

PUBLIC UTILITY DISTRICT NO. 1 of CHELAN COUNTY

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October 17, 2003

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FEDERAL ENERGY REGULATORY COMMISSION
10/17/03 AM 11:37
BY THE SECRETARY

Ms. Magalie Roman Salas, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington, D.C. 20426

Subject: Lake Chelan Hydroelectric Project FERC No. 637-022
Offer of Settlement

Dear Secretary Salas:

The Public Utility District No. 1 of Chelan County, Washington, has reached a settlement with the United States Forest Service, National Park Service, NOAA Fisheries, United States Fish and Wildlife Service, the Washington Department of Fish and Wildlife, the Washington Department of Ecology, the Confederated Tribes of the Colville Reservation, American Whitewater Affiliation and the City of Chelan regarding the issuance of a new license to the Lake Chelan Project. Enclosed is a copy of the "Offer of Settlement," the settlement agreement executed by the Parties, the proposed license articles and the Lake Chelan Comprehensive Management Plan. Copies of these documents are enclosed.

By copy of this letter, all participants are hereby notified, in compliance with Rule 602(d)(2) of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.602), that comments on the Offer of Settlement may be filed not later than 20 days after the filing of the Offer of Settlement and reply comments may be filed not later than 30 days after the filing of the Offer, unless otherwise provided by the Commission.

Sincerely,

Gregg Carrington
Director of Licensing

cc: Official Service List, FERC Portland Regional Office

Enclosures: Original, one hard copy, 8 CDs

LAKE CHELAN COMPREHENSIVE SETTLEMENT AGREEMENT

RECEIVED
8 OCT 17 AM 11:30
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THE SECRETARY

Final

LAKE CHELAN HYDROELECTRIC PROJECT
FERC Project No. 637

October 8, 2003



Public Utility District No. 1 of Chelan County
Wenatchee, Washington

Comprehensive Settlement Agreement

TABLE OF CONTENTS

LAKE CHELAN PROJECT OFFER OF SETTLEMENT

LAKE CHELAN PROJECT SETTLEMENT AGREEMENT

ATTACHMENT A: LICENSE ARTICLES

ATTACHMENT B: COMPREHENSIVE PLAN

LAKE CHELAN OFFER of SETTLEMENT

Final

LAKE CHELAN HYDROELECTRIC PROJECT FERC Project No. 637

October 8, 2003



**Public Utility District No. 1 of Chelan County
Wenatchee, Washington**

Offer of Settlement

Lake Chelan Hydroelectric Project Offer of Settlement

FINAL

Introduction

On October 8, 2003, Public Utility District No. 1 of Chelan County Washington ("Chelan PUD") and participants in the alternative relicensing process for the Lake Chelan Project, FERC No. 637 ("Project"), reached final agreement on a comprehensive settlement ("Agreement") of all matters addressed in the Lake Chelan relicensing process, including the water quality certification issued by the Washington Department of Ecology ("WDOE") under Section 401 of the Clean Water Act on April 21, 2003. Pursuant to Section 8.1 of the Agreement and in conformity with the Commission's Rules of Practice and Procedure, Rule 602 (18 C.F.R. § 385.602) Chelan PUD hereby submits this Offer of Settlement to the Commission for review and incorporation of the proposed license articles in Attachment A of the Agreement into the new license for the Lake Chelan Project. The development of the Agreement, its submission to the Commission, and this request to incorporate the agreed upon license conditions into the new license are in accord with the alternative relicensing procedures described by the Commission in its Order 596, Regulations for Licensing of Hydroelectric Projects, 81 FERC ¶ 61,103 (1997) and meet the goal of resolving relicensing issues through a collaborative process involving affected federal and state agencies and other stakeholders.

Background

On May 8, 1926, the Federal Power Commission ("FPC") issued a 50-year license authorizing the construction of the existing Project to replace the dam and powerhouse constructed in 1906. The Lake Chelan Dam was completed and became operational in 1928. On May 12, 1981, the Federal Energy Regulatory Commission ("FERC"), the successor to the FPC, issued Chelan PUD a new 30-year license for the Project, but made the license retroactive to 1974. That license is due to expire on March 31, 2004.

On July 6, 1998, FERC approved Chelan PUD's request to use the collaborative alternative relicensing procedures for the preparation of its license application, and to use an applicant-prepared preliminary draft environmental assessment in lieu of the Exhibit E environmental report. As part of the collaborative process, a total of 115 working group meetings and 39 full relicensing meetings were held between April 1998 and March 2002. Chelan PUD then filed an application for a new license for the Project with FERC on March 28, 2003, and an application with WDOE for a Section 401 certification on March 27, 2002. Both applications were developed by Chelan PUD in cooperation with interested agencies and stakeholders. Settlement discussions utilizing a professional facilitator continued following the

Offer of Settlement

submission of the applications for a new license and Section 401 certification, with an increasing focus on legal issues not previously resolved by technical staff from Chelan PUD and interested agencies.

Steady progress was made in settlement discussions and on December 13, 2002, Chelan PUD and the federal and state agencies intervening in the Lake Chelan Project relicensing proceeding wrote FERC Chairman Pat Wood III to request that the Commission delay the issuance of the final environmental assessment (FEA) until after the parties had submitted a comprehensive settlement agreement. The parties indicated that there was a high potential that a settlement would be submitted by April 15, 2003. In a letter dated February 5, 2003, Chairman Wood granted the request for a delay in the issuance of the FEA. Intensive negotiations continued in January through April 2003 and in early May, Chelan PUD believed final agreement had been reached with all parties. However, one agency party determined an issue of concern to them had not been properly resolved. Chelan PUD and the remaining agency worked from May through September 2003 to resolve this remaining issue and on October 8, 2003, final agreement was reached. The following parties signed on to the comprehensive settlement: Chelan PUD, the USDA Forest Service, the National Park Service ("NPS"), the NOAA Fisheries, United States Fish and Wildlife Service ("USFWS"), the Washington Department of Fish and Wildlife ("WDFW"), the Washington Department of Ecology ("WDOE"), the Confederated Tribes of the Colville Reservation ("CCT"), American Whitewater Affiliation ("AWA") and the City of Chelan.

Offer of Settlement

The product of the process described above is the Lake Chelan Project Settlement Agreement, including Attachment A, Proposed License Articles, and Attachment B, the Lake Chelan Comprehensive Plan, which encompasses the issuance of a new license for the Project by FERC and the Section 401 certification issued by Ecology. The Agreement establishes measures for the protection, mitigation and enhancement of resources affected by the Project under a new license to be issued by FERC and the Section 401 certification issued by WDOE. It also specifies procedures to be used by the parties to ensure the implementation of the license articles contained in the new license, consistent with this Agreement. It is the intent of the parties to establish a framework for future collaborative efforts for the protection, mitigation and enhancement of the resources affected by the Project, including Lake Chelan and the bypassed reach of the Chelan River.

Section 17 of the Agreement states that the parties entered into the agreement with the express condition that the Commission issue a new license in conformance with the Agreement. If the Commission issues a new license that is materially inconsistent with any provision contained in the Agreement the parties may withdraw from the Agreement. The parties have drafted the Agreement, including the proposed license articles, bearing in mind the Commission's policies regarding such matters. Therefore, the parties are confident that the Commission will be able to issue a new license that is conformance with the Agreement with no material changes.

Offer of Settlement

Explanatory Statement

This offer of settlement provides for a wide range of protection, mitigation and enhancement measures for the resources affected by the Lake Chelan Project. In particular, the settlement restores flows to the bypassed reach of the Chelan River, which has been dry for most of the year for the past 76 years. In the lowest portion of the bypassed reach, the Agreement would significantly enhance salmon and steelhead trout spawning habitat. The Agreement also provides for erosion control measures, the placement of large woody debris, measures to control dust at the head of Lake Chelan in the community of Stehekin, the replacement of survey monuments, tributary barrier removal, fish stocking, a revised lake level regime, wildlife habitat restoration, historic properties and cultural resources protection, recreational resources, a means of addressing unforeseen resource needs, and other measures and requirements.

The agency parties to the Agreement have agreed to support a license term of 45 years and not to oppose a license term longer than 45 years. Chelan PUD requests that the Commission issue a 50-year license.

Chelan PUD believes that a 50-year license is justified because the Settlement Agreement provides for extensive enhancement measures. These measures are particularly extensive for a project of this size (48 MW) and lack of complexity (e.g. a natural lake without anadromous fish). Furthermore, the Project was relicensed by the Commission in 1981 and is the first hydroelectric project to go through the relicensing process twice.

Notwithstanding the varied interests of the parties, this Agreement gained the support of all entities that fully participated in the alternative licensing process. The list of signatories provides ample evidence of the comprehensive nature of this Agreement. The parties to the Agreement concur that the Offer of Settlement is in the public interest and the record developed to date in this proceeding (and provided in the Comprehensive Plan) strongly supports the protection, mitigation and enhancement measures contained in the Agreement and license articles.

Enclosures

Attached as part of this Offer of Settlement are the Settlement Agreement executed by the parties, Attachment A – the Proposed License Articles, and Attachment B - the Lake Chelan Comprehensive Management Plan.

Offer of Settlement

Conclusion

The Offer of Settlement is clearly in the public interest. Therefore, Chelan PUD respectfully requests that the Commission approve the Offer of Settlement and incorporate the proposed license articles in Attachment A of the Settlement Agreement into a new license for the continued operation of the Lake Chelan Project.

Respectfully submitted,

PUBLIC UTILITY DISTRICT. NO. 1
of CHELAN COUNTY, WASHINGTON


Charles J. Hosken
General Manager

Enclosures
cc: Lake Chelan Settlement Group

Offer of Settlement

Certificate of Service

I hereby certify that I have this day served the foregoing document electronically and by first class mail upon each party identified in the official service list complied by the Secretary in this proceeding.

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Offer of Settlement

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Dated at Wenatchee, Washington, this 16 day of October, 2003

Charles J. Hosken
Charles J. Hosken, General Manager
Public Utility District No. 1 of Chelan County
327 North Wenatchee Avenue
Wenatchee, Washington 98801
Phone: (888) 663-8121

LAKE CHELAN SETTLEMENT AGREEMENT

Final

**LAKE CHELAN HYDROELECTRIC PROJECT
FERC Project No. 637**

October 8, 2003



**Public Utility District No. 1 of Chelan County
Wenatchee, Washington**

*Settlement Agreement***TABLE OF CONTENTS**

Section 1: Parties.....	1
Section 2: Recitals	1
Section 3: Purpose of the Agreement.....	2
Section 4: Definitions	2
Section 5: License Term.....	4
Section 6: Effective Dates	4
Section 7: Parties Bound.....	4
Section 8: Licensee Obligations to take Actions in Support of this Agreement.....	4
Section 9: Agency Obligations to Take Actions in Support of this Agreement.....	5
Section 10: Satisfaction of Relicensing Obligations.....	5
Section 11: Limitations	6
Section 12: Environmental Review, Comment and Consultation.....	6
Section 13: Chelan PUD Solely Responsible for Operations and Costs of Project.....	7
Section 14: Availability of Funds	7
Section 15: Force Majeure.....	7
Section 16: Dispute Resolution.....	8
Section 17: Withdrawal and Termination if Agreement Materially Changed	9
Section 18: Policy Committee and Resource Forums	12
Section 19: Payments	14
Section 20: General Provisions.....	16
Section 21: Notice and Communication.....	16
Section 22. Signatures	17

Settlement Agreement

Lake Chelan Hydroelectric Project Project Settlement Agreement

FINAL

Section 1: Parties

1.1. This Settlement Agreement is made and entered into this 8th day of October, 2003, between and among Public Utility District No. 1 of Chelan County, Washington ("Chelan PUD"), the USDA Forest Service, the National Park Service ("NPS"), the NOAA Fisheries, the United States Fish and Wildlife Service ("USFWS"), the Washington Department of Ecology ("WDOE"), the Washington Department of Fish and Wildlife ("WDFW"), the Confederated Tribes of the Colville Reservation ("CCT"), the City of Chelan, and American Whitewater Affiliation regarding the Project's New License. No later than December 10, 2003, additional entities may become supporters of this Agreement by executing a signature page and submitting it to Chelan PUD and to the Federal Energy Regulatory Commission ("FERC"). However, the signatures of such additional entities shall not be necessary to make this Agreement effective under Section 6, and the withdrawal of any such additional entities shall not be the basis for the withdrawal of any Party under Section 17.9

1.2. This Agreement shall be binding on and inure to the benefit of the above-listed Parties and their successors and assigns, unless otherwise specified in this Agreement.

Section 2: Recitals

2.1. The Lake Chelan Project is located on the Chelan River, at the outlet of Lake Chelan, a natural lake in Chelan County, Washington State. The Project generally consists of the Lake Chelan Dam, a 40 foot-high, 490-foot-long concrete gravity dam, a 2.2 mile long penstock, a surge tank, a powerhouse, a switchyard, recreational facilities on Lake Chelan, and waters and lands within the Project boundary, including Lake Chelan and a reach of the Chelan River that was largely bypassed by the diversion of water into the penstock. Since 1892, five dams have been constructed at the Project site.

2.2. On May 8, 1926, the Federal Power Commission issued a 50-year license authorizing the construction of the existing Project to replace the dam and powerhouse constructed in 1906. The Lake Chelan Dam was completed and became operational in 1928.

2.3. On May 12, 1981, FERC, the successor to the Federal Power Commission, issued Chelan PUD a new 30-year license for the Project, but made the license retroactive to 1974. That license is due to expire on March 31, 2004.

Settlement Agreement

2.4. On July 6, 1998, FERC approved Chelan PUD's request to use the collaborative alternative relicensing procedures for the preparation of its license application, and to use an applicant-prepared preliminary draft environmental assessment in lieu of the Exhibit E environmental report.

2.5. Chelan PUD filed an application for a New License with FERC on March 28, 2002.

Section 3: Purpose of the Agreement

3.1. It is the intent of the Parties that this Agreement shall resolve all matters addressed in the Lake Chelan relicensing process, or the amended water quality certification issued by WDOE for the Project on April 21, 2003, under Section 401 of the CWA. This Agreement establishes measures for the protection, mitigation, and enhancement of resources affected by the Project under a New License to be issued by FERC. It also specifies procedures to be used by the Parties to ensure the implementation of the Proposed License Articles contained in the New License, consistent with this Agreement. It is the intent of the Parties to establish a framework for future collaborative efforts for the protection, mitigation and enhancement of the resources affected by the Project, including Lake Chelan and the bypassed reach of the Chelan River. The Parties agree that this Agreement is fair, reasonable, and in the public interest within the meaning of FERC Rule 602, governing offers of settlement (18 C.F.R. § 385.602(g)(3)).

Section 4: Definitions

4.1. "Agencies" means the USDA Forest Service, the National Park Service, the NOAA Fisheries, the United States Fish and Wildlife Service, the Washington Department of Fish and Wildlife, and the Washington Department of Ecology.

4.2. "Agreement" means the entirety of this document, including the Proposed License Articles attached as Attachment A, and the Lake Chelan Comprehensive Plan, attached as Attachment B. In the event of an internal conflict between this document and either the Proposed License Articles or the Lake Chelan Comprehensive Plan, this document shall control. In the event of a conflict between the Proposed License Articles and the Lake Chelan Comprehensive Plan, the Proposed License Articles shall control.

4.3. "Consensus" means that the majority of the members of a Forum or the Lake Chelan Policy Committee agree, and that Chelan PUD and the Agency or Agencies that have relevant authority unanimously agree.

4.4. "Estimated Cost" means that the dollar figure provided serves as one of the guides to the scope of work intended by the Parties, in the event that the Parties disagree as to the intended scope of work during the term of this Agreement. The Estimated Cost does not define the total cost of the work or establish a limit on the costs necessary to accomplish the intended scope of work.

4.5. "FERC" means the Federal Energy Regulatory Commission.

Settlement Agreement

4.6. "Force Majeure" means any cause that prevents compliance with this Agreement that is reasonably beyond the affected Party's control and that could not be avoided with the exercise of due care, whether unforeseen, foreseen, foreseeable, or unforeseeable, and without the fault or negligence of the affected Party. Force Majeure may include, but is not limited to, natural events, labor or civil disruption, breakdown or failure of Project works, new regulations or laws that are applicable to the Project, orders of any court or agency having jurisdiction over the Party's actions, delay in a FERC order becoming final, or delay in issuance of any required permit.

4.7. "Lake Chelan Policy Committee" or "LCPC" is a committee consisting of signatories to this Agreement, their successors or designees, from the NOAA Fisheries, USDA Forest Service, NPS, USFWS, Chelan PUD, WDFW, WDOE, and the City of Chelan who have authority to make decisions on behalf of their respective organizations.

4.8. "License Articles" means the terms and conditions included in the New License issued to Chelan PUD by FERC for the continued operation of the Project.

4.9. "Licensee" means Public Utility District No. 1 of Chelan County, Washington or any successor to whom such license is transferred.

4.10. "New License" means the license to be issued by FERC for the continued operation and maintenance of the Project, pursuant to the Federal Power Act ("FPA").

4.11. "Other Measures" means any activities by Chelan PUD that have a financial impact on Chelan PUD and address an unforeseen resource need under Proposed License Article 12, including changes in Project operations that impact energy production, and in-kind contributions by Chelan PUD.

4.12. "Parties" means the entities that sign this Agreement, except entities that sign as supporters.

4.13. "Project" means the Lake Chelan Project, licensed to Chelan PUD by FERC as Project No. 637.

4.14. "Project Area" means the geographic area within the Project boundary, and the geographic area that is directly affected by the Project.

4.15. "Proposed License Articles" are license articles proposed by the Parties to FERC in this Agreement, and contained in Attachment A hereto.

4.16. "Unanticipated Agency Savings" means funds made available by Chelan PUD to an Agency pursuant to this Agreement, to the extent that such funds, following a reasonable amount of experience in implementing this Agreement, reasonably appear to be in excess of the amount needed to accomplish the purposes for which the funds were made available in each License Article. Unanticipated Agency Savings shall be determined by the Agency or Agencies to whom the funds were made available, in collaboration with Chelan PUD, on the tenth anniversary of the New License, and every five years thereafter.

Settlement Agreement:

Section 5: License Term

5.1. The term of this Agreement shall be the same as the term of the New License (including any annual licenses), unless sooner terminated pursuant to section 17 of this Agreement. The Agencies agree to support a license term of 45 years, and to not oppose a license term longer than 45 years. Chelan PUD will continue to seek a license term of 50 years.

Section 6: Effective Dates

6.1. **Effective Date of the Agreement.** This Agreement shall take effect upon signature of all Parties, and shall remain in effect for the term of the New License and for any annual license issued subsequent thereto, unless this Agreement is sooner terminated pursuant to section 17. Upon the signature of all of the Parties, only sections 8, 9, and 18 of this Agreement, and the provisions regarding Chelan PUD planning activities identified in the Proposed License Articles and the Comprehensive Plan, shall take effect. The remaining provisions of this Agreement shall take effect upon the effective date of the New License.

6.2. **Effective Date of the New License.** The effective date of the New License shall be the date that FERC issues the New License, unless the order issuing the New License or any part thereof is later stayed, in which case the effective date of the New License or that part which was stayed shall be the date such stay is lifted, unless otherwise specified by FERC.

Section 7: Parties Bound

7.1. The Parties shall be bound by this Agreement for the term of the New License, including any subsequent annual licenses, unless this Agreement is sooner terminated pursuant to section 17. A Party that withdraws from this Agreement shall not be bound following such withdrawal, except as provided in section 11.

Section 8: Licensee Obligations to take Actions in Support of this Agreement

8.1. By entering into this Agreement, Chelan PUD agrees to take certain steps for the purpose of assuring that all subsequent administrative processes related to this Agreement will yield results in conformance with this Agreement. Specifically, Chelan PUD shall: (a) within 30 days of the effective date of this Agreement, file an offer of settlement with FERC in support of this Agreement, pursuant to Rule 602 (18 CFR § 385.602); (b) submit a statement in support of this Agreement to NOAA Fisheries and USFWS as part of any comments in the ESA Section 7 consultation process; (c) ensure that any supplemental information, comments, or responses to comments filed by it with FERC in the context of the relicensing process are in conformance with this Agreement; (d) submit a statement in support of this Agreement to the Washington State Pollution Control Hearings Board, regarding the pending appeal of the section 401 certification; and (e) actively support, in all other relevant regulatory proceedings, incorporation of the Proposed License Articles into the New License.

Settlement Agreement

Section 9: Agency Obligations to Take Actions in Support of this Agreement

9.1. Subject to the limitations in sections 10 and 12, the Agencies agree to take certain steps for the purpose of assuring that all subsequent administrative processes related to this Agreement will yield results in conformance with this Agreement. Specifically, the Agencies agree to submit a statement in support of this Agreement to FERC, and (except WDOE) to submit a statement in support of the Agreement to WDOE regarding the pending appeal of the Section 401 water quality certification. If any Agency elects to submit comments in any other proceeding related to the New License, such comments shall be consistent with this Agreement.

Section 10: Satisfaction of Relicensing Obligations

10.1. The Parties intend that Chelan PUD's performance of its obligations under this Agreement and the Section 401 certification issued on April 21, 2003, shall satisfy Chelan PUD's legal obligations to every other Party under all applicable federal and state law regarding the relicensing of the Project, including the laws as provided below.

10.2. Section 18 of the FPA. Section 18 of the FPA states that FERC shall require construction, maintenance, and operation by a licensee of such fishways as the Secretaries of the U.S. Departments of the Interior (through USFWS) or Commerce (through the NOAA Fisheries) may prescribe. NOAA Fisheries and USFWS are not prescribing fish passage facilities at the Project at this time, although the Proposed License Articles reserve the authority of NOAA Fisheries and USFWS to do so in the future. In the event that NOAA Fisheries or USFWS prescribe fish passage for native non-stocked Columbia River salmon, steelhead, and Columbia River bull trout appearing immediately downstream of the base of the Lake Chelan dam in sufficient numbers to be a self-sustaining population in Lake Chelan, such event shall not constitute a material inconsistency with this Agreement for purposes of Chelan PUD withdrawal pursuant to section 17 of this Agreement, and the contingency fund provided in Proposed License Article 12 shall not be available for the costs of such fishways. In the event that NOAA Fisheries or USFWS exercise their authority under circumstances other than those described in the preceding sentence, such event shall constitute a material inconsistency for purposes of Chelan PUD withdrawal pursuant to section 17 of this Agreement; however, if Chelan PUD does not withdraw, Chelan PUD may, in its sole discretion, apply any available Unanticipated Agency Savings and/or funds from the contingency fund provided in Proposed License Article 12 to the cost of such fishways. Nothing in this subsection modifies any legal obligation of Chelan PUD to construct, operate, and maintained prescribed fishways.

10.3. Endangered Species Act. If FERC adopts the provisions of this Agreement as the proposed action, such proposed federal action shall be the basis for a section 7 consultation between FERC and NOAA Fisheries and/or USFWS, and any biological opinion relating to relicensing of the Project shall address and evaluate such provisions. As of the effective date of this Agreement, consultation under section 7 of the ESA has not been completed. Therefore, NOAA Fisheries and USFWS do not formally bind themselves to any outcomes or conclusions

Settlement Agreement

regarding the section 7 consultation. NOAA Fisheries and USFWS expressly reserve the right to consult with FERC, pursuant to the ESA, and to take such future actions as may be necessary to meet their obligations under the ESA. NOAA Fisheries and USFWS expressly contemplate that FERC's subsequent actions with respect to the issuance of the New License will fully satisfy the requirements of ESA section 7, including the terms and conditions contained in any biological opinion issued by NOAA Fisheries and/or USFWS. During the term of the New License, including any subsequent annual licenses, the Parties understand that, under the ESA, consultation may occur between USFWS, NOAA Fisheries, and FERC, pursuant to applicable law. In the event that NOAA Fisheries or USFWS exercise their authority pursuant to ESA, and such exercise requires Chelan PUD to take any actions that are materially inconsistent with this Agreement, Chelan PUD may withdraw pursuant to section 17 of this Agreement; however, if Chelan PUD does not withdraw, Chelan PUD may, in its sole discretion, apply any available Unanticipated Agency Savings to the costs of such required actions. Nothing in this subsection modifies any legal obligation of Chelan PUD to take such required actions.

10.4. Section 4(e) of the FPA. USDA Forest Service and NPS will issue their Final Terms and Conditions under section 4(e) for the lands they administer. USDA Forest Service and NPS anticipate that their respective Final Terms and Conditions under section 4(e) will be consistent with this Agreement.

10.5. Section 10(j) of the FPA. USFWS, NOAA Fisheries, and WDFW anticipate that any final recommendations under section 10(j) will be consistent with this Agreement.

10.6. Section 10(a) of the FPA. The Agencies anticipate that any final recommendations under section 10(a) will be consistent with this Agreement.

Section 11: Limitations

11.1. This Agreement establishes no principle or precedent with regard to any issue addressed in this Agreement, or with regard to any Party's participation in any other pending or future licensing proceeding. This Section shall survive termination of this Agreement, and shall apply to a Party that withdraws from this Agreement under section 17.

11.2. Nothing in this Agreement is intended to affect, diminish, impair, or predetermine any federally reserved or state law based water right that the Agencies, on behalf of the United States, may have in the Lake Chelan Basin or its tributaries.

Section 12: Environmental Review, Comment and Consultation

12.1. Nothing in this Agreement shall be construed to limit the Agencies from complying with their obligations under applicable laws and regulations to consider and respond to public comments received in any environmental review or regulatory processes related to this Agreement. This Agreement shall not be interpreted to predetermine the outcome of any such environmental review or regulatory process, or any appeals therefrom.

Settlement Agreement

Section 13: Chelan PUD Solely Responsible for Operations and Costs of Project

13.1. By entering into this Agreement, none of the Parties, except for Chelan PUD, have accepted any responsibility for the operation or costs of the Project.

Section 14: Availability of Funds

14.1. Implementation of this Agreement by the federal Agencies is subject to the requirements of the Anti-Deficiency Act, 31 USC §§ 1341-1519, and the availability of appropriated funds. Nothing in this Agreement is intended or shall be construed to require the obligation, appropriation, or expenditure of any money from the U.S. Treasury. The Parties acknowledge that the federal Agencies shall not be required under this Agreement to expend any appropriated funds unless and until an authorized official of the relevant Agency affirmatively acts to commit to such expenditures in writing. Implementation of this Agreement by the state Agencies is subject to the availability of appropriated funds. Nothing in this Agreement is intended or shall be construed to require the obligation, appropriation, or expenditure of any money from the Treasury of the State of Washington. The Parties acknowledge that the state Agencies shall not be required under this Agreement to expend any appropriated funds unless and until an authorized official of the relevant Agency affirmatively acts to commit to such expenditures in writing.

Section 15: Force Majeure

15.1. No Party shall be liable to any other Party for breach of this Agreement as a result of a failure to perform or for delay in performance of any provision of this Agreement if such performance is delayed or prevented by Force Majeure. Increased cost for the performance of this Agreement by Chelan PUD shall not be deemed to constitute Force Majeure. The Party whose performance is affected by Force Majeure shall notify the other Parties in writing within 24 hours, or as soon thereafter as practicable, after becoming aware of any event that such affected Party contends constitutes Force Majeure. Such notice will identify the event causing the delay or anticipated delay, estimate the anticipated length of delay, state the measures taken or to be taken to minimize the delay, and estimate the timetable for implementation of the measures. The affected Party shall make all reasonable efforts to promptly resume performance of this Agreement and, when able, to resume performance of its obligations and give the other Parties written notice to that effect. Upon receipt of notice of a Force Majeure event, any other Party may request that the Parties engage in dispute resolution under section 16 in an effort to modify this Agreement in a mutually satisfactory manner. If dispute resolution is completed without reaching an Agreement, any Party (other than Chelan PUD) may withdraw from this Agreement. If a Party other than Chelan PUD withdraws pursuant to the preceding sentence, Chelan PUD may withdraw pursuant to subsection 17.8 of this Agreement.

