follows:

lake inflow = change in lake storage + lake outflow

The lake outflow and lake levels are known. The lake storage was determined from an elevation-area-capacity curve. Using available maps, the lake area (at El. 1868) and the area at the next highest contour (El. 1880) were measured. A linear interpolation was assumed between the two measured areas to develop the area-elevation-capacity data. The lake inflow calculation was performed on a daily basis for the 26-year period of operation. The elevation-area-storage table as used in the storage operation model is presented in Table 3.3-9.

Table 3.3-9. Lake Wenatchee elevation-area-storage.

Elevation (feet NGVD29)	Area (acres)	Storage Capacity (acre-feet)
1867.6	2,416	0
1868	2,440	978
1869	2,500	3,448
1870	2,560	5,978
1871	2,619	8,568
1872	2,679	11,217
1873	2,739	13,926
1874	2,799	16,695
1875	2,858	19,515
1876	2,918	22,403
1877	2,978	25,351
1878	3,038	28,359
1879	3,097	31,426
1880	3,157	34,553

The Lake Wenatchee storage capacity was set to zero at El. 1867.6, the minimum historic elevation. The important thing about the elevation-capacity table is that it covers the entire potential range of lake elevations that could occur in the operation model, and not the assumed zero point of storage.

The following items summarize operation model input:

- Calculated daily lake inflows and historic daily flow data at Plain and Peshastin
- Historic daily lake levels and outflows to be used for comparison to potential operations with the rubber dam
- Elevation-storage capacity table for the lake
- Elevation-outflow table for uncontrolled discharge
- Instream flow requirements at Peshastin and Plain
- Operating criteria for the rubber dam

Operation model output included the following tables:

- Monthly average Lake Wenatchee elevations
- Lake Wenatchee elevation frequency data by month similar to the data presented in Table 3.3-1
- Lake Wenatchee storage
- Monthly average flows and flow frequency data for the lake outflow and flows at Plain and Peshastin that are similar to the data presented in Tables 3.3-3 through 3.3-7.
- Change in lake elevation, storage, and outflow in comparison to historic data

- Number of days in each month when instream flow requirements are not met at Plain and Peshastin

3.3.2.3 Operation Model Verification

The operation model was initially run with the calculated lake inflows and without any rubber dam to determine whether the model adequately simulates the existing conditions. A summary of the resulting simulated lake level frequency data is presented in Table 3.3-10. By comparison to Table 3.3-1, it can be seen that there is essentially no difference between the simulated and historic lake levels, except for a few tenths of a foot on the maximum day of some months.

Table 3.3-10. Simulated Lake Wenatchee level (feet NGVD29) frequency data – Historic Operation.

% of Time Lake Level is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	1871.8	1875.8	1873.7	1874.6	1872.1	1872.7	1874.3	1877.7	1875.6	1874.1	1871.0	1869.6
5	1869.6	1870.4	1870.3	1869.6	1869.5	1869.6	1871.6	1873.6	1873.6	1872.4	1869.7	1868.7
10	1869.2	1869.6	1869.5	1869.2	1869.0	1868.9	1870.9	1873.1	1872.8	1871.7	1869.4	1868.5
15	1869.0	1869.3	1869.2	1868.8	1868.9	1868.8	1870.5	1872.6	1872.5	1871.3	1869.1	1868.4
20	1868.9	1869.1	1869.1	1868.7	1868.6	1868.7	1870.2	1872.3	1872.2	1871.0	1869.0	1868.4
25	1868.7	1869.0	1868.9	1868.6	1868.5	1868.6	1870.0	1872.1	1872.0	1870.7	1868.8	1868.3
30	1868.6	1868.9	1868.8	1868.5	1868.4	1868.6	1869.8	1871.9	1871.9	1870.4	1868.7	1868.3
35	1868.5	1868.8	1868.7	1868.5	1868.3	1868.5	1869.7	1871.7	1871.7	1870.2	1868.6	1868.3
40	1868.4	1868.7	1868.7	1868.4	1868.3	1868.5	1869.6	1871.4	1871.5	1870.0	1868.6	1868.2
45	1868.3	1868.6	1868.6	1868.4	1868.3	1868.4	1869.5	1871.2	1871.4	1869.9	1868.5	1868.2
50	1868.2	1868.5	1868.6	1868.3	1868.2	1868.4	1869.3	1871.1	1871.3	1869.7	1868.5	1868.1
55	1868.1	1868.4	1868.5	1868.3	1868.2	1868.4	1869.2	1870.9	1871.2	1869.6	1868.4	1868.1
60	1868.0	1868.3	1868.5	1868.2	1868.2	1868.3	1869.1	1870.7	1871.0	1869.4	1868.4	1868.1
65	1868.0	1868.3	1868.4	1868.2	1868.1	1868.3	1868.9	1870.5	1870.8	1869.3	1868.3	1868.0
70	1867.9	1868.2	1868.3	1868.1	1868.1	1868.2	1868.8	1870.3	1870.6	1869.2	1868.3	1868.0
75	1867.9	1868.1	1868.3	1868.1	1868.1	1868.2	1868.7	1870.2	1870.5	1869.0	1868.2	1868.0
80	1867.9	1868.1	1868.2	1868.0	1868.0	1868.2	1868.6	1870.0	1870.3	1868.9	1868.2	1868.0
85	1867.8	1868.0	1868.1	1868.0	1868.0	1868.1	1868.6	1869.9	1870.2	1868.8	1868.1	1867.9
90	1867.8	1867.9	1868.0	1868.0	1867.9	1868.0	1868.5	1869.7	1869.9	1868.7	1868.1	1867.9
95	1867.8	1867.7	1867.8	1867.9	1867.8	1868.0	1868.4	1869.3	1869.6	1868.5	1868.0	1867.9
Minimum	1867.7	1867.6	1867.6	1867.8	1867.8	1867.9	1868.0	1868.5	1868.8	1868.2	1867.9	1867.8

Table 3.3-11 presents the simulated flow frequency for the lake outflows, which can be compared to the historic flow frequency of lake outflows as presented in Table 3.3-4. The agreement between historic and simulated flow frequency is mostly within about 1%, again with the exception of the maximum flows of record.

Table 3.3-11. Simulated flow (cfs) frequency at USGS Gage 12455000, Wenatchee River below Lake Wenatchee – Historic Operation.

% of Time Flow is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	4,145	9,986	6,706	8,026	4,551	5,282	7,578	13,205	9,690	7,304	3,079	1,603
5	1,615	2,474	2,278	1,545	1,426	1,534	3,808	6,605	6,596	4,967	1,669	701
10	1,203	1,592	1,468	1,141	1,033	953	2,974	5,821	5,431	3,940	1,321	585
15	1,009	1,294	1,204	854	873	774	2,541	5,147	5,007	3,431	1,090	510
20	863	1,130	1,048	721	657	691	2,268	4,729	4,690	3,136	958	469
25	736	1,000	920	647	540	644	2,040	4,463	4,380	2,817	814	438
30	633	919	833	575	479	607	1,790	4,182	4,200	2,459	735	413
35	553	824	754	533	455	572	1,653	3,915	3,973	2,234	678	394
40	493	729	695	498	431	533	1,527	3,618	3,760	2,025	608	372
45	423	652	647	465	409	510	1,425	3,384	3,589	1,885	567	348
50	362	581	598	427	386	489	1,297	3,181	3,459	1,716	537	332
55	298	524	571	399	361	471	1,177	2,971	3,295	1,563	506	314
60	266	456	539	374	345	443	1,061	2,757	3,090	1,392	473	303
65	249	403	485	348	329	414	926	2,555	2,900	1,291	446	288
70	232	365	444	323	312	382	820	2,356	2,718	1,144	412	275
75	218	334	400	309	295	358	719	2,179	2,524	1,031	387	262
80	207	304	358	287	281	341	660	2,050	2,312	903	369	252
85	195	267	325	269	270	318	600	1,882	2,175	807	338	240
90	181	208	282	248	238	286	537	1,700	1,894	698	310	230
95	168	153	193	221	194	267	493	1,294	1,632	582	288	215
Minimum	144	102	101	160	174	215	271	592	821	340	233	175

The overall agreement between simulated and historic data is better than expected. No simulation model should be expected to exactly reproduce historic results. The operation model is considered to be verified and should provide acceptably accurate results for the purposes for which it was intended.

3.3.2.4 Operating Criteria

Operating criteria are intended to provide guidelines and objectives for beneficial use of the rubber dam. For example, one of the alternative operations would collect water to storage during periods of high flows in the late spring or early summer and have an objective of releasing the stored water at the rate of about 100 cfs in excess of historic releases for about 60 days in the late summer to early fall time period. From the objective for this alternative operation, the implied storage capability of the rubber dam would be about 12,000 acre-feet.

Operating criteria also provide restrictions on the storage operation of the rubber dam. The most obvious restriction would be the maximum pool level to be controlled by the rubber dam. The rubber dam would be lowered to limit pool levels above the maximum operating level to the extent possible. Other restrictions would include the period of the year when the rubber dam could be raised, and the desired rate of release of the stored water. Another restriction that was included in the storage operation model was that the rubber dam would not be used to add water to storage on days on which instream flow requirements would not be met at Plain and Peshastin. The instream flow requirements at Plain and Peshastin are presented in Table 3.3-12 on a half-month basis.

Table 3.3-12. Instream flows (cfs) for the Wenatchee River (Ref: WAC 173-545-030, last update 6/9/88)

Month	Day	USGS Gage 12457000 Wenatchee River at Plain	USGS Gage 12459000 Wenatchee R. at Peshastin
Jan	1	550	700
	15	550	700
Feb	1	550	700
	15	550	700
Mar	1	550	750
	15	700	940
Apr	1	910	1,300
	15	1,150	1,750
May	1	1,500	2,200
	15	2,000	2,800
June	1	2,500	3,500
	15	2,000	2,600
July	1	1,500	1,900
	15	1,200	1,400
Aug	1	880	1,000
	15	700	840
Sep	1	660	820
	15	620	780
Oct	1	580	750
	15	520	700
Nov	1	550	750
	15	550	750
Dec	1	550	750
	15	550	750

The instream flow requirements provide a substantial restriction on the ability to collect water to storage in some years. The number of days in each month of each year when instream flows were not historically met at Plain and Peshastin are presented in Table 3.3-13 and Table 3.3-14, respectively.

Table 3.3-13. Number of days with flow less than instream flow requirement at USGS Gage 12457000, Wenatchee River at Plain – Historic Operation.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1933	14	0	0	0	0	13	2	0	0	0	0	0	29
1934	0	0	0	0	0	0	0	0	0	0	0	29	29
1935	20	0	0	0	0	0	0	0	0	0	0	11	31
1936	31	30	31	31	29	17	11	0	0	7	31	26	244
1937	31	30	17	31	28	24	0	0	0	0	11	26	198
1938	24	0	0	0	5	0	2	0	0	1	26	30	88
1939	25	10	1	0	1	21	0	0	0	0	16	30	104
1940	22	3	0	4	0	0	0	0	0	22	31	30	112
1941	11	14	0	29	28	0	0	0	15	31	31	15	174
1942	0	0	0	1	18	21	0	0	0	5	27	30	102
1943	30	18	10	6	1	10	0	0	0	0	0	22	97
1944	30	25	6	30	23	8	0	0	0	26	31	18	197
1945	18	8	4	1	0	1	14	0	0	7	30	27	110
1946	24	0	15	14	25	6	0	0	0	0	0	23	107
1947	22	12	0	0	0	0	0	0	0	0	15	29	78
1948	1	0	0	1	4	12	14	0	0	0	0	9	41
1949	0	0	0	27	15	0	0	0	0	0	0	8	50
1950	4	0	0	0	0	0	0	0	0	0	0	5	9
1951	2	0	0	0	0	0	0	0	0	0	1	21	24
1952	0	0	0	23	12	19	0	0	0	0	12	30	96
1953	31	30	31	8	0	0	3	0	0	0	0	16	119
1954	0	0	0	0	0	0	2	0	0	0	0	0	2
1955	0	0	0	0	0	17	9	3	0	0	0	9	38
1956	5	0	0	0	4	14	3	0	0	0	0	0	26
1957	0	0	0	8	4	0	0	0	0	1	8	29	50
1958	29	4	0	9	0	0	0	0	0	9	29	23	103
Average	14	7	4	9	8	7	2	0	1	4	12	19	87

Table 3.3-14. Number of days with flow less than instream flow requirement at USGS Gage 12459000, Wenatchee River at Peshastin – Historic Operation.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1933	14	0	0	0	0	2	2	0	0	0	0	0	18
1934	0	0	0	0	0	0	0	0	0	0	0	27	27
1935	20	0	0	0	0	0	0	0	0	0	0	13	33
1936	30	30	31	31	27	3	10	0	0	6	25	27	220
1937	31	30	19	31	28	22	0	0	0	0	5	28	194
1938	25	0	0	0	0	0	0	0	0	0	24	30	79
1939	26	10	1	0	0	20	0	0	0	0	16	30	103
1940	23	3	0	1	0	0	0	0	0	21	31	30	109
1941	11	16	0	28	27	0	0	0	13	28	31	10	164
1942	0	0	0	0	12	18	0	0	0	3	25	30	88
1943	30	18	7	0	0	9	0	0	0	0	0	25	89
1944	28	27	7	29	22	9	1	0	0	24	31	15	193
1945	15	10	1	0	0	0	18	0	0	2	29	25	100
1946	24	0	14	0	25	0	0	0	0	0	0	22	85
1947	21	8	0	0	0	0	0	0	0	0	10	26	65
1948	1	0	0	0	0	7	11	0	0	0	0	4	23
1949	0	0	0	19	11	0	0	0	0	0	0	2	32
1950	2	0	0	0	0	0	0	0	0	0	0	3	5
1951	0	0	0	0	0	0	0	0	0	0	0	19	19
1952	0	0	0	0	0	18	0	0	0	0	12	30	60
1953	31	30	31	8	0	0	4	0	0	0	0	15	119
1954	0	0	0	0	0	0	2	0	0	0	0	0	2
1955	0	0	0	0	0	15	14	4	0	0	0	10	43
1956	4	0	0	0	0	9	0	0	0	0	0	0	13
1957	0	0	0	6	2	0	0	0	0	0	6	30	44
1958	28	5	0	0	0	0	0	0	0	7	28	23	91
Average	14	7	4	6	6	5	2	0	1	4	11	18	78

Table 3.3-15 presents the number of days during which instream flows were not met at either Plain or Peshastin, which is the restriction on number of days during which water cannot be diverted to storage as included in the model. The range of number of days in a year not meeting instream flow requirements is large, varying from 2 days to 245 days in a year. The year 1941 is of particular note because storage would be restricted from about mid-June until mid-September. In other years, there would be no restrictions on collections to storage during the period when the rubber dam might be in use.

Table 3.3-15. Number of days with flow less than instream flow requirement at the Peshastin or Plain USGS Gages – Historic Operation.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1933	14	0	0	0	0	13	2	0	0	0	0	0	29
1934	0	0	0	0	0	0	0	0	0	0	0	29	29
1935	20	0	0	0	0	0	0	0	0	0	0	13	33
1936	31	30	31	31	29	17	11	0	0	7	31	27	245
1937	31	30	19	31	28	24	0	0	0	0	11	28	202
1938	25	0	0	0	5	0	2	0	0	1	26	30	89
1939	26	10	1	0	1	21	0	0	0	0	17	30	106
1940	23	3	0	4	0	0	0	0	0	22	31	30	113
1941	11	16	0	29	28	0	0	0	15	31	31	15	176
1942	0	0	0	1	18	21	0	0	0	5	27	30	102
1943	30	18	10	6	1	10	0	0	0	0	0	25	100
1944	30	27	7	30	23	9	1	0	0	26	31	18	202
1945	19	10	4	1	0	1	18	0	0	7	30	27	117
1946	24	0	15	14	25	6	0	0	0	0	0	23	107
1947	22	12	0	0	0	0	0	0	0	0	15	29	78
1948	1	0	0	1	4	12	14	0	0	0	0	10	42
1949	0	0	0	27	15	0	0	0	0	0	0	8	50
1950	4	0	0	0	0	0	0	0	0	0	0	5	9
1951	2	0	0	0	0	0	0	0	0	0	1	22	25
1952	0	0	0	23	12	22	0	0	0	0	12	30	99
1953	31	30	31	8	0	0	4	0	0	0	0	17	121
1954	0	0	0	0	0	0	2	0	0	0	0	0	2
1955	0	0	0	0	0	17	15	4	0	0	0	10	46
1956	5	0	0	0	4	14	3	0	0	0	0	0	26
1957	0	0	0	8	4	0	0	0	0	1	8	30	51
1958	29	5	0	9	0	0	0	0	0	9	29	23	104
Average	15	7	5	9	8	7	3	0	1	4	12	20	89

The storage that could potentially be impounded by the rubber dam is much smaller than the volume that would be required to meet all downstream instream flow requirements during the summer months. To provide background information on the historic deficiency of flows in relation to current instream flow requirements, Table 3.3-16 presents the storage volume (acre-feet) that would be required to meet requirements at Plain, or at Plain and Peshastin for the indicated periods. In a few years, no storage would be required as instream flows were met on every day of the season. More typically though, the storage required to meet downstream instream flows would be greatly in excess of any storage volume that is under consideration for the rubber dam.

Table 3.3-16. Storage (acre-feet) necessary to be impounded by the rubber dam to meet instream flow requirements at Plain or at Plain and Peshastin

	Meet Instream Flows at Plain Only		Meet Instream Flows at Plain and Peshastin	
Calendar Year	June 1 - Oct. 15 Storage (acre-feet)	June 1 - Oct 31 Storage (acre-feet)	June 1 - Oct. 15 Storage (acre-feet)	June 1 - Oct 31 Storage (acre-feet)
1933	0	0	0	0
1934	11,256	12,305	14,065	15,995
1935	4,465	6,436	6,325	9,094
1936	28,552	34,346	33,132	40,499
1937	16,518	17,863	19,583	21,362
1938	22,217	24,510	29,726	33,037
1939	21,098	22,949	29,472	32,261
1940	44,325	44,372	47,562	47,609
1941	62,122	62,122	66,184	66,184
1942	39,346	47,901	45,170	56,914
1943	8,390	9,780	11,802	13,609
1944	42,244	44,049	45,685	48,081
1945	25,002	28,235	25,769	29,022
1946	13,678	15,957	15,604	18,353
1947	10,467	10,467	10,491	10,491
1948	543	543	563	563
1949	1,501	1,501	1,501	1,501
1950	357	357	357	357
1951	2,809	2,809	3,221	3,221
1952	22,017	29,845	22,667	31,640
1953	2,561	2,561	3,667	3,667
1954	0	0	0	0
1955	2,475	2,475	4,395	4,395
1956	0	0	0	0
1957	12,883	16,086	13,668	17,401
1958 (1)	15,477		20,138	
Minimum	0	0	0	0
Maximum	62,122	62,122	66,184	66,184
Average	15,781	17,499	18,106	20,210

Note (1): Values represent June 1 through September 30, 1958.

The amount of water that is potentially storable by the rubber dam is substantial in most years under a given set of rules for collection to storage. This paragraph describes the criteria used by the operation model to determine the amount of water that could be stored by the rubber dam. As used in the operation model, the daily amount of water that was potentially storable was the minimum of the following three values:

1. Daily amount of historic flow at Plain in excess of instream flow requirements at Plain.
2. Daily amount of historic flow at Peshastin in excess of instream flow requirements at Peshastin.

3. 50% of the Lake Wenatchee daily inflow up to 3,000 cfs, plus 25% of the Lake Wenatchee daily inflow greater than 3,000 cfs.

The amount of Lake Wenatchee inflow that would be potentially available for storage under the rules presented above is presented in Table 3.3-17. Of course collections to storage by the rubber dam would only be desired only at limited times of the year. During most of the year, the rubber dam would be either fully down or would be operating in the augmentation (release) mode. Flow augmentation is used herein to denote flow released in excess of the historic flow on the corresponding day.

Table 3.3-17. Lake Wenatchee inflow (acre-feet) potentially available for storage with rubber dam.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1933	7,727	53,650	32,966	18,875	6,903	2,660	29,226	56,557	111,261	97,999	36,762	15,727	470,313
1934	46,965	47,149	63,593	46,647	32,620	65,699	113,231	93,164	66,284	29,076	8,065	4	612,497
1935	8,568	47,986	21,705	40,705	30,950	22,736	28,174	89,732	102,294	63,554	18,086	5,195	479,685
1936	0	0	0	0	0	4,585	53,642	116,177	95,103	17,447	0	674	287,628
1937	0	0	4,560	0	0	1,031	18,467	84,286	118,335	56,226	4,063	258	287,227
1938	4,623	24,878	21,908	17,706	4,457	11,610	51,954	101,326	101,331	40,668	805	0	381,267
1939	1,617	5,301	17,187	26,967	5,988	11,884	55,610	95,104	73,681	50,515	4,898	0	348,752
1940	2,128	16,960	29,582	5,188	7,118	25,945	58,152	94,988	63,512	4,919	0	0	308,492
1941	12,035	4,820	14,162	42	0	26,496	57,528	54,032	10,592	0	0	5,489	185,195
1942	33,535	23,003	30,966	4,951	254	2,261	45,911	66,975	66,604	27,671	444	0	302,576
1943	22	4,161	10,232	11,340	4,705	8,501	65,799	82,076	107,564	93,997	25,424	666	414,486
1944	0	674	16,683	12	839	12,505	31,415	71,081	58,372	1,984	0	4,450	198,015
1945	2,845	5,391	15,073	27,103	21,599	7,953	11,004	90,760	76,895	29,371	30	1,085	289,109
1946	11,000	15,568	4,967	4,083	228	6,994	37,550	121,994	100,920	69,906	16,845	708	390,764
1947	8,390	3,458	24,801	16,620	23,240	37,631	65,239	109,067	82,493	44,142	7,344	6	422,431
1948	31,792	27,879	19,057	8,796	6,931	2,674	24,003	97,055	128,565	52,116	21,480	4,764	425,111
1949	20,012	12,252	12,002	327	5,215	13,898	51,909	117,492	97,460	62,892	17,478	6,812	417,750
1950	17,259	51,219	38,614	19,058	10,597	25,169	29,373	83,553	132,505	105,524	38,401	8,304	559,576
1951	33,997	41,029	47,251	26,133	41,181	18,128	59,139	107,490	100,409	58,223	13,307	1,918	548,205
1952	26,355	22,527	8,920	323	1,603	4,097	48,056	93,255	81,320	45,219	7,525	0	339,201
1953	0	0	0	32,921	34,746	19,119	32,429	90,840	89,137	82,971	26,846	2,811	411,819
1954	12,668	26,746	32,168	20,830	12,192	13,793	32,266	100,657	108,041	114,437	58,701	25,284	557,785
1955	18,104	44,735	22,388	10,983	12,087	2,846	7,486	60,423	120,476	92,114	35,452	9,672	436,767
1956	27,680	52,456	21,905	11,642	2,049	2,896	51,972	124,561	118,254	94,895	26,893	10,071	545,275
1957	26,583	25,758	50,900	11,235	6,387	16,144	41,619	120,311	83,020	31,588	5,451	0	418,996
1958	2,933	5,621	11,285	5,534	12,477	17,362	37,873	124,311	87,171	13,926	214	930	319,638
Average	13,725	21,662	22,034	14,155	10,937	14,793	43,809	94,126	91,600	53,130	14,404	4,032	398,406
Maximum	46,965	53,650	63,593	46,647	41,181	65,699	113,231	124,561	132,505	114,437	58,701	25,284	612,497
Minimum	0	0	0	0	0	1,031	7,486	54,032	10,592	0	0	0	185,195

Additional rubber dam operating criteria include the following:

- The rubber dam was operated so that it achieves the maximum controlled pool level in all years. In designated dry years, storage would begin up to one month earlier than during normal or wet years. In practice, this operation could be keyed to snowpack in the mountains.
- Storage and release seasons would be designated and would be the same in most years, with the exception being the designated dry years. The rubber dam would not be operated to augment flows in the storage season. During the release season, lake storage would not increase beyond that which would have occurred under natural conditions.
- When the rubber dam is fully down, the historic rating curve would control lake outflows.

- The rubber dam would not control lake levels above the designated maximum level. At times high inflows would cause natural lake levels to rise above the designated maximum normal pool level for the rubber dam. During these high flow periods, the rubber dam would be fully down and the historic rating curve would control lake outflows.
- During the storage season, if downstream instream flow requirements were not being met, outflow at the rubber dam would equal inflow, which would result in a constant lake level.

3.3.3 Operating SCENARIOS

This section describes the potential operating scenarios for the water storage project and also describes specific alternatives that were analyzed using the hydrologic model of Lake Wenatchee.

3.3.3.1 Selection of Storage Levels

Two storage levels were selected for analysis. The first and lowest storage level is the OHW elevation, defined in Section 3.2 as 1870.3. The OHW level was selected at the outset of the project as it is the level below which the State owns the bed of the lake except those second class shorelands purchased by certain property owners. At the February 26, 2003 Project Team meeting the MWH team presented its estimate of the OHW elevation (1870.3 ft) and the potential water storage available at that elevation (6,700 acre-feet). MWH was asked at that meeting to analyze a storage level higher than OHW so that costs and benefits of two different storage levels could be compared.

Additional storage provided in Lake Wenatchee would likely be used to supplement instream flow in the Wenatchee River downstream and may also be used to offset future, increased water demands in the Wenatchee River Watershed. Analyses of water needs for instream flow was performed by comparing historic streamflow in the Wenatchee River to instream flows set by the Instream Resources Protection Program (IRPP) and WAC 173-545. The analyses found the volume of additional storage needed to augment streamflow to meet IRPP flows at the Wenatchee River at Plain gaging station ranged from 0 to 62,122 acre-feet and averaged 17,499 acre-feet for the period of June 1 to October 31 as indicated in Table 3.3-16. The additional volume of water needed to meet future municipal and domestic water demands is much less, estimated to be 7.3 cfs peak and 1868 acre-feet annually.

To meet those water needs, storage levels in Lake Wenatchee would need to be increased substantially. A comparison of lake levels to potential storage is listed in Table 3.3-18. A description of what the various lake levels correspond to is also contained in Table 3.3-18. The first three lake levels listed in Table 3.3-18 could satisfy most to all instream flow needs. The fourth and fifth lake levels indicated in the table represent peak lake levels that occur in most years and are lower in elevation than the first three levels. Although those levels would not satisfy most instream flow needs they would provide additional storage that would be useful to augment instream flow or offset future water needs.

Table 3.3-18. Comparison of lake levels to potential storage.

Description of Lake Level	Storage Elevation (ft-msl)	Storage Volume (acre-ft)
Maintain In-Stream Flow (all 29 of 29 recorded years)	1888.1	62,100
Maintain In-Stream Flow (all but the worst 2 of 29 years)	1882.4	42,200
Maintain In-Stream Flow (all but the worst 5 of 29 years)	1876.9	25,000
Mean Annual Spring Peak Lake Elevation	1873.9	16,400
90% Exceedance[1] Annual Spring Peak Lake Elevation	1872.4	12,300
Ordinary High Water	1870.3	6,700

[1] This is the Spring high water level that has been exceeded nine out of ten years of our 47 years of record

The elevations contained in Table 3.3-18 were preliminarily reviewed for their potential effect on shoreline property owners and structures. It was our opinion that the storage levels above 1872.4 ft have a high potential for impacts to shoreline property owners. As an example, a photograph of the Kane Boathouse that is annotated with various lake levels is shown in Figure3.3-10. The lake levels required to provide a reliable instream flow benefit would submerge most or all of the Kane Boathouse. Even the mean annual spring lake level of 1873.9 ft would keep two feet of water over the boathouse deck. It is our opinion that the next to the lowest lake level shown in Table 3.3-18 is a reasonable lake level to further analyze with the hydrologic model. This level was presented at the April 30, 2003 project team meeting as the consultants second, higher level recommended for further study.

Figure 3.3-10. Illustration of Water Levels at Kane Boathouse

3.3.3.2 Operation Model Alternatives

This section describes the specific alternatives that were considered. The impoundment structure operating objectives, guidelines, and restrictions are described in the following items.

- Alternative 1 – The maximum lake level controlled by the rubber dam would be at El. 1872.4. The normal collection season for storage behind the rubber dam would be from July 1 through August 22. Augmentation flows would be ramped up at a rate of 10 cfs per day from August 23 through August 31. Lake outflows would be augmented by 100 cfs in excess of historic outflows from September 1 until storage behind the rubber dam was exhausted.
- Alternative 2 – The maximum lake level controlled by the rubber dam would be at El. 1872.4. The normal collection season for storage behind the rubber dam would be from July 1 through August 22. Augmentation flows would be ramped up at a rate of 20 cfs per day from August 23 through August 31. Lake outflows would be augmented by 200 cfs in excess of historic outflows from September 1 until storage behind the rubber dam was exhausted.
- Alternative 3 – The maximum lake level controlled by the rubber dam would be at El. 1872.4. The normal collection season for storage behind the rubber dam would be from June 1 through June 30. Pulse flows would be released daily at the rate of 100 cfs for 4 hours from July 1 through August 15. Lake outflows would be augmented by 100 cfs in excess of historic outflows from August 16 until storage behind the rubber dam was exhausted.
- Alternative 4 – The maximum lake level controlled by the rubber dam would be at El. 1870.3. The normal collection season for storage behind the rubber dam would be from July 1 through August 22. Augmentation flows would be ramped up at a rate of 5 cfs per day from August 23 through August 31. Lake outflows would be augmented by 50 cfs in excess of historic outflows from September 1 until storage behind the rubber dam was exhausted.
- Alternative 5 – The maximum lake level controlled by the rubber dam would be at El. 1870.3. The normal collection season for storage behind the rubber dam would be from July 1 through August 22. Augmentation flows would be ramped up at a rate of 10 cfs per day from August 23 through August 31. Lake outflows would be augmented by 100 cfs in excess of historic outflows from September 1 until storage behind the rubber dam was exhausted.

For Alternatives 1, 2, and 3, which all have a maximum pool level controlled by the rubber dam at El. 1872.4, the designated dry years are 1940, 1941, and 1944. During these designated dry years, storage begins on June 1, which is necessary to achieve a stored water level at El. 1872.4 during the driest year of 1941.

For Alternatives 4 and 5, which both have a maximum normal pool level controlled by the rubber dam at El. 1870.3, the designated dry years are 1941 and 1944. During these designated dry years, storage begins on June 15. Storage can begin later in the dry years for Alternatives 4 and 5 because there is less water collected into storage with the rubber dam.

The maximum pool level controlled by the rubber dam at El. 1872.4 was based on a storage of about 12,000 acre-feet above the historic minimum level of the lake. The maximum lake level controlled by the rubber dam at El. 1870.3 is based on the ordinary high water level as determined from the vegetation line.

3.3.3.3 Operation Model Results

The operation model produced a great deal of output that is also evaluated in other sections of this report. This section provides summary results for each alternative in graphical and tabular form. The results are presented in comparison to the historic condition as a reference. The following types of summary results are provided for each alternative:

- Daily Lake Wenatchee water levels plots for an average water year, 1949, and a dry water year, 1941.
- Daily Lake Wenatchee outflow plots for an average water year, 1949, and a dry water year, 1941. These plots are provided for both the entire year, as well as an additional plot that is focused on the primary augmentation season.
- A tabulation of Lake Wenatchee elevation frequency in comparison to the historic condition for the entire 26-year period of simulation based on daily levels. This table is developed by a simple subtraction of corresponding values in the historic elevation frequency table from Alternative elevation frequency table. Positive values indicate higher lake levels for the alternatives in comparison to the historic condition.
- A tabulation of Lake Wenatchee outflow frequency in comparison to the historic condition for the entire 26-year period of simulation based on daily outflows. In the same manner as the elevation frequency difference table, this table is developed by a subtraction of corresponding values in the historic outflow frequency table from Alternative outflow frequency table. Positive values indicate flow augmentation.
- Daily flow plots at the USGS gage at Plain for an average water year, 1949, and a dry water year, 1941.

Results have been grouped in the following sections into three categories, which are Lake Wenatchee elevations, Lake Wenatchee outflows, and flow at the USGS gage at Plain.

3.3.3.3.1 Lake Wenatchee Elevation Results

Results show that the maximum storage in excess of historic conditions attained on any day for any of the five alternatives was 11,425 acre-feet, which was achieved by Alternatives 1 and 2 on August 22, 1944. As shown on Figure 3.3-11, during a normal year such as 1949 for Alternative 1, the maximum lake storage on any day impounded with the rubber dam would be 10,199 acre-feet in excess of the historic storage on August 22, which corresponds to a lake level 3.93 feet higher than for historic conditions. In comparison to Alternative 1, Alternative 2 shows a more rapid drawdown of lake level because the augmentation objective is 200 cfs rather than 100 cfs.

Alternative 3 begins both storage and release earlier in the year in comparison to Alternative 1 and Alternative 2. In 1949, the maximum additional storage impounded by the rubber dam in excess of historic conditions was 6,445 acre-feet on June 30. Due to the higher natural lake levels at the time of year scheduled for storage and release, the amount of storage impounded by the rubber dam to be used for flow augmentation is less for Alternative3 than for Alternatives 1 or 2 in 1949 and other similar years.

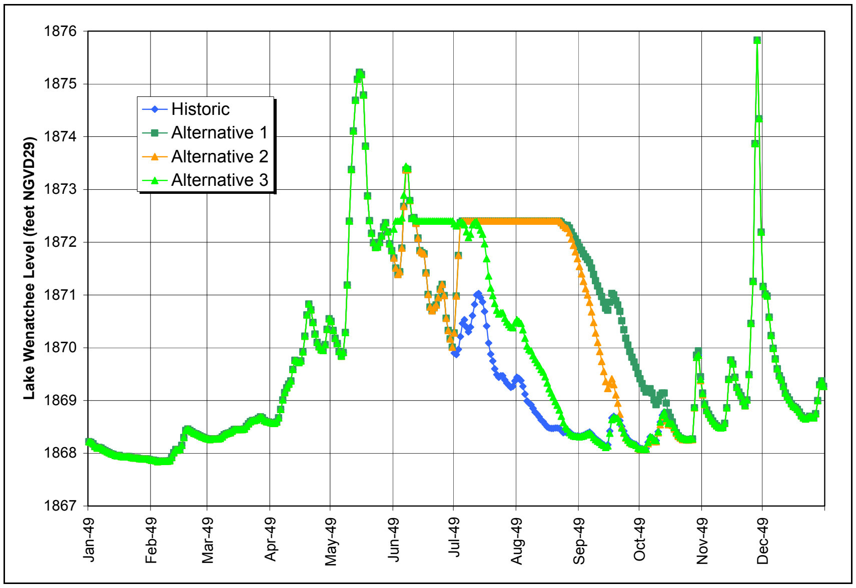


Figure 3.3-11. Alternatives 1, 2, and 3, and historic lake levels for an average water year – 1949.

Alternative 4 is similar to Alternative 1, except with a lower maximum lake level controlled by the rubber dam and with flow augmentation objectives cut in half. The maximum storage attained by the rubber dam in excess of historic conditions during 1949 was 4,653 acre-feet on August 22. Because this is about half of the amount available for Alternative 1 and the release schedule is also 50% of Alternative 1, flow augmentation is provided for almost the same time period as for Alternative 1. Lake levels for Alternatives 4 and 5 are shown on Figure 3.3-12 for an average water year.

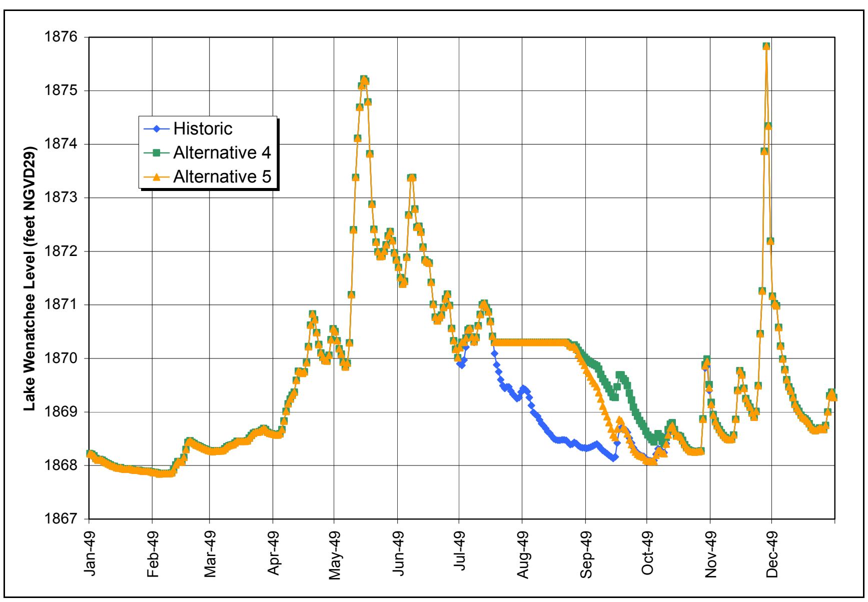


Figure 3.3-12. Alternatives 4 and 5, and historic lake levels for an average water year – 1949.

Alternative 5 is similar to Alternative 2, except with a lower maximum lake level controlled by the rubber dam and with flow augmentation objectives cut in half. Flow augmentation occurs for a period similar to that for Alternative 2.

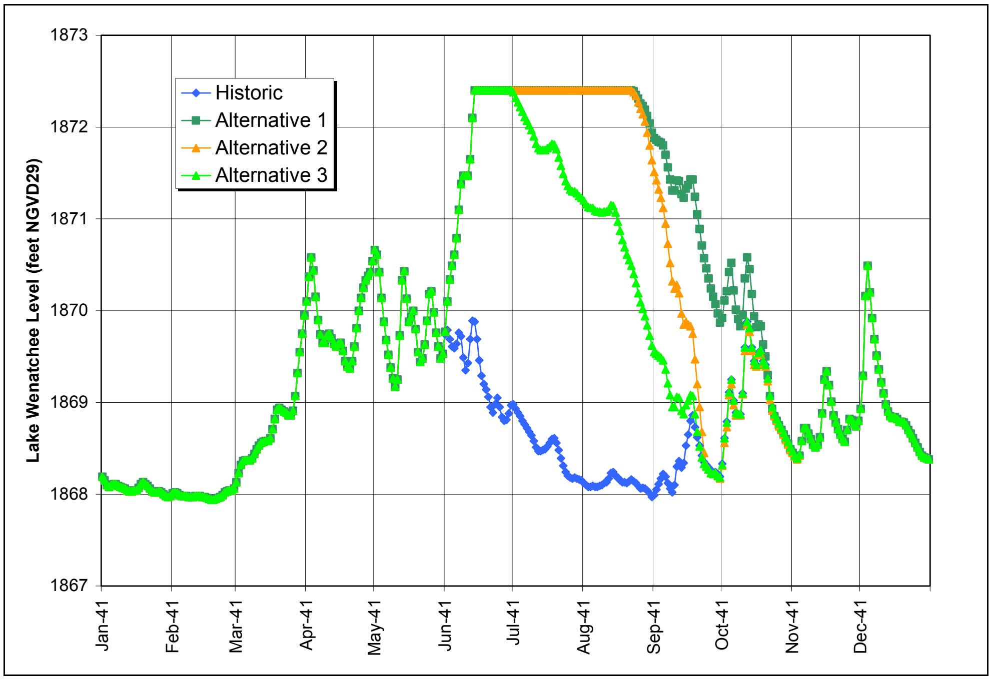


Figure 3.3-13. Alternatives 1, 2, and 3, and historic lake levels for a dry water year – 1941.

Lake level plots for all of the Alternatives are shown on Figure 3.3-13 and Figure 3.3-14 for a dry water year, which is 1941. Figure 3.3-13 shows storage beginning at the beginning of June and reaching a higher level during the dry year than was historically attained. This means that the storage project will provide maximum flow augmentation benefits during a dry year. Figure 3.3-14 shows that the maximum pool level controlled by the Alternative 4 and 5 rubber dam would be less than the maximum level that occurred historically in 1941.

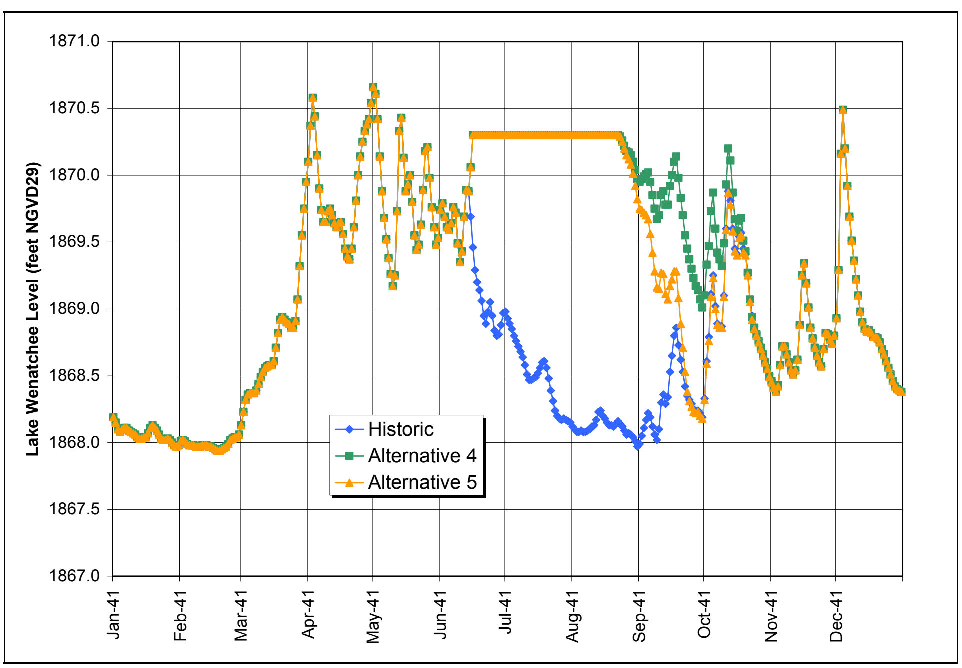


Figure 3.3-14. Alternatives 4 and 5, and historic lake levels for a dry water year – 1941.

Table 3.3-19. Alternative 1 Lake Wenatchee Elevation-Frequency Difference (feet) From Historic.

% of Time Lake Level is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2.6
5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.7	3.1
10	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	3.1	3.2
15	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	3.3	3.1
20	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.4	3.5	3.1
25	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.7	3.6	3.0
30	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	2.0	3.7	2.9
35	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.2	3.8	2.8
40	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.4	3.8	2.7
45	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.5	3.9	2.7
50	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.7	3.9	2.6
55	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.8	4.0	2.5
60	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.0	4.0	2.4
65	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	3.1	4.1	2.3
70	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.2	4.1	2.2
75	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.4	4.1	2.1
80	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.5	4.1	2.0
85	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.6	4.1	1.9
90	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.7	4.0	1.8
95	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.5	4.0	1.6
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.4	3.6	0.7

The elevation-frequency difference data tables presented in this section provide a great deal of precise numerical information. Rather than focusing on individual values, it is suggested that the reader should look for the broader trends in the results. The elevation-frequency difference tables are developed by subtracting corresponding values from the elevation-frequency table developed for each Alternative from the historic elevation-frequency table, which was presented as Table 3.3-1.

Table 3.3-20. Alternative 2 Lake Wenatchee elevation-frequency difference (feet) from historic.

% of Time Lake Level is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2.2
5	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.7	2.7
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	3.1	2.6
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	3.3	2.4
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.4	3.5	2.3
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.7	3.6	2.1
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	2.0	3.7	1.9
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.2	3.8	1.7
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.4	3.8	1.5
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.5	3.9	1.3
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.7	3.9	1.1
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.8	4.0	0.9
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.0	4.0	0.7
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	3.1	4.1	0.5
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.2	4.1	0.4
75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.4	4.1	0.3
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.5	4.1	0.2
85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.6	4.0	0.1
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.7	3.9	0.0
95	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.5	3.8	0.0
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.4	3.3	0.0

Table 3.3-21. Alternative 3 Lake Wenatchee elevation-frequency difference (feet) from historic.

% of Time Lake Level is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.3
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	1.4	0.2
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	1.4	0.1
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.1	1.3	0.1
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	1.3	0.1
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.4	1.2	0.1
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.5	1.1	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.6	1.1	0.1
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.6	1.0	0.1
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.6	0.9	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.7	0.9	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.8	0.8	0.0
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.8	0.7	0.0
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1.8	0.7	0.0
75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.8	0.6	0.0
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	1.7	0.5	0.0
85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	1.6	0.4	0.0
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	1.5	0.3	0.0
95	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	1.4	0.2	0.0
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.6	0.0	0.0

As shown on Table 3.3-21, the water level differences from historic for Alternative 3 are less than for Alternative 1 and Alternative 2. This is due to the earlier release schedule for Alternative 3, which is clearly exhibited on Figure 3.3-11 and Figure 3.3-13.

Table 3.3-22. Alternative 4 Lake Wenatchee elevation-frequency difference (feet) from historic.

% of Time Lake Level is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.3
10	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.4
15	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.4
20	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.4
25	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.4
30	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.3
35	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.7	1.3
40	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.7	1.2
45	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.8	1.2
50	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.8	1.1
55	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.9	1.1
60	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.9	1.0
65	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	1.0
70	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.0	1.0
75	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	2.0	0.9
80	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	2.0	0.9
85	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.5	2.0	0.8
90	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.6	2.0	0.8
95	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.8	2.0	0.7
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.4	1.6	0.3

Table 3.3-23. Alternative 5 Lake Wenatchee elevation-frequency difference (feet) from historic.

% of Time Lake Level is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.9
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.9
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.8
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.7	0.7
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.7	0.6
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.8	0.6
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.8	0.5
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.9	0.4
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.9	0.3
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	0.3
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.0	0.3
75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	2.0	0.2
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	2.0	0.1
85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.5	2.0	0.1
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.6	2.0	0.0
95	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.8	1.9	0.0
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.4	1.5	0.0

A comparison between Alternatives 4 and 5 in Tables 3.3-22 and 3.3-23 shows the effects of the more rapid releases for Alternative 5 (100 cfs versus 50 cfs). By October, Alternative 5 would have returned to historic lake levels.

3.3.2.6.2 Lake Wenatchee Outflow Results

This section provides a number of plots to visually compare the Lake Wenatchee outflows for average and dry water years as developed by the Alternatives in comparison to the historic outflows. Figure 3.3-15 presents the Lake Wenatchee outflows for Alternatives 1, 2, and 3 and the historic condition for the average water year of 1949. Figure 3.3-15 shows that outflow with the rubber dam would be the same as for the historic condition for much of the year. The area of greatest interest, the primary potential augmentation season from August 1 through October 31, is not distinctly visible on a graph that shows the entire year and is scaled to include higher flows. To more clearly present the augmentation effects, additional graphs that focus only on the augmentation season are presented for each of the Alternatives. For example, Figure 3.3-16 presents the same data as shown on Figure 3.3-15, except in a graphically expanded form for the augmentation season.

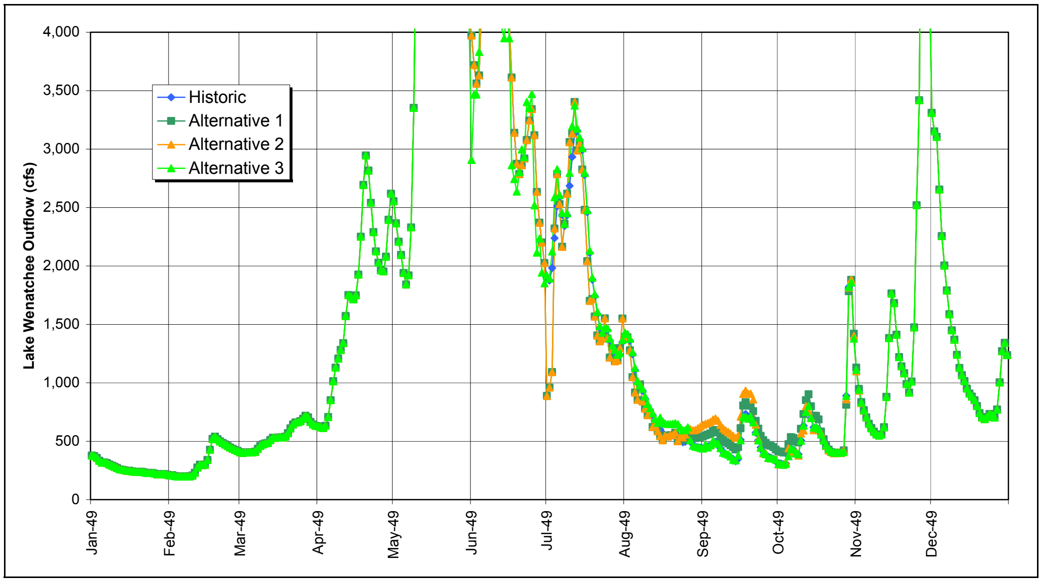


Figure 3.3-15. Alternatives 1, 2, and 3, and historic lake outflows for an average water year – 1949.

As most clearly shown on Figure 3.3-16, Alternative 2 provides the greatest augmentation, but for a shorter period of time than for Alternative 1, which augments flows through much of October. Alternative 3 has less water to store and release because it has different storage and release seasons in comparison to Alternatives 1 and 2. During 1949, Alternative 3 achieves a maximum storage (in excess of historic) of 6,445 acre-feet on June 30. Both Alternative 1 and 2 achieve a maximum storage (in excess of historic) of 10,199 acre-feet on August 22. Because of this, Alternatives 1 and 2 can augment flow in a total amount greater than Alternative 3.

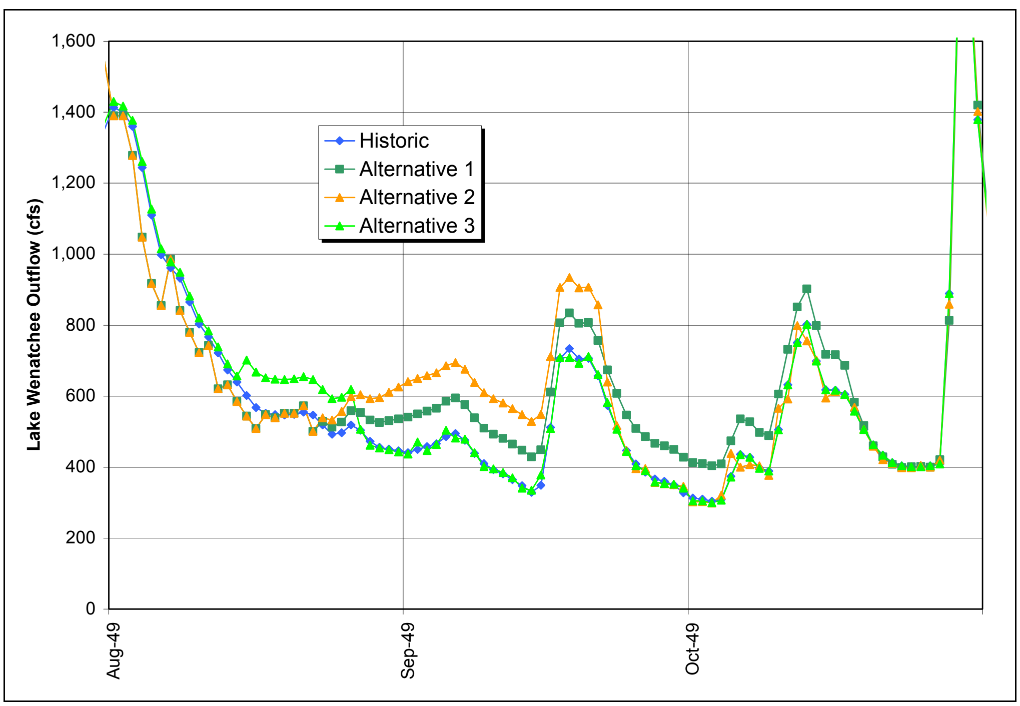


Figure 3.3-16. Alternatives 1, 2, and 3, and historic lake outflows for the 1949 augmentation season.

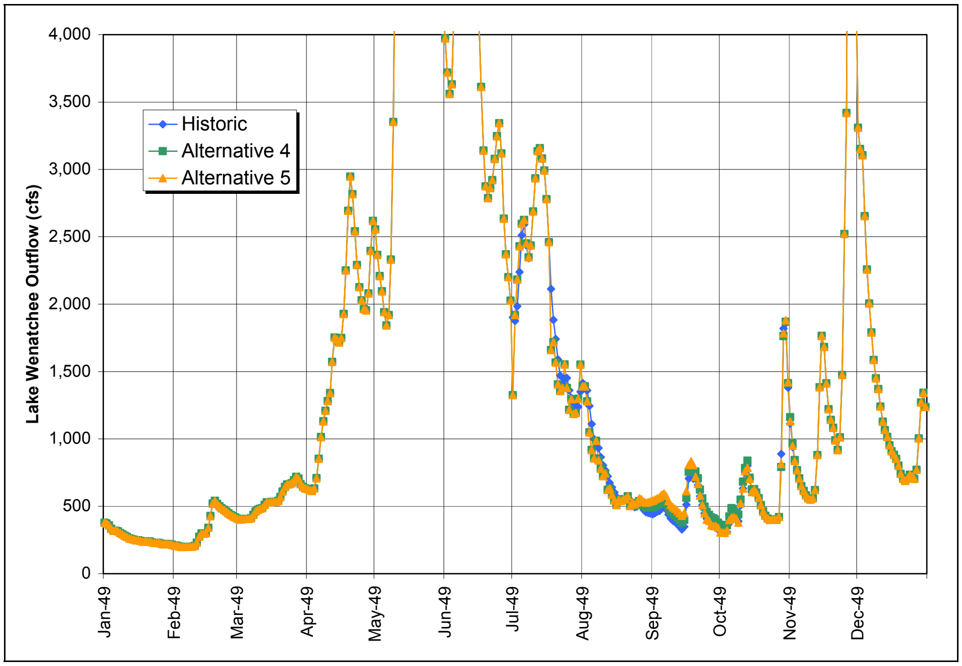


Figure 3.3-17. Alternatives 4, and 5, and historic lake outflows for an average water year – 1949.

Figures 3.3-17 and 3.3-18 show that augmentation flow for Alternatives 4 and 5 have a similar pattern to those for Alternatives 1 and 2. The primary difference is in the magnitude of augmentation, with more minor differences in the augmentation season.

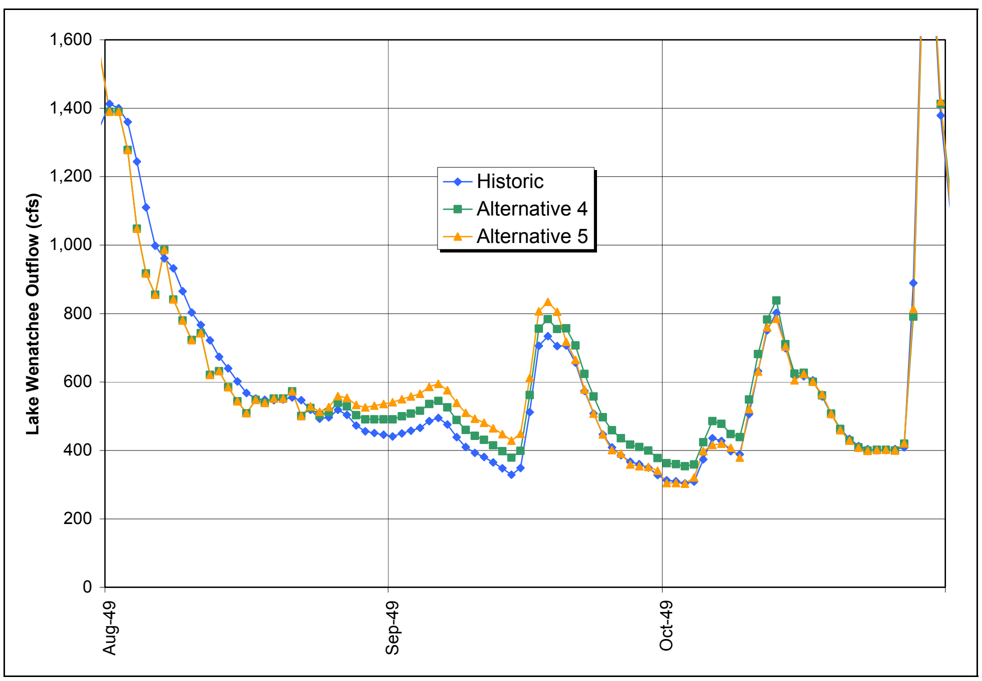


Figure 3.3-18. Alternatives 4, and 5, and historic lake outflows for the 1949 augmentation season.

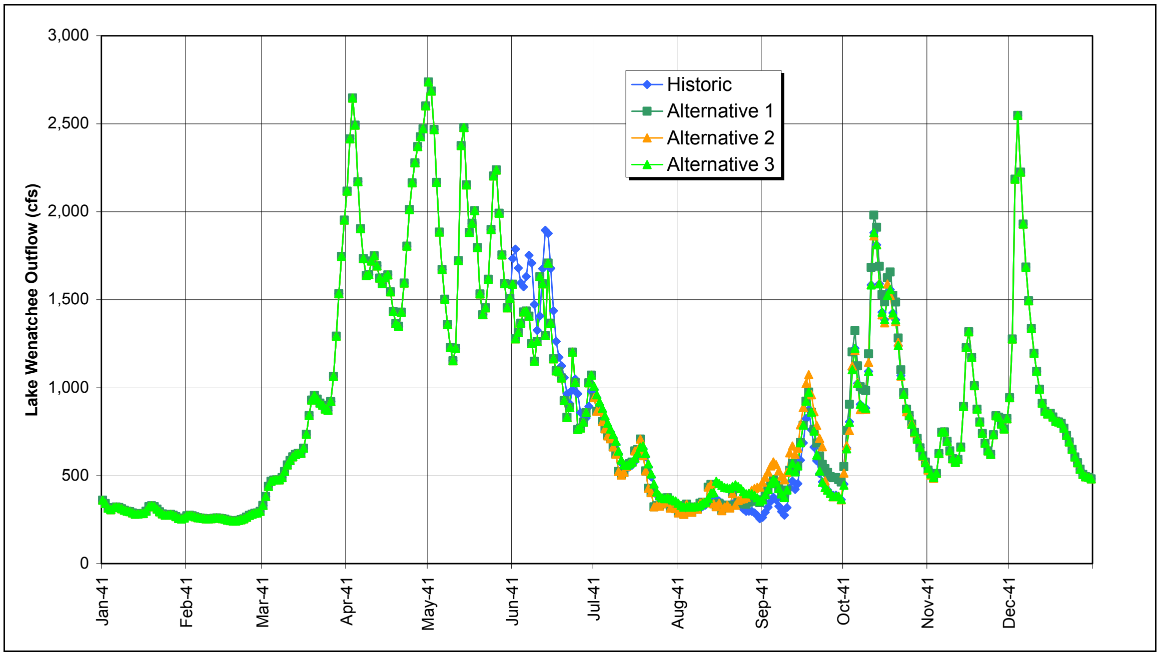


Figure 3.3-19. Alternatives 1, 2, and 3, and historic lake outflows for a dry water year – 1941.

During a dry water year, the flow augmentation would be most pronounced. Figure 3.3-20 highlights that flow augmentation can be a substantial percentage of total outflow during the driest periods.

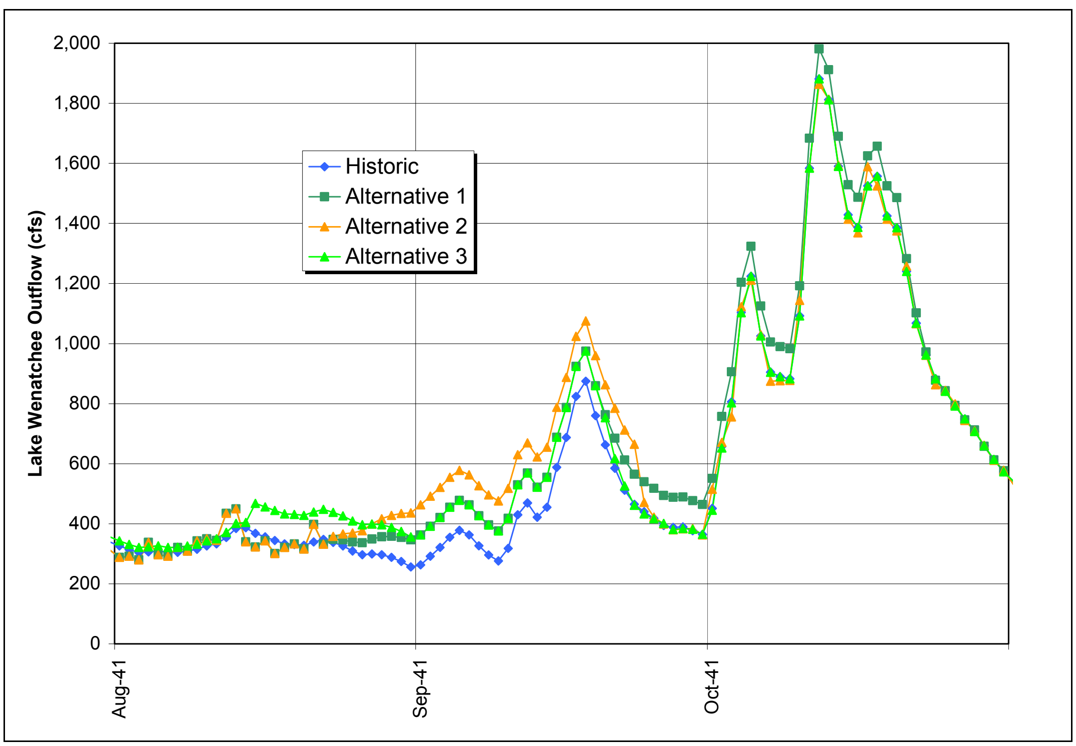


Figure 3.3-20. Alternatives 1, 2, and 3, and historic lake outflows for the 1941 augmentation season.

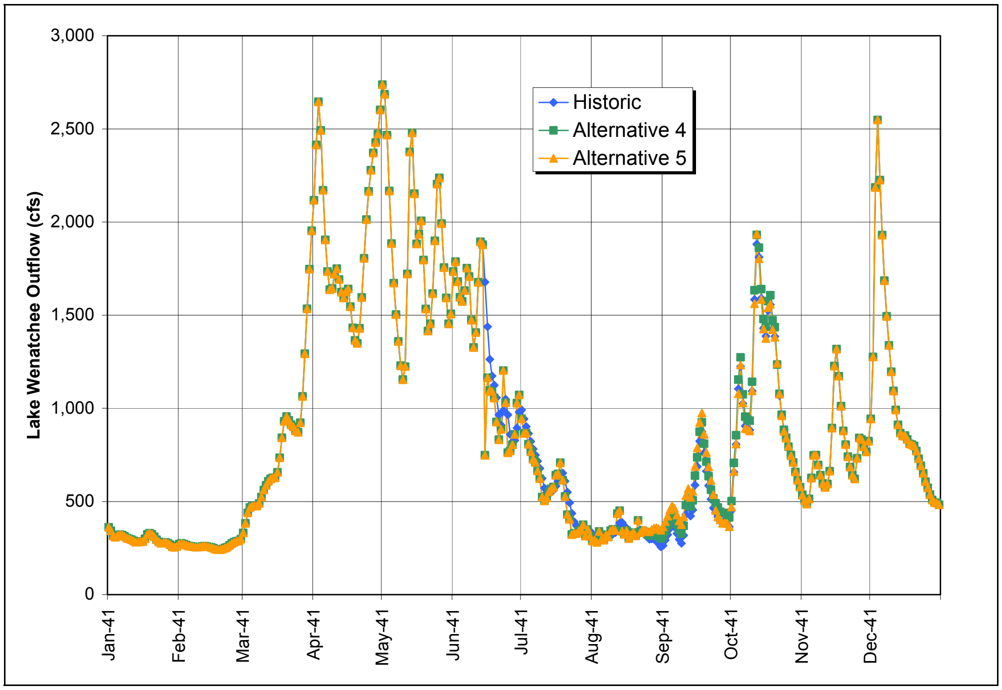


Figure 3.3-21. Alternatives 4 and 5, and historic lake outflows for a dry water year – 1941.

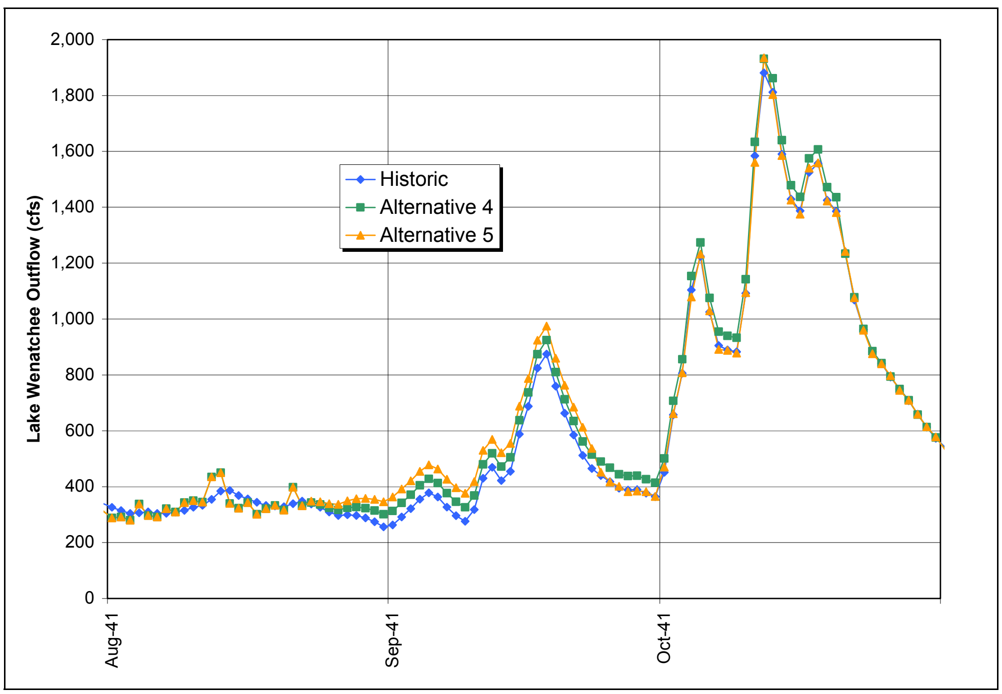


Figure 3.3-22. Alternatives 4 and 5, and historic lake outflows for the 1941 augmentation season.

Table 3.3-24 shows that the objective for Alternative 1 of augmenting historic flows by 100 cfs on each day in September is essentially fully accomplished. During October, the objective can be met on some days, but not on others. This causes the flow frequency difference from historic conditions to be less than 100 cfs in October. The negative values during parts of June, July, and August are indications of flow being taken into storage.

Table 3.3-24. Alternative 1 Lake Wenatchee outflow-frequency difference (cfs) from historic.

% of Time Flow is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	100	0	0	0	0	0	0	0	0	0	166	100
5	42	0	0	0	0	0	0	0	0	92	-80	100
10	39	0	0	0	0	0	0	0	0	-80	-63	96
15	41	0	0	0	0	0	0	0	0	-81	-45	98
20	28	0	0	0	0	0	0	0	0	-147	-55	100
25	55	-3	0	0	0	0	0	0	0	-269	-12	100
30	30	0	0	0	0	0	0	0	0	-196	-20	100
35	51	0	0	0	0	0	0	0	0	-176	-10	100
40	45	0	0	0	0	0	0	0	-2	-174	4	100
45	42	0	0	0	0	0	0	0	-1	-173	-3	100
50	45	0	0	0	0	0	0	0	0	-165	-4	100
55	75	-3	0	0	0	0	0	0	-2	-186	1	100
60	77	-1	0	0	0	0	0	0	-12	-172	5	100
65	76	0	0	0	0	0	0	0	-9	-194	-4	100
70	79	-2	0	0	0	0	0	0	-12	-138	7	100
75	77	-1	0	0	0	0	0	0	-2	-144	7	100
80	78	0	0	0	0	0	0	0	-24	-101	4	100
85	76	0	0	0	0	0	0	0	-60	-80	13	100
90	69	-2	0	0	0	0	0	0	-23	-43	23	100
95	26	-1	0	0	0	0	0	0	-202	-49	21	100
Minimum	3	0	0	0	0	0	0	0	-59	-27	-9	100

The indication to be taken from Table 3.3-25 is that the full 200 cfs flow augmentation can be provided for most, but not all of the month of September.

Table 3.3-25. Alternative 2 Lake Wenatchee outflow-frequency difference (cfs) from historic.

% of Time Flow is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	67	0	0	0	0	0	0	0	0	0	166	7
5	-22	0	0	0	0	0	0	0	0	92	-80	144
10	-1	0	0	0	0	0	0	0	0	-80	-60	152
15	19	0	0	0	0	0	0	0	0	-81	-45	172
20	-4	0	0	0	0	0	0	0	0	-147	-41	175
25	-15	-3	0	0	0	0	0	0	0	-269	0	174
30	-1	0	0	0	0	0	0	0	0	-196	8	178
35	7	0	0	0	0	0	0	0	0	-176	1	169
40	-1	0	0	0	0	0	0	0	-2	-174	19	167
45	-3	-1	0	0	0	0	0	0	-1	-173	23	169
50	1	0	0	0	0	0	0	0	0	-165	7	171
55	3	-3	0	0	0	0	0	0	-2	-186	7	173
60	3	-1	0	0	0	0	0	0	-12	-172	17	163
65	1	0	0	0	0	0	0	0	-9	-194	23	164
70	0	-2	0	0	0	0	0	0	-12	-138	29	162
75	1	-1	0	0	0	0	0	0	-2	-144	30	158
80	1	0	0	0	0	0	0	0	-24	-101	26	145
85	-1	0	0	0	0	0	0	0	-60	-80	32	82
90	-1	-3	0	0	0	0	0	0	-23	-43	35	34
95	1	-1	0	0	0	0	0	0	-202	-49	27	20
Minimum	2	0	0	0	0	0	0	0	-59	-27	-9	-8

Table 3.3-26 can be used to highlight the difference in storage and release characteristics between Alternatives 1, 2, and 3. Tables 3.3-27 and 3.3-28 present the Lake Wenatchee outflow results in relation to historic conditions for Alternatives 4 and 5.

Table 3.3-26. Alternative 3 Lake Wenatchee outflow-frequency difference (feet) from historic.

% of Time Flow is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	0	0	0	0	0	0	0	0	0	16	12	39
5	0	0	0	0	0	0	0	0	25	68	3	8
10	0	0	0	0	0	0	0	0	92	7	0	8
15	-1	0	0	0	0	0	0	0	130	54	6	7
20	0	0	0	0	0	0	0	0	260	34	11	13
25	0	0	0	0	0	0	0	0	90	17	10	16
30	0	0	0	0	0	0	0	0	-77	18	17	19
35	0	0	0	0	0	0	0	0	-45	17	20	19
40	0	0	0	0	0	0	0	0	-57	28	38	24
45	0	0	0	0	0	0	0	0	-92	19	39	31
50	-2	0	0	0	0	0	0	0	-122	3	40	26
55	-2	0	0	0	0	0	0	0	-143	18	43	25
60	-1	0	0	0	0	0	0	0	-143	17	41	24
65	-1	0	0	0	0	0	0	0	-127	17	48	17
70	0	0	0	0	0	0	0	0	-127	17	64	17
75	-1	0	0	0	0	0	0	0	-188	11	62	12
80	0	0	0	0	0	0	0	0	-130	17	59	6
85	0	0	0	0	0	0	0	0	-254	14	63	7
90	-1	0	0	0	0	0	0	0	-235	17	67	3
95	0	0	0	0	0	0	0	0	-265	17	59	-1
Minimum	0	0	0	0	0	0	0	0	-59	17	34	-4

Table 3.3-27. Alternative 4 Lake Wenatchee outflow-frequency difference (cfs) from historic.

% of Time Flow is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	9	0	0	0	0	0	0	0	0	0	0	50
5	25	0	0	0	0	0	0	0	0	0	-60	36
10	-2	0	0	0	0	0	0	0	0	0	-68	51
15	8	0	0	0	0	0	0	0	0	0	-45	50
20	3	10	0	0	0	0	0	0	0	0	-58	50
25	17	-2	0	0	0	0	0	0	0	0	-14	49
30	1	0	0	0	0	0	0	0	0	5	-22	49
35	20	0	0	0	0	0	0	0	0	-23	-31	49
40	19	3	0	0	0	0	0	0	0	-104	-8	50
45	10	0	0	0	0	0	0	0	0	-147	-15	50
50	13	0	0	0	0	0	0	0	0	-89	-13	50
55	29	-2	0	0	0	0	0	0	0	-98	-8	50
60	28	0	0	0	0	0	0	0	0	-78	-2	50
65	27	0	0	0	0	0	0	0	1	-112	-9	50
70	31	-2	0	0	0	0	0	0	0	-96	-4	50
75	31	0	0	0	0	0	0	0	0	-93	-3	50
80	36	0	0	0	0	0	0	0	7	-67	-5	50
85	34	0	0	0	0	0	0	0	6	-65	2	50
90	35	-1	0	0	0	0	0	0	-19	-38	11	50
95	10	-1	0	0	0	0	0	0	-25	-49	10	50
Minimum	5	0	0	0	0	0	0	0	-73	-27	-9	50

Table 3.3-28. Alternative 5 Lake Wenatchee outflow-frequency difference (cfs) from historic.

% of Time Flow is Equaled of Exceeded	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum	5	0	0	0	0	0	0	0	0	0	0	39
5	-27	0	0	0	0	0	0	0	0	0	-60	60
10	-2	0	0	0	0	0	0	0	0	0	-63	64
15	7	0	0	0	0	0	0	0	0	0	-45	75
20	-11	0	0	0	0	0	0	0	0	0	-55	78
25	2	-3	0	0	0	0	0	0	0	0	-12	74
30	-4	0	0	0	0	0	0	0	0	5	-20	77
35	1	0	0	0	0	0	0	0	0	-23	-10	65
40	-3	0	0	0	0	0	0	0	0	-104	4	68
45	-2	0	0	0	0	0	0	0	0	-147	-7	76
50	2	0	0	0	0	0	0	0	0	-89	-7	75
55	-1	-3	0	0	0	0	0	0	0	-98	0	82
60	4	-1	0	0	0	0	0	0	0	-78	4	75
65	0	0	0	0	0	0	0	0	0	-112	-4	74
70	1	-2	0	0	0	0	0	0	0	-96	7	72
75	1	-1	0	0	0	0	0	0	0	-93	7	74
80	2	0	0	0	0	0	0	0	7	-67	4	64
85	-1	0	0	0	0	0	0	0	6	-65	13	56
90	0	-2	0	0	0	0	0	0	-19	-38	23	32
95	2	-1	0	0	0	0	0	0	-25	-49	21	18
Minimum	2	0	0	0	0	0	0	0	-73	-27	-9	-4

3.3.2.6.3 Results for Flow at the USGS Gage at Plain

The effects on flow of storage and release by the rubber dam will be carried downstream. This section provides graphical indications of flow changes due to the rubber dam as focused on the primary augmentation season between August and October. The augmentation flows are mostly at a constant rate for long periods, which means that they can be assumed to translate directly downstream. There is a substantial intervening drainage area between Lake Wenatchee and Plain that supplies significant local inflow. Note that the figures in this section start at flows greater than zero to highlight differences among the alternatives and historic conditions at a location with substantial base flow. Because there are established instream flow requirements at Plain, these values have also been included on the figures as a reference point.

During 1949, flows at Plain were historically in excess of the instream flow requirement during all of August, with a few days below the requirement in September and October. Figures 3.3-23 and 3.3-24 show the effectiveness of each Alternative at increasing flows and reducing the number of days below the instream flow requirements.

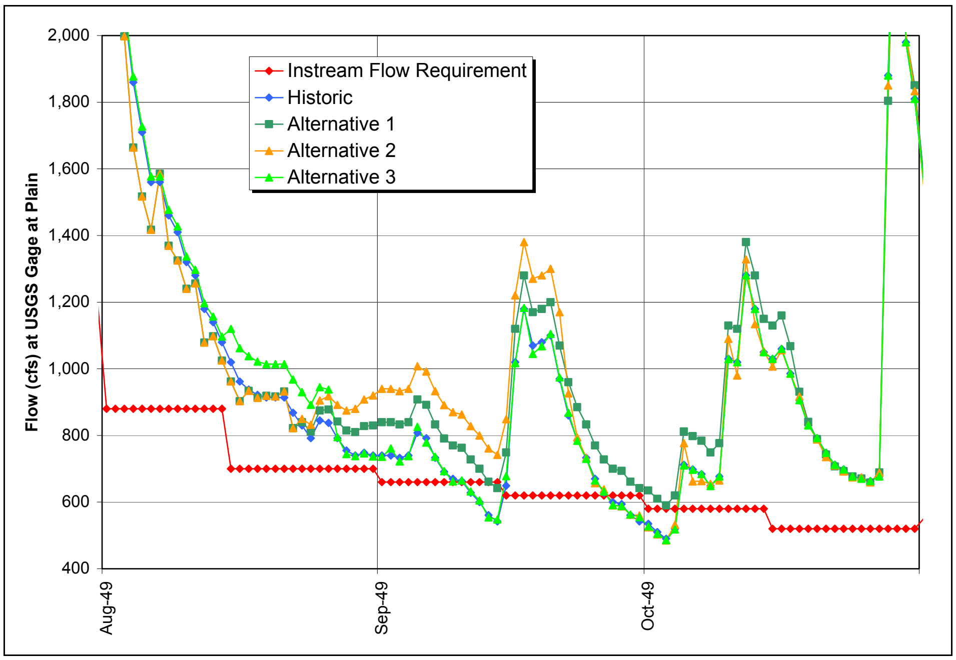


Figure 3.3-23. Alternatives 1, 2, and 3, and historic flows at Plain for the 1949 augmentation season.

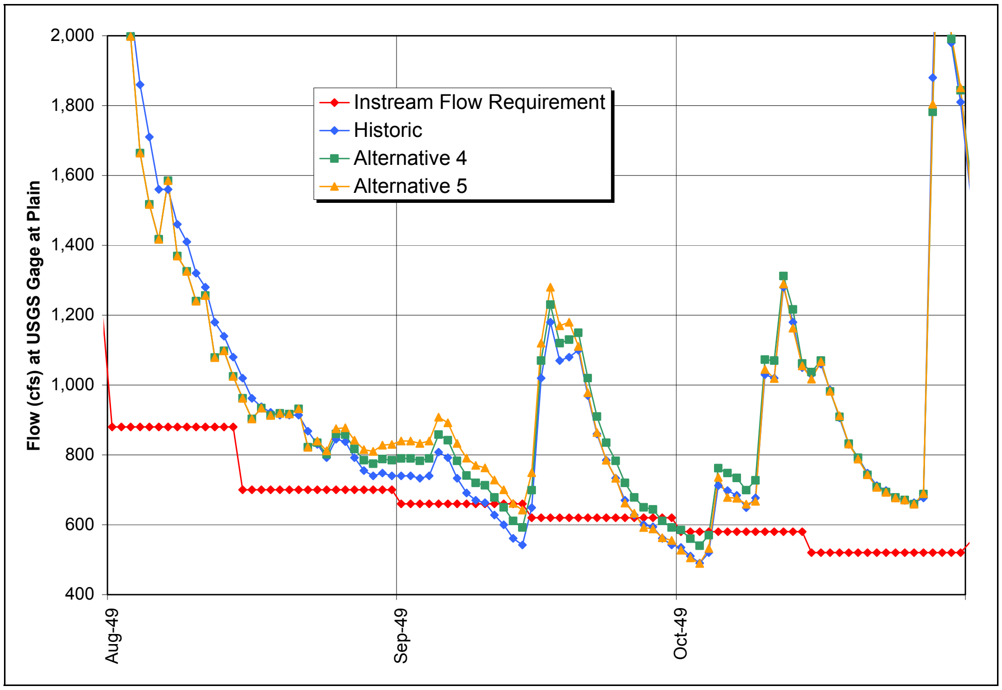


Figure 3.3-24. Alternatives 4 and 5, and historic flows at Plain for the 1949 augmentation season.

Figures 3.3-25 and 3.3-26 highlight the difficulty of a very dry year in which the historic flows were at times several hundred cubic feet per second below the instream flow requirements. Augmentation flows could make up a substantial part of the shortfall if they were properly timed. With regards to instream flow requirements, the greatest need was during August, with reduced needs due to rainfall in September, but this would be impossible to predict several weeks in advance.

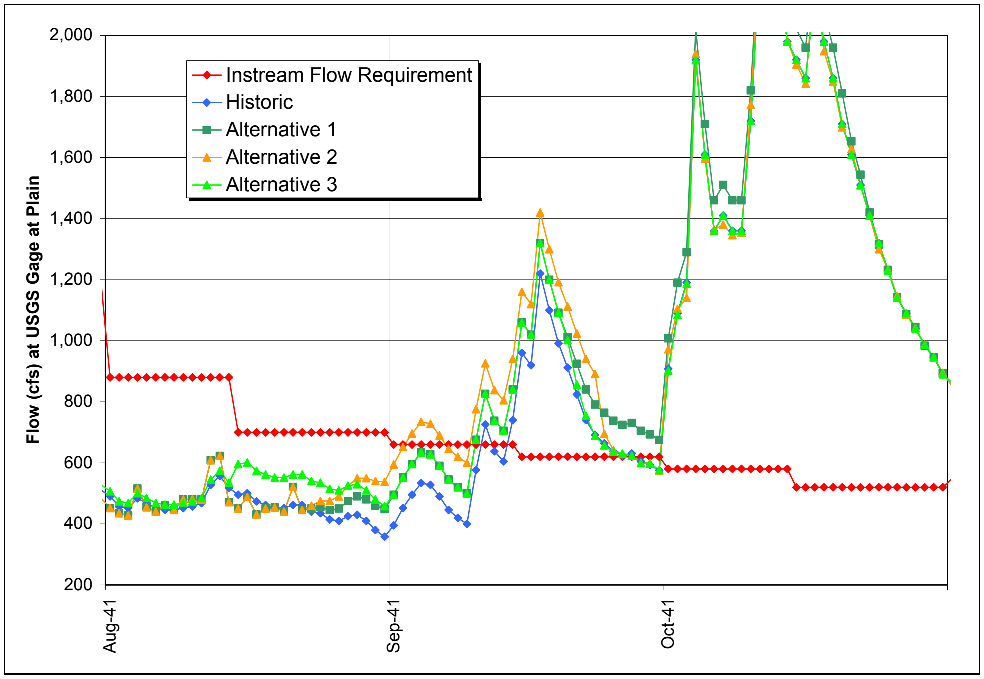


Figure 3.3-25. Alternatives 1, 2, and 3, and historic flows at Plain for the 1941 augmentation season.

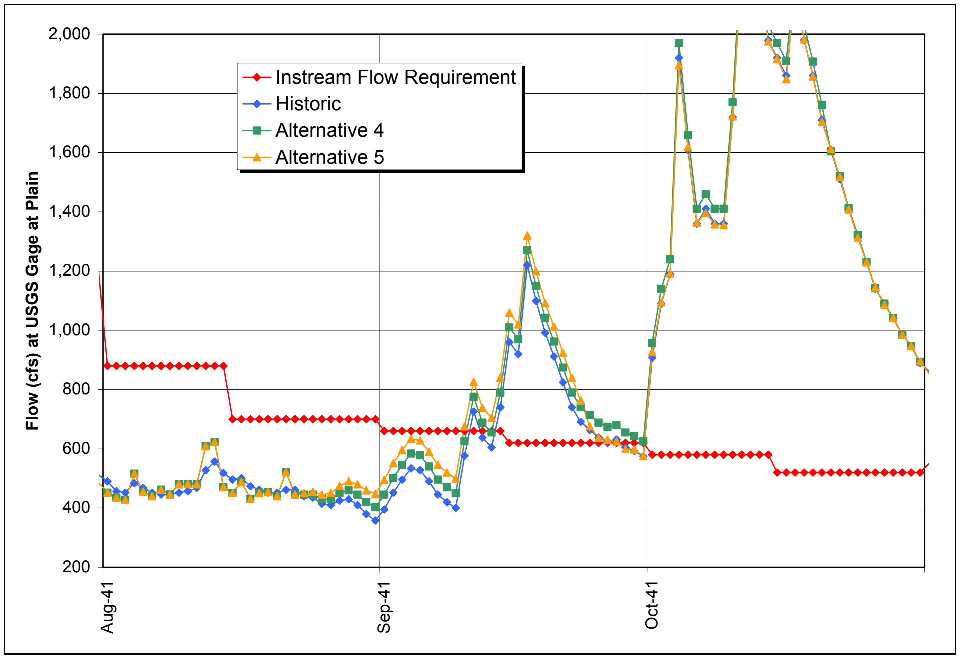


Figure 3.3-26. Alternatives 4 and 5, and historic flows at Plain for the 1941 augmentation season.

A final comparison of historic and alternative operation is provided in Table 3.3-29. For the months when the rubber dam would be storing or releasing flows for the various alternatives, Table 3.3-29 presents the average number of days with flow less than the instream flow requirement at the USGS gage at Plain. In comparison to the historic condition, it can be seen that all alternatives would result in fewer days below minimum requirements, ranging from 1 to 8 fewer deficient days on the average for the June through October season. Alternative 2 would be the most effective, reducing the days below minimum flow requirements by an average of 16% in comparison to the historic condition during the rubber dam operation season.

Table 3.3-29. Average number of days with flow less than instream flow requirement at USGS Gage 12457000, Wenatchee River at Plain – Historic and Alternative Operation.

Case	June	July	August	September	October	Total
Historic	1	4	12	19	14	50
Alternative 1	1	5	12	13	12	43
Alternative 2	1	5	11	11	14	42
Alternative 3	1	4	9	18	14	46
Alternative 4	1	5	12	17	14	49
Alternative 5	1	5	12	15	14	47

3.3.2.7 Future Operation Model Refinements

The operation model results revealed some areas where the operation of the rubber dam impoundment structure could be potentially refined. These refinements could improve the rubber dam operation as the project progresses to more detailed phases. Some areas where the operation model could be improved in future project phases are as follows:

- The rubber dam could be inflated (raised) later in many years and still achieve its maximum storage level. During wet years when all water needs can be met by natural flows, it may be unnecessary to raise the rubber dam at all. Mountain snowpack could be used as a reliable predictor of seasonal flow.
- The rate at which water is collected to storage could be reduced in most years. This would result in less change to downstream flow rates on collection to storage days.
- Releases from storage behind the rubber dam could be focused on lower flow days when the water is most needed, rather than being released at a constant rate.

3.3.4 Flood Operation

This section responds to Task 2.1.C Flood Operation Model of the scope of work. The primary issue is regarding whether the impoundment structure rubber dam bladder can be deflated (lowered) at a rate that would not increase historic maximum lake elevations. Another issue relates to the potential downstream impact of flood operation of the rubber dam. Where uncertainty exists, conservative assumptions were made throughout this analysis.

To provide estimates of the required deflation rate for the rubber dam, several data sources were checked. The rate of increase of Lake Wenatchee water levels during floods that have continuous records was examined. The period of record was also searched for maximum daily increases in water levels regardless of flow rate or time of year. A partial record of lake levels during the November 1990 flood was also examined.

The water level in Lake Wenatchee normally changes slowly, less than one foot in a day. Records indicate that day-to-day average lake level increases of more than one foot occur only about two times per year on the average. For the period of record for which continuous lake level records are available, January 1932 through September 1958, the lake levels during the four largest floods of record are plotted on Figure 3.3-27.

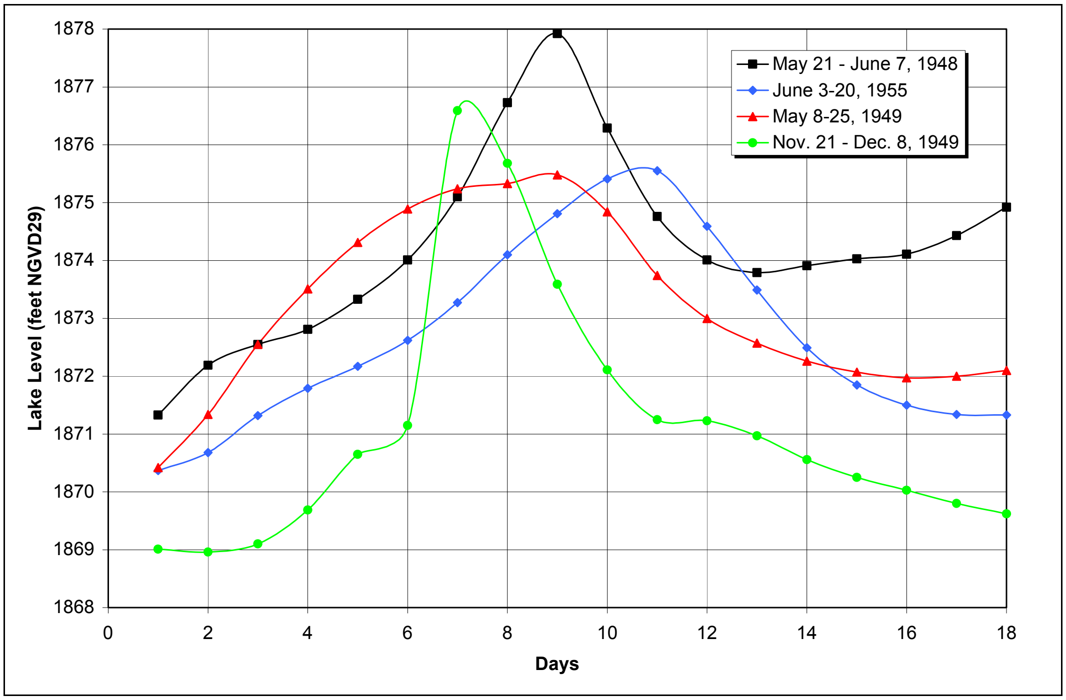


Figure 3.3-27. Lake levels during maximum floods having continuous records.