Settlement Agreement

Section 16: Dispute Resolution

16.1. In the event that any dispute arises among the Parties concerning this Agreement, the staff of the relevant Parties shall first attempt to resolve such dispute on an informal basis. If the staff cannot resolve the dispute within 30 days, any Party may request that the dispute be considered by the relevant members of the Lake Chelan Policy Committee, pursuant to section 18 of this Agreement.

In the event that such dispute is not resolved by the relevant members of the Lake Chelan Policy Committee within 30 days after referral of the issue by staff, a Party claiming a dispute shall give notice of the dispute to all Parties within 7 days of the end of the 30-day referral period. The Policy Committee shall hold at least one additional meeting within 30 days after such notice to attempt to resolve the disputed issue. If the additional meeting or meetings fails to resolve the dispute, the disputing Parties may agree upon the selection of a neutral mediator and the method of payment for such mediator within 15 days after notice by a Party that the additional meeting or meetings did not resolve the dispute. The mediator shall mediate the dispute during the next 60 days after selection. In the event that the Parties cannot agree on the selection of a mediator, or on payment of such mediator, or the mediation is not successful, within the respective time limits, the dispute resolution process shall be deemed to have been completed.

16.2. Any of the time periods provided in subsection 16.1 may be reasonably extended or shortened by agreement of the Parties, or as necessary to conform to the procedure of an agency or court with jurisdiction over the dispute. Unless otherwise agreed among the Parties, each Party shall bear its costs for participation in the mediation. Pending resolution of any dispute, and subject to the authority of FERC or other agency to order otherwise, Chelan PUD may continue operating the Project in the manner of its operation prior to the time the dispute arose.

16.3. If the dispute is within the jurisdiction of FERC, any Party may bring the matter before FERC for resolution after initiating the process provided in section 16.1 of this Agreement. If the dispute is not within the jurisdiction of FERC, any Party may, after initiating the process provided in section 16.1 of this Agreement, seek judicial, administrative, or other enforcement of the terms of this Agreement, which shall be enforceable under all applicable federal or state laws governing agreements of this type. In the event that a Party brings a matter before FERC, or seeks judicial, administrative, or other enforcement of the terms of this Agreement, the Parties shall nevertheless continue to engage in dispute resolution pursuant to this section to the extent practicable.

16.4. WDOE reserves the right not to participate in, or withdraw from, the dispute resolution under this section and elsewhere in this Agreement if it determines, in its sole discretion, that an urgent situation exists requiring expeditious action to maintain the status quo of affected resources or to prevent deterioration of water quality.

Settlement Agreement

Section 17: Withdrawal and Termination if Agreement Materially Changed

17.1. Consistent License Issued; No Appeal or Rehearing. The Parties enter into and jointly submit this Agreement with the express condition that the FERC approves and accepts all provisions of this Agreement and issues a New License in conformance with the terms of this Agreement. If FERC issues a license that is consistent with this Agreement, and no rehearing or appeal is taken, the Parties are bound by this Agreement.

17.2.1. Materially Inconsistent License Issued. If the FERC issues a new license that is materially inconsistent with any provision contained in this Agreement, whether through its own action or through incorporation of mandatory conditions or by any other means, this Agreement shall be considered modified to conform to the FERC order unless any Party to this Agreement, within 30 days of FERC's order, provides written notice that it objects to the material inconsistency. A request for rehearing at FERC shall serve as such notice. The Parties shall then work together to resolve the issue through the dispute resolution process provided in section 16. During this process, a Party may seek rehearing of the FERC order; however, the request for rehearing shall be withdrawn if unanimous agreement is reached on modifying this Agreement to conform to the FERC's order. If no such agreement is reached upon the completion of the dispute resolution process, a Party whose interests are affected by a material inconsistency may withdraw from this Agreement. The Parties reserve any remedies under applicable law to enforce the provisions contained in this Agreement but omitted by FERC.

17.2.2. Any Party may also seek judicial review of any FERC order that is materially inconsistent with this Agreement. The dispute resolution process shall not preclude any Party from timely filing for and pursuing judicial review of a FERC order that is materially inconsistent with this Agreement. However, the Parties shall follow the dispute resolution process provided in section 16 to the extent reasonably practicable while such appeal is being pursued. If a Party has filed for judicial review of a materially inconsistent order, and the Parties subsequently agree unanimously to modify this Agreement to conform to the materially inconsistent order, the filing Party or Parties shall withdraw the appeal, or recommend such withdrawal, as appropriate. If no such agreement is reached upon the completion of the dispute resolution process, and the outcome of the judicial review is materially inconsistent with this Agreement, a Party whose interests are affected by such material inconsistency may withdraw from this Agreement.

In the event that FERC issues a new license that is materially inconsistent with this Agreement, any Party that has filed or intends to file a motion to stay such New License, or any part thereof, may request in writing that other Parties confer (either in person or by phone) with such Party within 10 days regarding the willingness of such other Parties to support such motion for stay.

17.3. Consistent License Issued; With Appeal. If FERC issues a New License that is consistent with this Agreement, but the order issuing the New License is appealed, and such appeal could, if successful, result in a material inconsistency with this Agreement, the Parties shall, at the request of Chelan PUD (which request shall not be made prior to the 4th anniversary of the filing of the appeal), work together to agree on the deferral, if appropriate, of major capital

Settlement Agreement

expenditures by Chelan PUD (as well as annual funding made available by Chelan PUD and associated with such major capital expenditures) during the pendency of such appeal. The deferral plan shall be limited to deferring Chelan PUD expenditures under this Agreement in an amount that is approximately equal to the additional costs that could reasonably be expected to be imposed as a result of the appeal, if successful, minus the amount (either \$800,000 or \$1.3 million) to be made available by Chelan PUD as a contingency fund pursuant to section (f) of Proposed License Article 12. Such deferral plan shall become effective on the 5th anniversary of the filing of such appeal, and shall continue in effect until such appeal is concluded. If the Parties cannot reach agreement on the deferral plan within 30 days of such request, the matter shall be subject to dispute resolution pursuant to section 16. If no such agreement is reached upon the completion of the dispute resolution process, Chelan PUD may withdraw from this Agreement. If such appeal is successful, and the result is a material inconsistency with this Agreement, Chelan PUD may withdraw from this Agreement pursuant to subsection 17.2.1.

17.3.1 If, under the circumstances described in paragraph 17.3 of this subsection, Chelan PUD has filed or intends to file a motion to stay such New License, or any part thereof, during the pendency of the appeal, Chelan PUD may request in writing that other Parties confer (either in person or by phone) with Chelan PUD within 10 days regarding the willingness of such other Parties to support the motion for stay. If Chelan PUD's motion for stay is limited to those items agreed to in the deferral plan, such other Parties shall agree to support the motion. If such conference does not result in an agreement regarding support for the motion for stay, which is limited to the agreed to deferral plan, Chelan PUD may withdraw from this Agreement.

17.4. Inconsistency Subsequent to Issuance of New License. If, during the term of the New License, FERC or a court order modifies the New License or the operation of the Project in a manner that is materially inconsistent with this Agreement, any Party who objects to such order may give notice to the other Parties and commence dispute resolution under section 16 of this Agreement to determine whether such material inconsistency can be resolved by agreement of the Parties. In addition, the aggrieved Party may seek rehearing or appeal of such order. If no such agreement is reached upon the completion of the dispute resolution process, and the material inconsistency remains, any Party affected by such material inconsistency may withdraw from this Agreement.

17.5. FERC Jurisdiction. If the New License does not contain all of the provisions of this Agreement because FERC determines that it does not have jurisdiction to adopt or enforce the omitted provisions, the Parties agree to be bound by the entire Agreement, including the provisions omitted by FERC, unless any Party provides written notice within 30 days that it objects to the omission as creating a material inconsistency with this Agreement. A request for rehearing at FERC shall serve as such notice. If such written notice is given, the Parties shall then work together to resolve the issue through the dispute resolution process provided in section 16. During this process, a Party may seek rehearing of the FERC order; however, the request for rehearing shall be withdrawn if unanimous agreement is reached on accommodating such omission. If no agreement is reached upon the completion of the dispute resolution process, any Party that objected to the omission may withdraw from this Agreement.

Settlement Agreement

17.6. FERC Declines to Enforce. If a Party requests that FERC issue an order enforcing any provision of the New License, and FERC issues an order declining to enforce such provision, and Chelan PUD has failed to comply with such provision, any Party may give written notice to the other Parties of its intent to withdraw from this Agreement if such failure to enforce would result in a material inconsistency with this Agreement. If FERC fails to issue an order regarding the enforcement of such provision within a reasonable period of time, such failure shall be deemed to be an order declining to enforce such provision. A request for rehearing at FERC shall serve as such notice. The Parties shall then work together to resolve the issue through the dispute resolution process provided in section 16. During this process, a Party may seek rehearing of the FERC order; however, the request for rehearing shall be withdrawn if unanimous agreement is reached regarding such dispute. If no such agreement is reached upon the completion of the dispute resolution process, a Party whose interests are affected by FERC's decision not to enforce a license order may withdraw from this Agreement.

17.7. Review of Other Agency Actions. To the extent provided by applicable law, a Party may seek administrative rehearing and judicial review of any action by an Agency that is materially inconsistent with this Agreement. The dispute resolution process under section 16 of this Agreement does not preclude any Party from timely filing and pursuing an appeal under the respective Agency's applicable rules, or judicial review, of any such action that is materially inconsistent with this Agreement, or any final condition that relates to subjects not resolved by this Agreement. However, the Parties shall follow the dispute resolution process under section 16 of this Agreement to the extent reasonably practicable while any such appeal of an inconsistency is pursued. If a Party has filed for administrative rehearing or judicial review of any materially inconsistent action, and the Parties subsequently agree to modify this Agreement to conform to the materially inconsistent action, the filing Party shall withdraw the appeal, or recommend such withdrawal, as appropriate. If no such agreement is reached upon the completion of the dispute resolution process, any Party that filed for administrative rehearing or judicial review of a materially inconsistent action may withdraw from this Agreement.

17.8. Section 401 Certification Issued; With Appeal. If the pending appeal of WDOE's April 21, 2003, Section 401 certification to the Washington Pollution Control Hearings Board (PCHB) leads to a result that is materially inconsistent with this Agreement, the Parties shall then work together to resolve the issue through the dispute resolution process provided in section 16. During this process, a Party may seek rehearing of the PCHB order to meet the PCHB's procedural time limits; however, the request for rehearing shall be withdrawn if unanimous agreement is reached on modifying this Agreement to conform to the PCHB's order. If no such agreement is reached upon the completion of the dispute resolution process, a Party whose interests are affected by a material inconsistency may withdraw from this Agreement. Any Party may also seek judicial review of a PCHB decision that is materially inconsistent with this Agreement. The dispute resolution process shall not preclude any Party from timely filing for and pursuing judicial review of the materially inconsistent action. However, the Parties shall follow the dispute resolution process to the extent reasonably practicable while such appeal is being pursued. If a Party has filed for judicial review of a materially inconsistent order, and the Parties subsequently agree unanimously to modify this Agreement to conform to the inconsistent order, the filing Party shall withdraw the appeal, or recommend such withdrawal, as appropriate. If no such agreement is reached upon the completion of the dispute resolution process, and the

Settlement Agreement

outcome of the judicial review is materially inconsistent with this Agreement, a Party whose interests are affected by such material inconsistency may withdraw from this Agreement.

17.9. Effect of Withdrawal. If a Party withdraws from this Agreement, the remaining Parties may choose to continue to be bound by this Agreement. Alternatively, any remaining Party may choose to withdraw from this Agreement, following notice to the other Parties of the intention to withdraw and, if requested by any other Party, the use of the dispute resolution process under section 16 of this Agreement. If Chelan PUD withdraws from this Agreement, it shall be deemed null and void.

Section 18: Policy Committee and Resource Forums

18.1. Establishment of the Lake Chelan Policy Committee (LCPC). Within 180 days of the effective date of the Agreement, Chelan PUD shall establish a Lake Chelan Policy Committee (LCPC).

18.1.1. Scope of Responsibility of the LCPC. The LCPC shall be responsible for resolving conflicts arising within or among the Forums established in section 18.2, and for implementing Proposed License Article 12.

18.1.2. Membership of the LCPC. The following entities are eligible for membership in the LCPC: the WDFW, NOAA Fisheries, USDA Forest Service, NPS, USFWS, Chelan PUD, WDOE, and the City of Chelan.

18.1.3. Meetings of the LCPC. Chelan PUD shall provide administrative staff support and meeting rooms for meetings of the LCPC. The LCPC shall meet as necessary, pursuant to subsection 18.3, and Chelan PUD shall also provide notice of each such meeting.

18.1.4. Procedural Rules of the LCPC. Each entity serving on the LCPC shall designate in writing to Chelan PUD an authorized spokesperson and an alternate. The LCPC shall not act without a quorum, which shall consist of a majority of the members of the LCPC, present either in person or by telephone. Decisions of the LCPC shall be by Consensus. The LCPC may adopt such additional procedural rules for conducting its meetings as it deems necessary.

18.2. Establishment of Forums. Within 180 days of the effective date of the Agreement, Chelan PUD shall also establish and convene five forums to share information, coordinate efforts, and make recommendations to Chelan PUD and the Agencies regarding the implementation of the Comprehensive Plan. The forums shall be known as the Lake Chelan Fishery Forum (LCFF), the Chelan River Fishery Forum (CRFF), the Lake Chelan Recreational Forum (LCRF), the Lake Chelan Cultural Forum (LCCF), and the Lake Chelan Wildlife Forum (LCWF).

18.2.1. Scope of Responsibility of Forums. The LCFF shall be responsible for meeting to share information, coordinate efforts, and make recommendations regarding the implementation of Chapter 6 of the Comprehensive Plan, relating to the fishery resources of the Lake Chelan basin. The CRFF shall be responsible for meeting to share information, coordinate efforts, and make

Settlement Agreement

recommendations regarding the implementation of Chapter 7 of the Comprehensive Plan, relating to the fishery resources within the Lake Chelan basin. The LCRF shall be responsible for meeting to share information, coordinate efforts, and make recommendations regarding the implementation of Chapter 11 of the Comprehensive Plan, relating to the recreational resources within the Lake Chelan basin. The LCCF shall be responsible for meeting to share information, coordinate efforts, and make recommendations regarding the implementation of Chapter 10 of the Comprehensive Plan, relating to historic properties and cultural resources within the Area of Potential Effect as defined in Proposed License Article 10. The LCWF shall be responsible for meeting to share information, coordinate efforts, and make recommendations regarding the implementation of Chapter 9 of the Comprehensive Plan, relating to the wildlife resources within the Lake Chelan basin.

18.2.2. Membership of the Forums.

- (1) **Lake Chelan Fishery Forum (LCFF).** The following entities are eligible for membership in the LCFF: WDFW, USDA Forest Service, NPS, USFWS, the Confederated Tribes of the Colville Reservation (CCT), the Yakama Nation (YN), WDOE, Chelan PUD, the Lake Chelan Sportsman's Association (LCSA), and the City of Chelan.
- (2) **Chelan River Fishery Forum (CRFF).** The following entities are eligible for membership in the CRFF: WDFW, USDA Forest Service, NPS, NOAA Fisheries, USFWS, CCT, YN, WDOE, Chelan PUD, LCSA, and the City of Chelan.
- (3) **Lake Chelan Recreational Forum (LCRF).** The following entities are eligible for membership in the LCRF: the USDA Forest Service, NPS, Washington State Parks and Recreation Commission, Washington Interagency Committee for Outdoor Recreation (IAC), Chelan PUD, City of Chelan, Manson Parks and Recreation Department, the Lake Chelan Recreation Association, and American Whitewater Affiliation.
- (4) **Lake Chelan Cultural Forum (LCCF).** The following entities are eligible for membership in the LCCF: the Washington State Office of Archeological and Historic Preservation (OAHP), the Washington State Parks and Recreation Commission, the NPS, the Bureau of Indian Affairs (BIA), the USDA Forest Service, CCT, YN, Chelan PUD, and the Lake Chelan Historical Society.
- (5) **Lake Chelan Wildlife Forum (LCWF).** The following entities are eligible for membership in the LCWF: WDFW, USDA Forest Service, USFWS, NPS, Chelan PUD, CCT, YN, the Wenatchee Sportsman's Association, LCSA, the NCW Mule Deer Foundation, the Foundation for North American Wild Sheep, the Audubon Society, and the National Wild Turkey Federation.

Settlement Agreement

(6) **Additional Members.** Entities may be added to the membership of any Forum (but not the LCPC), upon receipt by Chelan PUD of a written request for membership, and upon a Consensus of such Forum.

18.2.3. Meetings. Chelan PUD shall provide administrative staff support and meeting rooms for meetings of the Forums. Chelan PUD shall also provide notice of each meeting. An initial meeting of each such Forum shall be convened by Chelan PUD within 180 days after the effective date of the Agreement. Also at the initial meeting, each Forum shall adopt a schedule for subsequent meetings, by a majority of those present.

18.2.4. Procedural Rules. Each entity serving on a Forum shall designate in writing to Chelan PUD an authorized spokesperson and an alternate. A quorum is not necessary for a Forum to make recommendations pursuant to section 18.2.1. Each Forum may adopt such additional procedural rules for conducting its meetings as it deems necessary.

18.3. Dispute Resolution/Appeal to the LCPC. The Forums shall make every reasonable effort to resolve any disputes arising within a Forum, as well as disputes arising between or among Forums. In the event of a dispute that cannot be resolved through such reasonable efforts, any member of a Forum may ask the LCPC to resolve a dispute. Upon such request, the LCPC shall be convened within 30 days, either in person or by telephone, and shall attempt to resolve the dispute by Consensus. If a dispute cannot be resolved by the LCPC, the matter shall be referred to the dispute resolution process provided in section 16 of this Agreement.

Section 19: Payments

19.1. All costs, balances, or payment amounts specified in dollars shall be deemed to be stated as of the year 2002, and Chelan PUD shall adjust such sums as of January 31 of each following year (starting in January 2004), or upon publication of, and in accordance with, the Consumer Price Index for all Urban Consumers, US City Average, All Items. Such Consumer Price Index is published by the U.S. Department of Labor, Bureau of Labor Statistics. If the publication of such Consumer Price Index is discontinued, the Parties shall select an appropriate alternative index to achieve the same economic effect.

19.2. Payments from Chelan PUD to other entities pursuant to the Proposed License Articles shall be handled as follows:

19.2.1. Chelan PUD shall enter into a mutually acceptable agreement with the USDA Forest Service that provides for the method of payment regarding Proposed License Articles 1, 5, 6, 9, and 11.

19.2.2. Chelan PUD shall enter into a mutually acceptable agreement with the NPS that provides for the method of payment regarding Proposed License Articles 2, 4, 6, 9, and 11.

19.2.3. Chelan PUD shall enter into a mutually acceptable agreement with WDFW that provides for the method of payment regarding Proposed License Articles 3, 6, and 9.

Settlement Agreement

19.2.4. Chelan PUD shall enter into a mutually acceptable agreement with the contractor preparing the food web model under Proposed License Article 6 that provides the method of payment for such food web model.

19.2.5. Chelan PUD shall enter into a mutually acceptable agreement with the Chelan-Douglas Land Trust, or another organization designated under paragraph (a)(6) of Proposed License Article 9, providing for the method of payment regarding Proposed License Article 9.

19.2.6. Chelan PUD shall enter into a mutually acceptable agreement with any necessary parties, providing for the method of payment regarding Proposed License Article 10.

19.2.7. Chelan PUD shall enter into a mutually acceptable agreement with the City of Chelan, providing for the method of payment regarding Proposed License Article 11.

19.2.8. Chelan PUD shall enter into a mutually acceptable agreement with each of the Agencies, providing for the method of payment, if any, regarding Proposed License Article 12.

19.2.9. Chelan PUD shall enter into a mutually acceptable agreement with an organization designated under paragraph (a) of Proposed License Article 14, providing for the method of payment regarding Proposed License Article 14. By joint written request, allowing sufficient time for Chelan PUD to arrange financing, NOAA Fisheries and WDOE may elect for the Chelan PUD to contribute, in advance, any of the annual payments to be made provided that each annual payment shall be adjusted by Chelan PUD for inflation pursuant to 19.1, and the total adjusted amount shall be reduced to present value by the actual discount rate applicable to Chelan PUD, and reduced by Chelan PUD's actual cost of financing.

19.3. The payment agreements entered into pursuant to subsection 19.2 shall, consistent with applicable federal and state law, provide for the method and timing of payments, the documentation of the amount and cost of work completed, a certification that such work was performed in a manner consistent with this Agreement, provisions for addressing liability, and a process for handling disputes regarding documentation, payment, or related matters. In addition, such payment agreements shall provide for the submission of annual planning reports to Chelan PUD by January 31 of each year during the term of the New License, including any subsequent annual licenses. The reports shall document all work that was completed during the preceding year, and the actual costs of such work. Annual planning reports shall also contain a detailed description of the work to be undertaken in the current year, a general description of the work to be undertaken in the following year, and the estimated costs of such work. If there is a disagreement regarding a payment agreement, or its implementation, such disagreement shall be resolved using the dispute resolution process pursuant to section 16 of this Agreement.

19.4. On an annual basis for the term of the New License, and any subsequent annual licenses, Chelan PUD shall make available a statement indicating the status of all funding provided by Chelan PUD under the Proposed License Articles, including the amount of funding provided and the amount of funding remaining available.

Settlement Agreement

19.5. At the request of any Agency, for the purpose of facilitating the solicitation of matching funds by such Agency, Chelan PUD shall provide a letter of intent stating that it will make available to such Agency a certain amount of funds on a certain schedule, consistent with the terms of the Proposed License Articles and the Comprehensive Plan.

19.6. The dollar amount of funding made available on an annual basis under this Agreement shall be adjusted in accordance with subsection 19.1 in the year in which it is made available, and any remaining balance, less any outstanding billings, shall be so adjusted each succeeding year of the New License term, including any subsequent annual licenses. Such amount, as adjusted, shall remain available during the term of the New License, including any subsequent annual licenses. In the event that such funding remains available at the expiration of the New License, including any subsequent annual licenses, such funding shall no longer be available.

Section 20: General Provisions.

20.1. Entire Agreement. All previous communications between the Parties, either verbal or written, with reference to the subject of this Agreement are superseded by the provisions of this Agreement, and, once executed, this Agreement constitutes the entire Agreement among the Parties related to the relicensing of the Lake Chelan Project.

20.2. No Third-Party Beneficiaries. Without limiting the applicability of rights granted to the public pursuant to applicable law, this Agreement shall not create any right or interest in the public, or any member of the public, as a third-party beneficiary of this Agreement, and shall not authorize any non-Party to maintain a suit at law or equity pursuant to this Agreement. The duties, obligations, and responsibilities of the Parties with respect to third parties shall remain as imposed under applicable law.

20.3. Modification of Agreement. This Agreement may be modified by unanimous written consent of the Parties at any time during the term of the New License, including subsequent annual licenses. If such modification requires the approval of FERC, Chelan PUD shall submit such modification to FERC for approval, and no actions relating to such modification shall be undertaken until such approval is received.

Section 21: Notice and Communication.

21.1. All written notices to be given pursuant to this Agreement shall be mailed by first class mail, or overnight express service, postage prepaid, to each Party at the addresses listed below or such subsequent address as a Party shall provide. Notices shall be deemed given five business days after the date of mailing, or on the date of receipt if overnight express or other receipt-notification service is used.

21.2. For purposes of implementing this Agreement, the Parties agree that the following individuals shall be designated to be the primary contact persons, and all written notices shall be posted to these individuals at the addresses listed below. Notification of changes of contact persons shall be made in writing and delivered to all other contact persons.

Settlement Agreement

For Chelan PUD:

Director of Licensing
327 N Wenatchee Avenue
Wenatchee, WA 98801

For USDA Forest Service:

District Ranger
Okanogan-Wenatchee National Forest
428 W Woodin Avenue
Chelan, WA 98816

For National Park Service:

Superintendent
North Cascades National Park Service
Complex
810 State Route 20
Sedro-Woolley, WA 98284

For NOAA Fisheries:

Hydrologist
National Marine Fisheries Service
525 NE Oregon Street, Suite 5000
Portland, OR 97232-2737

For United States Fish and Wildlife Service:

Project Leader
215 Melody Lane, Suite 119
Wenatchee, WA 98801

For Washington State Department of Ecology:

Central Region Section Manager
Water Quality Program
Central Region Office
15 W Yakima Avenue, Suite 200
Yakima, WA 98902

For Washington State Department of Fish and Wildlife:

Eastern Mitigation Coordinator
3860 Chelan Highway
Wenatchee, WA 98801

For Confederated Tribes of the Colville Reservation:

Post Office Box 150
Nespelem, WA 99155

For City of Chelan:

City Administrator
135 E Johnson
Chelan, WA 98816

For American Whitewater Affiliation:

Conservation Director
482 Electric Avenue
Bigfork, MT 59911

Section 22. Signatures

22.1. Signatory Authority. Each signatory to this Agreement certifies that he or she is authorized to execute this Agreement and to legally bind the Party he or she represents, and that such Party shall be fully bound by the terms hereof upon such signature without any further act, approval, or authorization by such Party.

22.2. Signing in Counterparts. This Agreement may be executed in any number of counterparts, and each executed counterpart shall have the same force and effect as an original instrument as if all the signatory Parties to all of the counterparts had signed the same instrument. Any signature page of this Agreement may be detached from any counterpart of this Agreement without impairing the legal effect of any signatures, and may be attached to another counterpart of this Agreement identical in form having attached to it one or more signature pages.

Dated this 8th day of October, 2003.

Settlement Agreement

For Chelan PUD:

Charles J. Hosken
Charles J. Hosken, General Manager

Settlement Agreement

For the USDA Forest Service:

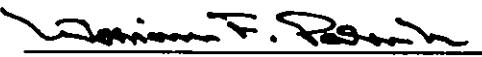
Linda Goodman

for Linda Goodman
Regional Forester, Pacific Northwest Region

10/8/03

Settlement Agreement

For the National Park Service:



William F. Paleck, Superintendent
North Cascades National Park Service Complex

Settlement Agreement

For the NOAA Fisheries:

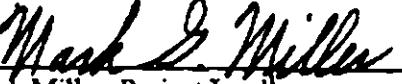

D. Robert Lohn, Regional Administrator

10/10/03 14:00 FAX 5097548575

USFWS EPHRATA WA

Settlement Agreement

For the United States Fish and Wildlife Service:


Mark Miller
Mark Miller, Project Leader
Central Washington Field Office

Lake Chelan Project No. 637
SS/7933

Page 22

Settlement Agreement
October 8, 2003

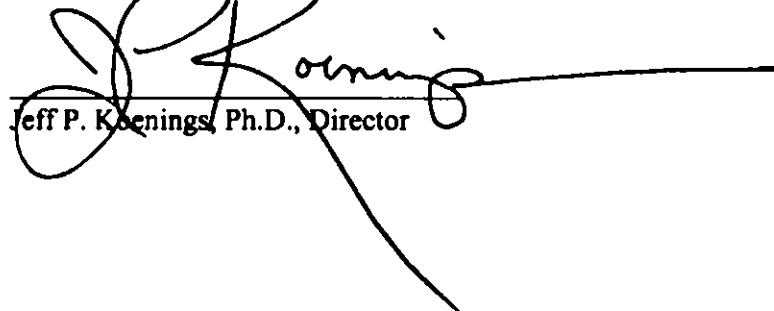
Settlement Agreement

For the Washington Department of Ecology:

Polly Zehm
Polly Zehm, Central Region Director

Settlement Agreement

For the Washington Department of Fish and Wildlife:



Jeff P. Koenings, Ph.D., Director

10/13/03 MON 16:01 FAX 5096342126

CCT FISH WILDLIFE

4002

Settlement Agreement

For the Confederated Tribes of the Colville Reservation:

 *Chairman*
(Signature, Title)

Settlement Agreement

For the City of Chelan:

W. Mitchell Atkinson

Mitch Atkinson, Mayor

Settlement Agreement

For American Whitewater Affiliation:


John Gangemi, Conservation Director

Settlement Agreement

For _____:

LAKE CHELAN LICENSE ARTICLES

Attachment A to the Lake Chelan Settlement Agreement

**LAKE CHELAN HYDROELECTRIC PROJECT
FERC Project No. 637**

October 8, 2003



**Public Utility District No. 1 of Chelan County
Wenatchee, Washington**

TABLE OF CONTENTS

Article 1. USDA Forest Service Erosion Control Plan.....	1
Article 2. NPS Erosion Control Plan	2
Article 3. Large Woody Debris Plan.....	3
Article 4. Stehekin Area Plan.....	4
Article 5. Survey Monument Replacement Plan	5
Article 6. Lake Chelan Fishery Plan.....	5
Article 7. Chelan River Fishery Plan.....	9
Article 8. Lake Level Plan	13
Article 9. Wildlife Habitat Plan	13
Article 10. Historic Properties and Cultural Resources Management Plan	15
Article 11. Recreation Plan.....	17
Article 12. Unforeseen Resource Needs.....	24
Article 13. Fishways.....	27
Article 14. Upper Columbia Spring-Run Chinook and Steelhead Conservation Measures.....	28

License Articles

**Attachment A
Lake Chelan Hydroelectric Project
License Articles**

FINAL

Article 1. USDA Forest Service Erosion Control Plan

(a) For the term of the New License, including any subsequent annual licenses, Chelan PUD shall be responsible for carrying out erosion control and monitoring measures on USDA Forest Service lands, in accordance with Chapters 1 and 3 of the Lake Chelan Comprehensive Management Plan (Comprehensive Plan), which are incorporated herein by reference. Specifically:

(1) Within one year of the effective date of the New License, Chelan PUD shall develop an erosion control implementation plan acceptable to Chelan PUD and the USDA Forest Service, as detailed in section 2.2 and table 1-4 of Chapter 1 of the Comprehensive Plan. The implementation plan and any updates or revisions shall be subject to the approval of Chelan PUD and the USDA Forest Service, and Chelan PUD shall file the plan and any updates or revisions with FERC. If Chelan PUD and the USDA Forest Service disagree regarding the plan or any updates or revisions, such disagreement shall be subject to dispute resolution pursuant to section 16 of the Agreement.

(2) Site-specific plans shall be prepared by Chelan PUD in consultation with, and with the approval of, the USDA Forest Service, for habitat and ground-disturbing activities on National Forest System Lands necessary to implement the erosion control implementation plan. The site-specific plans shall be completed at least one year before the habitat or ground-disturbing activity occurs. The site-specific plans shall include: (a) a map showing the location of the proposed activity; (b) a description of the USDA Forest Service land management area designation for the location of the proposed activity, and the applicable standards and guidelines regarding habitat and ground-disturbing activities at such location; (c) a description of the alternative designs and mitigation measures considered; (d) data collected from surveys, biological evaluations, or consultation conducted pursuant to applicable regulations; (e) a statement of the integrated weed management measures to be implemented, if any; and (f) an environmental analysis of the proposed action that meets applicable USDA Forest Service requirements for implementing the National Environmental Policy Act (NEPA). Chelan PUD shall conduct or fund such environmental analysis, including, but not limited to, scoping, site-specific resource analysis, and cumulative effects analysis sufficient to meet applicable USDA Forest Service regulations for compliance with NEPA. Chelan PUD may refer to or rely on any previous NEPA analysis for the activity to the extent that the analysis is not out of date, as determined by the USDA Forest

License Articles

Service. Any contractor or contractors selected by Chelan PUD to conduct the NEPA process shall be approved by the USDA Forest Service in advance of initiating such process.

Following scoping, Chelan PUD shall submit the scope of work for the environmental analysis, including, but not limited to, the range of alternatives that shall be addressed, to the USDA Forest Service for review and approval prior to completion of the environmental analysis, as described in section 2.2.1 of Chapter 1 of the Comprehensive Plan.

(3) Within two years of the effective date of the New License, Chelan PUD shall develop a monitoring and maintenance plan to address the need for ongoing monitoring of shoreline erosion on USDA Forest Service lands, and the need for maintenance of treated sites, as detailed in section 2.3 of Chapter 1 of the Comprehensive Plan. If Chelan PUD and the USDA Forest Service disagree regarding the plan or any updates or revisions, such disagreement shall be subject to dispute resolution pursuant to section 16 of this Agreement. Chelan PUD shall file the plan and any updates or revisions with FERC.

(4) Chelan PUD shall be responsible for the collection and use of large woody debris (LWD) in the erosion control efforts at sites designated in Chapter 1 of the Comprehensive Plan, and as described in Chapter 3 of the Comprehensive Plan.

(5) In consultation with the USDA Forest Service, Chelan PUD shall be responsible for securing any required permits relating to the implementation of this License Article and Chapter 1 of the Comprehensive Plan.

(b) Chapter 1 of the Comprehensive Plan may be modified in writing by mutual agreement of Chelan PUD and the USDA Forest Service at any time during the term of the New License or any subsequent annual licenses. If such modification requires the approval of FERC, Chelan PUD shall submit such modification to FERC for approval, and no actions relating to the modification shall be undertaken until such approval is received.

(c) The Estimated Cost to Chelan PUD of implementing Chapter 1 is \$2.68 million, as detailed in Table 1-1 of Chapter 1 of the Comprehensive Plan.

Article 2. NPS Erosion Control Plan

(a) Within 180 days of the effective date of the New License, Chelan PUD shall make available \$576,500. for the benefit of the NPS to implement erosion control work and monitoring at seven sites on NPS lands, as identified in the following table, in accordance with Chapter 2 of Comprehensive Plan, which is incorporated herein by reference. The seven sites are identified as follows:

*License Articles***NPS Erosion Sites**

Site Number	Location
61	Riddle Creek Cabins
79	Lakeshore Trail
80	Lakeshore Trail
81	Lakeshore Trail
90	Manly Wham
109	Lakeshore Trail
110	Lakeshore Trail

(b) Chelan PUD shall become responsible for implementation of the erosion control work and monitoring described in Chapter 2, but only to the extent that unanticipated circumstances limit or preclude the ability of the NPS to do so. If such unanticipated circumstances arise, Chelan PUD shall employ best efforts to implement such portion of the erosion control work and monitoring that the NPS is unable to implement, but only until the remaining portion of the \$576,500 is expended by Chelan PUD. Such expenditures by Chelan PUD shall include both payments to outside contractors and the cost of all work performed by Chelan PUD employees, including a reasonable allocation of overhead. Chelan PUD shall have no obligation to perform such work unless the NPS has provided written notice to Chelan PUD and the FERC that such unanticipated circumstances exist.

(c) Chelan PUD shall be responsible for additional funding as specified in Section 2.6 of Chapter 2 of the Comprehensive Plan. If Chelan PUD and the NPS fail to reach agreement regarding which, if any, additional sites qualify for treatment as specified in Section 2.6, the matter shall be referred to dispute resolution pursuant to section 16 of the Agreement.

(d) If at the time an erosion site project in this Article and Chapter 2 is to be performed, the average cost of materials and fuel necessary to implement erosion control projects has, over the preceding five years, increased by more than 10 percent above the adjustment provided in section 19 of the Agreement, Chelan PUD and the NPS shall attempt to agree on a plan for completing the remaining work and monitoring. The plan may include, but is not limited to, a reasonable increase in the \$576,500 to be made available by Chelan PUD, a reasonable modification of the timing for implementation of work without modifying the overall schedule provided in the Comprehensive Plan, or use of funds earmarked for future projects as long as the plan provides for funding such future projects. If the NPS and Chelan PUD cannot agree on such a plan, the matter shall be referred to dispute resolution pursuant to section 16 of the Agreement. An increase in the average cost of materials and fuel necessary to implement this License Article and Chapter 2 of less than 10 percent above the adjustment provided in section 19 of the Agreement shall not be the responsibility of Chelan PUD.

Article 3. Large Woody Debris Plan

(a) Within 180 days of the effective date of the New License, and by January 31st of each of the next nineteen years, Chelan PUD shall make available five thousand dollars (\$5,000) for

License Articles

the benefit of the WDFW to be used in obtaining or transporting Large Woody Debris (LWD) or other bioengineered bank protection and in-lake fish habitat restoration, enhancement, and mitigation materials (hereafter referred to as "bank and habitat materials") for use on state or private land within or adjacent to Lake Chelan, in accordance with Chapter 3 of the Comprehensive Plan, which is incorporated herein by reference. LWD consists of trees, logs, rootwads, woody debris, and other similar materials.

(b) The funds may be used by WDFW to purchase (as necessary) or transport LWD and other bank and habitat materials to WDFW-provided storage sites within the Lake Chelan basin, for eventual use in bioengineered bank protection and fish habitat installation projects on state and private lands within the Lake Chelan basin. LWD and other bank and habitat materials shall be used on state and private lands within the Lake Chelan basin to mitigate the impacts of future erosion control and bank protection projects within the Lake Chelan basin, as specified in Chapters 1 and 2 of the Comprehensive Plan.

(c)(1) For shoreline erosion control work on USDA Forest Service and NPS lands, work to improve tributary access, and other similar work, the quantity of LWD included in the work and/or placed as mitigation as required by permits using the one-to-one ratio, as described in Chapter 3, section 4.2 of the Comprehensive Plan, is expected by the Parties to provide adequate mitigation for natural resources. Because it is understood that the appropriate amount of LWD will vary from site to site, and from project to project, the ratio described in the preceding sentence shall be applied to the average amount of LWD for the projects performed during any five-year period.

(2) The Parties expect to support the one-to-one ratio on the amount of LWD and any other mitigation requirements in all permitting processes relating to such erosion control and other work, including, but not limited to, permits under Title 77 RCW (Hydraulic Project Approval) and section 404 of the Clean Water Act. If the total mitigation costs required by such permits exceed the costs that would result from the one-to-one ratio, Chelan PUD may reduce the funding provided to WDFW under this Article by the amount of the additional cost incurred.

Article 4. Stehekin Area Plan

(a) Within 180 days of the effective date of the New License, Chelan PUD shall make available \$160,000 to address dust control, the monitoring of dust, and related efforts, all to be carried out by the NPS. The \$160,000 includes \$100,000 for dust abatement (as specified in Section 4.7 of Chapter 4 of the Comprehensive Plan), \$45,000 to be provided on an as needed basis for additional dust abatement or monitoring efforts (as specified in Section 4.7 of Chapter 4 of the Comprehensive Plan), and \$15,000 for monitoring and evaluation of dust abatement efforts (as specified in Section 6.5 of Chapter 4 of the Comprehensive Plan). NPS management activities related to the Stehekin area are described in Chapter 4 of the Comprehensive Plan, which is incorporated herein by reference.

(b) Chelan PUD shall also perform monitoring and analysis of changes at the Stehekin River mouth, in accordance with section 6.3 of Chapter 4 of the Comprehensive Plan, at a cost not to exceed \$90,000.

License Articles

(c) Chelan PUD shall become responsible for implementation of the measures identified in License Article 4(a) and Chapter 4 of the Comprehensive Plan only if and to the extent that unanticipated circumstances limit or preclude the ability of the NPS to do so. If such circumstances arise, Chelan PUD shall employ best efforts to implement such portion of the work and monitoring as the NPS was unable to implement, but only until the remaining portion of the \$160,000 is expended by Chelan PUD. Such expenditures by Chelan PUD shall include both payments to outside contractors and the cost of all work performed by Chelan PUD employees, including a reasonable allocation of overhead. Chelan PUD shall have no obligation to perform such work until the NPS has provided written notice to Chelan PUD and FERC that such unanticipated circumstances exist.

Article 5. Survey Monument Replacement Plan

Within 180 days of the effective date of the New License, Chelan PUD shall make available funding to the USDA Forest Service not to exceed \$80,000 for survey work to locate, re-establish where necessary, and document survey monuments, in accordance with Chapter 5 of the Comprehensive Plan, which is incorporated herein by reference.

Article 6. Lake Chelan Fishery Plan

In conjunction with the Lake Chelan Fishery Forum (LCFF), Chelan PUD shall implement its responsibilities under Chapter 6 of the Comprehensive Plan, which is incorporated herein by reference. Specifically:

(a) **Food Web Model.** (1) When notified by WDFW pursuant to subsection (a)(2) of this Article, but not sooner than 180 days of the effective date of the New License, Chelan PUD shall make available \$100,000 to a contractor selected by Chelan PUD, after consultation with the LCFF, to develop a food web model for Lake Chelan, as described in section 5 of Chapter 6 of the Comprehensive Plan.

(2) Chelan PUD shall contract to develop the food web model when notified by WDFW, after coordination with NPS, USDA Forest Service, and USFWS, and after consultation with the LCFF, that, in addition to the \$100,000 to be provided by Chelan PUD pursuant to subsection (a)(1) of this License Article, there is funding available from non-Chelan PUD sources sufficient to fund the food web model contract. Chelan PUD may require a written commitment from such non-Chelan PUD source(s) of funding before or at the time Chelan PUD executes a contract for the food web model. If required, the written commitment shall be for the difference between the \$100,000 to be provided by Chelan PUD and the amount to be paid under the contract for the food web model. The food web model contract shall provide that the model and appropriate training shall be provided to the entities that are members of the LCFF.

(b) **Fish Monitoring and Evaluation.** (1) Within 180 days of the effective date of the New License, and by January 31st of each subsequent year, including any subsequent annual licenses, Chelan PUD shall make available \$20,000, to be used by the NPS, the USDA Forest Service, or WDFW, pursuant to a plan developed and adopted by the NPS, USDA Forest

License Articles

Service, and WDFW for monitoring and evaluating fish in Lake Chelan, as described in Chapter 6 of the Comprehensive Plan. The NPS, USDA Forest Service, and WDFW plan to consult with the LCFF in the course of developing such plan. If, in any year, the NPS, USDA Forest Service, and WDFW fail to develop and adopt such a plan, and submit it to Chelan PUD by January 10, Chelan PUD shall carryover that year's \$20,000 in funding until such plan has been developed, adopted, and submitted to Chelan PUD.

(2) Within 180 days of the effective date of the New License, and by January 31st of each subsequent year, Chelan PUD shall make available an additional \$20,000, to be used by the NPS, the USDA Forest Service, or WDFW, pursuant to the plan to be developed and adopted pursuant to subsection (b)(1) of this Article. However, Chelan PUD shall only be required to expend such additional \$20,000 on the basis of a one-for-one match (in cash or in-kind) in such year by the NPS, the USDA Forest Service, the USFWS, the WDOE, the WDFW, or any other organization approved as a source of matching funds by the LCFF. Funds made available in any such year, but not matched by December 31 of the following year, shall cease to be available. For any year in which a plan pursuant to subsection (b)(1) of this Article is not submitted to Chelan PUD, Chelan PUD shall carryover such additional \$20,000 in available funding until December 31 of the following year. If such plan is not submitted to Chelan PUD by December 31 of such following year, and one or more requests for payment has not been received by Chelan PUD for such additional \$20,000 by December 31 of such following year, such additional \$20,000 shall no longer be available.

(c) Tributary Barrier Removal. (1) Chelan PUD shall be responsible for removing alluvium barriers in tributaries to Lake Chelan for the term of the New License, including any subsequent annual licenses, in order to facilitate adfluvial salmonid access for spawning, as described in Chapter 6 of the Comprehensive Plan. Potential sites are listed alphabetically in Table 6-1 of Chapter 6 of the Comprehensive Plan, and in the following table:

Potential Tributary Barrier Removal Sites

Bear Creek	Lightning Creek
Big Creek	Little Big Creek
Cascade Creek	Lone Fir Creek
Castle Creek	Mitchell Creek
Coyote Creek	Poison Creek
Deep Harbor Creek	Prince Creek
First Creek	Pyramid Creek
Fish Creek	Railroad Creek
Four mile Creek	Riddle Creek
Gold Creek	Safety Harbor Creek
Grade Creek	25 Mile Creek
Graham Harbor Creek	

(2) Within the first five years of the New License, Chelan PUD shall implement the following actions within the drawdown zone of such tributaries: (i) remove existing barriers in up to 10

License Articles

high priority tributaries, and (ii) monitor up to an additional 10 tributaries to determine if the new lake level operating regime described in Article 8 and Chapter 8 of the Comprehensive Plan effectively removes existing barriers from the mouths of these tributaries.

(3) Every two years during the remaining term of the New License, or at a frequency recommended by LCFF and approved by NPS and USDA Forest Service, Chelan PUD shall fund monitoring of up to 10 tributaries, to determine if barriers are present or have reformed; and to remove any such barriers from up to two tributaries annually, unless barriers are clearly not caused by the Project (e.g., the result of fire, earthquakes, landslides, etc.). Any disagreement regarding whether a tributary barrier is Project-caused shall be resolved through dispute resolution pursuant to section 16 of this Agreement.

(4) The selection of tributaries for barrier removal and monitoring pursuant to this subsection shall be based on the recommendations of the LCFF, and subject to the approval of the NPS regarding tributaries on NPS lands, the USDA Forest Service for tributaries on USDA Forest Service lands, and the WDFW for tributaries on state lands. Any disagreement as to whether a tributary barrier was caused by the Project shall be resolved through the dispute resolution process under section 16 of this Agreement.

(5) The total Estimated Cost to Chelan PUD of the tributary barrier removal and monitoring work provided in this subsection is \$100,000.

(d) **Fish Stocking.** (1) For fish stocking in Lake Chelan and its tributaries during the term of the New License, including any subsequent annual licenses, Chelan PUD shall make available to WDFW for the Chelan Falls Hatchery site sufficient funding to annually rear approximately 5,000 pounds of salmonid fingerlings (for example: 500,000 fish at 100 fish/lb., presently kokanee) and 33,000 pounds of catchable-sized salmonids (for example approximately 100,000 fish at 3 fish/lb., presently rainbow trout and cutthroat trout), as described in section 4.6.3 of the Comprehensive Plan. The Estimated Cost to Chelan PUD of rearing such poundage of fish is \$30,000 per year.

(2) If WDFW, after coordination with the NPS, USDA Forest Service, and USFWS, and after consultation with the LCFF, decides, at any time during the term of the New License or any subsequent annual licenses, to reduce or eliminate fish stocking into Lake Chelan, the resulting savings shall be available to WDFW for other Lake Chelan fish management activities. Funds to be made available from reductions in fish production shall be determined as equivalent to the proportion of fish production poundage reduced. The funds saved shall be calculated as follows: take the number of pounds of fish production reduced, divide by the 38,000 pounds of fish initially to be produced, and multiply by the \$30,000 (as adjusted under section 19 of the Agreement up to the year of the decision to reduce production). For example, if 5,000 pounds of kokanee production was eliminated, \$3,950 would be available for other fish management activities ($5,000/38,000 \times \$30,000$ escalated = \$3,950 escalated).

(e) **Entrainment.** (1) Chelan PUD shall conduct no more than 140 days of entrainment sampling over four sampling years, using the same methodology used during the 2000 and 2001 field seasons, or another methodology of comparable cost recommended by the LCFF, and

License Articles

approved by WDFW, USFWS, and WDOE. Upon request of WDFW, Chelan PUD shall develop a sampling plan in consultation with USFWS, WDOE, and the LCFF, subject to approval by WDFW. The plan shall specify the sampling years and the allocation of sampling days among such years. The first sampling year shall not be prior to the seventh anniversary of the effective date of the New License, and the last sampling year shall be no later than the 35th anniversary of the effective date of the New License. The purpose of the sampling is to determine if significant numbers of adult spawnable age/size adfluvial westslope cutthroat trout are entering the power tunnel entrance.

(2) If less than 500 adult spawning age/size adult adfluvial westslope cutthroat trout are physically captured within any calendar year prior to completion of the four years of sampling, Chelan PUD, in consultation with LCFF, shall prepare an evaluation of the results of the entrainment monitoring and the method used. Chelan PUD, WDFW, USFWS, and WDOE shall determine whether the remainder of the four years of sampling should be conducted, at what intervals and what method should be used.

(3) If more than 500 adult spawnable age/size adult adfluvial westslope cutthroat trout are physically captured within a calendar year in the immediate vicinity of the power tunnel entrance, the WDFW, USFWS, or the WDOE may request that Chelan PUD install fish protection or exclusion devices for the power tunnel entrance, or that Chelan PUD implement other actions recommended by the LCFF and approved by WDFW, USFWS, and WDOE. Chelan PUD may object to the request on the grounds that such fish protection or exclusion devices, or such other actions, as the case may be, are not necessary. To assist in the determination of whether such fish protection or exclusion devices, or other actions, are necessary, Chelan PUD may conduct entrainment sampling in the power tunnel. If Chelan PUD so objects, and it cannot reach agreement with the Agency or Agencies making the request, the matter shall be referred to dispute resolution pursuant to section 16 of this Agreement. If Chelan PUD does not object, or the dispute resolution process results in a decision to install fish protection or exclusion devices, Chelan PUD shall seek recommendations from the LCFF regarding the design of fish protection or exclusion devices or such other actions. Chelan PUD shall conduct such tests as necessary to determine the effectiveness of such fish protection or exclusion devices or such other actions. Upon development of a successful design, Chelan PUD shall install such fish protection or exclusion devices or implement such other actions.

(4) For purposes of this Article, "adult" is defined as naturally-produced (non-stocked), spawnable age or size adfluvial westslope cutthroat trout. The size of adult westslope cutthroat is defined as 9-12 inches in total length, based on current Twin Lakes stock spawner size, but such definition may be adjusted upon a recommendation by the LCFF to WDFW, USFWS, WDOE, and Chelan PUD.

(5) As of the date of this Agreement, the species identified in this Article are not listed species under the ESA. If any identified species become a listed species under the ESA, this Article may be superceded by the ESA.

License Articles

Article 7. Chelan River Fishery Plan

Within one year of the effective date of the New License, Chelan PUD shall begin implementation of the plan to restore the fish and wildlife resources of the Chelan River, as described in this License Article and Chapter 7 of the Comprehensive Plan, which is incorporated herein by reference.

(a) **Biological objectives.** The Chelan River restoration plan is designed to achieve certain biological objectives concerning restoration and/or enhancement of biological resources in four separate reaches of the river and to support, maintain, and protect the designated and existing beneficial uses of the Chelan River basin, pursuant to applicable federal and State law. The biological objectives that Chelan PUD shall attempt to achieve for each reach are set forth in detail in section 4 of Chapter 7 of the Comprehensive Plan. The Parties believe that achievement of these biological objectives, through implementation of this License Article, would substantially restore a significant number of environmental values associated with the Chelan River.

(b) **Habitat Protection and Restoration measures.** Chelan PUD shall implement the following habitat protection and restoration measures:

(1) **Minimum flows and ramping rates.** Chelan PUD shall comply with the minimum flows and ramping rates provisions set forth in section 2.6.5, table 7-3, and section 3.2, table 7-6, respectively, of Chapter 7 of the Comprehensive Plan as soon as the structures needed to provide such flows are constructed, which shall occur no later than two years after the effective date of the New License. The structures for which construction is needed are a new flow release structure at the dam, estimated to cost \$350,000, and modifications to the channel in Reach 4. Prior to the date such structures are completed, Chelan PUD shall provide flows consistent with Chapter 7 of the Comprehensive Plan for the purposes of testing designs or structures or gathering other data, including water quality data.

(2) **Habitat modification in Reach 4 and the tailrace.** Not later than two years after the effective date of the New License, Chelan PUD shall complete modifications to improve habitat in Reach 4 and the tailrace, as set forth in section 3.1 and 3.2, respectively, of Chapter 7 of the Comprehensive Plan. Chelan PUD shall use standard river habitat restoration techniques to provide and maintain gravel areas for spawning, create pools, increase channel sinuosity, and moderate velocities, as described in sections 3.1, figure 7-9, and section 3.2, figure 7-10, in Chapter 7 of the Comprehensive Plan, or as agreed to by the Chelan River Fishery Forum (CRFF). This habitat work is estimated to have a capital cost of \$500,000.

(3) **Anadromous Fish Spawning Flows in Reach 4.** Beginning 90 days after the habitat modification in subsection (2) of this Article has been completed, Chelan PUD shall comply with the provisions for the pumping of tailrace water into Reach 4 set forth in section 3.3.6 of Chapter 7 of the Comprehensive Plan. As described in section 3.3.6, these additional flows into Reach 4 during the steelhead and late-run chinook spawning periods are to provide greater depths and velocities, which will improve spawning habitat conditions for these species. The capital cost for the pumping station is estimated to be \$2,500,000, with annual operating costs of \$20,000.

License Articles

(4) Redd Protection. Upon the effective date of the New License, Chelan PUD shall comply with the redd protection provisions set forth in section 4.1.3, table 7-10, and section 4.1.3 of Chapter 7 of the Comprehensive Plan. This measure is for the purpose of preventing damage to salmon redds that might occur as a result of powerhouse shutdown. As described in Chapter 7 of the Comprehensive Plan, detection of low dissolved oxygen (DO) levels in redds in the tailrace could trigger implementation of several alternatives, including intermittent powerhouse operation or installation and use of flow release pipes buried in the gravel.

(c) Implementation Program. Chelan PUD shall undertake the following program to monitor, evaluate, and adapt, where needed, the protection and restoration measures:

(1) Monitoring and evaluation. Chelan PUD shall begin implementation of all monitoring, evaluation, and reporting requirements set forth in section 5.4 and figure 7-13 of Chapter 7 of the Comprehensive Plan as soon after the effective date of the New License as practically feasible, but no later than two and one-half years after the effective date of the New License. The monitoring and evaluation program shall provide the basis for determining whether the biological objectives have been met. The monitoring and evaluation program shall also provide information needed to make changes to the habitat protection and restoration or monitoring and evaluation measures as may be appropriate to facilitate achievement of the biological objectives and of effective monitoring and evaluation. The monitoring and evaluation program will be used to determine if measures beyond those defined in subsection (b) of this License Article should be implemented.

(2) Reporting and evaluation of success and recommendation of new or modified measures. By no later than April 30, in each of years 4, 6, 8, and 10 following the effective date of the New License, Chelan PUD shall provide to the CRFF a final Biological Objectives Status Report that (1) summarizes the results of the monitoring and evaluation program, and evaluates the need for modification of the program, (2) describes the degree to which the biological objectives have been achieved, and the prospects for achieving those objectives in the next reporting period, (3) reviews measures implemented to meet those biological objectives, and (4) recommends any new or modified measures, including monitoring and evaluation, needed to achieve the biological objectives, to the extent practicable (hereinafter referred to as "new or modified measures"). Such recommendations shall contain a schedule for implementation. No later than February 28 of each such year, Chelan PUD shall provide a draft of such final report to the CRFF and consult with its members prior to issuing the final report. If a CRFF member is not in agreement with the draft report or recommendations and has an alternative evaluation or recommendation, Chelan PUD shall include a discussion of that alternative evaluation or recommendation in the final report.

(3) Management options to achieve compliance with biological objectives. Section 3.6 of Chapter 7 of the Comprehensive Plan sets forth a number of additional management options that Chelan PUD may implement to address specific problems that may arise in achieving biological objectives. Such options include pumping of tailrace water into Reach 4 for rearing salmonids, and actions to reduce the temperature in Reaches 1-3 (site-potential shade, refugia enhancement, flow increases during hot weather or daytime). These options have been identified as potential

License Articles

actions regarding the problems in question; however, future recommendations are not limited to these options.