The values plotted on Figure 3.3-27 represent daily average levels except on the day of the maximum level. The instantaneous maximum level was substituted for the daily average level on the day of maximum water level.

The rubber dam would probably be partially or fully inflated (raised) from June or July through about October. For the purposes of the flood operation analysis, it was assumed that the rubber dam could also be raised during May, at a time when peak flows frequently occur. The maximum daily rate of change for the floods during the time period when the rubber dam could be inflated is 1.63 feet on May 27-28, 1948. This lake level change occurred a day before the peak, so the lake level was probably rising all of the day. A lake level rise of 1.63 feet over 24 hours is an average rise of 0.068 feet per hour. Assuming some variation during the day, the maximum hourly rate of rise is estimated to be 0.1 foot per hour, equivalent to a rate of rise of 2.4 feet per day.

The November-December 1949 flood shows a far more rapid rate of rise than any of the flood occurring in May or June. This would be as expected because the November-December floods probably result primarily from rainfall, while the May-June floods probably result primarily from snowmelt. On November 27, 1949, the average lake level was 3.55 feet above the previous day, and the instantaneous peak lake level was 5.44 feet above the average lake level the day before. Because the lake level on the following day was much higher than on the previous day, the lake level probably peaked late in the day on November 27. The conservative assumption will be made that the 5.44 feet of lake level rise occurred over 12 hours, which equates to 0.45 feet per hour. This maximum rate of rise was rounded off to 0.5 foot per hour to represent the fall-winter flood season when the rubber fabric dam would probably be fully down.

The maximum recorded day to day lake level rise appears to be 4.00 feet, which occurred on February 27-28, 1932. The lake level continued to rise on February 29. A rise of 4.00 feet in 24 hours would equate to an average rate of rise of 0.17 feet per hour.

Three water levels were recorded at the Kane boathouse on Lake Wenatchee during the November 1990 flood. The following data is approximate based on scaling the available diagram. The water level increased by about 3.0 feet from Saturday evening to 5 AM on Sunday. Assuming that Saturday evening would mean 11 PM, the lake level rise would be 3.0 feet in 6 hours, or 0.5 feet per hour.

It is currently estimated that the rubber dam bladder at the Lake Wenatchee outlet would be 10-feet high at most. Bridgestone Industrial Products America, the manufacturer of rubber dams, has indicated that rubber dams are designed for deflation times of 30 minutes or less. A conservative assumption will be made that it would take one hour for the rubber dam to go from fully inflated to fully deflated. The maximum historic rate of lake level rise during the period when the rubber dam is likely to be up was found to be 0.1 foot per hour. This means that the dam can be lowered at least 100 times faster than the lake level rises. Including the entire year, the maximum rate of lake level rise is 0.5 foot per hour. This means that even during periods when the dam would not be raised, it could be moved at least 20 times faster than necessary. With extremely large margins of safety on the rate of deflation, more detailed analysis of historic hourly lake levels is not warranted.

Anticipated rubber dam operating criteria would include a maximum lake level that would be controlled by the rubber dam. The maximum lake level controlled by the rubber dam could be at about El. 1872.4, for example. If natural lake inflows caused the lake level to be higher than El. 1872.4, the rubber dam would be automatically deflated to maintain a lake level of El. 1872.4. Figure 3.3-27 indicates that if the rubber dam had been raised before the occurrence of large floods, it would have been lowered several days before the peak lake levels and peak lake outflows would have occurred. This indicates that operation of the rubber dam would have no affect on peak flood levels at downstream locations.

From the above information it is concluded that the rubber dam could be lowered at a rate fast enough so that it would not increase the historic maximum lake elevations or outflows during periods of high inflow. There is a very substantial margin of safety to the rate at which the rubber dam could be lowered in relation to the rate of rise of the lake level.

For the majority of the year, 8 or 9 months from mid-October to early to mid-summer, the rubber dam bladder would be totally deflated and lie flat on its concrete foundation. The concrete foundation, as described in Section 3.5, would be sized to simulate the Lake Wenatchee outlet channel in shape and flow-carrying capacity. Therefore, neither the rubber dam impoundment structure foundation or the rubber bladder, when deflated, will restrict flows nor raise lake levels above historic levels currently experienced.

3.4 WIND AND WAVE EROSION ASSESSMENT

This section assesses the potential change in shoreline erosion that would likely result from maintaining a higher than typical water level in Lake Wenatchee during summer and fall. The shoreline, docks and bulkheads along Lake Wenatchee are subject to wave erosion because of high winds that occur on the lake. The aspect of the lake lines up well with the direction of wind blowing off of the east slopes of the Cascade Mountains creating conditions conducive to wave generation and erosion.

The assessment methodology is to first characterize the wind regime on Lake Wenatchee throughout the year, estimate the wave heights that occur for different wind speeds, and estimate the potential wave energy that occurs at different lake elevations for existing conditions. The potential wave energy that occurs for the two potential operating scenarios (maintain lake levels at elevations 1870.3 and 1872.4) are calculated and compared to the potential wave energy that occurs for existing conditions. One location, on the south shore of the lake, was selected for the analysis.

This assessment only calculates the potential wave energy and does not correlate that energy to a change in shoreline, dock or bulkhead erosion. Additional information on the erosion resistance for each would be required to make that assessment.

3.4.1 Wind Data

Wind data was collected from two sources: the Remote Automated Weather System (RAWS) and WeatherFlow, Inc. The RAWS network is used by federal agencies to obtain wind and weather data for use in predicting, preventing, and fighting forest fires. The RAWS network has two stations located near Lake Wenatchee. The two stations are Viewpoint and Dry Creek. The Viewpoint station is located approximately seven miles northeast of Lake Wenatchee State Park, on the northeast facing slope of Wenatchee Ridge. The Dry Creek station is approximately 10 miles southwest of Lake Wenatchee State Park, on the southeast facing slope of Miners Ridge. Each station record begins in 1993, with stations collecting average daily data. Beginning in mid-August of 2001, hourly wind records are available. The majority of the data collected was obtained in the spring, summer and fall months.

WeatherFlow, Inc. provides wind data through www.iwindsurf.com for many locations throughout the United States. A wind monitoring station was installed in July of 2002 on the north shore of Lake Wenatchee. The data from the station is posted on the Internet in 15-minute intervals for use by windsurfers to track favorable wind conditions. The wind data from July 2002 to the present was obtained from the WeatherFlow, Inc. web-site in graphical format.

3.4.2 Wind Analysis

The Lake Wenatchee wind data available from the WeatherFlow, Inc. site will be most representative because of its location adjacent to the lake. However the length of the data set available from WeatherFlow, Inc. is very short so that data was only used to compare to the data available from the two RAWS stations.

The wind data from the Dry Creek and Viewpoint sites were obtained and analyzed for wind speed and duration throughout the year. Figure 3.4-1 shows the percent of time wind blows at a given speed and direction. The time period of July through October 2002 was used because it contains hourly data for the months of potential reservoir operation. The average wind speed for the period of record for Dry Creek station is calculated to be 5.1 mph, whereas the Viewpoint station is only 2.6 mph.

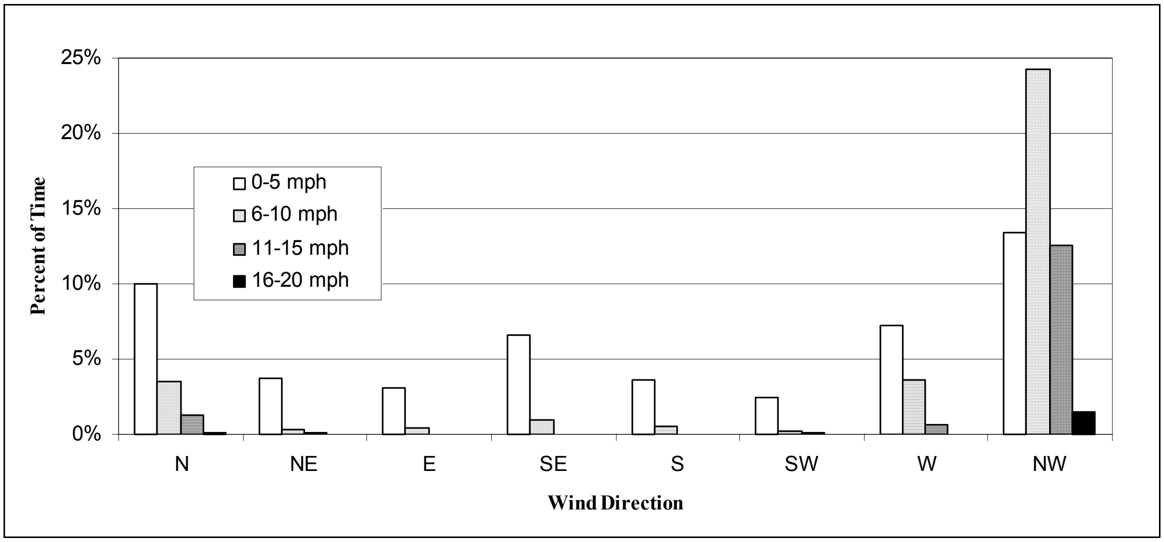


Figure 3.4-1. Prevailing Wind Velocity Occurance, RAWS Dry Creek Station, July-October, 2002.

The wind direction recorded by the Dry Creek station appears to correspond well to that recorded by the WeatherFlow, Inc. station. The wind direction recorded by the Viewpoint station did not correspond to wind direction recorded by the WeatherFlow, Inc. station or the Dry Creek station. The Dry Creek data more closely resembles the wind data from Lake Wenatchee because it is located in a valley that is more aligned to the prevailing winds than the Viewpoint station.

Wind speed data from twenty randomly selected days in the WeatherFlow, Inc. data set were compared to wind speed data from the Dry Creek Station. The WeatherFlow, Inc. station recorded wind speeds on average 1.5 times greater than the wind speeds from the Dry Creek station.

A multiplier factor of 1.5 was applied to the Dry Creek data to use in calculating wave height and wave energy on Lake Wenatchee. Figure 3.4-2 presents the average monthly wind speeds at the Dry Creek Station and the predicted average monthly Lake Wenatchee wind speeds.

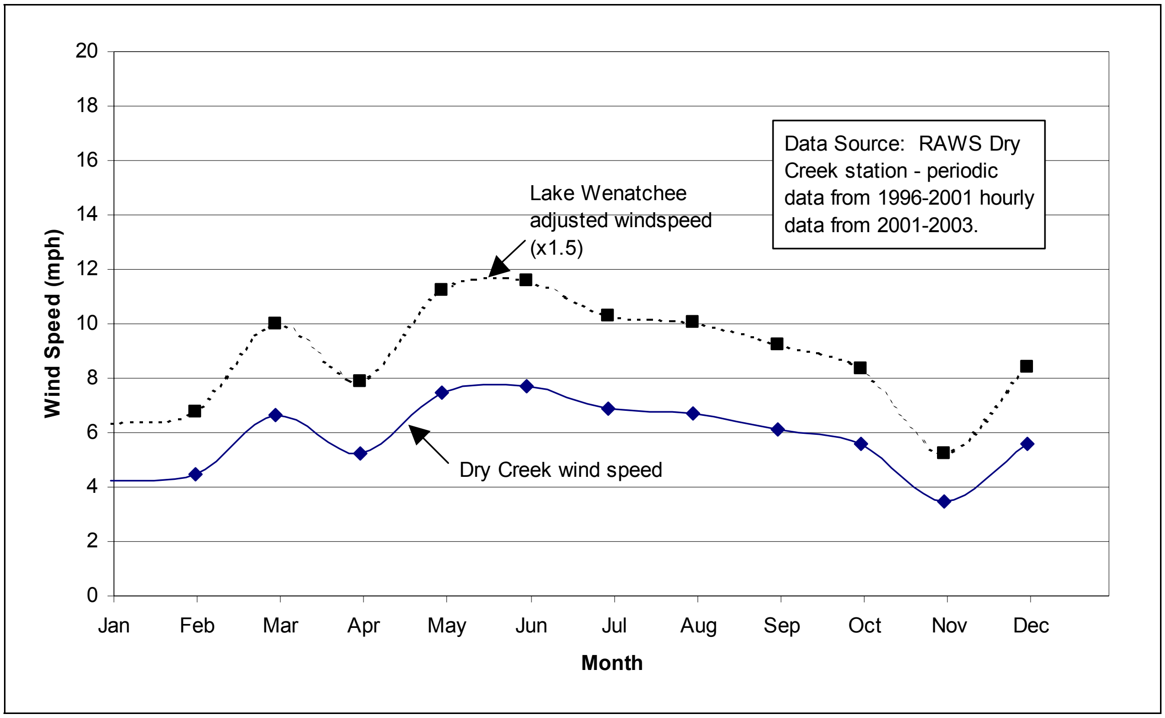


Figure 3.4-2. Monthly Average Wind Speed

3.4.3 Wave-Height Analysis

Wave heights were estimated using hourly and daily Dry Creek wind data adjusted to Lake Wenatchee along with the geometry of Lake Wenatchee. Wave heights were calculated using methods as described in *Wind-Wave Generation on Restricted Fetches* (Smith, J.M. 1991).

The methodology presented in *Effects of Simulated Water Level Management on Shore Erosion Rates* (Saint-Laurent, et al, 2001) was used to determine fetch lengths for wave-height calculations. Fetches were measured by a radial for each set of wind direction. These values are then interpolated, varying one degree at a time, after which a moving average is obtained for 15 consecutive values. For a given wind direction, the fetch retained (F = fetch length) among these values will be the one at an angle φ to the direction of the wind, such that the product

$$F_\varphi^{0.28} (\cos \varphi)^{0.44}$$

has a maximum value where F_φ is the linear fetch measured along the angle φ. The fetch and the angle φ can then be calculated for each wind direction and site being studied. A wind speed U (in m/s) acting along a fetch, defined by a length F (m) and a direction measured in relation to that of the wind generating waves of height H_s (m) and period T (s) from the following equations:

$$H_s = 0.0015\, g^{-0.5}\, F^{0.5}\, (U \cos \varphi)$$

$$T = 0.385\, g^{-0.72}\, F^{0.28}\, (U \cos \varphi)$$

where g is the gravitational acceleration (m/s^2).

Wind data from the WeatherFlow, Inc. station on Lake Wenatchee indicates that the prevailing winds are from the west-northwest (WNW). Twenty-one locations around Lake Wenatchee were mapped and wave heights estimated from the above equations using a WNW wind of 25 mph (represents typical medium-high wind) to illustrate the wave height calculation. Figure 3.4-3 shows the wave height contours approximated for this wind speed and direction. The southeast end of the lake, at Lake Wenatchee State Park, receives the largest waves. The wave height is estimated to be 1.4 feet high for a 25 mph wind from the WNW direction.

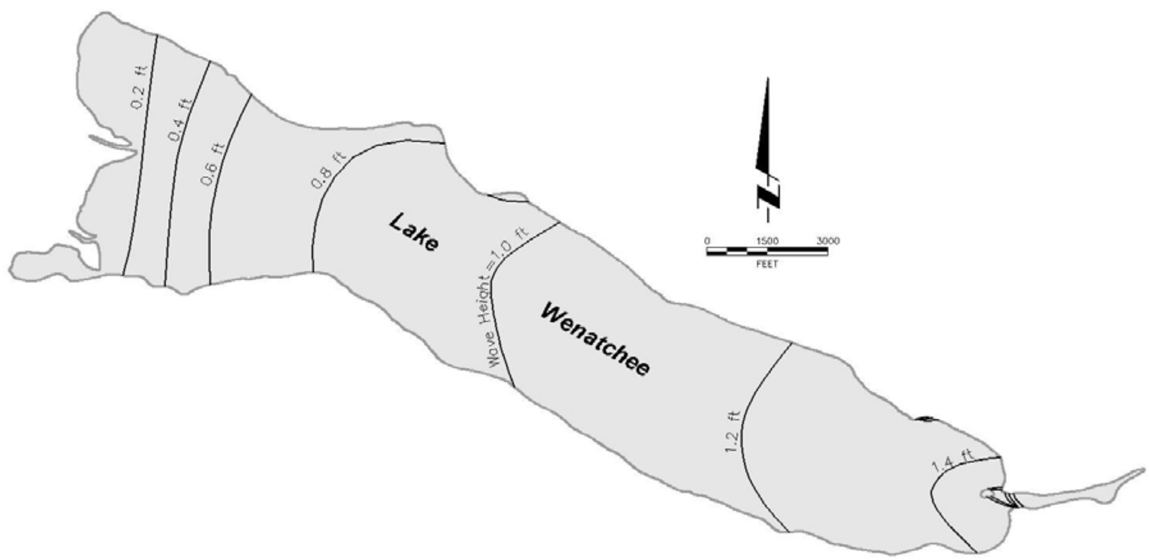


Figure 3.4-3. Wave Height Contours for 25 mph Wind Speed from WNW Direction

3.4.4 Wave-Energy Analysis

The wave heights and periods are such that it can be assumed that they are generated and travel in deep water. When approaching the shore, the waves are bent by refraction and (or) diffraction but the power remains constant provided there is no surf and that the frictional dissipation on the bed is negligible (Saint-Laurent, 2001). Wave power is calculated using the following equation:

$$P = 956\,(H_s)^2\,T$$

The unit of power is watts per meter of wave crest. Wave energy is calculated by multiplying the power by time, and is presented in the unit kilowatt-hours (kWh).

A single point on Lake Wenatchee was selected on the east end of South Shore Drive for calculating the wave energy generated during an average wind year. The wave power was calculated for this distinct location for each wind speed and wind direction value. The Dry Creek wind data adjusted to Lake Wenatchee was used for this analysis. Monthly average wind power and resulting wind energy was calculated for the period of record of wind data. To simplify the calculations, wind directions were grouped into two directions, WNW and ESE, assuming that the winds generally align with the valley of Lake Wenatchee.

The monthly average wind energy values were used in conjunction with the frequency of recurrence of lake levels to estimate total annual wind energy at different lake levels. The frequency of recurrence of lake levels for existing conditions and with the two potential operating scenarios are listed by month in Tables 3.3-19 through 3.3-23 of this report. Monthly average wave energy values were assigned to each lake level exceedence value, according to month. Note that each exceedence value represents an equal amount of time. In this case, the exceedence values are in 5% increments by month, so each value represents 5% of a month, which is approximately 1.5 days. The complete year of exceedence values with the associated wave energy were reordered by lake elevation. Wave energies were summed for every 0.5 feet of lake water level.

A comparison of wave energy between existing conditions and for the operational scenario that would impound water to El. 1872.4 is shown in Figure 3.4-4. This operating scenario would result in approximately 1.9 times more potential wave energy at or above the ordinary high water (OHW) lake level at the site along South Shore Drive. The wave energy above the OHW level was used in the comparison as our site reviews at the OHW showed little potential for wave erosion to occur. The threshold elevation where increased wave energy will cause increased erosion is not known, but is likely higher than the OHW. This analysis presents a conservative (high) estimate of the potential increase in wave energy. The potential increase in other parts of the lake is likely lower because of the lower wave energy at other locations.

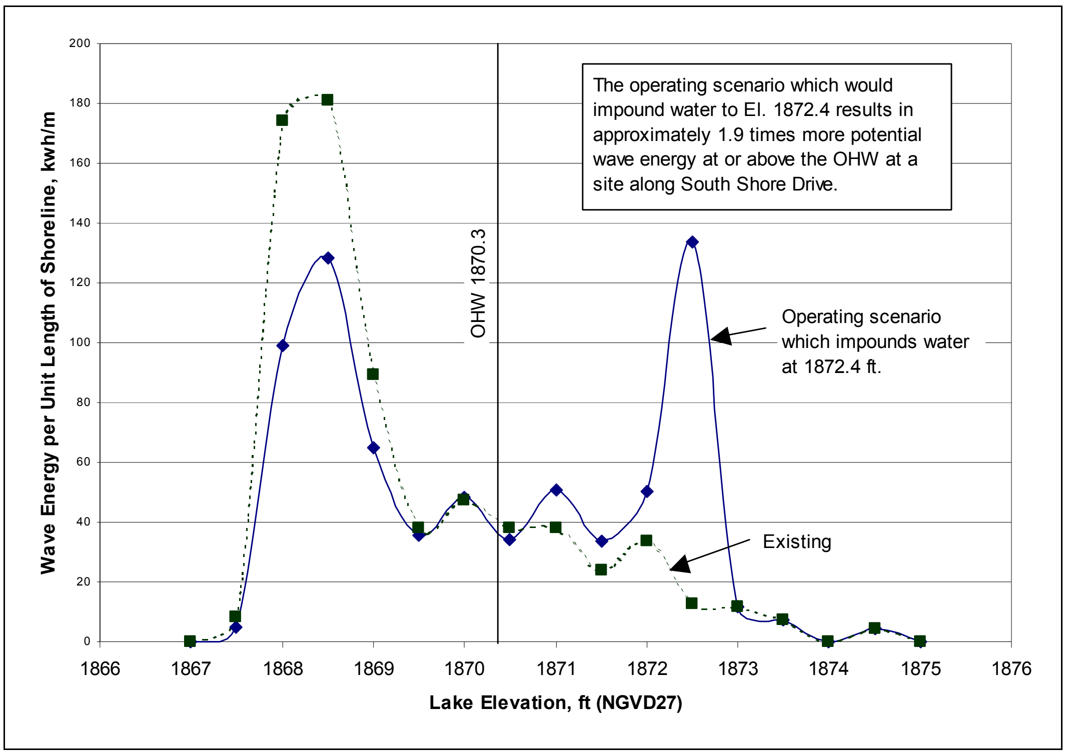


Figure 3.4-4. Comparison of Wave Energy at Site on South Shore Drive between Existing Conditions and the Operational Scenario that Impounds Water at El. 1872.4.

A comparison of wave energy between existing conditions and for the operational scenario that would impound water to El. 1870.3 is shown in Figure 3.4-5. This operating scenario would result in approximately 1.3 times more potential wave energy at or above the ordinary high water (OHW) lake level at the site evaluated on South Shore Drive.

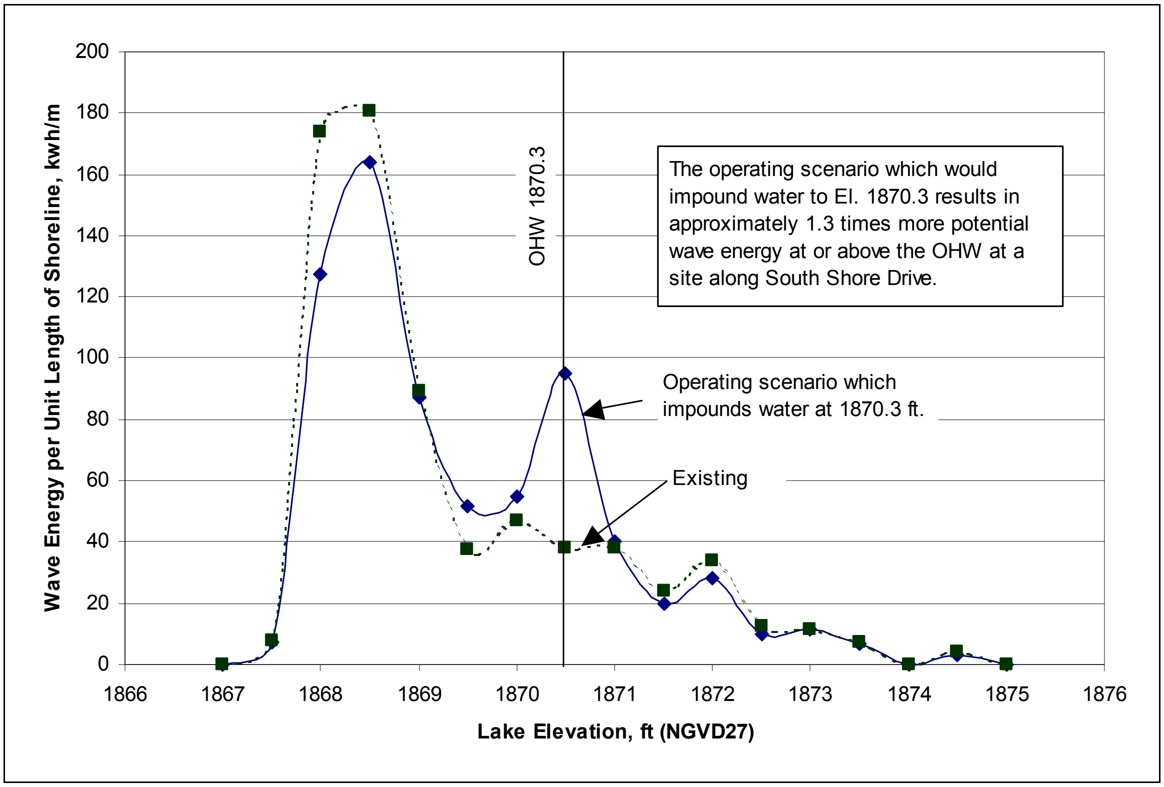


Figure 3.4-5. Comparison of Wave Energy at Site on South Shore Drive between Existing Conditions and the Operational Scenario Which Impounds Water at El. 1870.3.

This analysis provides an indication of the additional wave energy directed at one site evaluated on South Shore Drive where wave heights and energy are the highest for the lake. There is not a direct relationship between wave energy and erosion as there are many factors that affect the potential for shoreline erosion, such as beach slope, beach material and presence of vegetation. For structures on the lake, factors such as deck elevation and structure strength are important. Our review of shoreline conditions at the OHW lead us to the opinion that very little additional erosion would occur if the lake were to be maintained at El. 1870.3 (OHW). There is likely to be more wave erosion occurring if the lake is maintained at El. 1872.4 as the higher lake level would more deeply submerge structures and would submerge portions of shoreline that aren't usually submerged and therefore more likely to be susceptible to erosion.

A more detailed study of shoreline and structure conditions would need to be performed to more definitely address the erosion impacts from the two operating scenarios.

3.5 IMPOUNDMENT STRUCTURE

3.5.1 Background

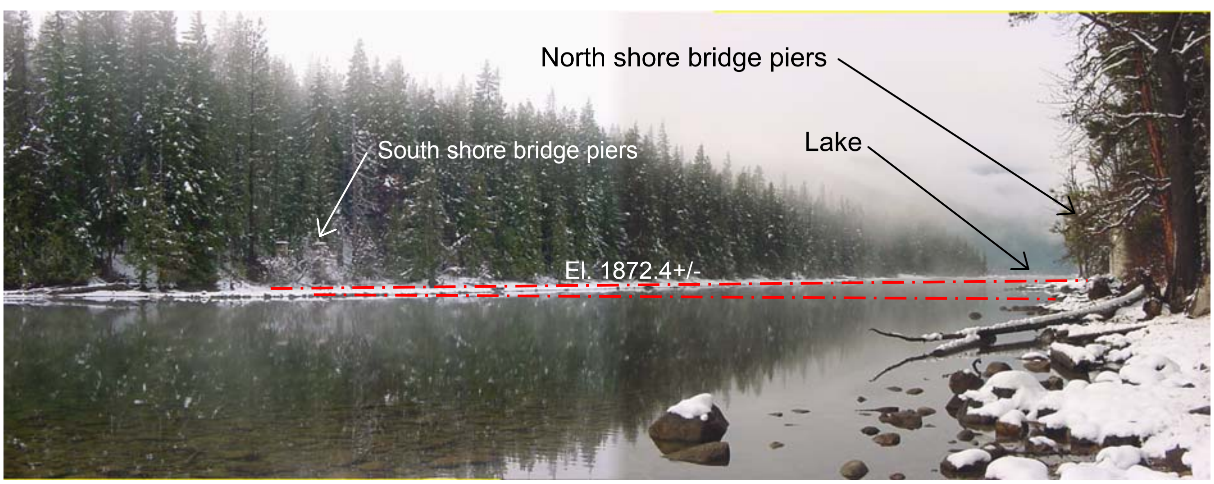
Currently, the Wenatchee River flows in an uncontrolled manner from Lake Wenatchee. As the lake level rises with increased inflow, more flow discharges from the lake into the Wenatchee River. An impoundment structure would be required to allow seasonal storage and release of water from Lake Wenatchee. The structure would span from the north shore to the south shore, across the entire width of the river, and would be raised and lowered on demand to allow storage of water during the late spring and summer and for controlled release of stored water during the late summer and early fall, respectively. During the remainder of the year the structure would be lowered such that lake outflows would pass unimpeded. This subsection addresses the technical features for constructing an impoundment structure downstream of Lake Wenatchee and proposes a potential layout for such a structure.

3.5.2 Field Reconnaissance

On December 13, 2002 MWH visited Lake Wenatchee for the purpose of walking the outlet to select a suitable potential location for a low-level impoundment structure. The structure would have a moveable crest that would allow impoundment of water in Lake Wenatchee during the summer and early fall when the lake level typically falls to its lowest annual levels. Choosing a suitable location for an impoundment structure is one aspect in determining the technical feasibility of seasonally raising the water surface in the lake.

The Wenatchee River (outlet channel) from Lake Wenatchee extends eastward about 3,300 feet from the mouth of the lake to the State Highway 207 Bridge. For the first 1,800 feet of the outlet channel, the river's hydraulic grade line closely matches that of the lake (i.e., the river water level is approximately equal to that of the lake). Downstream of that reach to the bridge, the water surface gradient is steeper with gravel bars and riffles (Photograph 3.5-1). Therefore, to minimize the height of a new impoundment structure, a location within the upstream most 1,800 feet of the outlet channel, at least 1,500 feet upstream of the bridge, was considered. The location selected in the field for the impoundment structure is located approximately 1,600 feet downstream of the mouth of the lake at a point where the river is about 200 feet wide. This is a location where there had previously existed a bridge crossing of the river and where four concrete piers, two on each bank, still exist (Photograph 3.5-2). This is a location where the river is the narrowest and, therefore, the structure length would be minimized. In addition, there are access roads to each bank from the north and the south, which would aid in construction and minimize ground disturbing activities away from the river. For the sake of the site visit, it was assumed that the lake/river level would be raised not more than 5 feet above the lowest recorded lake level. The overbanks adjacent to the preferred structure location slope steeply up and away, approximately at 1.5 or 2 horizontal to 1 vertical on both sides of the river (Photographs 3.5-3 and 3.5-4).

Photograph 3.5-1. Wenatchee River, looking upstream (westward), immediately downstream of Lake Wenatchee and upstream of the State Highway 207 Bridge.



Photograph 3.5-2. Potential location of impoundment structure on Wenatchee River, looking upstream.

Photograph 3.5-3. North shore overbank.

Photograph 3.5-4. South shore overbank.

The river depth was estimated at 4 to 5 feet at the potential location of the impoundment structure. Bedrock was not detected in the area and would not likely to be found during excavations for the structure foundation. The area selected for the impoundment structure is alluvium, which is likely from reworked glacial outwash. This means that the soils underlying the outlet channel are a fairly well graded mixture of silt, sand, gravel, cobbles, and boulders. These soils are strong enough to support a structure of the proportions contemplated. The depth to bedrock is not known. It is suspected that bedrock will be the Chumstick sandstone to be found at a depth of at least 200 feet.

During our trip we also visited with the Wenatchee Reclamation District and obtained copies of historical survey drawings of the Lake Wenatchee outlet channel. The survey information included cross-sectional information in the area where the impoundment structure is being considered to be located. For the sake of this feasibility study, and verified with field observations, we believe that the historical survey data to be accurate enough to allow structure layout and feasibility cost estimating.

3.5.3 Rubber Dam Impoundment Structure

3.5.3.1 General

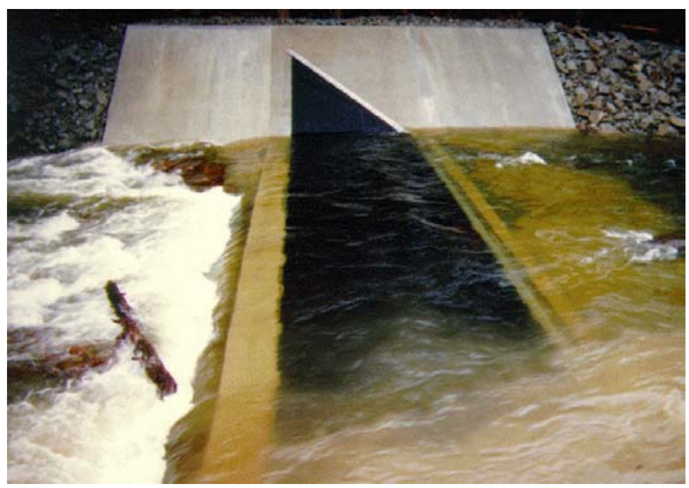
The site selected for the impoundment structure is approximately 1,600 feet downstream of the mouth of the lake as shown on Exhibit 3.5-1. There is a state park on both the north and south banks of the river at the mouth of the lake, which means that the public will have close access and viewing of the structure. The main criteria for choosing an impoundment structure type are as follows:

- Able to impound water to a depth of 4 to 5 feet
- Able to incrementally release water on demand
- Able to be lowered to allow all lake outflows to move unimpeded downstream without raising the water levels in Lake Wenatchee over historic levels
- Have automated controls
- Require minimal on-site operations and maintenance labor
- Be durable under all expected flows and debris loading

- Be vandal resistant
- Not cause any safety concerns to the public
- Be visually unobtrusive
- Allow passage of fish upstream and downstream of the structure
- Can be constructed in a single low flow season

A structure that meets these criteria is a so-called rubber dam structure. Other types of structures, which meet some of these criteria, involve steel gated structures that are extremely expensive to construct and maintain, and require a long instream construction timeframe. A rubber dam is a structure that consists of a concrete foundation, an air or water inflatable rubber bladder, associated equipment and controls, and a small equipment building. This technology has become quite popular in the U.S. in the last 20 years, and has a proven track record for reliability around the world. In 1987, MWH designed a rubber dam structure for the Weeks Falls Hydroelectric Project on the South Fork Snoqualmie River near North Bend, Washington, west of Snoqualmie Pass summit (Photographs 3.5-5 and 3.5-6). The rubber dam has been in operation for over 16 years in an isolated location without major problems or maintenance.

Photograph 3.5-5. Week Falls rubber dam; inflated with water over crest.



Photograph 3.5-6. Weeks Falls rubber dam; deflated.

3.5.3.2 Description of Rubber Dam Structure

Exhibits 3.5-1 and 3.5-2 shows a potential layout of a rubber dam structure on the outlet channel of Lake Wenatchee. The structure would be approximately 200 feet long from shore to shore and installed as a single span. The structure would be oriented at about a 5-degree angle with respect to a perpendicular line drawn from shore to shore to aid in the upstream passage of fish. The foundation of the structure would be of cast-in-place concrete slab with a flat surface at Elevation (El.) 1862.4, as indicated in Exhibit 3.5-3, and would be about 5 feet below the minimum lake level and about 8 feet below the Ordinary High Water line. The foundation would be constructed on structural fill and have a sheet pile cutoff wall. Sheet piling would be installed for three reasons; (1) to prevent scouring and undermining of the upstream side of the rubber dam foundation, (2) to reduce uplift pressures under the dam foundation, and (3) to prevent seepage immediately under the foundation that would cause piping of foundation material and failure of the foundation. It should be noted that the estimated depth of 25 feet is based on experience and not by specific analysis. It should be noted that a cutoff wall would not reduce or stop subsurface flow. A cutoff would lengthen the seepage path to reduce uplift on the structure and on the foundation downstream. If the Wenatchee River is typical of other rivers in the area, a large quantity of flow in the substrate would not be expected because the river bottom tends to seal itself and carry almost all of its flow in the channel. It would not be expected that much change would occur in subsurface flow resulting from the lake raise or the sheet piles. The feasibility of installing a sheet pile cutoff would need to be determined based on further study and explorations.

Heavy stone riprap would be placed upstream and downstream of the concrete foundation to inhibit scouring. The concrete abutments of the rubber dam foundation would be sloped at about 2.5 horizontal to 1 vertical.

The rubber dam bladder would be 10 feet tall when inflated and have a crest elevation of 1,872.4. A different bladder height and crest elevation could be selected based on the finally selected maximum lake level. The rubber bladder would be air-inflated and constructed of multiple layers of vulcanized heavy-duty, nylon-reinforced rubber, similar to an automobile tire, with an EPDM (Ethylene Propylene Diene Monomer) cover to withstand ozone and ultraviolet light. The thickness of the bladder would be in the range of 0.625 to 0.75 inches. The rubber body would be attached to the foundation with two sets of stainless steel anchor bolts and clamping plates.

There are only a few manufacturers of rubber dam products worldwide, with Bridgestone Industrial Products America, Inc. being the major supplier in the U.S. Another company, Obermeyer Hydro, Inc. markets an air-inflated bladder product that raises and lowers upstream steel gates (plates). The steel gates are purported to protect the rubber body against ice and debris. For the purpose of this study we have assumed that a Bridgestone Rubber Dam would be installed in the Lake Wenatchee outlet channel.

It is proposed that a cast-in-place concrete building or vault be located on the right (south) bank of the river adjacent to the right rubber dam abutment. The vault would essentially be constructed below grade so as to be hidden from view and would contain air-inflated rubber bladder blowers, automated air valves, and operational electronic controls. 120/240 volt AC power would be brought into the equipment vault via an underground or overhead distribution line. A fish ladder would be located on the left (north) shore of the river.

3.5.3.3 Operation of Rubber Dam System

Typical operation of the rubber dam would be in a totally deflated mode with the rubber bladder lying flat against its foundation. This mode of operation would occur for 8 to 9 months each year during the historically higher flow season. The foundation would be designed such as to simulate the shape of the river channel and would not impede flows or raise historic water levels in the lake.

Once inflated, the rubber bladder would impound water to a proposed depth of about 10 feet over the foundation or up to about 4 feet above historic lake levels depending on the operational alternative selected (see Section 3.3). Water on the downstream side of the bladder would be on the order of 4.5 feet deep, depending on river flow. When inflation takes place in the late spring or summer, the rubber bladder would be inflated gradually with air based on certain operating criteria (to be determined). Once the desired inflation is reached (about 2 pounds per square inch) and the proper lake level is obtained, the bladder would be switched to automatic mode, which monitors and maintains the upstream water level.

Storage and release algorithms would be part of a computer-based control system that would regulate the internal pressure of the bladder and inflation and deflation. A computer monitor, through various screens, would allow the operator to control set points, operate individual devices (blowers, discharge and crossover valves), monitor alarms and evaluate historical data.

The rubber bladder would be inflated with an air compressor to impound water. The internal air pressure would be adjusted automatically to maintain a constant upstream water level during storage and amount of deflation during periods of water release. The rubber dam would be operated in partially-deflated state during periods of release. The ability to control the rate of outflow, if required to be more precise, may require that a gage be installed downstream and tied to the rubber dam control system. Alternately, a separate slide gate or short-span Obermeyer gate may be required and installed adjacent to the fish ladder (not shown on Exhibit 3.5-2), and a rating curve developed to release a controlled amount of water. The rubber bladder would be automatically deflated to pass high flows. When fully deflated the rubber bladder would lay flat on its concrete foundation.

3.5.3.4 Performance and Maintenance of Rubber Dam Structure

Typically large woody debris, such as root balls, large trees and snags pass down the river during large storm events. At Lake Wenatchee such storms typically occur from about November through February. During those months the rubber bladder would be deflated and lying flat on its concrete foundation. The stage of the river at such events would be at least over 10 feet over the deflated bladder when such debris passes the dam and there would only be a limited possibility of puncturing the rubber bladder. In addition, Lake Wenatchee acts to attenuate the possibility of neutrally buoyant and sinking debris from passing downstream.

Rubber dam structures have been in operation in severe locations for many years. As previously mentioned, MWH designed a rubber dam structure on the South Fork Snoqualmie River, about 60 miles from Lake Wenatchee. It is 8 feet high by 75 feet wide, in a narrow river channel, and has been in service for over 16 years. Over the years it has passed a large quantity of gravel and woody debris. Though there have been major events (November 1995 and February 1996) at Weeks Falls, there has not been any damage to the bladder caused by woody debris. Over the years there has been the need to do some minor plugging and patching, but nothing that can be classified as serious. Damage to date has involved minor holes caused by rifle fire. Such holes are of minor concern to a rubber dam because the rubber bladder is maintained at such a low pressure (2 psi). These type of punctures cause slow leaks from the bladder that are compensated by occasional air being added automatically by the air compressor system. Holes can be repaired with plugs similar to those used on automobile tires while the bladder is still inflated. The operator of the Weeks Falls rubber dam, CHI Energy, Inc., is very supportive of the technology and vouches for the durability of rubber dams in northwestern riverine environments.

Also within the last 12 years, Dryden Dam on the Wenatchee River has been retrofitted with an inflatable rubber bladder to aid in diverting water into Wenatchee Reclamation District's Dryden Canal. The Dryden rubber dam is 3 feet high and inflated with water and has performed without major problems.

Rubber dams have been installed in steep gradient streams around the world that move massive amount of gravel and sharp rocks. Testing and in-service operation has found that the rubber bladders to have a life of 30 years or longer. In addition, testing for damage caused by ozone and ultra-violet (UV) light has found an insignificant amount of deterioration.

At the project site vandalism may be of concern. Vandalism may be in the form of knife slashes to the rubber bladder or breaking into the air handling/equipment vault. Since the project is in the vicinity of Lake Wenatchee State Park on both the north and south shores of the river, the public would have convenient access. It would be important to consider public access and safety in the design of the impoundment structure. The rubber bladder can be manufactured with ceramic chips embedded in the rubber layers to make slashing difficult. At some rubber dam installations, beavers gnawing on the rubber bladders have caused severe damage. Ceramic chips have also been used as a deterrent against beavers. The equipment vault would be constructed of reinforced concrete with heavy steel hatches and intruder alarms. Chain link fencing would be provided adjacent to the fish ladder and areas where the public would be protected against fall hazards and to limit access.

Access to the rubber dam via boat or by swimming would be possible from either the upstream or downstream side. Floating protective barriers would be installed approximately 100 feet upstream and downstream of the rubber dam to prevent boaters from falling over the rubber bladder or having access for purpose of vandalism. The rubber bladder may be considered an attractive nuisance and could attract people walking on or diving from the bladders. Since there will always be water on both sides of the rubber dam, fall danger will not be severe. Such activities are difficult to prevent but the aforementioned chain link fencing and warning signs would be provided to warn and restrict access. Regular patrol of the rubber dam installation by project operators or law enforcement personnel would be encouraged.

Road access would be provided to both the north and south end of the rubber dam structure. Primary access would be to the south end where the equipment vault is located. Daily visits by operations personnel may be necessary if vandalism is a problem. Otherwise, semi-weekly or bi-daily visits may appropriate to monitor and perform regular maintenance. Since the operation and control functions can be transmitted to a remote location for monitoring and manual control of the rubber dam, the facility would be unmanned. An abandoned access road exists from the south bank access road to the south shore of the proposed impoundment structure. This road would be upgraded, gated and used for access to the rubber dam and equipment vault. Access to the north end of the rubber dam and fish ladder would be through the state park on the north side of the river and may require access on a weekly basis. Since access to the facility would be infrequent, there would only be a minor impact to local traffic and recreational activities.

The rubber bladder requires no long-term maintenance except for patching and plugging of minor holes as may be required. The other features of the rubber dam system should require only nominal maintenance except for the electronic and electrical systems which would require periodic maintenance, replacement and upgrading of parts.

3.5.3.5 Rubber Dam Structure Aesthetics

The rubber dam impoundment structure requires construction of concrete, steel fencing and installation of a 10-foot tall by 200-foot long black rubber bladder. The majority of the concrete would be constructed in the river and be continually inundated and hidden from view. Only the upper portions of the sloping concrete foundations at each side of the river and the fish ladder would be visible. From the upstream side, the viewing corridors from the state parks would not see the bladder when inflated. From the downstream side the rubber dam would be visible when inflated. However when deflated the bladder would not be visible from the upstream or downstream sides. For fish passage reasons it is recommended that released flow pass over a partially-deflated rubber dam and adjacent to the fish ladder on the north bank. Alternately, and without regard to fisheries concerns, released water can be released over the entire length of the rubber dam (Photograph 3.5-5), which is more aesthetically pleasing, but creates a false attraction to upstream migrating fish.

3.5.3.6 Fish Ladder

A primary species of concern for adult upstream passage is Spring Chinook, which is an Endangered Species Act (ESA) listed fish that is present in the Wenatchee River during the period when the dam would be operated. Bull Trout and Westslope Cutthroat trout are resident species that also exist in the Wenatchee River. The resident trout are less capable swimmers than adult Spring Chinook and require lower steps for passing over ladders. Therefore, the conceptual design ladder proposed would step up in 6-inch vertical steps, which would enable passage of all the fish species present in the Wenatchee River.

The conceptual design of the fish ladder is called a pool and chute ladder, which is shown on Exhibit 3.5-2, and is considered to be more like a roughened channel fishway than a traditional stepped fish ladder such as a pool and weir or vertical slot ladder. The pool and chute ladder would consist of 15-foot wide V-shaped weirs with a 3-foot rectangular notch positioned in the base of the weir for each step. It would be located on the north side of the river adjacent to the state park. The orientation of the rubber dam would be angled upstream from the south to the north sides of the river, positioning the ladder entrance at the furthest point upstream. There would be 9 to 10 steps in the ladder, for a total rise of approximately 4.5 to 5 feet. This layout is based on the preliminary hydraulic design and operation of the rubber dam, in which the water surface upstream will be maintained at a high water surface elevation of 1872.4, and minimum tailwater surface at El. 1867.7 during the period of regulation. Flows in the pool and chute ladder would depend on the elevation setting of the base of the weir notch relative to the water surface upstream. Flows of 30 cfs to 40 cfs could be expected through the ladder under normal conditions for the configuration shown. Instream organic (rock and wood) structures may be required to maintain a channel to the ladder. Examples of these structures would be an excavated pool below the ladder entrance, and rock weirs positioned in the river upstream and downstream. Such structures would be designed and installed if they would not impede or raise the historical water surface in the lake under all flow conditions.

Advantages of the pool and chute ladder are an ability to easily pass debris and that it is hydraulically self-regulating. The pool and chute design would require less maintenance and operation for cleaning debris and regulating flow. The major disadvantage of the pool and chute ladder is that it is normally recommended for use in passing heights of 6 feet or lower due to the minimal energy dissipation in the small pools during high flows. The pool and chute design is appropriate for this design considering that it will be in operation only during the water storage months and its operating height will be less than 5 feet under all conditions. During other times of the year the rubber dam will be partially or fully deflated and a fish ladder will not be required. The timing of actual ladder use would become more refined as the operational hydraulics of the rubber dam is further developed during final design.

It is possible that a more traditional type of fish ladder such as a pool and weir or a vertical slot may be required if the design process proceeds. This may occur after the hydraulic details are more refined, and the resource agencies have reviewed the design. Agency input would be expected from NOAA Fisheries (formerly known as National Marine Fisheries Service or NMFS), the Washington Department of Fish and Wildlife (WDFW), and the U.S. Fish and Wildlife Service (USFWS). A higher capacity ladder may be necessary due to the numbers of fish in the river at the time of impoundment. Also, the hydraulic operation of the dam may require a fishway with higher capacity and additional attraction flow at the entrance depending on the flow in the river at the time of migration. The concrete foundation slab of the rubber dam would be recessed at its left end to allow the first point of deflation of the bladder to be adjacent to the fish ladder to provide attraction flow. It is not anticipated that a second fish ladder to be required on the right bank if water releases from the rubber dam are made adjacent to the left bank fish ladder.

3.5.3.7 Rubber Dam and Fish Ladder Construction Permitting Considerations

In order to construct the impoundment structure, or any structure within navigable waterways, certain permits and consultations would be required. Such permits may include U.S. Army Corps of Engineers Section 404 (Clean Water Act) permit, U.S. Fish and Wildlife Service/ NOAA Fisheries Section 7 or Section 10 ESA compliance, Washington Department of Fish and Wildlife Hydraulic Project Approval, and Washington Department of Ecology Short-term Water Quality Waiver, etc. The more pertinent of these permits and associated requirements are described in Section 4.0.

3.5.3.8 Rubber Dam and Fish Ladder Construction Considerations

The rubber dam impoundment structure would require excavation, installation of sheet piles, and construction of a concrete foundation in the river. All this construction must be performed while the outlet channel is continually flowing, therefore it would be desirable to perform instream work during a period of lower flow (summer and early fall). Installation of a cofferdam would be required to construct these features in the dry and to maintain water quality standards downstream of the project. An estimated construction schedule is shown in Figure 3.5-1. Times to design the project, obtain permits, purchase land, perform legal activities, etc. are not included in the schedule.

It is estimated that the project can be constructed on site in about 6 months with instream construction taking just over 4 ½ months with the use of a Portadam® cofferdam. Portadams consist of steel A-frames set in the river side-by-side and covered with an impermeable membrane to form a cofferdam around the required work area as shown in Photographs 3.5-7 and 3.5-8. Resource agencies have accepted this type of cofferdam in the past because it does not require water-polluting activities as occurs when installing an earthen cofferdam. In addition, Portadam cofferdams are much less expensive and quicker to install than cellular type cofferdams.

Photograph 3.5-7 Typical Portadam river crossing. (Photo courtesy Portadam, Inc.)

Photograph 3.5-8. Portadam at MWH Wynoochee Hydro Project on the Wynoochee River near Montesano, WA

ID	Task Name	Duration
1	**Bidding**	**10 wks**
2	Plans and specs complete	0 days
3	Advertise for bids	0 days
4	Bidding period	6 wks
5	Bid opening	0 days
6	Award construction contract	2 wks
7		
8	**Construction**	**44 wks**
9	Notice to proceed with construction	0 days
10	Procure rubber dam equipment	32 wks
11	Deliver rubber dam embedded parts	0 days
12	Deliver rubber dam body	0 days
13	Order cofferdam material	6 wks
14	Mobilize to project	3 wks
15	Improve access roads	1 wk
16	**In-River Work**	**18.8 wks**
17	Install Stage 1 (North) cofferdam and dewatering system	1 wk
18	Excavate fish ladder and left rubber dam foundation	1 wk
19	Install left side sheet piles	9 days
20	Form and place fish ladder slab	1 wk
21	Form and place fish ladder walls/weirs	4 wks
22	Complete excavation and install structural fill	1 wk
23	Form and place left side rubber dam foundation	4 wks
24	Install rubber dam body on left side	1 wk
25	Remove Stage 1 cofferdam and install Stage 2 (South)	1 wk
26	Excavate equipment building right rubber dam foundation	1 wk
27	Install right side sheet piles	9 days
28	Form and place equipment building slab	1 wk
29	Form and place equipment building walls/roof	3 wks
30	Complete excavation and install structural fill	3 days

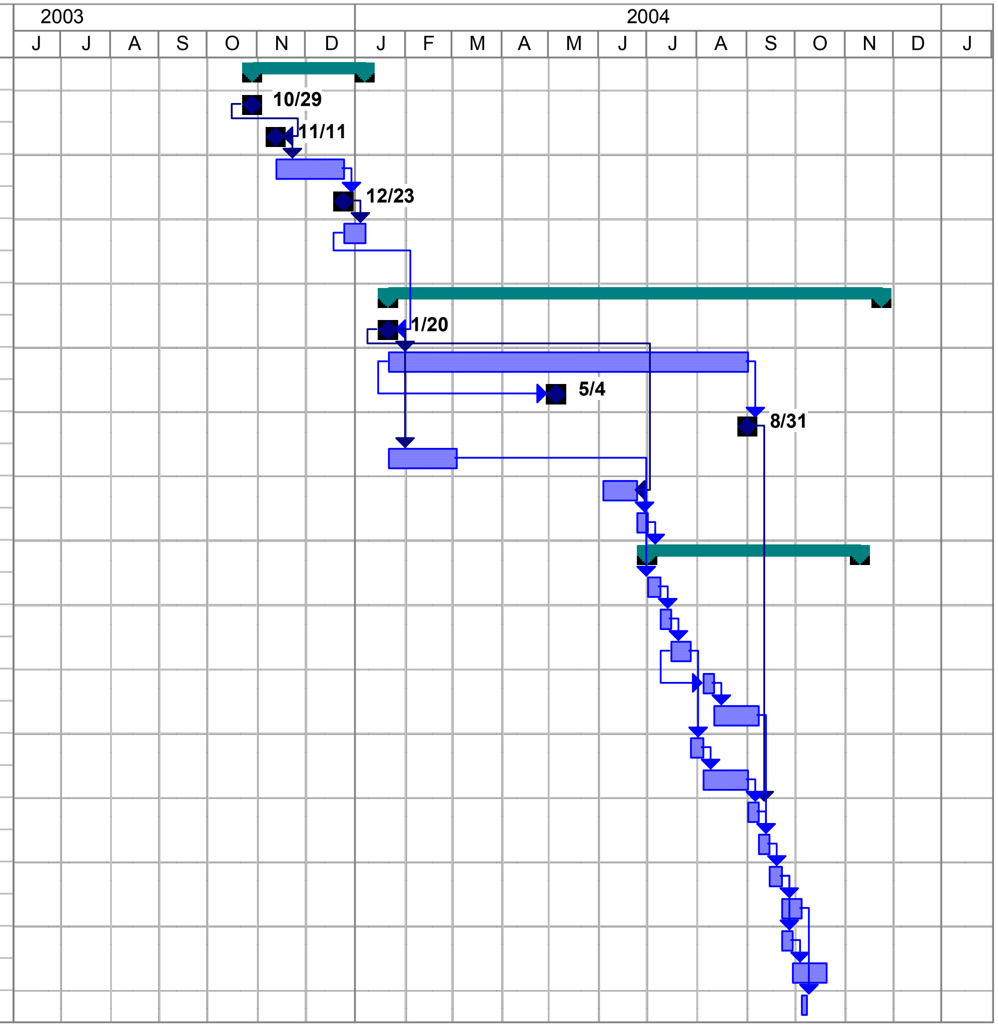


Figure 3.5-1. Lake Wenatchee Impoundment Structure – Construction Schedule.

It is proposed that the cofferdam be constructed in two halves or stages. The first stage would include installing the cofferdam around the north half of the structure (similar to Photograph 3.5-7), constructing the north half of the rubber dam foundation, attaching half of the rubber bladder, and constructing the fish ladder. Construction of the second half of the structure would require removing the first stage Portadam and reinstalling it around the south half of the construction area for construction of the remainder of the rubber dam structure and the equipment vault. Upon completion of the second half of the structure, the Portadam would be removed from the river. Instream construction would commence about July 1 and be completed by about the first of November. This time of year has generally been acceptable to the agencies, but is dependent on specific fish species present in the river downstream and their life stage.

Prior to mobilization to the site and construction of the impoundment structure, materials and equipment would need to be ordered. It is estimated that the rubber dam equipment would require a lead-time of 6 months from approval of shop drawings to delivery of the equipment. Therefore, award of a contract and notice to proceed would be given in early January with bidding 2 or 3 months prior to that.

3.5.3.9 Rubber Dam and Fish Ladder Cost Estimate

The anticipated total cost of the impoundment structure that would impound water to El. 1872.4, as shown in Table 3.5-1 is $5,777,000. The estimated construction costs include the major anticipated cost items only and are based on the construction schedule described in paragraph 3.5.3.8. Other minor items required to complete construction of a similar project are included as a line item called “Unlisted Items”. Unlisted items may include erosion control, dust control, construction permits, floating safety booms, etc. We have assumed that “Unlisted Items” to be 5 percent of the total construction cost. All construction costs are assumed to include contractor overhead, profit, insurance, and bonds.

Other development costs for geotechnical explorations, environmental studies and permitting, preliminary and final design engineering, and construction management have been estimated based on experience. These costs are based either on typical percentages of construction costs or past projects similar in nature and are not quotations to perform the work. Financing, legal, owner administration, land purchase, easements, mitigation, socioeconomic, and interest during construction costs are not included in the estimate.

In addition a construction contingency of 20 percent has been included and reflects the preliminary nature of engineering and the accuracy of estimating at this stage of study. The contingency is a percentage of both construction and development costs and attempts to cover the costs of the many unknowns at this stage of development. For example, if foundation conditions are substantially different than anticipated, then the contingency is a lump sum amount that can contribute to covering unanticipated costs and overruns. If the project is pursued and further engineering studies are undertaken, then the number of unknowns and contingency would be reduced.

It is estimated that the total cost of a structure to impound water to the Ordinary High Water level of El. 1870.3 would be approximately $5,400,000, or only about 6.5 percent less than the taller (El. 1872.4) structure.

The enclosed feasibility level cost estimate is our opinion of the cost of construction based on the limited information provided and gathered within our scope of work. Costs are for construction in 2003 and may vary based on future increased costs of labor and materials (inflation), competitive bidding environments and procedures, unknown field conditions, financial and/or market conditions, or other factors affecting the cost of the construction and the operation of the facilities, the design of which is not totally defined at this time, all of which are and will unavoidably remain in a state of change.

Table 3.5-1. Lake Wenatchee Impoundment Structure - Feasibility Cost Estimate*.

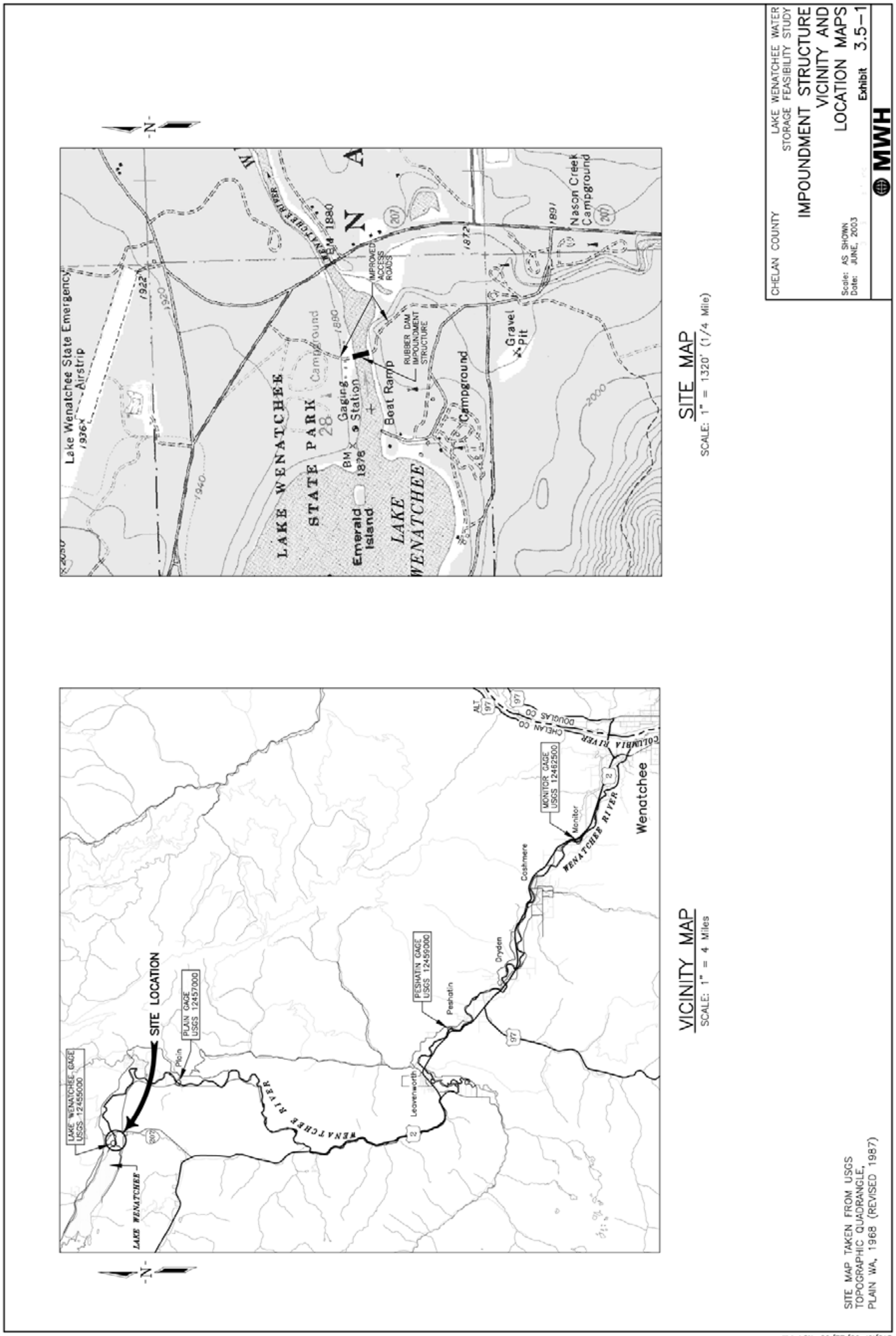
ITEM	UNIT	QUANTITY	UNIT PRICE	COST	SUBTOTALS
Mobilization	LS	1	$ 150,000.00	$ 150,000	
Clearing and Grubbing	AC	2	$ 5,000.00	$ 10,000	
Improve Access Roads	MI	0.6	$ 50,000.00	$ 30,000	
Access Gates	EA	2	$ 1,000.00	$ 2,000	
Cofferdams, install in halves	LF	600	$ 255.00	$ 153,000	
Dewatering	LS	1	$ 100,000.00	$ 100,000	
Underground Electrical Feed	LF	2,200	$ 25.00	$ 55,000	
Boat Ramp Access to River	LS	1	$ 165,000.00	$ 165,000	
					$ 665,000
Rubber Dam Structure					
Excavation	CY	2,000	$ 8.00	$ 16,000	
Structural Fill	CY	250	$ 56.00	$ 14,000	
Sheet Piles	SF	8,100	$ 30.00	$ 243,000	
Riprap	CY	1,200	$ 47.00	$ 56,400	
Concrete Foundation	CY	725	$ 310.00	$ 224,750	
Bladder/Associated Equipment	LS	1	$ 1,300,000.00	$ 1,300,000	
Piping, 4-inch black	LF	300	$ 6.00	$ 1,800	
					$ 1,855,950
Control Building					
Excavation	CY	1,000	$ 8.00	$ 8,000	
Structural Fill	CY	20	$ 55.00	$ 1,100	
Backfill	CY	700	$ 6.00	$ 4,200	
Concrete Foundation	CY	15	$ 300.00	$ 4,500	
Concrete Walls	CY	70	$ 350.00	$ 24,500	
Concrete Roof	CY	15	$ 450.00	$ 6,750	
Miscellaneous Metal	LBS	2,500	$ 3.00	$ 7,500	
HVAC	LS	1	$ 10,000.00	$ 10,000	
Electrical	LS	1	$ 15,000.00	$ 15,000	
					$ 81,550
Fish Ladder					
Excavation	CY	900	$ 8.00	$ 7,200	
Structural Fill	CY	60	$ 55.00	$ 3,300	
Sheet Piles	SF	1,300	$ 30.00	$ 39,000	
Concrete Foundation	CY	40	$ 300.00	$ 12,000	
Concrete Walls and Weirs	CY	100	$ 350.00	$ 35,000	
Miscellaneous Metal	LBS	9,600	$ 3.00	$ 28,800	
					$ 125,300
Subtotal				$ 2,727,800	
Unlisted Items	%	5	$ 136,400	$ 136,400	
Contstruction Cost	**LS**	**1**		**$ 2,864,200**	
Geotechnical Explorations	LS	1	$ 300,000	$ 300,000	
Environmental Studies/Permits	LS	1	$ 700,000	$ 700,000	
Engineering	LS	1	$ 500,000	$ 500,000	
Construction Management	MO	8	$ 56,250	$ 450,000	
Development Cost	LS	1		**$ 1,950,000**	
Contingency	%	20		**$ 962,800**	
TOTAL COST	**LS**	**1**		**$ 5,777,000**	

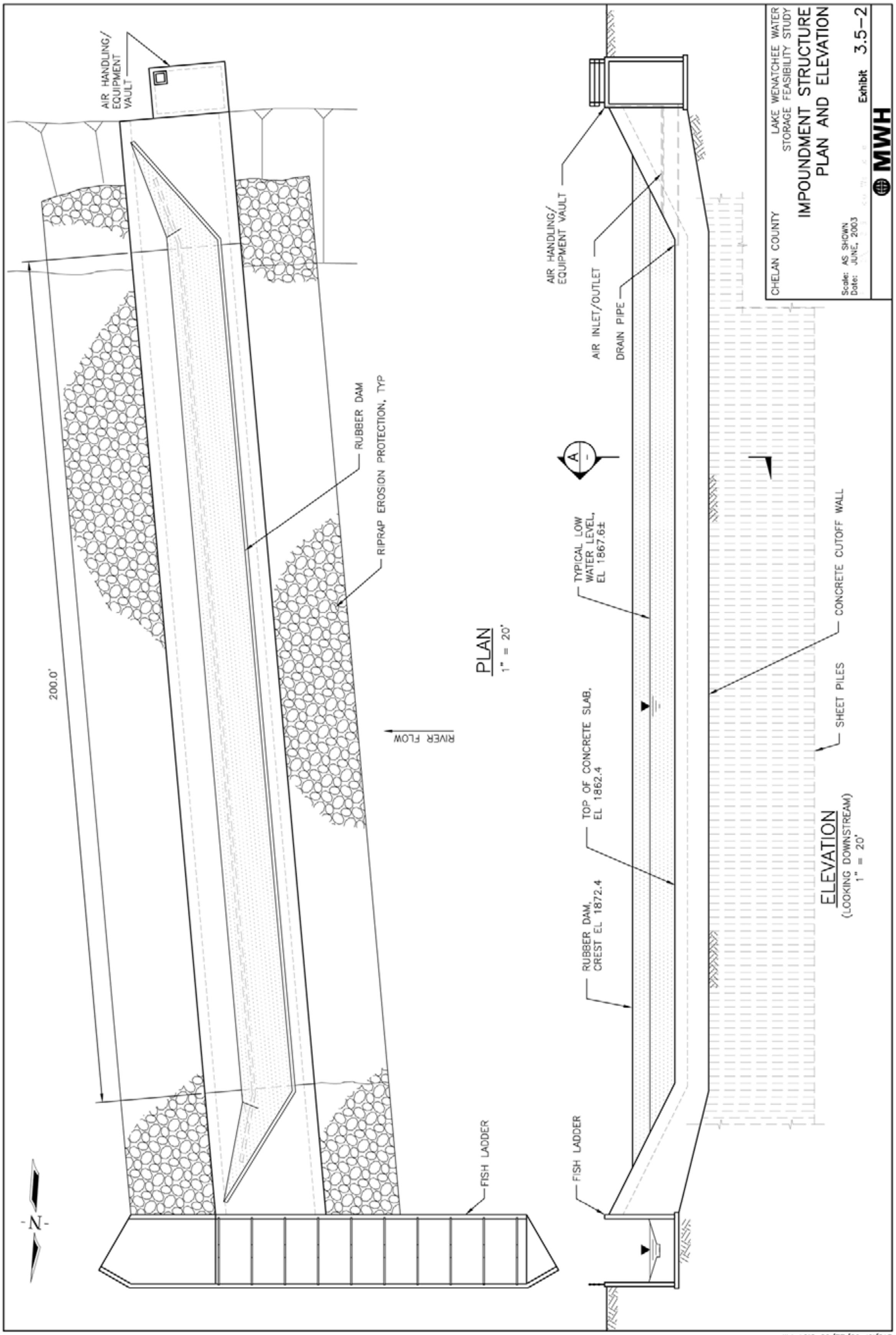
* For structure with a 10 foot high rubber dam (crest at El 1872.4).

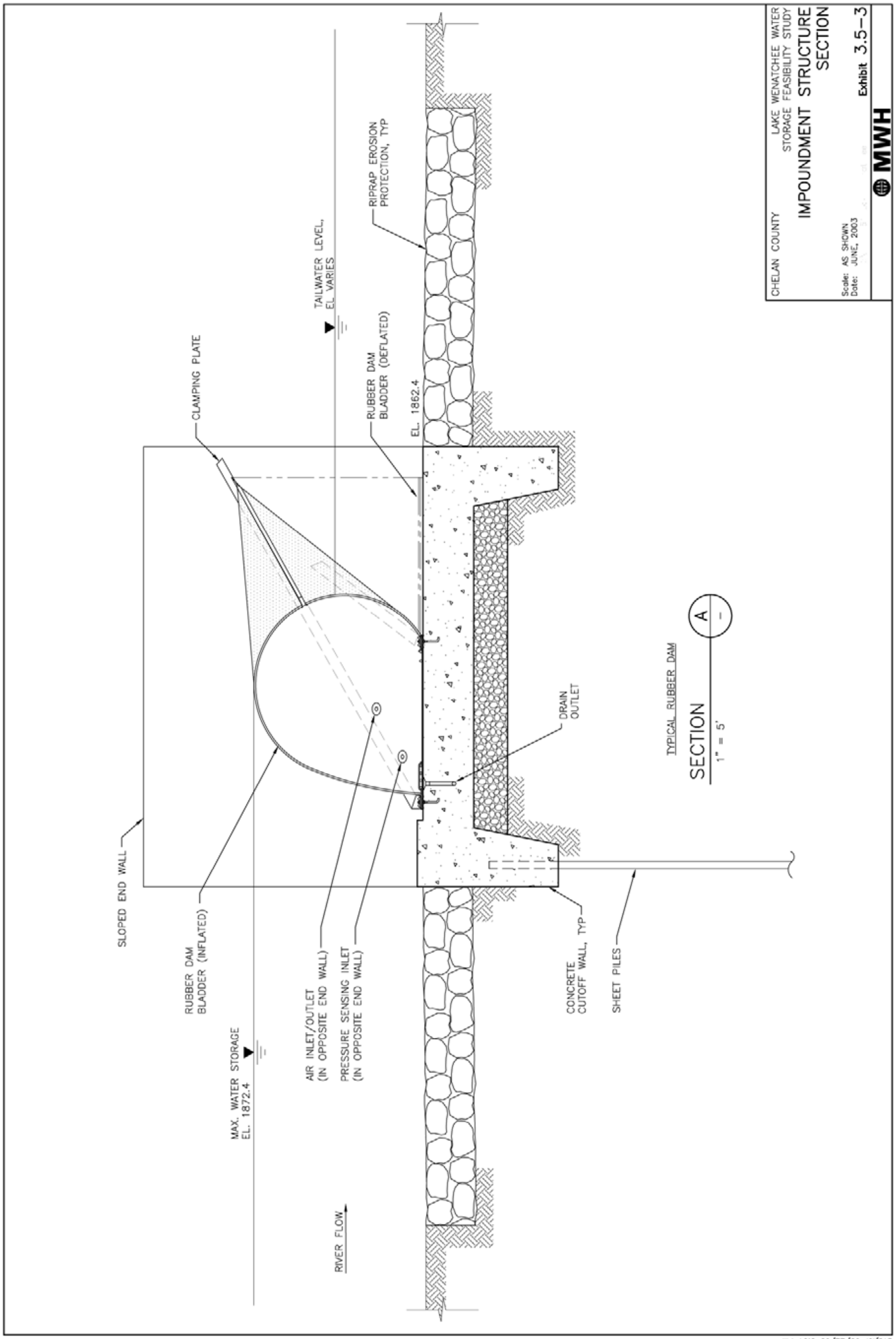
3.6 ADDITIONAL STUDY NEEDS

The following is a list of future technical study needs that are likely to be required if the project is taken to preliminary and final design:

1. Further refinement and study of rubber dam operational scenarios (Section 3.3.2.7).
2. Surveying of impoundment structure site, including river soundings, and access roads.
3. Geotechnical subsurface investigations and soils testing, including installation of piezometers to monitor groundwater levels.
4. Location and availability of power and communication lines.
5. Further study and refinement of wind and wave affects on the shoreline.


CHELAN COUNTY
LAKE WENATCHEE WATER STORAGE FEASIBILITY STUDY
IMPOUNDMENT STRUCTURE VICINITY AND LOCATION MAPS
Scale: AS SHOWN
Date: JUNE, 2003
Exhibit 3.5–1
MWH
SITE MAP
SCALE: 1" = 1320' (1/4 Mile)
Lake Wenatchee State Emergency Airstrip
LAKE WENATCHEE STATE PARK
Emerald Island
LAKE WENATCHEE
Gaging Station
Boat Ramp
Campground
Gravel Pit
Nason Creek Campground
IMPROVED ACCESS ROADS
RUBBER DAM IMPOUNDMENT STRUCTURE
VICINITY MAP
SCALE: 1" = 4 Miles
SITE LOCATION
LAKE WENATCHEE GAGE USGS 12455000
PLAIN GAGE USGS 12457000
PESHATIN GAGE USGS 12459000
MONITOR GAGE USGS 12462500
Plain
Leavenworth
Peshatin
Dryden
Cashmere
Monitor
Wenatchee
WENATCHEE RIVER
COLUMBIA RIVER
CHELAN CO
DOUGLAS CO
LAKE WENATCHEE
SITE MAP TAKEN FROM USGS TOPOGRAPHIC QUADRANGLE, PLAIN WA, 1968 (REVISED 1987)
BTaylor 06/22/03 4:54 PM


AIR HANDLING/
EQUIPMENT
VAULT
200.0'
RUBBER DAM
RIPRAP EROSION PROTECTION, TYP
PLAN
1" = 20'
RIVER FLOW
FISH LADDER
-N-
AIR HANDLING/
EQUIPMENT VAULT
AIR INLET/OUTLET
DRAIN PIPE
TYPICAL LOW
WATER LEVEL,
EL 1867.6±
CONCRETE CUTOFF WALL
SHEET PILES
TOP OF CONCRETE SLAB,
EL 1862.4
RUBBER DAM,
CREST EL 1872.4
ELEVATION
(LOOKING DOWNSTREAM)
1" = 20'
FISH LADDER
CHELAN COUNTY
LAKE WENATCHEE WATER
STORAGE FEASIBILITY STUDY
IMPOUNDMENT STRUCTURE
PLAN AND ELEVATION
Scale: AS SHOWN
Date: JUNE, 2003
Exhibit 3.5-2
MWH
BTaylor 05/22/03 5:01 PM


CLAMPING PLATE
TAILWATER LEVEL, EL VARIES
RIPRAP EROSION PROTECTION, TYP
RUBBER DAM BLADDER (DEFLATED)
EL. 1862.4
SLOPED END WALL
RUBBER DAM BLADDER (INFLATED)
AIR INLET/OUTLET (IN OPPOSITE END WALL)
PRESSURE SENSING INLET (IN OPPOSITE END WALL)
MAX. WATER STORAGE EL. 1872.4
RIVER FLOW
DRAIN OUTLET
CONCRETE CUTOFF WALL, TYP
SHEET PILES
TYPICAL RUBBER DAM
SECTION A
1" = 5'
CHELAN COUNTY
LAKE WENATCHEE WATER STORAGE FEASIBILITY STUDY
IMPOUNDMENT STRUCTURE SECTION
Scale: AS SHOWN
Date: JUNE, 2003
Exhibit 3.5-3
MWH
BTaylor 05/22/03 5:01 PM

4.0 LEGAL AND PERMITTING REQUIREMENTS

The purpose of this section is to review legal and permitting issues that may govern the feasibility of constructing a rubber dam structure at the outlet of Lake Wenatchee to impound water in the lake to a greater level than naturally occurs during summer and fall.

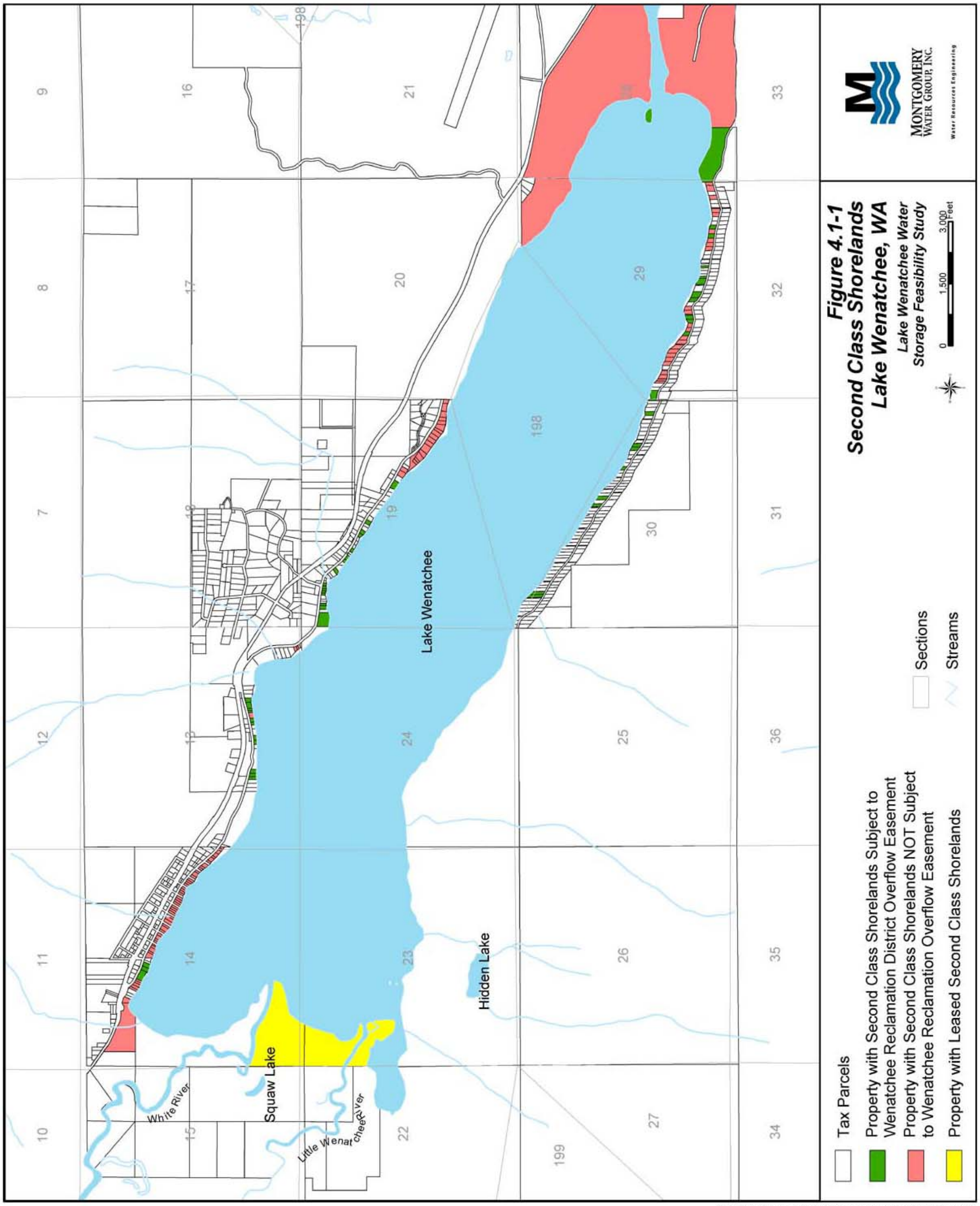
4.1 STATUS OF PREVIOUS PERMIT AND EASEMENTS

The Wenatchee Reclamation District (WRD) was an early proponent of a project to store water in Lake Wenatchee. In 1930, in response to decreased streamflow and concerns about an adequate water supply, the WRD proposed constructing a dam near the location described in Section 3.5 of this report. The dam was proposed to impound 10 feet of water between the normal high water and low water elevations. The estimated storage volume between those elevations was estimated to be 30,000 acre-feet. The WRD applied for a Reservoir Permit to impound water in Lake Wenatchee and applied for easements to inundate state-owned second-class shorelands within Lake Wenatchee. The following paragraphs describe the status of the Reservoir Permit and easements.

4.1.1 Status of Reservoir Permit

As part of the process to develop a reservoir, the WRD applied for a Reservoir Permit from the State of Washington that would allow the WRD to impound water at Lake Wenatchee. The WRD obtained Reservoir Permit No. 115 from the State of Washington Department of Conservation and Development, Division of Hydraulics on December 19, 1934. The permit authorized the WRD to impound 30,000 acre-feet, at a maximum depth of 10 feet and area submerged when full of 3,000 acres. The WRD later assigned this permit to Chelan PUD on September 12, 1963 for their use in studying the feasibility of constructing a dam on the Wenatchee River and impounding Lake Wenatchee. The Washington Department of Ecology (WDOE), the successor agency to the Department of Conservation and Development, gave notice to the PUD on March 24, 1976 that the Reservoir Permit would be cancelled unless the PUD showed cause to the Department why the permit should not be cancelled. The PUD did not respond and the Department, on May 28, 1976, ordered the Reservoir Permit to be cancelled.

A new Reservoir Permit will need to be applied for to impound water in Lake Wenatchee. Section 4.4 describes the process for applying to the WDOE for a new Reservoir Permit.



Y:\1000\1026_WRIA_45\GIS\PGGwork\mxd\lk_wentaxparcels.mxd, 6/3/03

4.1.2 Status of Overflow Easement

The WRD also applied to the State of Washington Commissioner of Public Lands in 1930 for the right to overflow the bed and shores of Lake Wenatchee and a portion of the Wenatchee River. The Department issued an Order on May 9, 1944 stating "the Wenatchee Reclamation District, its successors or assigns, is hereby granted the right, privilege, and authority to perpetually back and hold water upon and over the bed and shores of Lake Wenatchee and a portion of the Wenatchee River…" The WRD paid the state $3,138.75 to compensate for the "damage resulting to the state by the exercise of the right to overflow and inundate" and the damage amount "has been determined by statute and includes the value of the land to be overflowed, as well as all damages to adjoining lands of the state resulting from such overflow and inundation." The grant is subject to the rights of previous purchasers of second-class shorelands and a reservation of second-class shorelands on Emerald Island, part of the state park. A copy of the Order issued by the Commissioner of Public Lands and supporting Report and Supplemental Report of Engineer are included in Appendix B. The Order and the supporting reports contain descriptions of the properties where second-class shorelands were already purchased or were reserved by the Commissioner.

Copies of Deeds for second-class shorelands around Lake Wenatchee were obtained from the Washington Department of Natural Resources (DNR), who currently manage state-owned shorelands. Those Deeds were reviewed and classified into categories of Deeded second-class shorelands subject to an easement for overflow by WRD and those not subject to an easement for overflow. Of the approximate 70,000 feet of shoreline around Lake Wenatchee and the Wenatchee River to the site of the potential impoundment structure approximately 24,700 feet or 35% of the total shoreline length have second-class shorelands that have been sold and deeded to adjacent property owners. Of those second-class shorelands, approximately 19,600 feet were already purchased prior to the grant to WRD. An additional 780 feet were reserved surrounding Emerald Island in the state park. Exhibit 4-1 shows the location of those properties with Deeded second-class shorelands.

A comparison of the Deeds provided by DNR to the description of properties contained in the Order was made and some differences between the two sets of property descriptions were found. Because of the preliminary nature of this study, we did not pursue a more thorough search of DNR records to ascertain if the differences are due to not having all of the Deeds or if mistakes were made in writing the Order. Additional research would need to be performed prior to starting a program of determining the exact status of Deeds to second-class shorelands around Lake Wenatchee.

The Deeds for second-class shorelands issued by the state after 1942 were written subject to an easement for the right to overflow granted to WRD. Three exceptions were found in Deeds written in 1956, 1963 and 1966. The reason those Deeds did not contain an exception is not known. Other Deeds written during and after that time period contain the provision that the second-class shorelands are subject to overflow by WRD.

The Commissioner's Order was also written with a clause stating "if the construction or erection of a water power plant, reservoir or works for impounding water shall not be commenced within three years from the date of this order and be diligently prosecuted and completed within six years from the date of this order, this grant may be forfeited by the Commission of Public Lands by serving written notice of such forfeiture upon the Wenatchee Reclamation District, its successors or assigns, but the Commissioner for good reason shown to his satisfaction may extend the time within which such work shall be completed." No records have been found that indicate the Commissioner, or its successors, have started a process that would lead to forfeiture of the overflow easement.

The WRD assigned the overflow easement to Chelan PUD in 1963. The PUD reassigned the overflow easement to WRD in 1990. Both documents were recorded with the Chelan County auditor. The WRD currently owns the overflow easement and would be able to convey the easement to any project proponent.

For the alternative of storing water to Ordinary High Water (El. 1870.3) a project proponent would need to purchase easements from property owners who hold Deeds to second-class shorelands that are not subject to an overflow easement. The total length of second-class shorelands that require new easements is estimated to be 20,380 feet, which includes private property and Emerald Island. The property owner with the most second-class shorelands requiring new easements is Washington State Parks & Recreation, with a total length of approximately 9,430 feet (including Emerald Island).

For the alternative of storing water to 1872.4, a project proponent would need to purchase easements to flood private property above OHW in addition to the easements described in the previous paragraph. For that alternative, easements for the entire shoreline length (approximately 70,000 feet) would be required.

4.2 COMPLIANCE WITH TRIBAL NATION RIGHTS

4.2.1 Tribal Fishing Rights

The enactment of the Yakama Indian Treaty (1855) and subsequent executive order of July 2, 1872, the majority of the original Native Americans who inhabited regions that are presently Chelan, Kittitas, Yakima, Okanogan, and Douglas counties were resettled onto the Yakama Nation and Colville Confederated Tribes reservations. As guaranteed by the Yakama Treaty of 1855, the Yakama Nation reserved the right to continue to fish outside of the established reservation without interference from states or the federal government. The majority of the Wenatchee Basin was encompassed within lands ceded by the Yakama Nation to the U.S. government (Wenatchee River Subbasin Salmon and Steelhead Plan 1990).

The area of the Columbia River north from Priest Rapids Dam and extending to the Canadian border, including the tributaries, is part of the aboriginal territory of numerous Native American Tribes. Those tribes include, but not limited to, the Chelan, Wenatchee, Entiat, Columbia (Moses band), Yakama, Palouse, Okanogan, and Nespelem tribes. This entire area was used extensively by Indian people for fishing as well as being an integral part of their culture and religious way of life. It is still a significant resource area and includes many places considered sacred by Indian people today. (Wenatchee River Subbasin Salmon and Steelhead Plan 1990).

Among those tribes who signed the Yakama Indian Treaty at Walla Walla, Washington and reserved the rights to fish off-reservation were the Yakama, Chelan, Wenatchee, Entiat and Columbia tribes. The Confederated Tribes and Bands of the Yakama Nation and its members, as the legal successors in interest to those tribes, reserved those rights for itself and its members. Today members of those tribes reside on and off the reservation (Wenatchee River Subbasin Salmon and Steelhead Plan 1990).

In 1905 the U.S. Supreme Court ruled on its first case involving Native American fishing rights in the Pacific Northwest. The case of *United States v. Winans* (198 U.S. 371) upheld the treaty provisions of the Yakama Nation securing the rights of the tribe to fish at “usual and accustomed places.”

On February 12, 1974, Federal Judge George Boldt issued an historic ruling reaffirming the rights of Washington's Indian tribes to fish in accustomed places. The Boldt Decision revolutionized the state fisheries industry and led to violent clashes between tribal and non-tribal fishermen and regulators. In 1979, the Ninth Circuit Court of Appeals upheld Boldt's ruling, and on July 2, 1979, the U.S. Supreme Court largely affirmed it. Principles established by the Boldt Decision have since been applied to other resources, including shellfish.

The treaty Indian tribes of Washington possess off-reservation instream flow water rights associated with their treaty fishing rights. Tribal instream flow rights were first recognized in the general stream settlement and associated federal proceedings involving rights of the Klamath Indian Tribe in Oregon’s Klamath Basin (United States v. Adair, 723 F.2d 1394 (1983)). Tribal instream rights that derive from the treaties typically hold priority date of “time immemorial.”

Tribal instream rights have been recently recognized and implemented through the courts in the Yakama Basin of eastern Washington. South of the Wenatchee Basin, the Yakama Basin example provides a regional corollary for the proposed impoundment structure project. Decisions include the Yakima Basin general stream adjudication, in which the state Supreme Court recognized the primacy and priority of tribal in stream rights (Ecology v. Yakama Reservation Irrigation District, 121 Wn.2d 257 (1993)). An earlier federal decision required the Bureau of Reclamation to release water from its Yakama Project reservoirs to protect fish as well as provide water to its irrigation district customers (Kittitas Reclamation District v. Sunnyside Valley Irrigation District, 763 F.2d 1031 (1985)).

Recently, several Indian tribes have negotiated agreements with major water users to establish and protect instream flows for fisheries. A notable example involves the agreement between the Muckleshoot Indian Tribe and Tacoma Public Utilities (TPU) addressing exercise of TPU’s municipal water rights on the Green River. The agreement recognizes that current flows established by rule (WAC 173-509-030) are not adequate to protect Green River fisheries and propose new higher minimum flows.