(4) Implementation if agreement reached on new or modified measures. If Consensus is achieved by the CRFF and Chelan PUD as to new or modified measures needed to achieve the biological objectives or to carry out monitoring and evaluation, the recommended measures shall become part of the plan and implemented in accordance with an agreed schedule or, absent an agreed schedule, by August 1 of the reporting year. These new and modified measures are deemed to be part of the New License if Consensus is achieved by the CRFF and Chelan PUD. If, however, such measures require an amendment to the New License or FERC approval, Chelan PUD shall petition FERC to so amend the New License.

(d) Dispute Resolution and Reservation of Authority

(1) Resolution of disagreements over new or modified measures. If, within 60 days after issuance of the final Biological Objectives Status Report, the CRFF and Chelan PUD do not reach consensus as to new or modified measures needed to achieve the biological objectives, to the extent practicable, including the implementation schedule, or to carry out monitoring and evaluation, such disagreement shall be subject to dispute resolution pursuant to section 16 of this Agreement. During the pendency of the dispute resolution process, the minimum level of new or modified measures that the CRFF and Chelan PUD can agree upon shall be implemented.

(2) Compliance with biological objectives and state water quality standards. Chelan PUD shall comply with the implementation schedule as provided in Tables 7-10 and 7-11 in Chapter 7 of the Comprehensive Plan. No later than 10 years after the effective date of the New License, Chelan PUD shall provide WDOE with the information necessary to make a determination as to whether the biological objectives in Chapter 7 of the Comprehensive Plan and state water quality standards have been achieved. WDOE agrees that it shall confer with the CRFF prior to making a determination whether and to what extent the biological objectives contained in Chapter 7 have been met. If an Agency with relevant authority or Chelan PUD disagrees with WDOE's determination, it may invoke the dispute resolution process pursuant to section 16 of this Agreement. If WDOE determines that the biological objectives have been met but non-compliance with water quality standards exists, WDOE intends to initiate a process, if necessary, to modify the applicable standards through rulemaking or such alternative process as may otherwise be authorized under applicable federal and state law. If WDOE determines that some or all of the biological objectives have not been met and that Chelan PUD has undertaken all known, reasonable, and feasible measures to achieve those objectives consistent with supporting, protecting, and maintaining the designated and existing beneficial uses, WDOE intends to initiate a process to modify the applicable water quality standards to the extent necessary to eliminate any non-compliance with such standards. Such modification of state standards shall not release Chelan PUD from compliance with the implementation and monitoring measures required by this Article or Chapter 7 of the Comprehensive Plan. Chelan PUD shall, upon request by WDOE, fully respond to all reasonable requests for materials to assist WDOE in making determinations under this section and in any resulting rulemaking or other process.

License Articles

(3) Actions if Biological Objectives Not Achieved. Following the issuance of the final Biological Objectives Status Report in year 10, if Chelan PUD concludes that one or more biological objectives cannot be met in whole or in part despite its having undertaken all known, reasonable, and feasible measures to meet those objectives consistent with supporting, protecting, and maintaining the designated and existing beneficial uses, Chelan PUD may consult with the CRFF regarding whether to modify or eliminate a biological objective and/or associated implementation measure. Any disagreement resulting from such consultation shall be subject to dispute resolution pursuant to section 16 of the Agreement. Any changes to such biological objectives or implementation measures require the written consent of the WDOE, which shall not be unreasonably withheld pursuant to applicable federal and state law.

(4) WDOE reservation of authority. WDOE reserves the authority to issue orders to require new or modified measures beyond those otherwise provided for in this License Article and Chapter 7 of the Comprehensive Plan as may be reasonable and necessary to meet applicable water quality standards and other appropriate requirements of state law. In exercising such authority, WDOE shall consider any conflicts that arise between designated and/or existing beneficial uses, and reconcile such conflicts in a reasonable manner consistent with applicable state and federal law. Such new or modified measures may include, but are not limited to, changes to minimum flows and ramping rates. Prior to exercising such authority, WDOE agrees to issue a notice of intent to exercise its authority under this section. An Agency with relevant authority or Chelan PUD may within thirty days of such issuance initiate dispute resolution pursuant to section 16 of the Agreement. However, WDOE's authority shall not be limited by the outcome of the dispute resolution process contained in section 16 of the Agreement. Further, prior to exercising any such authority, WDOE will seek public input; however, if WDOE determines that, under the circumstances, more expeditious action is required, WDOE may limit such opportunities. This reservation of authority is not intended to create a right for Chelan PUD to seek review before the FERC of WDOE's exercise of such authority beyond that which may exist under applicable laws. Further, this provision is not intended to limit WDOE's authority to address unlawful discharges or other unlawful acts involving the Project that are actionable under RCW 90.48.

(5) Chelan PUD withdrawal and reservation of right to contest. In the event that WDOE imposes, under section (d)(4) of this Article, new or modified measures that cause the estimated capital costs required in sections (b)(2) and (b)(3) to increase by more than 25 percent, or the flow volumes required in section (b)(1) to increase by more than 2,900 cfs-days (i.e., 10 percent of the 80 cfs minimum flow), Chelan PUD may withdraw from the Agreement, which shall then be null and void. The costs associated with sections (c)(1) and (c)(2) of this Article shall not be considered a cost increase for the purposes of this section. The flow volume associated with Table 7-3 in section 2.6.5 and in section 3.3.7 (5,000 cfs-days) of Chapter 7 of the Comprehensive Plan shall not be considered an increase in volume for the purposes of this section. Prior to withdrawing, Chelan PUD shall engage in dispute resolution pursuant to section 16 of the Agreement. Chelan PUD reserves the right to contest the requirement of new or modified measures by WDOE on any and all legal grounds.

In the event that measures required to provide for redd protection would exceed the capital cost or flow limitations of this subsection, Chelan PUD may also either exceed such

License Articles

limitations, remove the spawning habitat in the tailrace, or exclude fish from the tailrace. Removal of the spawning habitat or exclusion of fish from the tailrace shall occur only upon approval by the Agencies with relevant authority.

Article 8. Lake Level Plan

(a) Beginning within one year of the effective date of the New License, and for the term of the New License, including any subsequent annual licenses, Chelan PUD shall make every reasonable effort to comply with the Lake level management practices described in Chapter 8 of the Comprehensive Plan, which is incorporated herein by reference. Specifically, Chelan PUD shall make every reasonable effort to comply with the following objectives (contained in section 3.1 of Chapter 8 of the comprehensive Plan): (1) maintaining minimum flows in the Chelan River (this objective has priority over lake levels); (2) reducing high flows in the Chelan River (this objective has priority over lake levels); (3) satisfying regulatory requirements for flood control (adjusting lake level); (4) providing usable lake levels for recreation (which varies between elevation 1,090 and 1,098 ft., depending on the slope of the shoreline and boat dock configurations); (5) reduce shoreline erosion; (6) preventing fish passage blockages (due to tributary barriers); and (7) minimizing the effect of refill on attainment of flow objectives for salmon in the mainstem Columbia River.

(b) Table 8-1 in Chapter 8 of the Comprehensive Plan, and included below, indicates the lake level elevations that Chelan PUD shall seek to achieve, to the extent consistent with the objectives listed in subsection (a) of this Article:

Proposed Lake Elevations (PME14)

Day	Minimum Elevation (ft)
May 1	1,087.6
June 1	1,094.0
July 1	1,098.0
August 1	1,099.0
September 7	1,098.7
October 1	1,097.2

Article 9. Wildlife Habitat Plan

Chelan PUD shall implement its responsibilities under the Wildlife Habitat Plan, as described in Chapter 9 of the Comprehensive Plan, which is incorporated herein by reference. Specifically:

(a) **Wildlife Habitat Restoration.** (1) Within 180 days of the effective date of the New License, Chelan PUD shall make available \$220,000 to the Chelan-Douglas Land Trust, for the acquisition of conservation easements in perpetuity on privately-owned lands located on the north shore of Lake Chelan, in accordance with section 4.1.1 of the Comprehensive Plan. For

License Articles

purposes of this License Article, all references to the Chelan-Douglas Land Trust refer to the Chelan-Douglas Land Trust or another organization selected pursuant to paragraph (a)(6) of this License Article. The goal is to secure easements on 400 acres of land, and priority shall be given to acquiring easements on lands between elevations 1,100 and 1,400 ft.

(2) Within 180 days of the effective date of the New License, Chelan PUD shall make available additional funding of up to 15 percent of the cost of easement acquisition (not to exceed \$33,000) to the Chelan-Douglas Land Trust, for fees associated with easement acquisition. Associated fees include administrative costs, appraisals, baseline inventories, escrow fees, hazardous substance assessments, legal fees, recording fees, stewardship fees, surveys, and fees relating to title reports and insurance.

(3) Within 180 days of the effective date of the New License, Chelan PUD shall make available \$32,000 to the Chelan-Douglas Land Trust, for shrub-steppe/mule deer winter-range habitat restoration efforts on the lands, if any, for which an easement is acquired under paragraph (a)(1) of this Article. Beyond making the \$32,000 available, Chelan PUD shall have no responsibility for the success of the restoration efforts to be carried out by the Chelan-Douglas Land Trust, in coordination with WDFW. In its contract with the Chelan-Douglas Land Trust, Chelan PUD shall require the Chelan-Douglas Land Trust to coordinate with WDFW in order to assure the highest likelihood of habitat restoration success.

(4) Chelan PUD and WDFW recognize the uncertainty of acquiring conservation easements on 400 acres, due to the variability of landowner participation. If less than 400 acres of conservation easements can be acquired, the funds remaining available under paragraphs (a)(1) and (a)(3) of this Article shall be made available by Chelan PUD to WDFW for habitat restoration within the Lake Chelan basin.

(5) If easements on 400 acres of land can be acquired for less than the \$220,000 made available under paragraphs (a)(1) of this License Article, 50 percent of any funds remaining available shall become available to WDFW for habitat restoration within the Lake Chelan basin, and 50 percent of the funds remaining available shall no longer be available.

(6) To implement this section, Chelan PUD shall enter into a contract with the Chelan-Douglas Land Trust or another organization that Chelan PUD and WDFW find suitable. The contract shall provide that any easements under paragraph (a)(1) of this License Article be acquired and maintained by the Chelan-Douglas Land Trust or other organization. If the organization with whom Chelan PUD initially contracts either dissolves or becomes unsuitable to Chelan PUD and WDFW, Chelan PUD shall enter into a contract with another organization that Chelan PUD and WDFW find suitable.

(b) Upland Habitat Improvements. (1) Within 180 days of the effective date of the New License, and by January 31st of each subsequent year, Chelan PUD shall make available to the USDA Forest Service \$20,000 per year during the term of the New License, and any subsequent annual licenses, for habitat and wildlife enhancement measures identified in section 3 of Chapter 9 of the Comprehensive Plan.

License Articles

(2) Within 180 days of the effective date of the New License, and by January 31st of each subsequent year, Chelan PUD shall make available to the USDA Forest Service \$5,000 per year for years one through three of the New License for noxious weed control at Threatened, Endangered, and Sensitive (TES) plant locations.

(3) Chelan PUD, in coordination with WDFW, shall continue to conduct wildlife surveys similar to those conducted during the second FERC license for the Project, maintain upland bird feeders, and/or conduct habitat improvement projects for a cost not to exceed \$10,000 per year during the term of the New License, and any subsequent annual licenses. Chelan PUD shall provide an annual wildlife survey report to WDFW.

(c) **Riparian Habitat Improvements.** (1) Within 180 days of the effective date of the New License, and by January 31st of each subsequent year, Chelan PUD shall make available to the NPS \$20,000 per year for the first five years of the New License, then \$10,000 per year for the remainder of the New License term, and any subsequent annual licenses, for Stehekin area habitat improvements.

(2) Within 180 days of the effective date of the New License, Chelan PUD shall make available:
(A) \$50,000 to the USDA Forest Service to enhance riparian habitat in the Lake Chelan basin;
(B) \$50,000 to the NPS to enhance riparian habitat in the Lake Chelan basin, and
(C) \$35,000 to the WDFW to enhance habitat in the Lake Chelan basin.

(d) **Transferability of Funds.** Upon the recommendation of the Chelan-Douglas Land Trust to the WDFW, and with the concurrence of WDFW, or upon the initiative of WDFW, Chelan PUD shall transfer available funds among paragraphs (a)(1), (a)(3), and (a)(2)(C) of this Article. If paragraph (a)(5) is applicable, only 50 percent of the remaining (a)(1) funds shall be transferred, and 50 percent of the remaining paragraph (a)(1) funds shall no longer be available.

Article 10. Historic Properties and Cultural Resources Management Plan

During the term of the New License, and during any subsequent annual licenses, Chelan PUD shall implement a Historic Properties and Cultural Resources Management Plan, in accordance with Chapter 10 of the Comprehensive Plan, which is incorporated herein by reference, and the Programmatic Agreement (PA) among FERC, the SHPO, and the Advisory Council on Historic Preservation. Specifically:

(a) **Lake Chelan Cultural Forum.** Within 180 days of the effective date of the Agreement, Chelan PUD shall form a Lake Chelan Cultural Forum (LCCF). The membership and procedures of the LCCF are governed by section 18 of the Agreement.

(b) **Permitting and Consultation.** Chelan PUD shall adhere to the permitting and consultation guidelines provided in the National Historic Preservation Act (NHPA), the Archaeological Resources Protection Act (ARPA), 36 CFR Part 800, and other applicable cultural resources laws and regulations. As described in section 5.7 of Chapter 10, Chelan PUD

License Articles

shall consult with appropriate federal and/or state agencies regarding its undertakings that affect cultural resources on Agency lands, and shall consult with the Confederated Tribes of the Colville Reservation (CCT) and Yakama Nation (YN) regarding actions affecting cultural resources of interest to those respective tribes. Chelan PUD shall acquire landowner permission prior to any activities on private lands.

(c) Area of Potential Effect (APE). The Historic Properties and Cultural Resources Management Plan contained in Chapter 10 is intended to ensure that continued Project operation will not adversely affect cultural resources identified within the Area of Potential Effect (APE). The APE for the Project includes lands within the Project boundary, as delineated in the expiring FERC license. This includes the operational limits of the reservoir drawdown zone, between 1,079 feet and 1,100 feet above mean sea level elevation. The APE also includes lands outside the Project boundary where Project operations directly affect the character or use of historic properties and/or traditional cultural properties. For example, the APE includes areas of Project-induced erosion that extend outside the Project boundary.

(d) Surveys. Chelan PUD shall survey the APE for cultural resources every 15 years, or when the CRF determines that surveys and monitoring are needed after high-flow events or unusually low water, in accordance with section 5.1 of Chapter 10.

(e) Inadvertent Discovery. In the event that archaeological deposits are inadvertently encountered during any Project-related activity, such activity shall cease, and Chelan PUD shall follow the protocol described in section 5.4 of Chapter 10.

(f) Traditional Cultural Properties Management Plan. Within one year of the effective date of the New License, Chelan PUD shall initiate development and implementation of a Traditional Cultural Property (TCP) management plan, as described in section 4.2 of Chapter 10. Chelan PUD's treatment plans for identified TCPs within the APE that are affected by Project operations are subject to the approval of the land management agency responsible for the property on which the TCPs are located. Chelan PUD shall consider any recommendations from the tribes regarding treatment plans.

(g) Information Management and Curation. Storage of all artifacts and archival collections shall adhere to applicable federal curation standards and sections 5.8 and 5.9 of Chapter 10 of the Comprehensive Plan. Chelan PUD shall prepare a draft curation plan within one year of the effective date of the New License, and complete a final curation plan within 3 years of the effective date of the New License.

(h) Evaluation and Nomination of Potential Historic Properties. Chelan PUD shall be responsible for the evaluation of sites within the APE that have been identified, but not evaluated, for possible inclusion in the National Register of Historic Places (NRHP), as provided in section 5.2 of Chapter 10. Chelan PUD shall be responsible for guiding nominations of potentially eligible sites through the NRHP nomination process. For publicly owned lands, the relevant land management agency is responsible for nominating any sites for listing on the NHRP. For tribal allotments, the Colville Confederated Tribes reserve the authority to approve the adequacy of the nominations.

License Articles

(i) **Cultural Resources Coordinator.** Within 180 days of the effective date of the New License, Chelan PUD shall appoint a Cultural Resources Coordinator to implement Chapter 10 of the Comprehensive Plan. The Cultural Resources Coordinator shall be the primary point of contact for all cultural resource tasks undertaken by Chelan PUD as provided in section 3.8 of Chapter 10.

(j) **Public Education.** Within three years of the effective date of the New License, Chelan PUD shall develop and implement an interpretive plan and educational program, as described in section 3.4 of Chapter 10 of the Comprehensive Plan.

(k) **Site Protection.** Within 180 days of the effective date of the New License, Chelan PUD shall begin implementing site protection measures for historic properties within the APE, as described in section 3.2 of Chapter 10 of the Comprehensive Plan.

(l) **Costs.** The estimated annual costs to Chelan PUD for the implementation of subsections (a) through (h) above are \$20,000, throughout the term of the New License. Chelan PUD shall provide annual funding of \$1,000, throughout the term of the New License, to support educational and interpretive activities pursuant to subsection (j). The estimated total capital cost to Chelan PUD to implement subsection (k) is \$225,000. In the event that the costs to Chelan PUD relating to a single site described in Table 10-2 of Chapter 10 of the Comprehensive Plan exceed \$150,000, License Article 12 shall apply. In the event that the funds provided in this section and the contingency fund provided in License Article 12 are exhausted, Chelan PUD shall continue to follow the procedures contained in the Programmatic Agreement.

Article 11. Recreation Plan

Chelan PUD shall provide recreational resources in accordance with Chapter 11 of the Comprehensive Plan, which is incorporated herein by reference. Specifically:

(a) **Docks of the USDA Forest Service.** Within 180 days of the effective date of the New License, Chelan PUD shall make available to the USDA Forest Service \$700,000, for the purpose of repairing and replacing the USDA Forest Service docks listed in Table 11-13 of Chapter 11 of the Comprehensive Plan. Within 180 days of the effective date of the New License, and by January 31st of each subsequent year of the New License, including any subsequent annual licenses, Chelan PUD shall also make available to the USDA Forest Service an additional \$39,000 for operations and maintenance of such docks. The implementation of the repair and replacement of such docks, as well as the operation and maintenance of such docks, shall be the sole responsibility of the USDA Forest Service. At any time after the 30th anniversary of the New License, Chelan PUD shall consider any requests made by the USDA Forest Service for additional funds to repair and replace the docks listed in Table 11-13 of Chapter 11, but Chelan PUD shall be under no obligation to grant any such requests.

(b) **In-Kind Engineering Services for the USDA Forest Service.** Beginning not later than 180 days of the effective date of the New License, Chelan PUD shall make available to the USDA Forest Service \$100,000 to pay for consulting engineering services related to

License Articles

standardizing the design of USDA Forest Service docks on Lake Chelan, as described in section 4.2.1 of Chapter 11 of the Comprehensive Plan.

(c) Recreational Enhancements of the USDA Forest Service (Years 1-30 of the License). Within 180 days of the effective date of the New License, Chelan PUD shall make available to the USDA Forest Service \$980,000, for use by the USDA Forest Service during the first 30 years of the New License for recreational enhancements within or adjacent to the Lake Chelan basin for USDA Forest Service recreation sites, as generally described in section 4.2.1 of Chapter 11 of the Comprehensive Plan. Within 180 days of the effective date of the New License, and by January 31st of each subsequent year of the New License, Chelan PUD shall also make available to the USDA Forest Service an additional \$6,000 for the operation and maintenance of such recreational enhancements. Implementation of such recreational enhancements, and their operation and maintenance, shall be the sole responsibility of the USDA Forest Service.

(d) Recreational Enhancements of the USDA Forest Service (Years 30 to the end of the License). Chelan PUD shall make available to the USDA Forest Service a maximum of \$340,000, beginning on the 30th anniversary of the New License and ending on the date the New License expires, for the purpose of implementing recreational enhancements within or adjacent to the Lake Chelan basin for USDA Forest Service recreation sites, consistent with the recommendations of the recreational use and needs assessment study funded by Chelan PUD pursuant to subsection (g), below. Implementation of such recreational enhancements shall be the sole responsibility of the USDA Forest Service.

(e) NPS Docks and Recreation Facilities. (1) Within 180 days of the effective date of the New License, Chelan PUD shall make available to the NPS \$149,000, for the purpose of repairing, replacing, and maintaining NPS docks at sites within the Project Area, in accordance with Table 11-15 of Chapter 11 of the Lake Chelan Comprehensive Plan. Chelan PUD shall also make available to the NPS a total amount of \$871,000 to enhance and stabilize NPS recreation sites within the Project Area, and for administrative costs associated with recreation projects, in accordance with section 4.2.2 of Chapter 11 of the Comprehensive Plan at locations identified in the table below.

NPS Recreation Sites Identified For Stabilization Projects

Site Number	Location
71	Weaver Point Dock
72	Sthekin Road
73	Sthekin Landing
75	Sthekin Access Road
76	Lakeshore Trail
82	Lakeshore Trail
83	Flick Creek Dock
113	Lakeshore Trail
210	Sthekin Landing

License Articles

(2) Chelan PUD shall become responsible for implementation of the recreation enhancement work described in this article and Chapter 11 of the Comprehensive Plan, but only to the extent that unanticipated circumstances limit or preclude the ability of the NPS to do so. If such unanticipated circumstances arise Chelan PUD shall employ best efforts to implement such portion of the recreation enhancement work the NPS was unable to implement, but only until the remaining portion of the funding provided by Chelan PUD is expended by Chelan PUD. Such expenditures by Chelan PUD shall include both payments to outside contractors and the cost of all work performed by Chelan PUD employees, including a reasonable allocation of overhead. Chelan PUD shall have no obligation to perform such work unless the NPS has provided notice to Chelan PUD and FERC in writing that such unanticipated circumstances exist.

(f) **NPS Recreational Enhancements (Years 30 to the end of the License).** Chelan PUD shall make available to the NPS a maximum of \$130,000, beginning on the 30th anniversary of the New License and ending on the date the New License expires, for the purpose of implementing recreational enhancements within or adjacent to the Lake Chelan basin for National Park Service recreation sites, consistent with the recommendations of the recreational use and needs assessment study funded by Chelan PUD pursuant to subsection (g), below.

(g) **Recreation Use Study.** Beginning in the 20th year of the effective date of the New License, and finishing in the 23rd year, Chelan PUD shall conduct a study assessing recreational use and needs within the Lake Chelan basin, at a cost not to exceed \$100,000. The scope and purpose of such study is described in section 4.3 of Chapter 11.

(h) **Whitewater Boating.** Within one year of the effective date of the New License, Chelan PUD shall file with FERC for approval, plans for a three-year whitewater boating monitoring study in the Chelan River in accordance with section 4.2.3 of Chapter 11 of the Comprehensive Plan. The whitewater boating monitoring plan shall be developed by Chelan PUD, in consultation with the American Whitewater Affiliation. Specifically:

(1) Upon FERC approval of such three-year study, Chelan PUD shall provide an annual schedule of whitewater releases for kayaks in the Chelan River during such three-year period. Chelan PUD shall release flows on the second and fourth weekends in July and September, except as provided in subsection (10). Flows on Saturdays shall be between 300 cfs and 375 cfs, and flows on Sundays shall be between 400 cfs and 450 cfs.

(2) Chelan PUD shall develop a reservation system for the whitewater boating monitoring study, whereby the scheduled water releases are made only if six or more kayakers make a reservation by 5:00 P.M. on the Thursday prior to the scheduled release date, and are physically present at the designated kayak put-in location by 10:00 A.M. on the date of the release, and liability insurance protecting the Chelan PUD's liability is in place, as provided in subsection (10) of this License Article. Additionally, each kayaker shall be required to sign a liability waiver in a form satisfactory to Chelan PUD prior to launching his or her kayak in the Chelan River. Only non-motorized, hard-shelled kayaks suitable for Class V whitewater shall be allowed, and no kayaker less than 18 years old shall be allowed. If the conditions contained in this paragraph are met, Chelan PUD shall begin the ramping-up of releases to meet the flows specified in subsection (1) of this License Article at 11:00 A.M., and shall begin ramping-down no sooner than 6:00 P.M.

License Articles

(3) A survey tool shall be designed by Chelan PUD, in consultation with American Whitewater Affiliation, to solicit input from whitewater boaters utilizing the Chelan River whitewater releases. The survey tool shall, at a minimum, query boaters on the suitability of the following: whitewater release dates, daily schedule, whitewater difficulty, spill volumes, access, carrying capacity, reservation system, and real time flow information.

(4) Chelan PUD shall conduct an annual meeting on or before May 1, whereby Chelan PUD and American Whitewater will review the annual whitewater report, as provided in subsection (5) of this License Article, and make adjustments as warranted to the annual schedule and spill volume (subject to the limitations in subsection (8) and (10) of this License Article), reservation system, and methods for liability protection for the upcoming year.

(5) Chelan PUD shall submit annual reports to FERC on or before June 1 for the previous year's whitewater boating monitoring study in the Chelan River for the initial three years after the effective date of the New License.

(6) Chelan PUD shall submit a final report upon completion of the three-year whitewater boating monitoring study by May 1 of the year following completion of such monitoring study. The final report shall, at a minimum, include information on the dates and volumes of each release for the three year study period, annual use patterns, and an analysis of user preferences based on survey data. The report shall also include recommendations for providing whitewater releases, if any, for the remainder of the New License term. The report shall also make recommendations regarding, at a minimum, an annual schedule of releases (including volume and timing), a reservation system, the minimum number of boaters required to trigger a release, and a mechanism for liability protection.

Chelan PUD shall include with the final report documentation of consultation with American Whitewater Affiliation, and copies of comments and recommendations on the final report. Chelan PUD shall allow a minimum of 30 days for the American Whitewater Affiliation to comment and to make recommendations prior to filing the final report with FERC for approval. If Chelan PUD does not adopt a recommendation, the filing shall include Chelan PUD's reasons for not doing so, based on, among other things, any relevant Project-specific information.

In the event that FERC fails to respond to the final report recommendations, the conditions associated with the three-year whitewater boating monitoring study shall remain in effect for a maximum of two years while pending a FERC ruling.

(7) Chelan PUD shall make publicly available for the three-year whitewater boating monitoring study and for the term of the New License real-time flow information via the Internet for the Chelan River. This information may be published on the Chelan PUD Web site or a third party Web site. The Internet site shall include, at a minimum, the annual schedule for whitewater releases, instructions and requirements for the reservation system, and real-time flow data information. Adjustments to the reservation system must be posted by May 1.

License Articles

(8) Upon completion of the three-year whitewater boating monitoring study and for the remainder of the New License term (except as provided in subsection (10) of this License Article), Chelan PUD shall provide whitewater releases on the second and fourth weekends in July and September, provided that a minimum number of kayakers make a reservation by the Thursday prior to the scheduled release, through a reservation system developed and implemented by Chelan PUD, and are physically present by 10:00 A.M. on the date of the release. Chelan PUD, in consultation with American Whitewater Affiliation, may adjust the flow levels used following the three-year study, but in no event shall the number of releases exceed eight, nor shall the flow levels exceed 450 cfs. Chelan PUD shall also determine, in consultation with American Whitewater, the minimum number of kayakers required for future flow releases, but in no event shall the number be less than six. Chelan PUD may also make changes to the schedule and/or reservation procedures, in consultation with the American Whitewater Affiliation.

(9) Chelan PUD shall not be obligated to provide whitewater boating flow releases in the Chelan River when the previous day's average Stehekin River inflow is less than 333 cfs, or when the Mid-Columbia Index is greater than \$150/MWh (as adjusted pursuant to section 19.1 of the Agreement).

(10) In order to facilitate whitewater releases in the Chelan River until the Washington State Recreational Use Statute RCW 4.24.210 is changed to Chelan PUD's satisfaction, as described in subsection (11) of section 4.2.3 of Chapter 11 of the Comprehensive Plan, including an amendment that expressly extends the immunity protections of such statute to recreational whitewater releases, or an alternative non-legislative mechanism is developed, Chelan PUD and American Whitewater intend to work together to secure liability insurance protecting Chelan PUD's self-insured retention (subject to a mutually agreed deductible not to exceed \$25,000) for each whitewater release in the Chelan River. Such liability insurance policy shall: (a) have a rating of A-8 minimum, (b) be Comprehensive General Liability for special events, (c) name Chelan PUD as an additional named insured, (d) be primary to other existing collectible insurance by Chelan PUD, (e) be purchased annually to cover all whitewater boating in the Chelan River as described in this License Article, whether such boating be sponsored by American Whitewater Affiliation or others, and (f) be approved by Chelan PUD in advance of any whitewater release. Once such insurance is obtained, whitewater releases shall be made in accordance with the schedule contained in this License Article.

Funding for the purchase of the insurance will be derived from foregoing a maximum of four whitewater release per year (September releases). Chelan PUD shall have no obligation to fund the purchase of insurance beyond the amount saved from the foregone releases from the preceding year. Only the whitewater releases that are covered by an insurance policy shall occur. The requirement for liability insurance shall only be removed if legislation is amended acceptable to Chelan PUD, or a mutually agreeable mechanism for liability protection is developed between American Whitewater and Chelan PUD.

(11) Chelan PUD, American Whitewater Affiliation, and other interested parties intend to work collaboratively to seek an amendment to the above-cited statute that expressly extends the immunity protections of such statute to recreational whitewater releases of the kind that would be

License Articles

provided by Chelan PUD pursuant to this License Article and as described in section 4.2.3 of Chapter 11 of the Comprehensive Plan. In the event that such amendments to the statute occur, Chelan PUD shall be responsible for all eight releases described in this License Article. In the event that such amendments to the statute do not occur within the three year whitewater boating monitoring study described in this License Article, Chelan PUD and American Whitewater Affiliation intend to work collaboratively to resolve outstanding issues. If any outstanding issues cannot be resolved within a one year period, the parties agree to use the dispute resolution process pursuant to section 16 of the Agreement.

(i) **Operation and Maintenance of Riverwalk, Old Mill, Manson Bay parks.** Chelan PUD shall continue, for the term of the New License, to own and operate the Riverwalk Park and Loop Trail and to maintain the shore access site, located in the City of Chelan, in accordance with section 4.2.4 of Chapter 11 of the Comprehensive Plan. Chelan PUD shall continue, for the term of the New License and any subsequent annual licenses, to own Old Mill Park and Manson Bay Park, and shall be responsible for oversight of related operation and maintenance agreements with Manson Parks Recreation District, in accordance with section 4.2.4 of Chapter 11 of the Comprehensive Plan.

(j) **Reach 1 Access Trail.** Beginning within one year of the effective date of the New License, Chelan PUD shall design and construct a non-motorized, non-paved, multi-use trail below the Lake Chelan Dam in Reach 1 of the Chelan River, in accordance with section 4.2.5 of Chapter 11 of the Comprehensive Plan. The trail shall provide managed access to the Chelan River and connect to the Riverwalk Loop Trail. Planning and development shall be conducted by Chelan PUD, in consultation with adjacent landowners, Chelan County, the City of Chelan, the Lake Chelan Trails Committee, and other interested parties. The total capital cost to Chelan PUD for the Reach 1 Access Trail shall not exceed \$250,000. The annual Estimated Cost to Chelan PUD for operation and maintenance of the trail is \$4,500 for the term of the New License.

(k) **Riverwalk Loop Trail Extension.** Beginning within one year of the effective date of the New License, Chelan PUD shall design and construct a paved trail that links Chelan PUD's existing Riverwalk Loop Trail to the Reach 1 Access Trail, in accordance with section 4.2.6 of Chapter 11 of the Comprehensive Plan. Chelan PUD shall seek approval from FERC for crossing the Lake Chelan Dam as part of the trail extension design. If FERC denies approval to cross the Lake Chelan Dam, the trail design and construction shall only include a trail from Riverwalk Loop Trail along the south shoreline of the Chelan River to link with the Reach 1 Access Trail. Planning and development shall be conducted by Chelan, in consultation with adjacent landowners, Chelan County, the City of Chelan, the Lake Chelan Trails Committee, and other interested parties. The total capital cost to Chelan PUD for the Riverwalk Loop trail extension shall not exceed \$500,000. The annual Estimated Cost to Chelan PUD for operation and maintenance of the trail is \$5,000 for the term of the New License.

(l) **Operation and Maintenance Under the Dan Gordon Bridge.** (1) Beginning within one year of the effective date of the New License, Chelan PUD shall implement efforts to stabilize the sidewalk and replace the handrail along the north shore of the Chelan River, under the Dan Gordon Bridge in accordance with section 4.2.7 of Chapter 11 of the Comprehensive

License Articles

Plan. The total capital cost to Chelan PUD for such sidewalk stabilization and handrail shall not exceed \$17,000. Chelan PUD shall not be responsible for stabilizing the right-of way area owned by the Washington State Department of Transportation, nor be responsible for rectifying any structural problems regarding the Dan Gordon Bridge. Beginning within one year and of the effective date of the a New License, Chelan PUD shall assume responsibility for annual maintenance associated with the sidewalk and landscaping along the north shore of the Chelan River, beneath the Dan Gordon Bridge.

(m) **Reservation of Lands.** Beginning within 90 days of the effective date of the New License, Chelan PUD shall reserve by not selling or otherwise disposing of land located in Reach 1 of the Chelan River Bypassed Reach, within a portion of Parcel A of Chelan County Short Plat No. 3195 lying northeasterly of the Chelan Gorge Road in accordance with section 4.2.8 of Chapter 11 of the Comprehensive Plan. Chelan PUD shall reserve such land for future recreational development, while continuing to protect and maintain Project purposes. Development or maintenance associated with such future recreational facilities shall not be the responsibility of Chelan PUD. Pursuant to FERC regulation, Chelan PUD shall not allow permanent structures within 200 linear feet of the Chelan Project penstock's centerline.

(n) **Micro Parks.** (1) Beginning within 90 days of the effective date of the New License, Chelan PUD shall quit claim deed to the City of Chelan Parcels #272214662242, #272214662229, and #272214662440, near Water Street. All three Parcels are owned by Chelan PUD, and are located along the south shore of Lake Chelan, approximately three miles from the City of Chelan. Chelan PUD shall include in such quit claim deed any rights it may hold to place docks and buoys in the waters immediately adjacent to such Parcels (subject to a five-year reservation of such rights for the benefit of adjacent landowners, as further specified in the quit claim deed), and subject to any easements and/or damage waivers related to Project impacts that it may hold relating to such Parcels.

(2) Beginning within 180 days of the effective date of the New License, Chelan PUD shall make available to the City of Chelan a total amount of \$20,000 toward the capital costs associated with the development of a micro park at Water Street (Parcels #272214662242, #272214662229, and #272214662440), in accordance with section 4.2.9 of Chapter 11 of the Comprehensive Plan. Development, implementation, and operation and maintenance of such micro park shall be the sole responsibility of the City of Chelan.

(o) **Utility Improvements for Local Trail.** Contingent upon the City of Chelan excavating or trenching from Don Morse Memorial Park to Riverwalk Park, Chelan PUD shall install in such trench primary underground facilities and remove primary overhead lines from the right-of-way area of the sidewalk along Johnson Avenue and State Highway 150 near Campbell's Resort in accordance with section 4.2.10 of Chapter 11 of the Comprehensive Plan. Chelan PUD shall not be responsible for any costs related to trenching, asphalt or concrete work associated with roadway and sidewalk improvements or repair.

(p) **Trail Linkage to PUD parks.** Chelan PUD shall consult with interested organizations and individuals to integrate new trails with existing parks owned and/or managed by Chelan PUD, including Old Mill Park, Manson Bay Park, and Riverwalk Park, in accordance

License Articles

with section 4.2.11 of Chapter 11 of the Comprehensive Plan. Specifically, Chelan PUD shall develop and construct modifications to existing Chelan PUD park entrances and exits to accommodate the integration of new trails. Chelan PUD shall not be responsible for development or operation and maintenance of such new trails.

(q) Don Morse Park Erosion. Within 180 days of the effective date of the New License, Chelan PUD shall make available to the City of Chelan in-kind services not to exceed \$60,000 for engineering and design services and provision of Chelan PUD-owned equipment, if available, for the purpose of controlling erosion at Don Morse Park beach area and marina breakwater on Lake Chelan, in accordance with section 4.2.12 of Chapter 11 of the Comprehensive Plan. Prior to the provision of such services, the City of Chelan shall execute an indemnity and/or hold harmless agreement in a form satisfactory to Chelan PUD. Such agreement shall indemnify Chelan PUD for all costs incurred by Chelan PUD as a result of any future litigation regarding the Don Morse Park beach area and marina breakwater, including costs and attorneys' fees incurred in any resulting litigation, and the cost of any money judgment entered.

Article 12. Unforeseen Resource Needs

(a) Recognition of Potential Needs. The Parties recognize that unforeseen resource needs may arise during the course of the New License. In order to meet such needs if they arise, while preserving a reasonable degree of certainty for the electric ratepayers of Chelan PUD, this License Article establishes the procedures to be followed. For the purposes of determining unforeseen resource needs, the following needs are not included: (1) measures required by License Article 7; (2) measures required by License Article 13; and (3) any ESA measures required.

(b) Identification and Notification relating to an Unforeseen Resource Need. Any Agency may invoke this section by notifying Chelan PUD and all other Agencies in writing that it has reason to believe that an unforeseen resource need has arisen. The notification shall describe in reasonable detail the basis for concluding that: (1) a Project-caused impact to natural resources (other than erosion) or cultural resources has occurred; (2) the impact has arisen from materially changed factual circumstances (i.e., new facts and/or the relationship among facts) after the effective date of the Agreement; (3) the impact was not addressed or anticipated by the protection, mitigation, and enhancement measures in this Agreement; and (4) additional funding or other measures are needed in order to mitigate the impact. The notification shall also contain any factual information in the possession of the Agency relating to the claimed unforeseen resource need.

(c) Initial Meeting of the Lake Chelan Policy Committee (LCPC). Within 60 days after notification has been made under subsection 12(b), Chelan PUD shall convene the LCPC to hold its initial meeting to determine whether conditions (1), (2), (3), and (4) of subsection 12(b) of this License Article have been met.

(d) Unanimous Agreement Results in Funding and/or Implementation of Other Measures. At any time during the term of the New License, including any subsequent annual licenses, if the LCPC unanimously agrees that conditions (1), (2), (3), and (4) of subsection 12(b)

License Articles

of this Article have been met, and unanimously agrees to an amount of funding and/or Other Measures that correspond to the estimated percentage of Project impact, such funding and the cost of other measures shall be provided through the use of Unanticipated Agency Savings, if any, or other method of financing unanimously agreed to by the LCPC.

(e) Lack of Unanimous Agreement Results in No Funding. Prior to the 25th anniversary of the New License, if the LCPC, within 180 days after its initial meeting under subsection 12(c), does not unanimously agree that conditions (1), (2), (3), and (4) of subsection 12(b) have been met, and on an amount of funding and/or Other Measures that correspond to the estimated percentage of Project impact, the LCPC shall promptly notify Chelan PUD and all Agencies of such lack of unanimous agreement, and no further action shall be taken regarding such alleged unforeseen resource need unless and until a subsequent notification is made under subsection 12(b), based on new information or subsequent to the 25th anniversary of the New License.

(f) Contingency Fund. Chelan PUD shall make available as a contingency fund \$500,000 on the 25th anniversary of the effective date of the New License. If the New License is for a term of 45 years or less, Chelan PUD shall make available an additional \$300,000 on the 30th anniversary of the effective date of the New License. If, however, the New License is for a term greater than 45 years, Chelan PUD shall make available an additional \$800,000 on the 30th anniversary of the effective date of the New License. From the 25th anniversary of the effective date of the New License through the expiration of the New License, including any subsequent annual licenses, the contingency fund shall be available to meet unforeseen resource needs through funding, or by compensating Chelan PUD for the costs of Other Measures.

(g) Decision Making and Funding Processes. Any notification under subsection 12(b) made after the 25th anniversary of the New License may qualify for funding from the contingency fund, pursuant to the requirements of this License Article.

(1) Consensus of the LCPC. The LCPC shall attempt to reach Consensus regarding whether conditions (1), (2), (3), and (4) of subsection 12(b) have been met. If the LCPC reaches Consensus that any of such conditions have not been met, the LCPC shall so notify Chelan PUD and all Agencies, and no further action shall be taken with respect to the alleged unforeseen resource need unless and until a subsequent notification is made under subsection 12(h).

If the LCPC reaches Consensus that conditions (1), (2), (3), and (4) of subsection 12(h) have been met, and agrees by Consensus to an amount of funding and/or Other Measures that correspond to the estimated percentage of Project impact, the LCPC shall consider whether there are any Unanticipated Agency Savings available. If Unanticipated Agency Savings are available, such Unanticipated Agency Savings shall be applied toward the agreed upon amount of additional funding or the cost of Other Measures until exhausted. If the amount of Unanticipated Agency Savings is insufficient to cover the agreed upon amount of additional funding or the cost of Other Measures, the contingency fund shall be used to fund the remaining amount.

(2) Independent Advisory Panel. If there is a lack of Consensus within the LCPC regarding whether conditions (1) and (2) of subsection 12(b) have been met, Chelan PUD shall

License Articles

convene an independent advisory panel to provide written advice on whether such condition or conditions have been met and, if met, the estimated percentage of impact caused by Project operations. The panel shall consist of one member designated by the relevant Agencies, one member designated by Chelan PUD, and one member chosen by the two designated members. If the two designated members are not able to agree on the selection of the third member within 30 days, the matter shall be referred back to the LCPC for decision. If the LCPC is not able to reach agreement within 30 days, the matter shall be referred to dispute resolution pursuant to section 16 of this Agreement. If the panel unanimously advises that either conditions (1) or (2), or both, have not been met, the LCPC shall accept such advice and promptly notify Chelan PUD and all Agencies that no further action shall be taken with respect to the alleged unforeseen resource need unless and until a subsequent notification is made under subsection 12(b). If the panel unanimously advises that both conditions (1) and (2) have been met, including an estimated percentage of Project causation, the LCPC shall accept such advice and attempt to reach Consensus regarding conditions (3) and (4) of subsection 12(b).

The administrative costs of the independent advisory panel, as well as the costs of the third member of the independent advisory panel, shall be borne 50 percent by the contingency fund and 50 percent by Chelan PUD. In the event that an Agency designates a non-governmental employee as its member of the independent advisory panel, the costs of such member shall be borne by the contingency fund.

(3) Dispute Resolution. If, after receiving the non-unanimous advice of the independent panel, there is a lack of Consensus within the LCPC as to whether conditions (1) or (2) have been met, or there is a lack of agreement as to the estimated percentage of impact caused by Project operations, the issue or issues upon which there was a lack of Consensus shall be subject to dispute resolution pursuant to section 16 of the Agreement. During the dispute resolution process, the written advice of the independent advisory panel shall be provided to the mediator.

If there is a lack of Consensus within the LCPC regarding whether either condition (3) or (4) of subsection 12(b), or both, have been met, the issues upon which there is a lack of Consensus shall be subject to dispute resolution pursuant to section 16 of this Agreement.

(h) General Provisions

(1) Chelan PUD may, in its sole discretion, apply Unanticipated Agency Savings and any funds available in the contingency fund to the cost of fishways prescribed by NOAA Fisheries or the USFWS pursuant to Section 10.2 of the Agreement.

(2) Petition to Reopen License. Other than as provided in section 10 of the Agreement, the Agencies shall not petition FERC to reopen the license until after the 35th anniversary of the effective date of the New License. Following the 35th anniversary of the license, Agencies shall not invoke, or otherwise rely upon any reopen clause set forth in the New License for the purpose of obtaining protection, mitigation, and enhancement measures beyond those required by this Agreement unless the contingency fund is exhausted. Chelan PUD may replenish the contingency fund sufficiently to address the unforeseen resource need that is prompting the

License Articles

reopener. If any Agency violates this subsection, Chelan PUD may withdraw from this Agreement, in which case this Agreement shall be null and void.

(3) FERC Approval. To the extent that any determination under this section involves terminating an activity required by the New License, or initiating an activity not authorized by the New License, including any subsequent annual licenses, Chelan PUD shall apply to the FERC for a license amendment. Any action necessitating a license amendment shall not be undertaken unless and until such license amendment is issued.

(4) Limitation on Chelan PUD's Obligations, and Reversion of Funds. Except as provided in section (g)(2) of this Article (relating to the administrative costs of the Independent Panel), Chelan PUD shall have no obligation to exceed the funds deposited in the contingency fund described in section (f) of this License Article. At the expiration of the New License, including subsequent annual licenses, any funds remaining available shall no longer be available

(5) Estimating Impacts on Energy Production. For purposes of estimating future decreases or increases in energy production, pursuant to the definition of "Other Measures" contained in subsection 4.11 of this Agreement, Chelan PUD has established a baseline energy production of 365,366 MWh using a computer model (CHEOPS) and input data (PME14). The baseline shall be the amount of energy initially produced under the Agreement, including the 18,654 MWh per year decrease in production (as calculated by the computer model) associated with the new lake level operating regime provided for in License Article 8, the minimum flows established in section 7(b)(1) of License Article 7, and any whitewater releases under License Article 11. If future changes in Project operations pursuant to the New License increase energy production, Chelan PUD shall annually estimate the dollar value of such increase. The dollar value of such increase shall be used to offset any deductions that previously occurred from the contingency fund as a result of decreases in energy production, or shall be carried as a credit toward any future deductions that may occur as a result of decreases in energy production, but in no event shall the operation of this subsection cause the amount of the contingency fund to increase above the amounts provided in subsection (f) of this License Article. Any disagreements regarding the application of this subsection shall be resolved through dispute resolution pursuant to section 16 of the Agreement.

Article 13. Fishways

(a) Authority is reserved to the FERC to require Chelan PUD to construct, operate, and maintain, or to provide for the construction, operation, and maintenance of such fishways as may be prescribed by Secretaries of the Interior or Commerce under section 18 of the FPA. Section 10.2 of the Agreement provides the actions that Chelan PUD may take if such authority is exercised.

License Articles

Article 14. Upper Columbia Spring-Run Chinook and Steelhead Conservation Measures

(a) Within 180 days of the effective date of the New License, and by January 31st of each subsequent year, including any subsequent annual licenses, Chelan PUD shall make available \$20,000, to be used to acquire water for instream flows through funding of water conservation measures or lease/purchase of water rights from willing sellers, as provided in Chapter 12 of the Comprehensive Plan. NOAA Fisheries and WDOE shall develop a list of proposed measures or lease/purchase of water rights, and submit it to Chelan PUD by January 10 of each year. Chelan PUD shall fund the implementation of those actions on such list, pursuant to a contract between Chelan PUD and an organization (such as Washington Water Trust) that Chelan PUD, NOAA Fisheries and WDOE find suitable, to the extent that holders of water rights voluntarily agree to conservation measures or leases/purchases. The water saved shall be dedicated to instream flows through either the Trust Water Rights program or other contractual arrangement. The \$20,000 funding shall be the total amount provided, covering all costs associated with the measures above.

(b) In the event that implementation of conservation measures or leases/purchases in a year do not use all the funding available, Chelan PUD shall carryover that year's \$20,000 in funding, or any unused portion thereof, into future years. In the event that conservation measures or leases/purchases requiring funding in a single year exceed the \$20,000, funding can be borrowed from future years, adjusted pursuant to Section 19.2.9 of the Settlement Agreement. Priority will be given to conservation measures and purchases that can be implemented early in the term of the New License. Total advance funding to be provided by Chelan PUD during the term of the New License, including any subsequent annual licenses, shall not exceed either \$500,000 or the value of annual funds for the remaining term of the license, adjusted pursuant to Section 19.2.9, whichever is less.

LAKE CHELAN COMPREHENSIVE PLAN

**Attachment B to the
Lake Chelan Settlement Agreement**

**LAKE CHELAN HYDROELECTRIC PROJECT
FERC Project No. 637**

October 8, 2003



**Public Utility District No. 1 of Chelan County
Wenatchee, Washington**

TABLE OF CONTENTS

- CHAPTER 1: EROSION CONTROL TREATMENTS AND CONCEPTS FOR LAKE CHELAN (USDA FOREST SERVICE)**
- CHAPTER 2: LAKE CHELAN EROSION CONTROL PLAN (NPS)**
- CHAPTER 3: LAKE CHELAN LARGE WOODY DEBIS MANAGEMENT PLAN**
- CHAPTER 4: STEHEKIN AREA IMPLEMENTATION PLAN**
- CHAPTER 5: SURVEY MONUMENT LOCATION AND RE-ESTABLISHMENT PLAN**
- CHAPTER 6: LAKE CHELAN COMPREHENSIVE FISHERY MANAGEMENT PLAN**
- CHAPTER 7: CHELAN RIVER (BYPASSED REACH) COMPREHENSIVE MANAGEMENT PLAN**
- CHAPTER 8: LAKE LEVEL MANAGEMENT**
- CHAPTER 9: WILDLIFE HABITAT PLAN**
- CHAPTER 10: LAKE CHELAN HISTORIC PROPERTIES AND CULTURAL RESOURCES MANAGEMENT PLAN**
- CHAPTER 11: LAKE CHELAN HYDROELECTRIC PROJECT RECREATION RESOURCES MANAGEMENT PLAN**
- CHAPTER 12: UPPER COLUMBIA RIVER SPRING-RUN CHINOOK AND STEELHEAD CONSERVATION MEASURES**

***CHAPTER 1: EROSION CONTROL TREATMENTS AND CONCEPTS
FOR LAKE CHELAN (USDA FOREST SERVICE)***

*Erosion Control Treatments (USDA Forest Service)****TABLE OF CONTENTS***

CHAPTER 1: EROSION CONTROL TREATMENTS AND CONCEPTS FOR LAKE CHELAN (USDA FOREST SERVICE)	1-1
SECTION 1: Introduction.....	1-1
SECTION 2: Implementation.....	1-2
2.1 Responsibility	1-2
2.2 Implementation Plan.....	1-2
2.3 Monitoring and Maintenance Plan	1-4
2.4 Preliminary Cost Estimates	1-6
SECTION 3: Anticipated Erosion Control Measures.....	1-7
3.1 Group 1.....	1-8
3.2 Group 2.....	1-9
3.3 Group 3.....	1-9
3.4 Groups 4 through 6.....	1-10
SECTION 4: LITERATURE CITED	1-17

LIST OF TABLES

Table 1-1: Estimated Costs and Lengths.....	1-7
Table 1-2: Group 1 Recreation Sites.....	1-9
Table 1-3: Group 3 Sites	1-11
Table 1-4: USDA Forest Service Sites Prioritized for Treatment.....	1-14
Table 1-5: USDA Forest Service Sites Proposed Timeframes.....	1-15

LIST OF FIGURES

Figure 1-1: Enhanced Placed Rock; this example shows singular perpendicular LWD placement, rock piles and vegetation.	1-12
Figure 1-2: Double-row rock placement (DRRP) using large rock, vegetation and large woody debris treatments	1-13
Figure 1-3: Aesthetic Site Ratio (AES) Example – Site 11	1-16

*Erosion Control Treatments (USDA Forest Service)***SECTION 1: INTRODUCTION**

Lake Chelan has approximately 118.8 miles of shoreline, of which approximately 50 miles is managed by the U.S. Department of Agriculture Forest Service (USDA Forest Service), and 10 miles is managed by the National Park Service (NPS). A 1999 inventory conducted by Chelan PUD, USDA Forest Service, NPS and other members of the erosion working group¹ identified 112 sites, comprising 40,780 linear feet of USDA Forest Service shoreline undergoing erosion. More detailed information on shoreline erosion around the lake may be found in the Inventory of Shoreline Erosion, Lake Chelan and Bypass Reach Study Report (Chelan PUD, 2000).

The plan contained in this Chapter outlines the treatment and monitoring of 40 of the 112 identified USDA Forest Service sites. Of these 40 high priority sites, Chelan PUD will be responsible for the treatment of 35 sites, and the USDA Forest Service will be responsible for treatment of the remaining five sites. In determining the work to be completed within this Chapter, USDA Forest Service staff analyzed all sites on USDA Forest Service lands and sorted the sites into groups based on the reason they were of interest and on the severity of erosion:

- Group 1 sites are those related to recreational sites.
- Group 2 sites are related to sites of interest for historical or cultural reasons.
- Group 3 sites are those of interest for aesthetic reasons that met USDA Forest Service criteria for severity.
- Group 4 sites are those of interest primarily based on aesthetics, which did not meet the criteria for Group 3.

Some sites are included in more than one group. Details of this sorting process are explained in Protection, Mitigation, and Enhancement Measures Submitted by the US Forest Service for Chelan County Public Utility District Relicensing Project No. 637, Shoreline Erosion, May 3, 2001.

Groups 1 through 3 include 39 sites, of which 34 sites will be treated by Chelan PUD. Group 4 consists of 21 sites in need of some form of treatment, but not immediately critical. Of these, one site was selected for treatment by Chelan PUD on the basis of an opportunity to enhance riparian habitat. The total estimated length proposed for treatment by the Chelan PUD on the 35 selected sites is 9,325 feet, as shown in Table 1-1.

¹ USDA Forest Service, National Park Service, and interested citizens participated through the alternative licensing process.

Erosion Control Treatments (USDA Forest Service)

SECTION 2: IMPLEMENTATION

2.1 Responsibility

Of the 40 high-priority USDA Forest Service sites, five are subject to easements (also known as damage waivers), whereby the landowner released Chelan PUD from liability for any damage to the property caused by Project operations. These five sites were in private ownership at the time that the easement was granted to Chelan PUD. The land was later acquired from the private landowner by the USDA Forest Service, subject to the easement. Consequently, Chelan PUD will be responsible to perform erosion control work, including erosion repairs, maintenance, and monitoring, only on the 35 sites for which no such easement exists.

Chelan PUD will be responsible for obtaining any necessary permits. In addition, Chelan PUD will be responsible for the collection, storage and placement of large woody debris (LWD) for use in the erosion control efforts at the 35 non-easement sites and for use as mitigation for the erosion control efforts, as described in Chapter 3.

Where this plan includes erosion work on Group 2 sites, Chelan PUD will provide coordination with the Lake Chelan Cultural Forum (LCCF) so that the affected cultural resources are addressed as defined in Chapter 10, the Historic Properties Management Plan. Chelan PUD will also perform erosion control work on sites in Group 2, regardless of easements, if required to protect cultural or historical resources from damage caused by shoreline erosion resulting from Project operations.

The USDA Forest Service plans to complete erosion control work on some sites with easements that are not in Group 2. These include site 41 (Moore Point), with 1,600 feet of shoreline erosion in Group 1, and sites 35, 35b, 36 and 42 in Group 3. These sites are not addressed in this Chapter, and are the responsibility of the USDA Forest Service.