As a result of the treaty rights to fish, tribes that were party to the treaties retain substantial governmental authority over the activities that affect hunting and fishing. Thus, treaty tribes have a right to co-manage and to participate equally in fishery management decisions affecting the Columbia River including its tributaries. Such co-management responsibilities include harvest management, habitat development or modification, fish culture and enhancement projects, as well as habitat utilization and restoration (Wenatchee River Subbasin Salmon and Steelhead Plan 1990).

4.2.2 Government-to-Government Consultation

Regulations that promote the protection of the Wenatchee Basin fisheries and habitat while facilitating government-to-government consultation between Tribal governments and federal agencies include the Watershed Planning Act and the Salmon Recovery Act.

The Watershed Planning Act 1998 (HB 2514) provides $3.9 million for counties, cities, water suppliers, tribes, state agencies, and representatives of a wide range of interests to join together to debate water issues. HB 2514 provides a structure for resolving conflicts about water that involves the interest groups in the watershed.

Watershed planning and management under HB 2514 provides an opportunity to improve or protect water quality, habitat and in stream flows. Other watershed planning and management efforts have been completed or are underway that do not depend on the HB 2514 process and may also support salmon recovery, such as the Salmon Recovery Act.

The Salmon Recovery Act 1998 (HB 2496) created a framework to set priorities for salmon restoration projects within watersheds and provides a forum for locally initiated projects to contribute to recovery. All partners will need to ensure these local processes use resources effectively, identify local needs and opportunities, promote retention of local options, and coordinate existing as well as new efforts.

4.2.3 Project Effects on tribal fisheries

Minimal effects to Tribal fisheries are anticipated based on the current rubber dam impoundment structure construction and operational scenarios. Section 6 in this report details the potential impact to aquatic resources found with the Wenatchee Basin.

A brief summation of Section 6 is given here.

- The operation of the rubber dam will generally result in increased lake levels during some or all of the months of July, August and September, and increased flows in the mainstem Wenatchee River during August and September;
- The operation of the rubber dam to augment flows in the mainstem Wenatchee River during late-summer/early-fall could benefit the upstream migration and holding of adult steelhead, chinook, and coho salmon;
- Operation of the rubber dam is not anticipated to affect flows or water levels important to adult salmonid migration and holding in the tributaries or in Lake Wenatchee;
- Steelhead spawning will not be affected by project operations, because steelhead spawn in the spring;
- Operation of the rubber dam will not affect high-flow rearing habitat in the mainstem Wenatchee River;
- Operation of the rubber dam is not expected to adversely influence smolt outmigration patterns or survival;
- Operation of the rubber dam will not affect high-flow conditions in the mainstem Wenatchee River;
- The operation of the rubber dam is not anticipated to affect juvenile outmigration in the tributaries or in Lake Wenatchee; and
- Operation of the rubber dam is not anticipated to affect predation and competition in the tributaries.

4.2.4 Recommendations

The construction and operation of the rubber dam impoundment structure as currently planned downstream from the confluence of Lake Wenatchee and the Wenatchee River would have an anticipated negligible effect to Tribal fisheries in the Wenatchee Basin. With appropriate government-to-government consultation, facilitated by the Watershed Planning Act and/or the Salmon Recovery Act, the proposed project would not infringe upon the rights granted to the treaty Indian tribes of Washington, which have been upheld in both the Ninth Circuit Court of Appeals and the U.S. Supreme Court.

4.3 REGULATORY AUTHORITY

This section describes entities that may own and operate the rubber dam and the framework they may operate within. Because of the nature of the project, the rubber dam impoundment structure would be operated by a public entity. A potential federal entity is the U.S. Bureau of Reclamation (USBR), which operates numerous reservoirs throughout Washington State (and the West). Although this project would not have an irrigation or power component, the USBR may be interested if there are substantial fisheries benefits from the project, which in turn may help them satisfy their responsibility under the Federal Columbia River System (FCRS) Biological Opinion. The USBR has been designated an “action agency” along with the Bonneville Power Administration and the U.S. Army Corp of Engineers. As directed in the ESA, these action agencies have consulted with National Oceanic and Atmospheric Administration (NOAA) Fisheries on the management of the FCRS. The Biological Opinion issued in 2000 directs the action agencies to participate in salmon recovery efforts.

A state agency that could construct and operate the project is the WDOE. The department has participated in the design, construction and operation of the Lake Osoyoos control structure, which regulates the level of Lake Osoyoos in Okanogan County, Washington. The project was implemented in conjunction with the Province of British Columbia. It is operated by WDOE in accordance with operating guidelines set forth by the International Joint Commission. A six-member Board of Control is responsible for overseeing management and compliance with operational orders. Operational decisions are made by WDOE accounting for storage, fisheries and recreation objectives (Symonds, 2001).

Local agencies that could construct and operate the project are Chelan PUD, Chelan County and the Wenatchee Reclamation District. Of those agencies, the PUD would be the most likely candidate for operations because of their extensive experience in operating dams, reservoirs and fish ladders and their regulatory compliance staff. The Wenatchee Reclamation District could operate the project as they have experience in operating water control structures. Chelan County would not likely be a candidate, as they do not have the experience and staff needed to operate the project.

As the rubber dam would serve multiple objectives, operation would require a cooperative effort between the rubber dam operator, fisheries agencies and other interested parties. The dam would be operated within a framework agreed to prior to construction of the project to ensure the multiple objectives are met. In similar situations, committees or Boards are assembled to perform the following functions:

1. Serve as a clearinghouse for hydrologic and meteorological data,
2. Forecast inflow to lake and run operational models,
3. Specify date of storage water capture based upon normal, drought and flood years,
4. Recommend preferred lake levels to enhance or not degrade fisheries in Lake Wenatchee,
5. Specify flows releases to Wenatchee River based upon:

   a. instream flow needs
   b. fisheries interests (both lake & river)
   c. water use needs
   d. recreation, navigation & tourism concerns
   e. special interests
6. Meet periodically or annually to review lake management and compliance with legal agreements,
7. Issue annual report documenting the performance of the project.

The operating committee or Board of Control should be comprised of WDOE, WDFW, USFWS, Chelan County and the project operator if different from the agencies listed. A tribal representative may also be on the Board or provide input to state and federal agencies.

4.4 PERMITTING REQUIREMENTS

This section provides an overview of applicable federal, state and local permits and other regulatory approvals necessary for construction of the rubber dam impoundment structure and operation of the reservoir. Likely major permits, approvals and related conditions associated with each are described, including permit timeframes, agency contacts, potential issues, project features submit to permits, potential approaches and mitigation requirements.

4.4.1 List of Permits

The federal, state and local permits and regulatory approvals necessary for construction of the rubber dam structure are provided in Table 4.4-1.

Corps of Engineers 404/Section 10

The principal federal laws that regulate activities in navigable waters and wetlands are Sections 404 and 401 of the Clean Water Act and Section 10 of the Rivers and Harbors Act.

A Corps permit is required when locating a structure, excavating, or discharging dredged or fill material in waters of the United States, including wetlands, or transporting dredged material for the purpose of dumping it into marine waters. A Corps permit is required for the activity of constructing a rubber dam structure in the bed of the Wenatchee River because it would require placing fill material in a regulated water body.

Any activity planned for waters in Chelan County are administered by the Central Washington field office, Chelan, WA, of the Seattle District, U.S. Army Corps of Engineers. The timeframe for processing a complete project such as this would likely be 6 to 12 months from the time of application, assuming the SEPA, NEPA, and ESA process is complete.

ESA Section 7 Consultation (Biological Assessment)

The Endangered Species Act (ESA) serves to identify species of plants and animals that are considered to be in danger of extinction (endangered) or species that are likely to become endangered (i.e., threatened). The law is administered by the U.S. Fish and Wildlife Service (USFWS) for terrestrial plants and animals, including resident fish, and by the NOAA Fisheries for marine animals and anadromous fish. These two agencies are collectively referred to as "the Services." Compliance with requirements of Section 7 of the ESA is triggered when there is a "Federal Nexus," which occurs when a federal agency is involved in constructing a project, providing funds for project implementation, or has regulatory jurisdiction over a proposed action. Federal action agencies are required to consider the impacts of proposed federal projects on threatened and endangered species found in the project area for proposed projects.

The responsible federal agency is required to document the degree to which the proposed action will impact any threatened or endangered species found in the proposed project area. The agency makes a determination of "no effect," "not likely to adversely affect," or "likely to adversely affect."

"No effect" determinations indicate that listed species will not be affected by the proposed action, typically because their habitat will not be altered or the species is not found in the area at the time of year when the proposed activity will occur, and the project actions would have no direct, indirect, or cumulative effects on listed species. No effect determinations are documented by the responsible federal action agency in a memo format and are generally not circulated to USFWS or NOAA Fisheries.

Table 4.4-1
List of Likely Federal, State and Local Permits and Regulatory Approvals

Permit Type	Timeframe	When Applicable	Regulatory Agency
Federal - Corps of Engineers 404/Section 10	6 to 12 months, depending on completion of SEPA process and Section 7 Consultation	Locating a structure, excavating, or discharging dredged or fill material in a Water of the U.S., including wetlands	U.S. Army Corps of Engineers Seattle, WA 98124 Regulatory Branch (206) 764-3495
Federal - Section 7 Consultation (Biological Assessment)	6 to 12 months	Required for Corps 404 Permit if federally listed threatened or endangered species may be affected	U.S. Fish and Wildlife Service National Oceanic and Atmospheric Administration Fisheries (206) 860-3200
Federal -NEPA	See SEPA below	For projects with Federal Nexus.	Federal lead agency to be determined
State - Dam Safety Construction Permit	2 to 4 months Longer for complex projects	Constructing, modifying, or repairing any dam or controlling works for storage of 10 or more acre-feet of water	Washington Department of Ecology Water Resources Program Dam Safety Section (360) 407-6600
State - Clean Water Act Section 401, Water Quality Certification	Concurrent with Corps 404 permit process. WDOE has up to 6 months after public notice to issue 401 cert.	Applying for a federal license or permit to conduct any activity that might result in a discharge of dredge or fill material into water or wetlands, or excavation in water or wetlands	Washington Department of Ecology Shorelands & Environmental Assistance Program (509) 574-3992
State -Water Reservoir Permit	Likely 12 months, can be expedited	Constructing a barrier across a stream, channel, or water course, if the barrier will create a reservoir	Washington Department of Ecology Water Resources Program (509) 574-3989
State -Hydraulic Project Approval (JARPA)	2 to 3 months; concurrent with Corps 404 permit process	Work that uses, diverts, obstructs, or changes the natural flow or bed of state waters	Washington State Department of Fish and Wildlife Fish and Wildlife Habitat Program (360) 902-2534
State - Section 106 of the National Historic Preservation Act	3 to 6 months; Longer for complex projects	Federal or federally assisted projects	Washington State Office of Archaeology and Historic Preservation in coordination with lead Agency (360) 586-3065
State - Aquatic Lease	6 – 12 months	May be required for impounding water onto State-owned lands	Washington Dept. of Natural Resources (360) 902-1400
State - NPDES	3 – 6 months	Construction sites > 5 acres	Washington Dept. of Ecology (509) 457-7107
County - Shoreline Conditional Use / Substantial Development	3 – 6 months but likely same time frame as EIS	Projects valued at $2,500 or more located on the water or shoreline area	Chelan County Department of Building/Fire Safety and Planning (509) 667-6225
County -State Environmental Policy Act (SEPA)	EIS process with public comment is usually 12 months, although appeals can stretch this out to 3 or more years	Scoping of project inputs would likely determine EIS is required	Chelan County Department of Building/Fire Safety and Planning (509) 667-6225
County - Chelan Co. Critical Areas Ordinance	Same as Shoreline and SEPA	Applicable to projects within Critical Areas defined by Chelan County.	Chelan County Building, Fire Safety, Planning Department (509) 667-6225

Action agencies typically document "Not likely to adversely affect" determinations in a way that is consistent with their own internal policies. A document is prepared that describes the proposed project, project impacts, conservation measures, and effects determination that is then submitted to the Services for their review. The Corps of Engineers routinely prepares Biological Evaluations (BE) to document its process through which the determination of "not likely to adversely affect" determination was made. This determination is the appropriate one when any potential effects of the activity will be insignificant or unlikely to occur. The BE is circulated to USFWS and/or NOAA depending upon the species involved. USFWS and/or NOAA will then issue a letter of concurrence with the determination, or not concur. If a nonconcurrence letter is sent, then the Services advise the action agencies to request formal consultation.

A biological assessment (BA) must be prepared whenever an action agency proposes a major construction project that will result in significant environmental effects (i.e., will require preparation of a NEPA EIS). A BA is also prepared when the action agency has determined that a project is likely to adversely affect a protected species. The action agency requests initiation of formal consultation with USFWS and/or NOAA. In response to this request, the Services will prepare a Biological Opinion (BO), which first determines whether the adverse effects would jeopardize the continued existence of any species. If a jeopardy determination is made, the Services identify reasonable and prudent alternatives (RPA) that are intended to avoid jeopardy to the species. The action agencies must implement these measures or appeal to higher authority. If jeopardy is not determined, then the Services identify reasonable and prudent measures (RPM), which the action agencies must implement to reduce impacts to listed species. Jeopardy determinations are rare.

The ESA specifically mandates that the Section 7 process is strictly between the Services and the action agency. However, either the action agency or the Services can request input from others.

National Environmental Policy Act (NEPA)

The National Environmental Policy Act (NEPA) is the basic environmental policy for the nation. It applies to (1) federal projects, (2) any project requiring a federal permit, and (3) projects receiving federal funding. NEPA is an umbrella statue that sets up a process to document potential environmental impacts of proposed alternatives to help decision makers take environmental considerations into account in project selection. NEPA also sets up a process to disclose information on the proposed project and solicit comments. Unlike other environmental laws, NEPA does not contain statues that help define project design. Rather, NEPA is a mechanism to identify and describe alternatives and their impacts, and possible ways to mitigate for those impacts.

NEPA review is likely to be required when any action is proposed that requires a federal agency to implement, fund, or approve (e.g., issue federal permit) a proposed action. Potential lead agencies for this project could be USFS (US Forest Service lands affected by project); Corps via 404; USFWS via Section 7; or, if applicable, any agency providing federal funding source.

Washington Department of Ecology Dam Safety Construction Permit

A Dam Safety Construction Permit is required before constructing, modifying, or repairing any dam or controlling works for storage of 10 or more acre-feet of water.

The proponent must submit plans and specifications to WDOE for review and approval. These must be prepared by a qualified professional engineer. Permit processing time averages from 6 to 8 weeks, but varies depending on project complexity. WDOE also inspects the construction of all dams to reasonably secure safety of life and property.

Water Quality Certification (401)

A water quality certification (certification) is required of any applicant for a federal license or permit to conduct any activity that may result in any discharge into surface waters. This includes discharge of dredge and fill material into water or wetlands.

The federal agency is provided a certification from the state that the discharge complies with the discharge requirements of federal law and the aquatic protection requirements of state law. In the case of Corps permit applications, timing of certification is tied to Corps permit applications. Public notice for a water quality certification may be submitted jointly with the Corps public notice.

National Pollutant Discharge Elimination System

As authorized by the Clean Water Act this permit issued by WDOE could be required if construction activities disturb threshold area (formerly set at 5 acres, now set at 1 acre under Phase II requirements.)

Aquatic Use Authorization (Aquatic Lease)

Washington Department of Natural Resources (DNR) typically requires DNR approval/authorization for activities that use state-owned aquatic lands, including beds of state navigable waters. Application time may vary from 6-12 months.

Hydraulic Project Approval (HPA)/Joint Aquatic Resource Permit Application (JARPA)

Any form of work that uses, diverts, obstructs, or changes the natural flow or bed of any fresh water of the state, requires a hydraulic project approval from the Washington State Department of Fish and Wildlife.

A complete application package for an HPA must include a completed Joint Aquatic Resource Permit Application (JARPA) form, general plans for the overall project, and complete plans and specifications of the proposed work within waters of the state. JARPA can be used to apply for Hydraulic Project Approvals, Shoreline Management Permits, Water Quality Certifications, and U.S. Army Corps of Engineers Section 404 and Section 10 permits. The application also must include complete plans and specifications for the protection of fish life.

County Shorelines Management Act Permit (Shoreline Conditional Use / Substantial Development Permit)

These permits are required for any development or activity valued at $2500 or more that is located on a state water or shoreline area. Waters of the state include lakes greater than 20 acres or streams with a mean annual flow of greater than 20 cfs. This requirement also applies to any use or activity that materially interferes with the normal public use of the water or shorelines of the state regardless of cost, for any activity listed as a conditional use in the local master program, and for any activity that requires a variance from the provisions of the local master program. Lake Wenatchee and the Wenatchee River in the vicinity of the proposed rubber dam impoundment structure are designated rural shorelines. At this time neither the Chelan County Code nor the Chelan County Shoreline Master Plan address dams as a permitted use. A Shoreline Conditional Use permit or a Variance from County Code could be obtained, or the County's code could be permanently amended to add dams as a permitted use.

To obtain a Conditional Use Permit (CUP), the proponent would need to complete a CUP application and submit it to the County's Planning Department for review, by the Land Use Hearing Examiner. The Hearing Examiner may approve the CIP, with or without conditions, or deny the application.

To obtain a variance from Chelan County, the proponent would need to complete a Variance Application form and submit it to the County's Shorelines Administrator. The County would than make a determination on whether to grant the variance, or describe any associated mitigation requirements or other conditions. If a shoreline variance or conditional use permit is required, the WDOE must also approve or deny the permit, or approve the permit with conditions.

To obtain a County code amendment that would add dams as a permitted use, the following process would apply. Chelan County reviews proposed code amendments twice annually, in February and August. A proposed amendment is first brought before the County Planning Commission, which issues a recommendation to the County Commission. The County Commission then reviews the proposed amendment and makes a determination to adopt or reject the amendment. Amendments accepted in the February cycle go into effect in July. Amendments accepted in the August cycle go into effect in January of the next year. permit varies as does processing time. Generally, a public hearing is required. The local official will require an affidavit of public notice, a location map, a topographic map, and a site plan.

Water Reservoir Permit

A reservoir permit is required before constructing any barrier across a stream, channel, or water course, if the barrier will create a reservoir. A reservoir is defined as a dam or dike that will store water to a depth of 10 or more feet at its deepest point, or one that will retain 10 or more acre-feet of water. This project meets those definitions.

Reservoir permit applications require information on the use and capacity of the reservoir and a legal description of the location of the structure. Processing time varies depending on project complexity. The process requires publication of a legal notice for two succeeding weeks.

Normally, a reservoir permit application is accompanied by an application for a permit to use water. This application describes the intended beneficial uses of water that will be withdrawn from the reservoir. Unless otherwise specified, a reservoir permit will allow the permittee to fill the reservoir once a year. The permit specifically states the period during which the reservoir is filled. Any entity proposing to use water stored in a reservoir must file for a permit to use water, which must refer to the reservoir as its source of water. For this project, the use of water may be for instream purposes or to provide water to meet future water needs. The allocation of water for each would need to be determined and water right applications filed for those water needs. However, if the water stored is used exclusively for instream flow supplementation, some protection of those needs is afforded by Chapter 173 – 545 WAC, the IRPP for the Wenatchee River Basin (see Section 2 for discussion). The state's Trust Water Program may also be used to set-aside water for instream flow purposes.

As discussed in the Aquatic Resources Section, a dam or other obstruction across or in a stream must be equipped with a durable and efficient fishway approved by Washington State Department of Fish and Wildlife.

State Environmental Policy Act (SEPA)

The Washington State Environmental Policy Act provides a way to identify possible environmental impacts that may result from governmental decisions. These decisions may be related to issuing permits for private projects, constructing public facilities, or adopting regulations, policies or plans.

Information provided during the SEPA review process helps agency decision-makers, applicants, and the public understand how a proposal will affect the environment. This information can be used to change a proposal to reduce likely impacts, or to condition or deny a proposal when adverse environmental impacts are identified. The intent of SEPA is:

- Integrate environmental review with other agency review processes;
- Integrate environmental review into early planning and use these reviews as the basis for analysis of future projects;
- Combine environmental documents with other documents;
- Use existing environmental information through incorporation by reference or adoption;
- Use exemptions for actions that do not have a significant effect on the environment and, therefore, do not require environmental review;
- Involve the public and other agencies in the review process;
- Write environmental impact statements in plain language that focus on significant issues and only briefly discuss nonsignificant issues; etc.

The Environmental Impact Statement (EIS) is used to document impacts of large and/or controversial projects where significant impacts are expected. Impacts are defined as being significant based on scientific input, public controversy, or legal requirements. The EIS is intended to be a disclosure document, providing decision makers with a systematic evaluation of the environmental impacts of a full spectrum of practicable alternatives including the no action alternative.

The Draft EIS describes all the alternatives being considered, and the expected impacts. Typically a preferred alternative is identified. The Draft EIS is circulated to the public for a minimum of 45 days. After the public review period is complete a Final EIS, which incorporates public input and responds to questions raised by the public, is prepared. The Final EIS is circulated for comment for 30 days, after which the Record of Decision (ROD) is prepared. The ROD describes which alternative the agency has chosen to move forward on and why that decision was made. The ROD also identifies what mitigation will be implemented to compensate for the impacts of the proposed project.

Section 106 of the National Historic Preservation Act

Section 106 of the National Historic Preservation Act requires federal agencies to take into account the effects of their undertakings on cultural resources (e.g., archaeological sites, historic buildings, and traditional cultural properties) and afford the Advisory Council of Historic Preservation (ACHP) a reasonable opportunity to comment on such undertakings. The Section 106 process seeks to accommodate historic preservation concerns with the needs of federal undertakings through consultation among the agency official and other parties with an interest in the effects of the undertaking on historic properties, commencing at the early stages of project planning. The goal of consultation is to identify historic properties potentially affected by the undertaking, assess its effect and seek ways to avoid, minimize or mitigate any adverse effects on historic properties.

Furthermore, cultural resources located on federal property and on other lands involved in projects relying on federal funding or permits are protected by both federal and state law. State law protects archaeological sites and other cultural resources on private and state lands in Washington. Washington cultural resource law (RCW 27.53) state that no known archaeological site or resource can knowingly be damaged without first obtaining a certified permit.

Due to the multiple state and federal jurisdictional control over the project area, the USDA Forest Service, Washington State Parks, Colville Confederated Tribes, Yakama Indian Nation, and the Washington State Office of Archaeology and Historic Preservation would likely be participants in the Section 106 consultation process for this project. Duration of the Section 106 process could be 3 to 6 months, but could be longer for more complex projects.

Local Chelan County Critical Areas Ordinance

Any activities occurring on land within county jurisdiction would require compliance with local CAO regulations associated with wetlands, fish/wildlife conservation areas, floodplains, and aquifer recharge areas.

4.5 POTENTIAL ISSUES, APPROACHES AND MITIGATION REQUIREMENTS

Potential issues associated with the concept of constructing and operating a rubber dam impoundment structure have been identified in various sections of this feasibility study. Legal issues were identified in this Legal and Permitting Requirements section, potential socioeconomic impacts are described in Section 5.0 and potential environmental impacts are described in Section 6.0. These analyses provide a preliminary view of potential issues based on the storage operation model, operating criteria, and operation model alternatives presented in Sections 3.4 and 3.5; and the impoundment structure described in Section 3.6 of this report.

4.5.1 Legal and Permitting Issues

One major issue identified in Section 4.1.2, relates to “overflow on the bed and shores of Lake Wenatchee” and second-class shorelands and the implications associated with the purchase of easements from property owners for storing water at El. 1870.3 (OHW) or at El. 1872.4. This issue should be addressed in greater detail, given its potential significance relative to project feasibility and costs.

A second issue relates to a dam as a permitted use under the Chelan County Code and Chelan County Shoreline Master Plan. This approval would need to be in the form of either a shoreline Conditional Use Permit or a Variance from the County Code. Because of the significance of this issue, it is recommended that the process for approval begin early to ensure that the project would be designated as an allowable use by Chelan County and approved by the WDOE.

A third issue relates to tribal fishing rights and instream flows for fisheries in the Wenatchee River and ultimately a need for a negotiated agreement and co-management responsibilities for the fishery within the basin. If the project moves ahead to the next study phase, the issues of fishery management/fishing rights and instream flows (as well as the associated issue of management of the rubber dam relative to the Endangered Species Act) should be addressed early in the planning process through definition of a planning approach, schedule, and schedule for meeting with involved parties.

The project would need to meet the requirements of NEPA and SEPA since the project would affect both federal lands and private/state lands on the lake. The lead agency will determine the environmental reporting process (EIS or EA/SEPA Checklist) to be used to define potential impacts a part of the scoping process. Initiation of the NEPA/SEPA process would ensure that potential environmental issues are identified and addressed early in the pre-design phase. This approach would allow for some issues and potential impacts to be avoided or minimized through project siting, operational modifications and design, thereby potentially reducing the need for mitigation.

4.5.2 Socioeconomic Impacts

Socioeconomic impacts associated with seasonally raising the water elevation in the lake would include impacts to property improvements caused by the higher sustained water elevations, wind-driven waves, and/or saturated soil conditions that could affect legally permitted shore-side property improvements such as footings, septic tanks and STEP sewer system connections, fixed docks, and boathouses. Detailed topographic survey and aerial photographs of the shoreline during pre-design would allow for more accurate locations of impacts to properties based on elevations of the improvements relative to proposed water elevations with the project.

Establishment of a summer water elevation of 1872.4 ft would affect boat ramps at Glacier View and Lake Wenatchee State Park and access to the boat launch also at the state park. That water elevation could also affect portions of the USFS south shore trail and several campsites at Glacier View. Estimated costs of modifying those facilities is presented in the mitigation section below.

Installation of the rubber dam impoundment structure at the Lake Wenatchee State Park would result in the loss of boat access to the Wenatchee River from the boat ramp. The estimated cost of establishing a new access downstream of the rubber dam has been presented in the feasibility cost estimate (Section 3.5.3.9) for the impoundment structure and in the mitigation section below.

The higher water elevations held in the lake could impact recorded archaeological deposits at the Headwater site and potentially increase risk on unrecorded resources.

4.5.3 Environmental Impacts

The project could potentially benefit several life stages of steelhead and chinook salmon in the mainstem Wenatchee River as a result of increased flows during late summer/early fall.

Potential negative impacts include the potential exposure of chinook redds in the mainstem Wenatchee River and sockeye redds along the shoreline of Lake Wenatchee, and stranding of rearing juvenile salmonids resulting from a decrease in water elevations in the lake and river. The approach to addressing these impacts is defined in the additional studies section below.

The project could also result in changes in wetland distribution and community composition along the lake. The quantification of the impacts could be determined through additional studies defined in the section below.

4.5.4 Mitigation Requirements

Mitigation requirements for the project will be defined as a part of the NEPA/SEPA environmental reporting process and as defined during negotiations for project permit approvals. Adverse impacts identified during NEPA and SEPA will be designed to, where possible, eliminate impacts or minimize impacts. Mitigations will also be defined as “conditions” in the JARPA Hydraulic Project Approval (HPA) and as a part of the JARPA Section 10/404.

Two items defined as impact costs in the Socioeconomic Impacts section were for the replacement boat ramp downstream of the rubber dam (($165,000), and extension of the boat ramp and launch access at the Lake Wenatchee State Park ($4,800). These are forms of mitigation that would also be part of the costs for constructing the project.

4.6 REQUIRED EASEMENTS

Besides permits from agencies to construct and operate the rubber dam and reservoir, the project proponent will need to obtain easements to inundate second-class shorelands owned by adjacent property owners that are not subject to an overflow easement, as described in Section 4.1. For the operational scenario of impounding to OHW (1870.3), it is estimated that easements would be required for 20,380 feet of second-class shorelands. For impounding at the higher level studied (1872.4), easements to inundate property would be required for all properties on the lake. There is approximately 70,000 feet of waterfront on Lake Wenatchee.

The other easement required would be from the Washington State Parks and Recreation Commission, who own Lake Wenatchee State Park. A temporary construction easement would be needed for equipment to access the work site and for a staging area to construct the rubber dam impoundment structure. A permanent easement or right of entry would also be needed for equipment to occasionally access and maintain the rubber dam as well as for a small equipment building that houses compressors and control equipment.

4.7 ADDITIONAL STUDY NEEDS

The following is a list of future study needs that are likely needed to fully address permitting and environmental issues.

1. Definition of ultimate use of stored water – instream flow augmentation, supply to future surface water users in the Wenatchee River Basin Watershed, or as mitigation for future groundwater use either in the aquifers supplying the Wenatchee River or in tributaries to the Wenatchee River (Section 2.7).

2. Future Operation Model Refinements – adjusting schedule for raising the rubber dam based on water year (wet, dry, normal) from snowpack conditions; reducing rate of water collection to storage; adjusting releases from storage to focus on lower flow days when water is most needed rather than release at a constant rate (Section 3.5.2.7).

3. Additional research regarding properties defined in the Overflow Easement Order and description of properties provided by Washington State Department of Natural Resources (Section 4.1.2).

4. Develop and negotiate agreement(s) with treaty Indian tribes regarding instream flows to protect fisheries (Section 4.2.1).

5. Define discriminating factors potential property buyers use when considering buying lake shoreline properties (Section 5.2.1.1.2).

6. Conduct systematic archaeological survey of the impoundment structure site and other project elements such as access roads and parking (Section 5.3.4).

7. Conduct temperature modeling in mainstem river (Section 6.5).

8. Conduct instream flow channel study to determine horizontal and longitudinal extent of potential impacts (Section 6.5).

9. Construction details, sequence and impact analyses (Section 6.5).

10. Fish passage details and impact analysis (Section 6.5).

11. Longitudinal survey of lake shoreline and of the Little Wenatchee and White Rivers to identify potential spawning habitat (Section 6.5).

12. Topographic survey to determine elevational range of plant communities and accessibility of off-channel fish habitats at specific lake levels (Section 6.5).

13. Characterization of wetland plant species composition and distribution of wetland plant communities (Section 6.5).

14. Installation and monitoring of ceilometres to determine extent of hydrologic influence on wetlands and groundwater (Section 6.5).

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 May14, 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).

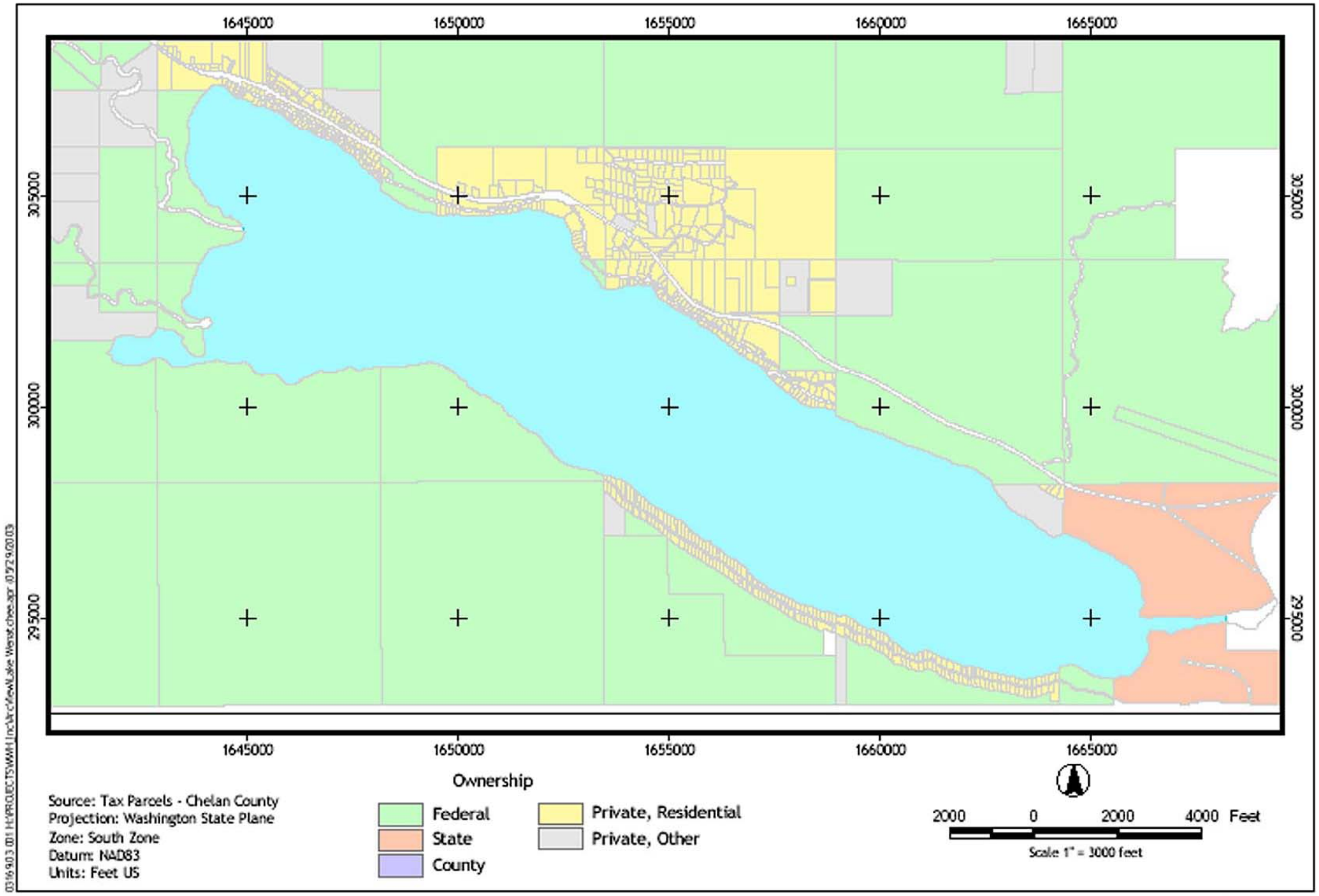
Facilities

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/recmain.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.)



Jones & Stokes

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 linear foot on the North shore. The South shore has an average value of $1,554 per linear 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 May14, 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."

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

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 OHW and is a reasonable representation of water conditions would be at this beach under the OHW 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.

Cubic Feet / Second												
YEAR	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

Percent Difference												
YEAR	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

Cubic Feet / Second												
YEAR	**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

Percent Difference												
YEAR	**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.

6.0 ENVIRONMENTAL IMPACT

The potential project impacts, both positive (i.e. benefits) and negative, to the aquatic resources are described in this chapter. The chapter first begins with a discussion of the amount of water supply potentially available from the project, followed by a description and rationale of the operational alternatives. Environmental baseline conditions are then described for Lake Wenatchee, the tributaries to Lake Wenatchee and the mainstem Wenatchee River including descriptions of the aquatic species, wetlands, and water quality. Following these descriptions, potential impacts to these aquatic resources from the five operational alternatives (Section 3.5) are assessed, along with their relative benefits, followed by a section of conclusions regarding such. We conclude the chapter with recommendations for and brief descriptions of additional studies that may be needed to address specific issues or concerns.

6.1 WATER AVAILABILITY

The relative magnitude of potential instream flow benefit ascribable to the water storage project is directly related to the amount of water that could be made available for downstream release. This study considered two lake elevations for determining the available quantity of water, 1872.4 feet and 1870.3 feet These lake elevations corresponded respectively to first, the 90% exceedence high water mark, and second, the ordinary high water mark. From a water storage perspective, the 1872.4 feet lake elevation would provide about twice the amount of water as would the 1870.3 feet elevation, and therefore, theoretically more biological benefits in the form of a higher magnitude and longer duration of instream flows that could be released downstream. The operational alternatives were therefore developed around these two lake elevations.

6.2 OPERATIONAL ALTERNATIVES

Given the two lake elevations under consideration (1872.4 and 1870.3 feet) and the respective volumes of water that would be available for each, the objective of the alternatives development process was to determine how to use the water in the most biologically meaningful fashion. Correspondingly, the development of the operational alternatives described in Section 3.5.2.5 was directed toward the release of supplemental flow to the mainstem Wenatchee River at those times that would provide the greatest benefit to fish. A number of factors were considered in this evaluation including; a) ESA status of the species; b) timing of when stored water would be available; and c) species periodicity/presence in the mainstem river during the time of water availability (Figure 6.3-1).

Consideration of those factors suggested that chinook salmon adult passage and spawning, and juvenile rearing should be the primary focus of the flow releases from the lake. Chinook are listed under the ESA and are present in the river when streamflows are characteristically the lowest (i.e. August through October). Important life history functions of chinook salmon during this period are as follows:

1) Adult passage occurs over a prolonged period extending from May through the end of September,
2) Spawning in the mainstem river is reported to occur as early as August and extend through October,
3) Egg incubation extends August through April, and

4) Juvenile rearing essentially occurs year-round.

Since flows in August average slightly higher than in September, the greatest potential biological benefit would likely be achieved by centering the flow releases from the rubber dam on September. During periods of extreme drought and low flow conditions, supplemental flow releases could potentially benefit chinook by providing more mainstem river spawning and juvenile rearing habitats.

Flow augmentation could also be directed toward providing some flow related benefits for sockeye salmon and spring chinook salmon upstream passage. Adult sockeye and spring chinook salmon move into and through Lake Wenatchee during the period from mid-June through July on their upstream migration to spawn in the upper tributaries (primarily Little Wenatchee and White rivers). Under conditions of extreme low flow during those periods, the provision of supplemental flows may provide some benefits related to upstream passage.

Based on these biological targets, the five alternatives described in Section 3.5.2.5 were developed. The first three alternatives assumed a lake elevation of 1872.4 feet and would make available additional stored water of about 12,300 acre-feet in excess of historic water levels. The last two alternatives (4 and 5) assumed an elevation of 1870.3 feet (OHWM) and would provide about half of the water (6,750 af) available in alternatives 1-3. Importantly, the use of the stored water would target low water/drought conditions when natural streamflows are well below average. Under normal or above average flow conditions, the rubber dam would generally not be used.

The five alternatives and their potential resource targets are summarized in Table 6.2-1.

Table 6.2-1. Description of five alternatives and their resource targets considered in the environmental impact analysis of the Lake Wenatchee Water Storage Feasibility Study.

Alternative Number, Lake Elevation and (Available Storage acre-feet (af))	Period of Seasonal Storage	Alternative Description	Resource Target
1 – El 1872.4 feet; (12,300 af)	July 1 – August 22	Upramp flows at 10 cfs increments from August 23-31; maintain flows at 100 cfs in excess of historic outflow from Sept. 1 until storage depletion	Mainstem chinook salmon spawning and juvenile rearing habitats
2 – El 1872.4 feet; (12,300 af)	July 1 – August 22	Upramp flows at 20 cfs increments from August 23-31; maintain flows at 200 cfs in excess of historic outflow from Sept. 1 until storage depletion (duration = ½ Alternative 1)	Mainstem chinook salmon spawning and juvenile rearing habitats
3 – El 1872.4 feet; (12,300 af)	June 1 – June 30	Pulse flows of 100 cfs released at 4 hour intervals from July 1 – August 15; maintain flows of 100 cfs in excess of historic outflow from August 16 until storage depletion	Upstream migration of spring chinook and sockeye salmon into Lake Wenatchee; early mainstem chinook salmon spawning and juvenile rearing habitat
4 – El 1870.3 feet; (6,750 af)	July 1 – August 22	Upramp flows at 5 cfs increments from August 23-31; maintain flows at 50 cfs in excess of historic outflow from Sept. 1 until storage depletion	Mainstem chinook salmon spawning and juvenile rearing habitats
5 – El 1872.4 feet; (6,750 af)	July 1 – August 22	Upramp flows at 10 cfs increments from August 23-31; maintain flows at 100 cfs in excess of historic outflow from Sept. 1 until storage depletion	Mainstem chinook salmon spawning and juvenile rearing habitats

6.3 ENVIRONMENTAL BASELINE OF THE AQUATIC RESOURCES

The baseline conditions of the aquatic resources in the Lake Wenatchee Water Storage Feasibility Study project area that may be influenced by the operation of the rubber dam are described in this section. The areas potentially influenced by the rubber dam are described as: 1) tributaries; 2) Lake Wenatchee; and 3) the mainstem Wenatchee River. Construction and operation of the rubber dam will have potential impacts on portions of the White River, the Little Wenatchee River, Nason Creek, the Wenatchee River, and Lake Wenatchee (Figure 1.0-1).

6.3.1 Areas Influenced by Lake Wenatchee Rubber Dam

The Wenatchee River basin is mainly within the rain shadow of the Cascade Mountains. The climate in the basin is characterized by heavy precipitation in the high elevations and semi-arid conditions in the lowermost portion of the basin. Most of the precipitation occurs as snow during the winter. Average annual precipitation is nearly 150 inches in the mountains and 8.5 inches or less in the city of Wenatchee (Andonaegui 2001). Stream flows are dominated primarily by snowmelt and the highest flows occur in May. Low flows typically occur from July until the fall rains in late September or October (Section 3.5).

6.3.1.1 Tributaries to Lake Wenatchee

Two rivers flow into Lake Wenatchee, the White River and the Little Wenatchee River. The general characteristics of these tributaries are described below.

6.3.1.1.1 Little Wenatchee River

The Little Wenatchee River flows into Lake Wenatchee at the western corner of the lake. The headwaters are in a broad high-elevation meadow that receives snowmelt from the mountains. The watershed is primarily forested and the U.S. Forest Service owns 97% of the land, with 61% of the watershed designated as wilderness (Hindes 1994). Logging has occurred on 7% of the watershed, mostly in the lower elevations (Hindes 1994). The lower two reaches of the river are depositional areas of an ancient lake bed, and both reaches are structurally complex, meandering, and connected to floodplain wetlands (USFS 1998). The downstream-most reach empties into Lake Wenatchee through a wetland delta and the stream substrate is sandy and there are several beaver ponds. Upstream of this reach, the riverbed contains a substantial number of gravel and cobble riffles, with most spawning habitat available at elevations above the usual high water lake level (Photograph 6.3-1). A gravel/sand mine is located in the vicinity of the gravel-sand transition region of the current stream, which indicates the upstream most extent of inundation-related effects from Lake Wenatchee. A natural barrier to upstream salmonid migration is located at RM 7.8 on the Little Wenatchee River (Mullan 1992). Salmon spawning correspondingly occurs between the reach influenced by lake backwater and the Little Wenatchee Falls (WDFW and WWTIT 1994).

Photograph 6-3.1. Little Wenatchee River near upper extent of lake backwater effect; the river contains extensive amounts of spawning gravel. Photos taken during November 2002 field reconnaissance.

6.3.1.1.2 White River

The White River drains snow and glaciers in the Cascade Mountains and Glacier Peak Wilderness. Although the entire river was identified as a potential Wild and Scenic River by the National Park Service, the lower third of the river flows through private lands including resorts and a golf course (Hindes 1994). The lower reach of the river is similar to the Little Wenatchee River in that it flows through a sandy-bottomed, complex wetland where it empties into Lake Wenatchee at the western corner of the lake (Photograph 6.3-2). However, the length of the lower White River influenced by high lake levels is considerably longer than in the lower Little Wenatchee River. A natural barrier to upstream salmonid migration is located at RM 14.3 (Mullan 1992), with most spawning occurring between the

Napeequa River and the White River Falls (WDFW and WWTIT. 1994), above the influence of the lake backwater.


Photograph 6.3-2. White River at FS Road 6500, looking downstream (left photo) and White River above lake influence zone. Photos taken during November 2002 field reconnaissance.

6.3.1.1.3 Other Tributaries

The outlet of Lake Wenatchee forms the Wenatchee River (RM 54.2)(Photograph 6.3-3), and Nason Creek flows in the Wenatchee at RM 53.6, downstream of the rubber dam location. There is a barrier to anadromy on Nason Creek at RM 16.8 (Mullan 1992). Other major tributaries that enter the Wenatchee River include the Chiwawa River (RM 48.4), and Icicle (RM 25.6), Chumstick (RM 23.5), Peshastin (RM 17.9), and Misson (RM 10.4) creeks (Figure 1.0-1).


Photograph 6.3-3. Lake Wenatchee looking upstream within outlet channel near proposed site of rubber weir (upper photo) and upstream view of Wenatchee River just below lake outlet at control riffle, from Highway 207 bridge (right photo). Photos taken during November 2002 field reconnaissance.

6.3.1.2 Mainstem Wenatchee River

Most of the annual stream flow in the Wenatchee River originates from tributaries in the upper basin including the White River (25%), Little Wenatchee River (15%) and Nason Creek (18%) (Bilhmer et al. 2002). At the outlet of Lake Wenatchee, the Wenatchee River is as at elevation 1,876 feet. The elevation at the confluence with the Columbia River is approximately 600 feet

For the purposes of this report, the mainstem Wenatchee River is referred to as the upper Wenatchee River, which extends from the outlet of Lake Wenatchee (RM 54.2) near Plain downstream to Tumwater Canyon (RM 35.6) and the lower Wenatchee downstream to the mouth at the city of Wenatchee (Photograph 6.3-4). The upper reach is characterized as a U-shaped valley consisting of glaciofluvial outwash deposits on the valley floor (Bilhmer et al. 2002). The river gradient in this reach is flat and has been reported as being approximately 0.3 percent (WDFW et al. 1990). The lower Wenatchee River includes the ten-mile stretch of Tumwater Canyon, which is a moderate gradient reach (<2%) through a bedrock canyon (Andonaegui 2001). At the downstream end of the canyon is Tumwater Dam (RM 31.0) and below this the river flows through a relatively confined channel that is down cut through a glacial floodplain. This includes the reach of the river below Leavenworth extending to Peshastin (Photograph 6.3-5) Dryden Dam is located at RM 17.0, and portions of the towns of Cashmere (RM 10.4) and Monitor (RM 6.0) and various orchards are located on the floodplain of the lower reach (Andonaegui 2001). At the mouth, Rock Island Dam at RM 453.4 on the Columbia River may at times impound water in the lower Wenatchee River (RM 468.4) resulting in deposition of fine sediment (Andonaegui 2001). Six other dams are on the Columbia River downstream of the Wenatchee River: Wanapum Dam at RM 415.8, Priest Rapids Dam at RM 397.0, McNary Dam at RM 292.0, John Day Dam at RM 215.6, Dalles Dam at 191.5, and Bonneville Dam at RM 146.1.

Photograph 6.3-4. Wenatchee River at Plain, looking downstream of Highway 209, and within Tumwater Canyon section above Leavenworth, Washington. Photos taken during November 2002 field reconnaissance.

Photograph 6.3-5. Upstream (left photo) and downstream (right photo) views of Wenatchee River near Peshastin, Washington. Photos taken during November 2002 field reconnaissance.

Normal low-flows in late summer/early-fall in the Wenatchee River are exacerbated by water withdrawals for irrigation (WDF et al. 1990). The largest water diversion on the river is the Dryden diversion at Dryden Dam (RM 17.0). In the upper Wenatchee River measured stream flows have not been greatly affected by water withdrawals. Water supply for small domestic systems and a single irrigation diversion near the town of Plain (RM 46.2) are the only uses upstream of the City of Leavenworth (RM 25.0) (Andonaegui 2001).

Minimum instream flow requirements were established in 1983 for three reaches on the Wenatchee River, as measured at gaging stations at the towns of Plain (RM 46.2), Peshastin (RM 21.5), and Monitor (RM 7.0) (WAC 173-545). The purpose of establishing minimum instream flows was to protect aesthetic, navigation, scenic, water quality, fish, wildlife, and other environmental values (Beery and Kelly 1983). These flows are often not met during the winter and late summer as a result of naturally low flows and diversions during the summer (WRWSC 1998).

6.3.1.3 Lake Wenatchee

Lake Wenatchee is a large, steep-sided lake located approximately 15 miles north of Leavenworth in the Wenatchee National Forest. It is fed principally by the Little Wenatchee River and the White River, and drains to the Wenatchee River. A large wetland is at the western end of the lake at the deltas of the Little Wenatchee and White rivers. A terminal glacial moraine at the east end of the lake is the natural dam that formed the lake. A diverse community of submerged aquatic vegetation along the shoreline extends to a depth of about 5.0 meters (Ecology 1997). The lake normally freezes over during the winter months and strong winds keep the lake mixed during much of the other seasons (Sylvester and Ruggles 1957). General physical characteristics of the lake (Ecology 1997) are presented below:

Size (acres)	2,480
Maximum Depth (feet)	244
Mean Depth (feet)	147
Lake Volume (acre-feet)	364,560
Drainage Area (square miles)	273
Altitude (feet)	1,875
Shoreline Length (miles)	13.3

6.3.2 Aquatic Species

Several populations of economically and culturally important fish species are found in the Wenatchee River system. Four species of anadromous (ocean-rearing) fish are present in the basin: chinook (*Oncorhynchus tshawytscha*), sockeye (*O. nerka*), steelhead (*O. mykiss*), and Pacific lamprey (*Lampetra tridentata*). While historically abundant, native coho (*O. kisutch*) have been extinct from the basin since the early 1900s. Reintroduction efforts were begun in 1997, with the first coho release in 1999. Other important salmonid species in the Wenatchee basin are bull trout (*Salvelinus confluentus*), kokanee (*O. nerka*), westslope cutthroat trout (*O. clarki lewisi*), and rainbow trout (*O. mykiss*). Three fish species in the Wenatchee River basin are protected under the federal Endangered Species Act (ESA). Steelhead and spring chinook in the Wenatchee River basin are listed as endangered under the ESA. Bull trout in the Wenatchee River basin are listed as threatened under the ESA.

The basin also supports a number of other native fish species including mountain whitefish (*Prosopium williamsoni*), mountain sucker (*Catastomus platyrhynchus*), largescale sucker (*Catostomus macrocheilus*), and bridgelip sucker (*Catostomus columbianus*), Umatilla dace (*Rhinichthys umatilla*), speckled dace (*Rhinichthys osculus*), redside shiner (*Richardsonius balteatus*), northern pikeminnow (*Ptychocheilus oregonensis*), peamouth chub (*Mylocheilus caurinus*), and three-spine stickleback (*Gasterostius aculeatus*) (Berg et al. 2002). Other species reported to be in the basin are longnose dace (*Rhinichthys cataractae*) and shorthead sculpin (*Cottus confusus*) (Hillman in Chapman 1989). In addition, the nonnative eastern brook trout (*Salvelinus fontinalis*) are distributed throughout the watershed (Berg et al. 2002). Isolated lakes in the watershed, including Fish Lake and several of the high alpine lakes are also stocked with a variety of nonnative game fish.

The Wenatchee River Subbasin is believed to contain 15 species of amphibians (Berg et al. 2002). Amphibian species likely to occur in the project area are the great basin spadefoot (*Spea internontana*), Pacific treefrog (*Hyla regilla*), roughskin newt (*Taricha granulosa*), and western toad (*Bufo Boreas*) (Hides 1994). In addition, the area potentially supports tailed frog (*Ascapus truei*) and two Washington State candidate/sensitive and Federal species of concern: the Columbia spotted frog (*Rana luteiventris*) and the Larch Mountain salamander (*Plethodon larselli*) (Berg et al. 2002). Additional important aquatic species that may be present in the watershed include two freshwater mussels species: the winged floater (*Anodonta nuttalliana* aka *A. oregonensis* or *A. wahlamatensis*), and the western ridge mussel (*Gonidea angulata*).

6.3.2.1 Fish Species

The salmonid and lamprey species in the Wenatchee River watershed share a set of common freshwater habitat needs, generally referred to as "cool, clean water." In particular, these species depend on water temperature cues to trigger upstream migrations and spawning activities. In addition, because these species lay their eggs in the gravel, they require areas where flows have sorted gravel by size and the substrate is relatively lacking in fine particles (such as sand and silt). Although each species have specific habitat requirements, in general, the requirements can be outlined as including:

- Clean, well oxygenated water;
- Adequate flows for migration, holding, spawning, and rearing;
- Cool water temperatures;
- Gravel areas for spawning that have less that 10% fines;
- Complex habitat containing pools, riffles, and structure (boulders or LWD); and
- Canopy cover to reduce heat adsorption.

The general life history of anadromous salmonid fish involves constructing nests (redds) in the gravel for spawning and incubation. Upon emergence from the gravel, the juvenile salmon rear in freshwater and then migrate to the ocean to feed and mature. The adult salmon then return to their natal sites to spawn and complete their life cycle. There are many variations on the timing and duration of these life cycles among species and from year to year within species. Each salmonid species present in the Wenatchee

River has a different length and timing of freshwater residence. Non-anadromous salmonid species complete their entire life cycle in freshwater.

Historically, all adult salmon and steelhead migrating up the Columbia River between 1939 and 1943 were intercepted at Rock Island Dam by the USFWS, as part of the Grand Coulee Dam Fish Maintenance (GCDFM) Project (Peven 1992). Fish collected at Rock Island Dam were then relocated to the Wenatchee, Entiat, Methow, and Okanogan river basins or they were used as broodstock at hatcheries located on Icicle Creek and the Entiat and Methow rivers (Peven 1992).

6.3.2.1.1 Chinook salmon (Oncorhynchus tshawytscha)

Chinook salmon are divided into three major run types: spring, summer and fall. Spring run fish are considered "stream type" while summer and fall run fish are "ocean type" (Healey 1983). Stream type fish spend one or more years in freshwater before outmigrating as smolts. Ocean type fish will generally spend less than one year in freshwater before outmigrating as subyearlings. Both stream and ocean type chinook are present in the Wenatchee River basin.

Adult spring chinook (stream-type) return to the Columbia River from the ocean in late March to early April and then enter the Wenatchee River during the period from May to June (Figure 6.3-1). Low summer stream flows through the Tumwater Canyon may delay entry into the Wenatchee River (WDFW 1994). Spawning takes place in August and September, peaking in mid- to late-August. Spawning areas for spring chinook in the Lake Wenatchee watershed include: Nason Creek, and the Chiwawa, Little Wenatchee, White, and mainstem Wenatchee rivers (Figures 6.3-2 and 6.3-3). After incubation, juvenile spring chinook emerge from the gravel from late March to early May. They generally spend their first summer rearing in the subbasin and outmigrate in late fall through the following spring. Numerous life history types may be exhibited in the Wenatchee basin including rearing and/or overwintering in tributaries, side channels, the mainstem Wenatchee, or Lake Wenatchee or outmigrating in the fall or winter (NMFS 1998). The extended use of freshwater habitats makes stream-type chinook more susceptible than ocean-type chinook to impacts from habitat alterations in the tributaries.

Four separate spring chinook stocks have been identified in the Wenatchee basin: Chiwawa River, Nason Creek, Little Wenatchee River and White River stocks (WDFW 1994). All four stocks were classified by WDFW as "Depressed" based on chronically low production (Andonaegui 2001). Adult fish are collected at upstream dams on the Chiwawa River and Nason Creek for hatchery broodstock at the Rock Island Fish Hatchery Complex. Hatchery supplementation of spring chinook in the Wenatchee basin has averaged 2,712,859 fish from 1982 to 1991. Spring chinook in the Upper Columbia Evolutionarily Significant Unit (ESU), including the Wenatchee basin, were listed as endangered under the ESA on March 16, 1999 (FR 64 14308). This listing includes all naturally spawned spring chinook as well as hatchery stock spring chinook from the White River, Nason Creek and Chiwawa River.

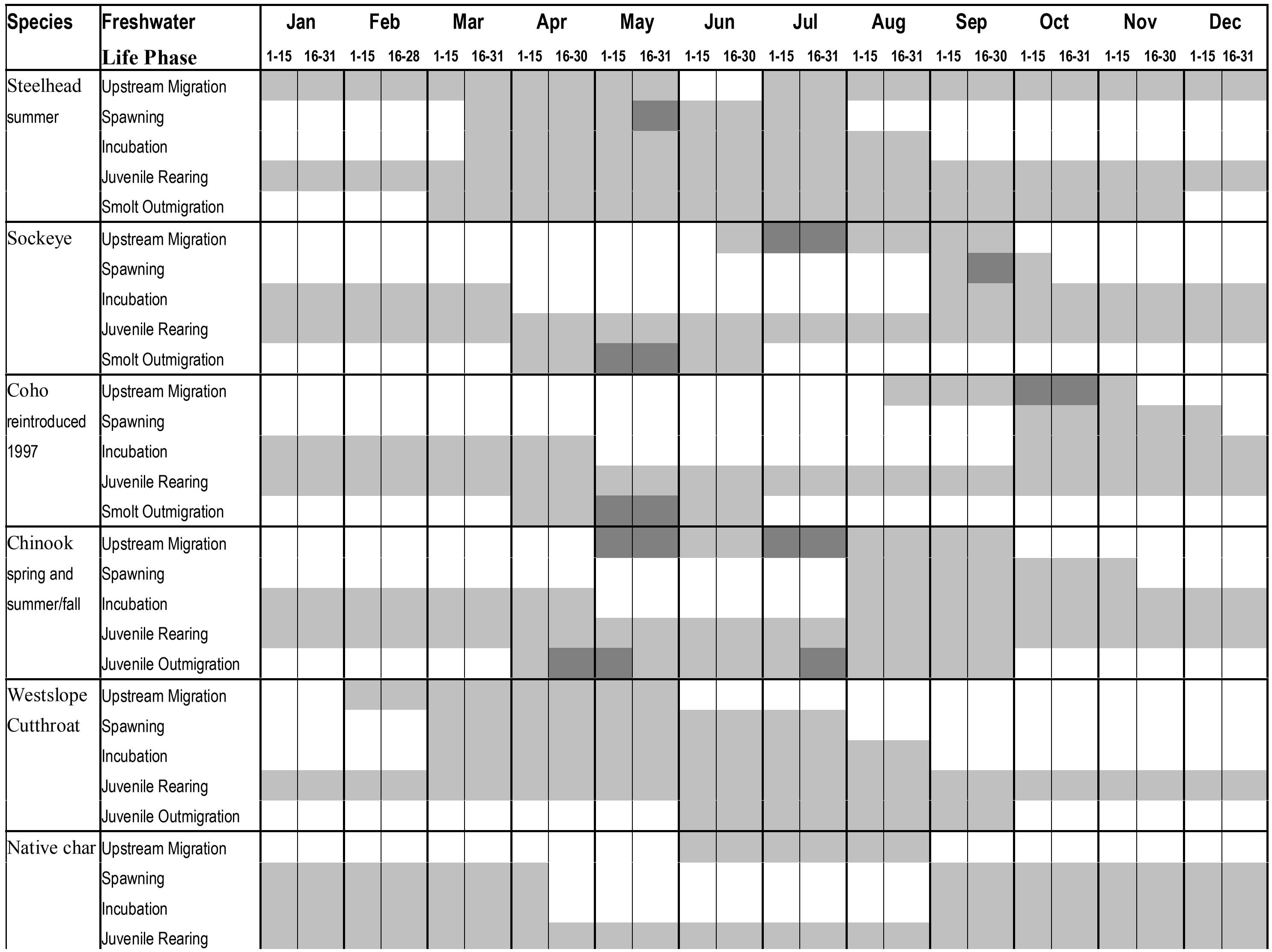


Figure 6.3-1. Temporal distribution of adult and juvenile salmonid habitat utilization in the Wenatchee River basin, Washington. Darker areas indicate times of peak occurrence at the mouth of the Wenatchee River. Data adapted from NMFS et al. 1998, Beery and Kelly 1982 and USFWS 1999.

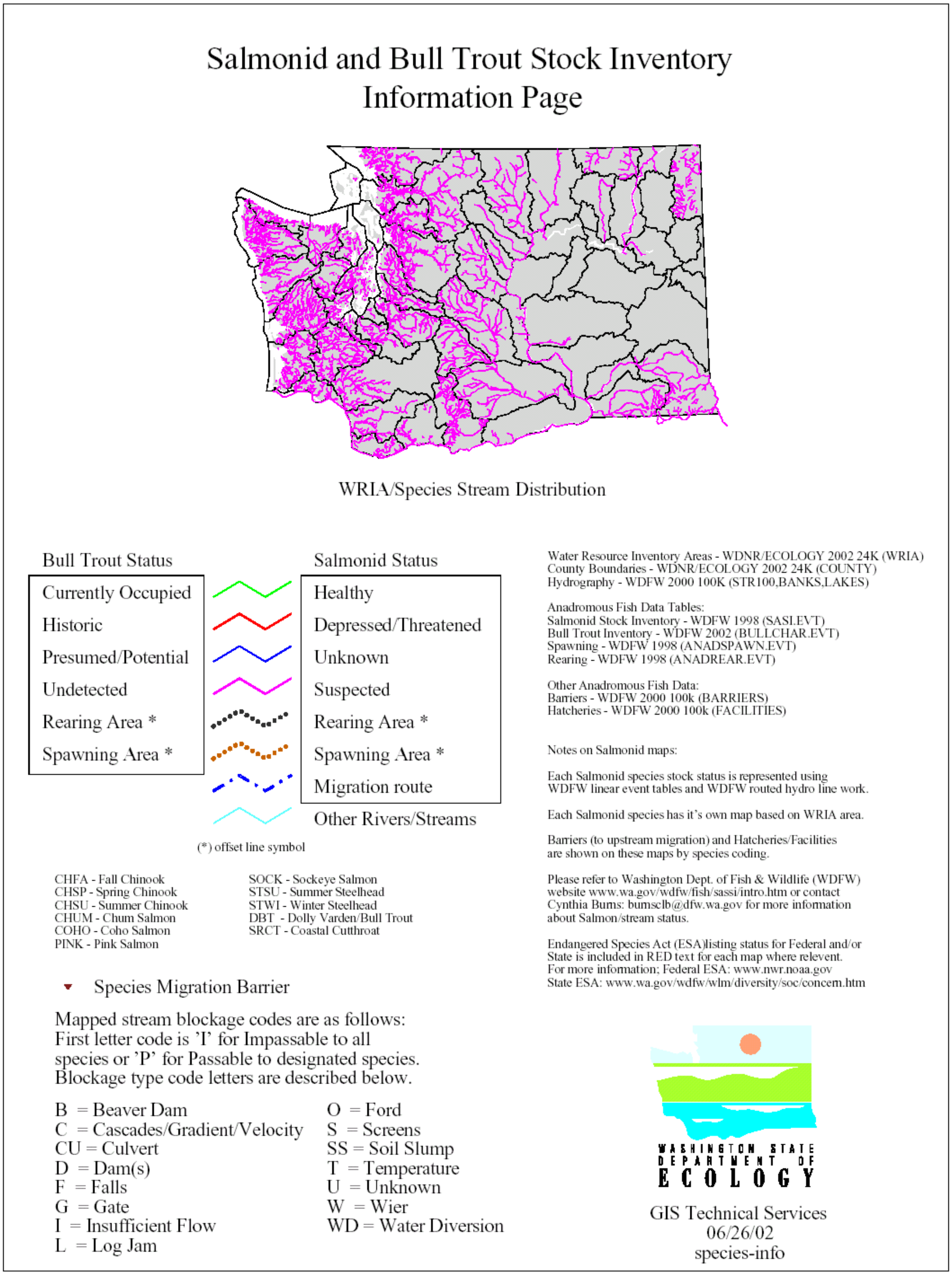


Figure 6.3-2. Legend and information page for the WRIA 45 fish distribution maps.

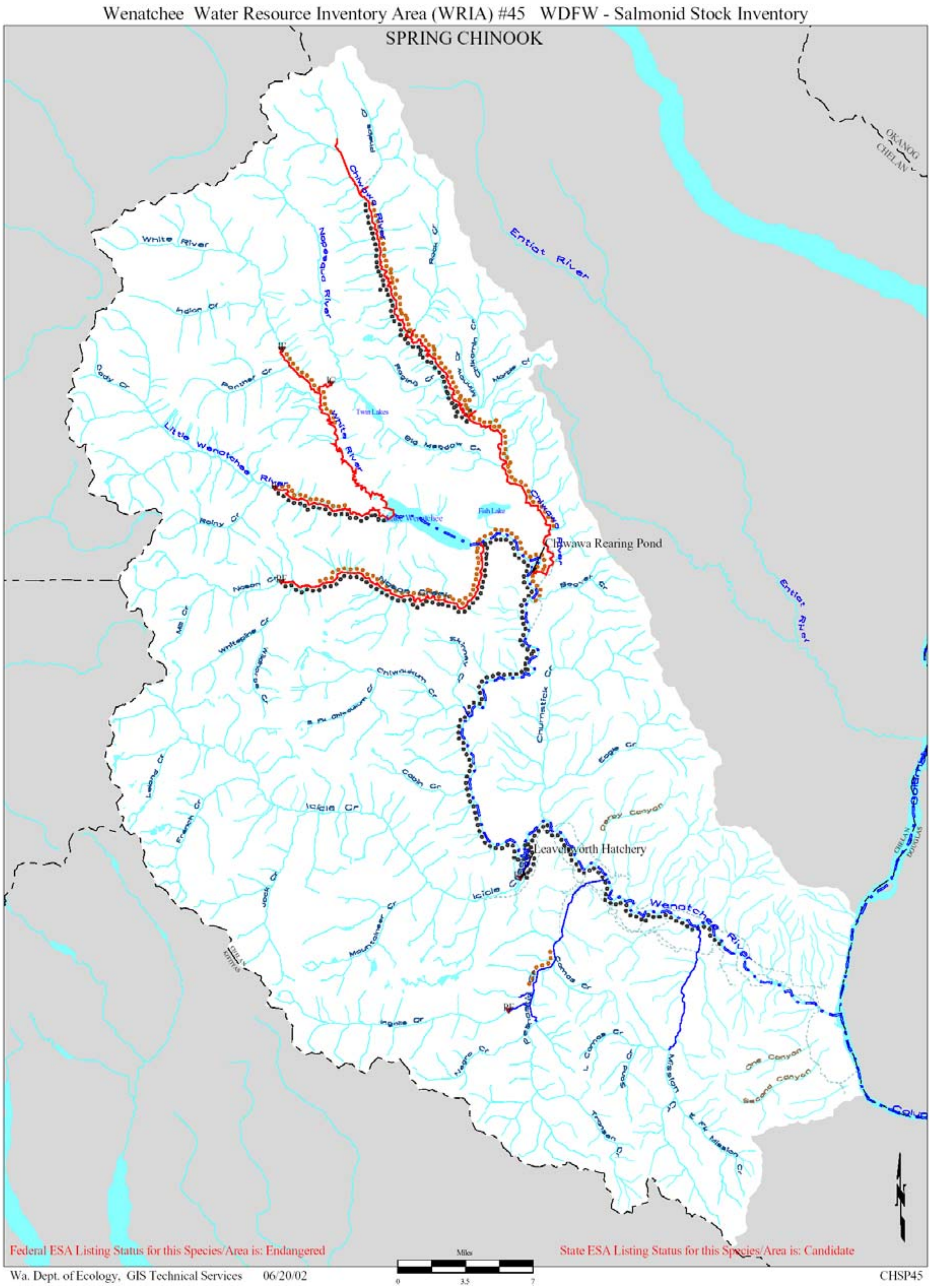


Figure 6.3-3. WRIA 45 spring chinook salmon distribution map.

Summer (ocean-type) chinook enter the Wenatchee River basin during the period from late June through August. Spawning starts in late September and continues into early November. Peak spawning occurs during early to mid-October (WDFW 1994). Summer chinook spawn in areas throughout the mainstem Wenatchee River, from the outlet of Lake Wenatchee downstream to its confluence with the Columbia River (NMFS et al. 1998). However, most of the spawning occurs within 8 miles of Leavenworth (WDFW 1994). Emerging summer chinook fry rapidly migrate downstream from the Wenatchee River during the period from late winter to spring, and typically exit the river basin prior to low streamflow conditions in the fall. This behavior indicates that conditions in the mainstem Columbia River and its reservoirs have a greater influence on the smolt survival of ocean-type chinook than the conditions in the Wenatchee River.

One summer chinook run has been identified in the Wenatchee River basin (WDFW 1994). This run is classified as "Healthy" based on escapement, and is the third largest naturally produced chinook run in the Columbia River basin (Andonaegui 2001). Recent summer chinook counts (1994 to 1998) at Rock Island Damon the Columbia River averaged approximately 18,400 chinook. The summer chinook run in the Upper Columbia River (including the Wenatchee River basin) are not listed under the ESA.

6.3.2.1.2 Sockeye salmon/kokanee (O. nerka)

Sockeye salmon differ from other salmon species by requiring a lake environment to complete their life cycle. Anadromous sockeye return to the Columbia River from the ocean beginning in mid-June with most returning in early July (WDFW 1994). The adults migrate into Lake Wenatchee during late July and early August, and they then spawn in September (Figure 6.3-1) (WDFW 1994; Andonaegui 2001). Principal sockeye spawning areas in the Lake Wenatchee basin include the Little Wenatchee River (RM 0 to 5), the White River (RM 5.5 to 9.3), and the Nepecqua River (RM 0 to 1.2) (NMFS et al. 1998) (Figures 6.3-2 and 6.3-4). Additionally, some fish may spawn along the shoreline at the upper end of Lake Wenatchee, but this has not been verified (NMFS et al. 1998).

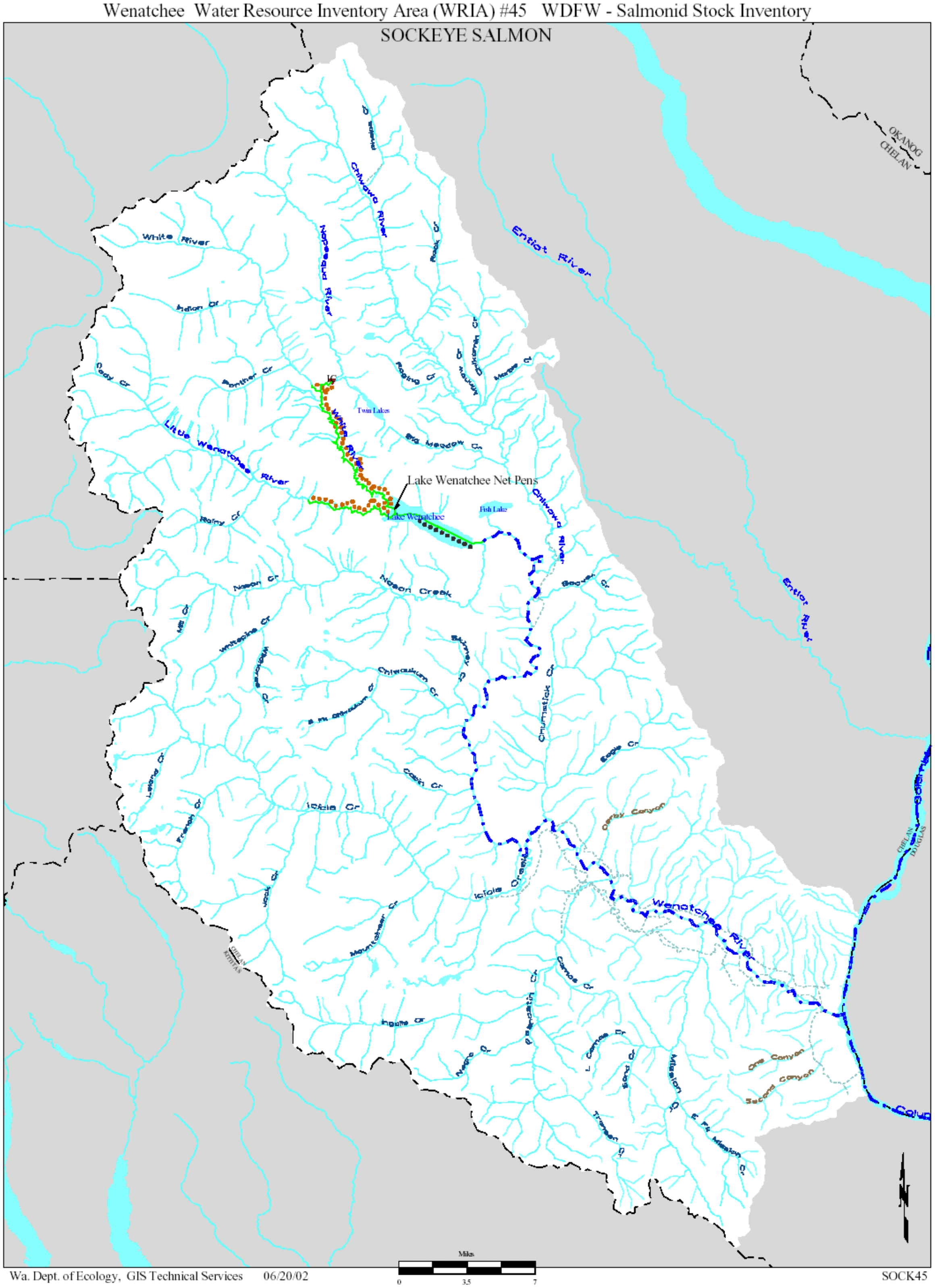


Figure 6.3-4. WRIA 45 sockeye salmon distribution map.

Sockeye fry emerge from the gravel during the period from early to late spring and then the fry quickly migrate into Lake Wenatchee to rear. A snorkel survey in 2001 of Lake Wenatchee detected the presence of sockeye fry in the littoral areas starting on May 11, although other surveys have reported that sockeye fry enter Lake Wenatchee between March and May (Murdoch and LaRue 2002). Most juvenile sockeye rear for one year in the lake, although, some may rear for two years (NMFS et al. 1998). A small percentage of sockeye remain in Lake Wenatchee their entire lives. These non-anadromous sockeye are known as kokanee, and are described below. Outmigrating sockeye smolts typically pass the Mid-Columbia River dams during the period from April through May (Andonaegui 2001).

Lake Wenatchee sockeye are one of only two runs still existing in the Columbia River Basin (USFS 1998). Historically, sockeye were produced in eight river systems in the Columbia River basin (Peven 1992). Today, only about 5 percent of the pre-1900 nursery lake habitat in the Columbia River basin remains accessible today to sockeye salmon (Gustafson et al. 1997). Although the Lake Wenatchee sockeye run is believed not to be in danger of extinction in the foreseeable future, concerns about the overall health of this run include the effects of hydropower development on the Columbia River and the effects on genetic integrity as a result of hatchery production and potential interbreeding with non-native kokanee (Gustafson et al. 1997). The historical sockeye salmon abundance in the Wenatchee River basin was drastically depleted by irrigation diversions and over fishing in the early 1900s (Andonaegui 2001 and WDFW 1994). Specifically, Dryden and Tumwater dams had historically poor rates of adult passage. Both fishways have been rebuilt and are no longer major passage barriers for adults.

The current sockeye population in Lake Wenatchee is a mixture of native sockeye and descendants of fish transferred to the basin during the GCDFM Project that began in 1939. As part of that project, 2.4 million Quinault River sockeye were released into Lake Wenatchee. Sockeye production at the Leavenworth hatchery was discontinued in 1969, but a hatchery program to rear fry in Lake Wenatchee pens was initiated in 1990 (WDFW 1994). Since 1993, native sockeye counts at Rock Island Dam have ranged between 8,500 and 41,500 (Andonaegui 2001). WDFW considers the Wenatchee River sockeye natural stock status to be “Healthy” at this time, based on escapement (averaging 30,000 adult fish since 1977). Wenatchee Basin sockeye are considered part of the Lake Wenatchee ESU. This ESU is not federally listed under the ESA and provides a growing recreational fishery.

Kokanee (freshwater sockeye salmon) follow an adfluvial (lake-rearing) life history pattern. These fish mature in Lake Wenatchee, spawn in the tributaries or along the shore, and die after spawning. Their life history characteristics are similar to sockeye, except that they are not anadromous, and the kokanee generally mature at a smaller size than their anadromous counterparts (Gustafson et al. 1997).

Hatchery reared kokanee have been released in Lake Wenatchee, including native stock and stock from Lake Whatcom (Gustafson et al. 1997). Kokanee are considered by the NMFS to be part of the Lake Wenatchee sockeye salmon ESU, are not presently in danger of extinction, and are not believed likely to become endangered in the foreseeable future (Gustafson et al. 1997).

6.3.2.1.3 Summer steelhead / Rainbow trout (O. mykiss)

Steelhead in the Wenatchee River are summer-run fish that return to the Columbia River basin from the ocean as upstream migrating adults during June through August (Figures 6.3-2 and 6.3-5) (WDFW 1994). Steelhead migrate or hold in freshwater through the fall and winter until they spawn in the spring. In the

Wenatchee system, spawning occurs from March through June, or as late as July in colder headwaters. Peak steelhead spawning probably occurs in late May. Unlike salmon, most steelhead do not die after spawning and are capable of spawning again in the following years. Steelhead smolts typically outmigrate from the Wenatchee River in March through early June. Fish counts at Rock Island Dam on the Columbia River indicate that the majority of steelhead smolts pass the dam in May. Most Upper Columbia River steelhead mature for one or two years in the ocean before returning to their natal streams to spawn (WDFW et al. 1990).

Resident forms of steelhead are called rainbow or redband trout. The relationship between steelhead and resident forms is not clearly understood. Steelhead progeny can mature as resident fish, and resident rainbow trout have the ability to become anadromous (Peven 1992). Steelhead/rainbow are found in a number of systems within the Wenatchee River basin: Mission, Sand, Brender, Peshastin, Chumstick, Icicle, Chiwaukum, and Nason creeks and the Chiwawa, Little Wenatchee, White, and Wenatchee rivers (NMFS et al. 1998) (Figure 6.3-5).

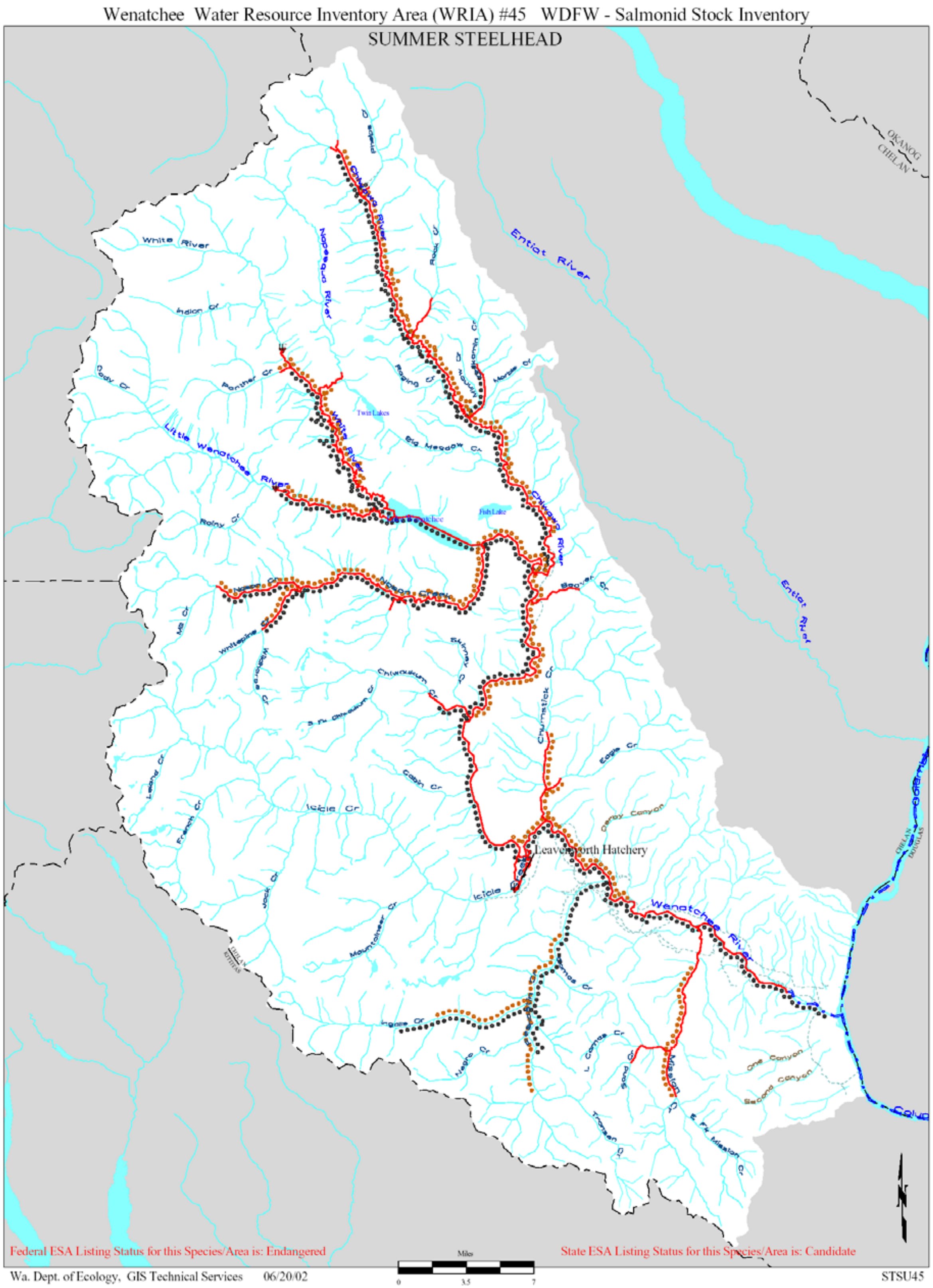


Figure 6.3-5. WRIA 45 steelhead distribution map.

The numbers of naturally spawning steelhead has declined over time. Peven (1992) reported that in 1987, hatchery steelhead accounted for 73 percent of the steelhead run entering the Columbia River. WDFW currently classifies the Wenatchee stock as "Depressed" due to chronically low production (WDFW 1994). The Upper Columbia ESU of summer steelhead, including the Wenatchee River basin, was listed as endangered under the federal ESA on August 18, 1997 (62 FR 43937).

6.3.2.1.4 Coho salmon (O. kisutch)

By the early 1900s, the Mid-Columbia coho salmon population was decimated, and today indigenous coho are not present in the Wenatchee River basin. Several factors contributed to the decline including harvest rates, impassable dams, unscreened irrigation diversions, logging, mining, grazing and water use practices in the tributaries (Andonaegui 2001). Historical adult coho populations in the Wenatchee subbasin were estimated by Mullan (1983 as cited in Andonaegui 2001) at 6,000 to 7,000. Historically, coho probably returned to the Wenatchee River in August and September and spawning likely occurred from October to mid-December (Figure 6.3-1) (Andonaegui 2001). Columbia River coho typically spend one year in freshwater before outmigrating as yearling smolts in April or May. Adult coho will spend approximately 18 months at sea before returning to spawn.

Because native coho salmon no longer occur in the Upper Columbia River system, the Wenatchee basin coho are not addressed under the ESA or by the WDFW (1994) Salmon and Steelhead Stock Inventory. The Yakima Nation has begun efforts to "restore coho salmon populations in mid-Columbia tributaries to levels of abundance and productivity sufficient to support sustainable annual harvest by tribal and other fishers" (Dunnigan 1999). In 1999, the Yakima Nation released approximately 525,000 coho smolts in the Wenatchee subbasin (Dunnigan 1999). In 2001, three coho redds were observed in Nason Creek (Murdoch and LaRue 2002).

6.3.2.1.5 Pacific lamprey (Lampetra tridentata)

One of the most primitive fishes found in the Wenatchee River system is the Pacific lamprey (NMFS et al. 1998). Pacific lamprey are often mislabeled as pest species due to the problems associated with the exotic sea lamprey (*Petromyzon marinus*) in the Great Lakes (Close et al. 1995). However, Pacific lamprey are native to the Wenatchee River. Lamprey have freshwater habitat requirements similar to the Pacific salmon, and therefore face the same habitat problems affecting salmonid abundance and distribution. In particular, elevated water temperatures (greater than 20ºC) and increased sediment in spawning gravels are two major habitat factors attributing to lamprey population decline (Close et al. 1995).

Pacific lamprey are anadromous and the adults return to freshwater in the fall and spawn in late-spring through early-summer (Close et al. 1995). Adult lamprey die after spawning and the spawned-out carcasses provide important nutrients to the stream system, as well as dietary items for other fish (Close et al. 1995). Juvenile lampreys, termed ammocoetes, swim up from the nest and are washed downstream where they burrow into mud or sand where they feed by filtering organic matter and algae (Moyle 1976). Ammocoetes generally remain in fresh water for 5 or 6 years (Wydoski and Whitney 1979). Larval lamprey transform to juveniles from July through October (Close et al. 1995). It is during this transition that they become ready for a parasitic lifestyle by developing teeth, tongue, eyes, and the ability to adapt to salt water. After metamorphosis, juvenile lamprey remain in fresh water for up to 10 months while migrating to the ocean. After reaching the ocean, Pacific lamprey attach themselves to and parasitically feed on other fish (Moyle 1976). They may remain in salt water for up to 3.5 years (Close et al. 1995).

Though historical and current population sizes of the lamprey are relatively unknown, it is clear that these fish were once a significant source of tribal subsistence as well as ceremonial and medicinal purposes. Recent reviews of the Jon Day, Umatilla, Walla Walla, Tucannon, and Grand Ronde subbasins revealed that Pacific lamprey populations are a fraction of past abundances in these basins (Jackson et al. 1997). Pacific lamprey are reported to occur in the White, Little Wenatchee, and mainstem Wenatchee rivers (Berg et al. 2002).

The USFWS was petitioned in February 2003 to protect Pacific lamprey under the ESA. However the USFWS stated that the species (and three other related lamprey species) would not be considered for ESA protection until there is more money to do the work.

6.3.2.1.6 Bull trout (Salvelinus confluentus)

Bull trout are a native char in the Wenatchee River system. Similar to steelhead and cutthroat trout, the species can spawn in more than one year. Bull trout spawning occurs in September and October, with timing dependent on cooling water temperatures. Bull trout life history strategies include anadromy as well as adfluvial (lake rearing), fluvial (river-rearing), and resident (stream rearing and spawning) forms (Pratt 1992). The Wenatchee River basin supports adfluvial, fluvial, and resident forms, and probably combinations thereof. The adfluvial form matures in Columbia River reservoirs or Lake Wenatchee and then ascends tributary streams to spawn. The juveniles rear for one to three years in the tributaries before migrating down to the lake or reservoir to mature. Fluvial populations move from rivers to smaller tributaries to spawn. Resident forms are generally smaller-bodied and spend their entire lives in headwater streams.

Adfluvial bull trout that rear in Lake Wenatchee spawn in the Chiwawa River and its tributaries, the White and Little Wenatchee rivers, and possibly in Nason Creek (WDFW 1994; Brown 1992) (Figures 6.3-2 and 6.3-6). The White River may also support a fluvial population (WDFW 1994). Resident populations are found only in the coldest streams and in streams without brook trout populations. Resident populations are believed to occur in Panther, Jack, Trout, Eightmile, Ingalls and French creeks and the Napecqua River. Bull trout spawning populations in the Wenatchee River basin are most abundant in Panther Creek (a tributary to the White River) and the Chiwawa River and its tributaries (Brown 1992). One of the major limiting factors to bull trout populations in the Wenatchee River basin is the presence of non-native brook trout. Similar habitat preferences and biology allow brook trout to hybridize with bull trout and eventually eliminate them (WDFW 1994).

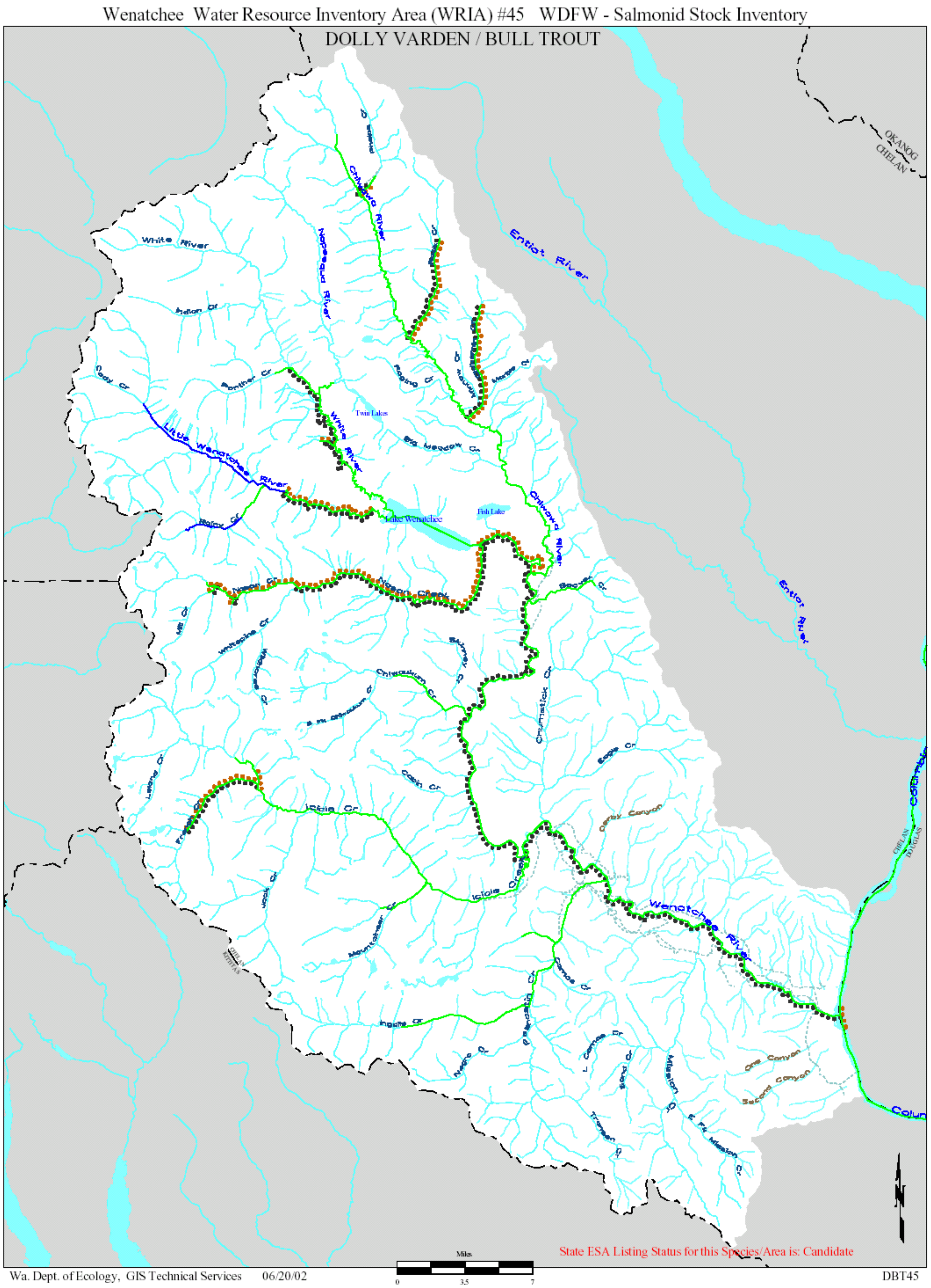


Figure 6.3-6. WRIA 45 bull trout distribution map.