2.2 Implementation Plan

Chelan PUD will develop an erosion control plan acceptable to Chelan PUD and the USDA Forest Service that implements this Chapter. The plan will contain:

- An implementation schedule, including a breakdown of sites to be treated in three-to-five year intervals. Such a breakdown should provide the flexibility necessary to work with unpredictable weather and lake conditions.
- Designs for treatment of the sites proposed for treatment in the first three to five year period to a level of detail adequate for USDA Forest Service review and for use in permit applications. Designs will be generally based on commonly accepted best management practices for this type of work, will take relevant permitting requirements into account, and will allow for adjustment to suit unknown site conditions.
- A method to address identification of new or existing non-easement erosion sites requiring treatment.
- A process for treating in a timely manner non-easement sites identified as needing additional treatment or maintenance work.

Erosion Control Treatments (USDA Forest Service)

2.2.1 Site Specific Implementation Plans

Site-specific plans will be prepared by Chelan PUD and approved by USDA Forest Service for habitat and ground disturbing activities on National Forest System Lands required by the New License, including activities contained within resource management plans required by the New License that will be prepared subsequent to issuance of the New License. Site-specific plans for activities will be prepared two years in advance of required implementation dates.

Site-specific plans shall include:

1. A map depicting the location of the proposed activity.
2. A description of the USDA Forest Service land management area designation within the Forest Plan for the location of the proposed activity and the applicable standards and guidelines.
3. A description of locations, designs and mitigation measures considered, including implementation and effectiveness monitoring.
4. Data collected from surveys, biological evaluations or consultation as required by regulations applicable to ground or habitat disturbing activities on National Forest System lands in existence at the time the plan is prepared.
5. Noxious weed control measures included as part of mitigation.
6. An environmental analysis or other appropriate National Environmental Policy Act (NEPA) analysis of the proposed action that meets the USDA Forest Service requirements for implementing NEPA.

General concepts of LWD are discussed in Chapter 3 of the Comprehensive Plan, which describes beneficial uses, LWD characteristics, and general standards and placement concepts.

NEPA Analysis

Chelan PUD is responsible for conducting the environmental analysis necessary for site-specific projects including, but not limited to, scoping, site-specific resource analysis, and cumulative effects analysis sufficient to meet the criteria set forth in USDA Forest Service regulations for NEPA. Chelan PUD may refer to or rely on any previous NEPA analysis for the activity to the extent the analysis is not out of date as determined by USDA Forest Service. Any contractors selected by Chelan PUD to conduct the NEPA process shall be approved by USDA Forest Service in advance of initiating the work. Following scoping, Chelan PUD shall submit the scope of work for the environmental analysis, including, but not limited to, the range of alternatives that shall be addressed, to USDA Forest Service for review and approval prior to completion of the environmental analysis.

Chelan PUD shall be responsible for revising and updating the erosion control implementation and subsequent site-specific erosion control plans based on the results of monitoring, site-specific project implementation segments, or changed site conditions, at least every five years of the New License, until all of the prioritized sites are treated successfully. Permitting and NEPA processes are the responsibility of Chelan PUD. The USDA Forest Service will make every effort to assist in these processes. Chelan PUD will develop site-specific plans along with any updates or revisions in cooperation with the USDA Forest Service. The plan and updates are subject to approval by the USDA Forest Service, and will be filed with the FERC.

Erosion Control Treatments (USDA Forest Service)

2.3 Monitoring and Maintenance Plan

Chelan PUD will develop a monitoring and maintenance plan. The plan will address monitoring of USDA Forest Service shorelines to determine a) whether new sites should be added to the Project-caused erosion site inventory based on criteria described below, b) whether treated sites meet erosion control objectives and c), whether existing inventoried sites have moved into the high priority for treatment category based on the criteria described below and Figure 1-3. The plan and any updates will be subject to the approval of the USDA Forest Service, and Chelan PUD will file the plan and any updates with the FERC.

The goal of erosion control is to stabilize existing and new high priority erosion sites on USDA Forest Service lands affected by Project operations. A site will be considered successfully treated when:

- 90 percent of the eroding toe of the treated slope on the lakeshore is stabilized (placed rock or other materials remain as positioned between elevations 1,098 feet and 1,104 feet).
- Vegetation in the form of native grasses, forbs, and shrubs, will be established on 90 percent of the site between elevations 1,100 feet and 1,106 feet, such that it is similar in diversity and density to the vegetation on nearby undisturbed sites of similar aspect, slope and soil conditions. Specific ground cover objectives to be obtained within five years of treatment will be included in each site-specific plan.
- Noxious weed control has been completed within five years of treatment.
- Site-specific LWD measures have been implemented.

The monitoring portion of the plan will include all USDA Forest Service shoreline affected by Project operations, and will use the 1999 inventory (Chelan PUD, 2000) as a baseline, together with reference photographs from the 1982 inventory. The plan will include a schedule and process for monitoring and documentation, including:

- Monitoring and reporting on the success of re-vegetation and toe-slope stabilization on treated sites in years one, three, and five following treatment of each site.
- Once treated sites meet design goals, standards of stabilization and vegetation, monitoring sites at five-year intervals over the New License term, to determine that site treatment objectives continue to be met.
- Trend monitoring (erosion rate and other significant changes) at selected sites at five-year intervals. Non-treated sites for trend monitoring, selected on a preliminary basis, include sites 4, 13, 34, 40, and 53.
- Updating the inventory of USDA Forest Service sites contained in the 1999 study at 20-year intervals over the New License term, starting on the 20th anniversary of the effective date of the New License. These updates will include photo documentation and current site sketches using the same or otherwise approved methodology.
- Monitoring the effects (safety, site disturbances etc.) of storage of LWD on USDA Forest Service lands.
- Monitoring LWD placed as part of the erosion control work for continued safety and stability of the structures at five-year intervals.
- Success of noxious weed control at treated sites.

Erosion Control Treatments (USDA Forest Service)

The maintenance portion of the plan will include provisions for Chelan PUD to perform additional structural, vegetation or noxious weed treatments on previously treated sites based on the following criteria:

- For LWD, any safety-related required maintenance is to be accomplished before the spring lake re-fill period.
- For rock, timing of maintenance depends on scale and workability in the drawdown zone.
 - If monitoring produces 100 feet of maintenance treatment needed during years of initial erosion control treatment by contractor or Chelan PUD crews, the maintenance should be added to the existing planned work.
 - If the initial erosion control treatments have been completed, the trigger for maintenance treatment by contractor or Chelan PUD crews shall be 200 feet of repair work needed.
- For vegetation plantings, timing is seasonal dependant with the fall planting season having the highest likelihood of success.
 - For the first two monitoring actions (years one and three) if greater than 50 percent of the plantings have failed, replanting will occur during the next fall planting period. This assumes initial planting occurs at 140 percent of the desired density and the goal is to be achieved by the 5th year after initial treatment.
 - The trigger for future monitoring years will be less than 75 percent of the baseline density and cover found on similar, undisturbed shoreline.
 - Trends in vegetation may be taken into account, based on consultation between Chelan PUD and the USDA Forest Service, so that replanting of a site meeting the above criteria may be delayed if a positive trend appears to exist in the vegetation at the site, and replanting may be accelerated if a negative trend exists.
- For noxious weeds, once noxious weeds introduced by the erosion control work are discovered, treatment shall be pursued before the plant can produce viable seed. Timing is dependant on seed viability or potential spread.

Chelan PUD will, following consultation with and approval by USDA Forest Service, implement additional measures to achieve erosion control objectives at previously treated sites that fail to meet treatment objectives five years after initial treatment, when retreatment costs are less than or equal to 25 percent of the original treatment costs. When retreatment cost will exceed 25 percent of the original treatment cost, Chelan PUD and USDA Forest Service will agree whether a) additional treatment of the existing site is warranted, or b) treatment of an equivalent linear footage of shoreline on another non-easement site will be performed in lieu of further treatment at the original site.

The monitoring and maintenance plan shall also include provisions for the treatment of new non-easement sites where erosion occurs due to Project operations. In particular, the USDA Forest Service may choose to add new or existing non-easement sites to the list of sites to be treated based on agreement between Chelan PUD and USDA Forest Service that they meet the

Erosion Control Treatments (USDA Forest Service)

evaluation criteria used in the original analysis to select sites from Group 1 and Group 3 for treatment. Chelan PUD shall be responsible for implementation of erosion control measures on such sites. Details of this evaluation are explained in Appendix F of the Inventory of Shoreline Erosion (Chelan PUD, 2000). The criteria used for selection were an aesthetic erosion site (AES) ratio of 4.0 or greater and a cumulative scale ratio of 0.6 or greater.

2.4 Preliminary Cost Estimates

Given the variety of methods contemplated, the variety of site conditions to be treated, and the uncertainties of weather, lake conditions, and barge availability, costs for erosion control work around Lake Chelan have proven difficult to estimate and should be considered preliminary. The estimates below are based on a combination of experience and input from contractors and other vendors who work around the lake.

The USDA Forest Service's most recent contract for erosion repair, performed at Flick Creek in 1995, had an average cost of \$224.00 per linear foot. For purposes of this cost estimate, the USDA Forest Service adjusted this average cost for inflation and differences in the work. The differences in work included the use of mortar at Flick Creek, which is not anticipated for this work, and additional costs for vegetation, LWD habitat enhancement, NEPA review, and permitting. This yielded an estimated unit cost of \$281.72 per linear foot, which was rounded to \$282 per linear foot.

The estimate in Table 1-1 is based on an average unit cost of \$282 per linear foot. The estimate takes into account some areas where a "half-treatment" is used. The USDA Forest Service and Chelan PUD recognize that some techniques will cost more or less than \$282 per foot. This information is provided as an Estimated Cost, as defined in section 4.4 of the Agreement.

*Erosion Control Treatments (USDA Forest Service)***Table 1-1: Estimated Costs and Lengths**

	Quantity	Item	Unit price	Est. total
Group 1	900'	Cribwall	282	253,800
	1,370'	std treatment	282	386,340
	830'	half-treatment	141	117,030
Subtotal	3,100'			
Group 2	600'	std treatment	282	169,200
Group 3	3,890'	std treatment	282	1,096,980
	1,545'	half-treatment	141	217,845
Subtotal	5,435			
Group 4	190'	half-treatment	141	26,790
NEPA process	as needed	NEPA	5%	113,399
Monitoring	Lump sum est.			53,000
Maintenance	yrs 5-20		2,400	36,000
	yrs 21-50		7,000	210,000
Total	9,325'			2,680,384

SECTION 3: ANTICIPATED EROSION CONTROL MEASURES

Chelan PUD and the USDA Forest Service intend to incorporate bioengineering techniques, exemplified by the techniques described in this Chapter, and fish enhancement measures to the extent feasible, at NFS sites treated. Details will be developed in each site-specific plan. If permits necessary to perform this work require mitigation (e.g. placement of LWD in the lake) this mitigation will be done at locations that do not create hazards for boaters and swimmers.

Currently anticipated erosion treatments include:

- Hand placed rock walls - most appropriate for trail applications, recreation areas
- Mortared placed rock walls - very limited application by USDA Forest Service adjacent to docks
- Enhanced placed rock (EPR) - general erosion or recreation sites
- Log cribwalls - trail areas and as retaining walls for placed fill
- Beach fill - limited application as recreation-enhancing option
- Vegetation Plantings – in conjunction with the above techniques
- LWD placement – usually in conjunction with the above techniques (Chapter 3, section 4)

Erosion Control Treatments (USDA Forest Service)

Other treatments may be identified in site-specific plans or as work progresses.

These techniques can all be modified to some degree to include such features as joint plantings, rock piles for fish habitat, LWD structures, and upslope revegetation.

The standard treatment considered in the cost estimate in Table 1-1 is an "enhanced placed rock" (EPR) treatment, illustrated in Figure 1-1. This treatment consists of large rock riprap, fitted into place rather than dumped, and with vegetation and LWD incorporated to provide additional protection for the slope's toe and for habitat.

Evaluation by the USDA Forest Service and Chelan PUD has led to the conclusion that many locations along the shoreline do not require a full treatment, but do require help in stabilizing the shoreline in the immediate vicinity of the high water line. Chelan PUD will treat these areas using a half-treatment that utilizes a single- or double-row rock placement (DRRP) using large rock, vegetation, and large woody debris treatments, as illustrated in Figure 1-2.

Site locations and proposed treatment for each site are included in Erosion Control Treatments and Concepts for Lake Chelan (Chelan PUD, 2001).

3.1 Group 1

Group 1 sites are those related to recreation areas. The 14 USDA Forest Service sites proposed for treatment are listed in Table 1-2. Chelan PUD will perform treatment on the 13 non-easement sites in this group.

In addition to these 14 sites, minor sites related to recreation include a few sites affecting lakeside trails or having an aesthetic impact on a recreation site. Erosion sites along recreation trails were inventoried. Treatment is needed for site 15, located between Graham Harbor and Graham Harbor Creek. Some toe repair is also needed along the Lakeshore Trail at site 54, west of Prince Creek. This is shown in photograph CD21 Fr33 from the 1999 erosion inventory. Chelan PUD will address sites 15 and 54 when the nearest large recreation site is treated. Site 17, next to Graham Harbor Creek, and site 87, near Big Creek, are minor sites with a direct aesthetic impact on recreation sites. Chelan PUD will treat sites 17 and 87 when the affected recreation site is treated.

*Erosion Control Treatments (USDA Forest Service)***Table 1-2: Group 1 Recreation Sites**

Recreation Site	Site No.	Length (ft)	Active (ft)	Cribwall (ft)	Treatment (ft)		
					EPR	DRRP	total
Big Creek CG	9	80	Prev. repair site	50	0	30	30
Domke Falls CG	24ab c	234	100		55	95	150
Corral Creek CG	11	235	60	60	60	0	60
Graham Harbor CG	14	100	Prev. repair site	100		monitor	
Graham Harbor Creek CG	16	192	Prev. repair site	160	20	0	20
Refrigerator Harbor CG	25	800	260	90	260	0	260
Lucerne CG/ Guard Station	26	340	170	600	170	0	170
Lucerne	27	474	150		110	50	160
Elephant Rock	31	20			monitor		
Moore Point CG ¹	41	1,600	460	460	easement site		
Cascade Creek CG	47	688	290		170	190	360
Deer Point CG	58ab	530	20	110	140	80	220
Mitchell Creek CG	59	1,054	110	80	265	155	420
Prince Creek CG	55	1,320	190	90	120	230	350
Total	14	7,667 ¹		1,800	1,370	830	2,200

¹ Site 41 is a USDA Forest Service recreation site with easement and is not included in treatment length totals.
Treatment includes replacement of 50 percent of the log cribwall, or 900 ft of cribwall.
Totals to be treated by Chelan PUD include 900 ft of cribwall, 1,370 ft of EPR, and 830 ft of DRRP, out of 6,067 ft of shoreline in the 13 Group 1 non-easement sites.

3.2 Group 2

Six erosion sites are thought to have the potential for affecting cultural resources. Four of these are included in Group 1 for treatment. One is included in Group 3 for treatment. The remaining site entails an estimated 600 feet of treatment. It is not included on the preliminary schedule, but will be treated as necessary under Chapter 10 (the Historical Properties and Cultural Resources Management Plan). Chelan PUD will coordinate and manage any erosion control work on Group 2 sites in accordance with Chapter 10. In particular, work on these sites will require prior review and approval of plans by the LCCF, and examination of the proposed work area.

3.3 Group 3

There are 27 sites of interest due to aesthetic concerns. USDA Forest Service staff selected these sites based on an analysis of visual impact of the erosion. As explained in Appendix F of the Inventory of Shoreline Erosion (Chelan PUD, 2000), a "site rawness ratio" or aesthetic erosion site (AES) ratio was defined and plotted for each USDA Forest Service site to assess the existing visual impact from shoreline erosion and to index impacts on soils and vegetation. In addition, a cumulative scale ration was calculated that includes the effects of nearby sites.

The AES ratio was calculated by estimating the total area (in square feet) of actively eroding or non-vegetated (bare) soil slopes at each site and dividing by the site length. The bare area was estimated using the site sketch with a 10-foot grid, together with the site photograph. Markings representing raw areas were made on the sketches and then tallied. Slope areas with existing

Erosion Control Treatments (USDA Forest Service)

visual screening, large woody debris, or otherwise visually "muted" areas were not included. The AES ratio takes into account the effects of variations in size and slope, including contrast and potential reflectivity. Reflectivity varied as the time of day and sun angle changed. Figure 1-3 provides an example of how the AES ratio was calculated.

The 27 sites selected for treatment represent the highest priority areas for addressing the full range of negative impacts of shoreline erosion, and are the sites expected to provide the highest ecological and visual return for the funds invested in treatment. Of the 27 sites, two (26 and 47) are already included in Group 1, one is included in Group 2, and five are covered by easements. These easement sites are not included in the summary of treatment of Group 3 sites shown in Table 1-3.

Group 3 is sorted into sub-groups, which are summarized, below, with their respective lengths. Easement sites are shown in bold and underlined. The "V" is used to designate groups of sites sorted based on visual impact. Non-easement sites, which will be treated by Chelan PUD as part of Group 3, include 9,979 feet of shoreline, of which 5,435 feet are proposed for treatment.

1) V1/V2 Sites - 9 sites with 2,170' of active toe erosion.

V1 sites 1, 2, 5, and 12

V2 sites 10, 29, 29b, **35b**, 45

2) V3/V4 Sites - 10 sites with 1,730' of active toe erosion.

V3 sites 8a, 8b, 23, 19, and **42**

V4 sites 10b, 13b, 26, 33, and 47

3) V5/V6 Sites - 8 sites with 1,950' of active toe erosion.

V5 sites 30, 37, and 50

V6 sites 5b, 20, **35, 36, and 41**

Site 41 is a recreational site with an easement that requires an estimated 550 feet of treatment. The USDA Forest Service will evaluate this site following any treatment which Chelan PUD may be required to perform under Chapter 10. Easement sites 35b, 42, 35 and 36 could be treated with shoreline LWD placements and other protective measures as USDA Forest Service funding allows.

3.4 Groups 4 through 6

Sites in Groups 4 through 6 are smaller and have lower priority for treatment. With one exception, they are not listed here. Site 32 has been selected for intermittent treatment (treatment of selected, short stretches) to take advantage of shoreline seeps in an effort to enhance riparian habitat. Chelan PUD will perform this treatment. The anticipated treatment length is 190 feet, broken into several pieces. For details of the other sites, refer to the individual site descriptions and sketches in the Inventory of Shoreline Erosion (Chelan PUD, 2000). As noted above, if Chelan PUD and the USDA Forest Service decide that monitoring shows that non-easement sites not currently selected for treatment are deteriorating such that they meet the criteria used to select sites in groups 1 or 3, these sites could be added to the list of sites to be treated.

*Erosion Control Treatments (USDA Forest Service)***Table 1-3: Group 3 Sites**

Site	Length (ft)	Active Toe (ft)	Treatment (ft)		
			EPR	DRRP	Total
1	210	90	100	40 ¹	140
2	410	175	200	190 ¹	390
5	1,075	225	150	260	410
5b	330	100	100	60	160
8a	30	10	10	30	40
8b	698	150	190	10	200
10	160	40	40	30	70
10b	140	50	70	10	80
12	820	525	470	50	520
13b	150	60	60	20	80
19	190	90	90	0	90
20	2490	550	640	260	900
23	580	370	300	70	370
29	445	230	190	110	300
29b	126	125	90	35	125
30	300	250	210	30	240
33	510	260	240	110	350
37	150	100	90	40	130
45	990	560	580	170	750
50	175	50	70	20	90
Total	9,979	3,760	3,890	1,545	5,435

¹ Field verified.

The proposed treatment in the table is based on review of photographs of group 3 sites.

Sites in Group 1 and easement sites, are not included in the table.

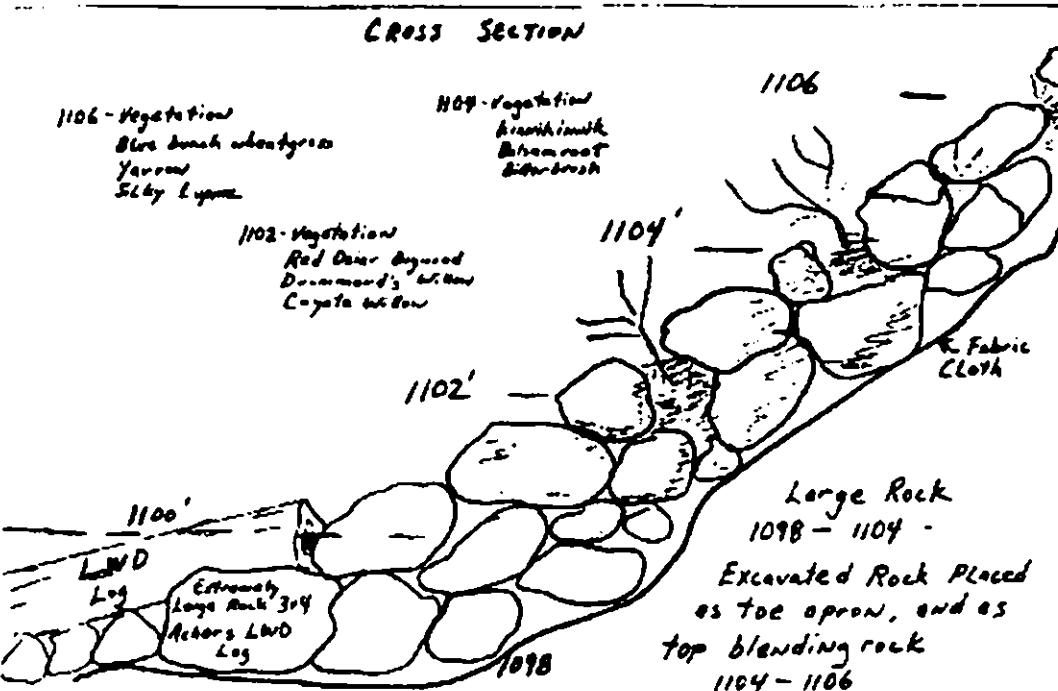
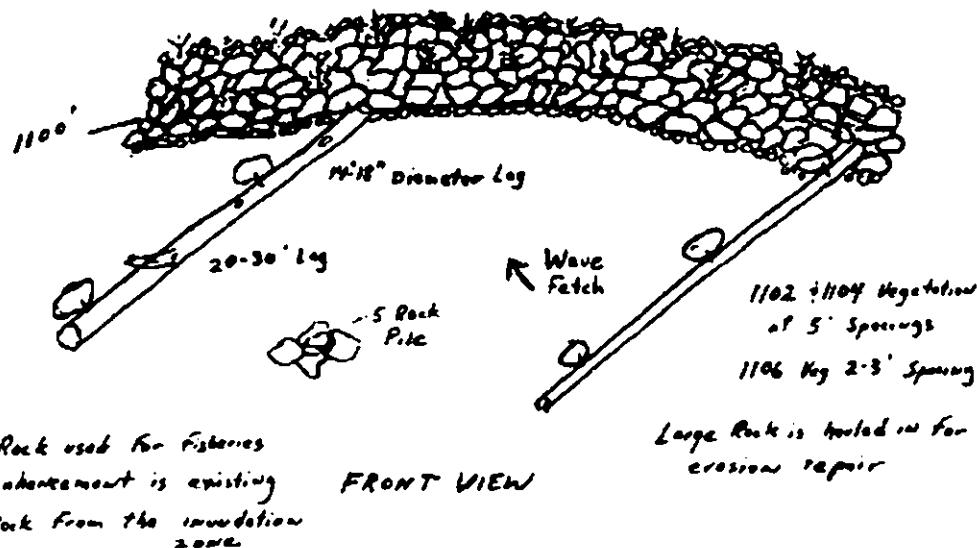
*Erosion Control Treatments (USDA Forest Service)***ENHANCED RIPRAP (DRAFT) (A)**

Figure 1-1: Enhanced Placed Rock; this example shows singular perpendicular LWD placement, rock piles and vegetation.

Erosion Control Treatments (USDA Forest Service)

DOUBLE ROW ROCK PLACEMENT (DRRP)
For Minor Spots - Showing some toe - Stability

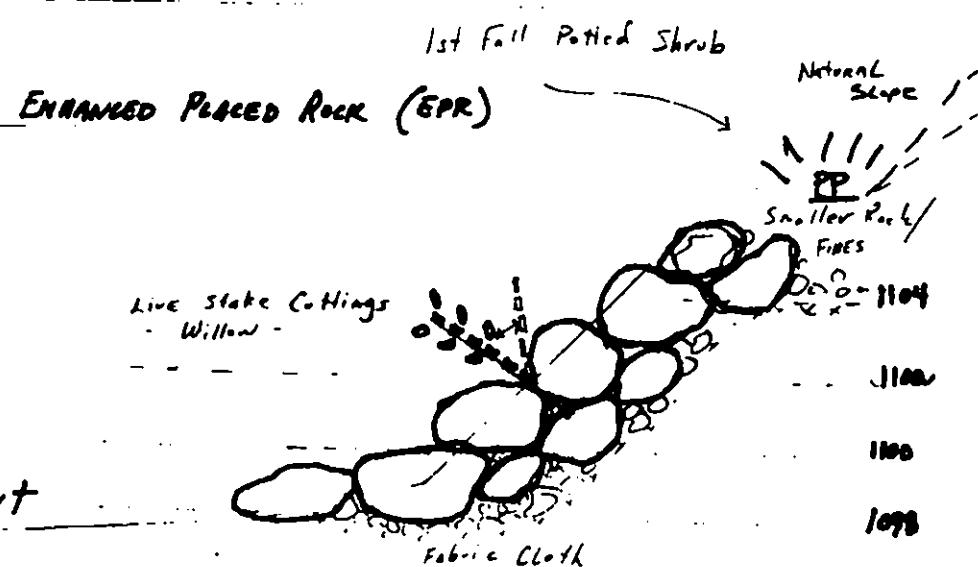
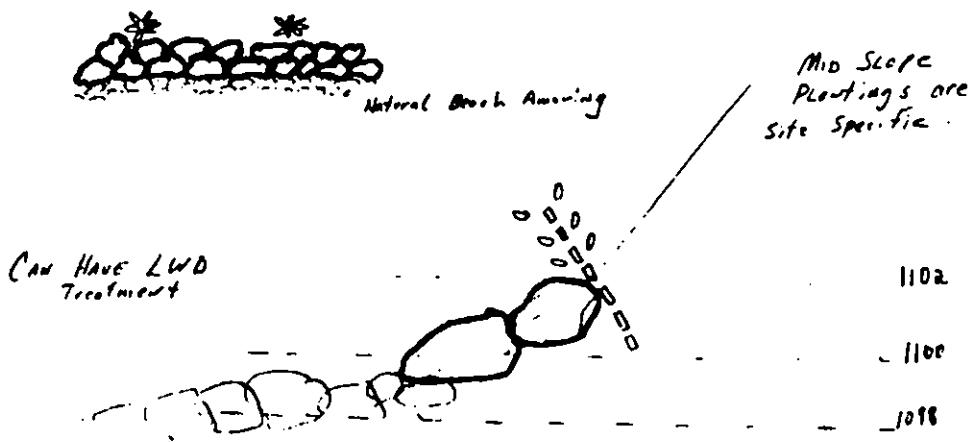


Figure 1-2: Double-row rock placement (DRRP) using large rock, vegetation and large woody debris treatments

*Erosion Control Treatments (USDA Forest Service)***USDA Forest Service Erosion Sites****Table 1-4: USDA Forest Service Sites Prioritized for Treatment**

Site	Group	Proposed Treatment Timeframes
1	3	2006-2011
2	3	2006-2011
5	3	2007-2012
5b	3	2012-2017
8b	3	2008-2013
8a	3	2008-2013
9 (87) ¹	1	2012-2017
10	3	2008-2013
10b	3	2008-2013
11	1	2007-2012
12	3	2009-2013
13b	3	2020-2025
14	1	Monitor
16 (15, 17) ¹	1	2005-2010
19	3	2017-2022
20	3	2023-2028
23	3	2018-2023
24abc	1	2004-2009
25	1	2010-2015
26	1	2011-2016
27	1	20011-2016
29	3	2014-2019
29b	3	2014-2019
30	3	2020-2026
31	1	Monitor
32	4	2006-2011
33	3	2013-2018
37	3	2022-2027
41	1	This is an easement site (addressed per LCCF).
45	3	2015-2020
47	1	2019-2024
50	3	2022-2027
55 (54) ¹	1	2004-2009
58ab	1	2005-2010
59	1	2005-2010

This draft schedule may change. Chelan PUD may accelerate this schedule. Schedule changes may be made after consultation and approval of both parties.

¹Site numbers in parentheses are minor sites noted in section 3.1. These are not included in the number of sites or other totals. Parts of these sites will be treated together with adjacent sites.

*Erosion Control Treatments (USDA Forest Service)***Table 1-5: USDA Forest Service Sites Proposed Timeframes**

<u>Approximate Timeframes</u>	<u>Sites</u>
2004 – 2009	55 (54) ¹
	24abc
2005 – 2010	16 (15, 17) ¹
	58ab
	59
2006 – 2011	1
	2
	32
2007 – 2012	5
	11
2008 – 2013	8ab
	10 /10b
2009 – 2014	12
2010 – 2015	25
2011 - 2016	26
	27
2012 – 2017	5b
	9 (87) ¹
2013 – 2018	33
2014 – 2019	29
2015 – 2020	29b
2016 – 2021	45
2017 – 2022	19
2018 – 2023	23
2019 – 2024	47
2020 – 2025	13b
2021 – 2026	30
2022 – 2027	37
2023 – 2028	50
2024 – 2029	20

¹Site numbers in parentheses are minor sites noted in section 3.1. These are not included in the number of sites or other totals. Parts of these sites will be treated together with adjacent sites.

Erosion Control Treatments (USDA Forest Service)

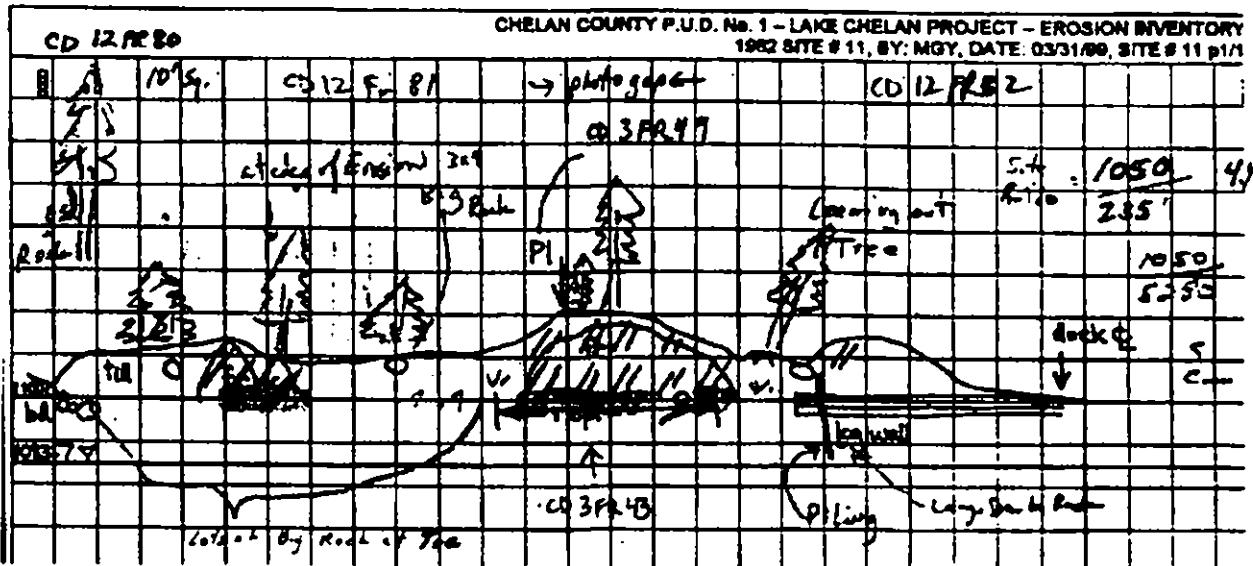


Figure 1-3: Aesthetic Site Ratio (AES) Example – Site 11

Site 11 modified sketch from USDA Forest Service/CPUD *Erosion Control Treatments and Concepts for Lake Chelan* (Chelan PUD, 2001)

Calculations:

The Aesthetic Erosion Site (AES) Ratio = (Square feet of bare area) ÷ (Site Length)

The sketch for site 11 shows 10.5 squares marked as bare soil, representing 1050 square feet. The site length is 235 feet. This gives an AES ratio of $1050 \div 235 = 4.4$ for site 11.

The Cumulative Scale Ratio = (bare area of all sites within 1-mile viewshed) / (1280 ft²)
To cover a 1-mile viewshed, the Cumulative Scale Ratio for site 11 includes sites 10 and 10b.

$$\text{Cumulative Scale Ratio} = (\text{bare areas from sites 10, 10b, and 11}) / (5280) \\ \equiv (1800 + 700 + 1050) / (5280) = 0.67$$

Because the AES Ratio is greater than 4 and the Cumulative Scale Ratio is greater than 0.6, site 11 has been listed for treatment.

Erosion Control Treatments (USDA Forest Service)

SECTION 4: LITERATURE CITED

Chelan PUD, 2000. Inventory of Shoreline Erosion, Lake Chelan and Bypass Reach Study Report – Final, Lake Chelan Hydroelectric Project No. 637. Chelan PUD, Wenatchee, Washington. September 1, 2000.

Chelan PUD. 2001. Erosion Control Treatments and Concepts for Lake Chelan, Okanogan and Wenatchee National Forests – Final, Lake Chelan Hydroelectric Project. FERC No. 637. Chelan PUD, Wenatchee, Washington. December 7, 2001.

USDA Forest Service, 2001. Protection, Mitigation, and Enhancement Measures Submitted by the US Forest Service for Chelan County Public Utility District Relicensing Project No. 637, Shoreline Erosion, May 3, 2001.

CHAPTER 2: LAKE CHELAN EROSION CONTROL PLAN (NPS)

*Erosion Control Plan (NPS)****TABLE OF CONTENTS***

CHAPTER 2: LAKE CHELAN EROSION CONTROL PLAN (NPS)	2-1
SECTION 1: Introduction	2-1
1.1 Site Selection	2-1
1.2 Responsibilities	2-1
SECTION 2: Implementation.....	2-2
2.1 Plan Implementation Schedule.....	2-2
2.2 Lake Chelan NRA Erosion Control And Recreation Enhancement Schedule Projection.....	2-3
2.3 Erosion Control Techniques.....	2-6
2.4 Material Sources	2-7
2.5 Revegetation	2-7
2.6 Monitoring and Maintenance.....	2-13
2.7 Cost Estimate	2-13
2.8 Erosion Cost Savings	2-15
2.9 Relationship to Other Plans	2-15
2.10 Permits	2-15
SECTION 3: Literature Cited.....	2-16

LIST OF TABLES

Table 2-1: Erosion Sites Requiring Treatment.....	2-4
Table 2-2: Site Number, Name, Treatment Length, and Erosion Control Technique	2-6
Table 2-3: Non-Easement Erosion Sites in Lake Chelan NRA Not Mitigated in the Erosion Control Plan	2-14
Table 2-4: Estimated Cost of Work to be Performed on Erosion Sites	2-14
Table 2-5: Estimated costs for LWD and related equipment.....	2-15

LIST OF FIGURES

Figure 2-1: Location of Erosion Sites in Lake Chelan National Recreation Area.....	2-5
Figure 2-2: General Rock Wall Design	2-8
Figure 2-3: General Rock Slope Revetment Design.....	2-9
Figure 2-4: General Live Log Cribbing Design	2-10
Figure 2-5: General Large Wood Design	2-11
Figure 2-6: General Perched Beach Design	2-12

Erosion Control Plan (NPS)

SECTION 1: INTRODUCTION

Shoreline erosion sites along Lake Chelan within the Lake Chelan National Recreation Area (Lake Chelan NRA) were surveyed by Chelan PUD, the USDA Forest Service, NPS and other members of the erosion working group in spring 1999 (Inventory of Shoreline Erosion, Chelan PUD, 2000). The members of the working group that took part in the inventory included Chelan PUD, USDA Forest Service, the NPS and some independent members. The results of this survey are summarized in Figure 2-1. Additional work to survey erosion sites was performed by NPS staff in summer 2000. These two surveys identified 3.7 miles of eroding shoreline out of 10 miles of lakeshore in the Lake Chelan NRA. All but two of the sites were identified in a previous survey by Chelan PUD in the early 1980s.

Several of the surveyed sites received erosion control treatment by Chelan PUD in the mid-1980s, and by the NPS in the early 1990s. Much of the erosion control attempted previously by Chelan PUD in the 1980s has failed or is failing, while work by the NPS in the 1990s has been limited to severe problems. The failed or failing work (which was performed by Chelan PUD, in cooperation with the NPS and USDA Forest Service), was based on minimal repair techniques and use of on-site materials, with no follow-up maintenance. It appears that rocks available on site were generally too small, making the repairs susceptible to damage by wave action.

The erosion control plan contained in this Chapter is intended to stabilize the shoreline at 16 sites selected by the NPS. The repairs planned for these 16 sites cover 3,535 linear ft, which amounts to less than 20 percent of the total eroding shoreline within the Lake Chelan NRA. A description of conditions, projected impacts, and general erosion control strategy for each of the 16 sites is provided in Lake Chelan Erosion Control Plan (Chelan PUD, 2001b).

1.1 Site Selection

Of 38 sites identified in the inventory, 16 sites were selected as having the greatest need for treatment to mitigate erosion because erosion threatens public recreation, emergency response, or administration facilities. Recreation facilities include campgrounds and the lakeshore trail. Emergency response and administration facilities include the road to the fire station, NPS houses, and Search and Rescue (SAR) caches at Stehekin. Ownership of some sites is subject to easements.

For purposes of funding and mitigation planning, the 16 sites are placed into one of two groups, consisting of seven erosion sites and nine recreation sites. Funding allotted for erosion control efforts at each of the erosion sites is included in this Chapter. Any erosion control work on recreation sites will be done as a necessary part of development or maintenance of recreational or administrative sites. Funding for work on those sites is not included in this Chapter.

1.2 Responsibilities

Chelan PUD shall make available to the NPS \$576,500, to implement the erosion control effort described in this Chapter for erosion sites. Payment to the NPS is governed by a separate

Erosion Control Plan (NPS)

administrative agreement between Chelan PUD and the NPS, pursuant to section 19 of the Agreement.

Chelan PUD and NPS anticipate the NPS will have lead responsibility for implementing the erosion control effort described in this Chapter. Chelan PUD shall become responsible for implementing this Chapter, but only to the extent that if unanticipated circumstances limit or preclude the ability of the NPS to do so. If such unanticipated circumstances arise, the NPS shall so notify Chelan PUD in writing. Upon receipt of such notification, Chelan PUD shall employ its best efforts to implement such portion of this Chapter as the NPS was unable to implement, but only to the extent of the funds remaining from the \$576,500 made available by Chelan PUD. Such expenditures by Chelan PUD shall include both payments to outside contractors and the cost of all work performed by Chelan PUD employees, including a reasonable allocation of overhead. Chelan PUD shall have no obligation to perform such work unless the NPS has provided written notice to Chelan PUD and FERC that such unanticipated circumstances exist.

The NPS is also responsible for designs of erosion control structures, and for obtaining any permits needed for construction from the U.S. Army Corps of Engineers (USACE) and the Washington State Department of Fish and Wildlife (WDFW). Both the NPS and Chelan PUD will cooperate and consult in the development of the progress report to be submitted to FERC.

SECTION 2: IMPLEMENTATION

2.1 Plan Implementation Schedule

For purposes of scheduling work, the 16 sites are prioritized as high, medium, and low; however, it should not be concluded that "low" priority sites should be ignored. In fact, all 16 sites are areas where active erosion is expected to threaten public facilities during the term of the New License for the Lake Chelan Project and are, therefore, of great importance.

From Table 2-1 there are eight high-priority sites, four medium-priority sites, and four low-priority sites. It is recommended that the stabilization of these sites occur in the first 25 years of the term of the New License, in accordance with a schedule outlined in section 2.2.

Adherence to a strict implementation schedule is not recommended for several reasons. First, variation in the lake level cycle from year to year may preclude work at any given site in any given year. Second, it may be cost-effective to work at some sites while other activities are taking place. For example, work on a dock at a campsite should be coordinated with design and implementation of erosion control at or near that site. Third, due to crew availability, material transportation, and weather, it is necessary to have a flexible implementation schedule. Finally, if the amount of work and funding levels are stable over a period of 5-10 years, it is much easier for the NPS to train and retain an erosion control crew.

Erosion Control Plan (NPS)

2.2 Lake Chelan NRA Erosion Control And Recreation Enhancement Schedule Projection

FUNDING AMOUNTS AND SOURCES

A-Erosion Control = \$266,500 (Chapter 2)

(Sites 61, 79, 80, 81, 90, 109 and 110)

B-LWD Management = \$310,000 (Chapter 2)

(Crew, small barge and crane)

C-Recreation Improvements = \$622,500 (Chapter 11)

(Sites 71, 72, 73, 75, 76, 82, 83, 113, 210)

Total funds available = \$1,199,000

IMPLEMENTATION AND FUNDING SCHEDULE

A. License years 1-3 = Total \$294,995 as follows

1. Annual Costs (\$45,500/year)

- Work at site 75 = \$113,300
- Work at site 90 = \$12,400

(Coordinated with Manly Wham Project)

- LWD crew @ \$3600/yr x 3yr. = \$10,800

2. One-time purchases yr. 1 (\$140,000)

- Purchase barge/crane yr. 1 \$130,000
- Revegetation startup yr. 1 \$10,000
- NPS boat upgrade to push barge \$18,495

3. \$904,005 available after year 3

B. License years 4-10 = Total \$486,000 as follows:

1. Annual costs (total \$66,577/yr.)

- Work at high priority sites 71, 79, 82, 109, 110, and 210 = \$381,100
- Work at low priority site 73 = \$30,900

(Coordinate with Stehekin Landing project)

- Complete work at site 90b = \$28,800
- LWD crew \$3600/yr x 7yr. = \$25,200 total

2. Fixed cost for NPS barge boat maintenance. = \$20,000

3. \$418,005 available after year 10

*Erosion Control Plan (NPS)***C. License years 11-15 = \$220,378**

1. Annual costs (\$44,075/year)

- Work at medium p. sites 61, 81, 83, and 113 = \$202,378
- LWD crew \$3600/yr = \$18,000

2. \$197,627 available after year 15

D. License years 16-20 = \$197,625

1. Annual costs (\$39,525/year)

- Work at site 76 = \$33,475
- Work at low priority rec. site 80 = \$30,900
- Work at remaining low priority sites 72 = \$77,250
- LWD crew funds = \$36,000

2. Fixed cost for NPS barge boat maintenance. = \$20,000

Table 2-1: Erosion Sites Requiring Treatment

Site No.	Priority	Site Category	Total length (ft)	Treatment length (ft)	Facility/resource/location
71	High	Recreation	1850	460	Weaver Point
75 ¹	High	Recreation	1405	440	Access road
76 ²	High	Recreation	1017	130	Lakeshore trail
79	High	Erosion	147	150	Lakeshore trail
82	High	Recreation	950	400	Lakeshore trail
109	High	Erosion	95	80	Lakeshore trail
110	High	Erosion	140	140	Lakeshore trail
210	High	Recreation	340	250	Stehekin Landing
61	Med	Erosion	145	125	Riddle Creek Cabins
81	Med	Erosion	960	260	Lakeshore trail
83	Med	Recreation	265	120	Lake trail, Fluk Cr
113 ³	Med	Recreation	280	280	Lakeshore trail
72	Low	Recreation	380-5000	300	Main Stehekin Road
73	Low	Recreation	790	120	Stehekin Landing
80	Low	Erosion	120	120	Manly Wham
90	Low	Erosion	156	160	Lakeshore trail
Subtotal		Recreation		2500	
Subtotal		Erosion		1035	
Total				3535	

¹ Site 75 length to be treated was increased from the inventory survey during subsequent field measurements by NPS.

² Site 76 is also a cultural resources site and may need additional treatment on that basis

³ Site 113 had a measured length of 190 ft in the inventory report, but in a subsequent field visit was changed to 280 ft.

Erosion Control Plan (NPS)

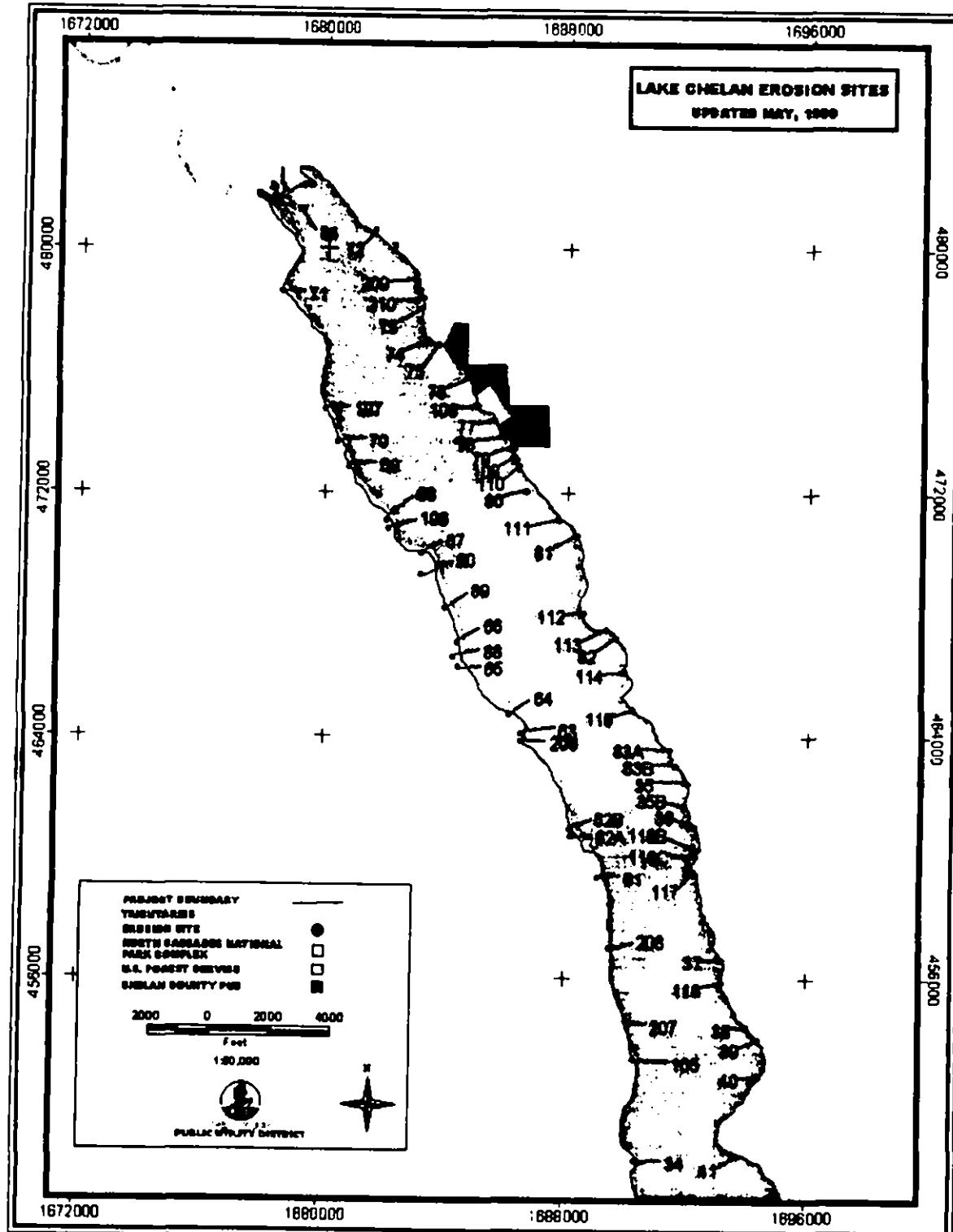


Figure 2-1: Location of Erosion Sites in Lake Chelan National Recreation Area

*Erosion Control Plan (NPS)***2.3 Erosion Control Techniques**

Erosion control techniques used to stabilize each site will include use of native rock, logs, soil and vegetation. Designs for use of these materials to stabilize shorelines will generally follow those described in the Chelan PUD publication Erosion Control Techniques and Permitting (Chelan PUD 2001). The five basic designs will include rock walls, rock slope revetments, log/live cribbing, perched beaches, and large woody debris (LWD) accumulations (Figure 2-2 through Figure 2-6).

Table 2-2: Site Number, Name, Treatment Length, and Erosion Control Technique

Site No. - name	Length (ft.)	Preliminary Technique
61-Riddle Creek Camp	125	continue rock wall
71-Weaver Point Camp	460	260 ft rock + 200 ft logs
72-Stehkin Road	300	rock wall
73-above dock ramp	120	rock or rebuild existing crib
75-fire and SAR cache road	440	rock wall
76-Lakeshore trail	130	rock revetment
79-lakeshore trail	150	rock revetment
80-lakeshore trail	120	rock revetment
81-lakeshore trail	260	logs
82-lakeshore trail	400	rock revetment
83-Flick Creek Camp	120	rock wall
90-Manly Wham Camp	160	120 ft logs + 40 ft rock
109-lakeshore trail	80	rock revet. or log crib
110-lakeshore trail	140	rock revet. or log crib
113-lakeshore trail	280	rock revetment
210-Stehkin landing	250	rock wall

Preliminary application of these techniques to each of the 16 sites is given in Table 2-2. Sketch maps, profiles and further descriptions of anticipated treatment are included in Lake Chelan Erosion Control Plan (Chelan PUD, 2001b). The total linear feet of proposed stabilization by category includes 580 ft to be treated with logs, 1300 ft to be treated with rock revetment and logs, and 1275 ft to be treated with rock wall. Use of rock is generally favored over wood, due to its greater expected longevity. Rock walls will be used at recreational sites with docks and swimming areas. Logs and rock slope revetment are inappropriate techniques at these sites because they can present safety hazards. Logs and rock revetments will be used along trail sites, where there are no docks or camps.

Gabions, concrete, or other heavily engineered approaches will not be used. Use of these erosion control techniques is problematic in the Lake Chelan NRA because of aesthetics, visitor safety and access, and low habitat quality.

All techniques will incorporate native vegetation into designs. Guidelines and a budget for revegetation are given under separate heading below.

The detailed design for each site will be developed prior to construction.

Erosion Control Plan (NPS)

2.4 Material Sources

Several sources will be used to obtain native rock, LWD, and other erosion control materials. Most large rock, sand, and gravel will be obtained from quarries near Lake Chelan. This material will be barged uplake to erosion control sites by private contractor. Smaller quantities of rock may be obtained from the Lake Chelan drawdown zone, where approved by the NPS archeologist and permitting agencies. LWD for work at several sites will be collected by the NPS from open water on Lake Chelan. It is anticipated that LWD will be collected by the NPS intermittently, following large flood pulses of wood into the lake, and stored for later use. The link between this plan and the management of LWD is discussed below in section 2.8.

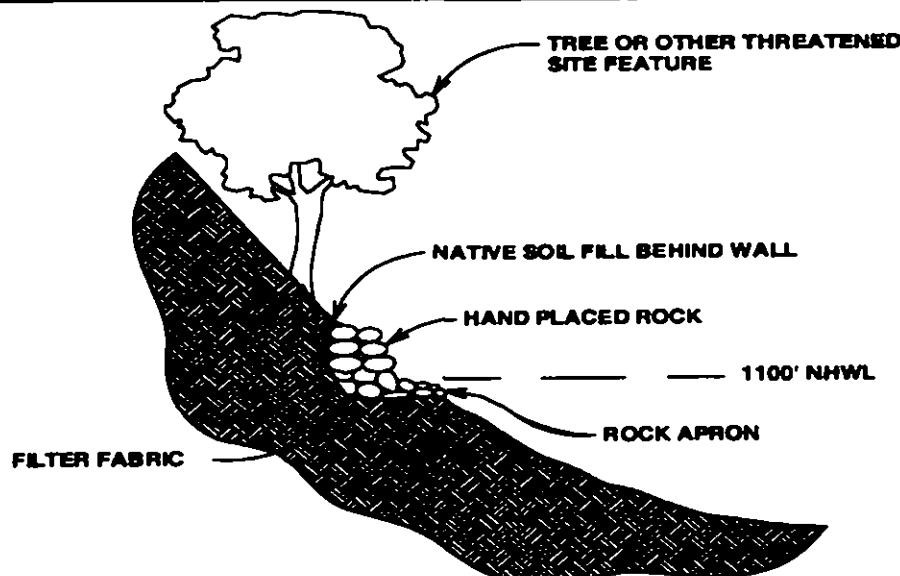
2.5 Revegetation

Native vegetation will be incorporated into all erosion control designs. This vegetation will provide several benefits. First, it will enhance stability of erosion control structures through root-reinforcement of soil. Second, vegetation will provide a means to control pedestrian traffic at a site, to the benefit of the shoreline ecology and the erosion control structures. Third, it will help establish riparian vegetation in otherwise barren areas of the shoreline.

Protecting the genetic integrity of native plant populations is an important aspect of the revegetation program. Plant materials, including seeds, cuttings and transplants will be obtained from as near to the erosion control site as possible. Plant species used will include only those currently found at each site, but will generally focus on use of shrubs. Slow-growing trees with large root systems and fragile ground vegetation will not be used at most sites.

It is anticipated that revegetation efforts will be supported by the NPS Greenhouse in Marblemount, and potentially by a small nursery in Stehekin.