Results from a recent USFWS radio-tag study indicated that adult bull trout in the Wenatchee River system migrate upstream and downstream and from one tributary to another (Ringel and DeLaVergne 2001). Adult bull trout tagged in Lake Wenatchee were found to migrate downstream into the Chiwawa, or upstream into the White or Little Wenatchee river systems to spawn (Ringel and DeLaVergne 2001) (Figure 6.3-6). Adult bull trout tagged in the Chiwawa were later found in the Chiwawa River system as well as upstream in Lake Wenatchee and the Little Wenatchee River and downstream in the Wenatchee River. It has also been reported that some adfluvial bull trout in Lake Wenatchee may migrate downstream into Nason Creek to spawn (WDFW 1994). Adult bull trout can also migrate upstream from the Columbia River and into these tributaries to spawn, although it is believed that the majority of fish spawning in the Chiwawa River system are adfluvial fish that migrate downstream from Lake Wenatchee (Murdoch et al. 2001; Ringel 2003). A separate radio-telemetry study on adult bull trout tagged in the Columbia River found that these fish migrated into the Wenatchee River in late June through September (Figure 6.3.1) (BioAnalysts 2002). Bull trout spawning populations in the Wenatchee River basin are most abundant in Panther Creek (a tributary to the White River) and the Chiwawa River and its tributaries (Brown 1992).

Data from a WDFW smolt trap on the Chiwawa River indicate that juvenile bull trout outmigrate from the Chiwawa during March through November with a peak outmigration during the period September to November when flows tend to be low, although large numbers also outmigrate with high flows in April, May and June (Ringel 2003). Many of these juvenile fish likely migrate upstream for almost 6 miles to rear in Lake Wenatchee although some migrate downstream to rear in the Columbia River.

Bull trout and Dolly Varden (*S. malma*) are difficult to distinguish based on physical characteristics, and both have similar life history traits and habitat requirements (WDFW 1998). Because the species are closely related and have similar biological characteristics, the WDFW manages bull tout and Dolly Varden together as “native char” (WDFW 1998). WDFW (1994) recognizes eleven bull trout/Dolly Varden stocks in the Wenatchee watershed: Icicle, Ingalls, Chiwaukum, Chikamin, Rock, Phelps, Nason and Panther Creeks, and Little Wenatchee, Chiwawa and White River stocks (Figure 6.3-6). Four of the eleven (Chikamin, Rock, Phelps and Panther creeks) have been categorized as “Healthy”, with the remaining seven listed as “Unknown”. Bull trout in the Columbia River Distinct Population Segment (DPS) (including the Wenatchee basin) are listed as threatened under the ESA. Section 4(e) of the ESA provides for the listing of a non-threatened species if the listing of this species provides a greater level of protection to the listed species. The USFWS indicated in January 2001 that Dolly Varden are being considered for listing as threatened due to their similarity of appearance to bull trout (66 FR 1628).

6.3.2.1.7 Westslope cutthroat trout (O. clarki lewisi)

Westslope cutthroat trout are a native subspecies of cutthroat trout (*O. clarki*). This interior species spends its entire life in freshwater. The species usually matures at 4 or 5 years of age and then spawns in small tributaries. Similar to steelhead/rainbow trout and bull trout, the westslope cutthroat trout typically does not die after spawning. Although cutthroat trout can spawn in consecutive years, individual fish may not spawn every year. Three life history strategies are utilized by westslope cutthroat trout: adfluvial, fluvial, and resident. Juvenile fish exhibiting adfluvial life histories mature in lakes and reservoirs. In the tributaries, adult and juvenile resident cutthroat remain in pools and runs that have temperatures of 7 to 16□C and provide a diversity of cover (USFWS 1999). Westslope cutthroat trout feed predominately on macroinvertebrates, such as aquatic insects and zooplankton, avoiding competition with piscivorous fish such as bull trout (Behnke 1992).

The original distribution of westslope cutthroat trout is not clearly known, and because the species hybridizes with other trout species, especially rainbow trout, genetically "pure" and "essentially pure" (as defined by NMFS) populations currently exist in the Wenatchee Watershed (NMFS et al. 1998). The pure stocks primarily occur in high-elevation headwater streams where temperatures may exclude competition and hybridization with other fish species. There are populations of westslope cutthroat trout present in the Chiwawa, Little Wenatchee, and White rivers, and Nason, Icicle and Negro creeks. Other creeks that were not sampled may also support pure or essentially pure stocks.

The USFWS considers the westslope cutthroat trout a species of concern. The USFWS received a formal petition to list the westslope cutthroat trout as threatened pursuant to the ESA. A status review determined a listing of the species was not warranted at this time. Responding to requests to more thoroughly take into account the hybridization issue from numerous agencies, the USFWS reopened the public comment period until March 31, 2003 (67 FR 77466).

6.3.2.1.8 Mountain sucker (Catastomus platyrhynchus)

The mountain sucker is a small fish (6 to 8 inches) that spawns in late-spring or early-summer (Scott and Crossman 1973). Mountain suckers prefer cool stream habitat and they feed primarily on algae and diatoms. Recently, mountain sucker have been observed near the smolt trap by Lake Wenatchee (Berg et al. 2002).

The mountain sucker is included in this summary of important aquatic resources since it is listed as a Washington State priority habitat species. However, little is known about its population status and distribution in the Wenatchee River basin.

6.3.2.1.9 Umatilla dace (Rhinichthys umatilla)

Umatilla dace are a small minnow that occur in three Columbia River drainages including the Wenatchee River subbasin (Berg et al. 2002). The Umatilla dace has only recently been verified as a species distinct from the leopard dace (*R. falcatus*). Umatilla dace prefer flowing water habitat with cobble or gravel bottoms and relatively warm, productive waters. Umatilla dace are a Washington State priority habitat species, however, little is known about its distribution and population status.

6.3.2.2 Amphibians

6.3.2.2.1 Columbia Spotted Frog (Rana luteiventris)

The Columbia spotted frog and the Oregon spotted frog were originally regarded as the same species (the spotted frog, *Rana pretiosa*). Recent genetic studies have concluded they are two separate species, but that they cannot be reliably distinguished by morphology. However, the two species have allopatric (non-overlapping) ranges, so they may be reliably identified based upon location (USGS 2003).

The Columbia spotted frog is always found in close association with water. Columbia spotted frogs breed in shallow (<60cm) water emergent wetlands such as edges of ponds and small lakes. Breeding takes place in late winter or early spring depending on levels of ice present. In the Columbia basin breeding typically occurs in late March or April. Eggs are deposited in still shallow water atop vegetation mats or wetland plants. The tadpoles will emerge from the eggs in a few weeks. Tadpoles metamorphose into froglets in their first summer or fall of rearing.

The Columbia spotted frog is classified as a Washington State candidate species and a Federal species of concern. As a State candidate species, WDFW will review species information for possible listing as endangered or threatened.

6.3.2.2.2 Larch Mountain Salamander (Plethodon larselli)

The Larch Mountain salamander is one of the rarest amphibian species in the Pacific Northwest, and hence little is known concerning their life history or distribution (Leonard et al. 1993). The species is terrestrial, associated with moss-covered talus slopes, and the species may occur in some upland areas of the White and Little Wenatchee rivers (NPPC 2002). The Larch Mountain salamander is classified as a Washington State sensitive species and a Federal species of concern due to its vulnerability and likeliness to become endangered or threatened.

6.3.2.3 Other Aquatic Species

Freshwater mollusks have freshwater habitat and water quality requirements similar to anadromous salmon, and the distributions of freshwater mussels are dependent on host relationships with fish (Gustafson et al. 1997). The mussel larvae (glochidia) parasitize the gills or fins of fish and, therefore, require fish hosts to complete their life cycle. Freshwater mussels associated with the distribution of sockeye salmon include the winged floater (*Anodonta nuttalliana*) and the western ridge mussel (*Gonidea angulata*). Other species of mussels, snails and clams may also be present in the Wenatchee watershed.

6.3.3 Wetlands

At the western end of the lake there is an extensive complex of wetlands associated with the outlets of the Little Wenatchee and White rivers. These delta wetlands include littoral wetlands along the lake shore, floodplain wetlands including abandoned oxbow channels, and beaver ponds. Based on analysis of aerial photographs, information from the Department of Ecology (Ecology 1997), and general observations, vegetation in these wetlands includes:

- aquatic plant communities composed of such species as waterweed (*Elodea* spp.), pondweed (*Potamogeton* spp.), and yellow water lily (*Nuphar polysepala*);
- emergent herbaceous communities dominated by sedges (*Carex* spp.), rushes (*Juncus* spp.), spikerushes (*Eleocharis* spp.), horsetail (*Equisetum* spp.), and bur-reed (*Sparganium angustifolium*);
- shrub communities composed primarily of willows (*Salix* spp.), and
- a few small stands of cottonwood (*Populus trichocarpa*).

Because the area to the west of the lake is an ancient lake bed (see Section 6.1.1), it has a very low gradient away from the lake. Channel movement, and associated sediment deposition and erosion, by the Little Wenatchee and White rivers has resulted in some relief to the land surface, which contributes to the heterogeneity of vegetation within the wetlands. Except for wetlands along the immediate shoreline of the lake, it is not known to what degree these wetlands are connected hydrologically with Lake Wenatchee. However it is likely that the influence of the lake on groundwater and wetland hydrology extends some distance, perhaps a hundred feet or more.

6.3.4 Water Quality

Water quality in any system is determined by the water source, watershed condition, geology, and the interrelated factors of water quantity and channel form. For example, a river that is dominated by snowmelt in a forested system will generally have colder and cleaner water than a river that receives rainfall that washes over a developed watershed. The water quality in the Wenatchee River basin is similarly varied between the upper tributaries that drain melting glaciers, the water in Lake Wenatchee, and in the Wenatchee River downstream of the towns of Leavenworth and Wenatchee. The water quality variables that are of the most concern to the protection of native salmon, trout, and char species in the Wenatchee River basin are low instream flows and elevated water temperatures (NPPC 2002). In many streams, such as the Wenatchee River, low instream flows can result in higher water temperatures since the temperature of rivers with smaller volumes equilibrate faster, leading to higher maximum water temperatures in the summer (USEPA 2002).

Currently two water quality criteria for temperature to protect aquatic life are used in the Wenatchee River system. Tributaries and the Wenatchee River from the headwaters to the National Forest boundary near Leavenworth are rated Class AA (extraordinary) by the State of Washington. This classification requires that water temperatures not exceed 16ºC due to human activities. The lower Wenatchee River is rated Class A (excellent) with the requirement that water temperatures not exceed 18ºC due to human activities.

In an effort to meet the requirements of the Clean Water Act and the ESA, the U.S. Environmental Protection Agency (USEPA) recently developed a set of draft recommended criteria for water temperature to protect native char and other salmonids (USEPA 2002). Most of these recommended temperature criteria focus on the maximum water temperatures that occur in the summer, although additional criteria are recommended for temperature-sensitive salmonid uses that occur in the spring to early summer and late summer to fall (Table 6.3-1). The criteria are based on average maximum temperatures calculated from the maximum temperatures over a seven-day period (7DADM: Maximum 7 Day Average of the Daily Maximums). The use of a 7DADM criterion as a guideline for water quality is different than the single temperature criteria Ecology currently used for Class AA and Class A waters.

Table 6.3-1. USEPA recommended temperature water quality guidelines for Pacific Northwest salmonid fish.

Salmon Species and Life Stage	Recommended Criteria
Bull Trout Juvenile Rearing Applies to waters where summer juvenile bull trout rearing currently occurs and may potentially occur. This use is generally in a river basin's upper reaches.	12°C (55°F) 7DADM
Bull Trout Spawning Applies to waters where and when bull trout spawning, egg incubation and fry emergence currently occurs and may potentially occur. This criteria is designed to protect bull trout spawning, which generally occurs in the fall in the same waters that bull trout juveniles use for summer rearing. If this criterion is met during spawning, the natural seasonal temperature pattern will likely result in protective temperatures for egg incubation (<6°) that occurs over the winter. This use is defined from the average date that spawning begins to the average date incubation ends (the first 7DADM is calculated 1 week after the average date that spawning begins).	9°C (48°F) 7DADM
Salmon/Trout "Core" Juvenile Rearing Applies to core juvenile rearing habitat. Generally, core juvenile rearing applies to the furthest downstream extent of current summer use for areas of degraded habitat where current summer distribution is shrunken relative to historical distribution. For areas of minimally degraded habitat, this use would apply to waters of core use based on density and/or habitat features. This use also applies to juvenile rearing waters that currently meet this criteria. This use is generally in a river basin's mid-to-upper reaches, downstream from juvenile bull trout rearing areas. However, in colder climates, such as the Olympic mountains and the west slopes of the Cascades, this use may apply all the way to the saltwater estuary. This use is designed to protect high quality summertime juvenile rearing habitat for salmon and trout. Protection of these waters for juvenile rearing also provides protection for adult spring chinook salmon that hold throughout the summer prior to spawning and bull trout migration.	16°C (61°F) 7DADM
Salmon/Trout Juvenile Rearing and Juvenile/Adult Migration Applies to waters where summer salmon and trout juvenile rearing and juvenile/adult migration currently occurs and may potentially occur. This use extends downstream from the "core" juvenile rearing use. In many river basins in the Pacific Northwest, this use will apply all the way to river basin's terminus (i.e. confluence with the Columbia or Snake rivers or saltwater). This use is designed to protect juvenile rearing that extends beyond "core" juvenile rearing areas and migrating juveniles and adults.	18°C (64°F) 7DADM
Salmon/Trout Migration on Lower Mainstem Rivers Applies in the lower reaches of mainstem rivers (e.g. mid-lower Columbia river, lower Snake river, and possibly the lowest reaches of other large mainstem rivers) in the Pacific Northwest where based on best available scientific information (e.g. temperature modeling and predisturbance temperature data) maximum temperatures likely reached 20ºC prior to significant human alteration of the landscape. The narrative cold water refugia provision would require all feasible steps be taken to restore and protect the river functions (e.g,. alluvial floodplains) that could provide cold water refugia in these river segments. *Note: this recommendation is a combination of a numeric criteria (20°C) and a narrative WQS requiring effective protection of cold water refugia that together protects this use.*	20°C (68°F) 7DADM, with a coldwater refugia narrative provision

Salmon Species and Life Stage	Recommended Criteria
Salmon/Trout Spawning, Egg Incubation, and Fry Emergence Applies to waters where and when salmon and trout spawning, egg incubation, and fry emergence currently occurs and may potential occur. Generally, this use occurs: a) in late spring-early summer for trout (mid-upper reaches), b) in late summer-fall for spring chinook (mid-upper reaches), c) in the fall for coho (midreaches), pink, chum, and fall chinook (latter three in lower reaches). This use is defined from the average date that spawning begins to the average date incubation ends (the first 7DADM is calculated 1 week after the average date that spawning begins).	13°C (55°F) 7DADM
Steelhead Smoltification Applies to waters where the early stages of smoltification occurs in steelhead trout. Generally applies in April and May for rivers where juvenile outmigration occurs except for the mid and lower Columbia and lower Snake rivers (e.g. the criteria would apply at the mouth of the major tributaries of the Columbia river basin). This use is designed to protect the early stages of steelhead smoltification. Smoltification of other salmonids is generally protected vis-a-vis the summer maximum criteria, but this criteria provides an added level of protection for other salmonids which can successfully smolt at higher temperatures than steelhead.	14°C (61°F) 7DADM
Notes: 1) 7DADM: Maximum 7 Day Average of the Daily Maximums; 2) “Salmon” refers to Chinook, Coho, Sockeye, Pink, and Chum salmon; 3) “Trout” refers to Steelhead and coastal cutthroat trout; 4) “may potentially occur” refers to waters that will likely support the use if temperatures are restored (from USEPA 2002, Table 3. Recommended Criteria That Apply To Summer Maximum Temperatures).	

Ecology has identified three probable causes of high water temperatures in the Wenatchee subbasin resulting from human activities:

- Riparian vegetation disturbance that compromises stream surface shading, through reductions in riparian vegetation height and density
- Channel widening (increased width-to-depth ratios) that increases the stream surface area exposed to energy processes, namely solar radiation; and
- Reduced summertime baseflows resulting from instream withdrawals or from wells in hydraulic continuity with the stream (Bilhimer et al. 2002).

Other water quality concerns in the Wenatchee River basin include low dissolved oxygen concentrations (DO) and elevated pH levels; and the presence of DDT, its byproducts and other insecticides in fish tissue. The locations of stream reaches in the Wenatchee River basin listed as impaired for water quality are shown in Figure 6.3-7. In the upper Wenatchee River basin, impaired reaches include the mouth of the Little Wenatchee River and Nason Creek for elevated water temperatures, and the Wenatchee River for elevated water temperatures and low instream flow. Misson Creek near the town of Cashmere was listed as impaired by Ecology for agricultural pesticides.

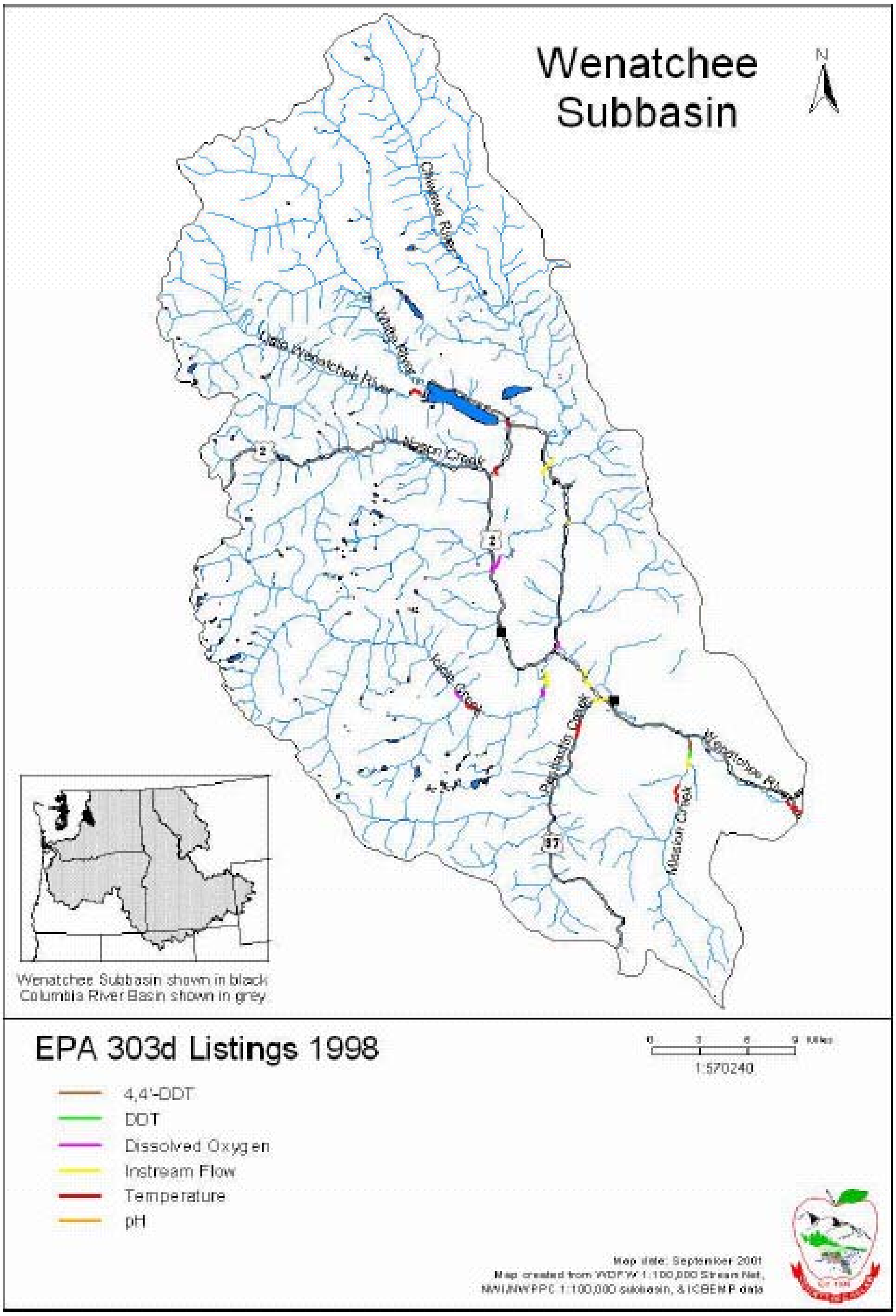


Figure 6.3-7. Map of the Wenatchee River basin indicating stream reaches that were included on the 1998 303(d) list of impaired waters (from NPPC 2002).

6.3.4.1 Tributaries

In the White River, melting glaciers maintain cool water temperatures and also result in highly turbid waters during the spring, early summer, and for short periods in the fall. The relatively pristine watershed helps maintain good water quality in the river, and typical of glacial rivers, the water is cold, well oxygenated, has low conductivity, and is low in nutrients (WRSC 1998). Water temperatures measured in the mainstem at the mouth of the White River during 1995/1996 ranged from 1.8 to 12.6ºC (WRSC 1998).

The Little Wenatchee River does not receive glacial melt water and it is therefore less turbid than the White River. However, sediment loads in the Little Wenatchee River from mass wasting are high, although it is unknown if this is related to natural flood-related pulses or if the rate of sediment loading is accelerated (USFS 1998). In addition, a gravel and sand mine located adjacent to the lower reach of the Little Wenatchee River is a testimony to the historical deposition of sediments in the river floodplain. Although water quality in the Little Wenatchee River is protected by its forested and relatively unaltered watershed, the river has a history of high water temperatures, and because of this the river was included on the 1996 and 1998 state 303(d) lists of impaired water (Ecology 1998). The causes of higher water temperatures in the Little Wenatchee River are currently being investigated and modeled by Ecology (Bilhimer et al. 2002). It is possible that the measurements of high water temperatures reflected lake water conditions rather than stream conditions, as most water temperatures were recorded near the mouth of the river where the river is dominated by wetlands and backwatering from Lake Wenatchee. Other researchers have questioned whether the higher water temperatures in this river are related to inadequate riparian shade in the harvested areas of the watershed or if the water temperatures are naturally high concomitant with greater bedrock influence to the channel and less hydrologic storage in the valley bottom till (USFS 1998). In addition, several large beaver dam complexes on the lower river are likely sources of warm water inputs. Although water temperatures at the mouth of the Little Wenatchee River sometimes exceed the 16ºC criterion, it rarely exceeds 17ºC.

Nason Creek enters the Wenatchee River (at RM 53.6) just downstream of Lake Wenatchee (RM 54.2). Nason Creek was identified as a source of thermal loading to the upper Wenatchee River during a study using Forward Looking Infra-Red (FLIR) thermal photography (Chelan Conservation District, 2003). During this study the water temperature in the river was 17.6ºC at RM 53.5 on August 16, 2002. Nason Creek was included on the 1996 and 1998 state 303(d) lists of impaired water for high water temperatures, as a result of measurements near the creek mouth (Ecology 1998). Water temperatures in Nason Creek measured during 1995/1996 ranged from 0.3 to 16.2ºC (WRWSC 1998).

6.3.4.2 Mainstem Wenatchee River

The Wenatchee River was included on the state's 303(d) list of impaired waters in 1996 and 1998 for low flows during the late summer and early fall, high water temperature, high pH, and low DO levels (Ecology 1998). High pH and low DO levels are typically indicators of nutrient enrichment. Exceedences of pH and DO were measured in the Wenatchee River downstream of the town of Leavenworth.

The uppermost reach of the Wenatchee River reflects the water temperature in Lake Wenatchee. Water temperatures measured in the mainstem at the Lake Wenatchee Bridge during 1995/1996 ranged from 0.7 to 17.1ºC (WRWSC 1998). Just downstream of the lake however, Nason Creek has been identified as a source of thermal loading. Water temperatures continue to increase in a downstream direction. An August 16, 2002 FLIR study measured surface water temperatures as 17.6ºC at RM 53.5, between 18.1º and 18.9ºC between the Chiwawa River (RM 48.4) and Leavenworth (RM 24.4), and between 19.7º and 20.3ºC in the lower approximately ten miles of river (Chelan Conservation District, 2003).

To address the high water temperature exceedences in the river, Ecology has developed a cooperative study with several other agencies to establish a Total Maximum Daily Load (TMDL) for water temperature (Bilhimer et al. 2002). This plan includes assessments of water quality in the Wenatchee River, and the mouths of the White River, the Little Wenatchee River, and Nason Creek.

6.3.4.3 Lake Wenatchee

Lake Wenatchee is an oligotrophic lake based on relatively high water clarity and low concentrations of phosphorous (Ecology 1997). Oligotrophic lakes are generally defined as being low-nutrient systems, with <10 mg/m^3 phosphorus, <200 mg/m^3 nitrogen, and <2 mg/m^3 chlorophyll a. Average summertime secchi depth (water transparency) in Lake Wenatchee was estimated as 20 feet and phosphorous concentrations were 4.8 ug/L (Ecology 1997). Although there are approximately 170 homes along the shoreline of Lake Wenatchee, septic systems are no longer used and all of the houses have been attached to a sewer system since around 1989. Recreational uses on the lake include: swimming, fishing, motor boating, jet skiing, camping, hunting, picnicking, and camping.

Relatively little information exists on the water quality and limnology of Lake Wenatchee. Water temperatures collected from depths of 10 feet and lower indicated that the lake does not strongly stratify into a distinct warmer upper layer and a cooler lower layer with associated layers of high and low DO and pH (Table 6.3-2) (Sylvester and Ruggles 1957). The data for June through October, 1955 (shown in Table 6.3-2) suggest that temperature declines gradually between 10 feet and 60–75 feet, and is notably lower at depths ranging from 150 to 175 feet. However, coincident measurements of DO and pH suggest that deeper waters of the lake do not received sufficient organic matter to substantially depress values of either parameter. In many other temperate lakes, the upper layer of water is warmed through the summer as it absorbs solar radiation and this layer does not mix with the lower, darker layer of water, which generally exhibits a markedly cooler water temperature and depressed DO and pH in summer through fall months. However, Lake Wenatchee is subjected to high winds that apparently keep the waters mixed throughout the year resulting in similar water temperatures and levels of dissolved oxygen and pH in the upper approximately 100 feet of the water column.

Other water quality parameters measured in Lake Wenatchee by Sylvester and Ruggles (1957) included total alkalinity, hardness, turbidity, conductivity and several metals. Their results from June 1955 through February 1957 provide a characterization of the lake as low alkalinity, very low hardness, very clear water with little turbidity and color, and low specific conductance. A single summertime chlorophyll a value of 1.7 ug/L measured in the lake (Ecology 1997) suggests phytoplankton algae levels are very low. All these features are characteristic of an oligotrophic lake, typically with low primary (algae) and secondary (zooplankton) productivity.

Little additional water quality data are available for Lake Wenatchee since the comprehensive surveys in the 1950. Some data were collected from August 1995 monthly through July 1996 at the Lake Wenatchee bridge (WRWSC 1998). These data were assumed to represent lake surface water conditions and indicate the following: 1) the surface lake waters remain very clear and of low turbidity; 2) nitrogenous nutrients (nitrate/nitrite and ammonia) were low enough to restrict algal growth; 3) total phosphorus was generally low, except for two mid-winter measurements; 4) water pH remained near 7.0 (neutral), except for 1 reading of 8.87 in February 1996; 5) dissolved oxygen was measured to be above 9.0 mg/L, except for two low values in August and September 1995 (both were above 90% of air saturation); and 6) specific conductance ranged slightly higher than in the 1950s, possible indicating a slight increase in water hardness and alkalinity. Lake surveys of water transparency, total phosphorus and chlorophyll were conducted periodically from 1989 through 1997 (Ecology 1997). The results showed that water transparency is high (secchi depths >20 feet) and chlorophyll and total phosphorus are very low. These available data, although somewhat sparse, suggest the lake waters remain oligotrophic with little evidence of effects from land use changes and development since the 1950s.

Table 6.3-2. Lake Wenatchee depth profiles of temperature, dissolved oxygen and pH (from Sylvester and Ruggles 1957).

Date	Depth (feet)	Temperature (C)	DO (mg/L)	pH
6/27/55	10	7.7	11.0	6.9
	135	6.6	11.0	6.8
7/12/55	10	9.4	10.8	6.9
	80	7.8	10.8	6.7
7/26/55	10	10.2	10.7	6.65
	50	10.1	10.5	6.95
	150	8.6	10.8	6.70
8/9/55	10	13.0	10.0	7.3
	75	10.3	9.95	7.2
	175	8.2	10.1	7.1
8/25/55	15	13.2	9.9	7.6
	75	NA	9.9	7.5
	140	NA	9.4	NA
9/7/55	10	15.2	9.75	6.9
	75	10.0	9.85	6.7
	175	NA	10.0	6.6
9/21/55	10	13.3	9.7	7.35
	60	13.1	9.7	7.32
	120	9.1	9.6	6.95
	170	8.3	9.45	6.90
10/23/55	10	10.8	9.5	7.1
	75	10.2	9.3	7.1
	175	7.8	8.7	6.8

NA = Not available

6.3.5 Sediment Quality

In the summer of 1992 and 1993, sediment samples were collected from ten stream sites in the Wenatchee River watershed including a site on the Little Wenatchee River, two sites on Nason Creek and on the Wenatchee River at Lake Wenatchee (Hindes 1994). The samples were analyzed for organic pollutants and heavy metals. The only contaminants detected were low concentrations of DDD (2.9 μg/kg) and DDE (1.0 μg/kg), which are both breakdown products of DDT, and trace amounts of copper, nickel and zinc (Hinde 1994). An earlier study indicated that bridgelip sucker and mountain whitefish collected in the Wenatchee River had high accumulations of arsenic, zinc, and DDT (Hopkin et al. 1985 as reported in Stanford 1988). Currently, only Misson Creek in the Wenatchee River basin is listed as impaired due to pesticides in fish tissues (Ecology 1998).

6.4 ENVIRONMENTAL IMPACTS AND BENEFITS OF RUBBER DAM OPERATIONS

The general types of environmental impacts and benefits that may occur as a result of the Lake Wenatchee Water Storage project are described in this section. Project effects focus on the potential impacts resulting from water storage in Lake Wenatchee and release of water to the Wenatchee River under the five alternatives (described in Sections 3.5 and 6.2). The potential short-term effects of project construction are not discussed.

Potential impacts (negative or positive) of project operations were evaluated in part using a set of matrix forms that included three flow-dependent ecosystem components; Fish Habitat and Life-stage Use; Ecosystem Processes; and Water Quality Conditions. The analysis was completed for three geographic areas that included; upper tributaries and the wetlands habitat at the confluence of the White and Little Wenatchee rivers (Tributaries), the mainstem Wenatchee River below the lake (Wenatchee River), and Lake Wenatchee. The assessment was made by comparing the baseline condition (i.e. existing conditions without construction and operation of the rubber dam), with conditions that would result from each of the five alternatives. The analysis consisted of qualitatively rating each of the flow-dependent ecosystem components as they would be influenced by each alternative relative to baseline conditions. A ranking system was used for this that denoted; no impact or change from baseline (=), negative impacts (-); and positive (benefits) impacts (+), and variations thereof. Rankings were defined as follows:

=	Component is or is approximately equal to Baseline Condition
=–	Indicator Component is approximately equal to or slightly reduced relative to Baseline Conditions.
=+	Indicator Component is approximately equal to or slightly improved relative to Baseline Conditions.
+	Indicator Component is improved or impact reduced relative to Baseline condition.
++	Indicator Component is substantially improved or impact substantially reduced relative to Baseline condition
–	Indicator Component is reduced or impact increased relative to Baseline condition; and
––	Indicator Component is substantially reduced or impact substantially increased relative to Baseline condition

The impacts analysis relied almost entirely on existing information and data and the matrix forms served to guide the assessment based on established scientific principles and current understanding of ecosystem relationships. However, more detailed analysis were completed with respect to evaluating the potential benefits associated with the release of supplemental instream flows and potential impacts related to wetlands inundation due to elevated lake levels. These are described in the respective sections below.

6.4.1 Effects of Rubber Dam Operations on Fish Habitat and Fish Use

Fish use is extensive in Lake Wenatchee during the summer period when lake levels would be higher than normal. The lake supports juvenile rearing and smolt outmigration of char, steelhead, and salmon during this period. Fish use in the mainstem Wenatchee River during the historical low-flow period in late-summer/early-fall (August and September) includes juvenile rearing and upstream migration of native char, steelhead, and salmon. Chinook salmon can also begin spawning in the mainstem Wenatchee River as early as August.

The operation of the rubber dam would generally result in increased lake levels (1872.4 feet – Alternatives. 1-3; 1870.3 feet – Alternatives 4-5) during some or all of the months of July, August and September, and increased flows [from 50 cfs (Alternative 4) to 200 cfs (Alternative 2)] in the mainstem Wenatchee River during portions of August and September (Section 3.5). As noted in Section 6.2 the lake elevation associated with alternatives 1-3 would provide about 12,300 af of supplemental water that could be released to augment instream flows above historical levels; alternatives 4-5 would provide slightly more than one-half of that amount (6,750 af).

Although a detailed instream flow study was not conducted as part of the feasibility assessment, several comparisons were made between existing conditions and those that would be provided via the alternatives, as a means to evaluate potential benefits of the supplemental flow releases on fish habitat. First off, it is important to note that average monthly flows directly below the outlet of Lake Wenatchee and near Plain are currently associated with relatively good habitat conditions in terms of quantity. This observation is indicated by comparing the mean monthly flows derived from USGS gage data and used in the operations model with general instream flow criteria set by Tennant (1976). The pre-project mean monthly flow below the outlet is roughly 52% (691 cfs) and 29% (379 cfs) of the mean annual flow (1318 cfs; see Table 3.5-3) in August and September, respectively. Tennant's (1976) approach suggests that a base flow around 30% of mean annual flow is associated with "good" habitat conditions, whereas a minimum (threshold) instream base flow could be considered to be around 10 percent of the mean annual flow. Although these criteria may not apply strictly to the Wenatchee River (they were based on streams and rivers in Montana), they should be approximately transferable for purposes of a screening level analysis.

However, under conditions of a low water year, flows within the river may be substantially lower than average flows; e.g. September flows in 1942 were 230 cfs compared with an average September flow of 379 cfs (Table 3.3-3). It would be during those times that the greatest benefits to fish habitat would be afforded by the five alternatives.

A broad estimate of the change in mean depths and mean velocities in the vicinity of the Plain gage that may result from the alternatives was made using an approximate stream width of 200 feet, an assumed Manning's n, and a reach slope derived from 1:24,000 USGS topographic maps. As indicated in Table 6.4-1, the mean depth and velocity increases that would occur are relatively small in both August and September for mean monthly flow conditions and flow augmentations of 50, 100 and 200 cfs. The mean depth is likely to increase by 0.1 feet for each 100 cfs added at mean monthly conditions. During lower flows, the depth increase would be greater as a greater proportion of flow is added.

Table 6.4-1. Estimated mean depth and velocity increases at the outlet of Lake Wenatchee and the Plain gage during August and September.

	August		September	
	at outlet	at Plain	at outlet	at Plain
Mean Monthly Flow (cfs)	691	1131	379	623
Mean Depth (ft)	1.2	1.6	0.8	1.1
Mean Velocity (fps)	2.9	3.5	2.3	2.8
Depth (ft) (+50 cfs)	1.2	1.6	0.9	1.2
Mean Velocity (fps) (+50 cfs)	3.0	3.6	2.4	2.9
Depth (ft) (+100 cfs)	1.3	1.7	1.0	1.2
Mean Velocity (fps) (+100 cfs)	3.1	3.7	2.5	3.0
Depth (ft) (+200 cfs)	1.4	1.8	1.1	1.3
Mean Velocity (fps) (+200 cfs)	3.2	3.8	2.7	3.1

n= 0.03
S= 0.0027
width (ft) = 200

These changes would likely become less noticeable/detectable in lower reaches of the river as additional tributary inflow occurs and channel width correspondingly increases. However, these are average values and do not reflect the variability in localized depths and velocities that occur in river systems and that serve to define fish habitats. Thus, although changes in average depths and velocities may be small, the actual amount of habitat afforded by the supplemental flows is unknown and will likely vary by specific location and associated channel characteristics. For example, there would likely be some localized benefits to upstream fish passage provided in areas such as Tumwater Canyon where channel constrictions result in defined fish passage portals under low flow conditions. Thus, provision of supplemental flows during naturally occurring periods of extremely low flow may facilitate upstream passage of adults. Additional study would be needed to determine the location and extent to which such flows would be beneficial.

The assessment of potential impacts and benefits resulting from project operations is presented below based on specific life history functions.

6.4.1.1 Adult Migration And Holding

Adult salmonid fish migrate upstream from the Pacific Ocean (anadromous life-forms) or the Columbia River or mainstem Wenatchee River (fluvial life-forms) to spawn in the mainstem Wenatchee River or to continue into Lake Wenatchee and the tributary habitat to spawn. During this migration, the actual upstream movement is an alteration of rapid travel through shallower riffle area and holding/resting in deeper pools. Bjornn and Reiser (1991) indicated a minimum depth of 24 centimeters is required for chinook salmon passage and at least 12 centimeters is necessary for other salmonid species. The mix of salmonid species in the Wenatchee River system creates a situation where migrating adults of at least one species are present in the river in every month of the year (Figure 6.3-1). However, from a flow magnitude perspective, the most difficult time for upstream passage and adult holding would likely occur during low flow periods, such as during August through October.

The operation of the rubber dam to augment flows in the mainstem Wenatchee River during late-summer/early-fall could provide some benefit to the upstream migration and holding of adult steelhead, chinook, and to a lesser degree coho salmon. The degree of potential benefit would be related to the amount and timing of flow available and hence alternative 3 and 2 would likely have the greatest and alternative 4 the lowest potential benefit (Tables 6.4-2 to 6.4-6). The largest benefits to migration and holding would likely be to steelhead and summer chinook during the lowest flow years, since these species spawn in the mainstem Wenatchee, and they would likely spend some time holding in the river prior to spawning. The pulse flow operational alternative (Alternative 3 – rated as +) specifically targets adult passage for spring chinook and sockeye during low flow conditions that may occur in July. It was postulated that pulse flows occurring during that period would facilitate passage of these species through Tumwater Canyon and into Lake Wenatchee where they would continue their migration into either the Little Wenatchee or White rivers.

Although adult coho transferred to the Wenatchee River could use the river as a transportation corridor, coho spawn in tributaries to the mainstem Wenatchee and, therefore, are unlikely to hold in the river for significant periods of time. Adult sockeye salmon could also be migrating in the mainstem Wenatchee River during the low flow period, although they typically complete their upstream migration to holding habitat in Lake Wenatchee by early August. Fluvial bull trout from the Columbia River could also be in the mainstem Wenatchee River during the critical low-flow period, although they are most likely to begin their migration up the Wenatchee River during high-flow in June.

Operation of the rubber dam is not anticipated to affect flows or water levels important to adult salmonid migration and holding in the tributaries or in Lake Wenatchee.

As described in Section 3.5.3.2, the rubber dam would be approximately 200 feet long from shore to shore and installed as a single span. The foundation of the structure would be a cast-in-place concrete slab with a flat surface, and the structure would be oriented at about a 5-degree angle with respect to a perpendicular line drawn from shore to shore to aid in upstream passage of fish. A fish ladder would be in operation during the spring and summer water storage months. During other times of the year, the rubber dam will be partially or fully deflated and a fish ladder will not be used. A fish ladder will need to be designed to allow adult and juvenile salmon, trout and native char (bull trout) to migrate upstream of the dam when the weir is fully inflated (Section 3.5.3.6). This is especially important for bull trout given the results of recent study findings that indicate adult and juvenile bull trout from the Chiwawa River move upstream into Lake Wenatchee. Even with provision of a ladder, it is possible there could be some delayed or impeded upstream migration for some individual fish during the time when the dam is inflated.

Table 6.4-2. Aquatic and fisheries impact evaluation matrix for three segments of the Wenatchee Watershed potentially influenced by project operations under Alternative 1 of the Lake Wenatchee Water Storage Feasibility Study.

Alternative 1 - Max Lake Level: 1872.4 feet; Supplementation: 10 cfs/day Aug. 23 – Aug 31; 100 cfs Sept 1 - ?				
	Conditions with Rubber Dam: Alternative 1			
Ecosystem Component	Baseline Conditions	Tributaries	Wenatchee River	Lake Wenatchee
FISH HABITAT AND LIFE-STAGE USE				
Adult Migration/Holding	=	=/=	= +/= +	=/=
Spawning/Incubation	=	=/=	= +/=	=/=-
Juvenile Rearing	=	=	=+	=
Juvenile Outmigration	=	=	=+	=
Predation/Competition	=	=/=	=+/=	=+/=
Stranding/Direct Mortality	=	=/=	= –/=	=/=
ECOSYSTEM PROCESSES				
Sediment Transport	=	=	=	=
Woody Debris Recruitment	=	=	= –	= –
Side-channel Connectivity	=	= +	= +	=
1° and Invertebrate Production	=	=	=	=
Littoral Zone	=	=	=	=-
Wetlands	=	–	=	–
WATER QUALITY CONDITIONS				
Water temperature	=	=	=	=
Dissolved Oxygen	=	=	=	=
Nutrients/BOD	=	=/=	=/=	=/=
pH	=	=	=	=
Suspended Sediment/Turbidity	=	=/=	=/=	=/=

Table 6.4-3. Aquatic and fisheries impact evaluation matrix for three segments of the Wenatchee Watershed potentially influenced by project operations under Alternative 2 of the Lake Wenatchee Water Storage Feasibility Study.

Alternative 2 - Max Lake Level: 1872.4 feet; Supplementation: 20 cfs/day Aug. 23 – Aug 31; 200 cfs Sept 1 - ?				
	Conditions with Rubber Dam: Alternative 2			
Ecosystem Component	**Baseline Conditions**	**Tributaries**	**Wenatchee River**	**Lake Wenatchee**
FISH HABITAT AND LIFE-STAGE USE				
Adult Migration/Holding	=	=/=	+/+	=/=
Spawning/Incubation	=	=/=	+/= –	=/= –
Juvenile Rearing	=	=	= +	=
Juvenile Outmigration	=	=	= +	=
Predation/Competition	=	=/=	= +/=	= +/=
Stranding/Direct Mortality	=	=/=	= –/=	=/=
ECOSYSTEM PROCESSES				
Sediment Transport	=	=	=	=
Woody Debris Recruitment	=	=	= –	= –
Side-channel Connectivity	=	= +	= +	= +
1° and Invertebrate Production	=	=	=	=
Littoral Zone	=	=	=	=
Wetlands	=	–	=	–
WATER QUALITY CONDITIONS				
Water temperature	=	=	=	=
Dissolved Oxygen	=	=	=	=
Nutrients/BOD	=	=/=	=/=	=/=
pH	=	=	=	=
Suspended Sediment/Turbidity	=	=/=	=/=	=/=

Table 6.4-4. Aquatic and fisheries impact evaluation matrix for three segments of the Wenatchee Watershed potentially influenced by project operations under Alternative 3 of the Lake Wenatchee Water Storage Feasibility Study.

Alternative 3 - Max Lake Level: 1872.4 feet; Supplementation: 100 cfs pulses Jul. 1 – Aug 15; 100 cfs Aug 16 - ?				
	Conditions with Rubber Dam: Alternative 3			
Ecosystem Component	**Baseline Conditions**	**Tributaries**	**Wenatchee River**	**Lake Wenatchee**
Adult Migration/Holding	=	=/=	+/+	=/=
Spawning/Incubation	=	=/=	=/=	=/=-
Juvenile Rearing	=	=	=+	=+
Juvenile Outmigration	=	=	=+	=
Predation/Competition	=	=/=	=/=	= +/=
Stranding/Direct Mortality	=	=/=	–/=	=/=
ECOSYSTEM PROCESSES				
Sediment Transport	=	=	=	=
Woody Debris Recruitment	=	=	= –	= –
Side-channel Connectivity	=	= +	= +	= +
1° and Invertebrate Production	=	=	=	=
Littoral Zone	=	=	=	=-
Wetlands	=	–	=	–
WATER QUALITY CONDITIONS				
Water temperature	=	=	=	=
Dissolved Oxygen	=	=	=	=
Nutrients/BOD	=	=/=	=/=	=/=
pH	=	=	=	=
Suspended Sediment/Turbidity	=	=/=	=/=	=/=

Table 6.4-5. Aquatic and fisheries impact evaluation matrix for three segments of the Wenatchee Watershed potentially influenced by project operations under Alternative 4 of the Lake Wenatchee Water Storage Feasibility Study.

Alternative 4 - Max Lake Level: 1870.3 feet; Supplementation: 5 cfs/day Aug. 23 – Aug 31; 50 cfs Sept 1 - ?				
	Conditions with Rubber Dam: Alternative 4			
Ecosystem Component	Baseline Conditions	Tributaries	Wenatchee River	Lake Wenatchee
FISH HABITAT AND LIFE-STAGE USE				
Adult Migration/Holding	=	=/=	= + /= +	=/=
Spawning/Incubation	=	=/=	= + /= +	=/=
Juvenile Rearing	=	=	= +	=
Juvenile Outmigration	=	=	= +	=
Predation/Competition	=	=/=	=/=	= +/=
Stranding/Direct Mortality	=	=/=	=/=	=/=
ECOSYSTEM PROCESSES				
Sediment Transport	=	=	=	=
Woody Debris Recruitment	=	=	= –	= –
Side-channel Connectivity	=	= +	= +	= +
1º and Invertebrate Production	=	=	=	=
Littoral Zone	=	=	=	=
Wetlands	=	–=	=	– =
WATER QUALITY CONDITIONS				
Water temperature	=	=	=	=
Dissolved Oxygen	=	=	=	=
Nutrients/BOD	=	=/=	=/=	=/=
pH	=	=	=	=
Suspended Sediment/Turbidity	=	=/=	=/=	=/=

Table 6.4-6. Aquatic and fisheries impact evaluation matrix for three segments of the Wenatchee Watershed potentially influenced by project operations under Alternative 5 of the Lake Wenatchee Water Storage Feasibility Study.

Alternative 5 - Max Lake Level: 1870.3 feet; Supplementation: 100 cfs/day Aug. 23 – Aug 31; 100 cfs Sept 1 - ?				
	Conditions with Rubber Dam: Alternative 5			
Ecosystem Component	Baseline Conditions	Tributaries	Wenatchee River	Lake Wenatchee
FISH HABITAT AND LIFE-STAGE USE				
Adult Migration/Holding	=	=/=	= +/= +	=/=
Spawning/Incubation	=	=/=	= +/=	=/=-
Juvenile Rearing	=	=	= +	=
Juvenile Outmigration	=	=	= +	=
Predation/Competition	=	=/=	= +/=	= +/=
Stranding/Direct Mortality	=	=/=	= –/=	=/=
ECOSYSTEM PROCESSES				
Sediment Transport	=	=	=	=
Woody Debris Recruitment	=	=	=-	=
Side-channel Connectivity	=	= +	= +	= +
1° and Invertebrate Production	=	=	=	=
Littoral Zone	=	=	=	=
Wetlands	=	–=	=	–=
WATER QUALITY CONDITIONS				
Water temperature	=	=	=	=
Dissolved Oxygen	=	=	=	=
Nutrients/BOD	=	=/=	=/=	=/=
pH	=	=	=	=
Suspended Sediment/Turbidity	=	=/=	=/=	=/=

LEGEND:

= Component is or is approximately equal to Baseline Condition

=– Indicator Component is approximately equal to or slightly reduced relative to Baseline Conditions.

=+ Indicator Component is approximately equal to or slightly improved relative to Baseline Conditions.

\+ Indicator Component is improved or impact reduced relative to Baseline condition.

++ Indicator Component is substantially improved or impact substantially reduced relative to Baseline condition

– Indicator Component is reduced or impact increased relative to Baseline condition

–– Indicator Component is substantially reduced or impact substantially increased relative to Baseline condition.

N/A Indicator Component is Not Applicable for the reach evaluated.

6.4.1.2 Spawning and Incubation

Adult salmonids select areas for spawning that can be defined by combinations of water depth and velocity in association with substrate of a certain size (Bjornn and Reiser 1991). In streams and rivers, spawning areas are typically located in pool tailouts and pool-riffle interchange areas containing clean substrates. Negative impacts to spawning habitat from human developments are typically the result of barriers to upstream migration (loss of habitat), increased rates of sedimentation (degradation of spawning gravels), or alterations in flow regimes resulting in redds that are subsequently inundated, exposed, or scoured.

Successful incubation of the embryos requires gravels with low concentrations of fines sediments and organic material (Spence et al. 1996; Bjornn and Reiser 1991). Large amounts of silt and sand can fill-in the gravel interstices of redds, diminishing intragravel flow and reducing available oxygen. High sediment levels can also entomb alevins and fry, preventing successful emergence. Variations in flow during incubation can also reduce successful incubation if reduced flows expose redds built during higher water levels, subjecting the developing embryos to freezing or desiccation. Extreme flows can also mobilize the bedload and wash the embryos downstream.

Supplemental water released to the mainstem Wenatchee River during late-summer/early-fall may potentially enhance to varying degrees (alternatives 1, 4 and 5 (= +); alternative 2 (+)) the amount of spawning habitat available to chinook in the mainstem Wenatchee River. The timing of the flow releases associated with alternative 3 and the limited amount of supplemental flow under alternative 4 suggest the benefits to chinook spawning habitat in the mainstem would be small compared to the other alternatives. If the fall rains coincide with the end of the period of supplemental water and water levels are not subsequently reduced during incubation, the increased spawning habitat could be a beneficial impact to spring and summer/fall chinook. Flows during the second half of October are on average 25% higher than those in the later half of September (NMFS et al. 1998). Negative impacts to incubating chinook embryos could occur if areas used for spawning are subsequently dewatered during the period between flow augmentation from the Lake Wenatchee Water Storage project and the onset of the fall rains. The only other salmonid species that spawn in the mainstem are steelhead. Steelhead spawning will not be affected by project operations, because steelhead spawn in the spring

The release of water stored in Lake Wenatchee during late-summer/early-fall could coincide with the peak of sockeye spawning in late September. Although it is unknown if sockeye spawn along the shoreline of Lake Wenatchee, the species is known to use this type of habitat in other lakes. Reduced lake levels during the period of sockeye spawning could result in redds being built in areas that would subsequently become dewatered as the stored water is released to the mainstem Wenatchee River. Thus, there is some potential negative impacts to lake-shore spawning (if it occurs) related to all of the alternatives (= –) (see Tables 6.4-2 through 6.4-6).

6.4.1.3 Juvenile Rearing

There is a large variation in the rearing habits of juvenile salmon. With the exception of summer chinook and the resident fish, the other species of juvenile salmonid fish in the Wenatchee River system rear for at least one winter before migrating downstream to the Columbia River. The salmonid species that specifically rear in the mainstem Wenatchee River are spring chinook, steelhead, and coho.

The amount of stream and river habitat available for rearing is a function of streamflow, channel morphology, gradient, and instream cover. Increased space and complexity can increase the carrying capacity. In general, limiting habitats for juvenile salmonid fish during low-flow summer conditions are cool water refugia. Juvenile rearing during high-flow conditions is often limited by a lack of low-velocity areas such as pools, accumulations of large woody debris, and off channel areas. Both high-flow and low flow refuge habitat were identified as two bottlenecks that can limit total juvenile salmonid densities in the mainstem Wenatchee River (Andonaegui 2001). The lack of high-flow refuge habitat can reduce survival of post-emergent fry and then the lack of low-flow, late-summer rearing capacity can further limit juvenile abundances (WDF et al. 1990). The large difference between the annual high-flow and low-flow in the Wenatchee River results in very little cover for rearing fish during low-flow conditions when the undercut banks and shoreline vegetation may be yards away from the water's edge (WDF et al. 1990).

Operation of the rubber dam will not affect high-flow rearing habitat in the mainstem Wenatchee River. The release of water stored in Lake Wenatchee during late-summer/early-fall may temporally increase the amount of low-flow refuge habitat and may afford some benefit (= +) to juvenile salmon species rearing in the river, with Alternative 4 providing the least benefit. The effects of extending the period of high water levels in Lake Wenatchee during the summer on juvenile fish rearing in the lake and at the mouths of the Little Wenatchee and White rivers are unknown. Higher water levels throughout the summer could benefit juvenile fish rearing in the wetland complex on the western end of the lake if the higher water levels help maintain open water and transportation corridors between ponded areas and the main lake (indicated as = + in matrix tables). However, baseline information on the habitat condition, use and productivity of this wetland area is lacking. In general, ponded wetlands connected to streams or lakes are highly productive for rearing coho. Inundated wetlands along the littoral areas of a lake can also provide productive feeding areas for juvenile sockeye, chinook, and other salmonid fishes. Conversely, fish rearing in these areas could become stranded when lake levels drop and connections to open water are lost.

As noted above, a fish ladder will need to be designed to allow both adult and juvenile salmon, trout and native char (bull trout) to migrate upstream of the dam when the weir is fully inflated (Section 3.5.3.6). This is especially important for adult and juvenile bull trout that have been shown to move from the Chiwawa River upstream into Lake Wenatchee.

6.4.1.4 Juvenile Outmigration

Flow and depth play physical roles in determining the timing and speed of juvenile salmonid migration (Spence et al. 1996). Low flow conditions on the Columbia River have been shown to increase the travel time for smolt outmigration (Bjornn and Reiser 1991). In the Wenatchee River system, smolt outmigration typically begins in the spring during March or April as the river flows are increasing, and steelhead and chinook can continue to move downstream throughout the summer. This timing is before the period when lake levels would be influenced by the rubber dam, thus the project is not expected to adversely or beneficially influence smolt outmigration patterns or survival.

Operation of the rubber dam will similarly not affect high-flow conditions in the mainstem Wenatchee River. Augmented flows in late-summer/early-fall could provide some benefit (= +) to steelhead and chinook smolts outmigrating in the mainstem Wenatchee River. The project operation is not anticipated to affect juvenile outmigration in the tributaries or in Lake Wenatchee, provided suitable fish passage facilities are integrated into the dam design..

6.4.1.5 Predation and Competition

In general, predation and competition are increased as water levels decrease. Low-flow conditions can increase the rates of predation and competition by reducing the amount of habitat and therefore reducing the amount of areas available to juvenile salmonids to avoid predation and competition. Low-flow conditions can also result in increased travel time for juvenile outmigration (Section 6.4.1.4) resulting in an increased risk of predation. Shifts in water quality characteristics associated with reduced flows during the summer period, such as increased water temperature and reduced DO, can favor predatory species such as sculpin, increasing the predatory risk to downstream migrating juvenile salmonids.

The increased flows provided by alternatives 1,2, 4and 5 during late summer may temporarily reduce predation and competition (= +) on juvenile salmonids in the mainstem Wenatchee River by providing some increased habitat area. Timing and the general low amount of supplemental flows in alternatives 3 and 4 suggest such benefits would be small. Juvenile salmonids most likely to be present in the mainstem Wenatchee River during supplemental late-summer/early-fall flows are steelhead and spring chinook.

The increased period of high water levels in Lake Wenatchee during the summer may reduce the rate of predation (= +) on juvenile sockeye as a result of increased lake volume and its associated increased refuge habitat. However, low lake productivity (cold, nutrient poor-water) and not predation is likely the most important limiting factor for sockeye production in Lake Wenatchee. Operation of the rubber dam is not anticipated to affect predation and competition in the tributaries.

6.4.1.6 Stranding and Direct Fish Mortality

Flow regulation can result in fish stranding if the fish do not leave habitats that are subsequently dewatered or isolated as flow levels are decreased. The risks of potential stranding in the mainstem Wenatchee River from the operation of the rubber dam would most likely affect juvenile fish that can utilize shallow edge habitats and side channels in which they would then subsequently be stranded when flows are decreased. The extent of these potential risks differs among the five operating alternatives. The largest risks of stranding in the Wenatchee River would occur under alternatives 3 and 2 in that order. Stranding could occur (= +) under Alternative 2 at the end of the period of supplementation in September if flows are not subsequently maintained by fall rains. Under Alternative 3 stranding could potentially occur (–) between the 4-hour pulses of augmented flows during July and mid-August. However, stranding can be minimized or avoided by ensuring that downramping rates are sufficiently low that fish have time to move with the declining water level.

Direct fish mortality is unlikely to occur from operation of the rubber dam for any of the alternatives (=). Some direct morality could occur, however, during the construction phase of the project as a result of water diversion and temporary sediment impacts.

Release of water stored in Lake Wenatchee to supplement late-summer/early-fall flows in the mainstem Wenatchee River will result in the lowering of the lake levels and potential stranding of juvenile fish rearing in the littoral areas. However, because the shoreline of Lake Wenatchee is generally steep, shallow littoral areas where stranding could occur are limited to the wetland area in the vicinity of the confluence with the Little Wenatchee and White rivers, at the western end of the lake. It is believed that trapping and stranding effects would be minimal in this area (=) because of the complex morphology occurring within the wetland habitat, and the generally low temperatures expected during the summer because of vegetative shading and connection with groundwater. Juveniles that are trapped would likely find over-summer refuge in beaver channels and pools. It is therefore possible that the project might result in increased occurrence of extended rearing. Whether such effects would be adverse is unknown. However, most actively migrating smolts should have exited the lake by the time the rubber dam would influence lake level (Figure 6.3-1), so most fish that are trapped in the wetlands area later in the summer would have been expected to rear in the system for another year anyway. Moreover, such wetlands can provide productive habitats for rearing juvenile salmonids (Section 6.2.3).

6.4.2 Effects of Rubber Dam Operations On Riverine And Lacustrine Ecosystem Processes

There are a number of flow dependent ecosystem processes that interact to create and maintain habitat quality and diversity in rivers such as the Wenatchee River. Fundamentally, it is the natural interannual and seasonal variability in flood flows that serves to shape channel morphology, transport sediments, distribute wood, and establish connectivity with floodplain and side channel areas. Operation of the rubber dam under the five alternatives will not affect flood and peak flows. Each alternative would however, typically increase discharge during some portion of the late-summer/early fall low-flow period in the mainstem Wenatchee River and they would increase the duration of high water levels in Lake Wenatchee during the summer. Our understanding of existing conditions and modeled storage and release strategies were used to determine and describe potential project effects on ecosystem processes.

6.4.2.1 Sediment Transport and Shoreline Erosion

Delivery rates and composition of sediments to channels within the Lake Wenatchee watershed and downstream are affected by many factors, including: geology, hydrology, climate, topography, and land use. Sediment transport rates within channels potentially affected by the project are influenced by hydrograph magnitude and timing, channel gradient and confinement, and particle size. Sediment delivery in the Little Wenatchee River has been particularly characterized as high as a result of both natural-origin and timber harvest –related mass wasting (USFS 1998).

The lower reaches of the White and Little Wenatchee rivers are depositional areas, reflecting the influence of backwater from the lake during the spring snowmelt runoff period. Cobble and gravel materials deposit in the vicinity of the high lake level elevation, and sand deposits more extensively between the high and low lake level elevations. The general location of the gravel-sand transition in the Little Wenatchee River is indicated by the presence of the gravel and sand pit. Sediment transport in the lower White River includes a large fraction of suspended fine sediments derived from glacial melt.

Lake Wenatchee is generally a sediment sink, and the location of the rubber dam is thus relatively armored. Primary fine and coarse sediment sources below the lake include riverbanks, tributaries, and the riverbed itself. There are some depositional areas between the outlet of Lake Wenatchee to the confluence with the Chiwawa River (RM 48.4) where the gradient is relatively low, as evidenced by a meandering channel form and broad floodplain. Downstream of this reach, the gradient increases through the Tumwater Canyon where sediments are generally transported downstream to below the confluence of Icicle Creek (RM 25.6), where some deposition occurs.

The effect of the rubber dam on sediment transport will likely be negligible (=) both above, within, and below Lake Wenatchee. Because the lake is essentially a sediment sink, effects below it are restricted to changes in the peak flow hydrograph and the corresponding changes in transport capacity and bank erosion. There will generally be no significant changes in extreme or moderate peak flow event magnitudes. Such events generally occur prior to the filling period (see hydrologic model runs for each alternative in Section 3.5), including in dry years. Some reduction in peak flow is expected for moderate magnitude events occurring during the filling period, which could decrease bank erosion and transport rates downstream. However, based on the hydrologic analysis, it appears that most sediment transport below the lake (if any) would occur prior to the filling period. More detailed analysis would be needed to determine if the effect were significant, including determining when sediment transport and bank erosion occur. In any case, the potential changes in sediment delivery and transport could balance each other, with negligible net effect on transport rates and deposition or erosion downstream at spawning locations.

Upstream of the lake, effects to sediment transport are expected to be negligible (=). Sediment transport occurs in the Little Wenatchee and White rivers primarily during snowmelt runoff, at a time when the lake level is already elevated and prior to the projected filling period. Significant transport should have subsided before the time that the lake level normally drops without the project. The operation of the rubber dam will delay the start of decreasing lake levels in Lake Wenatchee until late-summer. In an average year, the ordinary high lake level begins to decrease in mid July (Section 3.5). Project operations will result in elevated lake levels being held through late August under most alternatives. As lake levels decrease, stream velocities in the delta areas at the mouths of the White and Little Wenatchee rivers can increase, resulting in increased localized bedload movement (scour). However, the area affected in each stream corresponds to the existing location of the gravel-sand transition. Hence, there may be some redistribution of sand and fine gravel in the vicinity of the 1870-1873 feet elevation range as the lake level drops, but the area affected will likely not be significantly different from the area affected by without-project decreases in lake level. In addition, salmon, trout and char generally spawn upstream of the gravel-sand transition, and the timing of natural scour and project-related scour would both occur after incubating salmonid have emerged from the gravel. The project is therefore unlikely to impact survival to emergence of salmonids. In general, the areas that could be subjected to scour as a result of decreasing lake levels are locations dominated by sandy substrates that are unsuitable for spawning by salmonid species.

An extended water level during the summer could result in shoreline erosion occurring at a higher than normal elevation during the summer because of recreational powercraft. and wind-generated waves. Potential effects to shoreline vegetation would generally follow those outlined in section 6.3.6 relative to different lake levels. Section 3.4 provides a discussion of potential changes in shoreline erosion.

6.4.2.2 Woody Debris Recruitment

Large woody debris (LWD) has important functions in many rivers and streams, serving as cover and refuge for juveniles, smolts, and adult salmonids. LWD can also act as bed control structures that moderate bedload movement, creating and maintaining important spawning areas. LWD can also create lateral channel migration and complex channel forms. LWD is naturally recruited to stream channels as a result of stream bank undercutting, debris slides, seasonal flooding, and fire events.

The amount of LWD throughout the mainstem Wenatchee River is reduced from predevelopment levels (Andonaegui 2001). The amount of LWD is low even in the upper reach of the river from Lake Wenatchee (RM 54.2) downstream to the confluence of the Chiwawa River (RM 48.4), where in general, impacts to natural channel functions have been less than in the lower reaches. Recruitment of additional LWD to the channel is limited in this reach by the moderately confined nature of the channel as a result of downcutting through the glacial outwash (Andonaegui 2001). The lower reaches of the Wenatchee River have little to no LWD.

The operation of the rubber dam will not affect (=) recruitment of LWD into the tributaries since the dam will not affect debris slides, flooding, or other disturbance events that cause LWD to fall into those channels. The movement of LWD in Lake Wenatchee may be altered (= –), however, as a result of extending the period of high lake levels. Floating logs that would have been deposited along the shoreline with the naturally receding spring waters may remain mobile during the summer as additional water is stored behind the rubber dam and lake elevations remain high. The rubber dam may also temporally accumulate LWD floating out of the lake and delay its movement downstream (= –).

6.4.2.3 Side Channel Connectivity

Off-channel habitats can provide important areas for juvenile salmonid rearing and refuge from high flows (Groot and Margolis 1991). These habitats are typically low-velocity side channel, backwater sloughs, wetlands, or beaver ponds. Channelization and construction of levees, revetments, roads, and shoreline developments has considerably limited the available off-channel habitat on the lower Wenatchee River (Andonaegui 2001). The upper Wenatchee River has more off-channel habitat in the form of oxbows and adjacent wetlands than the lower reaches (Andonaegui 2001). However, the State Highway 207 crossing just downstream of Nason Creek has been identified disconnecting the flow to side-channels in this area during extreme high water events (Andonaegui 2001). Other road placements and developments have eliminated other off-channel habitats in the upper reach. The lower reaches of the White and Little Wenatchee rivers have abundant off-channel habitat as the low gradient, depositional reaches braid and meander through a series of wetland complexes.

The operation of the rubber dam will temporally increase the mainstem river minimum instream flows during the late-summer/early fall period and may help maintain or restore connections with off-channel habitats that could otherwise become dewatered or isolated from the main channel. As noted in section 6.4.1, the effects of this would likely be relatively small (= +) due to the comparatively low amount of water that would be supplemented to the lower river compared to natural flows. The operation of the rubber dam will not affect side-channel habitat in the tributaries, upstream of the lake influence. However, higher water levels throughout the summer in Lake Wenatchee could result in increased open water and transportation corridors (= +) between off channel areas in the wetland complex on the western end of the lake, including the lower portions of the tributaries, and the main lake.

6.4.2.4 Primary Production and Invertebrate Production

Primary production is the conversion of inorganic matter (nutrients) to organic matter through the process of photosynthesis. Primary production is highest in warm, sunny waters that contain high concentrations of nutrients. Primary production in forest streams in the Pacific Northwest is often limited by lack of sunlight and low concentrations of phosphorus and nitrogen. Primary production is higher in open backwater areas, such as off-channel wetlands and in lakes that are open to the sun. Primary production is an important food resource for zooplankton and aquatic insects and the fish that eventually feed on them. In shady forested streams, aquatic insects often rely on the input of terrestrially derived primary productivity (leaf litter) as the base of their food chain. Invertebrate production important to salmonid populations in the Wenatchee River system includes zooplankton in Lake Wenatchee and aquatic macroinvertebrates, such as immature insects, in the river and tributaries.

Increased rates of primary production and the associated invertebrate production above pre-development conditions likely occur in the lower reaches of the mainstem Wenatchee River as a result of removal of the riparian forests (more sunlight) and agricultural and residential run-off of fertilizers. Lake Wenatchee and the upper mainstem Wenatchee River exhibit naturally low rates of primary production as a result of cold water temperatures and the nutrient-poor waters of the tributaries that drain the forested upper basin. In many Pacific Northwest systems, productivity has been altered as a result of decreased numbers of returning adult salmon that would subsequently die and contribute ocean-derived nutrients to the stream and riparian area (Bilby et al. 1998). It is unknown to what extent the reduction of these nutrients has had on the productivity of Lake Wenatchee and the upper basin.

The operation of the rubber dam will likely have little to no effect (=) on the current levels of productivity in the river, tributaries or in Lake Wenatchee. Biological studies of plankton in Lake Wenatchee during late 1930’s and 1956–1957 were reported by Sylvester and Ruggles (1957). Their findings showed that the lake was oligotrophic, with little phytoplankton collected by net hauls and a sparse zooplankton community. They deduced that the plankton production in the lake was limited by nutrients governing phytoplankton growth. The zooplankton populations were dominated by rotifers, followed by cladocerans and copepods, and zooplankton abundance was characterized as being sparse, highly variable with time within an annual cycle, and probably controlled by grazing of the fish community.

There is little additional data on the plankton community of the lake. However, the lake remains highly transparent and low in nutrients that are needed to support primary producers (Ecology 1997). Prolonging higher lake elevation using the rubber dam would provide no mechanism to affect changes in the pelagic plankton community’s composition or interactions. A change in depth of 3 feet or approximately 2% of the lake’s mean depth for 2 to 3 months would be imperceptible to microscopic organisms.

6.4.2.5 Littoral Zone

The littoral zones of lakes are the areas where the water is shallow enough that light needed to support primary production can reach the bottom. The extent of the littoral zone is dependent on the bathymetry of the lake and the water clarity. Water clarity in Lake Wenatchee is relatively high. However, the overall shape of the lake is narrow and steep sided that limits the area of shallow littoral water. Most of the littoral zone is associated with the large wetland area on the western end of the lake where the White and Little Wenatchee rivers flow into the lake. A shoreline survey in 1994 (Ecology 1997) suggested that a healthy, diverse community of submerged aquatic vegetation extends to a depth of about 5.0 meters.

The operation of the rubber dam will extend the duration of high lake levels through late-summer. The extent and composition of submergent vegetation along the perimeter of the lake would likely stay the same. It is possible, however, that increased water depths during the summer could result in an upslope migration of submerged vegetation (from the deeper water towards the OHWM) as the plants respond to available light levels. This would likely be more pronounced for alternatives 1-3 (lake elevation 1472.4 feet) than alternatives 4 and 5 (lake elevation 1470.3 feet), although because of uncertainty in overall effects, all five are noted as = – in the matrices.

6.4.2.6 Wetlands

Wetlands are an important component of many river systems, providing areas of high primary productivity, nutrient cycling, and groundwater recharge and discharge. In some cases, wetlands are also littoral areas. On the mainstem Wenatchee River, approximately 585 acres of wetlands exist in the upper one mile of river from the mouth of Lake Wenatchee (RM 54.2) downstream to Fish Lake Run (RM 53.0) (Andonaegui 2001). An extensive complex of wetlands on Lake Wenatchee is associated with the outlets of the Little Wenatchee and White rivers.

The operation of the rubber dam could impact the wetlands on Lake Wenatchee as a result of changes in the water regime, or hydroperiod. Hydroperiod is defined as the depth, duration, frequency, and timing of inundation or soil saturation, and is one of the primary controls on the distribution of wetland plant species (Mitsch and Gosselink 1986). The typical pattern of vegetation zonation around lake shores, along river banks, and in wetlands is the result of variation in the degree of flood tolerance by wetland plant species. That is, plant species differ in their ability to tolerate increasingly greater depth, duration, and frequency of inundation or soil saturation. Plants are particularly sensitive to flooding during the growing season, so the timing or seasonality of inundation is important to consider in evaluating the effects of hydroperiod on plant species. Although many studies have shown an effect of hydroperiod on plant species distribution in wetlands, there are few quantitative data on how each component of hydroperiod affects wetland plant communities and how much of a change in each component is needed to significantly impact a particular plant species.

Several published studies have shown how changes in hydroperiod can affect wetland vegetation (e.g., Farney and Bookhout 1982; Kadlec 1962; Millar 1973; van der Valk et al. 1994). However, most primarily address wetland herbaceous vegetation and few (e.g., Farney and Bookhout 1982) have examined lake-associated changes in wetlands resulting from changing lake levels. Except for experimental studies (e.g., van der Valk et al. 1994), effects of specific hydroperiod components have rarely been examined.

An unpublished study of wetland changes in deltas of Chester Morse Lake (CML) in the western Cascade Mountains provides data specific to the question of changes in Lake Wenatchee wetlands in response to increases in lake level (Raedeke Associates 1997). As a major source of water for the City of Seattle, lake elevation in CML fluctuates in response to both natural, unregulated inflows and regulation of outflows to supply municipal water and instream flow needs. Delta wetlands at the eastern end of CML are characterized by extensive sedge and willow communities, with willow occurring at higher elevation than willow. Although variation in lake level is not entirely consistent year to year, there have been a higher frequency and duration of higher water levels in the lake since the early 1980s. Raedeke Associates (1997) found that concurrent with higher lake level and duration of inundation, there has been an upslope migration in the boundary between sedge dominated wetlands and unvegetated areas and in the boundary between sedge and willow dominated areas.

In Lake Wenatchee, the OHWM (1870.3 feet) generally marks the edge of perennial vegetation, and this elevation is probably similar to the lower elevation of emergent wetland vegetation. Wetland vegetation extends some elevation above this, but probably becomes dominated by upland species when flooding, or soil saturation, is infrequent. Generally, wetland vegetation occurs when soils are saturated to within 1 feet of the surface, although this depth can vary depending on soil permeability (ACOE 1987).

Based on studies in riparian zone of a semiarid region of Central Oregon, hydrophytic (i.e., wetland) vegetation was flooded on average at least once every 4.5 years (Chapin et al. 2000). Although this relationship has not been evaluated elsewhere, it provides a reasonable estimate of flood frequency occurring in wetland vegetation from a region climatically similar to the Lake Wenatchee area.

Historic average monthly May-June water levels in Lake Wenatchee (generally when the yearly high water level) were above 1872.0 feet once in four years and above 1873.0 feet once in ten years (Section 3.5). In the absence of a topographic survey, a reasonable estimate of the upper elevation of the wetland vegetation affected by lake water level would be 1873.0 feet. This elevation is equivalent to that flooded once every four years, or 1872.0 plus 1 foot to account for saturated soils above the level of inundation. Different communities of wetland vegetation would be distributed across this elevation range (1870.3 to 1873.0 feet) and an increase in depth, duration, or frequency of inundation in this elevation range due to the rubber dam could alter this distribution.

Several components of hydroperiod would be affected by raising water level with the rubber dam. Although a variety of hydrologic statistics can be used to quantify hydroperiod, average monthly water levels are a metric that captures much of the intra-annual variation in water level and is relatively convenient to use (Figure 6.4-1, Table 6.4-7). If wetland vegetation occurs between elevations of 1870 and 1873 feet, Alternatives 1, 2, and 3 would result in a generally greater depth of flooding. Lake levels under alternatives 1, 2, and 3 (average monthly elevations of 1872.08, 1872.08, and 1872.51 feet, respectively) would be higher than the historic annual high average monthly level of 1871.34 feet, occurring in June. There would be no change in annual high average monthly water levels under Alternatives 4 and 5.

Frequency of flooding for wetlands would also increase under alternatives 1, 2, and 3. Inundation to 1872 feet would flood most of the wetland elevation zone and result in saturated soils for the entire estimated zone (i.e., up to 1873 feet). During the 1933 to 1958 period of record, average monthly lake levels reached 1872 feet in 13 of 26 years. Under Alternatives 1 and 2, average monthly water levels at this elevation would occur in 24 of 26 years, according to the operational models. Average monthly water levels of at least 1872 feet would occur in all 26 years under Alternative 3. There would be no change from historic frequency of average monthly lake elevation reaching at least 1872 feet under alternatives 4 and 5.

Under alternatives 1 and 2 the rubber dam would also result in a shifting of the period of the annual high average monthly lake levels, according to operation models. Historically, the highest lake levels were generally in May to June. Alternatives 1 and 2 would result in annual high water levels occurring generally during July and August. Annual high water levels would still occur in either May or June under Alternatives 3, 4, and 5.

Under alternatives 1 and 2, duration of flooding would be greater. Average monthly water levels under historic conditions are above 1870 feet, the minimum required to inundate wetland areas, from May to June, and drop below 1870 feet through the rest of the year. Under alternatives 1 and 2, water levels would remain above 1870 feet from May through September, with water levels above 1872 feet in July and August. Inundation to 1870 feet would occur from May through July under Alternative 3. Under alternatives 4 and 5, inundation would remain above 1870 from May through August, but only the lower zone of wetlands (less than 1871 feet) would be affected.

Table 6.4-7. Predicted change in hydroperiod components as a result of five alternative rubber dam scenarios, Lake Wenatchee, WA.

Hydroperiod component	Historic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Magnitude of flooding[1]	1871.34	1872.08	1872.09	1872.51	1871.34	1871.34
Frequency of inundation to 1872 feet[2]	0.50	0.92	0.92	1.00	0.50	0.50
Timing of peak water level	May-June	July-Aug	July-Aug	May-June	May-June	May-June
Duration of inundation above 1870 feet	May-June	May-Sept	May-Sept	May-July	May-Aug	May-Aug

1 Annual high of average monthly water level.

2. Fraction of years in which average monthly water level is equal to or greater than 1872.0 feet.

The CML study by Raedeke (1997) shows two things pertinent to the question of rubber dam operation on Lake Wenatchee wetlands. One, a change in inundation duration of 30 to 50 days is associated with an upward shift in the lower elevation of sedge and willow dominated plant communities (although this component of hydroperiod is likely correlated with other components). And, two, the particular species present in the CML deltas can tolerate specific periods of inundation. Sedges at CML (shore sedge [*Carex lenticularis*] and inflated sedge *[Carex vesicaria*] can persist with inundation during as much as 140 out of 180 growing season days. Willow species occurring at CML (Pacific willow [*Salix lucida lasiandra*], Sitka willow [S. *sitchensis*]) can persist with as much as 70 days of inundation during the growing season. Sedge and willow at species at Lake Wenatchee probably have a parallel difference in maximum inundation periods, but the specific length of the period may be different due to differences in climate and growing season between CML and Lake Wenatchee.

Based on the extent and magnitude of hydroperiod changes predicted under the five alternative operational scenarios presented in Table 6.4-6, Alternatives 1, 2 and 3 have a high probability of altering wetland vegetation (–) in the delta wetlands of Lake Wenatchee. Alternatives 4 and 5 have a moderate probability (= –) of affecting wetland community structure in at least the lower elevation wetland zone (i.e., 1870 to 1871 feet). Changes in wetland vegetation resulting from these scenarios (assuming they would be maintained and not varied year-to-year) would likely consist of a movement up slope of plant communities presently occurring in the wetlands, but could also involve changes within plant communities. Under all alternatives, more flood tolerant species such as spikerush and bur-reed may displace sedges and rushes, with the OHWM (the interface between bare substrate and emergent vegetation) also moving up in elevation. Under alternatives 1, 2, and 3, willows would likely die back at the lower end of their elevational distribution and be replaced by more flood tolerant herbaceous species, such as sedges. Other woody tree species affected by lake water level, such as cottonwood, may also experience some mortality. Colonization of new areas by willow upslope of their present limit would be expected in time, but may take decades depending on the occurrence of fluvial or other disturbance to create open substrates for willows to become established.

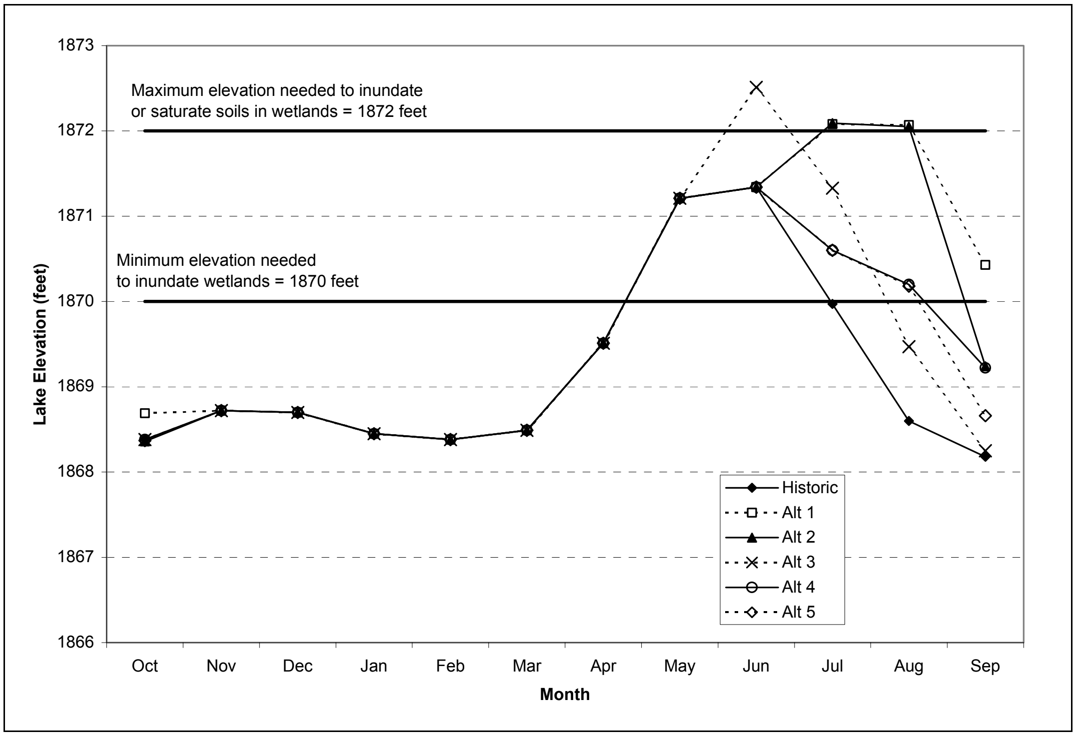


Figure 6.4-1. Average lake level elevations under different rubber dam operational models, Lake Wenatchee Water Storage Feasibility Study.

6.4.3 Effects Of Rubber Dam Operations On Water Quality Conditions

The general types of impacts that may occur to the water quality in Lake Wenatchee, the mainstem Wenatchee River and the major tributaries as a result of the operation of the rubber dam under the five alternatives are discussed in this section. Our understanding of existing conditions and modeled storage and release strategies were used to determine and describe potential project effects on water quality.

6.4.3.1 Water Temperature

Salmonids are cold water species and are considered at risk when temperatures exceed 23-25ºC (Bjornn and Reiser 1991). Upper lethal thermal limits range from 22.8ºC for cutthroat trout to 26.2ºC for chinook salmon (Bjornn and Reiser 1991). However, these values may vary according to recent temperature acclimation by the fish. A recent review of temperature requirements for Pacific Northwest salmonids used to support the draft. USEPA Region 10 guidance for temperature water quality standards suggests that adult salmon can generally survive a week or more at constant temperatures as high as 21ºC and can tolerate temperatures as high as 18ºC for prolonged periods under controlled experimental conditions (USEPA 2002). Additionally, water temperatures above 15.5^{o}C may contribute to low DO levels, another water quality parameter potentially limiting to salmonid populations.

High water temperatures are a limiting factor for salmonids in the mainstem Wenatchee River during the summer and potentially for salmonids near the mouth of the Little Wenatchee River. The causes of high water temperatures in the mainstem Wenatchee River is the object of an on-going study being conducted by Ecology (Bilhimer et al. 2002). Generally, low instream flows can result in higher water temperatures since the temperature of rivers with smaller volumes equilibrate faster, leading to higher maximum water temperatures in the summer (USEPA 2002). The operation of the rubber dam will have little effect on the overall lake surface temperature regime. The rubber dam would retain additional water in the lake basin during a portion of the period from July through September. The additional water mass of colder spring runoff (at <10 C) would tend to delay the normal rise in seasonal water temperature to some slight extent depending on annual solar heating regimes. As the anticipated increase in lake volume is between 12,000 and 6,000 acre feet and the nominal lake volume is 364,560 acre feet, the increase of between 3.3 and 1.65% in the spring is not expected to result in a significant seasonal temperature change. As a result, there would likely be little if any temperature benefits resulting from the release of supplemental flows from the lake to the mainstem river for any of the alternatives (=). Temperature modeling would be required to quantify the potential change in water temperature from release of additional flow.

6.4.3..2 Dissolved Oxygen

Low levels of dissolved oxygen (DO) may affect survival and growth of all salmonid freshwater life stages. Bjornn and Reiser (1991) concluded that DO levels of 8 to 9 mg/L are needed to ensure normal physiological function in salmonids. DO concentrations in forested rivers and streams are typically at saturation because of turbulent aeration and low primary productivity (Welch et al. 1998). Lakes and areas of calm open water, on the other hand, can have varied levels of DO dependent on seasonal and diurnal patterns of photosynthesis and decomposition. Lake Wenatchee, however, exhibits a relatively constant level of DO throughout its water column and throughout the year (Table 6.3-2), presumably as a result of wind-driven mixing (Sylvester and Ruggles 1957). DO concentrations are also dependent on water temperature, with the solubility of oxygen decreasing as water temperatures increase. The lower Wenatchee River was included on the state's 303(d) list of impaired waters in 1996 and 1998 for low dissolved oxygen levels (Ecology 1998).

The operation of the rubber dam will not likely influence DO levels in the mainstem Wenatchee River, nor will it affect DOs in the tributaries or in Lake Wenatchee (=). As noted below, high spring runoff flows in late May and June of 1996 were not associated with substantially higher nitrogenous or total phosphorus nutrients. Therefore, the DO regime is not expected to be modified by higher plankton productivity in the lake.

6.4.3.3 Nutrients and Biochemical Oxygen Demand

The source of nutrients in the Wenatchee River system includes autochthonous (algal and plant production within the stream/lake) and allochthonous (production from outside the stream/lake), such as from terrestrial leaf litter and spawned out salmon carcasses. High nutrient concentrations do not themselves generally create conditions that are directly harmful to salmonid species. It is the influence of the nutrients and organic pollution on the biochemical oxygen demand (BOD) that can lead to low DO concentrations that impact fish and other aquatic organisms (Hynes 1974). BOD is a measure of the rate at which DO is demanded by the microbial community to digest organic matter (Welch et al. 1998).

The operation of the rubber dam will not likely have measurable effects on nutrient concentrations or BOD in Lake Wenatchee, the Wenatchee River or the tributaries (=). Results of monthly water quality sampling in 1996, indicate that high springtime flows out of the lake are not characterized by substantially increased nitrogenous and total phosphate nutrient levels (WRWSC 1998). Retaining these flows behind the rubber dam would, therefore, be insufficient to promote planktonic algal growth to the extent that increased BOD would result later in the year.

6.4.3.4 pH

The pH of river and stream water naturally increases as streams flow downstream because of the increased time the water is in contact with bedrock and the increased amounts of solutes that enter the water (Welch et al. 1998). Ecologically, an acceptable pH range is between about 6 and 9 (Welch et al. 1998). Low pH waters can be naturally associated with wetland drainages that can contain high amounts of humic acids and it is common to find low pH waters in the stratified bottom layers of lakes. High pH waters can occur naturally as a result of high rates of photosynthesis, although in some cases the photosynthesis may be stimulated by increased amounts of nutrients from run-off, sewage, or other human derived sources. The lower Wenatchee River was included on the state's 303(d) list of impaired waters in 1996 and 1998 for high pH levels (Ecology 1998).

The operation of the rubber dam will not likely affect a measurable change in the pH regime in Lake Wenatchee, the Wenatchee River or the tributaries (=). In the absence of increased nutrient concentrations, noted above, increased algal productivity and hence pH increases should not occur. The pH values measure near the lake outfall in May and June 1996 (WRWSC 1998) remained within the acceptable range for salmonids (6.0 to 9.0 pH units) in the flows the dam would retain in the lake. Therefore, retaining the spring runoff for later flow augmentation should have no measurable effect on lake water pH levels.

6.4.3.5 Suspended Sediments and Turbidity

Fine particles suspended in the water column are typically measured as turbidity, which is a measure of the amount of light scattered by the particles in suspension. Rivers that drain glacial meltwater naturally have high amounts of suspended "glacial flour" and high turbidity with a characteristic milky color. Highly productive lakes also sometimes have high levels of turbidity resulting from phytoplankton and zooplankton in the water. In a river, it is natural for turbidity to increase as the water flows downstream and more solutes enter the water. Unnatural sources of suspended sediments and increased turbidity can include run-off from unpaved roads, increased rates of mass wasting resulting from timber harvest, increased rates of primary production, and increased rates of bank erosion and bedload movement resulting from increased flood or peak flows. Roads and housing development downstream of the Chiwawa River (RM 48.4) on the upper Wenatchee River may elevate sediment input to the river at this location (Andonaegui 2001).

The operation of the rubber dam will not likely have a substantial effect on the suspended solids or turbidity of Lake Wenatchee, the Wenatchee River or the tributaries (=). Water quality data collected in the spring of 1996 indicated that turbidity at the lake outfall did not increase with highest measured flows in May. However, total suspended solids increased from 0.2 to 5 mg/L from the May to June measurement (WRWSC 1998). Although turbidity did not show a similar increase, the operation of the rubber dam may retain an increased amount of sediment in the lake that otherwise would pass downstream. This sediment, if retained, would precipitate to the lake bottom during the three-month retention period. Consequently, the water later release for flow augmentation would carry a reduced sediment load.

6.5 CONCLUSIONS REGARDING POTENTIAL ENVIRONMENTAL IMPACTS AND BENEFITS

Until this study, it was not known how much water could be provided through construction and operation of a rubber dam at the outlet of the lake. Reconnaissance level studies had suggested that the OHW elevation would be higher (approximately to the 1872 feet elevation) than what the field surveys determined, suggesting that a reasonable amount of yearly stored water would be in the range of 11-12,000 acre-feet. However, as described in Section 3.2, the actual OHW was determined to be 1870.3 feet, which would provide approximately one-half of that amount.

This study identified several potential negative environmental impacts or issues that may result from project implementation. These included the potential impacts to existing wetlands and shoreline plant communities, and as well concerns related to bull trout connectivity between lake and riverine habitats.

Although specific field studies were not conducted that would help to define incremental benefits in terms of fish habitat relative to different streamflows, it can be surmised that such benefits in terms of supplementation of 50-100 cfs, would be relatively small when considering the channel dimensions of the Wenatchee River. River widths in the range of 150-200 feet are not uncommon, especially in wide riffle habitats, and even under extremely low flows (e.g. 300 cfs at Plain[1]) the additional 50 to 100 cfs for a short period of time (one month) would likely result in relatively small changes in water depth (≈ 1-2 inches). How these changes in water depth translate into changes in fish habitat is not known. However, extremely low flows that occur during warm summer months can create especially stressful conditions to fish. During such periods, the provision of even relatively small amounts of flow may temporally and spatially benefit fish populations. Clearly, the potential environmental impacts and benefits of the Lake Wenatchee Water Storage Project warrant further consideration.

6.7 POTENTIAL ADDITIONAL STUDIES

For many of the potential impacts identified on the mainstem Wenatchee River, instream flow modeling (habitat and temperature) would assist in the quantification of potential effects. Additional studies on the bathymetry and topography of the lake shoreline would also assist in the quantification of potential impacts within the lake. The following list outlines additional studies and information needed to fully evaluate potential project impacts:

- Temperature modeling in the mainstem river to assess the potential impacts/benefits of increased water released from Lake Wenatchee and to generally understand thermal regime characteristics of the watershed.
- Instream flow study to determine horizontal and longitudinal extent of potential impacts in the Wenatchee river from increased water released from Lake Wenatchee.
- Instream flow fish passage study to identify areas for which flow related migration delays may occur and to derive recommended passage flows that would facilitate upstream migration of adult salmonids.
- Construction details, sequence, and impact analysis.

[1] The 95% exceedence flow at Plain for September was computed as 344 cfs. This flow would be equaled or exceeded 95% of the time and therefore represents a extremely low flow condition.

- Fish passage details and impact analysis.
- Longitudinal survey of the lake shoreline and of the Little Wenatchee and White rivers to identify potential spawning habitat that could be inundated, exposed, or scoured as a result of manipulated lake levels.
- Topographic survey to determine elevational range of plant communities and accessibility of off-channel fish habitat at specific lake levels
- Characterization of wetland plant species composition and distribution of wetland plant communities to provide better information for assessing impacts to the wetlands along the lake
- Installation and monitoring of ceilometres to determine the extent of hydrologic influence by the lake and how groundwater or disconnected surface water responds to lake level fluctuation to provide better information for assessing impacts to the wetlands along the lake

7.0 SUMMARY AND CONCLUSIONS

7.1 SUMMARY

This report results from a Washington State Legislature grant to study the feasibility of storing additional water in Lake Wenatchee. The Legislature acted upon recommendations of the State's Water Storage Task Force to study the issue of water storage across the State. The focus on reviewing all potential solutions to shortfalls in instream flow and water supply was sharpened in the drought year of 2001, when streamflows dropped to historic lows in late summer and many water users across the state had their water supply interrupted as a result.

The Legislature appropriated funds for this study because of its location within the Wenatchee River Watershed, the history of past water storage studies and permits on Lake Wenatchee and ongoing efforts in Watershed Planning undertaken by the Wenatchee Watershed Planning Unit. The Wenatchee River Watershed is listed as one of the State's sixteen "critical basins" because of the presence of Endangered Species Act (ESA) listed species, development pressures and the potential for future water shortages. Previous studies and planning on water storage in Lake Wenatchee were performed by the Wenatchee Reclamation District and Chelan County PUD. The Wenatchee Reclamation District initiated a water storage project in 1930 in response to drought conditions in the Wenatchee River Watershed. They obtained permits to construct a low dam near the mouth of the Lake, which would impound water to the normal high water elevation. The project was not completed and Chelan County PUD acquired the permits from the District. The PUD envisioned a water storage project that was a component of a larger hydroelectric project. That project was dropped in the 1970's and the rights reassigned back to the District.

Chelan County Natural Resources Department is leading the Wenatchee Watershed Planning effort and assembled a project team to oversee the scope of the feasibility study and obtain public comment on the scope. The project team was assembled from a diverse group of public, local agency (city and county), irrigation, conservation, state, federal and tribal interests. Six public and project team meetings were held in the time period from September 2001 to June 2002. In four of these meetings there was discussion to obtain input on the scope. A final scope of work for the feasibility study was agreed to by the project team and is the basis for this study.

Five broad study areas were selected by the project team to cover the scope of the feasibility study. The study areas address the following issues:

- Water Needs
- Technical Feasibility
- Legal Feasibility
- Socioeconomic Impacts
- Environmental Impacts

The following paragraphs summarize those study areas.

7.1.1 Summary of Water Needs

The water stored in Lake Wenatchee could be used for several purposes; those being instream flow augmentation, water supply for future surface water users in the Wenatchee River Basin Watershed or as mitigation for future groundwater use either in the aquifers supplying the Wenatchee River or in tributaries to the Wenatchee River.

A review of potential population growth and growth in municipal, domestic, industrial and agricultural water use was made. From the perspective of population growth and growth in forecasted municipal demands, the estimated increase in water demands over the next 20 years is:

- 7.3 cfs on a peak daily basis and
- 1,868 acre-feet annually.

No growth in self-supplied industrial and commercial water use is forecast unless additional water is made available that would not be subject to interruption from low streamflow levels and minimum instream flows set by Chapter 173-545 WAC.

A review of agricultural water use was made and the following conclusions were made:

- Agricultural water use accounts for an estimate of 68,000 acre-feet of consumptive use (either water consumptively used by crops or exported outside the Wenatchee River Watershed)
- The area of irrigated agriculture appears to be stable and not declining.
- There is a substantial area of land that is currently zoned for residential use that can be converted from agricultural use.

Our opinion is that although annual water use may decline if that land is developed, peak water use may not change. The peak water demands are important as they have the most immediate effect on streamflow. A review of water right applications was made to compare to the predicted future water demands.

- The current applications are requesting 43 cfs from surface water and 10.9 cfs from ground water.
- The types of use requested on the applications are primarily municipal and domestic for surface water and irrigation for ground water.
- Most of the applications, if approved, would be subject to minimum instream flows and therefore interruptible during low streamflow periods.

Some of the applications, such as those contained in the Peshastin Creek basin, would not likely be approved as the basin is closed for further appropriation from June 15 to October 15. The difference between the forecast future water needs and the quantity applied for is mostly due to water right applications for irrigation. It appears those applications are primarily for landscape or lawn irrigation and not commercial agriculture. It was estimated the increase in irrigation demand from approval of those applications to be 8 cfs; the estimated effect on streamflow is a reduction of 5.6 cfs. The estimated increase in municipal and domestic demand is 7.3 cfs and the estimated effect on streamflow is a reduction of about 5 cfs.

The effect on streamflow from future municipal and domestic demand and from approval of pending water right applications for irrigation is an estimated reduction of about 10.6 cfs.

The largest potential water need is for instream flow. Chapter 173-545 WAC has set minimum flows for the Wenatchee River and some tributaries. Hydrologic analyses have determined the average shortfall between Wenatchee River streamflow (measured at Plain) and the minimum flows is 17,500 acre-feet per year. In 2001, the shortfall was 50,400 acre-feet for the time period of July to October.

While there should be continual updates of the information contained in this chapter there were no additional areas of water needs analysis that were identified for further study.

7.1.2 Summary of Technical Feasibility

To enable seasonal storage and release of water from Lake Wenatchee, an inflatable rubber dam was identified as the most suitable type of structure for the site. The rubber dam would be located on the Wenatchee River approximately 1,600 feet downstream of the mouth of the lake where the river is narrowest. The site is the location of a previous bridge crossing that was demolished, however the concrete bridge pilings still exist.

Two operating water levels were selected for analysis of benefits and impacts. The first water level is the Ordinary High Water (OHW). This water level is important as it is the demarcation between private property and State-owned shorelands, except those second-class shorelands sold to property owners. The OHW level was field surveyed and estimated to be El. 1870.3 above mean sea level. The second water level selected for analysis is El. 1872.4 above mean sea level, which corresponds to the spring high water level that occurs nine out of ten years.

A hydrologic model of Lake Wenatchee was prepared using historic streamflow and lake level data. The model was prepared to determine the existing water level regime of the lake and the effect of operating the lake as a storage reservoir. Five potential operating alternatives were analyzed with the model. The alternatives are:

Alternative 1 – Maximum lake level controlled by the rubber dam = El. 1872.4. The dam would start storing water July 1 and releasing water August 23. Lake outflow would ramp up to 100 cfs in excess of historic outflows on September 1 and water released until storage is exhausted.

Alternative 2 – Maximum lake level controlled by the rubber dam = El. 1872.4. The dam would start storing water July 1 and releasing water August 23. Lake outflow would ramp up to 200 cfs in excess of historic outflows on September 1 and water released until storage is exhausted.

Alternative 3 – Maximum lake level controlled by the rubber dam = El. 1872.4. The dam would start storing water June 1 and releasing water July 1. Pulse flows would be released at a rate of 100 cfs for 4 hours per day until August 15. Lake outflow would be augmented by 100 cfs in excess of historic outflows starting August 16 and water released until storage is exhausted.

Alternative 4 – Maximum lake level controlled by the rubber dam = El. 1870.3. The dam would start storing water July 1 and releasing water August 23. Lake outflow would ramp up to 50 cfs in excess of historic outflows on September 1 and water released until storage is exhausted.

Alternative 5 – Maximum lake level controlled by the rubber dam = El. 1870.3. The dam would start storing water July 1 and releasing water August 23. Lake outflow would ramp up to 100 cfs in excess of historic outflows on September 1 and water released until storage is exhausted.

The results of the model indicate Alternative 2 provides the greatest flow augmentation, but for a shorter time period than Alternative 1, which can augment flow through much of October if needed. Alternative 3 has less water to store and release because it has different storage and release seasons in comparison to Alternatives 1 and 2. Alternatives 1 and 2 were found to provide a maximum storage (in excess of minimum historic water levels) of 12,300 acre-feet in late August. The maximum increase in lake levels from historic levels is about 2.7 feet in July, 3.9 feet in August and 2.6 feet in September from Alternatives 1-3.

Alternative 5 can reliably provide a flow augmentation of 75 cfs in September. Alternative 4 can provide 50 cfs in September and for about one-half of October. The increase in lake levels from historic for the two alternatives is about 0.6 feet in July, 2.0 feet in August and 1.0 feet in September.

The rubber dam requires construction of a concrete structure to support the 10-feet high (maximum) by 200-feet long black rubber bladder. The concrete structure would be mostly submerged and hidden from view except at the sides of the channel where sloping walls would be visible. When deflated (for most of the year) the rubber dam will be submerged and not visible. A fish ladder is required and would likely sit on the north side of the river adjacent to the state park. The fish ladder would be a concrete structure with 15-feet wide weirs and a total rise of 5 feet. Rubber dams have been found to be very rugged and resistant to vandalism, debris and other damage.

The estimated costs of designing, permitting and constructing the rubber dam to impound water to El. 1872.4 are $5.8M. Those costs do not include financing, legal, interest during construction, project mitigation, land purchase or easement, and other costs not directly related to construction of the rubber dam structure. Some of these costs are identified in Chapter 5 and 6 and summaries of all costs both estimated and not are shown at the end of this chapter. The estimated costs to construct a rubber dam to impound water to El. 1870.3 are $5.4M.

A review of the potential increase in wind and wave-driven shoreline erosion was made for an example site on Lake Wenatchee on the south shore near the State Park. Lake Wenatchee is prone to high winds from a north/northwest direction during summer. The wind analysis shows a large potential increase in wave energy directed at the site if water levels are maintained at El. 1872.4 and a much smaller increase if water levels are maintained at El. 1870.3. It is out opinion that very little or no additional shoreline erosion would occur if water levels are maintained at the lower elevation.

Areas that the team identified for additional study in Technical Feasibility are further specific analysis of the wind and wave erosion potential. The scope of work for this study only asked for an approximation of the potential change in erosion by calculating the change in the wave energy from existing conditions. The effect on actual soil conditions of the surrounding beaches and banks as well as on water front structures was beyond the scope of this study. Further specific analysis of those areas should be made to more fully address erosion issues.

7.1.3 Summary of Legal and Permitting Issues

A review of the status of a reservoir permit issued to Wenatchee Reclamation District (WRD) was performed and it is concluded the permit was cancelled and would need to be reapplied for. The WRD purchased an easement in 1944 from the State of Washington for the right to inundate second-class shorelands and that easement still applies to all second-class shorelands purchased from the State after that date. Second-class shorelands extend up to the line of OHW. It was found that private property owners with a total of 10,950 and Washington Parks and Recreation Department with 9,430 front feet of waterfront own second-class shorelands that were purchased prior to the issuance of the overflow easement. An easement would need to be purchased from those property owners to maintain water levels at the OHW level. A total of 70,000 feet of shoreline exists around Lake Wenatchee and overflow easements from all property owners on the lake would need to be obtained to maintain water levels at El. 1872.4.

A review of the potential impact on Tribal fisheries was performed and the conclusion reached that the project would have a negligible effect on Tribal fisheries in the Wenatchee River Watershed.

A review of permitting issues was performed and the types of permits that would be required from Federal, State and local agencies described. The typical timeframe for acquisition of those permits was also described. The project would likely be subject to the NEPA process and would require a Corps of Engineers permit, bringing in the need for consultation under ESA. One to three years was the estimated timeframe for application and acquisition of the necessary permits. Approaches to permitting and additional information needed for the permitting process are provided.

7.1.4 Summary of Socioeconomic Impacts

Impacts of the Lake Wenatchee Water Storage Project on property values, property improvements and the cost of easements would vary with each alternative.

The assessed value of the property on Lake Wenatchee based on literature review and discussions with the Chelan County Assessors Office regarding the property values, relates only to linear frontage of shoreline as opposed to total square footage of shoreline area.

For the El. 1870.3 (OHW) Alternatives, storage to the OHW elevation would directly impact only those landowners holding unrestricted rights to second class shorelands. However, this taking may also impact individual owners' sense of value because of restricted access to seasonal beaches in the public domain. The cost of easement to inundate the second class shorelands where that right does not presently exist is estimate at between $1.4 and $3.5 million.

The analysis concluded that it is likely that there would be little or no impact to property improvements in the OHW alternatives.

For the El 1872.4 Alternatives, there would be a substantial loss of beach and shallow water shoreline on much of the lake. There would likely be increased shoreline erosion and vegetation mortality associated with the higher lake levels. There would likely slow the rate at which adjacent properties would increase in value. The cost of easements to inundate the second class shorelands where that right does not presently exist and compensation to landowners for lands that would be inundated between the OHW and El. 1872.4 is estimated at between $6.1 and $15.3 million.

A range of mitigation cost for improvements on the properties that may be affected by higher water levels. However, no overall cost of mitigation for these individual lot improvements can be made until a detailed, lot by lot inventory of the improvements and their elevations can be made.

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

It is likely that there would be some impact on the Headwater site in all Alternatives and consultation 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, tribes and federal agencies would need to be entered into to mitigate for effects to site 45CH208 and other potential resources.

The project should result in no adverse effect on whitewater boating and rafting because changes in flows would be small and flows would still accommodate a wide range of boating activities. 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.

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 a barrier to access to large segment of the reach of the river 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 t 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.

A study of market value as opposed to assessed value should be conducted with a representative sample of buyers, sellers and owners around the lake. A lot-by-lot survey of property improvements and their elevations to establish the number and cost of the mitigation that would need to take place particularly at the El. 1872.4 elevation.

7.1.5 Summary of Environmental Effects and Recommended Additional Studies

Several populations of economically and culturally important fish species are found in the Wenatchee River system. Four species of anadromous (ocean-rearing) fish are present in the basin: chinook, sockeye, steelhead, and Pacific lamprey. While historically abundant, native coho have been extinct from the basin since the early 1900s. Reintroduction efforts were begun in 1997. Other important salmonid species in the Wenatchee basin are bull trout, kokanee, westslope cutthroat trout, and rainbow trout. Three fish species in the Wenatchee River basin are protected under the federal Endangered Species Act (ESA). Steelhead and spring chinook in the Wenatchee River basin are listed as endangered under the ESA. Bull trout in the Wenatchee River basin are listed as threatened under the ESA.

The operation of the rubber dam to augment flows in the mainstem Wenatchee River during late-summer/early-fall could provide some benefit to the upstream migration and holding of adult steelhead, chinook, and to a lesser degree coho salmon. The degree of potential benefit would be related to the amount and timing of flow available and hence alternative 3 and 2 would likely have the greatest and alternative 4 the lowest potential benefit. The largest benefits to migration and holding would likely be to steelhead and summer chinook during the lowest flow years, since these species spawn in the mainstem Wenatchee, and they would likely spend some time holding in the river prior to spawning. The pulse flow operational alternative (Alternative 3) specifically targets adult passage for spring chinook and sockeye during low flow conditions that may occur in July.

Supplemental water released to the mainstem Wenatchee River during late-summer/early-fall may potentially enhance to varying degrees the amount of spawning habitat available to chinook in the mainstem Wenatchee River. The timing of the flow releases associated with alternative 3 and the limited amount of supplemental flow under alternative 4 suggest the benefits to chinook spawning habitat in the mainstem would be small compared to the other alternatives. If the fall rains coincide with the end of the period of supplemental water and water levels are not subsequently reduced during incubation, the increased spawning habitat could benefit spring and summer/fall chinook. Negative impacts to incubating chinook embryos could occur if areas used for spawning are subsequently dewatered during the period between flow augmentation from the Lake Wenatchee Water Storage project and the onset of the fall rains. The only other salmonid species that spawn in the mainstem are steelhead. Steelhead spawning will not be affected by project operations, because steelhead spawn in the spring.

Operation of the rubber dam will not affect high-flow rearing habitat in the mainstem Wenatchee River. The release of water stored in Lake Wenatchee during late-summer/early-fall may temporally increase the amount of low-flow refuge habitat and may afford some benefit to juvenile salmon species rearing in the river, with Alternative 4 providing the least benefit. The effects of extending the period of high water levels in Lake Wenatchee during the summer on juvenile fish rearing in the lake and at the mouths of the Little Wenatchee and White rivers are unknown. Higher water levels throughout the summer could benefit juvenile fish rearing in the wetland complex on the western end of the lake if the higher water levels help maintain open water and transportation corridors between ponded areas and the main lake. However, baseline information on the habitat condition, use and productivity of this wetland area is not available.

The project operation is not anticipated to affect juvenile outmigration in the tributaries or in Lake Wenatchee, provided suitable fish passage facilities are integrated into the dam design.

The release of water stored in Lake Wenatchee during late-summer/early-fall could coincide with the peak of sockeye spawning in late September. Although it is unknown if sockeye spawn along the shoreline of Lake Wenatchee, the species is known to use this type of habitat in other lakes. Reduced lake levels during the period of sockeye spawning could result in redds being built in areas that would subsequently become dewatered as the stored water is released to the mainstem Wenatchee River. Thus, there is some potential negative impacts to lake-shore spawning (if it occurs) related to all of the alternatives.

Release of water stored in Lake Wenatchee to supplement late-summer/early-fall flows in the mainstem Wenatchee River will result in the lowering of the lake levels and potential stranding of juvenile fish rearing in the littoral areas. However, because the shoreline of Lake Wenatchee is generally steep, shallow littoral areas where stranding could occur are limited to the wetland area in the vicinity of the confluence with the Little Wenatchee and White rivers, at the western end of the lake. It is believed that trapping and stranding effects would be minimal in this area because of the complex morphology occurring within the wetland habitat, and the generally low temperatures expected during the summer because of vegetative shading and connection with groundwater.

The operation of the rubber dam will temporally increase the mainstem river minimum instream flows during the late-summer/early fall period and may help maintain or restore connections with off-channel habitats that could otherwise become dewatered or isolated from the main channel. The effects of this would likely be relatively small due to the comparatively low amount of water that would be supplemented to the lower river compared to natural flows. The operation of the rubber dam will not affect side-channel habitat in the tributaries, upstream of the lake influence. However, higher water levels throughout the summer in Lake Wenatchee could result in increased open water and transportation corridors between off channel areas in the wetland complex on the western end of the lake, including the lower portions of the tributaries, and the main lake.

At the western end of the lake there is an extensive complex of wetlands associated with the outlets of the Little Wenatchee and White rivers. These delta wetlands include littoral wetlands along the lake shore, floodplain wetlands including abandoned oxbow channels, and beaver ponds. Based on the extent and magnitude of hydroperiod changes predicted under the five alternative operational scenarios, Alternatives 1, 2 and 3 have a high probability of altering wetland vegetation in the delta wetlands of Lake Wenatchee. Alternatives 4 and 5 have a moderate probability of affecting wetland community structure in at least the lower elevation wetland zone (i.e., El. 1870 to 1871). Changes in wetland vegetation resulting from these scenarios (assuming they would be maintained and not varied year-to-year) would likely consist of a movement up slope of plant communities presently occurring in the wetlands, but could also involve changes within plant communities. Under all alternatives, more flood tolerant species such as spikerush and bur-reed may displace sedges and rushes, with the OHW (the interface between bare substrate and emergent vegetation) also moving up in elevation.

High water temperatures are a limiting factor for salmonids in the mainstem Wenatchee River during the summer and potentially for salmonids near the mouth of the Little Wenatchee River. The operation of the rubber dam may provide little if any temperature benefits however additional studies, including temperature modeling is required.

Although specific field studies were not conducted that would help to define incremental benefits in terms of fish habitat relative to different streamflows, it can be surmised that such benefits in terms of supplementation of 50-100 cfs, would be relatively small when considering the channel dimensions of the Wenatchee River. River widths in the range of 150-200 ft. are not uncommon, especially in wide riffle habitats, and even under extremely low flows (e.g. 300 cfs at Plain) the additional 50 to 100 cfs for a short period of time (one month) would likely result in relatively small changes in water depth (» 1-2 inches). How these changes in water depth translate into changes in fish habitat is not known. However, extremely low flows that occur during warm summer months can create especially stressful conditions to fish. During such periods, the provision of even relatively small amounts of flow may temporally and spatially benefit fish populations. Clearly, the potential environmental impacts and benefits of the Lake Wenatchee Water Storage Project warrant further consideration.

Additional studies and information needed to fully evaluate potential project impacts include:

- Temperature modeling in the mainstem river to assess the potential impacts/benefits of increased flow released from Lake Wenatchee.
- Instream flow channel study to determine potential benefits to habitat in the Wenatchee River from increased flow released from Lake Wenatchee.
- Instream flow fish passage study to identify areas for which flow related migration delays may occur.
- Fish passage details and impact analysis.
- Survey of the lake shoreline and of the Little Wenatchee and White rivers to identify potential spawning habitat that could be affected as a result of changed lake levels.
- Topographic survey to determine elevational range of plant communities and accessibility of off-channel fish habitat at specific lake levels.
- Wetland studies to better assess impacts.

7.2 CONCLUSIONS

We offer the following conclusions for the Lake Wenatchee Storage Project:

7.2.1 If Water Is Stored To El. 1870.3 Ft (Alternatives 4 and 5)

The storage project would impound an estimated 6,750 acre-feet in excess of historic low water levels for. The average difference in lake water levels in August would be 2 feet; in September 1 feet. The project could reliably supply between 50 cfs and 75 cfs for the month of September and early October. That water would be used to augment instream flow in the mainstem Wenatchee River and/or to offset future water needs in the Wenatchee River Watershed. The project would supply more than enough water to meet future municipal and domestic water needs in the Watershed. The project could not provide enough water to substantially reduce the occurrence of Wenatchee River flows falling below instream flows set by Chapter 173-545 WAC.

Some potential environmental impacts exist for storage of water to El. 1870.3, there is a moderate probability of affecting wetlands in at least the lower wetland zone. Juvenile Bull trout upstream migration time may be adversely impacted.

Maintaining water levels higher than historic would affect beach recreation by reducing beach area but few other socio-economic impacts were identified. Costs of mitigation for damage to property improvements is unlikely. Cost for easement for inundation of second class shorelands (20,380 feet) in these alternatives is estimated to be between $1.4 and $3.5 million.

The construction cost, including permitting costs is estimated to be $5.4M.

On a unit cost of storage basis, the project construction and easement cost would be $1165 per acre-feet That cost is reasonable and much less than storage costs for other storage projects under consideration in Washington State. For example a review of potential storage projects under consideration in the Yakima River Watershed (EES, MWG 2002) found storage costs ranging from $1,200 to $8,100 per acre-feet of water supplied by the project during dry years. Unit costs from the *Water Storage Task Force Report to the Legislature* (Ecology, 2001) for projects constructed or proposed in Washington State range from $1,695 to $13,280 per acre-feet. The highest unit costs were for smaller projects or projects that required pumping to a reservoir and therefore more facility costs and long-term power costs.

This scenario of maintaining water levels at El. 1870.3 appears to be feasible and cost-effective and warrants additional study if a demand for the water exists and the potential impacts from implementation are less than alternative instream flow augmentation or water supply projects.

7.2.2 If Water is Stored To El. 1872.4 Ft (Alternative 1, 2 and 3)

The storage project would impound an estimated 12,300 acre-feet in excess of historic low water levels. The average difference in lake water levels in August would be 3.9 feet; in September 2.6 feet. The project could reliably supply between 100 cfs and 200 cfs for the month of September and early October. That water would be used to augment instream flow in the mainstem Wenatchee River and/or to offset future water needs in the Wenatchee River Watershed. The project would supply more than enough water to meet future municipal and domestic water needs in the Watershed. The project could not provide enough water to substantially reduce the occurrence of Wenatchee River flows falling below instream flows set by Chapter 173-545 WAC.

Environmental impacts are likely for storage of water to 1872.4 feet, including potential impacts to wetlands at the head of the lake and plant communities around the shoreline of the lake. The costs of mitigation are not identified. There would be increased flow benefits for mainstream Chinook salmon for passage spawning and rearing. Length of time for juvenile Bull trout's upstream migration could be affected adversely.

Socio-economic impacts would also be greater with this storage scenario. Storage to this water level would cause considerable loss of beach and would require purchase of flooding easements around the entire lake (70,000 feet) as well as inundation easements for some of the second class shorelands. Cost for these easement are estimated to be between $6.1 and $15.3 million.

Property improvements would likely be impacted, but costs of mitigation for damage to these property improvements cannot be known until a lot-by-lot inventory is done.

The construction cost, including permitting costs is estimated to be $5.8M.

Since large portions of the potential costs for these alternatives are not known the unit cost for storage at El. 1872.4 cannot be calculated.

It is our opinion storage to El. 1872.4 is problematic and would be difficult to implement because of impacts to wetlands and to waterfront property.

8.0 REFERENCES

Andonaegui, C. 2001. Salmon, steelhead, and bull trout habitat limiting factors for the Wenatchee subbasin (WRIA 45) and portions of WRIA 40 within Chelan County. Washington State Conservation Commission. Olympia, Washington. 321 pages on cd.

Beery, M., and J. Kelly. 1982. Wenatchee River Basin instream resources protection program including proposed administrative rules and supplemental environmental impact statement. Prepared by Water Resources Policy Development Section, Washington State Dept. of Ecology. Olympia, Washington. 35 p. plus appendices.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6. Bethesda, Maryland.

Benson, Earl D. et al., "Pricing Residential Amenities: The Value of a View". Journal of Real Estate Finance and Economics. January 1998, pages 55-73

Berg, L., D. Lowman and Yakama Nation Consultants. 2002. Wenatchee Subbasin summary. Draft report prepared for the Northwest Power Planning Council. 115 p.

Big Bear Municipal Water District. 1993. Analysis of Recreation and Economic Impacts of Alternative Water-Release Scenarios from Big Bear Lake. Prepared by Jones & Stokes Associates, Inc. Sacramento CA.

Bilby, R. E., B. R. Fransen, P. A. Bisson, and J. K. Walter. 1998. Response of juvenile coho salmon (Oncorhynchus kisutch) and steelhead (O. mykiss) to the addition of salmon carcasses to two streams in southwestern Washington, U.S.A. Can. J. Fish. Aquat. Sci. 55: 1909-1918.

Bilhimer, D., J. Carroll, S. O'Neal and G. Pelletier. 2002. Wenatchee River temperature, dissolved oxygen, and pH total maximum daily load. Year 1 technical study. Washington State Dept. of Ecology, Olympia, WA. Select pages only, full report available on-line at <www.ecy.wa.gov/biblio/0203069.html>.

BioAnalysts, Inc. 2002. Movement of bull trout within the mid-Columbia River and tributaries, 2001-2002. Final report prepared for Chelan County PUD, Rocky Reach Hydroelectric Project, FERC No. 2145.

Bjornn, T. C., and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 in W.R. Meehan editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19, Bethesda, Maryland.

Brown, L. G. 1992. Draft management guide for the bull trout on the Wenatchee National Forest. Prepared for Wenatchee National Forest by Washington Dept. of Wildlife, Wenatchee, Washington.

Burgner, R. L. 1991. Life history of sockeye salmon (Oncorhynchus nerka). Pages 1-117 in C. Groot and L. Margolis, editors. Pacific salmon life histories. University of British Columbia Press, Vancouver, Canada. 564 p.

Chapin, D. M., R .L. Beschta, and H. W. Shen. 2002. Relationships between flood frequencies and riparian plant communities in the upper Klamath Basin, Oregon. Journal of the American Water Resources Association 38: 603-617.

Chelan County. 1997. Chelan County Tax Assessment Records.

Close, D. A., M. Fitzpatrick, H. Li, B. Parker, D. Hatch, and G. James. 1995. Status report of the Pacific lamprey (Lampetra tridentata) in the Columbia River basin. Prepared for: U.S. Dept. of Energy, B.P.A. Environment, Fish and Wildlife Project number 94-026. Portland, OR.

Dunnigan, J. L. 1999. Feasibility and risks of coho reintroduction in Mid-Columbia monitoring and evaluation, 1999 Annual report prepared by the Yakima Indian Nation for Bonneville Power Administration, Portland, Oregon. 61 p.

Ecology (Washington Department of Ecology). 1997. Lake Water Quality Monitoring. Web site at <www.ecy.wa.gov/programs/eap/fw_lakes/lkwench1.html>.

Ecology (Washington Department of Ecology). 1998. Final 1998 Section 303(d) List - WRIA 45.

Ehinger, W. 1993. Water Quality Data Summary and Linear Trend Analysis of the Wenatchee River Basin. Report 93-e16. Washington Department of Ecology (Abstract only).

Farney, R. A., and T. A. Bookhout. 1982. Ohio Journal of Science 82: 103-107.

Feather, T.D., E.M. Pettit, and P. Ventikos. 1992. "Valuation of lake resources through hedonic pricing". Prepared for: U.S. Army Corps of Engineers, Institute for Water Resources. Fort Belvoir, VA

Groot, C. and L. Margolis, editors. 1991. Pacific salmon life histories. UBC Press, Vancouver, B.C.

Gustafson, R. G., T. C. Wainwright, G. A. Winans, F. W. Waknitz, L. T. Parker and R. S. Waples. 1997. Status review of sockeye salmon from Washington and Oregon. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-33. 282 p.

Hart, J. L. 1973. Pacific fishes of Canada. Fisheries Research Board of Canada, Ottawa.

Healey, M. C. 1991. Life history of chinook salmon (Oncorhynchus tshawytscha). Pages 311-394 in C. Groot and L. Margolis, editors. Pacific salmon life histories. University of British Columbia Press, Vancouver, Canada. 564 p.

Hindes, R. 1994. Wenatchee River watershed ranking project. Chelan County Conservation District. Wenatchee, Washington.

Jackson, A. D., P. D. Kissner, D. R. Hatch, B. L. Parker, M. S. Fitzpatrick, D. A. Close, and H. Li. 1997. Pacific lamprey research and restoration: annual report. Prepared for U.S. Department of Energy Bonneville Power Administration. Project Number 94-026, Contract Number 95 BI 39067. Portland, Oregon. 68 p.

Kadlec, J. A. 1962. Effects of a drawdown on a waterfowl impoundment. Ecology 43: 267-281.

Khatri-Chhetir, J.B. and J.C. Hite. “Impact of Reservoir Levels on the Market Value of Lakeshore Properties. 1999. Rivers, Vol 1, No. 2, pp. 138-147.

Klohn Leonoff, 1993. Icicle Irrigation District Comprehensive Water Conservation Plan.

Klohn Leonoff, 1993. Peshastin Irrigation District Comprehensive Water Conservation Plan.

Lake Wenatchee State Park. http://www.parks.wa.gov/parks/. Last updated: 2002

Lake Wenatchee YMCA Camp. http://www.fs.fed.us/r6/wenatchee/district/lakewen/district.html. Last updated: ??

Langsford N.H., and L.L. Jones. 1995. Effects of LCRA Lakes on riparian property values: Recreational and aesthetic components of lake side housing the Colorado River Basin. Technical Report No. 170. Texas Water Resources Institute, Texas A&M University, College Station, TX

Leonard, W. P., H. A. Brown. L. L. C. Jones, K. R. McAllister, and R. M. Storm. 1993. Amphibians of Washington and Oregon. Seattle Audubon Society, Seattle, Washington.

Millar, J. B. 1973. Vegetation change in shallow marsh wetlands under improving moisture regime. Canadian Journal of Botany 51: 1443-1457.

Mitsch, W. J., and J. G. Gosselink. 1986. Wetlands. Van Nostrand Reinhold. New York. 539 pp.

Monterey County Water Resources Agency. Unpublished report. Analysis of Effects on Property Values of the Salinas Valley Water Project. Unpublished report.

Montgomery Water Group, Inc., 2000. Greater Wenatchee Irrigation District Water Conservation Plan.

Montgomery Water Group, Inc., 2003. Wenatchee River Watershed Assessment.

Moyle, P. B. 1976 Inland fishes of California. University of California Press, Berkeley, CA.

Mullan 1992. appendix to Hindes 1994.

Murdoch, K. G., and M. L. LaRue. 2002. Feasibility and risks of coho reintroduction in mid-Columbia River tributaries. 2001 Annual report prepared by the Yakama Indian Nation. Prepared for Bonneville Power Administration, Division of Fish and Wildlife, Portland, Oregon. 51 p.

National Marine Fisheries Service and 9 coauthors (NMFS). 1998. Aquatic species and habitat assessment: Wenatchee, Entiat, Methow, and Okanogan Watersheds. 97 p. plus appendices.

Peven, C. M. 1992. Population status of selected stocks of salmonids from the mid-Columbia River basin. Chelan County Public Utility District. 52 p. plus appendices.

Pratt, K.L. 1992. A review of bull trout life history. Pages 5-9 in: Howell, P.J. and D.V. Buchanan, editors, Proceedings of Gearhart Mountain Bull Trout Workshop, Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Raedeke Associates. 1997. Wetland monitoring studies: Chester Morse Lake. Unpublished report submitted to Seattle Water Department, Washington. December.

Robertson, R.H..1918.Wenatchee National Forest Map. USFS Pacific NW Region.

Saint-Laurent, et al. 2001. *Effects of Simulated Water Level Management on Shore Erosion Rates*. Can. J. Civ. Eng. 28: 482-495.

Sanford, B. 1988. Wenatchee and Entiat rivers. Draft Subbasin Plan. Washington Dept. of Fisheries. Select pages only.

Scott, W. B. and E. J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada. Ottawa.

Smith, J.M. 1991. *Wind-Wave Generation on Restricted Fetches.* US Army Waterways Experiment Station. CERC-91-2.

Swift., C.H. 1979. Preferred stream discharges for salmon spawning and rearing in Washington. USGS Open File Report 77-422. U.S. Geological Survey, Tacoma, WA.

Symonds, Brian, British Columbia Ministry of Water, Land and Air Protection. Water Management in the South Okanagan, A Presentation to the BC/Washington Environmental Cooperation Council December 12, 2001.

Tennant, D.L. 1976. Instream flow requirements for fish, wildlife, recreation, and related environmental resources. P. 359-373 in: Orsborn, J.F., and C.H. Allman [Eds.]. Proc. Symposium and Specialty Conf. On Instream Flow Needs. Am. Fish. Soc., Bethesda MD.

Thompson, Dave. 2003. *Lake Wenatchee Water Storage Feasibility Study Technical Feasibility*, 21 February 2003. MWH file#1520618/1003551.

U.S. Army Corps of Engineers (ACOE). 1987. Corps of Engineers wetlands delineation manual. Technical Report Y-87-1. Corps of Engineers, Environmental Laboratory, Waterways Experiment Station, Vicksberg, Mississisppi.

U.S. Census Bureau 2003a. GCT-PH-1. Population, Employment, and Housing Units, Area, and Density: 2000 Data Set. http//factfinder.census.gov/home/en/datanotes

U.S. Census Bureau 2003b. DP-3. Profile of Selected Economic Characteristics: 2000 Data Set: 2000 Census Summary File 3 http//factfinder.census.gov/home/en/datanotes

U.S. Census Bureau 2003b. GCT-PH-14. Income and Poverty in 1999: 2000 Census Summary File 3 http//factfinder.census.gov/home/en/datanotes

U.S. Department of Agriculture Forest Service, Pacific Northwest Division. Lake Wenatchee Ranger District. http://www.fs.fed.us/r6/wenatchee/district/lakewen/district.html. Last updated: December 12, 2002.

U.S. Department of Agriculture Forest Service, Pacific Northwest Research Station. 1999. Revised Estimates for Direct-Effect Recreational Jobs in the Interior Columbia River Basin. General Technical Report PNW-GTR-483. Portland, Oregon

U.S. Department of Agriculture, 1992 Agricultural Census. From http://www.nass.usda.gov/census/census92/agrimenu.htm.

U.S. Department of Agriculture, Washington Agricultural Statistics Service, 2001 Washington 2001 Tree Fruit Survey, http://www.nass.usda.gov/wa/wfstoc01.htm

U.S. Department of Interior Bureau of Reclamation, 1998. Yakima River Basin Water Enhancement Project, Washington Draft Programmatic EIS.

U.S. Fish and Wildlife Service (USFWS). 1999. Status review for westslope cutthroat trout in the United States. U.S. Fish and Wildlife Service Regions 1 and 6. Portland, Oregon and Denver, Colorado. 185 p.

U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, Hoopa Valley Tribe, and Trinity County, CA. 1999. Trinity River Mainstem Fishery Restoration Project - Draft Environmental Impact Statement. Sacramento CA

U.S. Forest Service, Pacific Northwest Research Station. 1999. Revised Estimates for Direct-Effect Recreational Jobs in the Interior Columbia River Basin. General Technical Report PNW-GTR-483. Portland, Oregon

U.S. Geological Survey (USGS). 2003. Columbia Spotted Frog, Rana luteiventris, Oregon Spotted Frog, Rana pretiosa. Available on-line at <www.npwrc.usgs.gov/narcam/idguide/rpret.htm>. Northern Prairie Wildlife Research Center, North Dakota.

USEPA. 2002. 2nd Public Review Draft EAP Region 10 guidance for state and tribal temperature water quality standards. October 10, 2002. (yosemite.epa.gov/r10/water.nsf)

van der Valk, A. G., L. Squires, and C. H. Welling. 1994. Assessing impacts of an increase in water level on wetland vegetation. Ecological Applications 4: 525-534.

Washington Department of Fish (WDF) et al. 1990. WEN 041…..

Washington Department of Fish and Wildlife (WDFW). 1998. Washington State salmonid stock inventory bull trout / Dolly Varden. 437 p.

Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes. 1994. 1992 Washington state salmon and steelhead stock inventory. Appendix Three, Columbia River Stocks Volume. Washington Department of Fish and Wildlife, Olympia, Washington. Misc. pages concerning Wenatchee stocks.

Washington Department of Fish and Wildlife. May 2002. Sport Fishing Rules, Fishing in Washington.

Washington Department of Fish and Wildlife. Sport Fishing Rules, Fishing in Washington. May 2002. Effective through April 30, 2003. http://www.wa.gov/wdfw/fish/regs/2003/2003sportregs.pdf.

Washington Department of Fish and Wildlife. http://www.wa.gov/wdfw/fish/prospects/county_a-c.htm. Information on fisheries in Lake Wenatchee and the Wenatchee River.

Washington Lakes. http://www.washingtonlakes.com/. General info on fishing at Lake Wenatchee. Last updated:

Washington State Business and Tourism Department. 2002. Washington State County Travel Impact 1991-2001. Prepared by: Dean Runyan Associates. Olympia Washington

Washington, Department of Licensing. http://www.dol.wa.gov/vs/vesselregcounty. Last updated: ??

Welch, E. B., J. M. Jacoby, and C. W. May. 1998. Stream quality. Chapter 4 in (Naiman and Bilby eds.) River ecology and management. Springer New York.

Wenatchee River Watershed Steering Committee (WRWSC). 1998. Wenatchee River watershed action plan, a plan containing nonpoint pollution source control and implementation strategies. Chelan County Conservation District, Wenatchee, Washington. 112 p. plus appendices.

Wydoski, R. S., and R. R. Whitney. 1979. Inland fishes of Washington. University of Washington Press, Seattle, WA.

PERSONAL COMMUNICATIONS

Beale, Perry. Washington Department of Agriculture, May 2003

Bolser, Duane. Washington State Parks, Lake Wenatchee State Park. April 30, 2003. Recreational use on Wenatchee River and Lake Wenatchee.

Gadd, Powys. 2003. Forest Archaeologist, Wenatchee National Forest, May 19, 2003.

Halstead, Rick. Park Ranger, Lake Wenatchee State Park., Leavenworth, WA. Letter to April Zohn of Jones & Stokes. May 12. 2003

Martin, Don. River rafting operator, Leavenworth , WA. Telephone conversation, April 2003

McMillin, Denny. U.S. Forest Service, Wenatchee National Forest. Telephone conversation, April 2003

Meatte, Dan. 2003. Washington State Department Of Parks And Recreation, May 19, 2003.

Smith, Rick. Wenatchee Reclamation District, April 2003

Teeley, Joel. Icicle and Peshastin Irrigation District April 2003

U.S. Census Bureau 2003a. GCT-PH-1. Population, Employment, and Housing Units, Area, and Density: 2000 Data Set. http//factfinder.census.gov/home/en/datanotes

U.S. Census Bureau 2003b. DP-3. Profile of Selected Economic Characteristics: 2000 Data Set: 2000 Census Summary File 3 http//factfinder.census.gov/home/en/datanotes

U.S. Census Bureau 2003b. GCT-PH-14. Income and Poverty in 1999: 2000 Census Summary File 3 http//factfinder.census.gov/home/en/datanotes

U.S. Forest Service, Pacific Northwest Research Station. 1999. Revised Estimates for Direct-Effect Recreational Jobs in the Interior Columbia River Basin. General Technical Report PNW-GTR-483. Portland, Oregon

Washington Department of Fish and Wildlife. May 2002. Sport Fishing Rules, Fishing in Washington.

Washington State Business and Tourism Department. 2002. Washington State County Travel Impact 1991-2001. Prepared by: Dean Runyan Associates. Olympia Washington

Whitlam, Rob. 2003. State Archaeologist, Washington State Office Of Archaeology And Historic Preservation, April 18, 2003.

9.0 PUBLIC COMMENTS

Section 9.0

Public Comments: June 19, 2003 Public Meeting

Public comments and letters August 2001-August 2003

Comments/Questions
June 19, 2003 Public Meeting
Leavenworth High School

Cathy Mulhall's group:

1. Is this study driven by salmon/fish recovery issues?
2. I question the overall purpose for the study. The purpose has not been made clear. Is the storage of water for current needs or future needs?
3. Has the aesthetic impacts of putting in the Dam been overlooked?
4. The current river system within this water system is healthy, why look at this lake and not others? What are the potential river system impacts?
5. Who benefits from this project? Who needs the water?
6. I am concerned about the possible increase in water temperatures. Has this impact been addressed?
7. Per the consultants, both models meet current and future water needs, but what % of storage is actually needed? There are big differences between the capacities, how could both meet the needs?
8. Why not just build a pipeline from the Columbia River?
9. What other alternatives have been looked at to meet the water needs? Have similar studies been done to look at other alternatives?
10. Has water conservation been looked at as an alternative?
11. In our most recent drought year the only impact to salmon was the current fish ladder in Leavenworth. What is the impact of adding more impediments for the fish?
12. Was algae and other possible bacteria addressed in the study?
13. What amount of cfs is required for the estimated population growth of 26,000? Are the cfs outlined in this study enough to meet the needs?
14. What will happen to this document once it reaches Olympia? Who do we call in Olympia to be heard?
15. How nay more studies before implementation?
16. What is the timeframe to find out if this thing is going forward or not? How long will we have to live in fear that this may move ahead?
17. What is the likely hood of this study/project going away altogether?

Comments:

Water Needs:
1. I don't think that the water needs(who needs the water) was clearly spelled out for us.
2. The Water Needs Assessment was not specific enough.

Technical Feasibility:
1. The Dam type they selected will work.

Legal Feasibility:
1. Better have a lot of cash for litigation.
2. I don't think that this project should get a permit.

3. Can State Parks refuse to give an easement for this property?

Environmental Impacts:

1. What are the costs to the environment from an aesthetic point of view? The beauty of the lake will be lost.
2. The consultant states that no adverse affects would come from the 1870.3 level, I don't think that that is true!
3. Erosion will be severe.
4. I don't like the loss of bird habitat.
5. This project won't truly aid salmon.
6. The "plus side" of having the boulders deeper in the water therefore making boating safer is a crock. The rock currently on shore will now be below the water line.
7. Bull Trout was not talked about early in the process. They were largely ignored but are now part of the final.
8. This fish thing has been stretched to be a convenient excuse to get this project looked at. The fish will be damaged more than helped!
9. Will 100 cfs for 2 month really help anyone? I think only the irrigators will benefit.
10. We need hard facts.
11. There will be significant affects on the vegetation.
12. I seriously doubt the conclusion that 1870.3 will not affect erosion or life in and around the lake.

Socioeconomic Impacts:

1. I purchased my property for recreation use, specifically for the beach. Our grand children come to play and stay. I don't want to be selfish, but I don't know who will benefit? You have seen the faces of the Land owners who will lose so much, much more than just property. But, we have not seen the faces of those who want this project, who benefits from our loss?
2. We won't be compensated for loss of our beach.
3. What about the economic impact on our community. I don't think that people will want to come here anymore.
4. Our place was purchased for recreation. We've paid our taxes. We deserve to be heard.
5. The study suggests that we won't be adequately compensated.
6. I don't think the true facts have been given.
7. There will be impacts on the State Parks ability to provide services. And, how many kids will want to go to camp with no beach? The YMCA and the Campfire Girls need to be heard as well.
8. I am worried about water damage to my foundation.
9. I disagree with the minimization of the recreational impacts. For boats, hikers and campers, etc.

Jennifer Jerabek's group:

Water Needs:

1. Why is fish the priority? What about agricultural and farming needs?
2. " It is difficult to quantify that 1870 will have enough benefit to make the project worthwhile" (As a biological benefit to fish) Dudley Riser.
3. Financial impact, quantify loss of access/recreation to beach for landowners- ¼ of the year same for fish and for people.
4. If you lost access to ¼ of your pool, would you build it if you couldn't use it in the summer?
5. What benefit is Dam to future population?
6. Why are water rights being issued if there isn't enough water?
7. Is one goal of project to provide water for existing irrigation structures?

Environmental Impacts:

1. Trees that can't tolerate water will die when lake level rises. Ponderosa Pine/Fir, there would be a round ring of dead trees around the lake.
2. Quantify impact to homeowners of increased erosion, downed trees, turbidity from winds, and high water levels. Also turbidity impact of fish.
3. What about increase in algae growth and milfoil due to slowing of water? Less of a buffer area between fertilized lawns and lake-increase eutrophication and weed growth.
4. Quantify impact of water based recreation and fishery.
5. Quantify impacts on mosquito breeding season due to change in lake levels/West Nile Virus concern.
6. Consideration of heavy boat use during peak recreation-erosion of bank and shore.
7. Quantify financial loss of beach property.

Technical Feasibility:

1. Concern about choice of material (rubber) for dam. Inappropriate for this type of use. Concrete/Rock better for safety concerns.
2. Dam not impervious to gunfire/vandalism, and trees could puncture rubber material.
3. Attractive nuisance/public access issues at proposed site.
4. Consider alternative sites vs. flooding lake.
5. Has dredging lake been considered? So you create a lake vs. flooding an existing lake.

Legal Feasibility:

1. Can we sue (for property loss, docks, etc.?)
2. Can't use boat hoist/stationary docks when lake level is up.
3. Will existing boat docks be grandfathered in and who will pay to replace them?
4. 1870 proposal mitigation costs will not be minor as stated in study.
5. Does mitigation include legal costs?

6. High end costs identified in study to replace docks were too low.
7. In 2001, $15,000 for 60 feet with three pilings plus $1000 in permits.
8. Negative impacts are not quantified in study-have been minimized in report.
9. How can recommendation be made with out cost benefit analysis?

SocioEconomic Feasibility:

1. How can recommendation be made with out cost benefit analysis?
2. Dam to accommodate for future population growth will require cultural change (plants, landscapes for arid lands, zero lawns).
3. Why put boat launch below dam?
4. Consider dam elsewhere vs. flood existing mountain lake that is currently functioning well for fish habitat. Create a dam and reservoir elsewhere.
6. Wind is west to east, not from north.

Jeanette's Group:

Water Needs:

1. Did they figure the agricultural shrinkage when they calculated water use?
2. Where and to who, and why is water exported, distributed, or diverted?
3. DOE water use require…….would this change this requirement related to instream flows..ie. change in allowances for instream flows?
4. What is the difference between agicultural use and residential use related to quantity/amount?
5. Shortfall of 50,000 af…….at higher level there is only 20% improvement. On a scale of 1-10, what is the value of the improvement relative to the impact of the project? (loss of use, environmental, erosion, etc.)
6. Stated that the benefit to instream flows re: fish passage = low flow years. How often (%) are there low flow years ie. 1/10 years 1/50 years?
7. What agricultural areas would the water flow to?
8. What if the lake gets drawn down below average levels…can this happen? What if what we have stored isn't adequate…..will you pull more water?
9. 20% make up of shortfall of instream flow does not equal the negative impact.
10. We have estimated watershed….we are making conclusions before we gathered the evidence/data. Specifically the "watershed planning study."

Technical Feasibility:

1. Is the dam going to influence the Nason Creek Flows?
2. Will the reservoir classification on Lake Wenatchee require any special uses of the lake based on reservoir classification?
3. Do you have a copy of tax parcels that have been recorded from the technical feasibility study? Have all the parcels been recorded? Can property owners get copies?
4. Would any additional structures at the outlet of the lake increase potential winter flooding?
5. Will there be a study of potential erosion effects at higher levels?

6. How are minimum instream flows being determined by DOE? How was the minimum set?
7. If the permit lapsed, how can they go ahead with the project? If permit process is reestablished, how long will it take?
8. In terms of regulating flows, how will this be accomplished? Will a person be monitoring/adjusting air in dam? Air compressor? Noise?
9. At 1870 the lake would be 2 feet higher in August and 1 foot higher in September. What about July?
11. Are there only 2 levels if a dam is proposed? What about other levels?

SocioEconomic Feasibility:

1. How was the 25% value arrived at? Those months are the "use months".
2. How come there is no SE impact at the 1870 foot level since the beach is gone?
3. What is the SE impact of those below the lake? Was an impact study completed? If not, is it being considered?
4. In the presentation there was a list of existing uses…why was the use of beach missing?
5. SE effect to properties not on the water…related to those who come to use the beach…what is the SE impact?
6. will there be property compensation should a flood occur because of a failure to operate the dam appropriately?
7. Patterns of change in property values…why will there be no additional study?
8. I question the total cost of the project in relation to assessed land value…..how can this cost be determined when property value continues to increase?
9. How could compensation be calculated is structures such as docks and boat houses need to be moved or raised?
10. Are permits going to be required for this? What is the process for this?

General Comments:

1. The months July-October (based on the information from a 30 year resident) receive 98% of the use….not used in other months at all. Use of beaches in other times cannot be equated to the 25% value.
2. The study ignored the usage of the property owners and public of all the beach front of the lake….It's not just the private beach use. Public use is also a value from June – October.
3. The model they use does not place weight on beaches to specific properties. Equating the beach use to the entire property value must be at 100% ie. The property without the beach has no value…therefore the weighted value is 300-500%
4. I would like to see property values quantified, not averages, etc. Are we talking about real or assessed values? Are we going to evaluate real value for North and South Shore at a real market gross impact?

Environmental Impacts:

1. Why is the temperature change listed as a benefit?
2. What about the wetlands? Where is the information?
3. What is the effect on water fowl, other creatures? Mosquitos?
4. Are fish ladders totally effective for fish passage?
5. Will there be a special permitting process for modification of shoreline if lake is raised…ie. To create beaches/bulk heads at the lower level?
6. Describe how increased flow coming from lake outlet willl reduce temps in the wenatchee river?
7. Why are we putting a dam on one of the last natural lakes in Washington with year round access?
8. Who is actually after the water? City of wenatchee? Others? Certainly it isn't fisheries.
9. Describe in detail how wetlands would be replaced (spawning and rearing beds).
10. Is there a full environment impact report/study if the dam actually gets proposed?
11. I feel the environmental statement was skewed….promoted benefits.

Rich McBride's Group:

Socioeconomic Impacts:

1. Even in the lowest years few orchard acres were affected.
2. Orchards are acutally being removed.
3. Dollar value of shoreline calculation: uncertain of model; may be unreliable.
4. Assumptions of value may be flawed.
5. Slope relationships between the south shore and north shore vary greatly.
6. ¼ year calculation unrealistic, use annual basis.
7. Question the population projections.
8. What is the value of destroying the last natural lake in the state?

Environmental Impacts:

1. What will it really take to study the wetlands at lake wenatchee?
2. Emphasis has been on fish-what about other wildlife mammals?
3. Mosquito issues-likely to increase.
4. Fish biologist indicates that this project is not essential to fish, it might be beneficial however.
5. The aquatic plants-likely concern with milfoil.
6. Erosion-higher water level will increase erosion regardless of wind strength.
7. Time that the dam is in operation coincides with highest wind.
8. Wetlands, plants, and foilage near shore will be adversely affected.
9. What is the impact on the "fault line" at south shore with higher level?
10. The current sand beaches severely impacted-many current beaches will become rocks.
11. Who really benefits from this project?

12. No actual salmon run numbers studied-(biologists: salmon runs were okay anyway even in drought years).
13. Even in drought years, irrigation wasn't impacted.

Legal feasibility:

1. "United States Forest Service made statement that us government owns riverbed"
2. Will the "shoreline acquisition" be a process of condemnation or owner consent?

Technical feasibility:

1. Uncertainty of bull trout using fish ladders.
2. What is the life of the bladder?
3. We can build anything in this age-bigger question is, "should it be built?"

Water needs:

1. Population projections in question-study looked only at lake wenatchee, should look beyond.

General comments:

1. The project team did great job.
2. How many years would it take for population to use storage?

Cindy duncan's group:

Water needs:

1. Is there truly a water need?
2. Why is the state mandated flow at plain higher than the natural flow?
3. Is this a stop gap for 25 years? What about the next 50 years?
4. Why did they use data from the 1940's rather than current data? And, to obtain current, relevant, on site data?
5. Is there evidence that Lake Wenatchee causes endangered species-when Lake Wenatchee is reported to have best natural run in the state?
6. Will raising the lake level raise water temperature? Increase water stagnation? Algae? (killing frye)
7. Over a 12-month cycle down stream flow is not a benefit 8 months.

Environmental Impacts:

1. How will they help people who live on land adjacent to streams, culverts, and mosquitos?
2. Will algae increase by the flooding of tributaries?
3. Will beach erosion cause damage to water quality, property usage and property value?
4. Will there be more floating debris created by high water?

5. Will old drain fields be flooded? Impacts?
6. What is the effect on homeowners who draw their drinking water from the lake? (Septic Flooding)
7. Will the parasites in the lake increase? (Health/Medical Problems)
8. What would happen if there was a 500 year flood? Would the dam hold? What if it did or didn't? The debris?
9. Why are the highest fish runs occurring during draught or low flow years?

SocioEconomic Impacts:

1. I have a steel piling clock with rails long side the dock-my launching floats raise and lower with the water. How will this be taken care of?
2. Will wave action cause water to go over my dock?
3. Do submerged docks create a navigational hazard?
4. Will the state government agencies bring condemnation or eminent domain proceedings against each property owner?
5. Does the State, County, and other local governments place fish and mosquitos ahead of taxpayers?
6. Who is going to pay for this? How?
7. How will they compensate for loss of value of property fairly?
8. What law gives the project promoters the right to proceed?
9. Where does the project go from here? Does one agency pick it up as a promoter?
10. Would the attorney general office represent the state/county in any proceedngs pertaining to property?
11. Who would pay litigation costs?

General Comments:

1. The draft report ignores the impact on bull trout-this suggests bias in the report preparation.
2. Why was the designated consultant given the right to use dated information to arrive at their conclusion?
3. Who is going to benefit ultimately if the dam goes in? Who is it for?
4. This table is emphatically against the project.

Millie's group:

Water needs:

1. Is the primary benefit really domestic and commerical rather than continuous capacity for fish?
2. Is the irrigation benefit for landscape not agriculture?
3. Will holding the water increase water temperature and pose a health hazard for those who depend on the lake for drinking water?

4. This is not needed to benefit fish, we already have the healthiest natural systems in the state for fish.
5. The limited time available for the public presentation did not allow for clarificaiton of the need for the project and its benefits.

Technical Feasibility:

1. The prototype model of a “rubber” dam is in a snoqualmie river waterfall area and not a fish habitat area.
2. Ongoing operation, maintenance, and security costs are not addressed.
3. How proven is the effectiveness of the rubber dam technology?
4. The trend appears to be to take out dams, why are we considering putting one in?

Legal Feasibility:

1. I would anticipate numerous law suits since we have a natural system that already meets our needs.
2. Were tribes suing for water rights in the Wenatchee Basin?
3. There are some second-class shorelines that would require purchasing an easement. In the event the owner would not sell would they impose eminent domain?

Environmental Impact:

1. Will we increase stagnant water and increase risk of contamination, mosquitos, and west nile virus, etc.?
2. What would be increased damage to shoreline, docks, boat houses, etc?
3. What alteration would occur to wetlands, vegetation, wildlife?
4. Were trees without other surrounding vegetation counted as “vegetation” in the vegetation line?
5. What is the risk of increased growth of algae?
6. The area is aleady prone to landslides. Water and undercutting slope would lead to further erosion.
7. Will old septic tanks contaminate the lake?
8. This would severely harm salmon runs in the system, the presentation was not honest regarding this issue.

SocioEcononomic Impact:

1. This would have a negative impact on property value on the lake.
2. State Park is popular and has a positive impact on upper valley, this would diminish enjoyment of the park.
3. How will we pay for it?
4. This project being under consideration impacts the ability to buy and sell property while the outcome is unknown.

5. In the meantime, property assessments rise (assuming high values) and some tax options may be lost by 2004 (eg. Capital gains benefits)
6. People are stressed because a lot of people said no to this 2 years ago and I feel stress that this will harm a treasured lake.
7. What would need to be done to prevent people from floating over the dam and what would the aesthetic impact be?

General Comments:

1. I see no benefit to the people, the environment, or the fish to putting in a dam.
2. I am opposed to the project.
3. Why must man always try to have an impact on nature?
4. The economic cost of easement acquisition, installation, maintenance, etc. exceeds the benefit.
5. A moratorium on growth should be considered as an alternative to impact on the natural system.
6. It seems that the marketability of my property around the lake has to suffer to improve the marketability of orchards selling out, etc. down river.
7. We should celebrate the wild natural system we have, not destroy it.

Spence Taylor's Group:

Water Needs:

1. How reliable is the criteria used?
2. I am not for anything that increases growth in the valley.

SocioEconomic Impacts:

1. The intensified use of the property during short summer season does not justify prorating property loss over 12 months. Therefore: the actual loss should be 70-90%, maybe even 100%, rather than 25%.
2. Our family cabin is only used during summer months. This would impact us significantly.
3. What is the current level today?
4. Would it be possible to have elevation marker at State Park?
5. With the financial condition of our state, who is going to pay for this?
6. Who has the authority to make this decision? When will they?
7. If water is raised and land owners lose their beaches…then they will have to go and pay for beach use at the State Park.
8. Need a study on the number of septic systems affected at 1870' level.
9. What will the impact on the mosquito population be? How about West Nile Virus?
10. What is the plan to determine loss of value?

Environmental Impacts:

1. How much has been done to study impact of tributaries?
2. Would there be any reduction of stream flow when the dam is deflated? Channel restriction of dam? 3 highest floods have occurred during November-December.
3. How will this prolonged period of high water affect vegetation in delta area?

Legal Feasibility:

1. If this goes through, what is going to be the legal process to acquire property along the shoreline? Ie. Condemnation or negotiation?
2. Is there going to be a difference between primary and secondary shoreline acquisition?
3. This is totally stupid. A crazy idea.

Technical Feasibility:

1. How do augmented streamflows affect temperature? Is it significant? Is it significant for recreation (lake and river)?

General Comments:

1. Was there any cost estimate for other offsite storage?
2. Why not study other storage options? (that don't affect so many people)
3. Does this type of dam have a solid proven record?
4. What is the purpose of this?
5. Fish have been doing well for thousands of years, why change it?

Mary Jo Sanborn's Group:

Water Needs:

1. If orchard industry is in decline, what does that do to orchard water demand and population growth?
2. What is crop use by month?
3. Is residential use higher or lower than agiculture?
4. What are the tourism impacts (rafting, etc.) to different flow timing?

Technical Feasibility:

1. What is acceptable high water mark for each property owner?
2. Will new high water mark be accepted by regulatory agencies?
3. What rate will storage be captured?
4. Is easement still valid in deeds because was originally stipulated for hydro power?

5. If Dam is built, prefer lower elevation because of lower cost, fewer problems regarding inundation.
6. There may be alternatives elsewhere in Basin that no one considered.

Legal Feasibility:

1. What recourse will landowners have for increased impacts? (ie. flooding structures more frequently)
2. County needs to have a way to devalue property if beach is lost.
3. Buyer survey not adequate, needs to compare before and after, case by case evaluation. There are very different impacts to different properties.
4. Compensation should not be based on square footage lost, but on percent of beach lost.

Environmental Impacts:

1. Will Dam be fish friendly?
2. What does storage of water do to water quality, especially for people who pump out of the lake?
3. Continuous flushing of lake keeps water quality good.
4. Substantial damage to south side of lake (wind).
5. Building a dam to increase flows to help salmon is a red herring. Better justification for project needed.
6. Seems odd to be adding a dam in today's environmental/political climate.
7. Water quality will decrease with a dam.
8. Damage to the wetlands will be significant (No WSE fluctuation).

SocioEconomic Impacts:

1. Does anyone on the lake win with this project?
2. What are the impacts to the Chelan County tax base?

General Comments:

-----Original Message-----
From: Jeffmonda@aol.com [mailto:Jeffmonda@aol.com]
Sent: Saturday, July 28, 2001 7:59 AM
To: Mike Kaputa
Subject: Lake Wenatchee

Dear Mr. Kaputa,
My family has been a property owner on the shores of Lake Wenatchee since 1951. I am also an avid outdoorsman. As a result of both, I have some serious questions about the "water storage" study of the Lake Wenatchee system.

There have been three reasons provided for the need for this study; irrigation, flooding, and fish.

Could you please provide answers to the following questions.

1. Has the irrigation water taken from the Wenatchee river ever been turned off due to drought? If it has, what year?

2. As I understand, the flooding of the Wenatchee River does not cause property problem. There have been floods on the lake itself. If a dam is put in that raises the overall level of the lake, what will happen when those same type of spring floods hit. I realize that dams can be used to regulate water flow during flood seasons, but it cannot lover the lake any lower that low water mark before a dam is put in place.

3. Because the Wenatchee basis is home to several endangered species, it seems that placing a dam in the pathway is against common sense. The old Tumwater dam was never felt to be a problem, but it was this year. Now we are talking about placing another dam in the system. Is there any study that has ever shown that placing a dam in a river can help endangered fish?

4. Who is backing this idea? Because there is no money in irrigation, flood control or putting dams in rivers for "fish protection," I am suspicious that there is something that has not been stated. That something I suspect is hydroelectric power. Has there been active interest in hydroelectric power for this dam by any parties that may profit financially from electrical production?

I am not an environmentalist, as I do believe that mankind must use the environment. As you can tell by the questions presented, I do have some serious concerns about this project. As I see it, the property owners of the lake will not like it as they will loose all there beaches and it will not provide protection from the big floods. The irrigators will not see benifit as, unless I am wrong, there is not an increased need for irrigation from the Wenatchee River. The salmon will not benefit from the dam.

8/28/01

Wells Fargo Center, 999 Third Avenue, Suite 500
Seattle, Washington 98104-4012

Tel: (206) 624-0100
Fax: (206) 749-2200

August 23, 2001

BROWN AND CALDWELL

Environmental Engineering & Consulting

Michael Kaputa, Director
Chelan County Watershed Program
411 Washington Street
Wenatchee, WA 98801

91219.012

Subject: An Alternative to Lake Wenatchee Storage

Dear Mike:

In response to the proposed study to investigate the feasibility of impounding water at the outlet of Lake Wenatchee, Brown and Caldwell suggests an alternative storage proposal for the WRIA 45 Planning Unit to consider. The alternative storage would use groundwater storage in the watershed aquifers. Currently, we are studying the cumulative impact of water right transfers on the timing of irrigation groundwater return flows to the tributaries and mainstem of the upper Yakima River. We are under contract with the City of Cle Elum and Kittitas County to conduct this study as part of preparing an EIS for the proposed Trendwest resort development near Cle Elum. We hypothesize that irrigation return flow via stored groundwater significantly regulates river flow during the fall spawning period for Chinook salmon. The regulation is similar to that of an irrigation reservoir that stores high flows during the wet season and releases them in the dry season. The return flow regulation differs from the reservoir regulation by delaying the storage and release by several months. By understanding the irrigation groundwater return flow processes that results in the current flow timing in the Wentachee River watershed, we will be able to estimate the amount of flow regulation attainable by groundwater storage.

Brown and Caldwell suggests that the groundwater return flow and storage processes be investigated to determine two key components of the aquifer storage alternative for WRIA 45. First, the investigation would provide a range of flow variability in which mainstem flows be managed using the groundwater return flow processes to enhance fish flows during the late summer spawning season. Second, the investigation would assess the potential for recharging the excess surface water using wells and/or basins and recovering the groundwater using wells during low flow periods. The process of storing excess surface water supplies in groundwater aquifers, or aquifer storage and recovery (ASR) is being successfully all throughout the western United States. ASR could attain additional enhancement of flow to the enhancement potential of irrigation groundwater return flow management.

c:\documents and settings\mikek\local settings\temporary internet files\olk6\wenatchee groundwater storage proposalv2lt.doc/08/23/01/thm

Mike Kaputa
August 23, 2001
Page 2

Very truly yours,

BROWN AND CALDWELL

Tom Martin, P.E.
Principal Engineer

thm

cc: Jim Oliver, R.G. (Brown and Caldwell)

c:\documents and settings\mikek\local settings\temporary internet files\olk6\wenatchee groundwater storage proposalv2lt.doc/08/23/01/thm

From: BHoaglan@aol.com
Sent: Monday, September 03, 2001 6:24 PM
To: Mike Kaputa
Subject: Dam at Lake Wenatchee

Hi Mike,
My name is Bill Hoaglan and I live on the Wenatchee River about 4 miles below Plain in an area called Meacham Flats. During the record setting floods in the winters of 1990 and 1995 our Meacham Flats suffered some real damage, In fact the Wenatchee River nearly changed coarse leaving Meacham Flats as an island, we installed a Band-Aid repair so we could get back in to our homes, but I am afraid one more Grand Daddy flood will do us in.
This study that you are working on, would it or could it be beneficial in flood control, or could it take some of the sting out of a major flood? Looking at the USGS archives on the Plain gage station, I see that traditionaly all these major floods occur late November through December undoubtly due to a winter warm-up and rain on snow. I am aware of such a control dam on the Yakima at Lake Ketchless which seamed to solve their problem.
Thank you for looking into this from a flood control aspect. Bill Hoaglan, (509) 763-3748

From: Chuck Whittlesey [chuckwhittlesey@msn.com]
Sent: Thursday, September 06, 2001 9:52 AM
To: Mike Kaputa
Subject: Re: Lake Wenatchee Water Storage Study
Thanks for the note Mike. I'm happy this will provide more room. I didn't know where the school is since they are pretty far from most of us who are affected. My concern is that there are so very many folks impacted by this who live elsewhere (outside the immediate watershed and greater NCW area) who are unfamiliar with the area outside their cabin/property. These folks are difficult to get to a meeting as it is. If things change that make it seem more difficult then they are less likely to attend (human nature). I am wondering why this is not in the Lake Wenatchee area and not on a weekend rather than at night in an area not affected. It seems as though this gets more difficult rather than easy. I'm sure you have considered what is easiest for the residents of the entire watershed rather than what is most simple for those who are considering this action.

By the way, did you see the article regarding fish and water flows in the Wenatchee World two days ago? It commented on the current near record low water flow in the Wenatchee River; a once in a lifetime event. And the fisheries guy who commented on how it affected the Chinook salmon and other fish said it was not a problem for them! Pretty telling if any dam is put in to provide better flow for fish. Lowest flow in history, no problem for fish, first sockeye season in a long time, record catches, record return of salmon in the river, healthiest watershed in a long time. Do we need to mess with what seems to be working? Is this the best use of money? Also there is the new endangered plant in the confluence of the White and Little Wenatchee. I hear that flooding the peninsula would kill the plant. I can't remember what the name of it is but I do know that there is an organization that has scattered many thousands of seeds of that plant in the area just to ensure it is growing in the area.

Have you determined that any anticipated "flow regulation" that would result from a dam would certainly affect those property and home owners on the upper portion of the Wenatchee River just above Tumwater Canyon? Have all of those folks and all the folks some distance back from the river been notified of this impending action and the meeting? I have spoken with some of them and they don't know about this and they are concerned.

What about the Washington State Park system, US Forest Service, National Park Service who are all land owners and stake holders around the lake and river as well? Have they all been notified? Are there any Native American interests in the watershed? What about all the other regulating and other impacted and impacting agencies such as NMFS, WDFW, Corps of Engineers, etc.?

Will consideration of proposals from private consulting firms include firms who have a current or recent contracts with the county or your organization, be accepted? There is a built in perception of bias and/or conflict of interest if that is the case. How do you intend to overcome the perception that any company working for you will be biased toward supporting what you want rather than providing true science from which unbiased decisions can be made? If any company who has worked for you recently is seen as having a "lock" on the contract because of incumbency then it may create a perception that will negate the findings and in the end just have the effect of squandering the money. Close scrutiny should be paid here to ensure the best neutral image is maintained.

Thanks for the note regarding the latest change in the meeting site. I still haven't seen it in my mail box. I'm concerned that many folks get their mail the traditional way and they will be getting a change (no matter how slight) shortly before the meeting and this will have a chilling effect on whether they will attend. I'm also concerned that not everyone in the watershed has got notice yet. It can be argued that placing a dam in one of the countries remaining few healthy watersheds is a high profile issue. Such an issue will affect EVERYONE in the whole watershed and beyond. Is the public properly notified? If not, then any effort to move forward is rendered flawed and any money spent is squandered.

I look forward to meeting you soon.

Chuck Whittlesey

From: Norland [lwnw@home.com]
Sent: Friday, September 07, 2001 7:18 PM
To: Mike Kaputa
Subject: water storage study at lk wenatchee
mike,

Is this a done deal and we property owners are going to lose low beach waterfront? Is It really is strange that you are proposing to build a dam at the foot of lk wenatchee. This is a true alpine lake and how could you ruin the natural beauty of this area with another flood control device. If you are worried about flood control, DAM the white and little wenatchee rivers.

From: Jeff Thiel [thiel@bondhub.com]
Sent: Saturday, September 08, 2001 7:47 PM
To: Mike Kaputa
Subject: Water Storage Study emailing lists
I would like to be put on the email list to receive updates about the Water Storage Study on Lake Wenatchee. I own a home at the lake.

I have several questions about a dam on the lake:
1. who will receive the water? specifically, what are the names of the individual farmers or utility districts that would take more water out of the river downstream than they are taking today?
2. who will pay for the costs of the dam?
3. who will compensate property owners on the lake for loss of waterfront property?
4. what impact will the dam have on salmon spawning habitat? will it flood the spawning beds just below the outlet to the lake?

I would much prefer water conservation programs than see one of the only large natural alpine lakes in the state dammed.

Jeff Thiel
Director and Co-founder, BondHub Inc.
(206) 832-2663 x130
www.bondhub.com
jeff.thiel@bondhub.com

September 12, 2001

Chelan County Watershed Program
411 Washington Street
Wenatchee, WA. 98801

To Lake Wenatchee Watershed Project Team.

My name is Sandy Butler and I live at 16060 Cedar Brae Road, Lake Wenatchee (formerly known as the "South Shore Road"). I write this letter to express my opposition to any damming of Lake Wenatchee for water storage or any other purpose. My opposition stems from three primary concerns: environmental, aesthetic, and financial impacts.

Environmental Impact (most important)
The continued manipulation of the environment by human beings for our own needs must not continue. When many river dams are being re-evaluated and retrofitted to allow a more natural flow of life, how can we consider adding another dam? The planet as a living organism is telling us in a multitude of ways it is suffering. While we will never be able to destroy it completely, we may damage it so severely that it will no longer sustain many species including our own.

In the mailer I received entitled, Legislature Approves Water Storage Study Funds, there appeared a statement in the second paragraph which sums up my concern for areas such as Lake Wenatchee. The statement reads, "*. . . in this over allocated basin.*" How did this area become over allocated in the first place? Why do we think this dam will solve the problem of over allocation in the future? Why not think in terms of stopping the over use of this area and it's resources? Such as looking at controlled use of the area's current water supply and stopping any new growth in water usage.

This dam may solve the problems which we are presently facing but what about tomorrow and the many tomorrows to follow? What effect will the higher water level have on the current trees that do not stand in water year round? What will raised water levels do to the lake temperature and consequently the salmon populations, aquatic plants, and otters among a few? Again I say, we as human beings can no longer manipulate the Earth to our needs as if it were here for our use only. We have taken enough, we've changed enough, and we've used enough of the Earth's resources for our benefit. We must find other solutions to the water problems we face.

Aesthetic Impact
The piece of property on which I reside was purchased by my family in 1983 and has been my full time residence since 1997. Even as I write this letter I am sitting at the lake shore thankful for such a beautiful place to live. Certainly I have many things in my life for which I am grateful. However, on this particular day following one of the most sorrowful and horrific events in the history of humankind, I am especially thankful for this peaceful and precious piece of the Earth on which I reside.

A dam on Lake Wenatchee will change the landscape forever. Many residents have lovely and serene beaches during the low water period of the year. The permanent high water condition a dam creates will eliminate the lake shore for most Lake Wenatchee residents and visitors. That prospect just seems unacceptable.

Financial Impact
The financial impacts on residents are many but primary among them are property value and loss of investments already made.

For most Lake Wenatchee residents, a significant portion of their property value is based on the properties relationship with the lake. A reduction in the amount of beach or a reduction in the quality of the beach will impact the value of most waterfront property on the lake.

Secondly, I have made specific investments in a dock and boat lift on the beach. These investments will be entirely lost if a dam is installed and the year round water level of the lake is increased. As a fixed income family this would be a significant financial investment to lose.

In closing, it is important to leave this water system unaltered and natural. Nature is life in perfect balance and nature will maintain that balance if we just leave it alone! If this area is out of water, then nature is saying "enough". We must stop making decisions based solely on today's issues and never lose sight of the future consequences of those present day decisions. Let us gently use the Earth's resources with respect and gratitude.

Thank you for your time and consideration,

Sandra L. Butler

Sandra L. Butler

Leavenworth Audubon Adopt a Forest
POB 154, Peshastin, WA 98847

Pat Rasmussen - President
patr@crcwnet.com 509-548-7640

September 13, 2001

Wenatchee Watershed Planning

RE: Proposed dam on Lake Wenatchee

We are shocked that such a proposal to build a dam on Lake Wenatchee and turn it into a reservoir would even be considered or discussed. Up until now Wenatchee Watershed planning has been going in generally good directions. The Chelan County PUD has put much planning into restoration work for their HCP. Farmers in the Icicle and Peshastin Irrigation Districts have focused on taking the initiative to do voluntary projects that would improve salmon habitat. They put the 3.5 mile long Tandy Ditch into a pipe, reducing by a half the amount of water they would take out of the stream. Trout Unlimited has projects in the Entiat, Mission Creek, Icicle, Chumstick and Peshastin Creek watersheds to improve fish passage and provide overwintering for young fish.

Until this time, all have had a positive, pro-active, voluntary attitude to do the right thing.

Suddenly all that is turned around. A proposal to dam Lake Wenatchee and make it a reservoir is a stupid idea. And it shows incredible lack of understanding of how this river system functions. Have we really sat in all these watershed meetings, and still understand so little what we are doing?

The Wenatchee River watershed is one of the few remaining functional river systems in the Northwest, where 14 salmon species are listed as endangered or threatened. The sockeye salmon run that spawns in the White River and uses Lake Wenatchee to grow in before heading to the ocean is the second largest sockeye run in the lower 48 states, one of only two viable runs in the Columbia Basin. The reason for this is that it is one of the few naturally flowing river systems left. Who would even dream of ruining that?

I was so shocked that I decided to find out whose idea this was. It turns out that a few years ago, Rick Smith of the Wenatchee Reclamation District, had a meeting with Linda Parlette, George Sellar and Clyde Ballard where he proposed the idea. Last winter, with the drought approaching, he saw a chance to get it through and approached the legislature with the idea. Without asking any of the rest of us who care about Lake Wenatchee, he got $250,000 of public funds dedicated to this study that has no chance of going anywhere. It is a total waste of public funds.

We are not going to allow the best, functional river system left in the region to be ruined by a dam. Pursuing even the idea of such a dam will make our whole watershed planning effort look foolish. It will attract lawsuits in an area where people of good will have spent a lot of time and money doing the right thing, in part to avoid lawsuits. People all over the region are taking out dams – who would dream of proposing one?

This is a bad idea. It must be stopped now before $250,000 of public funds are wasted. In the future, Rick Smith should talk to the rest of us before he goes to the legislature to get money for something that would so alter a lake we all treasure. The money must be given back to the legislature so it can be used on something useful.

We would like to go on record as stating that we will do all that is legally necessary to stop this foolish project.

Pat Rasmussen

From: Dick and Karen Knight [fortknight.dk@verizon.net]
Sent: Friday, September 07, 2001 6:43 PM
To: Mike Kaputa
Subject: Lake Wenatchee Dam
Hello, Mike:
My name is Dick Knight. We own a home on the north shore of Lake Wenatchee. It is my understanding that the study for a dam proposes to keep the water level at the normal high water mark. Do you have information that explains this further? Prior to attending the meeting on September 13, we would like to understand where the water line would be on our property and how long during the summer this line would typically be maintained.
Thank you for your assistance.

From: orcatom [orcatom@msn.com]
Sent: Sunday, September 09, 2001 6:34 PM
To: Mike Kaputa
Subject: Lake Wenatchee Water Storage Study
Thank you for the notification of the Water Storage Study
Public Meeting.

In terms of the study and public meetings I would offer the following. Many owners of recreational property on the lake and surrounding areas live west of the mountains. In fact I know some that live east in Spokane and south to Cathlamet. The point is your letter was postmarked 9/5 and did not arrive at my address in Seattle until this weekend. That gives very little time to rearrange schedules to attend the public meeting on the 13th in Leavenworth. In fact I am going to be out of town and will be unable to attend what I consider a very important meeting that can have an impact on the residents and users of Lake Wenatchee for generations to come. Therefore I would like to go on the record as stating I feel this is unfair and adequate nofication, at least two weeks, needs to be given to residents who live outside the area and own property in the area to attend the public meetings. I would also know what the law states in terms of notification of property owners regarding public meetings in Chelan County.

I consider myself an open minded person but as a water front property owner on Lake Wenatchee and having relatives that have had property on the lake for over 60 years I have to say the thought of damming one of few free flowing natural lakes of this magnitude in the state has very little appeal. This is especially true with all the studies and talk regarding tearing down manmade obstructions to natural waterways in locations throughout the state. Time has proven them to be unwise decisions and detrimental to the environment over the long term.

Please place me on any email, mailing lists or other forms of communication so I can stay abreast of the study and also please provide me with a recap of the public meeting that will be held next week.

Thank you.

Tom Borgen
1914 5th Street
Kirkland, Wa. 98033
Phone; 206-954-5953

From: WGATOR3@aol.com
Sent: Tuesday, September 11, 2001 9:00 PM
To: Mike.kuputa@co.chelan.wa.us
Cc: Lisa de Vera
Subject: Lake Wenatchee

Mike, please put me on the list to receive information regarding the potential dam at Lake Wenatchee.
I am a little surprised that the state would consider building a dam at the outlet of the lake. It is fairly evident based on past experience that this would have a negative impact on fish. The natural ecosystem that currently exists is very healthy. A major reason is the natural flood and drought cycles that positively affect the lake. A dam creates a resivour of which we have plenty in the region for water storage. If you take a look at them they are also very unsightly when drained (i.e. Snow Lakes) or during low water years.
The dam in the Tumwater Canyon was a hindrance to fish passage this year and undoubtedly caused the demise of many fish. The dam in Shelton on the Goldsborough was recently removed because of the negative impact on fish. Maybe the state "experts" should study these situations and see if it can draw any corollaries.
Hopefully better uses for our time and money can be identified.

Sincerely,

Wally Gibbons

From: GEGibbons@aol.com
Sent: Wednesday, September 12, 2001 11:48 AM
To: Mike Kaputa
Cc: parlette_li@leg.wa.gov
Subject: Lake Dam

Mike, want to make sure I am on your Lake Wenatchee Storage mailing list. I am totally opposed to the project, and think the 250K could have been spent for much more important local projects. Have heard the meeting site has been changed and do hope to make the meeting.
Jerry Gibbons

From: robert.weisel@usbank.com
Sent: Friday, September 14, 2001 2:57 PM
To: Mike Kaputa
Subject: Lake Wenatchee

At the Thursday meeting regarding the Lake Wenatchee Water Storage Study, you mentioned a gentleman who had started a Friends of Lake Wenatchee group. Could you please provide me with his name, the correct name of the group, and any contact information.

As an additional question to be answered by the study, I suggest the following:
Given the strong salmon run at Lake Wenatchee this year when the snow-pack was extremely low (60% of normal at Stevens Pass), what indications are there that low flow in the Wenatchee River is negatively impacting salmon migration? In addition, has the impact that higher lake levels will have on fish habitat at Lake Wenatchee been studied? If so, what were the results?

Thank you very much for your assistance.

Bob Weisel

From: Friend of the Lake Wenatchee Watershed [FriendoftheLakeWenatcheeWatershed@communities.msn.com]
Sent: Friday, September 14, 2001 10:19 AM
To: Friend of the Lake Wenatchee Watershed
Subject: How high?

New Message on Friend of the Lake Wenatchee Watershed

From: John & Kathy Zipper

The question many people asked was "How high will the lake level be raised?" Without some idea of the range of possible dam heights to be considered in the study, how can we reasonably be expected to respond with "public input"?

I am concerned about the lack of information available at the 9/13 meeting. The presentation did not include enough specifics to give property owners an idea of the range of possible dam heights. I have emailed to Mike a request for additional info regarding river flows and the needs of the irrigators and fish. When I recieve more info, I will post it.

When I asked Mike and Rick "How much additional river flow is needed?" at the meeting, they didn't know and stated that the purpose of the study is to answer that question. The answer to that question will determine the dam height. Basic information regarding river flows and the rough range of needs for fish and irrigation is very likely already available. If the basic info is not provided, I believe that the deadline for "First public input" should be extended.

From: William Harris [wharris4@san.rr.com]
Sent: Tuesday, September 18, 2001 12:12 PM
To: Mike Kaputa
Cc: Tamzin@austin.rr.com

Mike Kaputa

Re: Dam at Lake Wenatche

While I realize there can be reasons for changing nature, the stated reason in this case is to store water for the river. This dry summer probably upset some people along the river.

We have owned a cabin on the south side of the lake for over 30 years. The high water mark reaches the entrance to the cabin. The water recedes to give us "a beach" by the time we gather for a family reunion 2-4 weeks each summer. Our cabin is still a cabin, the beach is our living room. We stay at our cabin, it is not a lodging for distant skiing or hiking trips.

In effect this dam would remove our gathering place. It would also remove most other activities enjoyed on this shore, reading, sand casting, imaginative play with driftwood, walking along the edge, in short our whole day is spent there.

I'm sure everyone can find environment reasons to support their wishes. I would point out that several of our cedar trees are unstable as it is and more water would undermine them.

The present environment has endured for eons. Please let it continue as nature intend. Do not make it a swamp full of mosquitos. Mrs. W.A. Harris lot #42

From: Friend of the Lake Wenatchee Watershed
[FriendoftheLakeWenatcheeWatershed@communities.msn.com]
Sent: Tuesday, September 18, 2001 3:35 PM
To: Friend of the Lake Wenatchee Watershed
Subject: Coalition to oppose dam

New Message on Friend of the Lake Wenatchee Watershed

From: Gayle Craig

September 18, 2001

Dear Fellow Lake Wenatchee Property Owner:

If you attended the Lake Wenatchee dam study meeting on September 13th, you probably share the frustration and concern many of us have over the total lack of information and answers we were given at the meeting. If you were waiting until you had more information from Chelan County, the Chelan County Watershed Program, the Wenatchee Reclamation District, and Senator Linda Evans Parlette before you decided whether or not this dam proposal is a threat to the Lake Wenatchee waterfront property owners, you have no more information now than you did before the meeting! Two days after the terrorist attack on the United States, this was a very difficult time for all of us, yet many people still made the round-trip drive to Leavenworth, in the middle of the work-week, only to have the County coordinators strategically put us into groups with facilitators that, by design, had no connection or knowledge about Lake Wenatchee or the dam proposal. And then we left, still not knowing: how high is "normal high water" ?, will they be able to lower the lake level below the natural low water level (visualizing Lake Chelan or Keechelus or Lake Tapps in the winter) ?, "normal high water level" for how many months of the year?, and what about compensation for our deeded second class shorelands or lost property values? There are many many mor questions and issues, and although we didn't expect all the answers, we thought we would get some information to base our opinion on.

Well, we did learn one thing -- we need to form a coalition to get some answers and determine what action we need to take to protect our property. If you are a Lake Wenatchee property owner who opposes this project, we need your membership and support. We need to be organized so we can get some answers and take whatever action is necessary to protect our lake frontage. If you wish to join us to actively oppose this dam proposal, send us your name, Lake Wenatchee property address(es), mailing address, phone, and email.

Sincerely,

The Craig Family

email: scraig@lwproperties.com

Gary and Gayle Craig, 509-763-3579

17575 North Shore Drive, Leavenworth, WA 98826

Steve and Kelly Craig, 509-763-3578

17225 North Shore Drive, Leavenworth, WA 98826

From: Friend of the Lake Wenatchee Watershed [FriendoftheLakeWenatcheeWatershed@communities.msn.com]
Sent: Wednesday, September 19, 2001 11:59 AM
To: Friend of the Lake Wenatchee Watershed
Subject: In opposition to the dam!

New Message on Friend of the Lake Wenatchee Watershed

From: Chuck Whittlesey

Friends,

Gayle has summed up her impression of what appears to be the first, last, and only public meeting regarding a study to determine where they are going to put a dam at Lake Wenatchee. It was strange to be in a room of so many people who oppose this concept of damaging the last un-molested watershed in the Pacific Northwest and have no public comment allowed. Senator Parlette, and County Concilman Hawkins stood by as democracy was trampled. Our tax dollars were spent by the bureaucrats as they implimented their grand plan to spend more of our tax dollars to put a dam on Lake Wenatchee and damage our property.

I am aghast at the swift skill by which they rammed their position down our throats, rushed us through a hollow process of group discussions, and pushed us out the door. I commend them on one thing: the effective stiffling of public opinion and democratic process prior to ruining the environment in the name of endangered fish. Can you believe that Rick Smith actually got up in front of the group and said that he wanted to dam the river in order to improve water flow. That is the same as saying do away with girls in order to protect their virginity. Twisted logic at its highest level of blind arrogance. These are bureaucrats and public servants who have morphed into a self serving cabal over which they intend us to have zero control.

It would seem that time has come to organize and bring suit in order to stop this travesty from continuing forward.

Look forward to a more focused name for a more focused organisation. We then need to establish some leadership roles and begin to fill them with folks who can effectively carry the issues forward. As is always the case in circustances like this, money will need to be raised to pay for legal assistance and advice. We then need to have the resolve to see this through to an end that is satisfactory for the homeowners and taxpayers on the Lake and River.

Please continue to encourage others to join this site and look for further info regarding this dam issue.

Chuck Whittlesey . . .

From: Friend of the Lake Wenatchee Watershed [FriendoftheLakeWenatcheeWatershed@communities.msn.com]
Sent: Sunday, September 30, 2001 9:38 AM
To: Friend of the Lake Wenatchee Watershed
Subject: New member

New Message on Friend of the Lake Wenatchee Watershed

From: Bob Nilsen

I oppose the dam proposal at Lake Wenatchee as well. I live at 23300 Lake Wenatchee Hwy, and windsurf, swim & fish in the lake. It's one of the most beautiful lakes I've ever seen and find it unthinkable that someone who has actually seen the lake would like to change it. I've lived here for 12 years and have seen the lake rise and drop naturally. I belive the natural rising and dropping of the lake level is important to maintaining the clean shorelines. To hold the water at a constant level would certainly eliminate that cleaning action. We already know what dams do to fish runs, we've spent millions on those studies already in the Columbia River drainage. I guess we need to take a closer look at our legislators and what they represent.

-----Original Message-----
From: Snyder, Jeri (SEA) [mailto:jeris@prestongates.com]
Sent: Monday, October 01, 2001 3:50 PM
Subject: Lake Wenatchee Water Storage Feasibility Study

Dear Senator Parlette; Mr. Kaputa, Ms. de Vera, Ms. Walker and Chelan County Commissioners:

We are writing this letter to give our concerns about the proposed dam at Lake Wenatchee.

First, we would like to point out that many property owners around Lake Wenatchee are "absentee" property owners, who live and work out of town and therefore would be unable to attend public meetings held during the week; and, not held at the Lake. In addition, any public meetings held mid-week in the fall/winter make it impossible for those absentee owners to attend.

Second, why was this meeting not held at the Rec Club at the Lake? This would be comparable to holding a public meeting about issues involving the City of Wenatchee in Cashmere. Public meetings that affect Lake Wenatchee should be held at Lake Wenatchee - not Leavenworth.

The meeting held on September 13th was taped and transcribed. We've had a chance to listen to the tape and would like to comment about the comment made that there has not been much participation in the watershed study and/or this proposal by people around the lake. Please see our first and second points above. It is obvious that you are not aware of the type of ownership which exists around the Lake. You know now about a group of property owners and interested persons called "Friends of Lake Wenatchee" which has been in existence since 1980. We formed to help protect the Lake and surrounding forests from over or inappropriate development, logging and now a proposed dam. We all have one goal and that is to keep Lake Wenatchee and its environment as pristine and untouched as possible. The pressures on this Lake both natural and man-made have been enormous.

We have the additional following concerns:

1. The drawings and diagrams shown at the meeting were out of date and inaccurate. We invite all of you to tour the lake by boat to see the homes, docks and millions of dollars of improvements on the lake, the wetlands and public shore lands. On the north shore, there are homes every 50 feet and some stacked behind each other. On the north and south shore, almost every piece of private lakeshore land has been developed. Do you have the numbers? You should be working with current, up to date information, maps and photos, not ones from 1930 so your study will report the proper impact of this proposed project.

2. Location: The site for this proposed dam is not appropriate. The

lake is heavily populated and a high recreational site for the public of this State (and others). IF a water storage facility is really necessary, why not Tumwater Canyon. The impact of such a dam in the Tumwater would be much less than at Lake Wenatchee and, the Tumwater already has a "dam" in place. This site seems much more logical.

3. Fish: When dams are being torn down to benefit fish, building another one seems completely inappropriate. This year has been the best run for fish in a decade. Adding yet another obstacle in their spawning path, putting a dam in the middle of the Chinook spawning grounds, just does not make sense or add up. Clearly, you cannot state "fish" as a reason for this dam.

4. Irrigation. It was stated in the meeting that there has been an over appropriation of water and irrigation rights in the Wenatchee River basin. The $250,000 should be spent to education farmers and land owners about conservation now. Not put a band aid on the problem. Orchards are disappearing rapidly from the valley. Is irrigation really an issue here?

5. River Free Flowing: The Wenatchee River is one of the last free-flowing rivers in the state of Washington and it make no sense to put a dam at the mouth. This river should stay untouched and natural for the benefit of generations to come.

6. Drought Year/Floods: Any data taken this year would be inaccurate in regard to water levels and flows because of the drought. For this reason, this study should not even be taking place at this time. Do you have accurate information about the floods that have occurred on this lake and the impact on the area in the last 15 years? This would be vital information to any study. These events were horrific and impacted the lake and property owners around the lake. We have videos of the 1990 flood.

7. Lake Wenatchee Wetlands: The wetlands around the lake are vital to the environment there, and are part of a very fragile wetlands ecosystem in the Cascade mountains. These would be destroyed. We simply cannot justify this project at the risk of losing them.

8. Septic Systems and Drinking Water: There are homes and septic systems that would be flooded if the water level was increased to 10 feet over the mean high water mark. Do you know how many people take their domestic water supply from the Lake? Clearly this is a public health issue that should be addressed.

We are opposed to this project and are frustrated that $250,000 of our tax money is being used to "study" it. It simply does not make sense and is NOT a "win-win" situation for anyone, especially Lake Wenatchee.

Ted and Jeri Snyder
(members of Friends of Lake Wenatchee)
15690 Cedar Brae Road
Leavenworth, WA 98826
(509) 763-3199

From: Robbie Cape [rcape@microsoft.com]
Sent: Monday, October 01, 2001 11:47 AM
To: Mike Kaputa
Subject: Lake Wenatchee Water Storage

I just wanted to quickly record my opposition to this project, and even the study. I have read over the meeting notes, and want to reiterate all the points against the project.

I don't see how, even at this early stage, the benefits of this project will outweigh the costs/opposition to it. My sense is that the county could very well be wasting valuable time and money with this study.

Anyhow, that's my vote.

Thanks for listening.

- Robbie

October 4, 2001

Chelan County Watershed Program
411 Washington Street
Wenatchee, WA 98801

Attn: Mike Kaputa

Dear Sir:

For the last 38 years, my wife and I have owned a house on 200 feet of lakefront on the South Shore of Lake Wenatchee. I am writing to express concern over possible plans to build a dam at the lake's outlet for water storage. I see major problems with this that would affect us personally.:

1. One of the delightful features of our property is a sandy beach in front of the house, along with a rocky shoreline covering the rest of our frontage. We would expect a dam, to be effective, would raise the lake level to permanently cover our beach, along with the rest of the second class shorelands (which we own) in front of the lakefront lots.

2. In 1990 and 1995 we had "100-year-floods" (or was it 500?) on the lake. Any additional water storage in the lake might alleviate downstream flooding but would <u>worsen</u> flooding around the lake itself.

3. We have a dock which, for most of the year, is accessible from our beach. The only time we cannot accessit (without swimming) is during the brief period of highest snow melt runoff, usually in June. Using the lake for additional water storage would increase the length of time we could't access our dock, possible through most of the summer and into the fall. Under present regulations we could not add a walkway over the beach to get to the dock. Also, depending on the water storage level, the shore end of our gangway could be under water anyway.

Unfortunately, we were unable to attend the September 13 public meeting on the subject. Pleawe accept this letter as part of our input to the study process. We feel strongly that the benefuts, if any, of the proposed project will accrue downstream, while its negative impact will weigh on the property owners on the lake.

Shortly after we bought the property in 1963, there was a major proposal to build 3 dams on the Wenatchee River, including one at or near the lake's outlet. Fortunately, that one was shot down in flames at the time. Hopefully history will repeat on this one.

Vin
Outlook

PAGE 2

Just this past year we made a major investment to strengthen and upgrade our house. We find the thought very dismaying that our beach may be flooded and our dock rendered useless in the near future.

Yours very truly,

Orlien N. Becker
Margot L. Becker

Orlien N. Becker
Margot L. Becker
16120 65th Avenue S.E.
Snohomish, WA 98296-8722

Telephone 425-485-1084

no E-mail

From: charlie carmody [soundsaboutright@yahoo.com]
Sent: Sunday, October 07, 2001 9:33 PM
To: Mike Kaputa
Subject: Lake Wenatchee Water Storage Feasibility Study-Community Meeting Notes

ascii Mr. Kaputa, thank you for the information withregards to:
(1) Lake Wenatchee Storage Study Public Meetingon Sept., 13, 01.
(2) Proposed Work Plan Schedule distributed at the meeting.
(3) Your efforts with regards to Rick Smith'sPowerpoint presentation.

If these are the questions that were presented to you and your staff, and must be answered before a successful study of the proposed installation of a dam for water storage, fish ladder, and possibly a small auxillary generator can be initiated, then...I must say, it looks like an event in a movie I saw, " Class Action" with Gene Hackman. Hackman asked one lawyer firm for information it possessed to help his case. The firm gave Hackman every scrap of paper it possessed which inundated Hackman's firm with useless information in an attempt to cloud the real issue, and to stall the proceedings. I find it interesting that all the "Groups" are headed by women. I also find it interesting that all the property owners directly effected by the outcome of the study were not contacted by these "Groups", myself included. I think emotion needs to be taken out of the survey, with regards to dock costs, and private beach size and use as criteria for this study. The majority effected by this prodject need to be heard, even if it means going "door to door". There are thousands who will be effected by the desisions proposed by a commity. There is a real possibility of water shortages, now and in the future. Scientific estimations on studies are simply un-acceptible even if 1% are correct. In my opinion, for the water sheds, irrigation, and municipalities effected by drought and electricity fluxuations, simply for these three reasons...exclusive of the numerous questions presented at the meeting, the scrutiny of this prodject needs to be informed, fair, and presented with compassion for those effected adversely. Although my property will not be effected directly, (my property is on Dirty Face mountain (2.88ac) near the previous site of the Cougar Inn) I am certainly interested in the completion of this commity or study. Please let me know if I can help. Thank you and your staff be taking the time to inform. All the best.
Charles J. Carmody
soundsaboutright@yahoo.com

October 7, 2001

To: Mike Kaputa
Chelan County Watershed Program
411 Washington Street
Wenatchee Wa 98801

Fr: Robert Nilsen
23300 Lake Wenatchee Hwy
Leavenworth, Wa. 98826

Re: Dam project

Dear Sir,
I think in this new era of warming ocean currents and (el nino) we have found that the weather patterns are very unpredictable. We had two 100 year floods in the early 1990's. I think the potential for flooding has become much greater today. I was wondering how the dam would be protected from all the logs & stumps that are present in the lake during extreme flooding? Would there have to be a log boom across the lake in the deeper water above the state park? If so that would render the boat launch at the state park useless. If the log boom were placed below the state park boat launch in the shallower water there would be the likelihood of a log jam forming and possibly breaking. The property below the dam on Cedar Brae rd it seems would be at extreme risk during flooding. Would there have to be slope protection below the dam and for how far downstream? Would those property owners have to sacrifice their property for the embankment? How many acres of land would have to be cleared adjacent to the dam for construction staging area and access roads? It seems that the lake acts as a natural safety valve or water overflow during extreme flooding, so if you keep the lake at its high water level during flood season heavy rain & runoff would affect the river almost immediately. Also the sudden drop in water elevation at the dam would create much more turbulence downstream for miles below the dam. Would the 207 bridge have to be upgraded? It just seems like there would be an increased risk of flood damage all the way to the Columbia River. Who controls the water flow? US Army Corp of Engineers? It seems that for a project of this size there would have to be federal funding. How long does that take and do you really want to get the federal govt. involved in developing one of the finest recreational treasures in Chelan Co.

I've worked for 30 years on pipeline projects in river beds, Corp of Engineers dam projects, slope protection along rivers, built marinas and have seen the damage to riverbeds as a result of those projects. I think that if the public were aware of the tremendous impact a project like this has on the environment, they would surely be against it. There are other alternatives for maintaining enough water to get through drought periods. Maybe you could spend some of that $200,000 to look at those alternatives.

Thank you
Robert A. Nilsen

P.O. Box 65
Snoqualmie, Washington 98065

October 15, 2001

Mike Kaputa
Chelan County WAtershed Program
411 Washington Street
Wenatchee, Washington 98801

Dear Mr. Kaputa:

Thank you for sending the Lake Wenatchee WAter Storage Study report.

We want to be on record for opposing the project. How much of our beach would be submerged by your project? We've been told the "going rate" for lake front property is about $4000 per running foot. We own 120 feet.

Why do you believe it necessary to build a dam? One year with less precipitation than normal should not warrant such action.

Yours truly,

Robert & Marie Jarrett

Robert & Marie Jarrett

From: Donald Melton [dkmelton@hotmail.com]
Sent: Monday, October 22, 2001 2:07 PM
To: Mike Kaputa; Lisa de Vera
Subject: Lake Wenatchee Storage Feasibility Study
October 22, 2001

To Whom It May Concern:

We are writing this letter to express our concern about the proposed dam at Lake Wenatchee. We have owned our property at Lake Wenatchee for over 25 years and find the proposed dam on the lake to be the worst idea we have heard of since the old "WPPSS" fiasco of the 1970's. It is a very bad idea.

The idea that we (the residents and property owners) need to bail out Chelan County because it has "oversold" existing water rights is absurd. Why not simply buy out the oversold water rights directly? It would make much more sense then destroying a lake and it's eco-systems, not to mention the investments of millions of dollars of private property. It is a very bad idea.

Who will compensate the property owners for this "taking" and consequential "damages" to our properties if the project is built. We do not want the dam built, we want the lake left as it is today.

The argument that the water is need for irrigation purposes is also absurd in a time when the traditional agricultural industry of Chelan County is going bankrupt because of foreign competition and changing world economic market conditions. Save our precious resource for all to enjoy.

Stop the feasibility project now before you waste any more money.

We are co-owners of the property located at 15700 Cedar Brae Road and we represent the view and ideas of the entire "family" which contains 12 individuals of voting age.

Don and Penny Melton
3819 Bagley Avenue North
Seattle, Wa 98103
dkmelton@hotmail.com

Mussen Properties
C. C. "Skip" and Kay A. Mussen

1415 Jefferson Street
Wenatchee, WA 98801
(509) 662 5759
Fax (509) 664-3244

October 25, 2001

Mike Kaputa
Chelan County Watershed Program
411 Washington Street
Wenatchee, WA 98801

Dear Mike:

Thank you for sending the report of the September 13, 2001, meeting in Leavenworth which I was unable to attend. The meeting was about the proposal to dam Lake Wenatchee to establish a water reservoir.

My original intention was to be neutral on the subject until I found what the proposed lake level would be and how it would affect my property at 16335 North Shore Drive on Lake Wenatchee.

After reading your report I have decided that to wait until some more information would be available would be too late. Such discussions as raising the level 10 feet, or even 5 feet, would seriously impact my property. My home is right on the beach. We had water in our crawl space under the cabin during both the 1990 and the 1995 floods.

I also am concerned about the structure of the committee, where only three property owners would serve. This puts the property owners, who have a lot to loose, in a distinct minority on the committee. The agency people, I think, would be all for the project no matter the loss to the property owners.

Therefore, you can put me down as opposed to the project.

CHARLES C. "SKIP" MUSSEN
16335 North Shore Drive
Lake Wenatchee

29 October, 2001

Michael Kaputa
Chelan County Watershed Program
411 Washington Street,
Wenatchee, WA 98801

OCT 31 2001
PLANNING DEPT

Dear Mr. Kaputa,

Reference is made to the Lake Wenatchee Water Storage Study and your request for comments.

The following comments are submitted for consideration and inclusion in your study. I have been involved in three major floods at Lake Wenatchee, 1980, 1990 and 1995. I have personally observed the disastrous impact of these floods on the properties along the north shore of Lake Wenatchee, especially the property of Ann K. Hoyt, 16181 North Shore Drive.

In each case a weather system known locally as the "Pineapple Express" brought excessive moisture into the Pacific Northwest. When a low pressure area stalled over the Cascade mountains, excessive flooding resulted on both sides of the Cascade Mountains. The resulting run off reaches Lake Wenatchee causing the lake level to rise rapidly. There is not enough room at the mouth of the lake to let the excessive water move on without flooding. This was not always the case.

When Highway 207 was moved to it's present location, the road bed was built up forming a dam across the low area where excess waters had always flowed during times of flood, thus avoiding damage to property on the lake. Add to this obstruction the flood waters from Nason Creek which now must flow to the present location of the Wenatchee River before they can drain down stream. Nason Creek forms, in effect, a hydraulic dam at the mouth of Lake Wenatchee.

In 1980 the flood waters rose to with in six inches of the floor of the cabin belonging to Ann K. Hoyt. Her small basement and outbuildings were flooded. In 1990 and again in 1995 the water rose to 23 1/2 inches inside her cabin. I believe that the difference between the water levels in 1980 and 1990 / 1995 was that there was less vegetation in the later years due to the heavy logging and thus more water reached the drainages at a faster rate than in 1980. Once the flood waters flowed over highway 207, the level of the lake seemed to stabilize and when the rains stopped the flood waters receded from the cabin in about 24 hours in each case.

To place any further obstructions at the mouth of Lake Wenatchee or in the Wenatchee River is inviting greater flooding than we have already experienced. We do not need a dam at the mouth of Lake Wenatchee. We need to keep this lake in it's natural state. Leave Lake Wenatchee alone.

Sincerely,

David M. Klinger
P.O. Box 537,
Leavenworth, WA 98826-0537
(509) 548-5480
dklinger@rightathome.com

From: Bill Robinson [WCTU@mindspring.com]
Sent: Wednesday, October 31, 2001 10:30 AM
To: Mike Kaputa
Subject: Lake Wenatchee Storage comments

Oct. 29, 2001

Mr. Michael Kaputa
Director
Chelan County Watershed Program
411 Washington St.
Wenatchee, WA 98801

Mr. Kaputa:

On behalf of the Washington Council-Trout Unlimited, thank you for developing a very professional process for addressing the issues which surround the Proposed Lake Wenatchee Storage project.
Your format for running the Public Meeting on this proposal in Leavenworth, WA on Sept. 13, 2001 was well thought out. The breakout sessions certainly helped to maximize the time allotment for discussion of the proposed project's "needs assessment".
There was certainly a potential issue which could have very acrimonious-the basic misunderstanding that the project proposal should not go forward despite the state legislative directive. In listen to several groups around the one I attended, this was certainly an issue which a number of interests continued to vocalize-we do not want this project so lets save $250,000 and not proceed.

In any event, upon review of the summary meeting notes they track fairly well with the notes which I had taken. Additionally, the issues raised seem to be a fairly consistent across the various groups.

Our interest lies in several arenas, environmental/ fisheries, community issues and process.

We urge your agency to go back to the basics and review why this proposal has not been successfully implemented since first being proposed in the 1920's. There must be a thread of commonality which runs through all of the years and proposals as to why this proposal has failed to be supported across time.

Fisheries and Environmental Concerns:

We most certainly have major concerns regarding the impacts to anadromous and resident salmonids which utilize Lake Wenatchee and the upper basin tributaries. The fact that the upper basin tributaries are the spawning and rearing habitats for 3 stocks of salmonids listed as "Endangered" under the Endangered Species Act most certainly creates significant legal and environmental problems. The fact that the 3 "listed species" spring chinook, summer steelhead and bull trout have critically low populations and that the sockeye population is not stable but any stretch of the imagination. Our concerns here revolve around the degradation of critical habitat and wetland inundation, passage and generation impacts, flow regimes which affect water quality and quantity in the reach immediately below the project to the confluence of Icicle Creek and on to the confluence of the Columbia River. The proposed study must address the impacts of the flow regimes on the salmonid and benthic communities at all lifehistory stages.
The spring chinook and steelhead populations are limiting factors to fisheries management process which certainly are recognized impacts to treaty fishing rights and non-treaty fishing privileges throughout the Columbia River system and are dealt with in the context of US v Oregon, Pacific Fisheries Management Council and North of Cape Falcon fisheries management processes. Spring chinook, additionally are a component of the Pacific Salmon Treaty (the spring chinook produced at the USFWS Nat'l Fish Hatchery are an "index stock" which is monitored by the PST). It is the position of the WCTU that there be no negative impacts to the salmonid resources affected by this proposal.

Not no net loss-no loss at all.
We believe that this is a position which will be held by the treaty tribes and the state and federal family of agencies as well.

Community and Process Concerns:

In listening to the crowd at the meeting, there was certainly a feeling of hostility in this arena.
It appears that the state legislature got out in front of itself with this proposal without regard to the local constituent base. Or perhaps only a segment of the local community interests were being brought forward. It appears that the project proponents are pushing this proposed study forward as a win/win for people and fish-benefits to the communities in the Wenatchee River watershed and flows for fisheries resources.

This doesn't pass the "straight face test" for example when one looks at property rights issues in the area surrounding Lake Wenatchee, local health issues such as impacts on septic systems above the proposed storage dam. Neither are the flows for fish.

There is a significant disconnect between the community interest groups.
Many see the proposed project as a veiled attempt to access more water for interests in an already over appropriated basin.
Many also see the lack of scientifically based support for the proposal regarding the water flow needs of the fisheries resources throughout all lifehistory stages. Most will agree that flows which purport to meet the needs of salmonids- do not under these types of "flows for fish" projects. We are seeing this tact in many area's of the country and the impacts upon review are certainly not as "pro-fish" as proponents would have people believe. The development of the "Advisory Committee" also needs to be addressed. It was apparent that several very significant interest groups were not included in public process. The lack of representation fro the recreational fishing community and the recreational boating industry came to mind immediately. There was also the lack of clarification as to the identification of who were the "environmental and conservation" were. It also appeared that there was poor communication/involvement between your agency and the treaty tribes in this project. All in all, it was apparent that the local public involvement component of the proposal was not well thought out.

We are also concerned about the development of the mitigation package for this proposal. It is our belief that in the end, if all the impacts of this proposal are accurately identified, that this project will not "pencil out" financially. Perhaps this is the "common thread" which has run through all of the previous iterations of the proposal-back to the 1920's.

The WCTU has a policy which looks at storage proposals on a case by case basis. Our basic criteria is that the projects provide real benefits to salmonid resources at all lifehistory stages, do not degrade water quality or quantity standards for the project area and that they provide economic sense and fiscal responsibility to the public.

We remain very interested in the Lake Wenatchee Water Storage Study process. Please keep our organization on any and all mailing lists and apprised of opportunities for public involvement.

Yours in Conservation,

Bill Robinson
Executive Director
Washington Council-Trout Unlimited

From: Steve Craig [scraig@lwproperties.com]
Sent: Wednesday, October 31, 2001 1:15 PM
To: Mike Kaputa; Lisa de Vera; Sarah Walker; John Hunter; Buell Hawkins;
Ron Walter; Linda Evans Parlette (E-mail); Mike Armstrong (E-mail);
Clyde Ballard (E-mail)
Subject: Lake Wenatchee Dam Proposal

Dear Chelan County Watershed Department, Elected Chelan County Commissioners, and Elected Senator and Representatives of the 12th District:

My wife Kelly and I own waterfront property on Lake Wenatchee, where we have resided together full-time for the past 5 years. We are not of the high-wealth, technology-employed property owners with no 'roots' to the area that so many in the Wenatchee Valley believe all lakefront property owners to be. Instead I would consider ourselves 'locals', as I personally have lived on Lake Wenatchee for the past 22 years. In addition, my parents own waterfront property, where the reside full-time, and my brother and his wife also own lakefront property; he lived here for 20 years. Therefore our concerns stem from many years of experience at Lake Wenatchee.

We are very concerned that the pending feasibility study is a one-sided affair on behalf of orchardists and farmers in the lower Wenatchee valley, whereas the property owners of Lake Wenatchee would bear the costs of such a development.

I have talked with nearly 200 property owners in the Lake Wenatchee area. Please let it be clear that we all feel that the feasibility study, in itself, is a waste of valuable budget resources. Nonetheless, the County Watershed Department has made it clear that the feasibility study will proceed, and given this be the case, there are significant concerns that must be addressed:

1. Taking of our Private Property. Artificially raising and maintaining the level of the lake is a direct attack on our private property rights. Many of yourselves as publicly elected officials have advocated the preservation of property rights. Conversely, the proposed dam would cause a taking of our private property, and thus a depredation of our property rights. A high percentage of our overall property values come in the form of the actual beach frontage and inherent lake usage as the lake currently exists. Artificially raising and maintaining the lake would directly take away and impact these assets to our properties.

2. Residual Effects on Shorelands. Maintaining the lake at the average high water level would have negative residual effects on the shorelands.

Ecological. First, there would be significant erosion of the shoreline banks and soils, with the deposits going directly into Lake Wenatchee and the lower river system. Preventing erosion has been a foremost priority in shoreline regulation reform, including Chelan County's adoption of new shoreline regulations in July, 1999. If the State and County adopted regulations to prevent erosion, it does not make sense to create ecological conditions that would result in further massive erosion?

Additional Taking of Property Rights. Since citizens began owning private property on Lake Wenatchee, we have made improvements to the portions bordering the lake. If the level of the lake is raised and maintained at the normal high water mark, many of these improvements eroded, and thus damaged or destroyed. These include landscaping, docks, boathouses, retaining walls, decks, and even cabins. Again, these improvements are assets to our property, and damaging or destroying them would be considered a taking of our property.

3. Salmon and Steelhead. These migratory fish have been navigating the rivers of the Columbia River system for tens of thousands of years, quite possibly even longer, and have experienced both droughts and floods of greater magnitude than anyone can comprehend. The very fact that these fish still exist today proves that water levels are not the cause of their recent decrease in numbers, nor would artificially maintaining higher stream flows be the answer to a resurgence in numbers. The decrease in the numbers of these fish has occurred at the same time as society has constructed hydroelectric dams on the Columbia River. In a time when we are adopting new shoreline regulations, changes in forestry practices, modifying fish harvest regulations, and even breaching dams, why would we would we create another impediment to these fish?

4. Flooding. Lake Wenatchee has experienced three massive floods since 1980, resulting in significant damage to homes and property. Please understand that these floods occurred when there were no artificial barriers preventing water to be released from the lake. Inevitably, the lake will flood again. However if there is an artificial dam preventing water from being released as nature had intended, the financial damages will be multiplied compared to previous years. Are the County and/or State governments prepared to bear the financial liability of these additional damages?

We are opposed to this project, and it is very apparent from the very outset that the financial and environmental costs of such a project greatly outweigh any potential benefits.

Sincerely,

Steve and Kelly Craig
17225 North Shore Dr.
Lake Wenatchee, WA
(509) 763-8056

12-7-01

Dear: Senator Parlette
County Commissioners
Mr. Kaputa
Ms. de Vera
Ms. Walker

Please review and add my comments to the public hearing process being conducted by your committee on the Wenatchee River Dam Proposal. My concerns and confusion are further amplified when we currently have similar proposals to breech dams rather than build new ones. Also, this proposal was made and decided against about 25 years ago. Is this something that we need to review every quarter of a century or when we have a drought year?

I have reviewed most of the comments from the public meetings that have been held to date and agree with many of the points raised. I do not wish to repeat the same points, so I will limit my comments to just a few points.

++ Bridge Built in 1941 On Highway #207

This bridge was build in 1941 by the Washington State Department of Transportation at a site approximately 500 yards East of the original bridge built in the early 1900, s. Enclosed are documents found in the archives with all of the construction detail and design provided by Pacific Car and Foundry. Mr. Farhad Bira is still searching for information that details how much the road area was raised and the extent to which the river channel was narrowed. Old timers on the Lake believe many of the high water floods that we have experienced in the last twenty years are directly attributable to outflow being restricted. Some may even claim that this was in effect created a **DAM** by limiting the outflow of the water from Lake Wenatchee. The roadbed of Highway #207 was also raised approximately 12" after the flood of 1995. A study needs to be made to determine the history of flooding before and after the building of the 1941 bridge. The design and drawings will be forwarded to the committee and any other engineering documents as received.

++ Property Values at Risk on Lake Wenatchee

A print out will be provided of all the properties by parcel number as part of the documentation to support valuations of just the waterfront properties on Lake Wenatchee. The Lake contains approximately fourteen miles (75,320 feet) of water front property, both private and public. According to recorded real estate sales in the last three year property has been selling for $5,000 per front foot. The potentially affected property values without improvements is approximately $376,600,000. There are approximately 220 homes and cabins with an approximate value of $250,000 each, adding another $55,000,000 in value. The committee needs to consider the potential loss in property values of some significant percentage (%) of $486,600,000. This would include loss of property taxes and the damage claims brought forth by every property owner affected. None of these figures include the commercial properties and the forty homes along Brae Burn Road that would add another $4,000,000 of potentially damages properties.

++ KALER GLEN WATER RIGHTS AND PERMITS

Eight years ago a very controversial and contested water permit was granted to Kaler Glen to draw water from Nason Creek and from the Washington State Forestry property above Kaler Glen. It is public knowledge that an eighteen hole golf course used tremendous amounts of water. Since this study is about water use, some analysis should be made as to the water take allowed under the permits granted. Documentation of the water used should be available from the water logs required as part of the permit requirements.

++ Coalition of Columbia Basis Irrigators Petitioning NMFS to De-list Seven Species of Fish

Your committee is reviewing the merits of building a low level dam on the Wenatchee River out of consideration for the Columbia Basis farmers and orchardist. At the same time the same affected individuals are formally petitioning NMFS to de-list seven other stocks in the Columbia and have served notice of their intention to litigate the issue. There is also a coalition of environmental and fishing groups who are seeking to intervene in the **ALSEA** case with an appeal. Further information can be found under Alsea Valley Alliance v. Dept. of Commerce (99-6265-HO,Or) (Sept. 13, 2001)

notice of their intention to litigate the issue. There is also a coalition of environmental and fishing groups who are seeking to intervene in the **ALSEA** case with an appeal.

In summary, the proposal to build a low level dam on the Wenatchee River is ill-conceived and significantly a more complex issue than the proposed study envisioned when passed by the legislature. I cannot support this proposal as a viable option to conserve water with all the untenable consequences that this presents to fisheries, property owners and recreational user of Lake Wenatchee and all the rivers systems above and below the Lake.

Thank you for reading the material I have provided. If there is more information that I can provide, please let me know.

Best regards,

Ray Aspiri

Lake Wenatchee and Vashon Island Resident
Member of the Friends of Lake Wenatchee Forests

8808 SW Glen Landing, Vashon Island, Wa. 98070
(206) 567-4049 Alt. # (206) 441-7290

Confederated Tribes and Bands
of the Yakama Nation

Established by the
Treaty of June 9, 1855

December 17, 2001

DEC 21 2001
PLANNING

Commissioner Ron Walters, Chairman
Chelan County Board of Commissioners
350 Orondo
Wenatchee, WA 98801

RE: Proposed water storage in Lake Wenatchee.

Dear Commissioner Walters:

Over the past couple years the Yakama Nation has enjoyed an increasingly favorable relationship with Chelan County in the area of natural resource protection and enhancement. We look forward to advancing this relationship in time.

Both Chelan County and the Yakama Nation recognize that protecting and enhancing our natural resources, and specifically our aquatic and fisheries resources requires a commitment beyond the level which many of our neighbors and citizens recognize in their daily lives. Often, this commitment is even beyond the courage that our leaders have to offer. Our leaders must be direct and diligent in protecting natural resource values that have been long established in law (Tribal Treaty obligations, Endangered Species Act, Clean Water Act, State mandates, etc). The Yakama Nation has appreciated the recent and enthusiastic response that Chelan County as expressed in recognizing these interests. We support this and offer some words of encouragement.

The proposal for enhanced water storage in Lake Wenatchee is not an acceptable response to water shortages in the Wenatchee Basin. The Yakama Nation asks Chelan County to not hide behind the veil of fish protection and enhancement water to justify a dam on Lake Wenatchee in order to address the over-appropriation for out-of-stream uses. Clearly, this is a proposal that protects and likely enhances agricultural interests. Although the Yakama Nation is generally not opposed to development of agricultural interest, we strongly disagree with any attempt by Chelan County to blur or confuse agricultural interests with fish (anadromous salmonid) recovery interests.

Respectfully, we ask that Chelan County meet with the Yakama Nation to discuss several pivotal issues:

- What evidence is there to suggest that salmonid recovery will be enhanced by additional Lake Wenatchee storage capacity?
- How much capacity is envisioned and what are the likely engineering options to provide this storage capacity and how might these options incorporate fish passage considerations?

- What species will be positively affected and what might be the negative effects to fishery interests?
- In what life stages will survival be enhanced and why is this increased survival expected?
- How would additional storage be used to augment a "natural flow regime" for the main-stem Wenatchee that would enhance flow modifications to current irrigation activities?
- Finally, how will all additional water storage be used in the agricultural community during "low" flow years? Will these interests have additional water beyond their ability now and how would this water be "appropriated" between fish and agricultural interests?

Clearly, all of our governing bodies are looking for solutions towards the significant and substantial impacts that continue to impact our salmon, and our aquatic and riparian resources. With the recent and continuing changes in Chelan County's approach in natural resource issues, we are encouraged that there is a substantially greater awareness in salmonid recovery interests. However, until Chelan County can address the basic questions we have stated above, it is not clear why this proposal is being presented in such a noticeable public format. Will the public come to expect something that is not feasible or defensible?

The Yakama Nation is very concerned that public perception within the Wenatchee Valley will come to expect that additional manipulations to the watershed will "fix" past problems with salmonid production. This is the same perception that (generally) Euro-Americans and other emigrants have "understood" for the past 150 years. Have we not learned yet? What is different about this proposed project?

As always, the Yakama Nation is interested in a continued and productive dialog with Chelan County. We look forward to your timely response to this letter. If you have specific or technical questions, please do not hesitate to call my staff representative, Lee Carlson at 509-865-6262.

Sincerely,

Virgil Lewis, Sr., Chairman
Fish and Wildlife Committee
Yakama Nation Tribal Council

cc: Lee Carlson
Bob Rose
Mike Kaputa

From: ASPIRIENT@aol.com
Sent: Tuesday, January 22, 2002 7:56 AM
To: Mike Kaputa; scraig@lwproperties.com
Cc: john.zipper@zipperzeman.com
Subject: Re: Lake Wenatchee Watershed Storage

Mike: A number of individuals who participated with "The Friends of Lake Wenatchee Forrest" could provide some valuable input on the Dam Proposal. It would be helpful if there is a project plan that defines the elements of the project that are to reviewed and a timetable for scheduled meetings of the committee. Is there a committee that you plan to form? Who is currently on the committee? How many members are needed and who is needed to make the committee representative of all the divergent interests? How often will the committee be meeting? What are the responsibilities of the committee members and do they have a voice or vote on the final recommendations? Where will they meet?

There are a number of individuals, including myself, who would participate if the meetings can be help monthly for the six month term of this project.

Best regards,

Ray Aspiri

✓

Lake Wenatchee Water Storage Feasibility Study

Instead of identifying the 3-5 top issues as requested, I offer an alternative approach... Since this is a feasibility study, with the emphasis on whether this project is capable of being done or carried out, the study should focus on the following aspects of feasibility:

Technical
Economic
Legal
Social/Environmental.

For each of these areas, there are a number of questions that need to be addressed that will, collectively, answer the question of project feasibility.

Technical Feasibility
-Is the geology at the proposed dam site capable of supporting a structure that can effectively store water and provide fish passage; and, what would this structure look like?
-What would be the potential additional water storage capacity of the lake with a structure and what would the "footprint" of the pool be?

Economic Feasibility
-What would be the direct cost of the project including the planning costs, construction costs, opportunities foregone, mitigation measures, etc?
-How would use of stored water translate into economic benefits?
-What is the predicted effect on property values?

Legal Feasibility
-Does this proposed action meet existing federal, state and local laws and regulations?

Social/Environmental
-What would be the estimated benefits of this project including flood control, irrigation, fish, etc?
-What would be the short-term and long-term impacts to lakefront property owners including: private, state and federal lands?
-What would be the effect on lake limnology and species movement through the lake and around the lake?
-What would be the extent and environmental effect on lands inundated by this project including change in character, shoreline wildlife, bank erosion, etc?
-What direct and indirect effects would the dam have on the life cycle of Spring Chinook*, Sockeye*, Bull Trout* and Steelhead* and other fish?

Note: The fish species denoted with (*) must be fully addressed in this feasibility study. Spring Chinook, Steelhead and Bull Trout are listed species and the Sockeye run is the second largest in the continental United States. How will the dam at the outlet of the Lake affect these important species? How much juvenile rearing habitat will be affected by the project and how will the habitat loss affect the listing and recovery of these species? (April 12, 2002)

Glenn Hoffman

-----Original Message-----
From: Jeffmonda@aol.com [mailto:Jeffmonda@aol.com]
Sent: Tuesday, April 16, 2002 11:32 AM
To: Mike Kaputa
Subject: Lake Wenatchee

Mike,
The meeting at Leavenworth was a good meeting. My question that I asked to the committee was not answered. The question that needs to be answered is:

Is the committee going to determine if it is feasable to build a dam?

The idea of a feasability study is that somebody has to make a recommendation based on the data. If the data produced by the company hired to do the study does not address the concerns of the committee, then the study is invalid. If the committee does not review the findings and determine if it is feasable to build the dam, there is no way to say those concerns are addressed.

I want it to go on record that every Lake Wenatchee land owner that I have talked with is very againts "waisting" the money on this study.

Sincerely, Jeff Monda, MD

From: Barbara_KellyRingel@r1.fws.gov
Sent: Thursday, April 25, 2002 2:19 PM
To: nsmith@nwi.net
Subject: Lake Wen storage study

Nancy,

A few quick thoughts on top priorities for scope of study:

1. Direct and indirect impacts to fish.
- How dam will impact migration in Wenatchee, specifically the juvenile bull trout (6-12 inch typically) migrating up to Lake Wenatchee from the Chiwawa River. It is possible that we could conduct a small radiotag study of these juvenile fish if time and funds allow.
- Impacts to chinook and sockeye salmon spawning in the Little Wenatchee and White River.

2. Modeling of how water storage would affect flows throughout the entire Wenatchee River, compared to the natural hydrograph. Also include information about water diversions in the system.

Another note, if the group at some time would like Judy DeLaVergne and I to present information about bull trout and movement patterns we could do that. Thanks

Barbara Kelly Ringel
U.S. Fish and Wildlife Service
7501 Icicle Road
Leavenworth, WA 98826
509-548-7573
509-548-5743 FAX

1. What is the cost/benefit of this project. Is this project necessary or can it's goals be achieved through other means?

-Can conservation and other agricultural system improvements provide a comparable savings of water for less cost, making the

project unnecessary?

-How can an accurate assessment of the loss of aquatic habitat, as a result of this proposed storage project, be determined,

can it be mitigated and by whom?

2. What are the impacts of the proposed storage project to the fisheries resources of the Wenatchee River for all life history

stages of listed stocks and stocks of concern

-Identify the impacts of the proposed project to downstream/upstream juvenile and adult migratory life history stages including

fish passage.

-What are the proposed flow regimes for the proposed project? What are the intended and unintended consequences to both

juvenile and adult, anadromous and resident life history, particularly during the spring run off and low flow periods between

July and October?

-Is a higher, more moderated flow regime beneficial to fish at all life history stages? Better than the naturally functioning

hydrograph which currently exists?

-Will there be a hydropower component included in the proposed project? What are the effects of this on migrating salmonids?

How long will it take to get F.E.R.C. approval and license for such a venture and at what cost?

3. How will growing the reduction in agricultural lands and the increase in land development throughout the basin effect water rights

and water diversions as a result of this proposal? Can agricultural water rights be transferred to development uses? Are any

"savings" from such transactions left instream?

4. The proposed project will negatively impact a significant number of private landowners both above and below the proposed project.

What financial resources are available to mitigate for certain litigation? Who / what is the responsible party that will have to pay

the litigation costs and the potential damages.

5. How can a "no net loss of habitat or fisheries resources" be achieved given the magnitude of impacts associated with this

proposed project on the Wenatchee River ecosystem?

Bill Robinson

Executive Director

Washington Council-Trout Unlimited

WCTU@mindspring.com <mailto:WCTU@mindspring.com>

206-932-6959

Steve Craig - landowner

listed below are some of the major concerns of the landowners on and around Lake Wenatchee.

1. Bridge Built in 1941 On Highway #207. This bridge was built in 1941 by the Washington State Department of Transportation at a site approximately 500 yards East of the original bridge built in the early 1900's. Much of the road area was raised and the river channel was narrowed. Old timers on the Lake believe many of the high water floods that we have experienced in the last twenty years are directly attributable to outflow being restricted. Some may even claim that this was in effect created a DAM by limiting the outflow of the water from Lake Wenatchee. The roadbed of Highway #207 was also raised approximately 12" after the flood of 1995. A study needs to determine the history of flooding before and after the building of the 1941 bridge. The design and drawings will be forwarded to the committee and any other engineering documents as received.

2. The conceived dam site would be further up-stream and likely be higher in elevation than the bridge and road described above. Under similar weather conditions that contributed to the previous floods, a dam would further compound flood level water heights. This will cause additional damage to lakefront homes and improvements to the tune of hundreds of millions of dollars. A study needs to determine the magnitude of additional flooding caused directly by the dam, and access the dollar value of the damaged properties.

3. Lakefront property owners own the 2nd class shore lands in addition to their normal property, which of course add a tremendous value to property owners. Holding the water level high through the spring, summer, and fall would be a taking of these lands. A study needs to determine the loss in property value for which owners would need to be awarded damages.

4. Holding the water level high would negatively affect our ability to use our waterfront properties. Because lakefront usage largely drives lakefront property values, the overall value of our properties would decrease given the loss of "desirability" of lakefront properties. A study needs to determine the loss in property value for which owners would need to be awarded damages.

5. Holding the water at a higher level will cause the lands, buildings, improvements, etc. above the higher water line to be further damaged. Lake Wenatchee is a notoriously windy lake, with waves commonly 2-3 feet high. Holding the water high will cause additional erosion waves carve away the increasingly saturated soils. The normal high water already comes up the base of several lakefront cabins; holding the water there will damage the stability and safety of these structures . A study needs to determine the loss in property value for which owners would need to be awarded damages.

6. Domestic water supply and septic systems. Many property owners, both lakefront and non-lakefront, take their domestic water supply directly from the lake. While some property owners have converted to the P.U.D. sewer system, many properties still operate traditional septic systems with drain fields right down by the lake. A study needs to determine the ecological effect these potentially flooded septic systems will have on the quality of the domestic water supply (and of course to fish and wildlife as well).

Comments from Karl Halupka:

For bull trout, flow augmentation in the Wenatchee River resulting from dam releases during the midsummer period would be unlikely to have substantial benefit for either migrating adults or rearing juveniles. Bull trout adult migration through the Wenatchee River downstream of the Lake typically occurs during high flow periods. In the late spring/early summer they move upstream during snowmelt hydrograph peaks, and in the fall they move downstream after fall rains have begun. Most juvenile rearing occurs in the Chiwawa River and in or upstream of the Lake.

All life stages of bull trout would, however, be adversely impacted by needing to use passage structures at the dam to complete their complex migrations. Because bull trout movements in the drainage are so complex, the passage structures at the dam would need to pass effectively both large migratory adults and smaller juveniles in both directions during all months of the year. Adults moving upstream after overwintering in the Columbia River and mainstem Wenatchee would encounter the passage structure en-route to the Lake and upstream spawning tributaries, and during downstream migrations to overwintering areas. Adults that overwinter in the Lake and spawn in the Chiwawa would encounter the passage structure during their downstream movements to spawning areas and upstream movements to winter in the Lake. The level of juvenile migration throughout the system is unknown, but some level of movement is expected.

Lisa de Vera

From: Bill Bauer [mayor@cityofleavenworth.com]
Sent: Tuesday, June 11, 2002 10:53 AM
To: Lisa de Vera
Subject: RE: May 30, 2002 Minutes and Revised Scope of Work

Lisa,

A couple of thoughts on the Lake Wenatchee Feasibility Study.

1. Water Needs- Would there be "new" water rights created, how much and how would they be allocated?

2. Environmental Impact- Would "new wetlands" be created? Where? What impact on current owners of those properties?

Thanks for the prompt minutes and the good work.

Bill Bauer, Mayor
City of Leavenworth

1

From: Daniel.R.McDonald
Sent: Wednesday, January 22, 2003 5:12 PM
To: Lisa de Vera
Subject: Ordinary High Water Definition

Lisa:

A while back you asked me for the definition of Ordinary High Water that I read at the meeting of the Group and shortly after that Bob Montgomery sent you an e-mail in which he said the following: "Ordinary High Water (OHW) definition was read from a court case involving Lake Whatcom. In that case a supporting argument on defining the high water mark was derived from an earlier case which stated "?.soil which is submerged so long or so frequently, in ordinary seasons, that vegetation will not grow on it, may be regarded as a part of the bed of the river which overflows it." The inference is the bed is below the OHW. Washington State DNR told us that the courts are using the line of vegetation as the OHW, which is the demarcation between uplands and 2 (superscript: nd) class shorelands. The 2(superscript: nd) class shorelands are located waterward of the OHW and extend to the line of navigability. The line of navigability is to the depth for customary commercial vessel draft plus 1 or 2 feet additional depth. DNR said that it is 6-10 feet of depth. We didn't attempt to define the line of vegetation in the meeting ? that is usually defined by a biologist at the site. That may differ slightly in different parts of the lake but we won't know until we look more carefully at it."

I thought that he was answering that question, but in recent review I realized that I had not answered your directly so I thought I had better do that now. My definition comes from "Waterfront Titles in the State of Washington" by George N. Peters Jr., published by the Chicago Title Insurance Company. This was sent to me by the DNR's expert in this area as a very good summary of the issues dealing with shorelands. In the definition section it says: Ordinary High Water - The visible line of the bank along non-tidal waters. Sometimes referrted to as the line of vegetation, although the latter term is not technically the same. Boundary between uplands and shorelands on navigable waters. Line of Vegetation - Sometimes, though not technically correct, referred to as the boundary between uplands and shorelands.......... In addition this contact at DNR said that they considered the Line of Vegetation and Ordinary High Water as equal to each other. He said that the reason that they use the Line of Vegetation is because the courts turn to that because water courses and shorelines change over time and the Line of Vegetation will change with it whereas a more rigid survey method doesn't change. Hence this semi-subjective measurement rather than a more objective measure.

Dan McDonald

From: Bruce Jacobsen
Sent: Monday, February 24, 2003 10:10 AM
To: Lisa de Vera
Subject: RE: Lake Wenatchee Water Storage Meeting Notice WED Feb. 26th
6:30 PM, Leav City Hall

I would like to comment by email, and I hope that is acceptable. I am one of many people who have a vacation home at lake wenatchee, so Wednesday night meetings are hard to make in Leavenworth.

First, I acknowledge there are multiple uses for water, and living next to a former orchidist, I understand farming's import to this region.

But I have several issues about what is going on:

A. At least from a distance, it seems accepted that this will occur, and folks are planning on how it will occur. I truly wonder if a dam makes
any sense for the following reasons:

1. Endangered species. Given that putting a dock in the water takes extra permitting, given fishing is forbidden for some species, my common sense makes me wonder. I also have seen the dams and the efforts to remediate salmon breeding, and they seem less than sucessful. But that's not scientific information, I just wonder about being at cross-purposes here: a hatchery, docks hard to put in, no fishing, and a dam?

2. The current use of the lake. 75 years ago if you had built a dam, few would have noticed. Now lake Wenatchee has become a major recreational site. There are tens of millions, if not hundreds of millions, of vacation homes. Property on Ray's side of the lake sells
for $500,000 or the like. Just multiplying through, and saying: hmm, if you reduce values by even 5%.... Produces a huge cost.

This too is a community. The damage to the value here seems incredibly high. It seems an incredibly unlikely lake to view as a watershed for farmers, as opposed to one that is used by an active community.

3. The current use of the lake, part II. In addition to the homes, there is are incredibly highly used state parks, a YMCA camp, and so on. How about the beach at the state park, for instance? The sheer quantity of people who use this lake for recreation is enormous.

4. The current economy. The state is slashing spending to sheer essentials. We cannot afford health care for poor families, teachers for schools, keeping open state parks, but we can afford another study of this dam. It just seems odd. Five years ago, of course, I would not
have said this.

5. My neighbor's opinion. He is an ex-farmer from Wenatchee. He cannot believe this is worth the investment to build a dam. He thinks the cost of the studies, the likely of environmental lawsuits, not to mention building it, will so outweight any benefit to farmers. He doubts this project would have afforded any benefit to him when he ran his orchard. His point of view: If they want to help farmers, $25,000/year would be 10X more valuable than this dam.

6. The general state of farming. There is a glut of apple production right now, and everyone is moving to specialized crops.

7. Efforts of the county (I got the survey) to diversify the economy. Well, flooding the front yards of the high-tech people who love this region isn't actually showing a commitment to a diversified economy. I know it is second homes for many, but I would not be surprised if there were an increasing number of high-tech startups in Leavenworth next time the economy turns.

8. The community's support for wildlife. From the Nason Ridge effort, to open space efforts in the White River, this community is voting with significant efforts and dollars that they want the wildlife, beauty and recreational opportunities of this region preserved. I understand the legitimate demands of farmers, but the amount of the economy already supported by recreation: mountain springs lodge, the state parks, the houses being built by local contractors, Kahler Glen, strikes me as very big number. And increasing. And the lake really is the hub of it all.

In general, I must admit I just do not understand why it is in the county's efforts to pursue this.

Respectfully yours:

Bruce Jacobsen

Lisa de Vera

From: Juris Vagners [vagners@aa.washington.edu]
Sent: Monday, April 07, 2003 6:04 PM
To: Lisa de Vera
Subject: Re: Lake Wenatchee Water Storage Feasibility Study

Hi Lisa!

In reviewing the latest information on the Feasibility Study, I note the following paragraph:

"A Shoreline Erosion analysis will be done in the following manner. Obtain existing wind speed and direction data from the Stevens Pass weather station (the closest station with wind data) and calculate potential wave heights along various sections of the lakeshore of Lake Wenatchee. The wave height calculations will be based upon fetch length and wind duration. The calculation will be performed for existing conditions and with-project conditions to compare the wave heights at different elevations and time periods when water may be impounded at higher elevations.
Note: A direct correlation between lake level, wave height and potential shoreline erosion cannot be prepared as topographical, soils and structure elevation and condition information along the lakeshore is not available. However, the height and duration of waves at various lake levels will provide an indication of potential changes in shoreline erosion."

Having lived at Lake Wenatchee for the last four years (and frequently visited for ten years before then) I would like to offer the observation that basing wind speeds on Lake Wenatchee on Stevens Pass weather station data would severely bias the findings. I have been an active wind surfer on the Lake for the last fifteen years, so I have had ample opportunity to correlate wind speeds on the Lake with what is reported as the prevailing conditions at Stevens Pass. To put it succintly: Unless you have a reasonable amplification factor to use, the Stevens Pass wind speeds have little to do with the actual wind conditions on the Lake. Reported westerly winds of fifteen to twenty miles per hour on the Pass are usually a good indicator that it is blowing on the Lake, but the wind speeds on the Lake are usually twice that, if not more, due to the unique orientation of the Lake valley as well as the driving forces of the pressure differential between Western Washington and Eastern Washington.

As we say in the wind surfing world - westerly winds on the Pass are an indication that it may be "nuking" on the Lake, but you don't know what sail to rig until you actually get there.

Please consider a more careful analysis of the situation.

Juris Vagners
Professor Emeritus
Aeronautics and Astronautics
University of Washington

Lisa de Vera

From: D. SATTERFIELD [davesfield@attbi.com]
Sent: Wednesday, May 28, 2003 8:00 PM
To: Lisa de Vera
Subject: Comment on Lake Wenatchee Water Storage Feasibility Study

As landowners on the Lake Wentachee S. Shore, we are extremely concerned about the possibility of higher water levels throughout the summer. Our lot is very steep with the usable portion being the beach. Higher water levels could potentially cover 75-100% of our normal summer recreation area, and adversely affect the use and enjoyment of our property.

We are also concerned about the proposed dam blocking access to the Wenatchee River from the lake and the State Park boat launch. We regularly paddle our kayaks from our property to the headwaters of the river, and continue downstream to Plain. The proposed dam would make this enjoyable trip impossible.

Without a usable beach at our property, our resale value would be greatly diminished.

As property owners, we appear to have nothing to gain and much to lose if this project is completed.

We would like to attend the June 19th meeting , but it is on a Thursday and we would have to take off two days of work to attend. Seems like you are trying to make it more difficult for landowners that live outside of Chelan County to be involved. It would be much more convenient to hold the meeting on a Friday.

Molly and David Satterfield
23417 Edmonds Way
Edmonds, WA 98026
Phone: 425 672-4679

Comments received post final report:

From: Al Hillel
Sent: Tuesday, July 01, 2003 11:10 PM
To: Lisa de Vera

Subject: Re: (no subject)

THE LETTER BELOW IS ALSO SENT AS AN ATTACHMENT IN THIS EMAIL.

July 22, 2003
Dear Ms. DeVera,

I am writing to offer my opinions on the Lake Wenatchee Dam Proposal. I am a property owner on the north shore since 1985. A number of issues have been discussed regarding the feasibility of constructing a dam, as well as some of the benefits and losses associated with building the dam. Overall, in my 18 years observing the lake, water levels, and erosive abilities of the waters in high wind conditions, I am opposed to the dam, and see very little that has been suggested as a benefit that would warrant consideration of the project. I will outline my thoughts as numbered entries below.

1- Salmon: A number of comments were made suggesting the potential benefit to the Lake Wenatchee salmon runs, such as maintaining water levels for upstream migration, and stable water levels for egg hatching. As a first point, about 3 years ago, when the lake was at its lowest in about 20 years, the salmon run was one of the largest recorded, suggesting that the salmon are not in need of managed water levels. I had the opportunity at the last "town meeting" to talk with Dudley Reisen, the fishery consultant for the feasibility study, in my small discussion group. He pointed out that the success of salmon runs is multi-factorial, and depends on the hatch of the salmon run originally, the water temperature, ocean storms, the level of predator populations, and ocean storms. The "belief" the flow levels need to be managed for the salmon is completely unfounded, and of interest, according to Mr. Reisen there is no association in Lake Wenatchee with the health of a particular year's salmon run and water level. Where is the chart in this feasibility study that reports on year v. salmon run population? There is no such chart because there is no correlation between the two. Perhaps more simply stated, the salmon have been coming into Lake Wenatchee (the few that make it past all the other dams) for 50,000 years without water level regulation, and it is rather presumptuous to suggest that our management is likely to improve conditions for them. Dr. Reisen offered that there are no reliable studies in the fishery literature to support a belief that managed water levels will benefit the salmon runs. In any case, the dam would not prevent the levels from dropping in a dry year, but would instead delay the drop by about 5 weeks. Low water time will be changed from August to September. Salmon used to laying eggs in August with the anticipation that the stream levels will not drop significantly would, if the dam were in place, perhaps be laying their eggs in the soon-to-be dry bushes.

2- Shoreline: Changing the shoreline could have drastic effects. One issue is the vegetation, again which has been in place for eons. What is the estimate of numbers of trees lost? What is the management of dead trees? Will they be cut and stumps left in place? Will the trees be left to fall into the lake along the shore? What will happen to the areas of shoreline such as the northeast-undeveloped area where trees grow to the waters edge? Will the trees die? What will happen to the marshlands at the west end of the lake? Where is the wetlands report that discusses raising the water levels in the marshes?

On another note, the north shore, starting from about one mile east of the western end of the lake, takes an enormous impact from the wave action during the frequent high winds that create white caps. The undeveloped areas along the north shore have reached a stable condition, with either rocky shores, or shallow beaches that temper the wave action during high surf. When the water level is raised, how many years will it take for the shoreline to readapt? Will it readapt in our lifetimes? What will be the impact of the erosion into the lake?

The questions of shoreline erosion begin to have an enormous economic and individual impact when the areas that are developed undergo examination. A tour along the north shore shows a number of “solutions” that cabin owners have adopted to deal with the wave action. Some have left natural rocky beaches when their property is deep enough to allow a cabin between the shoreline and road. Others have built “bulkheads” of various designs to raise the level of the shoreline so that they could build a cabin. Even at the current water levels, were the feasibility study to interview landowners, the difficulties of maintaining these bulkheads would become apparent. Erosion is a big factor, and in the years that the water levels stay high in June, it is not uncommon to have areas of the developed shoreline washed away. How will these protective beaches and bulkheads be managed after the dam is built? Most cabins are built at a height above the lake to allow for high water in all but the 100-year flood level. With increased erosion, and a dam in place to impede runoff, how will these shorelines be protected? In the event of the rapid thaws that occur every few years, will the impede outflow change a high water level to a flood level (the difference between “high” and “flood” is 12 to 18 inches)? Who will improve these current bulkheads for a higher water level? Who will maintain the damage to the cabin “yards” and the cabins themselves when these “floods” occur when they might not have otherwise occurred? Who will decide whether such “floods” occurred due to the dam or due to “nature”, and thereby decide in each instance if compensation is appropriate?

3- Lake Wenatchee, in addition to being a wonderful natural resource, is a prime recreation area. For these purposes, many properties have docks. The levels of the docks have been designed to be useable primarily from late June to early September based on usual water levels. If the lake were raised, these docks would not be useable until early August at the soonest. How will this be managed? For instance, my fixed docks cost about $18,000 nine years ago. To redesign, and rebuild them would be an expensive undertaking. How will this be managed? Who will do the building, and who will assure that it is done to good standards? Will the Chelan County building department, SEPA, Fish and Wildlife, and the Army Corps of Engineers (all of whom reviewed and had to approve the plans before I could build my dock) approve a redesign, even though the regulations have changed since 1994? Since concrete docks are not longer allowed, will these agencies grant exceptions so that my neighbors and modify their docks to the new water level? Or will the old concrete docks need to be removed since these will now be "new docks"? Who will pay for this, who will manage it? The value of Lake Wenatchee waterfront is about $5000/ft. If the shoreline becomes more hostile due to wave action, if the yard between the cabin and lake is narrowed, if the cabin is more in jeopardy at high water level, what will be the dollar/ft value? Will it be $4000/ft? Or maybe $3000/ft? Or if the cabin is very close to the water will it be $2000/ft? Or if the building lot becomes unbuildable, will it be $500/ft?

In summary, a dam on Lake Wenatchee has no precipitating need, has no clear benefit, has innumerable unanswerable concerns, and will have a natural and economic impact that could be devastating. In an era in which we are realizing the adverse effect of previously built dams and trying to find the funds to dismantle them, it seems unconscionable and irresponsible to plan on putting in a dam in one of the last accessible natural lakes in Washington. It seems inconceivable and irresponsible to build a dam on a lake that supports one of the few viable (although endangered) salmon runs left in the state of Washington when it is clear that there is no known benefit to the salmon, and a multitude of immeasurable risks to the salmon.

It also is remarkable that this effort to consider a dam on Lake Wenatchee follows the passage of the Shoreline Protection Act, which prohibits and activity that would cause a change within 100 feet of any shoreline.

Were this a totally undeveloped lake, the concerns could be focused on the issues of the impact to nature, but this is a very developed lake with enormous economic value. The costs to compensate and rebuild the properties would be staggering, and likely be 10 to 20 times the actual cost of the dam. In the most conservative case, if the value of the shoreline was assessed at a drop of $1000/ft due to the loss of beach area, for the over 300 properties, this would be over 30 million dollars. A more realistic estimate would be 70 to 80 million dollars. This figure would not include the cost of bulkheads, maintenance of these bulkheads, changes to cabins needed to accommodate the new water level, and changes to docks to adapt to the new water level. Overall, the economic compensation would easily exceed $100,000,000 as an initial cost, with additional economic impact at risk depending on the possible erosion and incidence of flood levels.

Clearly, this dam would have an enormous impact in a delicate ecology, and with no compelling reason (such as frequent flooding of the Wenatchee River) to build this dam, continued efforts to justify it are irresponsible. If the dam were built, at the risk of tremendous environmental and economic costs, what will be the legacy? As inhabitants of an extraordinary natural resource, are we compelled to try to extract every possible product of the environment? When will we have extracted enough? How big an ecological mortgage is the limit? If we investigate and perceive more equity, shall we always re-mortgage to the limit? Or slightly beyond the limit to be sure we got it all? Aren't there times when we should leave a bit of a margin in case we are wrong? A dam on Lake Wenatchee is an unwise venture for the sake of limited benefit at the risk of enormous, unrecoverable loss.

Al Hillel

From: Barb Larimer
Sent: Thursday, July 31, 2003 8:20 PM
To: Lisa de Vera
Subject: Lake Wenatchee Water Storage Feasibility Study

We are a family of 14 parents and children who have had a cabin at 15470 Cedar Brae Road since 1972. (Lot 25 and the east half of Lot 26) This past year we invested in a significant upgrade of this cabin.

We want to express our deep concern about changes in water levels at Lake Wenatchee. We have reviewed the study recently posted on your website and find that it raises as many questions as it purports to answer. We have observed first hand for many years the effects of natural changes in the Lake levels on the small beach in the front of our cabin and on the dock we built long ago. These have been quite significant and we are concerned that the higher water levels at certain times of the year will increase these effects nearby.

We all are very disturbed that others would have another natural shoreline altered in this manner. We all are very concerned that the change that is being studied would be proposed for the benefit of a small agricultural interest when not only the present property owners, but all the residents of the State of Washington would bear the loss of this great shoreline. We need to protect our natural shoreline, not destroy it.

What also would happen to the water quality? We have drunk water straight from the lake for over 30 years.

It is also difficult to discern the motives behind this proposed project. It is hard to determine who the beneficiaries are for whom we on the lake would be taking the risks of altered lake levels, loss of wetlands, fish habitat, perhaps even safety.

We are frankly very skeptical about a project which appears to offer significant impact on the lake for a relatively small amount of intermittant, additional flow. Please keep us on any contact lists you decide to maintain. Our family's contact is Barbara Larimer, 3016 30th Avenue West, Seattle, WA 98199. Her email address is b.larimer@comcast.net.

LARCO, a family partnership

From: JDBraun
Sent: Friday, June 20, 2003 1:44 PM
To: Lisa de Vera
Subject: Water Storage comments
We believe this study was a tremendous waste of tax payer money. It would have been more logical to study all possible water storage areas in Chelan County, such as the Little Wenatchee and Icicle Canyon. Each member of this committee should give an opinion as to his thoughts about its validity.
Dick & Joan Braun

From: Bruce Jacobsen [bruce@thejacobsens.com]

Sent: Monday, July 21, 2003 1:22 PM

To: Lisa de Vera

Subject: RE: Lake Wenatchee Water Storage Feasibility Study-Final

Comments

The dam makes no sense. Studying this project further makes no sense. A. The endangered species issues are unstudied (why?) and preclude this being a viable candidate. In a lake where building a dock is highly problematic, a dam makes no sense. B. The economic costs were understudied, underestimated. The lost of value to the current home owners; the consequent lost of tax dollars; the cost of buying land rights; the diminishment of recreational value and hence dollars -- are huge costs. The simple logic of: we're going to diminish the values of houses that already exist, so we can increase the value of houses yet to be built, or build more of them -- escapes me.

The supply of water may be a limiting factor to development. Why not just turn off the water on some existing homes so you can build more, or tell current homeowners they can use only 1/2 their current water?

From: Dana Aspinwall

Sent: Wednesday, July 30, 2003 6:16 PM

To: Lisa de Vera

Subject: Lake Wenatchee Dam Study

This should not be called a study as it is a compilation of data used to support a project in which the reports' authors hope to gain thedesign contract--a clear conflict of interest to objectivity. It is designed to make the public accept the least obnoxious alternative. Weprefer the "No Action" alternative. This company spent so much time on site that they believe that the Blue Grouse Lodge is on the lake and that there is a golf course in the White River valley (neither of which is even close).

In spite of opptomistic comments to the contrary, property values would be negativelyaffected, and the purchase of second class shorelands would be much more expensive than estimated. (We will not give up ours without a fight) I also have property in the lower White River that would be negatively impacted. We cannot agree with the conclusion that the effect on property owners is "not significant". Many of the conclusions are based on conjecture and the report says that the "effects are unknown". Beaches will be gone and new erosion will be at the expense of improvements. Who knows what effect the resulting turbidity would have on water temperature and the many private water systems on the lake. Old and new logs and debris will be floated and be a hazzard to boaters, docks and seawalls. Any restrictive structure in the river including the side abuttments that the proposed dam would rise against will increase the damage caused by flood events.

The major environmental impact is barely mentioned. The hydroperiod in the delta at the west end of the lake would be devastating. There is more than an uphill move of willow and sedges. It is heavily forested with Red Osier Dogwood, Cottonwood, Aspen, Western Red Cedar, Grand Fir and in some higher islands Douglas Fir, White Pine and even Ponderosa Pine They now tolerate the short seasonal inundation but would die from an extended period of high water table The waters would be choked by oxygen robbing organic matter. The "side channel habitat" would be warm, stagnant water that would mostly breed mosquitos. With mosquito bourne diseases making it to our state, it becomes a health concern as well. (not to mention the effect on the recreation tourist of a longer mosquito season) Also there is the possibility that the extended high water would allow the White River to form a new outlet into the lake about one quarter mile south of the former Cougar Inn site, which would lead to silting in the bay and further impact private property.

Finally, this is a proposal that has always been a bad one, has been turned down repeatedly over the last 70 years and needs to die now, A quarter million dollars of taxpayer money has been wasted on this "study". Technical feasability does not mean that it is a wise use of public funds. The costs to the property owners, Chelan County and the enviroment far outweigh the benefits. The proposed project does not provide the current needs which is admittedly on the decline. We want to live on a lake--not a reservoir. Thank you.

Earl Landin and family

_

July 30th, 2003

Lisa deVera
Project Coordinator
Chelan County Natural Resource Program
411 Washington Street
Wenatchee, WA 98801

RE: 15300 Cedar Brae Road and Water Storage Consultant report

Concerns and Considerations:

1. **Consultant's methodology of valuing 2nd class shorelands**. As a land owner currently holding these rights, I believe the manor in which Jones & Stokes applied the DNR model was not properly matched to the historical parameters at Lake Wenatchee. Therefore, I believe that Jones and Stokes' estimate of monies needed to obtain 2nd class shoreland lease rates at $1.4 - $3.5 million at the 1870.3 level are significantly under valued and the math and attitude for arriving at these numbers are inaccurate. Facts I believe that Jones and Stokes' overlooked are as follows and I ask that these issues be addressed in the overall decision.

   A) It is my understanding that Jones & Stokes (J&S) used a simple averaging methodology in assessing the values for North Shore and South Shore properties. One should note that:
      - There are more linear feet of shoreline on the North Shore with 2nd class shorelands than there are on the South Shore, and
      - Assesed values on the North Shore on average, are three times that of the South Shore. The methodology that J&S, should have been used should have included a weighted average calculation in order for J&S to determine the value per square foot of second class shorelands. This would have returned a more accurate value per square foot to the study giving the decision makers a realistic view of the amount of money that would be needed. Should the J&S numbers be used without this correction, the project would be immediately over budget. Why was their no weighting in their calculation?

   B) It is my understanding that J&S did not conduct proper research and ignored testimonies from Realtors in the area and two landowners on the committee in applying another model. Again, a misrepresentation. In this case, since testimony was issued, and any basic research company could have arrived at the same conclusion, leads me to believe that the data was intentionally ignored, thereby causing another inaccurate result. As I understand it, the methodology used was historically inaccurate data to determine the gross value of second class shorelands. J&S multiplied the gross value of second class shorelands by a factor of 25% since the 2nd class shorelands supposedly would only be flooded 3 months of the year (i.e., 25% of the year). However given the seasonal nature of Lake Wenatchee, the months of July, August, and September account for nearly 100% of the use of these 2nd class shorelands. Again, I understand numerous testimonies were given, and I would like to understand why this data was ignored. My and other lakefront owner's value are tied to this period of recreational use. Why was this data ignored?

C) Flooding would affect my ability to use and would devalue my property as the beech is the one use we have of the property. I understand that J&S did not account for a very noticeable factor – many of the lakefront properties are very steep. Why was Beachfront, which accounts for the vast majority of the overall values of many lakefront parcels not considered in J&S' math? Common sense, the law of economics and history show us, that during the past 100 years, when those things which create value of property are eliminated (i.e. beaches that are submerged by water, thereby eliminating alternative uses / activities on the property), the property values fall dramatically. Therefore, the math used and assessment methodology, should more correctly place additional weight on the significance of these shorelands, realistically in the range of a 300% to 500% multiplier. Again, why was this ignored in this study?

2. **In the study, where are the landowner categories of**:
- lake-view and neighboring properties which utilize many of the County, State, and Federal beaches, and
- those properties on the Wenatchee Riverfront which also benefit from lower water levels during July, August, and September?

It seems that the latter would be at direct risk of substantial flooding in the event of dam breakage or severe leakage. Again, history shows us that property values will devalue with just the knowledge of a dam being up-river from these riverfront properties. Why were these categories not included in the study as they would have impact on the decision?

3. **Dock Value:** Being a dock owner, I believe, ney I know, that there has been inadequate analysis on the true costs of adjusting existing docks, boathouses, retaining walls, etc. in order to work with a water level of 1870.3. For example, Table 5.1-2 on page 5-6 of the report states that docks have a high value of $14,400. I have a very simple dock. Docks for the past several years have increased in cost due to the rise in products used, environmental concerns, and limitations on construction methods and heavy permit fees. For example, my dock, three years ago, cost me almost $16K and I have a very simple floating dock. Therefore, the $14,400 number is questionable. I am aware of several dock systems at $20,000 - $30,000, all within 300 yards of my property. These incorrect base prices combined with a lack of assessment of how many systems will need modifying have resulted in an inaccurate assessment of the total overall costs of constructing a water storage facility. Therefore, it begs the question; How was the $14,400 number derived and did anyone take into consideration the last three years of governmental requirements for Dock, anchoring and piling construction?

4. **Legal fees.** I did not see any areas in the report that addressed or attempted to address the huge legal costs of building a dam as landowners, environmental groups, or the like, or any lawsuits to be filed to block any such proposal, especially with the inaccuracies currently within the report. These lawsuits would undoubtedly last for 5-10 years, and the costs need to be properly addressed in calculating an overall cost of a dam.

5. **Wind / wave analysis.** I have to be frank here. This analysis had to be based on a relative calm wind day, not the norm. I have lived here for over three years now. I live on the South Shore at the Southeast end of the lake. Wave heights commonly exceed those calculated in this report. For example, it is stated that wave heights of 1.2 feet will result at the southeast end of the lake when there are 25 MPH winds at a water level of 1872.4 feet. Even under normal low summer water levels, I have experienced wave heights of 3+ feet crashing over the dock and my beachfront erodes quickly. Therefore shoreline erosion will occur in much greater magnitude than this report forecasts, having negative effects both on property values and lake ecology. Additionally, the high water mark rises due to the energy behind the wave. I did not see any studies showing the effect of the energy on the 3 ft+ waves (i.e. if water is already high, how much higher will it go with this energy behind each and every wave?). How did the consultants come up with what appears to be a very inaccurate number?

6. **Market Savvy:** Property devaluation cascading, should have been considered in the report. If a dam is constructed, the aspects of the waterfront property will be compromised, and thus the waterfront parcel will drop in value. Since values cascade to non-waterfront property, the value of the non-waterfront property must decline to a level where buyers are once again attracted. Said another way, Lake Wenatchee waterfront properties, which have historically been the highest valued properties in the area, will decline due to the negative changes of Dam construction and use. Because properties that are near high valued properties, traditionally move with the market, all other properties in the area rise or decline based on value (i.e. should the

waterfront property rise in value, the non-waterfront properties rise in value as well. Subsequently, should the waterfront property sink in value, their market demand is affected by the lower cost of waterfront property. Therefore lakefront and non-lakefront property in the Lake Wenatchee area are all affected. I did not see any consultant numbers, criteria, or recommendations in this area. Was this addressed?

7. **Historic Structures:** I have two cabins on my property that were built in I believe 1929. If they are not historic, they are at least grand-fathered in and are currently standing on my property. One we are fixing up to turn into another sleeper cabins. It has a fairly new roof on it and we just leveled it. Under the water levels identified, they would be put in jeopardy as one of the cabins is closer to the water than the main structure. How will this affect my right to enjoy the use of my property?

I am disappointed in what appears to be the lack of thoroughness by the consultants, or possibly a complete disregard of the instantly recognizable data and historical analysis available. But it is obvious to landowners both waterfront and non-waterfront alike that 1870.3 and 1872.4, will have titanic effects on sinking property values both on and around Lake Wenatchee as well as incredibly expensive litigation and mitigation of Risk.

Sincerely,

David R. Starr
Waterfront Owner

Doug Weber	Home Address	July 31, 2003
16601 Northshore Drive	17700 Bear Creek Farm RD NE	
Leavenworth	Woodinville, WA 98077	

Public Comment on Lake Wenatchee Water Storage Feasibility

The Lake Wenatchee water storage feasibility study suggest that supplementing stream flow in the upper Wenatchee River during late spring, summer, and early fall would benefit spring Chinook salmon migration, spawning, and early life history survival. The following data indicates that this precept is incorrect.

Figures presented below are compiled from two data sources: average stream inflow recorded at Plain over the months of July through October in the years 1957 to 1978; and escapement of naturally produced spring Chinook salmon in the upper Wenatchee River and its tributaries for the years 1961 to 1978.

The average four-month flow data covers the time period when one or more of the operating alternatives presented in the feasibility study would be releasing Lake Wenatchee storage water into the Wenatchee River. Escapement data (number of spawning spring Chinook) is shifted: four years to the left (Figure 1) to represent flow conditions when the parents were migrating and spawning and the progeny undergoing early egg development; and shifted three years to the left (Figure 2) to represent flow conditions during rearing, and for some yearlings, outmigration (other yearlings outmigrate the following spring).

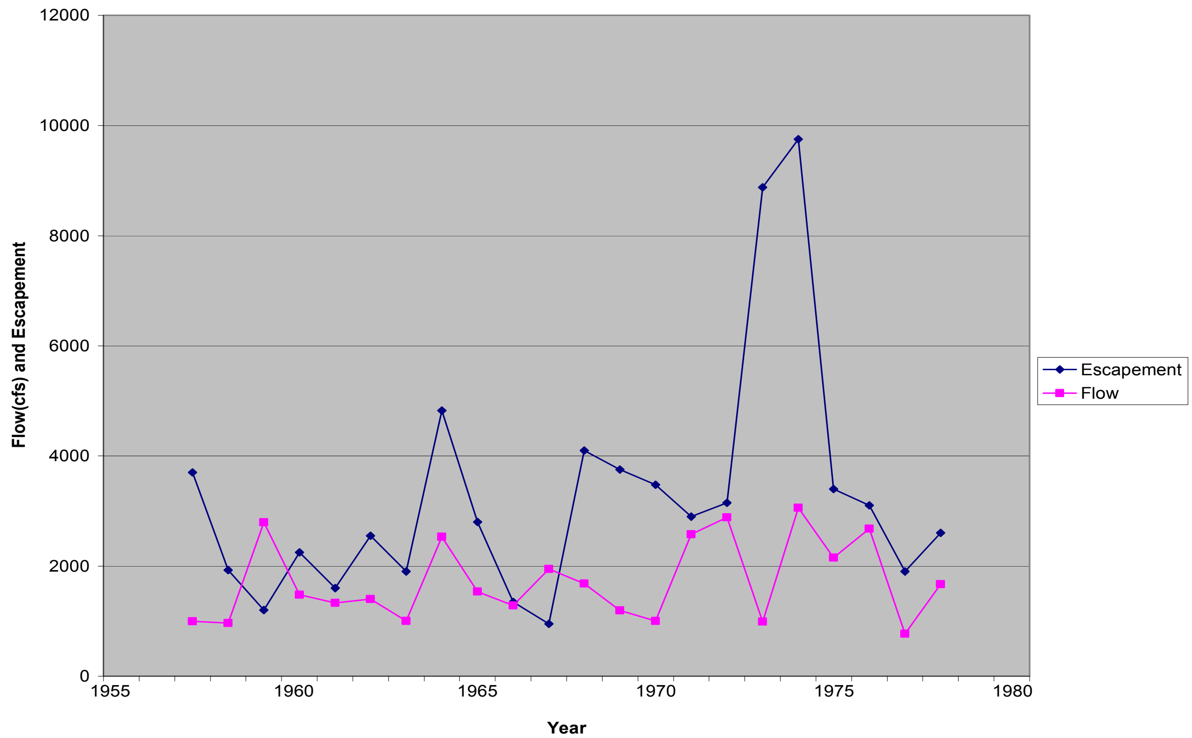


Figure 1. Average July through October instream flow at Plain (Years 1957-77) compared to spawning escapement of naturally produced spring chinook salmon to the upper Wenatchee River four years later (1961-81).

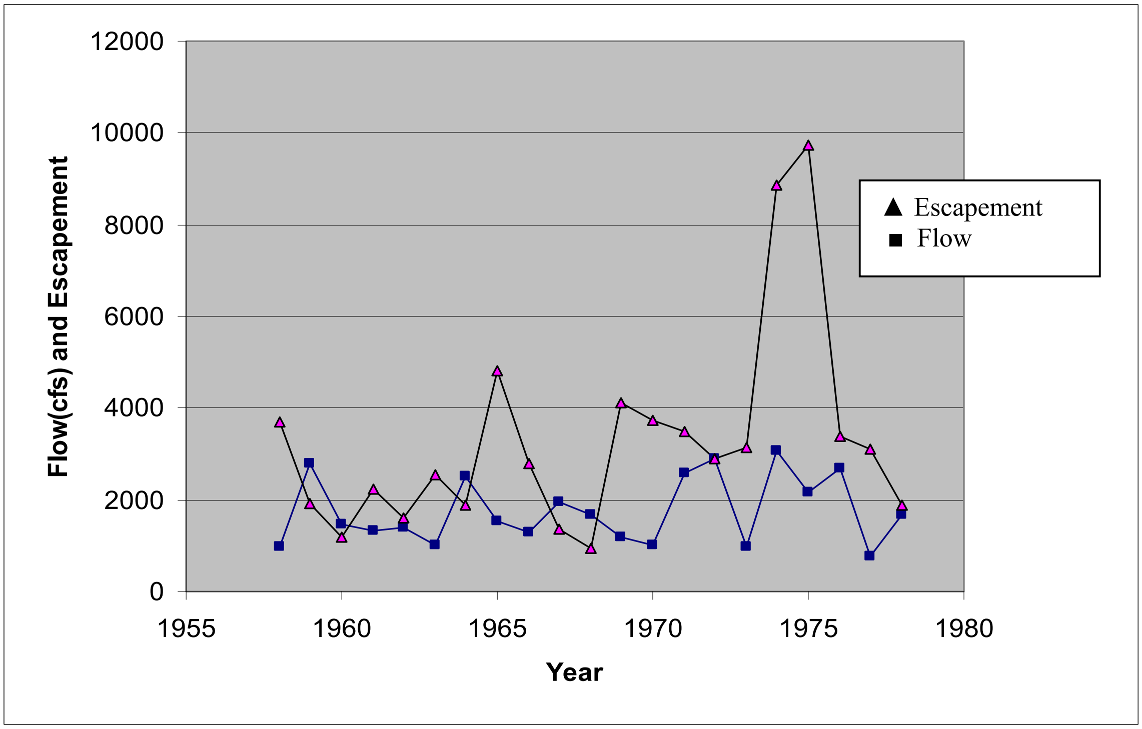


Figure 2. Average July through October instream flow at Plain (Years 1957-77), compared to spawning escapement of naturally produced spring chinook salmon to the upper Wenatchee River three years later (1962-81).

The data in figures 1 and 2 is replicated in figures 3 and 4 as escapement versus instream flow. The low R^2 values shown in the later two figures indicate little linear relationship between stream flow during late spring / summer / early fall months and chinook escapement three and four years later.

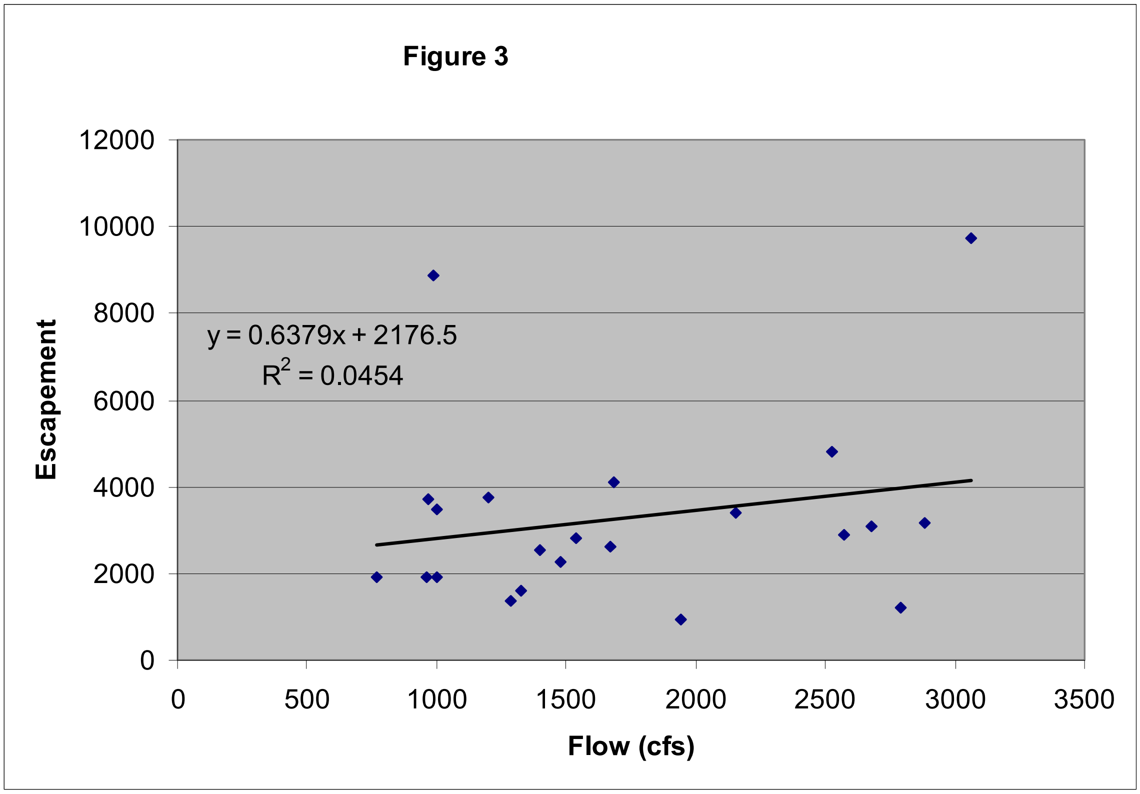


Figure 3
12000
10000
8000
6000
4000
2000
0
Escapement
y = 0.6379x + 2176.5
R2 = 0.0454
0
500
1000
1500
2000
2500
3000
3500
Flow (cfs)

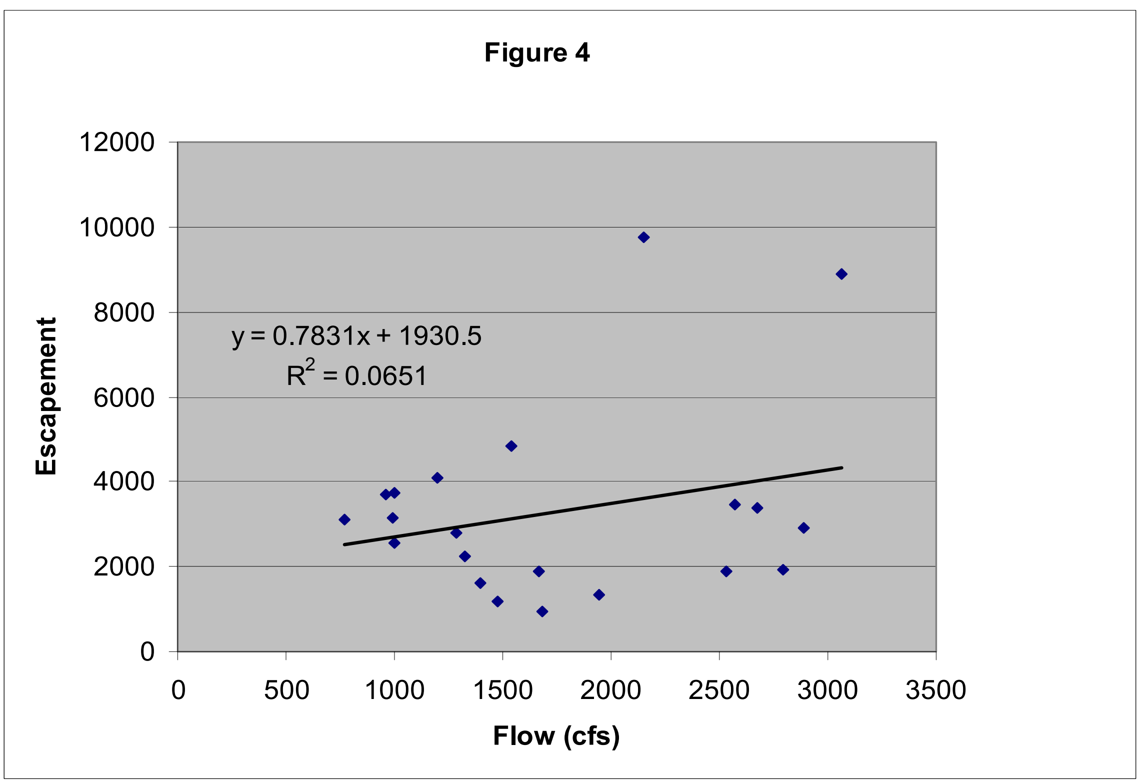


Figure 4
12000
10000
8000
6000
4000
2000
0
Escapement
y = 0.7831x + 1930.5
R2 = 0.0651
0
500
1000
1500
2000
2500
3000
3500
Flow (cfs)

In addition, if supplemental water flow from July through October were to benefit wild spring chinook in the upper Wenatchee River this would effect less that 20 percent of the naturally produced population since over 80 percent of the escapement is to the tributaries.

Thus, justification for the rubber damn will have to stand on merits other than being of benefit to migration, spawning, and rearing of wild spring Chinook salmon.

From: Eric Hipke
Sent: Tuesday, July 01, 2003 12:28 AM
To: Lisa de Vera
When I first heard that a study was being done to dam Lake Wenatchee I laughed about how somebody had managed to fool some grant money into their pockets. It's hard to believe that in this day and age with all the talk about removing dams around the NW that something this outrageous would be suggested. Well, I'm no longer even smiling because the process has continued on farther than I thought rational thinking possible.

Lake Wenatchee is one of the few glacial valley lakes of its size that have not been dammed in Washington. It is as free flowing and natural as it was when it was created. It would be a crime to upset the balance that exists with the ecosystem, the animals and the humans.

If you raise the normal fluctuating level of the lake, you don't have to be a scientist to know that increased erosion will take place. The trees closest to the water will fall as their roots are saturated and undermined. The land those trees used to hold in place will be washed away by wave action. Then the hillsides will start sliding into that void. Any kid that's sprayed a hose at the base of a mound of dirt can tell you that's what will happen.

It will take years for that scenario to play out. But when it does and the damage to the cabins, roads, sewer lines, and campgrounds starts occurring, you can bet the lawsuits will start pouring in. And with all the Microsoft money that's come into the area recently, you can bet the Chelan taxpayers will be paying for some costly court battles against high priced lawyers.

And then there's the ecologic loss of the wetlands at the head of the lake and the increased erosion will cloud the clear water of the lake itself. The effect on the existing fish and wildlife would most likely be detrimental. It all adds up to a dam being a bad idea.

If we humans are running out of water in the area, maybe we should realize that we are getting to big for our britches in the area and need to limit growth. Possibly in the near future we'll be able to manage our water more efficiently with improvements in conservation and farming techniques. Who knows? But please, let's not destroy the natural Lake Wenatchee valley with a shortsighted blunder.

Sincerely,
Eric Hipke

From: ASPIRIENT@aol.com

Sent: Monday, June 23, 2003 6:56 PM

Greg: Thank you for making a very good point. There should be some positives, such as benefiting the agricultural and residential development that have water need needs that go beyond forecasted availability. There are also requirement to increase the in-stream flows to support fish during the drought years. This process has demonstrated that a delicate balance exists between competing needs. I am confident that those needs can be met in the future with technology and conservation that uses water more effectively. Best regards, Ray Aspiri The Friends of Lake Wenatchee Forests

---

Lisa deVera
411 Washington Street
Wenatchee, WA 98801

Re: Lake Wenatchee Water Storage Feasibility Study

A dam at the outlet of Lake Wenatchee might be technically feasible but it is a poor option if the effort is to provide additional water in the Wenatchee watershed. It is pretty clear from reviewing the previous studies that adequate water is available to the Wenatchee Irrigation District to provide for the agriculture needs of the Wenatchee watershed. Draught years in the 20's and 30's prompted the early studies – but despite low flow years the Wenatchee Irrigation district has had adequate water. The only problem for fish has been since the new fish ladder was put in at the Tumwater Dam – water had to be diverted by a wood diversion system. The salmon seemed to be able to jump the Tumwater Dam even in low years. And the salmon returns have never been higher. It is obvious that the need for water is not agriculture, not salmon but to provide water to the homes and businesses that will be built as the orchards are pulled out. The projected growth in Leavenworth, Cashmere and Wenatchee has been covered in recent articles in the Wenatchee World. If the Peshastin Port site is developed many homes will be required, and a stable water supply required. But putting a 10-foot inflatable dam at the outlet of Lake Wenatchee will not make a significant input to the anticipated water needs.

When the major effort in the United States is to preserve natural eco-systems and habitat, and remove offending dams, especially in the Northwest, it is mind-boggling that anyone would seriously want to destroy the most significant remaining natural lake-river spawning system producing natural Sockeye salmon and Chinook salmon whose runs have never been healthier. The lake-river systems are healthy because they fluctuate naturally, the spawning beds, food chains, lake shore, water temperatures are natural and not destroyed by a dam that mitigates all of the above.

Water needs will become critical and solutions will need to be found. But putting a dam on Lake Wenatchee is a poor choice. Even though technically feasible, I think the socioeconomic and environmental impacts are just too great – the costs too high. Many of the summer homes would lose their waterfront. The residents of Lake Wenatchee are considered somewhat unusual in that they tolerate a constantly changing shoreline, somehow exist with hordes of mosquitoes, and have adapted to constant winds, waves and cold water. We love it – Lake Wenatchee is a retreat, Lake Chelan is a resort. We don't want a lake with a fixed, sterile shoreline, warm water, Milfoil, sucker fish, and destroyed spawning beds in the lower Little Wenatchee and White Rivers.

Other options need to be investigated. Water conservation efforts should be maximized. I am told that the micro irrigation systems conserve large amounts of water. Help orchardists convert from the old overhead and large volume under tree sprinklers to the new micro systems. Investigate putting a high dam in Tumwater Canyon and develop a much better and safer road following the railroad down the Chumstick. The Tumwater is scenic, but it can be explored by boat. Only the Alps and a very few cabins would be effected. Consider a dam on Ingalls Creek. It would have no effect on salmon or other fish, and would not destroy or displace summer homes or recreation. It could provide significant water storage with little environments impact.

Finally, it seems to me that a great number of Washington citizens would be largely deprived of an escape to a pristine outdoor experience. The Lake Wenatchee State Parks at both the Glacier View end and North and South Parks would lose a great deal of their waterfront as would the Lake Wenatchee YMCA Camp and Girl Scout Camp at Zanika Loche.

I feel the State of Washington has much better uses of its resources than continue the study of putting a dam on Lake Wenatchee. It has twice before been deemed not practical. Please put it to rest once and for all.

Gerald and Barbara Gibbons
16215 North Shore Road
Leavenworth, WA

From: greg overturf
Sent: Tuesday, June 24, 2003 6:20 AM
To: Lisa de Vera
Subject: Lake Wenatchee Water Study

Lisa; thanks for the opportunity to make a few comments. The study that was conducted was put together rather well and did contain most of the information to be able to move forward in the process. However there is more information that the contractor has indicated that could be made available or will be required in order to allow the project to gain the required permits. Tiering to previous studies required for the salmon enhancement program if it was based on "sound science" rather than a knee-jerk reaction should be included. I was at Lake Wenatchee last week and noticed more docks/floats have been constructed over recent years and was wondering if the owners had to comply with the Corp permitting process to construct them- Is lake Wenatchee considered a navigable water and does it fall under the Corp of Engineers permitting process.
Thank you.
Greg Overturf
Sitka, AK

From: Gwendolyn Walsh
Sent: Friday, July 25, 2003 10:51 AM
To: Lisa de Vera
Subject: Lake Wenatchee Dam

Lisa and whoever else:

I have been unable to attend the meetings recently, due to having my foot in a cast, but I have downloaded the report, so have a sense of what is going on. I have been going to Lake Wenatchee since 1960 when my husband did research for the Leavenworth Hatchery. Our family purchased a 100 foot lot and built a cabin at the West end of the lake on Northshore drive in 1975. We have seen many seasonal changes and watched many salmon runs in the fall. I am very opposed to the alteration the the natural cycles of Lake Wenatchee by any kind of dam(inflatable or otherwise), as it is one of the best examples of how natural cycles work in the whole Northwest. In the year 2001,(I think) when everyone was worried about low water, I hiked up Mt. Mastiff and saw that the Spring water was still flowing off the mountain in Mid-September. Although the natural cycle of flows altered the lake level, I saw that there was still plenty of water for over 300 returning Chinook salmon on one section of the Wenatchee river. It was a great year for sockeye as well. Lake Wenatchee is rich in all kinds of biological life in the outlets of the Little Wenatchee and White River where they flow into the Lake. Any artificial alteration of Lake levels in those areas would cause irreversible damage to that ecosystem. These are very significant wetlands which should be protected. We are 3 generations of Lake Wenatchee property owners, and we all object strongly to altering the lake with any kind of dam device. Not because of what it would do to our property, but because of the damage to the ecosystem. At a time when people on the Missouri River, the Elwa,, and the Columbia River are rethinking old decisions to build dams and altering natural ecosystems, I think it is time for humans to get wise and stop trying to change nature. The fish runs will certainly be impacted, and so much else will be as well. It is obvious that this whole project is more about politics and financial gain to a few. We owe it to future generations to put a stop to this project. This lake has been studied before and rejected for dams, so lets listen, and stop further studies. Washington State has so many other needs, lets not waste money. So, our family votes to Stop The Dam(n) Project NOW. Wendy Walsh, 18000 Bear Creek Farm Road, Woodinville, 98077// 17815 Northshore Drive

---

From: jhipke@juno.com

Sent: Tuesday, July 15, 2003 8:26 AM

To: Lisa de Vera

Subject: Feasibility

Public comment,

Your study appears well done and organized. The meeting presentations clear and informative. We would have enjoyed more about the working functions of the dam. My concerns are a reflection of a home owner, viewed from five generations on the same site and in the same cabin. I have seen water quality change with construction, terrane destruction. I remember periwinkle, muscles and clear rocky bottom. A beach alive with frogs. I fear the decline will escalate. It is our water source. My grandparents chose to build on the lake shore. They loved the native vegetation of our hillside. It was not vanquished for construction We have had many high water experiences inside our cabin and crawl space, the clean up and property damage considerable. During OHW our dock, and sandy beach are covered. An old growth ceder, at waters edge will surely die if OHW is extended/These are my additions to the study for your consideration. I, of course, hope there will not be a dam constructed.

Sincerely, Suzanne Hipke 15360 South Shore Road

From: Jeff Monda

Sent: Sunday, July 20, 2003 6:14 PM

To: Lisa de Vera

Subject: Re: Lake Wenatchee Water Storage Feasibility Study Final Report

Lisa,

I have reviewed the final study. I think there are some significant weak areas. I believe that the conclusions about the affects on the fish are very unfounded. I would like to see any evidence that a dam has ever improved conditions for fish. To say that putting a dam in would improve the natural river system for the fish is outlandash. This system is one of the only remaining river systems that mankind has not ruined. The Lake Wenatchee drainage has functioned well for millions of years without intervention to improve instream flows. A conclusion like this calls into question the whole study.

Sincerely,

Jeffrey Monda

Land owner at Lake Wenatchee.

To: Lake Wenatchee Storage team and Consultants

From: John Zipper

Date: June 23, 2003

Comments regarding June 4, 2003 draft report and information presented at June 19, 2003 meeting

General comment 1: The report has apparently been modified after the June 4 draft. These modifications were presented in summary form at the June 19 meeting, but a revised draft was not submitted to the project team for review and comment. The following comments are based on my interpretation of the current state of the report.

General comment 2: The project team established a scope of work for the study and prioritized the scope during several meetings prior to consultant selection. The environmental and socioeconomic impacts of the project were given high priorities by the project team. Once the consulting team was on board, the scope of work was negotiated with County representatives (without input from the project team), and some of the critical impact issues were, (in my opinion), given lower priority than the team had earlier decided. Despite attempts to modify the scope, we were left with a fairly general look at impacts of the project. As stated in the June 4 meeting, the elements of the scope were given approximately equal priority in the scope of work. The end result of this is a general look at impacts of the project, which does not satisfy the concerns of lakefront property owners.

Socioeconomic impacts: The valuation of second class shorelands, and private land between OHW and elevation 1872.4, was not accurately depicted by the recent revisions. The DNR formula apparently was used to represent the loss of value caused by flooding these lands for 25 percent of a year. The months of flooding are the only months that waterfront recreation uses of these lands are feasible due to weather constraints and the typical recreation season of June through September. The values should be based on 100 percent loss of use rather than 25 percent. The cost impact of flooding beaches presented on June 19 is low by a factor of 4.

Environmental impacts: I submitted information on June 4 to document geologic conditions on over one mile of the south shore, at the 1872.4 elevation mark. In summary, for over one mile of shoreline, flooding to elevation 1872.4 will increase erosion of the toe of steep slopes, causing damage to slopes and improvements constructed on theses slopes. This information should be incorporated into the final report. I understand that the scope of work did not allow evaluation of individual parcels. We are talking about a condition that is prevalent on well over a mile of shoreline and is easily confirmed by visual reconnaissance of the shoreline. This condition should be acknowledged in the report.

Environmental impacts: I've listened to concerns raised by Fish & Wildlife about bull trout impacts since the project team meetings began. The final report should acknowledge those concerns and specifically state whether the project will or will not impact bull trout. If the project impacts to bull trout are a potential fatal flaw, the report should so state.

Environmental impacts: It is my understanding that the 1872.4 alternatives will kill all trees located at or below this elevation. This is a serious impact that should be described in plain terms. Trees have an economic value. The value of shoreline trees should be addressed in the report.

Conclusions: If the 1872.4 alternatives introduce fatal flaws, the report should so state. The impacts that have been generally identified are numerous, and it is my opinion that a more negative conclusion than "problematic" is appropriate. Consider something along the lines of "The 1872.4 alternatives are probably not feasible due to the impacts to wetlands, shoreline vegetation and improvements, economic impacts to property owners, recreation, and ________."

From: Katy Hipke   Sent: Monday, July 28, 2003 3:47 PM

To: Lisa de Vera

Subject: Lake Wenatchee Water Storage

Having read the Lake Wenatchee Water Storage Feasibility study, I fail to see that the benefits of this plan and any of its proposed alternatives outweigh the risks. Ecological impacts from loss of fish habitat, wetlands, soil stability, and water quality degradation, to name a few, and economic impacts to personal property and recreation are significant factors that in my opinion far outweigh this relatively easy "fix" to water shortage issues. A better solution might be found in conservation. Or more realistic planning. I emphatically oppose the damming of this beautiful free-flowing glacial lake,

Katy Hipke, 718 W. Highland View Drive, Boise, Idaho 83702

From: Michael S Lesky
Sent: Wednesday, July 23, 2003 6:14 PM
To: Lisa de Vera
Subject: lake wenatchee project
Greetings,

I wish to have this comment included in Section 9.0. I am in favor of moving forward with this project for the following reasons. The first and most important reason in my estimation is the maintaining of instream flow. The state has mandated the maintenance of specific instream flows and if these flows drop below set points, constraints have and will be place upon watersheds. These constraints fall upon all, especially in light of an Endangered Species residing within this watershed.

I favor and support the raising of the lakes level to the OHW level.   However, I would interject that water be released earlier than August 23. Wenatchee river sockeye need minimum stream flows sooner than this. This was quite evident in 2001 when sockeye could not ever get up the fish ladder, below the candy shop. The PUD had to construct water diversion to increase ladder flow rates.

Lastly, by maintaining instream flow rates the county and state will avoid a possible claim against them at a later date. These claims have proved costly in past history, not only to local agencies, but to entire valleys and communities. Not just local landowners. I understand that this project is still a long way from initiation, however, at this time and having seen the study I am in favor of continuing and moving towards completion.
Thank you
Michael S Lesky

From: WHTRVRRD@aol.com
Sent: Thursday, July 31, 2003 4:59 AM
To: Lisa de Vera
Subject: Re: Lake Wenatchee Water Storage Feasibility Study-Final
Comments

Lisa,
Following is my comment with respect to the final report on the suggestion to

dam Lake Wenatchee.

++++++++

Lake Wenatchee Water Storage Study

First and foremost, we must remember this is only the final report of a FEASIBILITY STUDY. There are no excavators or ready-mix trucks waiting at the foot of Lake Wenatchee. At this time no capable group has 'volunteered' to manage the idea to a completed project. In fact, there is no real proof that we need to dam Lake Wenatchee to increase the flows in the Wenatchee River. For that matter, the need to increase the late season flows in the River can be questioned based on recent salmon returns.

Before we look further at damming Lake Wenatchee we need to examine other options. We must also be open to accepting new options as we look at those we are aware of.

OPTIONS
1) Water storage (Damming of Lake Wenatchee and other bodies of water) and controlled release to augment flows.
2) Replace the open irrigation canals with closed pipe systems. Account for water diverted compared to water delivered.
3) Practice water conservation in all current human uses.
4) Restore the streambeds and banks of streams like Nason Creek, Chumstick Creek, Peshastin Creek, Mission Creek, and the Wenatchee River where man has relocated the streams for his convenience.
5) Change the property tax laws that are forcing landowners to convert their property from agriculture to housing. I.E., a minimal property tax augmented by a tax based on the returns from the crop.
6) Use the growth management act (Amended or modified) to our benefit instead of fighting it.
7) Inventory all water wells and the use to which the water is being put. In the process, account for all so called exempt wells. This process should not be used as a threat or way to shutdown undocumented wells.
8) Encourage beaver activity where they do not harm human activity or the property owner is willing to accommodate them.
9) Reward conservation without threatening water rights.

The solution to the water problem in the Wenatchee River Valley is not just local. We need adjustments to local, state, and federal statutes to solve our water problems.

Paul K. Gray
545 N. Larch Street
East Wenatchee, WA 98802
E-mail: WHTRVRRD@aol.com
Phone: (509) 662-6834
FAX: (509) 663-8104

Confederated Tribes and Bands
of the Yakama Nation

Established by the
Treaty of June 9, 1855

August 5, 2003

Chelan County Natural Resource Program
Lisa de Vera, Project Coordinator
350 Oronado St.
Wenatchee, WA 98801

RE: Comments regarding the Lake Wenatchee Water Storage Project

Dear Ms. De Vera,

Thank you for this opportunity to provide comments on the proposed Lake Wenatchee Storage Project. I am including a copy of a letter that we sent to Commissioner Ron Walters in December 2001, expressing our early concerns about the project and I will express our comments on the study in relation to how they address those initial concerns.

YN pivotal issues are depicted in **Bold;** MWH report excerpts are depicted in *Italics*:

What evidence is there to suggest that salmonid recovery will be enhanced by additional Lake Wenatchee storage capacity?

> *The operation of the rubber dam to augment flows in the mainstem Wenatchee River during late-summer/early-fall could provide some benefit to the upstream migration and holding of adult steelhead, chinook, and to a lesser degree coho salmon. The degree of potent ial benefit would be related to the amount and timing of flow available*
>
> *Supplemental water released to the mainstem Wenatchee River during late -summer/early-fall may potentially enhance to varying degrees the amount of spawning habitat available to chinoo k in the mainstem Wenatchee River.*
>
> *If the fall rains coincide with the end of the period of supplemental water and water levels are not subsequently reduced during incubation, the increased spawning habitat could benefit spring and summer/fall chinook. Ne gative impacts to incubating chinook embryos could occur if areas used for spawning are subsequently dewatered during the period between flow augmentation from the Lake Wenatchee Water Storage project and the onset of the fall rains.*
>
> *The project could not provide enough water to substantially reduce the occurrence of Wenatchee River flows falling below instream flows set by Chapter 173 -545 WAC.*

We interpret the results of the study to indicate that there is no clear benefit to salmon recovery as a result o f additional Lake Wenatchee storage. The design would not ensure that minimum instream flows were met annually and the success of supplemental flows is dependant on fall rains starting simultaneously with the expiration of supplemental flows.

How much capacity is envisioned and what are the likely engineering options to provide this storage capacity and how might these options incorporate fish passage considerations?

A review of potential population growth and growth in municipal, domestic, industrial and agricultural water use was made. From the perspective of population growth and growth in forecasted municipal demands, the estimated increase in water demands over the next 20 years is: 7.3 cfs on a peak daily basis and 1,868 acre-feet annually.

It was estimated the increase in irrigation demand from approval of those applications to be 8 cfs; the estimated effect on streamflow is a reduction of 5.6 cfs. The estimated increase in municipal and domestic demand is 7.3 cfs and the estimated effect on streamfl ow is a reduction of about 5 cfs.

The effect on streamflow from future municipal and domestic demand and from approval of pending water right applications for irrigation is an estimated reduction of about 10.6 cfs.

The project would supply more than enough water to meet future municipal and domestic water needs in the Watershed.

The largest potential water need is for instream flow. Chapter 173 -545 WAC has set minimum flows for the Wenatchee River and some tributaries. Hydrologic analyses have determined the average shortfall between Wenatchee River streamflow (measured at Plain) and the minimum flows is 17,500 acre-feet per year. In 2001, the shortfall was 50,400 acre -feet for the time period of July to October.

To enable seasonal storage and release of water from Lake Wenatchee, an inflatable rubber dam was identified as the most suitable type of structure for the site. The rubber dam would be located on the Wenatchee River approximately 1,600 feet downstream of the mouth of the lake where the river is narrowest.

The rubber dam requires construction of a concrete structure to support the 10 -feet high (maximum) by 200-feet long black rubber bladder. The concrete structure would be mostly submerged and hidden from view except at the sides of the channel where sloping walls would be visible. When deflated (for most of the year) the rubber dam will be submerged and not visible. A fish ladder is required and would likely sit on the north side of the river adjacent to the state park. The fish ladder would be a concrete structure with 15-feet wide weirs and a total rise of 5 feet.

The project operation is not anticipated to affect juvenile outmigration in the tributaries or in Lake Wenatchee, provided suitable fish passage facilities are integrated into the dam design.

Future agriculture needs are small to non-existent. Future municipal/domestic needs are for 539 AF by 2025, but enhanced conservation efforts could save up 600 AF. The greatest potential need then is for instream flow supplementation. The consultants indicted that the inflatable dam need only be operated during years with less than normal flows, but that becomes problematic. Under low flow conditions, the dam becomes an insurmountable barrier to fish passage, so an effective fish ladder is required. The ladder described in the report operates at 30-40 cfs, which might not be sufficient if large numbers of fish are present. The report does not adequately consider the effects on fish passage through the lake, both upstream and downstream, as a result of decreased flows during storage periods.

What species will be positively affected and what might be the negative effects to fishery interests?

The operation of the rubber dam to augment flows in the mainstem Wenatchee River during late summer/ early-fall could provide some benefit to the upstream migration and holding of adult steelhead, chinook, and to a lesser degree coho salmon. The degree of potential benefit would be

2

related to the amount and timing of flow available The largest benefits to mi gration and holding would likely be to steelhead and summer chinook during the lowest flow years, since these species spawn in the mainstem Wenatchee, and they would likely spend some time holding in the river prior to spawning.

Supplemental water released to the mainstem Wenatchee River during late -summer/early-fall may potentially enhance to varying degrees the amount of spawning habitat available to chinook in the mainstem Wenatchee River. If the fall rains coincide with the end of the period of supple mental water and water levels are not subsequently reduced during incubation, the increased spawning habitat could benefit spring and summer/fall chinook.

Negative impacts to incubating chinook embryos could occur if areas used for spawning are subsequently dewatered during the period between flow augmentation from the Lake Wenatchee Water Storage project and the onset of the fall rains.

The report concluded that there would not be a negative impact to any local tribal fishery, but it did not examine the impact to the Zone 6 tribal fishery. The report also did not examine the potential negative eff to redds that, as a result of supplemental flows, are constructed in areas that will become shallow water aft supplemental flows cease. Those redds become subject to freezing.

In what life stages will survival be enhanced and why is this increased survival expected?

Operation of the rubber dam will not affect high -flow rearing habitat in the mainstem Wenatchee River.

The release of water stored in Lake We natchee during late-summer/early-fall may temporally increase the amount of low-flow refuge habitat and may afford some benefit to juvenile salmon species rearing in the river, The effects of extending the period of high water levels in Lake Wenatchee duri ng the summer on juvenile fish rearing in the lake and at the mouths of the Little Wenatchee and White rivers are unknown. Higher water levels throughout the summer could benefit juvenile fish rearing in the wetland complex on the western end of the lake if the higher water levels help maintain open water and transportation corridors between ponded areas and the main lake.

However, baseline information on the habitat condition, use and productivity of this wetland area is not available.

The project operation is not anticipated to affect juvenile outmigration in the tributaries or in Lake Wenatchee, provided suitable fish passage facilities are integrated into the dam design.

The release of water stored in Lake Wenatchee during late -summer/early-fall could coincide with the peak of sockeye spawning in late September. Although it is unknown if sockeye spawn along the shoreline of Lake Wenatchee, the species is known to use this type of habitat in other lakes. Reduced lake levels during the period of sockeye spawning could result in redds being built in areas that would subsequently become dewatered as the stored water is released to the mainstem Wenatchee River. Thus, there is some potential negative impacts to lake -shore spawning (if it occurs) related to all of the alternatives.

Release of water stored in Lake Wenatchee to supplement late -summer/early-fall flows in the mainstem Wenatchee River will result in the lowering of the lake levels and potential stranding of juvenile fish rearing in the littoral are as.

It is believed that trapping and stranding effects would be minimal in this area because of the complex morphology occurring within the wetland habitat, and the generally low temperatures expected during the summer because of vegetative shading and connection with groundwater.

The operation of the rubber dam will temporally increase the mainstem river minimum instream flows during the late-summer/early fall period and may help maintain or restore connections with off-channel habitats that could otherwise become dewatered or isolated from the main channel. The effects of this would likely be relatively small due to the comparatively low amount of water that would be supplemented to the lower river compared to natural flows. The operation of the rubber dam will not affect side-channel habitat in the tributaries, upstream of the lake influence. However, higher water levels throughout the summer in Lake Wenatchee could result in increased open water and transportation corridors between off channel areas in the wetland complex on the western end of the lake, including the lower portions of the tributaries, and the main lake.

High water temperatures are a limiting factor for salmonids in the mainstem Wenatchee River during the summer and potentially for salmonids near the mouth of the Little Wenatchee River. The operation of the rubber dam may provide little if any temperature benefits however additional studies, including temperature modeling is required.

Although specific field studies were not conducted that would help to define incremental benefits in terms of fish habitat relative to different streamflows, it can be surmised that such benefits in terms of supplementation of 50-100 cfs, would be relatively small when considering the channel dimensions of the Wenatchee River. River widths in the range of 150-200 ft. are not uncommon, especially in wide riffle habitats, and even under extremely low flows (e.g. 300 cfs at Plain) the additional 50 to 100 cfs for a short period of time (one month) would likely result in relatively small changes in water depth (» 1-2 inches).

How these changes in water depth translate into changes in fish habitat is not known. However, extremely low flows that occur during warm summer months can create especially stressful conditions to fish. During such periods, the provision of even relatively small amounts of flow may temporally and spatially benefit fish populations. Clearly, the potential environmental impacts and benefits of the Lake Wenatchee Water Storage Project warrant further consideration.

Some of the applications, such as those contained in the Peshastin Creek basin, would not likely be approved as the basin is closed for further appropriation from June 15 to October 15. The difference between the forecast future water needs and the quantity applied for is mostly due to water right applications for irrigation. It appears those applications are primarily for landscape or lawn irrigation and not commercial agriculture. It was estimated the increase in irrigation demand from approval of those applications to be 8 cfs; the estimated effect on streamflow is a reduction of 5.6 cfs.

The report is clear that a great deal more information is needed before this question can be adequately addressed.

How would additional storage be used to augment a "natural flow regime" for the main-stem Wenatchee that would enhance flow modifications to current irrigation activities?

No growth in self-supplied industrial and commercial water use is forecast unless additional water is made available that would not be subject to interruption from low streamflow levels and minimum instream flows set by Chapter 173-545 WAC.

A review of agricultural water use was made and the following conclusions were made: Agricultural water use accounts for an estimate of 68,000 acre-feet of consumptive use (either water *consumptively used by crops or exported outside the Wenatchee River Watershed) The area of irrigated agriculture appears to be stable and not declining.*

There is a substantial area of land that is c urrently zoned for residential use that can be converted from agricultural use.

Our opinion is that although annual water use may decline if that land is developed, peak water use may not change. The peak water demands are important as they have the most immediate effect on streamflow. A review of water right applications was made to compare to the predicted future water demands.

The current applications are requesting 43 cfs from surface water and 10.9 cfs from ground water.

The types of use requested on the applications are primarily municipal and domestic for surface water and irrigation for ground water.

Most of the applications, if approved, would be subject to minimum instream flows and therefore interruptible during low streamflow periods.

The largest potential water need is for instream flow. Chapter 173 -545 WAC has set minimum flows for the Wenatchee River and some tributaries. Hydrologic analyses have determined the average shortfall between Wenatchee River streamflow (measured at Plain) and th e minimum flows is 17,500 acre-feet per year. In 2001, the shortfall was 50,400 acre -feet for the time period of July to October

Basically, the report says that the need for future irrigation water is very small and that the alternatives considered in this study would not store enough water to meet the minimum instream flows under low flow conditions.

Finally, how will all additional water storage be used in the agricultural community during "low" flow years? Will these interests have additional water beyond their ability now and how would this water be "appropriated" between fish and agricultural interests?

The effect on streamflow from future municipal and domestic demand and from approval of pending water right applications for irrigation is an estimate d reduction of about 10.6 cfs.

The largest potential water need is for instream flow. Chapter 173 -545 WAC has set minimum flows for the Wenatchee River and some tributaries. Hydrologic analyses have determined the average shortfall between Wenatchee River streamflow (measured at Plain) and the minimum flows is 17,500 acre-feet per year. In 2001, the shortfall was 50,400 acre -feet for the time period of July to October.

The project could reliably supply between 50 cfs and 75 cfs for the month of September and early October. That water would be used to augment instream flow in the mainstem Wenatchee River and/or to offset future water needs in the Wenatchee River Watershed. The project would supply more than enough water to meet future municipal and domestic water needs in the Watershed. The project could not provide enough water to substantially reduce the occurrence of Wenatchee River flows falling below instream flows set by Chapter 173-545 WAC.

This scenario of maintaining water levels at El. 1870.3 appears to be feasible and cost-effective and warrants additional study if a demand for the water exists and the potential impacts from implementation are less than alternative instream flow augmentation or water supply projects.

If water is stored to elevation 1872.4, The storage project would impound an estimated 12,300 acre-feet in excess of historic low water levels. The average difference in lake water levels in August would be 3.9 feet; in September 2.6 feet. The project could reliably supply between 100 cfs and 200 cfs for the month of September and early October.

That water would be used to augment instream flow in the mainstem Wenatchee River and/or to offset future water needs in the Wenatchee River Watershed. The project would supply more than enough water to meet future municipal and domestic water needs in the Watershed. The project could not provide enough water to substantially reduce the occurrence of Wenatchee River flows falling below instream flows set by Chapter 173-545 WAC.

It is our opinion storage to El. 1872.4 is problematic and would be difficult to implement because of impacts to wetlands and to waterfront property.

The report concludes that the greatest need for water is to augment instream flows but, the storage elevations considered are insufficient to provide the volume required to meet minimum instream flows under low flow conditions. The storage elevations considered would be sufficient for future municipal water needs but storage brings environmental and fish passage effects that might negate any benefit. Water conservation efforts could provide the same volume. Finally, agricultural needs seem to be steady or declining. Any future water rights developed would be interruptible rights under low flow conditions which are the only times that storage would be activated.

We continue to believe that the Lake Wenatchee/Wenatchee River system is functioning fairly well. It will not benefit by being turned into a storage project. We believe that the MWH report supports this position. Certainly, we can build an inflatable dam but the adverse environmental and ecological effects far outweigh any meager storage benefits gained.

Again, thank you for this opportunity to provide comments. If there are any questions please feel free to give me a call at (509) 865-6262 or email to lcarlson@yakama.com.

Sincerely,

Lee C. Carlson
Yakama Nation Fisheries Program

LCC
Enclosures (1)

cc: Paul Ward
Carroll Palmer
Virgil Lewis

Confederated Tribes and Bands of the Yakama Nation

Established by the Treaty of June 9, 1855

December 17, 2001

Commissioner Ron Walters, Chairman
Chelan County Board of Commissioners
350 Orondo
Wenatchee, WA 98801

RE: Proposed water storage in Lake Wenatchee.

Dear Commissioner Walters:

Over the past couple years the Yakama Nation has enjoyed an increasingly favorable relationship with Chelan County in the area of natural resource protection and enhancement. We look forward to advancing this relationship in time.

Both Chelan County and the Yakama Nation recognize that protecting and enhancing our natural resources, and specifically our aquatic and fisheries resources requires a commitment beyond the level which many of our neighbors and citizens recognize in their daily lives. Often, this commitment is even beyond the courage that our leaders have to offer. Our leaders must be direct and diligent in protecting natural resource values that have been long established in law (Tribal Treaty obligations, Endangered Species Act, Clean Water Act, State mandates, etc). The Yakama Nation has appreciated the recent and enthusiastic response that Chelan County as expressed in recognizing these interests. We support this and offer some words of encouragement.

The proposal for enhanced water storage in Lake Wenatchee is not an acceptable response to water shortages in the Wenatchee Basin. The Yakama Nation asks Chelan County to not hide behind the veil of fish protection and enhancement water to justify a dam on Lake Wenatchee in order to address the over-appropriation for out-of-stream uses. Clearly, this is a proposal that protects and likely enhances agricultural interests. Although the Yakama Nation is generally not opposed to development of agricultural interest, we strongly disagree with any attempt by Chelan County to blur or confuse agricultural interests with fish (anadromous salmonid) recovery interests.

Respectfully, we ask that Chelan County meet with the Yakama Nation to discuss several pivotal issues:

- What evidence is there to suggest that salmonid recovery will be enhanced by additional Lake Wenatchee storage capacity?
- How much capacity is envisioned and what are the likely engineering options to provide this storage capacity and how might these options incorporate fish passage considerations?

FISHERIES RESOURCES
MANAGEMENT PROGRAM

DEC 19 2001

RECEIVED

- What species will be positively affected and what might be the negative effects to fishery interests?
- In what life stages will survival be enhanced and why is this increased survival expected?
- How would additional storage be used to augment a "natural flow regime" for the main-stem Wenatchee that would enhance flow modifications to current irrigation activities?
- Finally, how will all additional water storage be used in the agricultural community during "low" flow years? Will these interests have additional water beyond their ability now and how would this water be "appropriated" between fish and agricultural interests?

Clearly, all of our governing bodies are looking for solutions towards the significant and substantial impacts that continue to impact our salmon, and our aquatic and riparian resources. With the recent and continuing changes in Chelan County's approach in natural resource issues, we are encouraged that there is a substantially greater awareness in salmonid recovery interests. However, until Chelan County can address the basic questions we have stated above, it is not clear why this proposal is being presented in such a noticeable public format. Will the public come to expect something that is not feasible or defensible?

The Yakama Nation is very concerned that public perception within the Wenatchee Valley will come to expect that additional manipulations to the watershed will "fix" past problems with salmonid production. This is the same perception that (generally) Euro-Americans and other emigrants have "understood" for the past 150 years. Have we not learned yet? What is different about this proposed project?

As always, the Yakama Nation is interested in a continued and productive dialog with Chelan County. We look forward to your timely response to this letter. If you have specific or technical questions, please do not hesitate to call my staff representative, Lee Carlson at 509-865-6262.

Sincerely,

Virgil Lewis, Sr., Chairman
Fish and Wildlife Committee
Yakama Nation Tribal Council

cc: Lee Carlson
Bob Rose
Mike Kaputa

June 30, 2003

Lisa DeVera
Chelan County Natural Resource Program
411 Washington Street
Wenatchee WA 98801

Subject: Lake Wenatchee Storage Feasibility Study

Dear Ms. DeVera:

I would like to take this opportunity to thank the staff of the Chelan County Natural Resources Program, Montgomery Watson Harza and Montgomery Water Group for their fine effort in compiling the data for such a diverse project. Also, Nancy Smith, our facilitator, did a great job of bringing our project team to focus on the issues at hand and extrapolating the information of the group.

Wenatchee Reclamation District has been putting water to beneficial use in this watershed for over 100 years and is proud of its efforts in stewardship in the maintenance and operation of its irrigation system supplying water to over 9,000 users in its 34-mile canal system. A state-of-the-art fish screen is in place owned and operated by Chelan County Public Utility District.

The storage project was and still is a possible tool to help with the management of water for instream flows in this watershed. There are still many questions and concerns that need answers before a project proponent would move forward with this project.

Wenatchee Reclamation District is one of the initiating bodies of watershed planning undertaking all four elements of quantity, quality, instream flows and habitat. Along with the City of Wenatchee and Chelan County, Wenatchee Reclamation District has a commitment to the process and to the people of Chelan County.

Future water use and needs will continue to tax our water supply. Alternative storage, conservation and good management of our precious water resources will continue to be a challenge in the future.

Sincerely,

Ricky J. Smith
Superintendent

From: Steve Craig
Sent: Tuesday, June 24, 2003 2:07 PM
To: Lisa de Vera;
Subject: Comments on the consultant report

As a full-time resident on Lake Wenatchee for the past 23 years, and as the owner and broker of Lake Wenatchee Properties, Inc., a real estate firm specializing in waterfront sales on Lake

Wenatchee, I feel the project consultants need to consider the following points in accessing feasibility of water storage on Lake Wenatchee:

1. Valuing 2nd class shorelands. The manor in which sub-consultant Jones & Stokes applied the DNR model was not properly matched to the parameters at Lake Wenatchee. Therefore their estimate of purchasing 2nd class shoreland lease rates at $1.4 - $3.5 million at the 1870.3 level are significantly low. Here's why:

a) In applying the model, Jones & Stokes took a simple average of the assessed values for North Shore and South Shore properties. Given that (i) there are a greater number of linear feet of shoreline on the North Shore with 2nd class shorelands than the South Shore, and (ii) average assessed values on the North Shore are three times that of the South Shore, Jones & Stokes should have used a weighted average model in order to determine the value per square foot of second class shorelands.

b) In applying the model, Jones & Stokes multiplied the gross value of second class shorelands by a factor of 25% since the 2nd class shorelands would only be flooded 3 months of the year (i.e., 25% of the year). However given the seasonal nature of Lake Wenatchee, the months of July, August, and September account for nearly 100% of the use of these 2nd class shorelands. Numerous testimonies was given by myself and the other two landowners on the committee, as well as public attendees at the bi-monthly meetings, that lakefront property values are greatly tied to summer use.

c) In applying the model, Jones & Stokes did not account for a very obvious factor that exists at Lake Wenatchee - many of the lakefront properties are very steep, and the beachfront accounts for a huge majority of the overall values of many lakefront parcels. In other words, if the beaches are submerged by water, it is not possible to do alternative uses / activities on the property. Therefore, the model should place additional weight on the significance of these shorelands, quite potentially in the range of a 300% to 500% multiplier.

2. Through my profession, I commonly find that County Assessor values are lower than true market values - many times up to 25%. Paragraph 5.1.1.2.2, page 5-7, refers to the Assessor's comments of an average per front value of $5,000 for land, which I concur on this statement. Given that these higher values are more accurate, all mathematical analysis on effects to property values, purchase of 2nd class shorelands, etc. should be based on these more accurate numbers.

3. Two other landowner categories have been completely ignored in determining the effects to property values - (i) lake-view and neighboring properties which utilize many of the County, State, and Federal beaches, and (ii) riverfront properties on the Wenatchee River which also benefit from lower water levels during July, August, and September, plus would be at direct risk of massive flooding in the event of dam breakage or severe leakage. Just the stigma of a dam being up-river of these riverfront parcels will have an effect on values.

4. There has been inadequate analysis on the true costs of adjusting existing docks, boathouses, retaining walls, etc. in order to work with a water level of 1870.3. For example, Table 5.1-2 on page 5-6 of the report states that docks have a high value of $14,400. However I am aware of

several dock systems at $20,000 - $30,000. These incorrect base prices combined with a lack of assessment of how many systems will need modifying have resulted in an inaccurate assessment of the total overall costs of constructing a water storage facility.

5. Wind / wave analysis. Through my years of observation, wave heights commonly exceed those calculated in this report. For example, it is stated that wave heights of 1.2 feet will result at the southeast end of the lake when there are 25 MPH winds at a water level of 1872.4 feet. Even under normal low summer water levels, I have experienced wave heights of 3+ feet! Therefore shoreline erosion will occur in much greater magnitude than this report forecasts, which will have effects both on property values and lake ecology.

6. Legal fees. This report has made no attempt to address the huge legal costs of building a dam as landowners, environmental groups, etc. file lawsuits to block any such proposal. These lawsuits would undoubtedly last for 5-10 years, and the costs need to be properly addressed in calculating an overall cost of a dam.

7. Market economics - the trickle down effect. Property values throughout the Lake Wenatchee / Plain areas are tied together. Buyers make decisions to purchase a property based on the costs and benefits each property provides. For example, a buyer may elect to purchase a non-waterfront parcel with a view of the lake for $80,000 because a waterfront parcel directly across the street is selling for $350,000. The benefits of owning waterfront property are not worth the additional $270,000 premium in the buyer's opinion. If a dam is constructed, the aspects of the waterfront property will be compromised, and thus the waterfront parcel will drop in value. Now that same buyer may choose to purchase the waterfront parcel given a relatively smaller difference in price. There is now less demand for the non-waterfront property at $80,000, thus finally the value of the non-waterfront property must decline to a level where buyers are once again attracted.

The trickle down effect is very real. Lake Wenatchee waterfront properties, which have historically been the highest valued properties in the area, would see their values decline due to the negative changes to the properties. All other properties in the area would then decline in value too as their market demand is affected by the lower cost of waterfront property. Therefore we're not just talking about lakefront property values being affected, we're talking about all properties in the area.

The bottom line is that both alternatives, 1870.3 and 1872.4, will have huge effects on property values both on and around Lake Wenatchee.

Steve Craig
Owner / Broker
Lake Wenatchee Properties, Inc.

E-mail scraig@Lwproperties.com
Website www.Lwproperties.com
PH (509) 763-3578

From: Tim Beard
Sent: Thursday, July 31, 2003 11:57 PM
To: Lisa de Vera
Subject: Comments Re: Lake Wenatchee Water Storage Feasibility Study

July 31, 2003 SENT VIA Email (lisa.devera@co.chelan.wa.us) and FAX 509-667-6527

Ms. Lisa deVera
Project Coordinator
Chelan County Natural Resource Program
411 Washington Street
Wenatchee, WA 98801

Re: Lake Wenatchee Water Storage Feasibility Study

Dear Ms. Vera:

In response to the above feasibility study, I provide the below comments.

I am totally against the idea of creating a dam on Lake Wenatchee. This is a wonderful and beautiful natural lake, which was the main reason I chose to buy my residence in 1992. I believe that is also the main reason why other property owners on and around the lake choose to make homes there. It should be left in its natural state.

Before the idea of a dam, which serves only the interest of others who would not negatively be impacted by such a project, goes any further, significant investigation and consideration should be given to other alternatives that could meet the future needs of those other areas and interests. Some ideas to consider include:

- the use of wells.
- capture and storage of a portion of the winter/spring heavy water flows from the Wenatchee River for subsequent use. Such storage could be created in resorvoirs close to areas identified as needing additional water (e.g., Leavenworth, Dryden, Cashmere, Peshastin, etc).
- creating artificial lakes in canyons by damming other water ways (e.g., Icicle Creek).
- the acquisition of additional water from other areas
- raising the level of Lake Chelan, a lake that is already dammed, and piping water to the areas of need. An increase of just one-half to one foot in Lake Chelan from the spring rains and snow melt would provide a tremendous amount of additional water.
- don't allow additional development if water resources are not available.

The Conclusions section of the study states that the proposed alternatives "…could ***not*** (emphasis added) provide enough water to substantially reduce the occurrence of Wenatchee River flows falling below instream flows set by Chapter 173-545 WAC." Undoubtably, there will be more "drought" years in the future in which water supply will fall short of demands. This will most likely be true whether this or other projects are implemented. However, the only thing that is certain about the project studied here is that, if implemented, a natural lake and those who own property around it will only be negatively impacted, and the "goal" of the project which benefits others will not be met.

Any future money spent on addressing the goals of the project should be spent looking at other solutions. Lake Wenatchee should be left alone.

From: Griff, Vicki
Sent: Saturday, July 19, 2003 10:26 AM
To: Lisa de Vera
Subject: Public Comments on Lake Wenatchee Dam Proposal

I worked for a major Federal water resource agency. Because of this expereince, I see several FATAL FLAWS in your "study" which trouble me. I will mention just four:

1. Your "planning" is totally backward! You don't START with a project, then try to justify it (especially when it is a 1930 irrigation project and your own "study" denies a growing need for irrigation).

2. Where is the Economic Analysis?
Where are the estimates of the Benefits and Costs, the B/C ratio? Where is the quantification of the negative impacts of this project? For example, the flooding of beaches, loss of recreation, increased erosion, etc. Interestingly, you don't even pretend it is an economically justified project.

3. What about alternative dam sites? In 1930 Lake Wenatchee was largely devoid of homes and little thought was given to its environment, private property impacts, water based recreation and endangered fish runs. If (and that's a mighty BIG "If") a dam were even economically justified, why not consider alternative dam sites, why flood an existing lake?

4. Why have you tried to stifle public comment? We attended the first public meeting and were disappointed that you did not allow questions, you did not permit public comment. Rather, you broke us into small groups with "facilitators" taking notes. The Open House announcement you mailed for the June 19, 2003 meeting said that there would be a "public comment" period at 7:45 PM. We expected – finally – a chance for us to stand up and voice our questions and concerns in front of the audience and a court reporter. But no, you changed the agenda from a 7:45 PM "public comment" period to "small group sessions"

Burying my letter and your "facilitator" notes in the back of your "feasibility report" does NOT constitute Public Involvement. Why are you so afraid to do an economic analysis, to consider alternative dam sites, to even allow public comments??

Vicki Griffith
16609 N. Shore Dr.
Leavenworth, WA 98826

---

30 July, 2003

Chelan County Natural Resources Program,
Attn: Lisa deVera,
411 Washington Street,
Wenatchee, WA 98801

Dear Ms. deVera,

Below are my comments in response to the Lake Wenatchee Water Storage Feasibility Study Final Report for inclusion in Chapter 9 of that Report.

As a home owner who's year around residence is located on the north Shore of Lake Wenatchee, I am opposed to any project which will manipulate the natural rise and fall of the lake. Damming the mouth of the lake would be a violation of my property rights and deny me the use of a portion of my shore during warmest time of the year when I need and use it most.

My home is located on the North Shore and receives the direct brunt of the wind and waves which come out of the west and northwest. This is because of the fact that the lake is situated in a southeast -northwesterly direction and the high mountain ridges on either side of the lake impact the generally northwest winds. A prolonged rise in the lake level would subject the structures on my property to greater damage than would occur normally.

In my view this project is a short sighted review and does not represent the true situation at Lake Wenatchee. I concur with the thoughts expressed by my neighbors in an article "Lake Wenatchee deserves a better study" published in the Wenatchee World Opinion Page on 3 July, 2003. A copy of that article is attached. To dam this natural lake is unwarranted, unproductive and unnecessary. Do not proceed further with this idea.

Sincerely,

Ann K. Hoyt
16181 North Shore Drive,
Lake Wenatchee,
Leavenworth, WA 98826

To: Lisa Devera
From: Tom Borgen
17867 North Shore Drive
Lake Wenatchee, Wa.
Re: Feasibility Study

In fairness to the perceived needs of the County in terms of seeking additional water sources I have attended meetings and read as much as possible regarding the proposed water storage plan for Lake Wenatchee prior to contacting you regarding my thoughts.

The bottom line is this when you cut through the statistics, assumptions and everything else that was put into the models and use some common sense its evident that the cost to the environment and the land owners property outweighs the benefit of the proposed dam.

Here are three reasons

1. If the water were at the proposed level during the summer many banks, beaches and bulk heads will not stand up to the additional wear and tear, its hard enough now during the high water months. Look up and down the lake and its very evident that the higher water levels will cause significant erosion and damage.

2. Have members of the study team visit the lake on one of the many windy weekends in the summer. When you combine the higher water level with the two to three feet high swells caused by the winds coming from the west at 25 MPH plus you are going to have problems. There is a reason the NW wind surfers have Lake Wenatchee dialed into their weather beepers, its one of the two best spots in the NW to catch high winds during the summer. The combination of wind and high water in my opinion is not being taken seriously.

3. Paddle up the White River or Little Wenatchee and envision the raised water level during the summer months. Again common sense will tell you that the habitat will be destroyed or altered by tampering with nature and raising the water level to a point where it should not be during that time of the year.

In summary, Lake Wenatchee and its water shed is a natural wonder, one of the few natural lakes that has not yet been tampered with. Its time to take a stand to protect it and therefore the proposed dam project should be rejected.

Thank you.

Subject: Comment on Lake Wenatchee Water Storage Feasibility Study
From: Doug Weber 16601 Northshore Drive, Leavenworth//mailing address 17700 Bear Creek Farm Rd. Woodinville 98077

29July 2003

I have known of, lived on, and lived with Lake Wenatchee for the past 40 years and find that one of the pleasures of the lake is experiencing seasonal variations which include dramatic changes in water levels following Fall rains, Spring runoff, and the more subtle Summer ups-and -downs. How dull and banal it would be to view a stagnant, undynamic situation for months on end if the Lake were a water storage facility.

Apart from aesthetics, I have a more practical concern when it comes to raising the water level. My property has a stone retaining wall where it borders the Lake. Wind driven waves beat at this wall for about 3 months every Spring, then the water lowers, erosions subsides, and waves only shift the beach sands about. Experience has demonstrated that with annual maintenance and occasional repair, the wall can handle this short term high water level and wave action.
With ordinary high water(1870.4 ft) for six months of the year, the retaining wall would be short-lived. With impoundment water at 1872.4 feet and wind, there would likely be uncontrollable erosion and annual basement flooding, a situation which would leave me very disgruntled.

Portions of the Lake Wenatchee Water Storage Feasibility are well presented with careful and well documented analysis. Other portions are hypothetical and subjective.

Over all, I believe that using Lake Wenatchee as a water storage facility is not justified, unnecessary, and in the end would be more costly and more detrimental than beneficial. The people, animals, etc., residing in the Wenatchee Basin have gotten along just fine for many, many years with natural instream flows. Thus, "why try to fix it if it ain't broke?"

All my neighbors and I are very opposed to this project.

From: GERSMNT@aol.com
Sent: Thursday, July 31, 2003 1:40 PM
To: Lisa de Vera
Subject: Lake Wenatchee Water Storage Feasibility Study
Please be advised that I, Gerry M. Salkowski, Trustee am the owner of three waterfront lots on the South side of Lake Wenatchee, to wit: Lot's #41, #42, #44 and I further represent Mason & Nancy Smith, M.D. who own lot #43. The total water frontage is approximately 455.2 feet.

We are against the construction of any new dam at either of the suggested levels because of the loss of beach and dock usage. We believe that the loss to us particularly at the higher suggested level will be substantial.

Naturally, the public interest must be served but if the lake is dammed, we would expect to be compensated in accordance with the 5th amendment to the constitution which requires just compensation for private property taken for public use.

Sincerely,

Gerry M. Salkowski, Trustee
representing Lot's #41, 42, 43, 44

From: Tom & Marilyn Fleming
Sent: Tuesday, July 08, 2003 9:06 PM
Subject: Lake Wenatchee dam

Comments. I am a land owner on north shore Lake Wenatchee. I am against water storage dam for following reasons;
1. This is one of the few undammed glacier fed lakes. Putting in a dam would change the tourist appeal of the area. the sense of enjoyment of this natural area has not been taken into account.
2. Raising the level for several months a year would change vegetation around lake and cause a "bath tub like" ring at edges thus changing aesthetics.
3. There may be unintended and unexpected input on environment including fish habitat e.g.. raise in water temperature or other changes in biosphere.
4. There may be flooding of foundations or septic systems or other unanticipated changes.
5. The cost does not include purchase of boat houses, docks or other fixed structures which would be flooded.
6. My land plus many others will lose beaches during flooding times causing loss of enjoyment of lakeside areas.
7. State park plus other properties would lose valuable beaches and boat launches.

8. The need for this water has not been demonstrated. If there is a need for agriculture has the possibility of a pipeline from the Columbia been investigated?
9. Ruining the habitat and surroundings of the lake for a small increase in useful use of water is not justified.
10. The increased flow to the Wenatchee river for 2-3 months does not warrant use of dam and elevating the level of the lake for several months.
11. Use of the dam opens up the possibility of drawing down the Lake in the future if water needs increase.
12. Recreational use of Lake will be dramatically changed
13. Cost of dam does not include maintenance or running of dam; also does not include possibility of damage to dam. Also there is no entity that has agreed to run dam.
14 Cost does not justify building dam; also no source of funds or way to pay back has been identified.
15. Economic loss to land holders is impossible to determine ahead of time. Loss of value to landowners is not taken into account.
16. Land erosion around edge of lake could cause irreparable damage.
17. Benefit to fish and other aquatic habitat can be estimated but not known for sure.
18. Many dams have caused damage to the environment and removal is being recommended by many. Another dam is not needed.
19. Finally the need for this additional stored water for 2- 3 months a year has not been demonstrated.

Therefore I recommend that this idea be dropped. The Lake Wenatchee Water Storage Feasibility Study shows this to be a bad idea and not worth pursuing. There are many unanswered questions including economic impact, whether the dam is needed, and irreparable damage to lake environment. Lets stop this consideration of the dam before any more money is spent on a bad plan for a dam. Lets not put in a dam that might need to be removed in 10 - 20 years due to damage to the environment. Please inform our legislators that this has been investigated as mandated by legislature and found not to be justified.

From: Brett Baba
Sent: Thursday, July 31, 2003 2:31 PM
To: Lisa de Vera
Subject: Lake Wenatchee Water Storage Study

I am an owner of a waterfront property along the south shore of Lk. Wenatchee. The property has 100' of water-frontage and supports an existing house built in the 1950's, which is located near the water.

I am writing to express my fervent opposition to the 5 proposed alternatives being considered that would involve water storage at the lake and the attendant increase in water levels during the summer months.

My opposition is based on the loss of property value we would experience, the loss of beach, the likelihood of damage to the existing structure and the effects of erosion on the property. In addition I object to the deleterious effects a dam would have on fish migration.

The Feasibility Study states that there are no case studies on which to base expectations for lakefront property values subject to increased water elevation on a natural lake. It is stated in part 5.3.1 that *"increase in water elevations could affect shoreline property values and potentially slow the rate of increase in property values*,.."

My family, other users of the house and I are among those residents who place a very high value on "*beach accessibility during the summer months."* Paragraph 3 of part 5.1.1.2.2 indicates that beach accessibility is a large part of the perceived value of lakefront properties. We would be very bitter over the loss of our beach and hurt by the subsequent loss of property value.

When we purchased our weekend house, we did so with the expectation that we would have a beach.

Because it was built in the 1950's, our house is near the water and has a basement that is at a low elevation. Extreme high water has entered the structure in the past. Clearly, increased water elevations put us at additional risk for structural damage. The upland portions of our land are occupied with ingress/egress easements and steep slopes. The existing house occupies the only place on the parcel that is buildable.

Lake Wenatchee is unique in the state for it's recreational quality and accessibility. I see the water storage scheme as very damaging, and urge you to abandon it.

Brett Baba
16000 Cedar Brae

From: Gwendolyn Walsh [grendyl@earthlink.net]
Sent: Saturday, July 26, 2003 9:51 AM
To: Lisa de Vera
Subject: Water storage Feasibility Study

Lisa:
I sent you an e-mail earlier, but I forgot to mention that if the water levels in Lake Wenatchee are raised to the levels described in the Feasibility report, they will cover both my well and my neighbor's wells. These are dug wells which were installed 30 years ago, and function perfectly all year. Raising the water levels will contaminate the wells and render them useless.
This is totally unacceptable. This is also another reason why I am very opposed to the possibility of a dam on Lake Wenatchee. Thank you. Wendy Walsh, 18000 Bear Creek Farm Road, Woodinville, 98077, // 17815
Northshore Drive, Lake Wenatchee

From: jhipke@juno.com
Sent: Thursday, July 24, 2003 7:11 AM
To: Lisa de Vera
Subject: Lake Wenatchee Dam Comments

My family are owners of the the cabin on lot 14 Cedar Brae. Our Lake Wenatchee address is 15360 So. Shore Road. The cabin is on the lower part of the property and has been affected by floods several times in the past. I think the proponents of the dam should have staked the high water level caused by the dam on each property so we would know exactly the damage caused. We have a nice sandy beach and an old log crib dock. During spring runoff the dock gets covered for a few weeks and the water sometimes comes up to the cabin. During the summer though we have full use of the beach and the dock.

It appears that whether the 1870.3 ft. or the 1872.4 ft. water level caused by the rubber dam is used, either level will ruin our beach and put our dock under water during the summer. Also some trees close to the water in the spring may die as their roots will be continually wet.

With the damage to properties like ours. the State Park, the U.S.Forest Service land, the wet lands at the head to the lake, and the fish, this dam should not be built.

From: Karen Webster [websterca@attbi.com]
Sent: Monday, June 23, 2003 6:08 PM
To: Lisa de Vera
Subject: Lake Wenatchee water storage proposal

Dear Lisa:

I attended the June 19, 2003, meeting at Cascade High School in Leavenworth concerning the Lake Wenatchee Water Storage Feasibility Study. My husband Clifford and I are property owners on the lake and have just completed this month a new home at 16050 Cedar Brae.

I did not know about the water storage study until about two weeks ago, so I was glad for the opportunity to listen to both the consultants and property owners on this issue.

We would like you to know that as property owners, we are not in favor of this water storage proposal that would raise the level of the water on Lake Wenatchee. As I listened to all of the information presented last Thursday, it was apparent to me that there were more negatives than positives. Even the impact to fish and wildlife seemed slight, and perhaps even negative if you consider what the project would do to the surrounding wetlands. One of the prime reasons for owning property at Lake Wenatchee is the ability to use the beach area in the summer months. Should this project be implemented, our property would not have any beach at all at high water, which would negatively impact the usability and the value of this property.

Please add our voices to those that are strongly opposed to this project.

Thank you,
Karen Webster
206-935-6451
email: websterca@attbi.com

From: Kenneth D MacDonald Sent: Friday, June 13, 2003 3:40 PM
To: Lisa de Vera
Cc: Bob Bugert (E-mail); Mike Kaputa
Subject: Re: Lake Wenatchee Water Storage Feasibility Study

Lisa and Mike, I took a real quick look at the feasibility study today. I would have to agree the fish section lacks substance. Besides some editorial needs to fix some mistakes (in my view) and reflect new info, there is not enough information to draw any conclusions about fish; ESPECIALLY since passage is not included. Call me crazy but I would assume fish is going to be a huge issue on this. It would seem to me that the studies listed in the end of the document are definitely needed to see if the changes to fish habitat are significant or not and in which direction. I am still disappointed that this project is ahead of the watershed planning effort and instream flows and until those efforts are complete I don't know how any rational decision on a go or no go is possible, at least for fish. The potential benefits are conjecture (probably all they could do under the contract). Also the potential benefits are accrued ONLY if all the water remains in the channel. The main concerns over flow in the mainstem Wenatchee (to my knowledge) are below Dryden so for there to be any real benefits the flows need to be maintained to the mouth of the river. Sorry I can't give you anything more substantive now. As I said, I plan to attend the open house and presentation on Wednesday.

Kenneth D.MacDonald, Forest Fish Biologist
Okanogan-Wenatchee National Forest
phone: (509) 662-4361 email: kmacdonald@fs.fed.us

Comments on *Preliminary Draft* of **Lake Wenatchee Water Storage Feasibility Study**

Issued: June 4, 2003

Commenters:

Matt Karrer: Leavenworth and Lake Wenatchee District Hydrologist, US Forest Service
Phone: 509-548-6977 x201
Cameron Thomas, Leavenworth and Lake Wenatchee District Fish Biologist, US Forest Service. Phone: 509-548-6977 x232

600 Sherbourne Avenue, Leavenworth, WA 98826

General Comments: We assume the great majority of the purpose of this project is to help sustain listed salmonid fisheries in the Wenatchee Watershed. Under this assumption, we are uncomfortable with the lack of appropriate supportive peer-reviewed literature presented in this draft. We are also uncomfortable with some of the summaries made from material presented in this draft Specifically:

Page 3-20,23: Historic instream flows were set by Washington department of ecology in 1983. These flow levels are currently being reviewed and may be altered. On page 3-23, a distinction should be made that low flows occur in the lower Wenatchee.

Page 3-22: The last paragraph implies that the maximum water height will be exceeded. What contribution will the dam have?

Page 3-26 We would like to see this table and discussion highlighted in the conclusion in final study. Specifically, if the dam will not make up low flows on many low flow years, we would like to see a discussion that describes the potential benefits gained versus biological drawbacks.

Page 3-28 How would early operation alter flushing flows, and resultant physical and biological processes? Early operation could lead to loss of some bankfull flow events, which dominate channel maintenance over time.

Page 3-31 Alternatives are premature until IFIM's are completed by Watershed Planning committee

Page 3-47, 48 Data seems to suggest the dam would only provide benefit in driest years. Salmon often have die-offs under natural conditions in dry years. We would like to see literature citations/comparison of natural watersheds to managed watersheds in dry years, regarding salmonid response to low flow thru a generation of their life cycle.

Page 3-68 We would like a best guess displayed on operating costs, the assumptions underlying the cost estimate produced, and an idea who would bear the cost.

Page 6-3 Some of the last coho observations were made in the Chiwauwa drainage in the late 1960's.

Page 6-16 The three probable causes listed are suppositions that are not clearly proven. Much of the Wenatchee from Lake Wenatchee Downstream occurs in its natural channel, and is naturally constricted.

Recent temperature measurements taken at summer low flow identified water temperature leaving Lake Wenatchee at 16 degrees centigrade, and temperatures rose to 18 degrees in the lower river before dropping slightly in near the mouth from Columbia river influence. How much of the 2 degree difference can be proven to come from the suppositions for high temperatures, and how will water storage lower that temperature?

Page 6-22 regarding "6.2.1 Adult Migration and Holding", this is general information regarding fish passage. Is there a specific citation indicating that low flows in July have created a migration barrier to adults in the Wenatchee, other than the dam at Tumwater canyon (which has been mitigated by placing boards on the structure to direct fish to the ladder)?

Page 6-26 The statement "operation of the dam will not affect flood and peak flows" is not supportable. The number of bankfull flows that occur in a typical river over 1.5 to 2 years is six- **some of these flows will be lost thru dam operation.**

Page 6-27 Same as 6-26

Page 6-30 Lake Wenatchee has a small littoral zone and relatively small wetland area. We would like to see a more indepth analysis of potential biological costs to this community.

Page 6-32 We would like to see a discussion of Lake Chelan/Stehekin Flats to contrast what has occurred in similar terrain in this bioregion.

Page 6-35 We would like to see potential temperature changes modeled

---

From: Rgo021648@aol.com
Sent: Monday, June 23, 2003 9:17 AM
To: Lisa de Vera
Subject: Lake Wenatchee Water Storage Feasibility Study
from - Mike and Rita Ogdon 17739 North Shore

when the dam is in place and there is a MAJOR water flow out of the high country how fast will you be able to get the extra water out of the lake so there will not be major water damage to land and property?

Even with the water level at the 1870.3 ft. the wetland area will have water in it for a long period of time than it is now causing the mosquito breeding time to be extended for the whole year instead of a few months. Since Leavenworth already has problems with them and we need to be aware of the West Nile virus how do you plan to get rid of them?

From: Rick Szeliski
Sent: Tuesday, June 17, 2003 9:32 AM
To: Lisa de Vera
Subject: Public Comment on Lake Wenatchee Storage Feasibility Study

Dear Ms. deVera and authors of the Feasibility Study:

I am writing to most strongly object to the statements and conclusions presented in the SocioEconomic Impact section of your study (and summarized in the presentation slides and Summary and Conclusions section). This part of the report contains numerous factual errors, omissions, mis-representations, and appears to have been written by partisan interests bent on ignoring the true impact of water storage on the lakefront residents of Lake Wenatchee. I demand that it be re-written to more accurately reflect the true socioeconomic impact that the proposed water storage would actually have.

Let me first give you some background on how I came to be a lakefront property owner. My family of four had been looking to rent or purchase lakefront property for a number of years. We had visited many lakes near Seattle and in the Cascades region, and fell in love with Lake Wenatchee because of its beauty and the unusual quality of the beaches that are there during the summer.

Not wishing to rush our decision, we visited the lake a few times and then rented properties for a few weeks in the summers. In conversations with Steve Craig and other neighbors, and through our own observations, we were keenly aware of the fact that the water levels on the lake fluctuate a large amount over the course of each year. The basic fact about Lake Wenatchee that is pretty much ignored in the whole report is this.

*** Most properties on the lake are not usable for summer recreation activities except during the months of July and August when the lake level drops to a sufficiently low level. ***

This is due to a variety of reasons, the greatest of which is that the beaches that fringe most of the lake do not become usable until the water levels drop to near their summertime lows. Let me use our property as an example.

Because of the large fluctuations in water levels and the very high wind and wave action present throughout most of the non-summer season, our property has a stone retaining wall where it fronts the lake. During the high water season, the usable land ends there, with the water crashing against the wall. All we can do is to sit on our property and gaze at the lake.

During the late summer, however, the water starts to recede, and we can finally start using our beach. The kids play in the sand and run around in the water. We start to swim. We beach our rowboat, kayak and windsurfer, and sit on the warming sand enjoy the sunny summertime weather.

The water storage proposal threatens to unilaterally take away the main feature of our property that led us to purchase it: a beautiful beach that we can use in the summertime. This fact is totally ignored in the report. I really can't comprehend how such a huge omission and mis-representation can have happened, unless it was a deliberate attempt to bias the whole report towards a desired conclusion.

If the report writers believe that my own property is an unusual example, they haven't carefully studied the lake during their visits. A large number of the properties have retaining walls or bulkheads (built of stone or concrete) below which lie beaches that get exposed in the summertime. The remaining properties (including the more natural beaches occuring along the YMCA camp, camp Zanika, and various state properites) have sloping beaches that are extremely short and rocky (and mostly unusable) during the high water season. The photographs included in the presentation slides clearly show the same thing: at the proposed new elevation, most of the beaches are gone, with the water lapping up against vegetation such as trees and in some cases inundating fixed structures such as docks.

Which brings me to the second major impact that maintaining a higher water level would have: the inundation of fixed structures such as docks that surround the lake. Let me use my neighbor's dock as an example. This dock consists of two large concrete blocks built during the time of the early lake development. During most of the year, the blocks are below water level, and hence unusable. Only during the latter part of July and August does the water finally recede enough for them to be used to safely get in and out of watercraft.

This is not some oversight by the people who built the dock. Everyone on the lake is keenly aware of the yearly water fluctuation, and has designed their fixed water structures to be usable during the months of July and August when most people take their summer vacations. I don't understand how any of this information could have failed to appear in your report, as even a casual conversation with any lakefront property owner or user would reveal these facts.

Furthermore, I noticed in the minutes from the April 30th meeting that "There was also expert opinion offered that the quantified value of $1,000 per front foot for having secondary shorelands as part of owning property". I don't see any reference to this fact in the report that was subsequently written. Instead, I see in the presentation statements like "Higher water elevation unlikely to decrease property values". What's going on here? How can the report writers make such statements when they are directly refuted by expert evidence?

In our own case, I know that the loss of the "secondary shorelands" (which we refer to as "our beach") would take away the main reason we bought the property in the first place, and render the property basically worthless in terms of summer recreation. I actually think that the $1000 per front foot offered offered by the "expert opinion" may be too low, given that the main attraction of Lake Wenatchee to many people is precicely the condition of the beaches during the summer months.

I can't find at the moment in the report the linear footage of the lake and the corresponding linear footage of privately held land. (I thought I saw a figure of 70,000, but I can't find it right now.) Assuming an average lot size of 100 linear feet (which is obviously low for the large land-holders such as the camps) and roughly 300 residential parcels, this gives a shoreline length of 30,000 linear feet. Mutiplied by the (what I believe to be low) $1,000 per linear foot loss in property value, this brings the amount of compensation due to property owner to over $30 million dollars, which dwarfs the estimated cost of dam construction. This fact needs to be brought out clearly in the report.

Let me now point out some of the more eggregious errors in the report (and reflected in the presentation and summary).

page 5-7: "... elevations that remain stable result in property values that are higher than fluctuating lake elevations..." This is obviously a totally irrelevant fact. Lake Wenatchee was developed by people who where keenly aware of its fluctuating nature. Putting this statement in is akin to proposing that the residents of Aspen artificially heat their wintertime temperatures to above freezing because "... temperatures that are warmer result in property values that are higher than fluctuating temperatures..."

The paragraph following that statement is just as irrelevant, and should be stricken. The fact is, we are talking about a lake with a long history of (rational) development, not some abstract comparison between two lakes that have evolved separately. Unless the government is proposing to re-develop every parcel of land adjoining the lake, you cannot include "facts" like this in the study because they are totally mis-leading.

page 5-7: The statements about lot values being more dependant on frontage width rather than lot size precisely bolsters the argument that what matters most is the quality of the shoreline. People on the lake don't buy "frontage width" for bragging rights or because it increases the view. They buy it because of usable recreational opportunities, which only materialize once the beaches and fixed water structures become usable.

page 5-15: "...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." This is precicely the main argument I have been making.

How can these statements be followed by "These changes could have a dampening effect on the rate at which shoreline properties are increasing in value however it is unlikey that the higher water elevations, as a single factor, would be attributable to a decrease in property values"? Where do the authors pull such statement out of? There is absolutely no evidence to support this (malformed) sentence. Instead, it should be replaced by: "These changes would likely have a dramatic effect on the property values, as most of the value in lakefront property is associated with the quality of the shoreline. Expert opinion has pegged this drop in values at $1,000 per linear foot, resulting in an estimated total loss in property value of ... amount." Furthermore, the sentence "Over time, substrate in the higher shoreline will stabilize and become devoid of vegetation" must be stricken. Of course, over decades or centuries, such effects will occur, but what landowner would be content with such prospects? ("That's o.k., don't use your land for a few decades, then everything will be alright, we think, trust us...")

page 5-16: "While there is no information regarding the discriminating factors potential property buyers use when considering the purchase of shoreline property on the lake, it is unlikely that potential buyers have any knowledge of lake hydrographs or the appearance of the lake at OHW as a decision factor for purchase." This is completely inaccurate, and I don't understand how the authors can make such statements. Have they not bothered to talk to any lakefront residents? Did they deliberately ignore public comments and statement made by lake owners' representatives during meetings?

The most discussed topic around the lake is the water levels and when they will drop low enough for certain activities to be doable. The realtors at the lake are always very careful to point out where the water levels will be during at different times of the year, and how this will affect the shoreline. I really can't believe there are any lakefront property owners who were stupid enough to purchase and/or develop their properties without being aware of lake level fluctuations. Instead, a more accurate sentence might read: "Potential property buyers have historically been keenly aware of the fluctuation in lake water levels and the appearance of the lake at favious times as a decision factor for purchase. Any change in potential level fluctuations, and especially the lake levels during the summer months, would have an immediate and dramatic effect on the attractiveness of lakefront property to potential buyers, with a concomitant dramatic drop in property valuations."

The last sentence states: "Although not part of this study, a well-framed survey of potential property buyers arond the lake would provide insight as to the importance of such factors." Such as survey MUST be part of THIS study. Otherwise, any statements about socioeconomic impacts are just wishful thinking on the part of the authors.

Let me close by summarising my main points. Changing the level of the lake during the summer months would have an immediate and dramatic impact on the usability and attractiveness of all lakefront properties on the lake. Most beaches would become unusable (remain flooded), as would a large number of fixed structures such as docks. This would have an immediate and dramatic negative impact on proprety values, and would turn Lake Wenatchee from one of the most beautful and attractive recreational lakes in the State to yet another stagnant reservoir that unfortunately seem to abound far too much in our beautiful territory. I demand that the report be re-written to more accurately reflect these realities, so that a fair and balanced decision can be made about the advisability of water storage in Lake Wenatchee.

Yours truly,

Richard Szeliski and Lyn McCoy
16559 N. Shore Drive
Leavenworth, WA

From: WHTRVRRD@aol.com
Sent: Thursday, June 12, 2003 12:27 AM
To: Lisa de Vera
Subject: Comment on the Lake Wenatchee Water Storage Feasibility Study

Lisa,
The attachment is the only part of the MWH report I take issue with.
Following are my comments.

1) First and foremost we must remember this is only the final report of a FEASIBILITY STUDY.

2) Finally, this study provides us, the citizens of the Wenatchee River Valley, with the basic information to answer the question, "Do we want to look further at damming Lake Wenatchee?"

3) Over all I see this study as well put together and about what I would expect for the dollars involved, the time available, and the magnitude of the idea.

Paul K. Gray

From: Robert Friele [rfriele@attbi.com]
Sent: Wednesday, June 04, 2003 11:14 AM
To: Lisa de Vera
Subject: Lake Wenatchee Water Storage Feasibility Study Open House

Dear Lisa deVera,

I'm one of the out-of-town landowners around Lake Wenatchee and wanted to express my disappointment that the date and time for this very important Open House report presentation practically guarantees that people like myself are excluded. Even though I live in the Seattle area it still takes about 2 1/2 hours to get to Leavenworth from home, so I would have to take almost a full day off from work to participate, as well as the probable expense to have a babysitter to watch my kids in the evening. And my wife especially could not participate since she is a physician and can't just take off for a day whenever she wants and leave her patients in the lurch. Weekends are about the only reasonably feasible time for us, and I know there are many landowners with similar circumstances.

Obviously, I have a very high stake in the outcome of this feasibility study and although I am reading the materials provided on your website it in no way substitutes for the personal interaction that an event like this Open House provides. "Actions speak louder than words" is a favorite saying of one of my business partners and I have found it be very true. You realize this (consciously or not) just from the very fact of having these public meetings. Please select dates and times for future meetings that allow EVERYBODY to participate, without creating significant hardship to a large percentage of people that will be permanently affected by the outcome of this study and the future ramifications it will provide.

Sincerely,

Robert Friele
Lake Wenatchee landowner
206-459-6665
rfriele@attbi.com

MR. MIKE KAPUTA

Director, Department of Natural Resources
Chelan County
411 Wenatchee Street
Wenatchee, WA 98801
Fax: 509.667.6475

16 June 2003

Dear Mike:
As a landowner on Lake Wenatchee, my wife Alexandra and I are very concerned in regards to the construction of a dam facility on this beautiful (natural) lake. At a time when concerned citizens and governments are routinely searching out ways to remove dams on watersheds, we find it particularly distressful that this project has received any attention at all.

In terms of endangered/ threatened species this lake supports a population of Bull Trout, and seasonal populations of Spring Chinook and Steelhead. It is critical that the existing balance between the seasonal shoreline (summer pool level) be kept in a natural, unaltered state. The impact to natural food supplies coming from nymphs and other aquatic insects could be significantly impacted if the shoreline is submerged during the late spring summer and early autumn months.

The impact to property values has not been reasonably defined as yet in terms of any published documentation. The affect of the wind and continuous high pool levels during the summer months will surely cause bank erosion. Clearly this will have impact of property values. In addition, the loss of this natural exposed rocky shoreline during the summer changes the appeal of this delicate area. It would disallow any type of foot travel along the shoreline. Walking along the beach during the day (and at night) is deeply cherished by our family. There is a loss in a safety factor as well when the shoreline is taken away and property owner's yards go directly into the lake with no buffer.

In closing, I feel it is the fiduciary responsibility of the County to keep Lake Wenatchee in its existing natural state and curtail this dam construction project.

Sincerely,

Steven Taber
17640 North Shore Drive
Leavenworth, WA 98826
509.763.0370
Steve@TheTabers.net

Comments on the
Lake Wenatchee Water Storage Feasibility Study, June 2003, Final Report.

by

Thomas H. Kahler, Fisheries Biologist, PO Box 3291, Wenatchee, WA, 98807

Submitted July 30, 2003

The report seems to be written from the perspective that there would theoretically be greater biological benefit from the storage of more water in Lake Wenatchee; an assumption that focuses on potential biological benefits in the river downstream of the lake in the form of instream flow, rather than on the potential impacts to the lake ecosystem. However, there is insufficient investigation of or cautions in the face of data gaps regarding the importance of the lake as rearing habitat for juvenile sockeye, spring chinook, (coho—in the future, perhaps), and multiple life-history phases of bull trout and their prey, to warrant such an assumption. Considering the modest increases in flow that would result from the various storage alternatives, perhaps we should focus more carefully on the potential impacts to the lake ecosystem.

Little attention was paid to the inevitable loss of shoreline vegetation (other than the wetlands) that will occur to some degree under all of the proposed alternative storage scenarios, although there are compelling examples from other systems of such loss (Lorang et al. 1993). Please contact Dr. Jack Stanford or Dr. Mark Lorang at the University of Montana (Flathead Lake Biological Station) for information regarding this inevitability. The loss of shoreline vegetation results from the inundation of beaches during the growing season. Under an unmodified hydrograph, erosion and sediment transport create beaches at the peak of the hydrograph, and those beaches are subsequently colonized by early successional vegetation (e.g., willows, cottonwoods) as the water level subsides. Prolonging the high water through the growing season precludes the establishment of such vegetation, and results in the loss of the existing vegetation.

Loss of shoreline vegetation could have a variety of biological and physical consequences. For example, overhanging vegetation and small woody debris, which provide critical refuge habitat for juvenile salmonids and other small-bodied fish, would be reduced, as would the input of detritus from that vegetation. In other oligotrophic systems, researchers have found that detritus from shoreline vegetation constitutes a significant component of the nutrients in the littoral zone (France 1995; France and Peters 1995; France et al. 1996). To date, no one has investigated the contribution of detritus from shoreline vegetation to the whole-lake or benthic productivity of oligotrophic Lake Wenatchee. Additionally, as stated above, investigations into the habitat use and behavior of juvenile salmonids, their prey, and their predators in Lake Wenatchee, and specifically, in the nearshore, have not been completed. Therefore, we are not equipped to predict the consequences of the loss of detritus and complex habitat features on juvenile salmonids. Finally, loss of shoreline vegetation will result in changes in the rates and patterns of shoreline erosion and sediment transport.

Changes in the characteristics of shoreline vegetation were not factored into the analysis of wave energy. Indeed, assumptions regarding the opinion in the report that "…very little additional erosion would occur if the lake were to be maintained at El. 1870.3…" were not supported or clearly defined. While an increase in wave energy resulting from the two alternatives that were analyzed was noted, the analysis did not consider what would happen to the shoreline under prolonged exposure to wave forces—that is the real question. Under any of the proposed storage alternatives, the shoreline of Lake Wenatchee would be subjected to wave action at high water (relative to the unmodified state) over an artificially prolonged period. A review of the available literature from such sources as the *Journal of Coastal Research*, *Ocean and Coastal Management*, and *Coastal Management* should provide ample empirical evidence that such a scenario would result in substantial erosion, and the catch-22 situation of the accompanying vegetation loss would exacerbate that erosion. Again, see Lorang et al. (1993).

Errata:

Stranding of redds in the Wenatchee River seems an inevitable consequence of the proposed storage alternatives. Please provide additional evidence, in the form of analysis of known spawning locations and water levels, for why that would not occur or how that could be minimized. On a related note, the "pulsing" alternative introduces additional opportunities for stranding, as noted in the report. The importance of habitat persistence for juvenile fish (Freeman et al. 2001) should be investigated, and the assumption that fish can leave areas of potential stranding if given enough time (ramping) is presumptuous.

It appears that the gravel-sand transition could potentially move upstream in the White and Little Wenatchee Rivers. Were any attempts made to quantify how far upstream would the depositional zone move?

Have any measurements been made of the depth of the hyporheic zone at the proposed dam location?

Can it be demonstrated that the proposed ladder could accommodate the upstream migration of juvenile salmonids (all species)?

References:

France, R. L. 1995. Macroinvertebrate standing crop in littoral regions of allochthonous detritus accumulation: Implication for forest management. Biol. Conserv. 71:35-39.

France, R. L., and R. H. Peters. 1995. Predictive model of the effects on lake metabolism of decreased airborne litterfall through riparian deforestation. Conservation-Biology 9:1578-1586.

France R., H. Culbert, and R. Peters. 1996. Decreased carbon and nutrient input to boreal lakes from particulate organic matter following riparian clear-cutting. Environmental Management 20:579-583.

Freeman, M. C., Z. H. Bowen, and E. R. Irwin, 2001, Flow and habitat effects on juvenile fish abundance in natural and altered flow regimes: Ecological Applications, v. 11, p. 179-190.

Lorang, M. S., J. A. Stanford, F. R. Hauer, and J. H. Jourdonnais. 1993. Dissipative and reflective beaches in a large lake and the physical effects of lake level regulation. Ocean and Coastal Management 19: 263-287.

From: wallace gibbons [wallacegibbons@mac.com]
Sent: Friday, July 25, 2003 10:00 PM
To: Lisa de Vera
Subject: Lake Wenatchee Water Storage

Dear Lisa, Please add my name to the list of individuals that oppose the proposed dam at Lake Wenatchee. Disrupting one of the last natural ecosystems in the lower 48 makes no sense. A dam will increase water temperatures, flood wetlands, ruin lake shore vegetation, decrease property values and negatively impact fish. I would like to see the science that supports the logic that a dam can improve fish survival. Currently, many dams are implicated in the demise of fish species all over the world. Please put an end to this project as soon as possible and save the tax payers some money.

Wally Gibbons

From: LaPatra, Bill
Sent: Friday, August 01, 2003 8:21 AM
To: Lisa de Vera
Subject: FW: Lake Wenatchee Water Storage Study
Dear Feasibility Study Team,
We are owners of land and a cabin on the south shore of Lake Wenatchee and would like to share some comments and concerns regarding the Water Storage Study.

We are adamantly against the five proposed alternatives being considered for water storage. Our primary use of the cabin and beach is during the summer, the same months you have proposed to eliminate our beach with the higher water level.

Our primary objection to the proposed dam is the destruction of the beaches around Lake Wenatchee and the environmental impact to the lake . The primary reason for our use of our cabin is enjoyment of the lake. The beach is our interface with the lake and is truly critical for that enjoyment. Our family activities are centered around the beach and it's edge on the lake. My family and other users of the house are among those residents who place a very high value on " beach accessibility during the summer months." Paragraph 3 of part 5.1.1.2.2 indicates that beach accessibility is a large part of the perceived value of lakefront properties. We would be very bitter over the loss of our beach and hurt by the subsequent loss of property value.

We have made a substantial investment in our place and the result of the dam would severely hurt the balance of beach frontage and net result in a loss of value to our property. We see the negative environmental impacts to the shore edge and ecosystem of the lake being long term and unacceptable. It will take decades for the lake to recover from any of your dam options. When we purchased our weekend house, we did so with the expectation that we would have a beach. Because it was built in the 1950 's, our house is near the water and has a basement that is at a low elevation. Extreme high water has entered the structure in the past. Clearly, increased water elevations put us at additional risk for structural damage. The upland portions of our land are occupied with ingress/egress easements and steep slopes. The existing house occupies the only place on the parcel that is buildable. Inaddition we have an easement access at the existing beach level to cross our neighbors property when we need to deliver heavy cargo like construction materials, kitchen equipment and other neccessary items. The raise in water level will no longer allow use to use that easement, thus resulting in a loss of access to our cabin. There have got to be better ways to manage water in our state. I dispute the theory in your report regarding the need for increased water usage, as we see the decrease of agricultural land being sold and redeveloped. Ag. land is historically a much bigger user of water than residential uses. There are better ways to manage peak water needs than adversely affecting the quality and character of one of the few alpine lakes in our state where people own property. Zoning limitations may be the solution that must put in place to preserve the pristine beauty and natural flow of Lake Wenatchee. Do not let the downstream geed of developers upset the rare beauty and balance of this upstream lake.

Lake Wenatchee is unique in the state for it 's recreational quality and accessibility. I see the water storage scheme as very damaging, and urge you to abandon it.
Thanks for letting us comment.
Bill, Molly, Madeline, Clara and Tessa LaPatra
16000 Cedar Brae

From: Bruce Jacobsen
Sent: Monday, July 21, 2003 1:22 PM
To: Lisa de Vera
Subject: RE: Lake Wenatchee Water Storage Feasibility Study-Final Comments

The dam makes no sense. Studying this project further makes no sense.

A. The endangered species issues are unstudied (why?) and preclude this
being a viable candidate. In a lake where building a dock is highly problematic, a dam makes no sense.

B. The economic costs were understudied, underestimated. The lost of value to the current home owners; the consequent lost of tax dollars; the cost of buying land rights; the diminishment of recreational value and hence dollars -- are huge costs.

The simple logic of: we're going to diminish the values of houses that already exist, so we can increase the value of houses yet to be built, or build more of them -- escapes me.

The supply of water may be a limiting factor to development. Why not just turn off the water on some existing homes so you can build more, or tell current homeowners they can use only 1/2 their current water?

Sent: Sunday, June 29, 2003 5:18 PM
To: Lisa de Vera
Subject: (no subject)

Subj: **Dam Project**
Date: 6/27/03
To: lisa.devera.@co.chelan.wa.us

I am writing this letter in response to the dam project, and the flooding of Lake Wenatchee. We live on the North Shore, and I am sending pictures of our property, as well as surrounding docks, that will be like this all summer long, with the installation of a dam on the Wenatchee River. As you can see in the photos, we would have the loss of a beach for the entire season. Also the boat hoist would be useless, and with the winds we get on the lake, this is the only way to keep your boat safe. I am totally against this project. In your report you state that the wind comes from the North, and North West. I have been up here for 28 years and the prevailing winds, 90% of the time, come from the West. In your photos down at the meeting, why don't you show the loss of property, (photos) of property that has no beach with the high water. What would you want a boat launch below the dam for? Just to accommodate the rafters that float the river? Another $171,000 dollars spent for what? We have (as seen in the photos) a bulkhead to protect the loss of property, and with the high water, we are constantly looking for logs to keep away from the bulkhead, we lost half of this, one year because of high water and logs coming in and destroying the bulkhead. You will note in the photos that the first and third docks would be underwater, and another not in the photo would be lost as well. The fish have been doing fine for 100s of years, and I don't see that the State needs to spend well over 5 million, (just a starting point) to supply them this minimal amount of water. With news all the time in the paper and the TV, they are taking out dams, Nationally, and here you want to install a dam. Something doesn't add up right here.

Darold H Bieber


5 28 '03

From: Tom & Marilyn Fleming
To: Lisa deVera
Sent: Tuesday, July 8, 2003 9:06 PM
Subject: Lake Wenatchee Dam

Comments. I am a land owner on north shore Lake Wenatchee. I am against water storage dam for following reasons;

1. This is one of the few undammed glacier fed lakes. Putting in a dam would change the tourist appeal of the area. the sense of enjoyment of this natural area has not been taken into account.
2. Raising the level for several months a year would change vegetation around lake and cause a "bath tub like" ring at edges thus changing aesthetics.
3. There may be unintended and unexpected input on environment including fish habitat e.g.. raise in water temperature or other changes in biosphere.
4. There may be flooding of foundations or septic systems or other unanticipated changes.
5. The cost does not include purchase of boat houses, docks or other fixed structures which would be flooded.
6. My land plus many others will lose beaches during flooding times causing loss of enjoyment of lakeside areas.
7. State park plus other properties would lose valuable beaches and boat launches.
8. The need for this water has not been demonstrated. If there is a need for agriculture has the possibility of a pipeline from the Columbia been investigated?
9. Ruining the habitat and surroundings of the lake for a small increase in useful use of water is not justified.
10. The increased flow to the Wenatchee river for 2-3 months does not warrant use of dam and elevating the level of the lake for several months.
11. Use of the dam opens up the possibility of drawing down the Lake in the future if water needs increase.
12. Recreational use of Lake will be dramatically changed
13. Cost of dam does not include maintenance or running of dam; also does not include possibility of damage to dam. Also there is no entity that has agreed to run dam.
14 Cost does not justify building dam; also no source of funds or way to pay back has been identified.
15. Economic loss to land holders is impossible to determine ahead of time. Loss of value to landowners is not taken into account.
16. Land erosion around edge of lake could cause irreparable damage.
17. Benefit to fish and other aquatic habitat can be estimated but not known for sure.
18. Many dams have caused damage to the environment and removal is being recommended by many. Another dam is not needed.
19. Finally the need for this additional stored water for 2- 3 months a year has not been demonstrated.

> Therefore I recommend that this idea be dropped. The Lake Wenatchee Water Storage Feasibility Study shows this to be a bad idea and not worth pursuing. There are many unanswered questions including economic impact, whether the dam is needed, and irreparable damage to lake environment. Lets stop this consideration of the dam before any more money is spent on a bad plan for a dam. Lets not put in a dam that might need to be removed in 10 - 20 years due to damage to the environment. Please inform our legislators that this has been investigated as mandated by legislature and found not to be justified.

From: JDBraunSD@aol.com
Sent: Monday, July 21, 2003 8:03 PM
To: Lisa de Vera
Subject: Re: Lake Wenatchee Water Storage Feasibility Study-Final Comments
To Whom It May Concern: I feel that this study was a waste of taxpayers' money. I attended the first meetings at Cascade School and followed up on other meetings. When I went to the last meeting recently at Cascade School we were put into small groups just as at the very first meeting. We still asked questions and had NO answers. This study is a spinning wheels situation.
Joan Braun, Cashmere

July 31, 2003

Mike Kaputa
Chelan County Watershed Program
411 Washington Street
Wenatchee, WA 98801

Subject: Comments regarding June 2003 report
Lake Wenatchee Water Storage Feasibility Study

Dear Mike,

This letter summarizes my comments, for inclusion in the final report as public comments. As you know, I was an active participant in the study as a member of the Project Team that you assembled and managed. I appreciated the opportunity to participate and congratulate you on completing the study under a tight schedule.

By way of background for my comments, I own a cabin on the south shore of Lake Wenatchee. I am a registered professional engineer, practicing geotechnical engineering. Some of the local projects I provided professional geotechnical engineering for include the Kahler Glen EIS, the Highway 2 Wenatchee River Bridge in Leavenworth, and landslide repairs on Highway 2 for WSDOT. I purchased my property on Lake Wenatchee in 1991, and repaired foundation damage that had occurred during the fall 1990 storm. I have directly observed the effects of several major floods on the lake, as well as shoreline tree falls, slides, and erosion caused by typical wave and storm erosion.

My comments are:

1. **Due to the increased shoreline erosion and damage to existing homes resultant from storage at elevation 1872 feet or higher, alternatives 1, 2 and 3 are not feasible.** The study demonstrates that storage above elevation 1872 will significantly increase erosion by wind blown waves. The probable extent of damage was not determined by the consultants. I believe that with even a cursory examination of the south shore, it should have been obvious to the consultants that numerous houses are located on steep slopes that terminate at approximately elevation 1872. These houses will undoubtedly be at

increased risk of damage if storage alternatives 1, 2 and 3 are pursued. Other improvements such as STEP sewer tanks, bulkheads, docks and access roads will also be damaged. While the report implies concern, I believe that the report conclusions are off base in this regard. These alternatives can not possibly be considered feasible when the probable widespread damage is considered.

2. **Storage to elevation 1872 feet or higher results in significant changes to the naturally occurring environment. Because such changes are not consistent with public land use policy and impair the natural environment of Lake Wenatchee, Alternatives 1, 2 and 3 are not feasible.** The report describes probable killing of shoreline trees, alteration of the wetlands at the head of the lake, and shoreline erosion. The conclusions of the report leave open the possibility of storage above elevation 1872 feet. The environmental impacts caused by storage to this level are severe and render these alternatives not feasible.

3. **The increased river flow benefits of the planned storage alternatives 4 and 5 are negligible in comparison the impacts and costs.** Since alternatives 1, 2 and 3 are clearly not feasible or prudent, the benefits of alternates 4 and 5 should have been evaluated in clearer terms. The increase in flow to the Wenatchee River provided by these two alternatives is negligible in comparison to the total water needs. The consultants provided estimates of project cost and impact costs that might look attractive to the County or Legislature in terms of dollars per acre foot of storage, but the impact costs are understated and the benefits in terms of river flow are negligible. The benefits to fish are not significant, and the project may actually result in a net impact on fish populations.

4. **The cost to make property owners whole and compensate for reduced property values, reduced recreational use of the lake, and impact to private property is understated.** These costs are better understood by others, but I can testify to my own use of my property and my observations of my neighbors. Recreational use of the lakefront only occurs to a significant degree during warm weather and low water, which occurs from early July through Labor Day. Many properties are only used for water related recreation. The storage project would curtail or in some cases eliminate these recreational uses during this period. The study looked at compensation for second class shorelands, but neglected this much higher component of property value impact. Compensation for the impacts to these property owners should entail the full value of the property and improvements.

5. **The impacts to public lands on the lake shore are significant, and will not allow agencies to support this project.** The State Park will be impacted by loss of beach, increased erosion, and loss of the raft launching ramp. The Forest Service owns and leases out waterfront homes. Non profit groups such as YMCA and Campfire will be impacted. The opposition to this project will not consist only of private property owners.

6. **The public is not behind this project, and never will be.** Despite plenty of meetings open to the public, the public participation at the meetings was usually small. When large public turnout did occur, the public was against this project. The key concept that will

undoubtedly result in widespread opposition to this project is this: Lake Wenatchee is the major link in a free-flowing river system. The public will never support damming Lake Wenatchee because it is relatively untouched by man-made intrusions. The lawsuits that assuredly will result from pursuit of this project will be a drain on the County budget, which would be a waste for a project that can never overcome widespread public opposition.

Thanks again for allowing me to participate in this study. I hope that the optimistic conclusions of the report do not cause the Legislature to allow further public expenditures on this project. I believe that public opposition will ultimately kill the project, because the impacts of the project do not justify the minimal benefits that it may provide.

Sincerely,

John Zipper
9111 Cascade Drive
Edmonds, WA 9802

From: MBaker1958@aol.com
Sent: Wednesday, July 30, 2003 11:51 PM
To: Lisa de Vera
Subject: Re: Lake Wenatchee Water Storage Feasibility Study-Final Comments
Dear Mrs. DeVera,

I am a third generation property owner on Lake Wenatchee. My family has been visiting this lake since the late 1890s-- from my grandparents to my grandchildren. My family is well acquainted with the high and low water levels, the seasonal fluctuation of the shoreline and its vegetation, the changes that occur naturally in the clarity and temperature of the water, the bountiful sockeye salmon runs in the late summer and fall, the erosion that is naturally caused by the great winds that blow on this lake particularly in the summer months, and the natural beauty of the shoreline and beaches that have remained essentially the same for the past century. We are greatly concerned about the results that a dam on this lake would have on all the above.

1. When the lake level is raised to high water level for several months, what would be the result of high velocity winds (often 25 mph) and wave action on this "new" shore line that is several feet above the natural rocky and sandy shore? Raised water line would greatly narrow all land owners' property. What would be the result of wind, water and wave action on their property?

2. The lake's high water in the past has always greatly multiplied the mosquito population. What would many months of high water level cause? The upper end of the lake is mostly swampy land that would be doubled in size by high water.

3. High water always brings much increased drift wood, snags, roots, and logs into the lake. What navigational problems and recreation hazards would this cause?

4. What would several months high water do to the clarity and purity of the water in the lake. Over 50% of the property owners around the lake take their water from the lake.

5. Who can fore see and safely change or interrupt nature's delicate ecosystem that now exists around Lake Wenatchee? The West end of the lake is a haven for hundreds to thousands of animals. What would be the long term results to this ecosystem that has survived so well for thousands of years?

6. With Washington State having such a large deficit, how can one justify spending the money for such a dam? Who is going to pay for it?

6. What land developers are behind this proposal and why?

7. How are the costs of compensation for lost property, beach, docks, etc., going to be met?

My husband and I have attended at least three of the public meetings and have been informed and updated on the study for this Dam Proposal by the 3 property owner representatives on the Study committee. We have yet to hear and understand compelling needs for this dam that warrant the changing of this pristine beauty of Lake Wenatchee for ever. We resoundingly support the arguments posed by so many others who also oppose the Dam project. We have been privy to property owners concerns and opinions all around the lake and heartily agree with the arguments used by Ray Aspiri, Steve Craig, Al Hillel, and Sylishki to name a few.

My husband and I were impressed with the last public meeting at Cascade H. S. in Leavenworth and the presentation that was made there. We felt that the study committee and leaders had fulfilled their duties. A great many of the lake's property owners turned out for this meeting to voice their opinions and ask questions. It was most apparent that the consensus was against the construction of this Dam. We think that it is important for us to complete this process by further voicing our dissension in this email.

Marilyn and Tom Baker

From: ROBERT.WEISEL@usbank.com

Sent: Wednesday, June 18, 2003 5:25 PM

To: Lisa de Vera

Subject: Lake Wenatchee Water Storage Feasibility Study

As a homeowner on Lake Wenatchee, I have the following issues with the Lake Wenatchee Water Storage Feasibility Study dated June 4, 2003:

1. If I have understood the presentation, the two primary benefits of the dam are related to the improvement of irrigation capacity and water for the future growth in the Leavenworth area. An increased in the irrigation requirement of the area will not occur because of crop stability and more efficient watering system. The 20 year projected growth in the Leavenworth area is extremely difficult to predict and does not support a project of this impact at this time

2. In the slide entitled "Summary of Socioeconomic Impacts" the comment is made that "Higher water elevation unlikely to decrease property values". This is inaccurate. On our property, the increase water level will cover our beach, result in our dock becoming extremely difficult to use , and will probably render our pileings inoperable.

3. The negative impact on the salmon and the lake wetland is inexcusable given the weak justiification for the dam.

While threats are a poor argument, you can be assured that we will not be reluctant to seek legal counsel to insure that our rights are not violated. I suspect that we will not be alone in that fight.

Finally, A large percentage of the homes on the lake are second homes. It is somewhat questionable, why this meeting is being held on a weekday. To receive a true representitive response, it should have been held on a day that would allow access to more people from the Western part of the state.

Thank you for considering these issues. I hope to be able to attend the meeting and present these thoughts in person.

Robert and Christine Weisel

From: T. William Booth
Sent: Thursday, July 31, 2003 12:17 PM
To: Lisa de Vera
Cc: thsbrucker@earthlink.com
Subject: LakeWenatcheeStorageFeasibilityStudy
Lake Wenatchee Water Storage Feasibility Study
Comments by Beatrice C. and T. William Booth
5521 17th Ave. N.E. Seattle, WA, 98105 and
16925 Fir Drive, Leavenworth, WA (above Lk. Wenatchee)
July 31, 2003

1. The environmental effects are underestimated and incompletely studied. They concern only fish and plant species. The natural system is more complex than just those forms. With respect to the "extensive complex of wetlands" at the western end of the lake: as the current sedges and rushes hypothetically move upslope they move to sloping land encompassing less area at some given elevation than the large flat area of the current wetlands. The spikerush and bur-weed hypothetically replacing them would occupy this larger flat area. The original wetland with its multitude of bacterial, protist, algal, invertebrate, vertebrate, and higher plant species would then be greatly diminished in area and number of individuals, and another complex of species would fill the larger flat area. How would this change affect the entire system including the source of food for the salmon and other fish? We cannot just write off major man-induced changes in an ecosystem as a simple exchange of plant species.
The effect of the reservoir is on birds and other non-fish vertebrates is not considered, although these are important components of any living system.

2. Why install a ten foot dam when at most you are considering raising the water level five feet.? This invites worse manipulation of the natural system in the future.

3. We are concerned about the small benefits of this project (a small amount of water, really), compared with the high cost, especially those of purchasing the easements for inundation of second class shorelands and perhaps flooding easements.

4. We are also concerned about losing the natural beauty of the outlet of Lake Wenatchee. Not only would the dam intrude, but the replacement launch facility as well

would eliminate some of the natural setting along the river that is so precious to campers and day-users.

5. In conclusion, we are sure it is feasible to build the dam under consideration, but at what cost to a gorgeous, natural place, where campers vie with each other to camp along the river? At what cost to a natural migration of fish, and an intact ecosystem? Perhaps the last, large headwater lake in the Washington without a dam! Why not save it as a State Treasure?

From: Griffvicki@aol.com

Sent: Monday, July 21, 2003 3:37 PM

To: Lisa de Vera

Subject: Public Comments: Dam Proposal, Lake Wenatchee

A "RUBBER DAM" OR A "SAFE DAM" AT LAKE WENATCHEE?

Rubber is cheaper than concrete and steel, but what about Dam Safety? Imagine the flood damage and possible loss of life resulting from an 8 or 10 foot wall of water rushing from a failed rubber dam at Lake Wenatchee.

Why are you even proposing something like a "rubber" dam? The answer is simple: Cost! When you are proposing a dam that has few benefits and causes plenty of adverse impacts to an existing natural lake and environment, you better keep the costs cheap, cheap, and cheap. Rubber is cheaper than concrete and steel, cheaper than doing it right, cheaper than doing it SAFELY. After all, a concrete gravity dam grounded on bedrock would be safe but it would be much more costly. Ditto for a heavy rock fill dam (with an adequate concrete cut-off trench underneath and a concrete spillway that could safely pass say a 500-year flood). Costly. But safe. Rubber bladders and wooden weirs have their place. A reasonable use of a rubber dam or a weir would be for an irrigation diversion from a stream. If it did fail, it would only release a small quantity of dammed water. Flood damage would be little, if any. Human lives would not be endangered. However, if a dam at Lake Wenatchee failed, it would dump an 8 or 10 foot wall of water from a six-mile long reservoir. Look out below!

This from an engineer who has directed multi-purpose dam and reservoir planning for one of the "major Federal water resource agencies" mentioned in the County’s dam study. Did we ever seriously consider – or have I even seen - a "rubber dam" for a use such as proposed for Lake Wenatchee? No, never.

My recommendation: do it right, do it safely, or don’t do it at all!

M. Joel Griffith 16609 North Shore Drive Leavenworth, WA 98826

From: William Ballantine [williamballantine@msn.com]
Sent: Wednesday, July 23, 2003 2:04 PM
To: Lisa de Vera

Hats off to Steve Craig, Ray Aspiri and the many others who have taken time out of their lives on this project.
I have a cabin on Lake Wenatchee and would lose almost all of my waterfront if the dam goes through. I vote, NO!

While I think a dam has its uses letting the water rise as high as I have been told it would is not one of them. Sorry I am playing catch up this latte in the game.

Bill Ballantine

United States Department of Agriculture **Forest Service** **Okanogan and Wenatchee National Forests Lake Wenatchee & Leavenworth Ranger Districts** **22976 HWY 207 Leavenworth, WA 98826 (509) 763-3103 Fax (509) 763-3211**

File Code: 2540
Date: August 01, 2003

Mike Kaputa
Chelan County Natural Resource Program
411 Washington Street
Wenatchee, WA 98801

Dear Mike:

Thank you the opportunity to comment on the Lake Wenatchee Water Feasibility Study, and the progress of investigations to date. I had my staff review the Preliminary Draft dated June 4, 2003, and those comments were electronically sent and received by Chelan County. I would like to express some of my general concerns in this letter, based upon my understanding of the legal aspects of this project, and our review of the study as it relates to the ecology of the lake.

I sent you and earlier letter that outlined our legal concerns regarding the ownership of the bed of the river and Lake Wenatchee. So far, there is insufficient evidence that the State of Washington has followed the proper process for claiming ownership. Therefore, our position is that ownership of the bed still lies with the federal estate. As such, additional federal laws and requirements could apply to this proposed project.

Also, it should be noted that the Forest Service's 1990 Land and Resource Management Plan recommended this section of the Wenatchee River for inclusion into the Wild and Scenic River System as a "Recreation" river. A dam would be an unacceptable structure according to the criteria, since it must be "free flowing." The Forest Service is directed to protect the essential values of the river until Congress has had an opportunity to act.

Regarding federally listed fish and the hydrologic effects of the proposed dam, I am concerned that the initial report does not go into great enough detail regarding the alteration of temperatures, potential to affect flow, wetland alteration and resultant effects on the fish community. Specifically, I would like to see temperature changes modeled to better describe how impounding water will cool or maintain outflow temperatures. I am not convinced that stream temperatures downstream of the structure will be maintained or cooled. Often, it has been presented that this dam is being proposed in large part to benefit listed fish. I believe the dam is actually proposed to ensure that water rights will remain viable downstream. If this is in fact the case, this should be addressed in future iterations of this study in a more straight forward manner. Benefits for water users versus possible ecological harm to listed fish species should be disclosed.

I am also concerned about the affects of the proposed dam on the wetland ecosystem. The wetlands that exist at the confluence of the Little Wenatchee River, White River, and Lake Wenatchee are recognized "forested wetlands" within the Intermountain West, due to the relative scarcity of this type of habitat within the Columbia Basin system. The Lake Wenatchee wetlands provide nesting for the bald eagle (federally listed as Threatened), common loons (Sensitive species) and harlequin ducks (Federal Species of Concern). In addition, these wetlands are found to be important both for nesting, and refugia during migratory periods for waterfowl and neotropical migratory birds. In Lake Wenatchee proper, there is potential loss of the lake substrate which provides continuity for the fresh water Western Pearl Mussel (*Margaritifera falcata)* and possibly the California Floater Mussel *(Anodonta californiensis)* a Federal Species of Concern. The study should address the regulatory feasibility of altering the habitat of federally listed species.

The shorelines of Lake Wenatchee and Wenatchee River provide riparian roosting/foraging habitat for several species of wildlife including osprey, bald eagle, great blue heron, songbirds, and aquatic mammals. Human developments currently alter and encroach upon the Lake Wenatchee shoreline. I would like to see the cumulative effects to the wetlands and shoreline better described in future iterations of this study.

I would like to point out that the Lake Wenatchee and Leavenworth Ranger Districts are actively working with several partnerships on restoration projects to improve wetlands and the riparian to benefit wildlife and fish in the Lake Wenatchee basin. The proposed dam would negate these projects.

Finally, I would like to mention that as this proposed dam is being studied, a watershed planning exercise is also underway in the Wenatchee Watershed. A part of this study is looking at instream flows. At the very least, I would ask that you postpone any decision to move forward with this proposal until that study is complete and decisions have been made on strategies for addressing instream flows and water quantity.

Thanks again for the opportunity to comment.

Sincerely,

Robert A. Steel

for GLENN M. HOFFMAN
District Ranger

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Central Washington Field Office
215 Melody Lane, Suite 119
Wenatchee, Washington 98801
Phone: (509) 665-3508 Fax: (509) 665-3509

July 31, 2003

Mike Kaputa
Coordinator, Chelan County Natural Resources Program
411 Washington Street
Wenatchee, Washington 98801

FWS Reference: 1-9-2003-TA-W0335
HUC: 17-02-00-11

Mike
Dear Mr. Kaputa,

Thank you for the opportunity to provide comments on the draft Lake Wenatchee Water Storage Feasibility Study. Thank you as well for all the hard work that went into preparing this draft. Your Program has done an outstanding job of coordinating the process for completing this study, especially in regards to providing opportunities for public and agency involvement. The topic of this feasibility study is contentious, and you and your staff did an excellent job of creating and maintaining a constructive and civil atmosphere in which this study could be completed.

Although the FWS participated on the Project Team for this feasibility study, this involvement should not be construed as support for project implementation. The FWS believes that good feasibility studies are essential to making good decisions. All members of the Project Team worked hard to improve the quality of the feasibility study, and the FWS in particular sought to improve the study's evaluation of project impacts to fish and wildlife resources. The FWS feels that the study successfully demonstrates that the proposed benefits of water storage in Lake Wenatchee do not outweigh the project's negative impacts, especially adverse environmental impacts to wetlands and bull trout (*Salvelinus confluentus*), listed as "threatened" under the Endangered Species Act of 1973 (16 USC 1531, et. seq.) as amended. The study also indicates that alternative approaches to water management show strong potential to address conflicting water demands in the Wenatchee Basin, without imposing a similar level of adverse environmental impacts.

General Comments:

1. This feasibility study was conducted at an awkward time. Concern about conflicts among competing water needs in the Wenatchee Basin was a primary motivation for initiation in 1999 of the Wenatchee Watershed Planning Process. As you know, this planning process is designed to use an inclusive process to thoroughly evaluate water quantity, water quality, instream flows, and habitat issues in the watershed, and to develop a plan for managing those aspects of water resources. The products of this planning process would have been useful inputs into the Lake Wenatchee Storage feasibility study. The time line of the feasibility study, however, ran ahead of completion of Watershed Planning. Consequently, the storage feasibility study was compelled to do a cursory evaluation of topics that Watershed Planning will explore in much greater depth and detail. Specifically, while Watershed Planning is in the process of re-evaluating minimum instream flows set by chapter 173-545 of the Washington Administrative Code, the feasibility study used these minimum flows to identify instream flow as the largest potential water need to be served by the dam. The outcome of Watershed Planning could potentially make substantial changes in the size of this need, and therefore the feasibility of the proposed dam. Completing this feasibility study ahead of Watershed Planning casts doubt over the findings of the feasibility study because its foundational premises are subject to substantive change in the near future.

2. Early in the process of developing this feasibility study the FWS commented that the operations of a proposed dam will largely determine the ongoing environmental effects of the dam. The authors of the feasibility study did an excellent job of attempting to address this concern by crafting a group of potential operational scenarios for consideration. The tradeoff, however, is that development of these scenarios left insufficient time and resources to adequately address environmental impacts.

   During the project team meeting on April 30, 2003, the consultant team mentioned that about equal resources had been devoted to each of the report segments. Although equitable, this allocation does not adequately consider the relative complexity, difficulty, and volume of information resources that need to brought to bear to adequately address each of the report's primary topics. Development of the hydrological model and alternative operating scenarios is a math exercise of limited complexity that can be accomplished with limited relevant information that is readily acquired. Evaluation of environmental effects, in contrast, involves both quantitative assessments of effects as well as application of qualitative professional judgments about complex interactions among organisms and the physical environment, and relevant information is both voluminous and often accessible only through direct contact with biologist and other professionals who conducted specific studies.

   Equitable allocation of time among topics did not allow the consultants writing the report to develop the sort of detailed familiarity with the watershed necessary to adequately assess the project's environmental effects. Review of the existing large volume of watershed-specific information is necessary to sharpen professional judgments about how the project being studied could affect the structure and function of the watershed. In the absence of extensive professional experience in the basin, detailed familiarity with the particular aspects of the Wenatchee Basin can be gained only through careful study of the large body of information that has been collected on the Wenatchee Basin through the years. This background takes considerable effort to compile and months to review.

Many sources of information relevant to assessment of environmental impacts were not cited and presumably were not consulted or reviewed. For example, extensive information contained in watershed assessments produced by the U.S. Forest Service was not cited. The Habitat Limiting Factors report by Andonaegui (2001) is a tremendous resource, but the feasibility study's reliance on this single resource is excessive and suggests a lack of familiarity with alternative primary sources of information.

Lack of detailed specificity is apparent throughout the Environmental Impact section of the report. Many of the central issues regarding impacts to bull trout are mentioned under the heading of "Potential Additional Studies" and are not described in any substantive way in the draft study. The FWS believes that it is not appropriate to reach conclusions about the environmental impacts of a proposed project when many of its primary mechanisms of impact to listed species have not been adequately addressed.

The report focuses unduly on the putative benefits of the project for aquatic species, particularly benefits to anadromous fish species, while not adequately disclosing adverse effects to other species and their habitats. One premise of the report is that increased seasonal instream flows will provide a benefit to salmonids. However, the FWS is not aware of any entity involved in management of fish and their habitats or recovery of listed salmonid species that supports the proposed project. Low summer flows are a natural occurrence in the watershed, and the degree to which this factor limits salmonid production in the watershed is unclear. Likewise, the level of potential benefit that could be obtained is speculative. Finally, summer Chinook is the anadromous fish run most likely to experience any beneficial effect from the studied project, and this run is not currently listed, while bull trout will experience only negative impacts, and this species is listed as threatened.

In the Environmental Impacts section, spring Chinook (listed as "endangered") and summer Chinook salmon (unlisted) usually are not differentiated. During the period from late August through October when flows are proposed to be augmented, spring Chinook salmon are already in tributary streams and would not benefit from the increased flows. Summer Chinook salmon are holding and spawning in the mainstem Wenatchee River during the augmentation period. The amount of benefit to summer Chinook to be expected from augmented flows is unlikely to be substantial, and is also unlikely to improve the abundance of this stock which is already classified as "Healthy" by the Washington Department of Fish and Wildlife (WDFW 1993). Benefits are unlikely to be substantial because more than 60 to 70 percent of the summer Chinook salmon are estimated to spawn upstream of Icicle Creek. Instream flow above Icicle Creek is reduced by only a small amount due to water diversions, so most summer Chinook already experience a relatively natural flow regime on their spawning areas.

In some instances, the study mistakenly infers benefits of increased flow for anadromous salmon. For example, Section 6.3.2.1.1 includes the statement that, "Adult spring chinook return to the Columbia River from the ocean in late March to early April and then enter the Wenatchee River from May to June. Low summer stream flows through the Tumwater Canyon may delay entry into the Wenatchee River (WDFW 1994)." This is incorrect. High summer stream flows through Tumwater Canyon delay movement of spring Chinook salmon up the Wenatchee River. This is a natural occurrence that would not be affected by dam operation scenarios presented in the study.

Upstream migration of sockeye salmon can also be delayed in Tumwater Canyon. Sockeye reaching Tumwater Dam during mid-July through early August in some years are delayed because the fish have difficulty locating the dam's ladder. This delay is exacerbated at lower flows because flow patterns do not attract fish to the ladder. All alternatives in the feasibility study, except alternative 3, would decrease flows in the river during the sockeye salmon migration, which may result in further delay of sockeye salmon at Tumwater Dam. This potential negative effect is not mentioned in the report. Most sockeye are in tributaries when flows would be augmented, and would not benefit from flow augmentation.

The general topic of migration delay at dam structures is not discussed in the feasibility study. Even in the presence of a ladder that fish have the physical ability to ascend, there can be significant impacts if fish are delayed below the structure because of avoidance of the structure or difficulty finding the ladder. Recent studies of swimming performance of bull trout and telemetry studies of bull trout in the Wenatchee River and in the mainstem Columbia River all suggest that this species may be prone to behavioral reluctance to pass through ladders and avoidance of new structures.

Bull trout migrations would be adversely affected by the dam. The primary spawning area for these fish is in the Chiwawa River watershed which is almost 6 miles downstream from Lake Wenatchee. Adults moving to their spawning areas would need to migrate downstream over the dam. Post-spawning surviving adults migrate back upstream to Lake Wenatchee and would need to migrate past the dam. This would occur when the fish have already expended significant energy spawning. Avoidance of the structure and delay of migration would negatively impact the bull trout population. Juvenile bull trout at age 3 or 4 migrate from the Chiwawa River to Lake Wenatchee. Portions of the population migrate when the dam would be in operation and could be affected by avoidance of the structure, difficulty finding the ladder, difficulty ascending the ladder, all resulting in delay of migration. Delay of migration can result in failure to spawn, reduced spawning success, and reduced survival of juveniles.

Likewise, the topic of increased predation on juvenile fish due to predators aggregating near the structure and taking individuals disoriented by falling over the dam or passing through the ladder was not addressed.

The putative beneficial effects of the dam would occur during low-flow water years (about 25 percent of all years). The negative effects of the proposed dam would occur every year.

- Because of the timing of bull trout movements and patterns of habitat use in the Wenatchee basin, bull trout would not benefit from proposed flow augmentation. They would, however, suffer from the adverse impacts of needing to traverse the dam in both upstream and downstream directions as both juveniles and spawning adults. They would also encounter ongoing adverse habitat effects from the dam, especially due to reductions in woody debris transport and declines in wetland quality. Telemetry studies indicate that adult bull trout spend extended periods during the winter at or near the dam location.

- Some readily apparent conclusions that could be drawn from the information gathered are not presented, particularly conclusions that are not supportive of dam construction. The following example is typical. The Water Needs chapter estimates that future water needs for the next 20 years are expected to increase instantaneous demand by about 7.5 cfs. Efficiency improvements in existing delivery systems are estimated to have the potential to increase instream flow by 14 to 20 cfs. The total cost of these delivery efficiency improvements is estimated to be about $2 million. A reasonable conclusion to reach from these facts is that delivery efficiency improvements in existing infrastructure can provide more than 2 times expected water needs at about one third of the direct costs of dam installation. And these efficiency improvements are unlikely to have the level of environmental impact associated with new dam construction and operation.

- Currently, the report covers compliance with Tribal Nation Rights only in the Legal Feasibility chapter, with a summary of environmental effects. This issue also has socioeconomic components and perhaps this issue should be included in the Socioeconomic chapter and excerpted in Chapter 4 as well.

- A composite list of additional study needs is presented in Chapter 4. This is an awkward place for this list, and the FWS suggests that lists of "additional study needs" should be featured in each chapter, with a composite list prominently displayed in the "summary and conclusions" chapter. Lists of study needs for all topic areas are appropriate and should be more fully developed to highlight major uncertainties that could not be adequately addressed in the present feasibility study. The current list of additional study needs is not adequately thorough, especially for chapters 2, 3, 5, and 6.

8. Following from number 7, the study's approach to conclusions could be improved by being more explicit about remaining critical information needs. The FWS feels that it is somewhat misleading to conclude that the 1870.3 option is "feasible and cost-effective" given the existing gaps in analysis, particularly of environmental impacts. The FWS feels it would be more appropriate to state that among the options considered, only the 1870.3 option may be feasible pending further study to address critical additional information needs, and list these information needs. Perhaps also list the most substantive obstacles to implementation of any of the alternatives, such as the WRD's need to re-apply for a permit to impound water in Lake Wenatchee, the need to purchase overflow easements, and substantial environmental impact mitigation needs.

Specific Comments

1. Section 2.1 – perhaps include in the introductory paragraph an explicit statement that the "high" projection for population growth was used to develop projections of water needs, and this choice corresponds with other Chelan County planning processes.
2. Instream Flow Needs. More detail about the background of IRPP flows, especially the relationship between these flows and the ongoing Watershed Planning Process, would be very helpful for putting these flows in context.
3. 3.4.3.6 Fish Ladder. Are notches or slots feasible alternatives to fish passage at a bladder dam? This section discusses only ladders, leading to this question about other options. Effectiveness of these structures for passing all life stages of bull trout and other species in both directions throughout the operating season is an important consideration that should be briefly mentioned here.
4. 4.3 Regulatory Authority. The suggestion that the U.S. Bureau of Reclamation could be an owner/operator of the storage dam, and could use construction and operation of this dam to fulfill responsibilities for salmon restoration under the Federal Columbia River System Biological Opinion issued by NOAA Fisheries, has no merit. Benefits from this project are questionable and adverse effects to listed species are substantial. Furthermore, on May 7, 2003, Judge J. A. Redden (District of Oregon) issued a decision that the Federal Columbia River System Biological Opinion was arbitrary and capricious and remanded the Opinion to NOAA Fisheries for clarification of outstanding issues. The structure of this biological opinion and the Bureau's responsibilities may change appreciably as a result of this remand.
5. Table 4.4-1. Many of the timeframes in this table seem very optimistic. For example, the timeframe of 6 to 12 months to complete section 7 consultation on a project such as this with extensive effects to listed species is very optimistic.
6. Section 5.2.2. Treatment of recreation effects, especially valuation of factors such as the sockeye fishery in Lake Wenatchee, seems to lack specificity.

7. Environmental Impact. The description of potential project impacts has several important gaps.
    a. Construction impacts – Chapter 3 presents a proposed construction timeline and approach and this could have been used to provide a first rough approximation of construction effects. These effects will be substantial for bull trout and freshwater mussels in particular.
    b. Effects on bald eagle – another listed species that could be directly affected and should be addressed, at least briefly.
    c. Effects of the sheet pile anchoring the dam on hyporheic and shallow groundwater flow and resultant effects on instream water quality and quantity and effects on habitat quality, including invertebrate production. This subsurface "dam" would operate year-round.
    d. Woody debris recruitment – will operation of the dam and ladder result in the need to cut up large woody debris and transport it away from the dam site?
    e. Effects on water temperature. Should discuss the potential for stored water to accumulate heat and contribute to increases in instream water temperatures.
    f. Wetlands and shoreline vegetation effects – consequences for migratory birds and other terrestrial species (especially listed species) that could be adversely affected should be described.
    g. Table 6.4-2 to 6.4-6. Perhaps create a summary table that provides a more readily interpreted "box score." Add to the legend some explanation of the meaning of using a forward slash to separate ratings.

If you have any questions about these comments, please contact Karl Halupka at 509.665.3508, extension 11, or by e-mail at Karl_Halupka@fws.gov.

Sincerely,

Mark G. Miller

Supervisor

cc: FWS, Leavenworth (Barbara Kelly-Ringel)
NOAA Fisheries, Ellensburg (Justin Yeager)

30 July, 2003

Chelan County Natural Resources Program,
Attn: Lisa deVera,
411 Washington Street,
Wenatchee, WA 98801

Dear Ms. deVera,

Reference is made to the Lake Wenatchee Water Storage Feasibility Study Final Report.

As an interested citizen who attended almost all of the meetings on this subject, my comments below are forwarded for inclusion in Chapter 9 of the Lake Wenatchee Water Storage Feasibility Study Final Report.

Lake Wenatchee is one of the last large natural lakes in the state of Washington. We should not change that status. In other words do not mess with mother nature.

I do not doubt that our needs for water will increase in the coming years due to increased population growth, shrinking water supplies due to wasteful over use and global warming. No one has determined what savings could be achieved by detailed conservation measures. The Irrigation companies in the valley in many cases do not have complete records. Metering is almost non existent and old systems leak. Granted leaking systems return water to the ground but it is indicative of an inefficient system. Before any dam is built at Lake Wenatchee, A complete and detailed study of all available conservation measures in the entire Wenatchee River Drainage must be conducted. This should also include any areas outside of the Wenatchee River Drainage which are serviced by irrigation companies or others using Wenatchee River Water.

A complete study of alternate sources of water in the Wenatchee Drainage must also be undertaken. Eventually the policy of watering non agriculture properties such as lawns and yards will have to be examined with a view of changing the water laws of the state and perhaps the country. Drinking water and efficient agricultural irrigation must be the top priority with fish recovery a close second.

The Technical Feasibility portion of the study was fairly detailed based on sketchy existing data. I recommend that programs be initiated to develop a complete data base for the Wenatchee River Drainage before trying to further study the idea of building a dam at Lake Wenatchee.

A possible conflict of interest concerning the legal firm providing the legal portion of the study surfaced early in the study and in my mind was never satisfactorily resolved. The same firm also represented the Wenatchee Reclamation District which could be a major beneficiary of a dam at Lake Wenatchee. An example of an unanswered legal question was the U.S. Forest Service Representative assertion that the Federal Government owns the river bottom while the studies legal representatives claimed that the ownership was vested in the State of Washington. A truly impartial legal representative will need to resolve all legal issues.

The Socioeconomic Impacts were based, in my view, on a shallow and sketchy review based in part on lack of funds and time. The article that appeared in the 3 July, 2003 edition of the Wenatchee World Newspaper's Opinion Page titled "Lake Wenatchee deserves a better study" expands on this point and others. This article, authored by three members of the study board, covers flaws of the study in greater detail. I concur with their statements.

The Environmental Impact portion of the study appeared to be the weakest segment and was a broad brush of the environmental situation in the upper valley. I will leave it to those who are versed in the appropriate sciences to provide the details but as was pointed out at one of the last study board meetings, Bull Trout, a species listed as threatened, feed part of the year at the very site the study selected as the site of a future dam. I have the perception that environmental implications were largely ignored in this study.

In conclusion, it is feasible to build any dam of any size at any place in this day and age. The real question, not answered by this study, is should it be built at all. I do not think that this project should be taken any further. I recommend that the entire idea of building a dam at Lake Wenatchee be dropped.

Sincerely,

David M. Klinger
P.O. Box 537,
Leavenworth, WA 98826

1 Enclosure: Wenatchee World Article, "Lake Wenatchee Deserves a better study".

STATE OF WASHINGTON

WASHINGTON STATE PARKS AND RECREATION COMMISSION

7150 Cleanwater Lane • P.O. Box 42650 • Olympia, Washington 98504-2650 • (360) 902-8500

Internet Address: http://www.parks.wa.gov

TDD (Telecommunications Device for the Deaf): (360) 664-3133

July 28, 2003

Ms. Lisa de Vera
Project Coordinator
Chelan County Natural Resource Program
411 Washington Street
Wenatchee, WA 98801

RE: comment s on the Lake Wenatchee Water Storage Feasibility Study

Dear Ms. de Vera:

The document has been reviewed by State Parks' staff at Lake Wenatchee State Park, and in our regional and headquarters offices, and we have these comments to submit.

The study by the consultant, MWH, is commendable in its systematic approach to the assignment; the scoping resulted in five rational broad study areas. The report is well-organized and well-written. It brings together in one document a substantial amount of information, and identifies many areas where much more comprehensive data and critical analyses are yet needed. It is successful in clarifying many issues and acknowledges that some conclusions are inevitably tenuous, even premature.

Herewith more detailed comments:

Technical Feasibility

- <u>Shoreline erosion</u>: Further study is required to determine potential shoreline erosion at both storage elevations. Though in the Summary, MWH suggests that little or no increase in erosion would occur with water stored at OHW, their assessment "only calculates the potential wave energy and does not correlate that energy to a change in shoreline, dock or bulkhead erosion. Additional information on the erosion resistance for each would be required to make that assessment." [p. 3-52].
- <u>Public safety</u>: MWH acknowledges that the 10' x 200' bladder dam would be an "attractive nuisance" and, that given its proximity to the North and South park areas, would be highly accessible to the public. Chain link fencing, warning signs and floating barriers would be used to minimize vandalism and safety concerns. Park management is concerned that due to their proximity, the bulk of security and law enforcement activity will fall to rangers. This deserves and requires

further consideration. There seems to be little analysis provided in regards to such dam safety potential issues as catastrophic failure from natural events or terrorism. While the proposed structure is no Grand Coulee, risks commensurate with its scale should still be considered. The study fails to adequately assess the potential impact on safety of recreationists participating in water sports. No information is given related to standards for safety upstream of the dam. Is the current boat launch at Lake Wenatchee even usable, when dam safety standards are applied?

- River access: Loss of upper river access for recreationists resulted in a suggestion that an alternate boat launch, restroom and parking area be built below the dam, within the state park, on the south shore. We question the practicality of this suggestion, given the steep gradient at that location. An estimate for construction is provided ($165,000), but no estimates of the costs of operation, maintenance, and fee collection to be incurred by State Parks were given. Additionally, alternate locations for State Parks' burnpile and stockyards would be needed.
- Swim beach: Designated swim beach float cables and anchors would have to be replaced or rebuilt. These presently are of the appropriate length to be adjusted within average water elevations during summer months and they cannot be used during seasonal high water.
- Boat ramp: Storage at OHW will have minimal effect on our existing boat ramp structure, though there may be significant additional erosion based on our observations during "natural" OHW. Storage at 1872.4 or above will require replacement of the ramp.

Legal Feasibility

- 20,380 feet of shoreline (out of 70,000 feet total around Lake Wenatchee) have second-class shorelines which were sold or deeded to property owners prior to 1942. All deeds issued after 1942 were written subject to an easement for the right to overflow by the Wenatchee Reclamation District. State Parks owns 9,430 feet of such second-class shoreline not subject to such overflow right easement. As the study notes, water storage to or above OHW would require the purchase or lease of easements from State Parks for shoreline inundated. Purchase of easements and/or mitigation for actual construction activities, as well as for long-term use of property, is mentioned but the economic costs need to be assessed and projected. State Parks might not be a willing seller of such an easement if adverse impacts to the public's beaches, shorelines and vegetation communities couldn't be mitigated to our satisfaction. Legal feasibility is inextricably intertwined with socioeconomic feasibility.

Socioeconomic Impacts

- Loss of beach/shoreline: Water storage at OHW or above would result in loss of nearly all open upstream river and lakeshores, except for the main South beach and a small rocky beach in the North. July through September, the water recedes, exposing open grassy beaches which are a key attraction for our visitors who want an alternate to the crowded and noisy swim beach. These are the only option for our campers in the North. At OHW, the majority of our shorelines will have water up to and within the "shrub line". This would cause a very significant loss of public access to water and shore-based recreation (fishing, hiking, sunbathing, picnicking, etc.). We strongly disagree with the MWH conclusion that there would be little or no impact to shore fishing for this reason [p. 5-20, 5.2.2.2.1]. In addition, a developed trail along the North shore of the river would be lost. Inadequate information was collected by the study to make a determination on the impact of recreation and the corresponding impact on the local economy. At the 1870.3 foot level, water will be in the riparian vegetation along much of the shore, during peak recreation periods. Without a usable beach, the public will either not come (resulting in an economic loss of approximately $9.80/visitor/day to the local economy (Dean Runyan Associates 2002)), or they will destroy the riparian vegetation in order to create a usable beach (resulting in environmental impacts). These issues, too, require further study and detailed analyses. To local residents, the loss of recreational beaches is a loss of quality of life in a county that is economically struggling. To the state's residents, it diminishes the recreational value of one of its significant state parks. The loss of recreational value can have secondary and tertiary effects—reducing revenue from camping and day-use fees, making this park ore of a burden on the tax-supported portion of the agency's budget.

<u>Swim beach</u>: There would be a significant loss of developed swim beach at both storage elevations.

<u>Submerged hazards</u>: MWH states "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." [p. 5-20, 5.2.2.1.2]. This is referring to storage at OHW. There are many submerged hazards around the shore of the lake, but particularly in and around the main channel from the park boat ramp to the open lake. These hazards exist at all elevations we experience—regardless of the level of the lake, there always exist hazards just below the surface. For example, a boulder exposed during low, late summer conditions is arguable *less* a hazard than the same boulder, just submerged during OHW. Furthermore, the location of the dam just downstream from the boat ramp presents a hazard in the event a boat motor stalls.

<u>Upper river access</u>: Floating the upper Wenatchee River in rafts, tubes, canoes, and kayaks, etc. from the state park to Plain and/or Tumwater Canyon is a very popular recreational activity during the summer. Hundreds, possibly thousands, of people engage in these activities, either privately or as customers of several local commercial outfitters. The state park boat launch is the only significant developed public access to the entire upper Wenatchee River. Placement of a dam just downstream of the park boat launch will end reasonable public access to the river for floating these many miles of river. MHW suggests construction of a second, alternate launch facility just downstream of the dam on the South shore [see comment above, Technical Feasibility]. The Wenatchee remains a named candidate for State Scenic River status and this value should be acknowledged and weighed in the cost/benefit calculus, too.

- Archaeological: As one of the state's principal stewards of archaeological and other cultural resources, we are especially concerned about potential impacts to known and unknown archaeological sites around the headwaters of the Wenatchee River. To its credit, MWH acknowledges potential harm to these resources, both from higher water levels and from actual construction, and notes that further study is needed.

Environmental Impacts
While a number of ecological and fisheries-related issues are both very real and of strong concern to State Parks and its stewardship, education and interpretation missions, we confidently defer to colleagues in WDOE and WDFW to assure those are fully addressed. A number of aesthetic impacts are of special concern to us, and were not adequately addressed by the consultant, if at all.

- Dam and facilities: Currently there is a very high scenic and aesthetic value along the Wenatchee River at the proposed location of the dam—a natural mountain lake and free-flowing river surrounded by a forested state park. It is difficult to evaluate the harm done to the experience of the visitor with the placement of a concrete and rubber dam, numerous buoys, floating barriers, and WARNING—DANGER signs in the river, as well as on-shore fish ladders, roads, a concrete equipment vault and store yard, all surrounded by chain link fencing. MWH states "From the upstream side, the viewing corridors from the state parks would not see the bladder when inflated." [p. 3-64, 3.5.3.5 "Rubber Dam Structure Aesthetics"]. This ignores the visual impact of the floating barriers, warning buoys and warning signs.
- Trees and vegetation: Submerging natural perennial shoreline vegetation for months, rather than days or weeks, would kill these varied flowers, grasses and shrubs. It is possible that numerous trees would die as well, particularly at the higher storage level, as their roots would be submerged for extended periods. MWH acknowledges this only as a side note to potential cultural resource impacts, but fails to mention the broader implication of shoreline tree mortality. "Prolonged flooding would result in mortality and/or reduced vigor of shoreline vegetation and roots." [p. 5-27, 5.2.4.1]. As the lake level drops due to water releases in the late summer and fall, a broad band of shoreline will be exposed which would no longer support significant vegetation (possibly allowing spread of noxious weeds). This grey band ("Bathtub Ring") would be visible all around the lake and river. These impacts could be quite pronounced on Emerald Island, given that its maximum elevation appears to be only slightly higher than the proposed elevations. Holding water at the higher proposed levels will drastically impact the ecology of the wetlands in the deltas of the White and Little Wenatchee Rivers. More study is needed to assess what these impacts will be, short and especially long-term.
- Trails: We disagree with MWH's conclusion that there would be "only a minor impact to local traffic and recreational activities" as a result of the structures, facilities, and the daily to weekly maintenance activities [p. 3-64, 3.5.3.4]. The dam and its associated storage structures, air compressors, generators, fish ladder, fencing, warning signs, etc., would be placed where they would intersect a

Salmon Interpretive trail, groomed cross-country ski trails (North and South), and a Winter Snowshoe Wildlife Interpretive trail. To what extent would our users' experience and expectations be affected by all of this? Access to the dam site would not be possible during the winter months without damaging or destroying groomed ski trails and/or the sled hill.

In summary, as a feasibility study this report appears adequate to conclude that the project is not feasible at the 1872.4 foot level. The report is sufficient to demonstrate that at the 1870.3 foot level, a much more thorough environmental assessment is needed to determine if the project is ecologically and economically feasible.

I would also caution that the study report should avoid use of conclusive language about whether certain impacts on the environment may or may not be "significant". Declarations of whether a project's effects on the environment are significant or not, etc., is properly a function and legal responsibility of NEPA/SEPA officials. The MHW conclusion that maintaining water levels at the 1870.3 level appears feasible and "cost-effective" seems premature, too, given the acknowledgement that mitigation, easements, and "other" socio-economic costs are not included. Such costs may be prohibitive, if fully acknowledged and measured.

Thank you for the opportunity to comment on this study.

Sincerely,

William C. Jolly
Environmental Program Manager

Cc Jim Harris, Eastern Region Manager
Rick Halstead, Lake Wenatchee State Park
Mark Schulz, Environmental Specialist
Deb Petersen, Environmental Specialist

P.S.: The comments submitted to you by Mr. Al Hillel on July 22, 2003 seem to us to be quite meritorious, and worthy of your consideration, as well.

O:\Environmental\STAFF\JOLLY\Lake Wenatchee Water Storage comments July 28.doc

Lisa de Vera
Project Coordinator
Chelan County Natural Resource Program
411 Washington Street
Wenatchee, WA 98801

RE: LAKE WENATCHEE WATER STORAGE FEASIBILITY STUDY-FINAL COMMENTS

The Lake Wenatchee Water Storage Feasibility Study has probably only just started! While we would like for this to have been the first and last phase, more money will need to be spent on this study so that the right and responsible conclusions are reached.

COMMENTS ON ALTERNATIVES 1 & 2& 3:
We are absolutely against any storage plan that holds the lake level at 1872.4 ft. The negative socioeconomic impacts and the negative environmental impacts resulting from these three operating alternatives will be beyond anyone's imagination. The legal fuss against these plans from the area property owners will be even more surprising.

COMMENTS ON ALTERNATIVES 4 & 5:
We are against any storage plan that holds the lake level at 1870.3. We are not as extremely opposed to these alternatives as we are to 1 & 2 & 3.

We need to be convinced that the rubber dam and other structures will not add additional flow restrictions to the narrowest part of the river which will be problematic during our winter flooding periods. This is of more concern to us than the other multitude of problems we can think of.

We need assurance that no plans can ever be implemented to increase the water storage level at a future date.

We need to see some plans that will correct the out-flow area around the Wenatchee River Bridge. The highway acts as a dike and creates problems in the winter flooding periods. The need for altering and changing the roadbed at this point is imperative.

GENERAL COMMENTS:
Again, we must state that we will be committed to oppose alternatives 1 & 2 & 3. We don't want to be unreasonable about alternatives 4 & 5 because we can see the need for additional water storage. We just really don't think that Lake Wenatchee needs to be disturbed by this project. We are hoping that further studies will find alternative sites for water storage in other areas.

Dave and Sally Kane, Lake Wenatchee Property Owners
115 Kane Lane
Orondo, WA 98801
Sally J. Kane David P. Kane

July 28, 2003

Lisa de Vera
411 Washington Street
Wenatchee, WA 98801

Ref: Lake Wenatchee Water Storage Study Preliminary Draft

Dear Ms. de Vera:

My wife and I have owned property on the shoth shore of Lake Wenatchee for 40 years. We have two lake front lots, and own the 2nd Class shorelands in front. It includes about 50 feet of (Mostly) sandy beach, a dock, a home, and a boat house. We use the proprty as a summer second home. We, our children and grandcheldren have played on the beach, swum and boated in the water. The beach and dock are key to our use and enjoyment of the property.

1. Water Levels

Under Alternative 4 or 5 of the study, I understand water levels would be held at ordinary High Water, or 1870.3 feet. This would inundate most if not all of our beach. The access to our dock is across the beach and over a rough rock causeway to a concrete structure anchoring the end of a 30-foot gangway. Both beach and causeway would be underwater, as they were during last month's high water.

Under Alternatives 1, 2, or 3, the beach would be completely flooded, and there would probably be some water inside the boat house, as well as around the foundation blocks of our sundeck. Although the water's edge would probably not reach to lower foundation posts of our house, wetting and loosening of soil arough them would likely occur.

2. Timing

All of the improvements on our property were built for, and have lived with, the normal level fluctuations of the lake. In our experience, high water typically occurs in June, and lasts at most 2 or 3 weeks. During this time we get visiting logs of all sizes, which sometimes act as battering rams when wind and waves are high. The logs don't always go away, but the battering stops as the water level recedes.

As I mentioned, for many reasons ours is a summer place . Its use is centered around water based activities of which there is little around the lake from November until the snow is gone (Mid-April to early May on the South Shore). All of the Alternatives would keep the lake level high during "prime time", namely July and August. Depending on the rate of release, this could extend well into September. Add in the time of natural high water in June, and the whole summer becomes "high water time".

3. Damage to Other Properties

Many of the older cabins and houses on the South Shore were built at lower elevations than ours. Some of these have been raised to prevent interior flooding, but the foundations remain exposed to high water and especially logs. Our next-door neighbor to the east is a prime example.

Page 2.
July 28 2003
Lisa de Vera

4. Fish

The fish populations of Lake Wenatchee, its tributaries and the Wenatchee River have had thousands of years to adapt to varying lake levels and rates of flow.

5. Economics

Using the effect of the proposed project on the rate of rise of real estate prices as the primary measure of impact on private property owners, is offensive to me. My wife and I have no interest whatever in selling and intend that our Lake Wenatchee property stay in the family after we are gone. In the meantime, we are opposed to any project that will deprive us (and them) of the main sources of our enjoyment of it. True, we could build a bigger, longer causeway or an additional gangway at considerable trouble and expense, if we could get the permits. We could also protect our foundations with a bulkhead. However, there is no way we could dis-inundate the beach.

Yours very truly,

Orlien N. Becker

Orlien N. Becker
16120 65th Avenue S.E.
Snohomish, WA 98296-8722

Lake Address
15780 Cedar Brae Drive

Public Comments on proposed Dam at Lake Wenatchee
c/o Lisa deVera, Chelan Co.
411 Washington Street
Wenatchee, WA 98801

Damming Lake Wenatchee for irrigation water storage was originally proposed in 1930. My, how things have changed since then! My pioneer father bought property on Lake Wenatchee in the 1930's. There were only a few summer cabins on the lake in those days. Almost a century later now, there is a lot of high cost development all around the lake. And irrigated orchards (like the one on Pioneer Avenue in Cashmere where I grew up) continue to be ripped up and paved over for suburbs.

The original 1930's dam permit has lapsed. The County's current study originally suggested irrigation water was the main purpose of this dam. Now their own study indicates that there is no increasing demand for irrigation water. But are they willing to stop spending hundreds of thousands of dollars of taxpayer money on more studies of something that no one I know wants or needs? No, they want to continue studying and spending taxpayer money.

The County's own study not only indicates no need for more irrigation water, it admits that a Lake Wenatchee dam would have many adverse impacts. However, they made no attempt to put a dollar value on these losses (summer flooding of beaches, increased wave erosion and water turbidity, decreased property values, reduced public recreation and impacts on three endangered fish runs.

This study was funded by a Washington State Legislature grant. Please State legislators; don't waste our precious tax money on further studies of something that doesn't even pass the "straight face" test!

Charlotte Griffith

Charlotte Griffith
601 Lowe Street
Wenatchee, WA 98801

United States Department of Agriculture **Forest Service** **Okanogan and Wenatchee National Forests Lake Wenatchee & Leavenworth Ranger Districts** **600 Sherbourne Leavenworth, WA 98826 (509) 548-6977 Fax (509) 548-5817**

File Code: 5500
Date: June 13, 2003

Mr. Mike Kaputa
Director for Chelan County Resources
411 Washington Street
Wenatchee, WA 98801

Dear Mike,

This letter states the Forest Service's position concerning the current ownership of the bed of Lake Wenatchee.

As you know, I raised this question quite some time ago. Since then, we have had discussions with Mr. Steve Ivey, Aquatic Land Surveyor, Land Survey Unit, Engineering Division, Washington Department of Natural Resources and follow up discussions with our Office of General Counsel.

Mr. Ivey's note to the Wenatchee National Forest stated that there was no doubt that the bed of Lake Wenatchee belonged to the State of Washington. However, we have been advised by our attorney that this is not correct.

They advised that only the Federal Court can determine if a body of water is navigable for purposes of application of the various tenets regarding ownership of the beds of those bodies of water, unless Congress has passed legislation declaring navigability. We find no evidence that Lake Wenatchee has gone through this determination. This issue could be addressed in a State Court but only if the United States specifically waives sovereign immunity.

In closing, we are advised to continue our position that the bed of Lake Wenatchee and the Wenatchee River, inside the National Forest Boundary, are National Forest System Land until they have been determined to be navigable by a federal court.

If you need additional information about this project please feel free to contact me.

Sincerely,

GLENN M. HOFFMAN
District Ranger

Washington Growers Clearing House Association
1505 North Miller Street, Suite 260
PO Box 2207
Wenatchee Washington 98807
Phone: 509-662-6181; Fax: 509-664-6670

June 23, 2003

Lisa de Vera
411 Washington Street
Wenatchee, Washington 98801

Subject: Lake Wenatchee Water Storage Feasibility Study

Dear Ms. De Vera,

The Washington Growers Clearing House Association is a grass roots tree fruit grower association with approximately 2,400 Washington tree fruit grower members. Approximately 870 of those members reside in or have orchard in Chelan County.

As a member of the Lake Wenatchee Water Storage Feasibility Study Project Team, I would like to thank the staff of the Chelan County Natural Resources Program, the facilitator (Nancy Smith) and the Bob Montgomery Group for their excellent work on this feasibility study.

From the start of the study, it was very clear that the time and money available for this study was limited and that not all the various issues brought up during various discussions could be studied thoroughly. The project team developed a scope of work and agreed that part of the study was to include references to areas where additional study would be needed, if such a project were ever proposed. I believe that the study has accomplished the goals outlined by the Project Team. The incredible amount of data generated and collected for this report will be very valuable during current and future watershed planning discussions.

As a tree fruit representative I would like to add to and clarify certain tree fruit related elements in the report. First the tree fruit industry in the Wenatchee Watershed is a relatively mature industry; acreage is not expected to increase in any significant amount and is more likely to decline slightly, over the years. Despite the fact that the Wenatchee Watershed has some of the best fruit producing climate and soil conditions in the world, the state regulatory environment, and the distance to the market puts Washington tree fruit producers at a competitive disadvantage to domestic and subsidized foreign competitors. In addition to the economic challenges, urban encroachment will also contribute to a gradual reduction in orchard acreage. To what extent or how fast any potential tree fruit acreage reduction will occur is unknown.

The tree fruit production areas of Washington State are located in desert regions. Without adequate irrigation water, tree fruit growers cannot produce a top quality, economically viable tree fruit crop. Insufficient irrigation can negatively impact fruit size and quality, reduce yields, and in the worst-case scenario kill or severely injure the tree. Over irrigation can interfere with the natural nutrition of the tree, negatively impacting fruit size and quality, cause tree rot, mildew, and kill the tree, etc. Many tree fruit growers monitor soil moisture levels to schedule irrigation timing and amounts for maximum benefit and minimal use. Growers have a definite economic incentive to irrigate properly.

Lake Wenatchee Water Storage Feasibility Study
Page 2 of 2

As new cost effective irrigation technologies become available tree fruit growers have implemented those tools with the help of the Natural Resources Conservation Service (NRCS), Washington Tree Fruit Research Commission and the WSU Cooperative Extension Service, etc.

Over the years the tree fruit grower funded Washington Tree Fruit Research Commission has funded research to aid growers in the more efficient use of water. At present the Research Commission with the aid of WSU Cooperative Extension is conducting a deficit and partial root zone-drying irrigation project in the Wenatchee Watershed etc., to determine the impacts of varying amounts and timing of water use. Experiments are being conducted on the effects of withholding water at certain growing stages of the tree before replenishing the soil moisture, thereby reducing overall water use.

WSU Cooperative Extension aids growers in implementing new research findings and technologies at the orchard level. Such efforts will continue to aid growers in understanding state of the art water management techniques and increase the efficient use of irrigation water.

NRCS has a federally funded Environmental Quality Incentive Program (EQIP), which is designed to aid agricultural producers technically and financially in their efforts to manage irrigation, soil nutrients and pests in an environmentally sound manner. Unfortunately, the tree fruit grower applications are not recognized as a funding priority, all of the Chelan County applications (about 90) were turned down this last funding cycle.

Most tree fruit growers in the Wenatchee Watershed receive their irrigation water via irrigation district canal systems. Each of those districts has maintenance and operation programs to ensure that water is delivered as efficiently and cost effectively as possible. All irrigation district systems have approved fish screens and most are gravity feed. A high percentage of the irrigation canals are lined and that percentage continues to grow yearly. Repairing and relining of the irrigation canal lining is a continuous yearly project. Each year, each irrigation system monitors the amount of water diverted and reports the amount diverted to the Washington State Department of Ecology. Each irrigation system has methods in place to ensure that they do not divert more water than their district (or collective users) is authorized by their state approved water right. Canals are patrolled regularly to ensure that the system is operating properly.

The Washington State tree fruit industry has and will continue to demonstrate a strong commitment to the cost effective efficient use of irrigation water.

It appears that if the Wenatchee Watershed population growth estimated in this study does in fact occur and recognizing it is very difficult to restrict population growth, the watershed will, in the very near future, have a serious water problem. Being pro-active in identifying water conservation measures, additions and improvements to current water management practices (including various types of water storage) plus securing funding for implementation is critical to the protection of the quality of life, the environment and the economic viability of the watershed.

Thank you.

Sincerely, Kirk B. Mayer

Kirk B. Mayer, Manager

TALL TIMBER
HOMEOWNER ASSOC.

June 18, 2003

Lisa DeVera
Chelan County
Natural Resource Program
411 Washington Street
Wenatchee, WA 98801

RE: Lake Wenatchee
Water Storage Study
Prelim Draft

We represent the Tall Timber property owners which is a 50 lot sub division located up the White River Road, and have the following concerns.

1. The introduction states that they will study <u>down river</u> effects. What about <u>upriver</u> effects on the White and Little Wenatchee rivers?

2. Page 2-15 states there is no irrigated land up the White River. This is not true. Our water right has irrigation rights.

3. Page 6-2 states there is a resort and golf course on the White River, this is totally false.

PLEASE KEEP US ON YOUR MAILING LIST.

Sincerely,

Steven S. May Corporate Secretary
Tall Timber Homeowners Assoc.
9 Skagit Key
Bellevue, WA 98006

COMMENTS

Lake Wenatchee Water Storage Feasibility Study

The County encourages continued public comment on the study and the final draft report. Public comment will continue to be accepted in written form, either by letter or e-mail, until July 31, 2003, and will be incorporated into the final report as a "Public Comment" chapter. All project information including the final draft report can be found by visiting our website at www.co.chelan.wa.us/nr/nr5.htm. If you would like a CD version or paper copy of the report, please call Lisa deVera at (509) 667-6533. Due to the length of the report and budget constraints, paper copy requests can only be accommodated on a case-by-case basis. All public comment should be directed to:

Lisa deVera
lisa.devera@co.chelan.wa.us
411 Washington Street
Wenatchee, WA, 98801
Fax: (509) 667-6527
Electronic submissions are encouraged

This study has been a waste of tax payer's money!!! It is not realistic financially in any way, shape or form.

General Comment:

Lots of excellent work has been done on this project, but if the objective of this proposal is to protect the fisheries from low flow, it should be based on some indication that long-term historic flow is diminishing (due to global warming or whatever). You present no evidence of such a trend, so let's just let mother nature continue to take care of our fisheries.

If the objective is to provide more water for human use during low flow, the cheaper more logical method if matching human needs and flow would be to limit development to the water available.

I'm sorry Senator Parllette enabled my tax dollars to be spent on this hare brained scheme.

Sally Soest, Plain

COMMENTS

Lake Wenatchee Water Storage Feasibility Study

The County encourages continued public comment on the study and the final draft report. Publi comment will continue to be accepted in written form, either by letter or e-mail, until July 31, 2003, anc will be incorporated into the final report as a "Public Comment" chapter. All project informatior including the final draft report can be found by visiting our website at www.co.chelan.wa.us/nr/nr5.htm If you would like a CD version or paper copy of the report, please call Lisa deVera at (509) 667-6533 Due to the length of the report and budget constraints, paper copy requests can only be accommodated oi a case-by-case basis. All public comment should be directed to:

Lisa deVera
lisa.devera@co.chelan.wa.us
411 Washington Street
Wenatchee, WA, 98801
Fax: (509) 667-6527
Electronic submissions are encouraged

NO

Appendix A

Project Team Members,
Scope of Work

Project Team Members
Lake Wenatchee Water Storage Feasibility Study

Name	Organization
Bill Bauer	Mayor, City of Leavenworth
Bill Robinson	Washington Council~Trout Unlimited
Buford Howell	Icicle Creek Watershed Council
Cot Rice	Cascade Orchards Irrigation Company
Dennis Carlson	National Marine Fisheries Service
Glenn Hoffman	US Forest Service~Lake Wen./Leavenworth
Gordon Irle	Mayor, City of Cashmere
John Hunter (in 2002)	Chelan County Commissioner
John Zipper	Landowner
Karl Halupka	US Fish and Wildlife Service
Keely Murdoch	Yakama Nation
Kirk Mayer	Washington Growers Clearing House
Lee Carlson	Yakama Nation
Mike Kaputa	Chelan County Natural Resource Program Director
Nancy Smith	Facilitator
Patrick Verhey	Washington State Dept. of Fish and Wildlife
Peter Burgoon	Water Quality Engineering
Ray Aspiri	"The Friends of Lake Wenatchee Forest"
Ray Newkirk	Department of Ecology
Rick Halstead	Washington State Parks
Rick Smith	Superintendent, Wenatchee Reclamation District
Steve Craig	Lake Wenatchee Properties~Landowner
Keith Goehner (in 2003)	Chelan County Commissioner

Exhibit B

STATEMENT OF WORK
LAKE WENATCHEE WATER STORAGE FEASIBILITY STUDY

The following Tasks 1 through 5 describe the work that is required to complete the Feasibility Study and Task 0 describes work done for project management. The sections following Tasks 1 through 5 contain a description of the budget and schedule to complete those tasks.

Task 1 -WATER NEEDS

1 A. Current and Projected Water Use for Residential, Municipal & Industrial Purposes
Estimates of current water use for residential, municipal and industrial purposes are being prepared for the Wenatchee River Basin Watershed Assessment study that is ongoing. Excerpts from the scope of the Watershed Assessment that describe the current residential, municipal and industrial water use estimate task are copied below for reference.

> "Current surface water use will be estimated by subbasin by first summarizing the results of the water rights database task and then verifying those results using data from a range of entities. The major surface water users will be grouped into categories of municipal, industrial, fish propagation and irrigation for crops. The major municipal and industrial surface water right holders will be contacted to verify the quantity of use and the type of use. Return flows from the water users will be estimated using data from wastewater treatment plants and experience gained from similar analyses in central and eastern Washington. The net consumptive use is the diversion minus return flow.
>
> Major groundwater users will include the same groups but will also include domestic water users. To estimate domestic water use, two sources of data will be used: water use records from Class A and B water systems and from domestic exempt wells using population data, zoning data and existing service areas for water purveyors. Data from water purveyors using groundwater will be used to directly calculate total and representative per capita consumption. That per capita consumption will be used to quantify water use in areas served by domestic wells or in water systems without sufficient well pumping data".

This study will use that current water use data and develop estimates of future residential, municipal and industrial water use based upon forecasts of population and industrial growth and changes in land use. The potential for future changes in water use from changes in land use such as residential growth or conversion from agricultural land to residential uses will be reviewed by analyzing Comprehensive Plans, zoning maps and planning activities in the study area. One concern may be the growth of domestic exempt wells, which can withdraw water for up to six households without applying for and receiving a water right. Future water uses will be forecast based upon growth projections and water use estimates for different land uses. Future growth will be projected using estimates and data from Chelan County Planning Department and the Office of Financial Management (OFM).

Summary tables of estimated current and future surface and ground water use by subbasin in the Wenatchee Watershed will be prepared along with a discussion of methods, results and data limitations of these estimates.

1 B. Current and Projected Water Use for Agricultural Purposes
Estimates of current water use for agricultural purposes are being prepared for the Wenatchee River Basin Watershed Assessment study. Excerpts from the scope of the Watershed Assessment that describe the current agricultural water use estimate task are copied below for reference.

> "Water diversions from irrigation districts and private ditch companies such as the Wenatchee-Chiwawa Irrigation District, Icicle & Peshastin Irrigation District, Wenatchee Reclamation District and others will be obtained by contacting those entities to gather available data. Water used consumptively for agricultural uses will also be estimated using available data on agricultural land area and cropping patterns from Chelan County, the National Agricultural Statistics Service (NASS) and the U.S. Department of Agriculture (USDA). Crop evapotranspiration (ET) will be estimated using the best data on crop ET from the WSU Tree Fruit Research Center, our calculations using weather data in the Watershed and a modified Blanney-Criddle method or by using average crop irrigation requirements obtained from the Washington State Irrigation Guide (WSU, SCS, 1985). The Ecology water rights database also has information useful for estimating water usage, such as irrigated acreage".

Future agricultural water use will be estimated by reviewing urban growth patterns and conversion of agricultural areas into residential areas, as described in the task to estimate future residential water use. The conversion of agricultural area into residential area can reduce the overall volume of water use but may not change the peak water use unless the change is accompanied by an improvement in water application practices. The potential for changes in agricultural water use due to changes in cropping patterns and water conservation will also be reviewed.

Using the above information the report will include tables using the data generated in the Watershed Assessment to predict agricultural irrigation water demand for both ground water and surface water along with discussion of methods, results and data limitations of these predictions.

1 C. Regional Use - Water Storage Needs
Water storage needs will depend on the additional quantity of instream flow desired for the Wenatchee River as well as the additional withdrawals from surface or groundwater required to support additional growth in the Wenatchee Watershed, to the extent that additional water use affects Wenatchee River flows. The existing instream flows for the Wenatchee River are contained in Chapter 173-545 WAC, the Instream Resource Protection Program (IRPP) for Wenatchee River Basin. The Watershed Planning Unit has not yet undertaken a new instream flow setting program but may in the next few years provided sufficient funding and community support exist. That effort would occur beyond the schedule of this study. For this study, various levels and duration of instream flow will be used to estimate water storage needs. These flow levels and duration will be discussed and agreed upon with the Technical Subcommittee to ensure a proper range of instream flow conditions are analyzed. This analysis will be performed with the hydrologic model described in the Technical Feasibility section.

1 D. Comparison of Water Savings from Conservation and System Improvements to Water Needs
For this task, water conservation opportunities will be reviewed and summarized as to their potential effect on water use and diversions. The water conservation opportunities may result in reduced water use in the residential, municipal and industrial and irrigation sectors. For residential, municipal and industrial water users water conservation opportunities result from programs such as metering, leak detection, demand management, water audits, water reuse and others. For agricultural water users, water conservation opportunities result from on-farm irrigation efficiency programs, improvements to canals and laterals, automation, re-regulating reservoirs and changes in points of diversion.

Major water users will be contacted to determine if Water Conservation Plans are available. Typically, the plans are required for municipal water users by Dept. of Health while they are optional for irrigation diverters but may be prepared under the State's Referendum 38 program. Water savings identified in those plans will be summarized. Where Water Conservation Plans are not available, current water use (per capita for municipal systems, per acre for irrigation water users and conveyance efficiency for irrigation canals) will be compared to other similar water systems and irrigation districts in north-central Washington that have implemented water conservation plans. We will estimate a range of potential water savings for each sector. The range will cover moderate to aggressive water conservation measures. The costs of the water conservation measures will also be estimated to provide a comparison of the benefits and costs compared to additional storage.

1 E. Inventory of Water Rights

The amount of surface water and groundwater allocated will be estimated using the DOE's new Geographic Water Information System (GWIS) prepared by DOE and well data. All certificates and permits in the DOE database will be considered current rights; applications will be considered potential rights. Claims will also be considered current rights if there is sufficient information to warrant inclusion in the water rights analysis. Private wells will be added since they may withdraw up to 5,000 gallons per day. The number and locations of private wells will be assessed using zoning and population data described in the Residential Water Use task and the Department of Ecology well database.

The water-rights coverage produced for this task will illustrate the distribution and types of water rights in the WRIA based on the GWIS database and our estimates of water use from domestic wells.

The deliverables for this task will discuss the methods and results of the water-rights inventory, including any data shortcomings associated with the analysis. The report will include tables of estimated groundwater and surface water allocations by status and by purpose of use, along with potential water rights (applications).

A comparison of the water rights summary to water use (estimated in previous tasks) will be provided. This comparison is proposed as means of estimating the quantity of the water rights held that are actually being used.

1 F. Allocation of New Water Rights

A summary of the current water rights applications will be provided in the previous task. For this task we will analyze the potential effect on Wenatchee River stream flow from approving those applications, as well as approving water rights applications to provide for future growth in water use due to residential, municipal and industrial use. The analysis will be performed by estimating the effect on Wenatchee River flows from surface and groundwater diversions. This method directly subtracts the increased allocations (in the case of surface water withdrawals) or to lag (attenuate) in time the effect of the additional withdrawals on Wenatchee River flow (used for groundwater withdrawals). Similar analyses have been performed in the Kittitas Valley for estimating the effect of reducing irrigation seepage and increasing groundwater withdrawals on stream flow.

1 G. Use of Additional Water Storage

Additional water provided by Lake Wenatchee could be used to increase instream flow for environmental purposes and/or meet future water needs for the Wenatchee Watershed and/or for other purposes identified by the Wenatchee Watershed Planning Unit. The volume of water available will vary depending on streamflow conditions in the White and Little Wenatchee Rivers. The first component of this task is to quantify the amount of water available from the project on a monthly basis for a range of runoff conditions from drought to wet conditions. That work will be performed using a hydrologic model that is discussed in the Technical Feasibility section. The second component is to list the purposes that the additional water supply could be used for and define the water needs for those purposes (i.e., increase instream flow in the Wenatchee River by 100 cfs during August and September during drought years, provide for 25 cfs municipal demand). That work is described in previous tasks. The third component is to compare the volume of water supply available from Lake Wenatchee to the desired uses. A discussion of the ability of the project to supply the various purposes or groups of purposes will be prepared and presented to the Technical Subcommittee for review and comments.

1.H. Potential Improvement in Instream Flow
The potential improvement in instream flow will be analyzed using the hydrologic model described in the Technical Feasibility section. The model will be run for a long period to establish the volume of water that would be available during different hydrologic conditions ranging from drought periods to wet periods. The model will have a daily time step and will have the capability to analyze the improvement in instream flow for a variety of desired instream flow rates and duration of improved instream flow.

Task 2 - TECHNICAL FEASIBILITY

2.A. HYDROLOGY

2.A.1. USGS Data Gathering

Daily flow data is available on the Wenatchee River at the following USGS gages:

- USGS gage 12455000, Wenatchee River below Wenatchee Lake. Period of record is from January 1932 through September 1958. Drainage area is 273 square miles.
- USGS gage 12457000, Wenatchee River at Plain. Period of record is from October 1910 through September 2001. Drainage area is 591 square miles.
- USGS gage 12459000, Wenatchee River at Peshastin. Period of record is March 1929 through September 2001. Drainage area is 1,000 square miles, approximately.
- USGS gage 12462500, Wenatchee River at Monitor. Period of record is October 1962 through September 2001. Drainage area is 1,301 square miles.

Daily flow data will be gathered at Plain and Peshastin for the common period of record with the gage below Wenatchee Lake. The gage at Monitor does not have a common period of record with the gage below Wenatchee Lake, but the flows are only about 7% greater than the flows at Peshastin so it is assumed that estimation will yield reliable results.

For the gage below Wenatchee Lake, additional information will be gathered. All stage-discharge rating curves will be requested from the USGS. Hourly stage-discharge information will be gathered for the three largest floods of record during the period of potentially increased storage.

2.1.B. Create Storage Operation Model

A reservoir storage operation model will be developed to simulate the water levels and outflows from Lake Wenatchee under the proposed conditions. The model will operate on a daily time increment for the 26 year period from 1933 through 1958.

Reverse routing utilizing the USGS record of daily outflows and the existing outlet rating curves will allow development of inflows to Lake Wenatchee. The daily outflow data and the existing rating curves will be used to develop a continuous record of daily Lake Wenatchee elevations for the 26-year period.

The storage model will be written in Fortran computer code to provide maximum flexibility of operation and output formatting and to utilize available flow frequency routines. Input to the model will include operating criteria for the dam structure. Output from the model will include Lake Wenatchee elevation frequency (a duration curve) for each month, and flow frequency for each month at the Lake Wenatchee outlet and for the Wenatchee River at Plain and Peshastin. The flow frequency and Lake Wenatchee elevation frequency data will be compared to the historic data to determine the incremental effects of the proposed storage project. A series of runs will be performed based on alternative water storage scenarios on Lake Wenatchee.

2.1.C Flood Operation Model

Hourly flood hydrograph data will be developed for the three largest floods of record that have occurred during the season when the rubber dam may be in operation. The largest floods will be selected after a review of hydrologic records. Floods that appear to have a rapid rise will be selected over floods with a greater peak, but a slower rate of rise. Hourly outflows will be calculated from lake elevation data and the available rating curves. Hourly lake inflows will be calculated by reverse routing. A model will be developed to determine if the dam can be lowered at a rate that would not increase historic lake elevations. Alternatively, the maximum rate at which the dam would have to be lowered to avoid raising lake levels will be determined.

The hydraulic and flood impacts from the project in areas downstream from Lake Wenatchee will also be reviewed to determine the effect of operating the dam. The potential change in flood levels or river levels will be estimated using the output from the flood operations model and stage-discharge information available in downstream reaches from USGS and other stream gages.

A Shoreline Erosion analysis will be done in the following manner. Obtain existing wind speed and direction data from the Stevens Pass weather station (the closest station with wind data) and calculate potential wave heights along various sections of the lakeshore of Lake Wenatchee. The wave height calculations will be based upon fetch length and wind duration. The calculation will be performed for existing conditions and with-project conditions to compare the wave heights at different elevations and time periods when water may be impounded at higher elevations.

Note: A direct correlation between lake level, wave height and potential shoreline erosion cannot be prepared as topographical, soils and structure elevation and condition information along the lakeshore is not available. However, the height and duration of waves at various lake levels will provide an indication of potential changes in shoreline erosion.

2.1.D Gathering Data on Normal High Water

Normal high water information will be developed based on a frequency analysis of the 26 years of daily Lake Wenatchee water levels that are developed for the storage operation model. Normal high water information will also be developed based on a frequency analysis of the instantaneous annual maximum lake elevations.

2.2 CIVIL ENGINEERING

2.2.A Field Reconnaissance – dam site feasibility and impacts on existing infrastructure

Prior to any field visits, data will be gathered regarding topography, geologic formations and seismicity in the vicinity of the outlet for Lake Wenatchee. Once this information has been gathered, our geotechnical subconsultant, and a MWH senior civil engineer will make a one-day reconnaissance level site investigation. The visit will involve walking the length of the outlet channel from the lake to the vicinity of the bridge downstream of the lake. Distance and channel width measurements will be made and a boat will be launched to determine water depths in the outlet channel. Geology will be noted in the area and notes taken to allow siting of a storage structure. In addition, access roads and other existing features will be noted to allow feasibility level planning of construction activities and potential affects.

Once the site investigation has been completed, a memorandum will be written, condensing the data gathered in the field and making recommendations for siting of a storage structure and construction considerations. This memo will be the basis for future technical feasibility analyses and cost estimates and can be included in the feasibility report as an appendix.

2.2.B Storage Structure Feasibility Design

Based on the field reconnaissance, a storage structure will be laid out at the location determined best for development. The layout will include foundation layout, number of spans, mechanical equipment building, potential electrical feed, and access road. The structure's ability to allow sediment and woody debris passage will be assessed. Two 11" x 17" drawings will be developed for inclusion in the feasibility report.

2.2.C Fish Ladder Feasibility Design

A fish ladder will be integrated into the design of the storage structure. The ladder will be designed for the fish indigenous to the upper Wenatchee River and Lake Wenatchee. We assume that the ladder will need to be designed for bulltrout, the weakest swimming species likely to be found in the area. One 11" x 17" drawing will be developed for inclusion in the feasibility report.

2.2.D Feasibility Level Cost Estimate

Based on the layout of the storage structure and the fish ladder, quantities will be computed and construction sequence determined. The cost estimate will be based on unit prices for similar work and a generous contingency added to account for the feasibility level of the design and layout of the structures.

Task 3 - LEGAL FEASIBILITY

3.1.A Project Compliance with Existing Federal, State, and Local Laws

This subtask will involve an evaluation of the proposed project to determine how well it complies with existing laws and regulatory agency requirements. This will involve a review of the existing statutes and also discussions with the appropriate regulatory agencies such as the Corps of Engineers, Washington State Department of Ecology, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and Washington Department of Fish and Wildlife.

Note: In order to reduce the cost of this task to fit within Chelan County's budget we have reduced expenditures on legal time to just $9,000. This will mean that the questions that we can ask of our legal team will be very limited and targeted.

3.1.B. Compliance with Endangered Species Act

Steelhead, Chinook, and bull trout, three species of fish involved in this project, are listed in the Endangered Species Act (ESA) and migrate into and out of the lake. Installation of a control structure on the lake outlet will necessarily have to incorporate fish passage facilities in the form of fish ladders, bypass channels, or by other means. Based on our inspection of dam site conditions it appears one or more fish ladders would be the preferred fish passage solution if fish passage cannot be accomplished over the dam section itself.

For this task the issue becomes whether the dam and fish passage facilities can be designed, constructed, and operated in such a manner that the project is in compliance with the requirements of the Endangered Species Act. Our team will assess how a storage structure can be designed with ESA-listed species present and meet regulatory requirements. In addition to the structure itself there are ESA compliance issues associated with how the project is operated. In this task the effects on instream flows in the river, water quality, wetlands, impacts on downstream fish spawning areas, passage past the dam of gravels, sands, and woody debris to replenish downstream spawning habitat, and other issues will be assessed and reported.

3.1.C. Compliance with Tribal Nations Rights

This subtask will involve evaluation of the impacts the project may have on Tribal Nation rights due to the altered flow regime. In principle, withholding of some water during the spring runoff for release into the river later in the year could affect the fishery resources of the Wenatchee River Basin and perhaps even the Upper Columbia River system. The Tribes (Yakama and Colville and others) have certain legal rights to harvest a percentage of the fishery resource. The scope of this task will be to evaluate the possible impact of the project on the fishery resource and from a legal standpoint assess whether the project is in compliance with the rights of the Tribal Nations to a portion of the fishery resource.

3.1.D. Permitting Requirements

This subtask will involve the identification of all applicable federal, state, and local permits, and other regulatory approvals necessary for construction of the dam. The task will also include related actions of the project, which may require permitting or regulatory agency approvals. A list of the likely major permits and approvals follows:

- Corps of Engineers 404/Section 10
- Washington Department of Ecology Dam Safety
- Clean Water Act Section 401, Water Quality Certification
- Section 7 Consultation (Biological Assessment)
- Hydraulic Project Approval
- County Shorelines Permit
- Water Storage Permit
- State Environmental Policy Act and possibly NEPA Compliance

Early coordination with the regulatory agencies will be an important component of defining permitting elements and issues. The MWH team will insure that there is open communication between the team and agency representatives assigned to the project. As a part of the permit review process, the study team will identify the permits and prepare a summary of related conditions associated with the applicable permitting or approval processes. In addition we will define threshold determinations whether the proposed project is likely to satisfy applicable federal, state, and local requirements necessary to obtain the permits and/or approvals.

The product of this subtask will be a technical memorandum identifying the permits, potential issues, permit timeframes, agency contacts, project features subject to permits, potential approaches (and additional study needs) for completing permitting process, and mitigation requirements.

3.1.E. Regulatory Authority
This subtask will address issues such as the entity that would own and operate the dam and the liability and regulatory compliance obligations or other liability they would assume in doing so. There are only a small number of candidates, including the Washington Department of Fish and Wildlife, Wenatchee Reclamation District, and the Chelan County Public Utility District (PUD).

3.1.F. Responsibility for Mitigation
This subtask will involve evaluating institutional responsibilities for mitigation of impacts due to installing a regulating structure at Lake Wenatchee. Typically, responsibility for mitigation lies with the owner of the project. In this case, the organization that would ultimately own and operate the project has not been established. Candidates might include the Wenatchee Reclamation District, which owns the Dryden Dam, the Washington Department of Fish and Wildlife, and Chelan County PUD, although their interest in assuming such responsibility is unknown. The responsibility and cost of mitigation would likely be worked out when determining the source of funding for the project.

We will evaluate the legal statutes concerning responsibility for mitigation and the circumstances under which legal and financial responsibility might be assumed by entities other than the Owner.

3.1.G. Evaluate the Status of the Water Storage Permit
The Wenatchee Reclamation District (WRD) had for many years held a permit for storage on Lake Wenatchee. Some years ago, Chelan County PUD was interested in possibly developing a small hydro project near Lake Wenatchee and the WRD permit for storage was transferred to the PUD. The PUD never did implement the project and the permit was transferred back to WRD. WRD believes it has retained the right to store water at the lake.

For this subtask, we will review the history of the storage permit and current regulations that govern the duration a permit remain valid. We assume the history and details of the storage permit will be provided for our review. If the permit has lapsed, we will evaluate whether it can be renewed and under what circumstances. Dave Sonn of Jeffers, Danielson, Sonn, and Aylwood, P.S. (JDS&A), of Wenatchee, is legal counsel to the WRD and has been actively involved with the permit issues. He has agreed to provide services to our team through WRD, provided there is approval of both WRD and the Project Team.

Task 4 - SOCIOECONOMIC IMPACT

4.1. Assess Changes in Land Use – Short and Long Term Impacts on Lakefront Property

Under this task we will assess changes in land use associated with the water storage project. The focus of this task will be to determine the potential effects on public and private land uses occurring around Lake Wenatchee as a result of increasing water storage during the summer months.

4.1.A Identify Land Ownership Patterns and Improvements

Under this subtask the Team will identify the land ownership patterns occurring around Lake Wenatchee. We will also identify the land uses and general types of land improvements associated with the different ownership classes such as septic systems, docks and building foundations. Because of the large number of private parcels around the lake we will not conduct a parcel-level inventory of land improvements.

4.1.B Assess Sensitivity of Land Uses and Improvements to Changes in Lake Hydrology

Under this subtask, the Team will determine the sensitivity of the land uses and improvements identified in Subtask 4.1.A to the expected changes in lake hydrology that would occur as a result of operation of the water storage project. Information will be gathered from the U.S. Forest Service (USFS), Washington Department of Parks, and local landowners to determine how existing land uses and improvements may be affected by higher lake levels during the summer. This information will then be compared to with-project and without-project hydrologic conditions to determine if a significant change in the frequency the surface elevation of the lake reaches a level which land uses or improvements are adversely affected.

4.1.C Assess Changes in Property Values

If the analysis conducted under Subtask 4.1.B concludes that land uses and improvements occurring on private lands could be substantially affected by operation of the water storage project, potential effects on property values will be described. The change will be qualitatively described based on discussion with landowners, real estate brokers, and conclusions of similar studies. The purpose of this assessment is to determine if an overall increase or decrease in the value of properties around the lake would occur as a result of operating the water storage project.

4.2. Assess Changes in Recreation Activities

Under Task 4.2, the Team will assess potential changes in water-dependent and water-enhanced recreation occurring at Lake Wenatchee and the Wenatchee River.

4.2.A Identify Recreation Activities and Lake-Level/River-Flow Thresholds

Under this subtask, we will identify the recreation activities occurring on Lake Wenatchee and the segment of the Wenatchee River affected by operation of the water supply project. Water-dependent and water-enhanced activities will be identified based on type, location, and season. Annual use numbers will be reported if available from the USFS and Washington Department of Parks.

The relationship of water-dependent and water-enhanced recreation activities to changes in the surface elevation of the lake and changes in river flows will be identified. This information will be expressed as the minimum, maximum, and optimum lake levels or river-flows necessary to support a particular type or class of recreation activity.

4.2.B Assess Changes in Recreation Activities

Under this Subtask, potential changes in recreation occurring at Lake Wenatchee and the Wenatchee River as a result of project operations will be assessed. With-project and without-project hydrologic conditions will be compared with the lake-level and river-flow recreation thresholds developed under Subtask 4.2.A. Changes in recreation opportunities will be compared to baseline conditions to determine the intensity and context of expected changes.

Working with the environmental impact assessment team, we will assess potential changes in fishing opportunities occurring at Lake Wenatchee and the Wenatchee River. Changes will be qualitatively described based on changes in the quality of the aquatic habitat of Lake Wenatchee and the Wenatchee River.

4.3 Assess Expected Project Costs and Benefits

Under this task the major costs and benefits of the project will be reported. The purpose of this assessment is to provide feasibility-level description of the major costs and benefits of the projects. This portion of the analysis assumes that the study-area for estimating project-related costs and benefits will be Chelan County.

4.3.A Describe Regional Economy

For purposes of establishing baseline conditions, a description of the regional economy will be developed. This will include a description of employment, income, and the major economic sectors present in Chelan County. This information will serve as the basis for determining the magnitude of a change in economic activity associated with the water supply project.

4.3.B Estimate Project Costs

Under this subtask, the construction, operation, and maintenance costs of the rubber dam will be reported. Information provided by the project engineers will serve as the basis for estimating these costs. Based on the conclusions from Subtask 4.2.A and B, the costs to repair or compensate for damages to property as a result of operating the water supply project will be reported.

4.3.C Estimate Changes in Recreation Expenditures

Based on the conclusions of Task 4.2, expected changes in recreation use and the associated changes in recreation expenditures will be estimated. These changes will be based on the information gathered from recreation providers at Lake Wenatchee and the Wenatchee River. Estimated changes in expenditures by recreationists will be based on existing spending profiles for similar recreation activities.

4.3.D Estimate Changes in Economic Output

Under Subtask 4.3.C, potential changes in economic output associated with enhancing the water supply will be assessed. Based on the conclusions of the water needs assessment, changes in output will be estimated based on changes in land uses (e.g. agricultural, residential, commercial, and industrial) within the water delivery area.

4.3.E Employment and Income

Based on the results of subtasks 4.3 A, B and C changes in regional employment and income will be estimated. The purpose of this task is to place the economic changes associated with construction and operation of the water storage project in context with the regional economy. If sufficient quantitative information is generated as part of the previous tasks, changes in employment and income will also be estimated quantitatively.

4.4 Impact on Cultural Resources

4.4.A Records Search/Literature Review

The team will collect and review existing literature and archival data applicable to the project area. The primary sources of data will be the State of Washington Office of Archaeology & Historic Preservation in Olympia and the University of Washington Libraries. The study area for the Lake Wenatchee Water Storage Feasibility Project will incorporate the whole of Lake Wenatchee including the construction footprint of the storage structure near the mouth of the Wenatchee River and following the shoreline surrounding the lake at ordinary high water levels. A project binder will be compiled of relevant background information on the previously recorded archaeological and historic properties within the proposed project's Area of Potential Effect (APE).

4.4.B Field Survey

We will conduct a cultural resources field survey of APE. The purpose of the field survey will be to:

(1) Confirm previously recorded archaeological sites and/or historic structures in the proposed project area

(2) Survey sections of the proposed project area that have not been adequately inventoried; and

(3) Identify and characterize those areas in the proposed project area that would have a higher probability for encountering cultural resources during construction excavation. The focus of the field survey would be on the construction footprint of the storage structure.

Specific activities of the field survey will include:

Documenting and assessing previously recorded archaeological sites and/or historic structures within the APE; and

Map and describe any newly discovered archaeological sites and/or historic structures in the APE.

Subtask 4.3 Technical Letter Report/Consultation

We will characterize the cultural setting; and describe the prehistory, ethnography, recent history, and traditional cultural uses of the project area; and analyze potential impacts of the proposed project to existing and/or newly identified cultural resources.

We will assist in consultation with Office of Archaeology and Historic Preservation OAHP to:

(1) receive their input regarding mitigating any adverse effects on archaeological sites, historic structures, and traditional cultural properties associated with the project; and

(2) (2) Facilitate the OAHP letter of concurrence on the APE of the project area.

We will identify the affected Native American Tribe(s) that will need to be consulted with in order to comply with Section 106 of the National Historic Preservation Act of 1966, as amended.

Task 5 - ENVIRONMENTAL IMPACT

This task is focused on evaluating environmental impacts (both positive and negative) that may result from the construction and operation of a storage structure at the mouth of Lake Wenatchee. The task is specifically targeted at addressing two resource issue questions identified in the proposed scope of work. These are:

- What would be the effect of the construction and operation of an inflatable dam on lake limnology/ecosystem and species movement through the lake and around the lake? and
- What direct and indirect effects would the dam have on the life cycle of Spring Chinook, Sockeye, Bull Trout, Steelhead and other fish? Secondary questions/issues related to this include:

  Is high water flow a benefit to migrating salmonids (juvenile downstream and adult upstream) and lamprey?
  Quantity and quality of downstream aquatic habitat for species listed in item 6 and freshwater mussels.

5.1 Literature and Data Compilation and Review – The initial effort will focus on identifying, compiling and reviewing information and data relevant to understanding the fishery and aquatic ecology of 1) Lake Wenatchee, including its bathymetry, limnological characteristics (water quality, productivity), fish communities and their life history characteristics, invertebrate productivity (zooplankton/phytoplankton), and the location of major tributaries (and their fish composition), and 2) Wenatchee River below Lake Wenatchee, including habitat and water quality characteristics, fish species composition, relative abundance, and periodicity. This information will be obtained via electronic searches as well as personal contacts with state, federal, tribal and county agency and resource specialists, and library searches. The Team will develop and maintain a project library of reports and information specific to the aquatic resources of the Wenatchee Basin.

5.2 Field Reconnaissance – Lake Wenatchee and Wenatchee River – Based on the results of an initial review of literature, R2 will complete a field reconnaissance of Lake Wenatchee (via boat) and the reach of the Wenatchee River that will be influenced by the project. Visual observations of shoreline areas and major tributaries will be made as well as wetland areas adjacent to the White River and Little Wenatchee River deltas. A general qualitative habitat survey will be completed of the Wenatchee River, with a focus on areas that may be influenced the most by flow augmentation. Photographs and videotaping will be taken during the field surveys. Because of weather concerns this fieldwork should be completed early in November. The field trip will be coordinated with other team members and as well agency and other stakeholder personnel.

5.3 Identify and Evaluate Potential Project Effects – Subsequent to the site visit and the review of existing information and data, the Team shall identify potential effects of storage options implementation on the lake and river ecosystem due to the changed hydrograph, with a focus on fishery resources. The effects will be organized around major headings that relate to life history functions of important salmonid species. Examples of these include: water quality (temperature, dissolved oxygen, etc.), food production, juvenile rearing habitat, spawning habitat (shoreline spawning and effects of holding lake level at full pool elevations longer than normal), connectivity/access to tributaries (important for adfluvial bull trout populations and anadromous species), adult upstream and juvenile downstream migration, species interactions/competition, among others. A temporally and spatially explicit matrix evaluation form will be developed that provides for a qualitative rating of the relative magnitude of project effects (both positive and negative) on important life history stages and habitat components. The specific ratings will be determined based on the expected effects of project implementation relative to each element. This analysis will rely in part on the lake operations and river hydrology model being developed in the Technical Feasibility task. A narrative (suitable for inclusion in the feasibility report) will be prepared which describes the rationale and basis for each of the ratings.

5.4 Identify and Prioritize Additional Study Needs: The results of the qualitative assessment will be used to identify and prioritize issues requiring additional investigation. For each issue identified, R2 shall prepare a short Technical Memorandum that explains the rationale and need for the study, provides a general description of study components, and an estimate of approximate costs for study conduct.

Task 0 – Contract Administration

Contract administration will consist of three elements:

- Attendance at meetings to keep the with the Lake Wenatchee Water Storage Feasibility Study Project Team (the Project Team) and/or the leadership of the Team apprised of progress on the study,
- Coordination of work on the tasks and,
- Dovetailing the task reports into a final overall Feasibility Study report.

It is anticipated that there will be three progress meetings over the course of the project, and that the final draft report will be presented to the Project Team at a formal public hearing. This contract will cover the cost of preparation of twenty-five copies of the final report. It has been agreed that Chelan County will pay for the meeting facilitator.