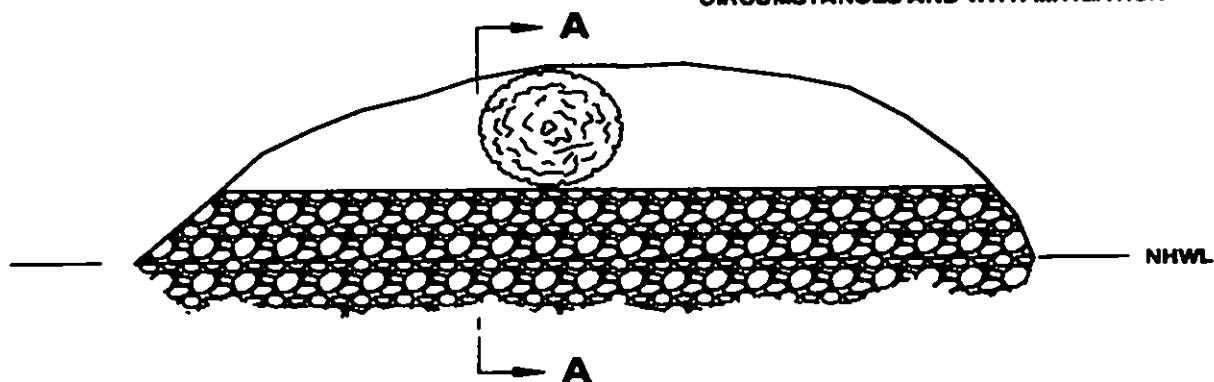
Erosion Control Plan (NPS)



SECTION A-A

NOTES:

- MINIMIZE SPACE BETWEEN WALL AND EXIST. SOIL FACE.
- FLATTER SLOPE ON FRONT OF WALL IS STRONGLY PREFERRED. SLOPE STEEPER THAN 2:1 ALLOWED ONLY IN SPECIAL CIRCUMSTANCES AND WITH MITIGATION



PLAN VIEW (NTS)

ROCK WALL

Figure 2-2: General Rock Wall Design

Erosion Control Plan (NPS)

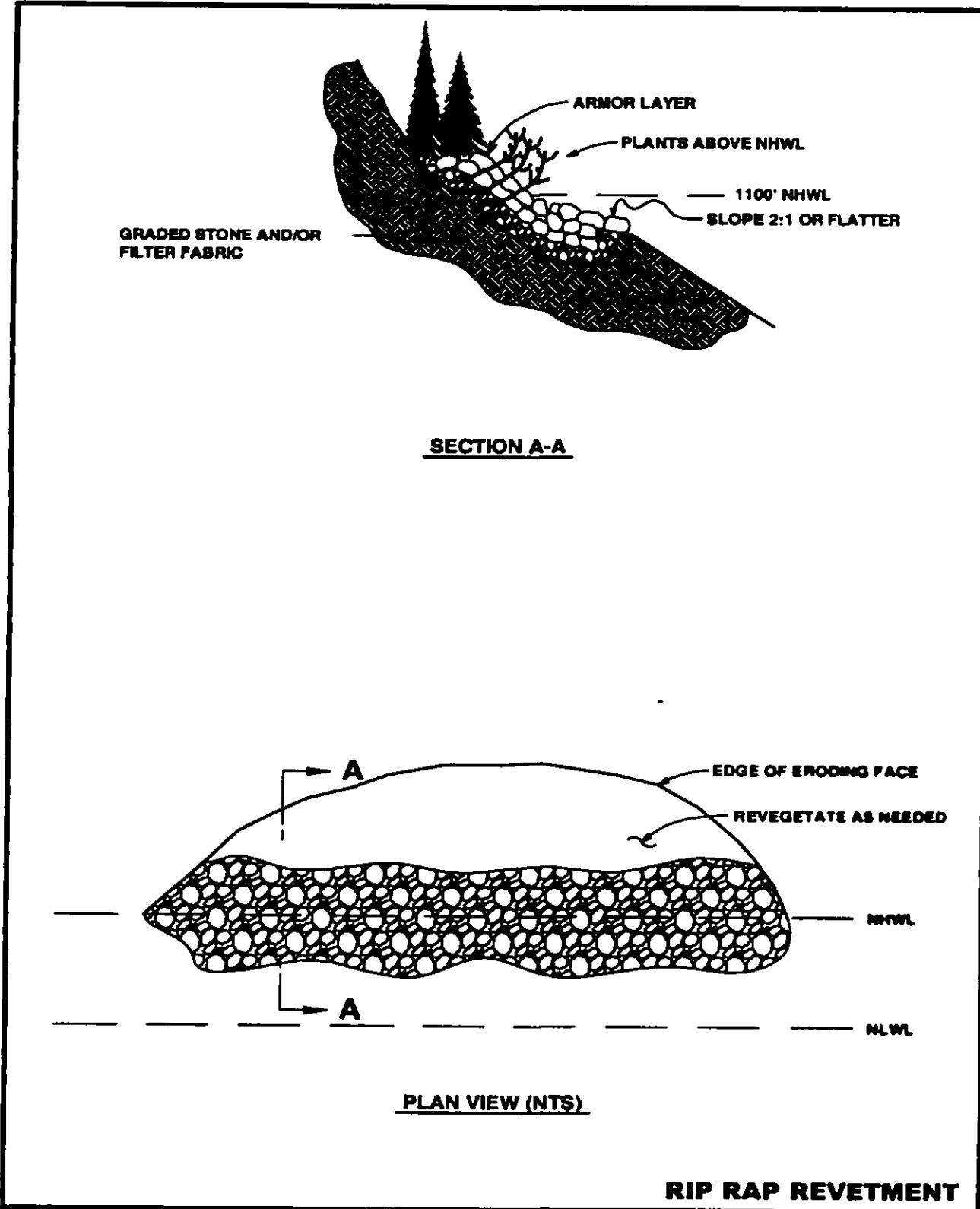
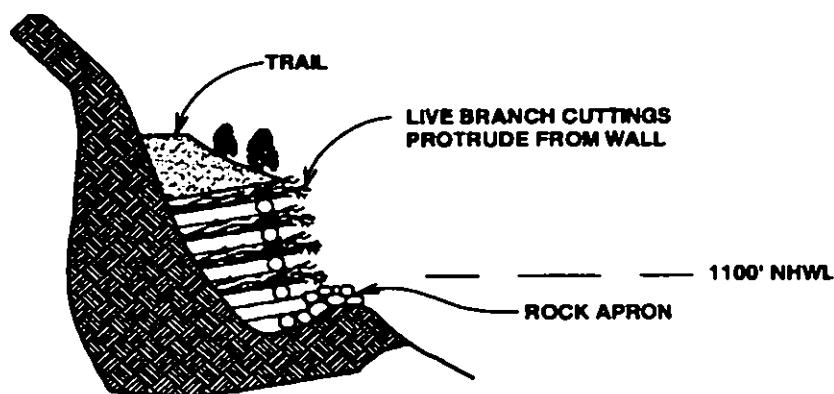


Figure 2-3: General Rock Slope Revetment Design

Erosion Control Plan (NPS)

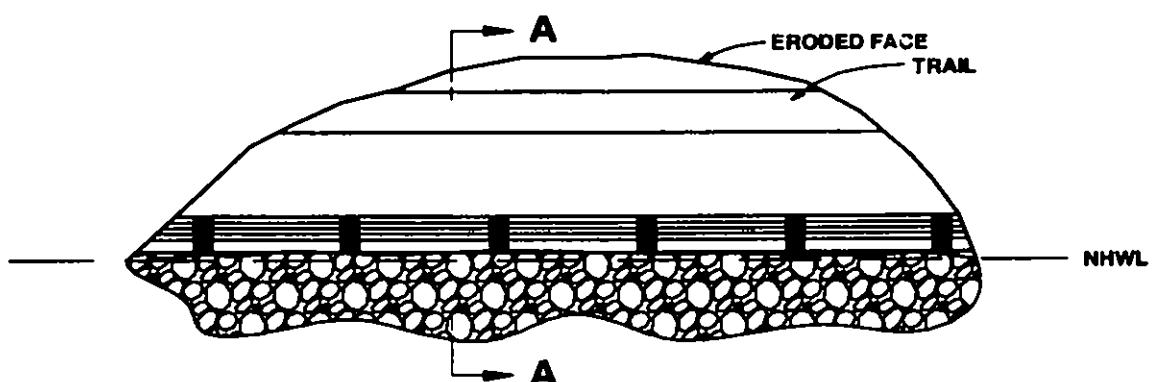


SECTION A-A

VEGETATED CRIB WALL

NOTES:

- THIS METHOD MAY BE SUITED TO VERY STEEP SITES THAT REQUIRE EROSION REPAIR TO MAINTAIN FEATURES SUCH AS TRAILS.



PLAN VIEW (NTS)

CRIB WALL

Figure 2-4: General Live Log Cribbing Design

Erosion Control Plan (NPS)

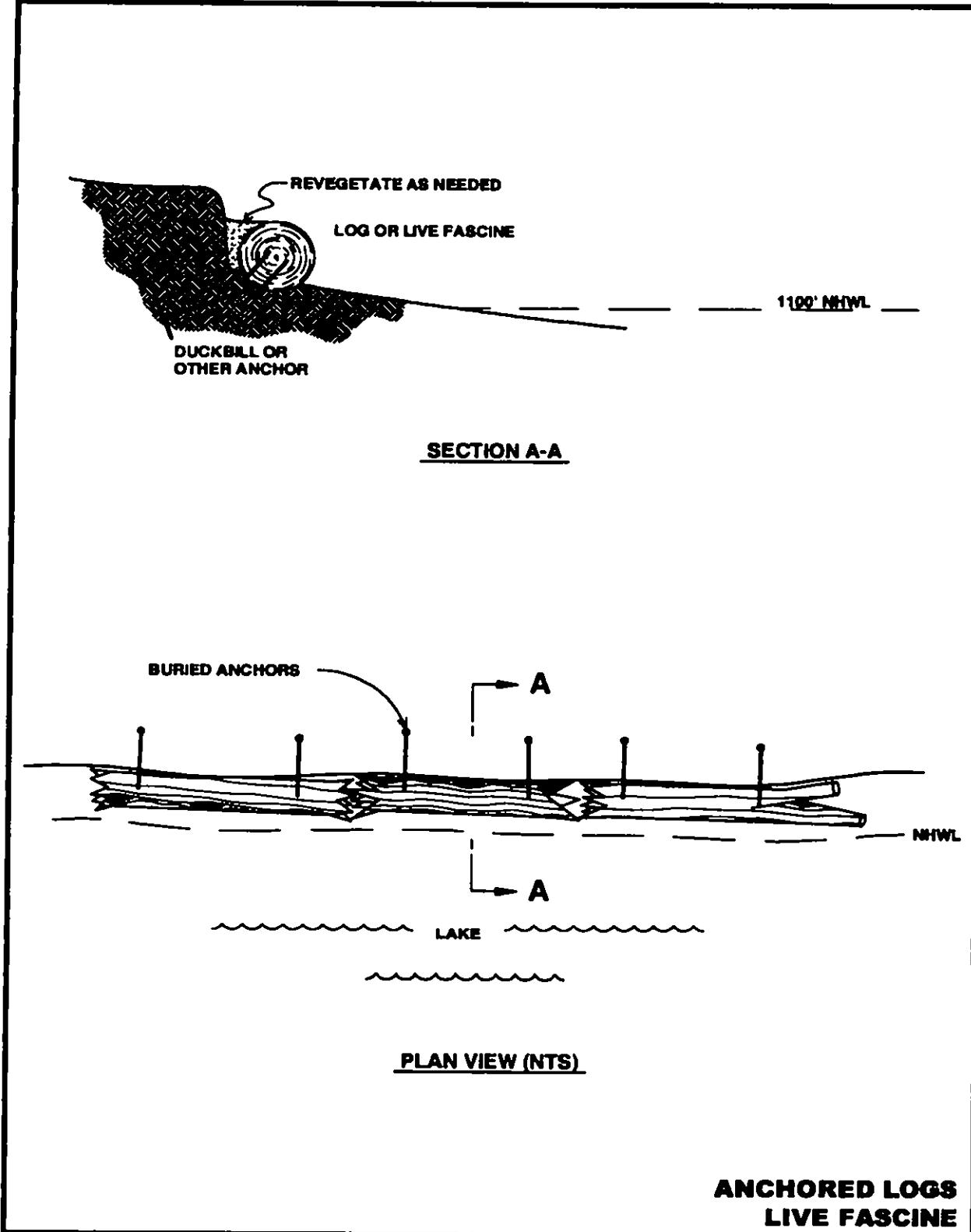
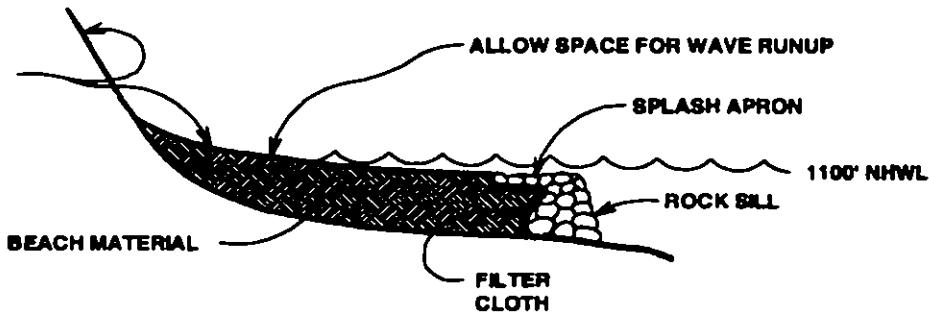


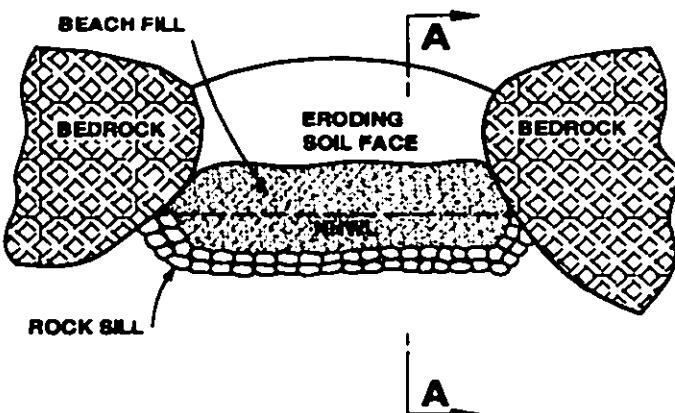
Figure 2-5: General Large Wood Design

Erosion Control Plan (NPS)

REVEGETATE AS NEEDED
ABOVE NHWL



SECTION A-A



PLAN VIEW (NTS)

NOTES:

- RAISE BEACH GRADE TO ABSORB WAVE ENERGY BEFORE WAVES REACH THE ERODING FACE
- SELECT FINAL BEACH SLOPE AT WHICH MATERIAL USED IS STABLE UNDER WAVE IMPACT.

PERCHED BEACH

Figure 2-6: General Perched Beach Design

Erosion Control Plan (NPS)

2.6 Monitoring and Maintenance

Monitoring of erosion control work will consist of: (1) monitoring of structures built under this plan from Table 2-1; and (2) monitoring of erosion rates and processes at selected sites from Table 2-3. This plan calls for systematic monitoring of existing structures and adjacent shorelines during the spring and/or fall drawdown periods. Necessary repairs will be made by the NPS to structures as soon as possible, coordinated with any similar or related work nearby. Maintenance will include rebuilding of rock aprons that protect the toe of the various types of erosion control structures. It will also include inspection and repair of the ends of structures.

All 38 erosion sites will be monitored at 20-year intervals using the 1999 inventory (Chelan PUD, 2000) as a baseline, together with reference photographs from the 1982 inventory. The NPS erosion control plan will include a schedule and strategy for monitoring and documentation of sites, including:

1. Trend monitoring (erosion rate and other significant changes) at selected sites; and
2. Updating the inventory of NPS sites contained in the 1999 study at 20-year intervals, starting on the 20th anniversary of the effective date of the New License. These updates will include photo documentation and current site sketches using the same or otherwise approved methodology.

The maintenance portion of the plan will include provisions for NPS to perform reasonable additional treatment on non-easement sites, based on agreement between Chelan PUD and NPS that observations from the monitoring program and/or observations at other times show a need for such treatment. It will include rough plans for treatment of non-easement areas not selected for mitigation in the erosion control plan, including previously identified sites that were not fully treated, new sites not previously identified, and the 14 sites identified and not selected for treatment in Table 2-3. In particular, the NPS may choose to add new or existing non-easement sites to the list of sites to be treated based on agreement between Chelan PUD and NPS that they meet the evaluation criteria used in the original analysis to select sites from Group 1 (Erosion) for treatment. As mentioned in section 1.1, selection of sites for treatment was based on a threat to NPS facilities.

Cost estimation for work at previously identified or new non-easement sites will follow the procedure used for the sites in the erosion control plan (i.e. \$60 x 4ft x site length). Additional funding for additional erosion control work shall be provided by Chelan PUD only once the total length of shoreline treatment on erosion sites (non-easement sites) exceeds the treatment length of 3,535 ft for which funds are already provided.

2.7 Cost Estimate

Cost estimates are provided in Table 2-4 for work to be performed on erosion sites as a basis for funding provided in this Chapter. This estimate is based generally on cost analysis of the Riddle Creek and Stehekin Landing Projects on Lake Chelan, where all material used was barged uplake. Estimated costs are provided in Table 2-5 for LWD and equipment to be used for mitigation work related to those sites and other work on NPS lands, including those in Chapter 4 and various recreational projects. Additional details on the cost estimation procedure are given

Erosion Control Plan (NPS)

below in sections 2.6.1 and 2.6.2. The total estimated cost for all erosion control and LWD funding in this Chapter is \$576,500.

Table 2-3: Non-Easement Erosion Sites in Lake Chelan NRA Not Mitigated in the Erosion Control Plan

Site number	Site length	Active length	Location
63	350	100	Bridal Veil Creek
64	300	70	Canyon Creek
65	510	140	South Shore
66	210	50	South Shore
67	600	180	Castle Creek
68	740	340	One Mile Creek
69	75	20	South Shore
70	265	340	South Shore
88	290	40	South Shore
89	210	0	South Shore
106	210	50	South Shore
107	170	20	Lakeshore Trail
111	30	20	Lakeshore Trail
206	190	0	Bridal Veil Creek
Totals	4150	1370	

Table 2-4: Estimated Cost of Work to be Performed on Erosion Sites

Site No.	Erosion Control ¹	Reveg. Cost ²	Total Cost by Site	Site Name / Location
61	30,000	2,180	32,180	Riddle Cr. Cabins
79	36,000	2,620	38,620	Lake Trail
80	28,800	2,100	30,900	Lake Trail
81	62,400	4,550	66,950	Lake Trail
90	38,400	2,800	41,200	Manly Wham
109	19,200	1,400	20,600	Lake Trail
110	33,600	2,450	36,050	Lake Trail
Totals	248,400	18,100	266,500	

¹ Erosion control costs are based on a typical cost of \$60 per ft² for treatment of a 4-ft-tall strip. They include maintenance from year 10 to the end of the New License term, estimated to be \$50,000 for this group of sites, and equipment maintenance in years 10, 20, and 40 of the New License, estimated to be \$10,000 per occurrence.

² Revegetation costs are based on a cost of \$7 per plant and treating a 5-ft-wide strip with 1 plant per 2 ft².

*Erosion Control Plan (NPS)***Table 2-5: Estimated costs for LWD and related equipment**

Item	Assumptions	Total Funds
LWD barge & gear	Purchased in year 1 of license	\$130,000
LWD crew & supplies	Average of \$3,600 per year	\$180,000

2.8 Erosion Cost Savings

Savings realized from erosion control work completed on individual sites will remain available for future site maintenance, cost overruns, monitoring and rehabilitation during the remainder of the New License term.

2.9 Relationship to Other Plans

The erosion control plan contained in this Chapter is closely related to the LWD management plan contained in Chapter 3 and the Stehekin Area Management Plan contained in Chapter 4.

In response to these needs and concerns, this plan calls for the NPS to build LWD structures at several key sites along the lake to mitigate for the construction of large rock walls without wood and to improve fish habitat. These sites include those where LWD is the primary erosion control agent (Figure 2-1; sites 71, 81, and 90), the mouths of two small tributaries from a list that includes Riddle, Hazard, Fourmile, Flick, Castle and Bridal Veil creeks, and may include dust source areas on Stehekin Flats.

Natural accumulations of LWD along shorelines will not be reduced to provide LWD for work described in this Chapter. The LWD management plan is not designed to remove all of the wood from Lake Chelan. Only large pieces of wood will be relocated to erosion control sites, or the sites listed above. However, not all large wood pieces floating in the lake will be collected and used. Some wood will continue to be allowed to move freely downlake from the Stehekin River.

Erosion control work at cultural sites on NPS land will be planned and funded as provided in Chapter 10, relating to Historic Properties and Cultural Resources Management.

2.10 Permits

Permits for erosion control work within the Lake Chelan NRA must be obtained from two agencies. WDFW issues hydraulic permits, while the USACOE issues Clean Water Act 404 permits. Under this plan the NPS would obtain appropriate permits for all 16 sites, as well as the LWD structures. Permit applications would be filed as final designs are completed in the year before an erosion control structure is installed. If possible, permits with a term of at least three years will be sought.

State of Washington Shoreline Management Act permits will not be acquired for work at these sites. The Shoreline Management Act does not apply to federal actions on federal lands.

Erosion Control Plan (NPS)

SECTION 3: LITERATURE CITED

Chelan PUD, 2000. Inventory of Shoreline Erosion, Lake Chelan and Bypass Reach Study Report – Final, Lake Chelan Hydroelectric Project No. 637. Chelan PUD, Wenatchee, Washington. September 1, 2000.

Chelan PUD, 2001a. Erosion Control Techniques and Permitting – Final, Lake Chelan Hydroelectric Project. FERC No. 637. Chelan PUD, Wenatchee, Washington. May 4, 2001. 61 pp.

Chelan PUD, 2001b. Lake Chelan Erosion Control Plan, Lake Chelan National Recreation Area – Final, Lake Chelan Hydroelectric Project. FERC No. 637. Chelan PUD, Wenatchee, Washington. December 7, 2001.

***CHAPTER 3: LAKE CHELAN LARGE WOODY DEBRIS
MANAGEMENT PLAN***

Lake Chelan Large Woody Debris Management Plan

TABLE OF CONTENTS

CHAPTER 3: LAKE CHELAN LARGE WOODY DEBRIS MANAGEMENT PLAN 3-1

SECTION 1: Introduction.....	3-1
SECTION 2: Geographical and Historical Context.....	3-1
SECTION 3: Project Relationship.....	3-2
SECTION 4: Implementation.....	3-2
4.1 Protection of Naturally Stable LWD Accumulations	3-2
4.2 Beneficial Use of LWD	3-3
4.3 Collecting Usable LWD on Lake Chelan	3-3
4.4 Banking of Required LWD Structures	3-3
4.5 Identification of Potential Storage Sites	3-4
4.6 Funds for WDFW	3-4
4.7 Preparation for Flood Events	3-5
SECTION 5: Literature Cited	3-5

Lake Chelan Large Woody Debris Management Plan

SECTION 1: INTRODUCTION

The USDA Forest Service, the National Park Service (NPS), the Washington Department of Fish and Wildlife (WDFW), and Chelan PUD have agreed to use large woody debris (LWD) in the implementation of the erosion control and fishery plans contained in Chapters 1, 2 and 6 of the Comprehensive Plan. This Chapter describes how the LWD is to be managed in order to achieve those purposes. Funding only for the collection and transportation of LWD by WDFW is described in this Chapter. Funding for the use of LWD to achieve erosion control is described in Chapters 1 and 2, and potential sources of funding for the use of LWD for fishery management are described in Chapter 6.

The benefits of LWD are summarized in the Lake Chelan Fisheries Investigation (Chelan PUD 2000). Potential benefits include increased habitat for fish, substrate for invertebrate production, and shoreline stabilization. Use of LWD in the lake carries with it some risk and uncertainty with respect to effects on native versus non-native species of fish. The impact of LWD placement on fish may be monitored under the Lake Chelan Comprehensive Fishery Management Plan (Chapter 6).

This plan is not meant to address the removal of all LWD that comes into the lake, nor to address all safety issues that might arise due to the presence of LWD on the lake.

SECTION 2: GEOGRAPHICAL AND HISTORICAL CONTEXT

Lake Chelan is surrounded by an extremely rugged landscape, with steep slopes and cliffs along much of the west end of the lake and rolling hillsides with shrub-steppe habitat around the east end of the lake. Most of the LWD comes into the system from the western tributaries, which are larger and have more heavily wooded drainage areas. Some LWD is also contributed by shoreline erosion. The most significant source streams are the Stehekin River, Railroad Creek, Fish Creek and Prince Creek.

The primary source of LWD is floods. The Project has experienced three large floods that have carried massive amounts of LWD into the lake. These floods and their effects can be summarized as follows:

- Floods that delivered significant amounts of LWD to the lake occurred in 1949, 1972, and 1995.
- The cleanup effort after the 1995 flood removed an estimated 690 tons of LWD from the lake, including more than 900 large logs.
- The average log size was 12 to 14 inches in diameter and 60 feet long.
- Two to three percent of the material was fresh, with root wads attached.
- The cleanup after the 1995 flood cost approximately \$500,000.

Lake Chelan Large Woody Debris Management Plan

Historically, most of the incoming LWD has been removed from the lake and chipped, burned, or salvaged for logs. Some wood from the 1995 flood was used to enhance fish habitat at tributaries.

SECTION 3: PROJECT RELATIONSHIP

There is no reason to believe that Project operations significantly influence how much LWD enters the lake, or the timing of its arrival. Opinions differ as to whether management of the lake level in accordance with Project licenses has any effect on LWD in the lake. No change in the behavior of LWD in the lake has been observed or documented since prior to Project development. Partly due to the length of the lake, LWD typically does not reach the dam at the lake's lower end. Instead, it typically becomes waterlogged and sinks, is stranded along the shoreline, or is removed from the lake. However, the use of LWD in the erosion control and fishery management plans is strongly desired by the USDA Forest Service, NPS, and WDFW, and Chelan PUD has acceded to those desires in order to facilitate settlement among the parties to this relicensing proceeding.

SECTION 4: IMPLEMENTATION

4.1 Protection of Naturally Stable LWD Accumulations

The current NPS Management Plan for the Lake Chelan NRA generally does not allow for manipulation or removal of LWD on the Stehekin River, because of its ecological importance. Similarly, USDA Forest Service policy generally does not allow removal or manipulation of LWD; however, it is known that large individual pieces are occasionally removed for firewood or for shoreline protection on private lands. These agency policies reflect a desire on the part of the agencies to act so that stable LWD is not removed. According to these policies, stable pieces may be moved temporarily during erosion control work, but should be placed back in a manner that preserves cover and ecological values. Where unstable or potentially hazardous pieces of LWD are to be used, they should be anchored in such a way that they have fisheries, riparian, and/or shoreline erosion benefits.

The number of sites around Lake Chelan with naturally stable accumulations of LWD is limited. The few shallow bays with gently sloping shorelines, such as Driftwood Bay at Lucerne, are examples. Due to differences in overall topography, there are more small bays and coves along the NPS portion of the lake than exist farther downlake on USDA Forest Service lands.

Lake Chelan Large Woody Debris Management Plan

4.2 Beneficial Use of LWD

The beneficial use of LWD in the lake will take one of two forms under this plan. In some instances, LWD will be placed on site and will become an integral part of erosion control work. In other instances, it will be used not as part of erosion repairs, but will be placed off site to satisfy requirements of permits necessary to perform the erosion control work.

Examples of the first category are sites at which LWD is used to protect the shoreline from waves. The second category consists of off site placement where LWD is placed not primarily to provide erosion control, but to improve aquatic habitat, in accordance with permit requirements. This will occur, for example, at recreation sites where boating and swimming are expected. LWD will not be placed on site in such cases because it would create a safety hazard. The placement of LWD related to erosion control efforts during the New License is addressed in Chapter 1, regarding USDA Forest Service lands, and in Chapter 2, regarding NPS lands.

Under the existing WDFW mitigation policy, one-to-one mitigation is an acceptable standard. This standard allows the mitigation to be calculated based on an area formula. In accordance with this policy, the quantity of LWD included in erosion control work and/or placed as mitigation required by permits shall not exceed the amount required using the one-to-one ratio between the area of disturbed soil and the area of LWD used as mitigation.

The typical disturbed area is expected to be three feet wide (i.e. from the lake edge toward the uplands). Therefore, each linear foot along the shoreline that is disturbed would require mitigation with three feet of a log one foot in diameter. For techniques that disturb a narrower area, proportionately less mitigation would be required. If a log includes a rootwad, the area covered by the rootwad when placed shall be counted in addition to the area of the log.

4.3 Collecting Usable LWD on Lake Chelan

Collection of LWD under this plan will not be comprehensive and is not done with the intent of assuring safe boating conditions on the lake or managing all LWD that enters the lake. Collection of LWD under this plan will be limited to material needed by the USDA Forest Service, NPS, or Chelan PUD to support erosion control work around the lake, dust control on Stehekin Flats, or for tributary enhancement work.

Not all the woody debris entering the lake is expected to be suitable for the uses mentioned above. Ideal characteristics of pieces considered suitable for collection and use include:

- At least 10 feet long
- At least 1.0 to 1.5 feet in diameter
- Pieces with root wads attached
- Pieces with some remaining branch structure

LWD needed to support projects will be collected by the individual agencies carrying out those projects. Final selection criteria will be determined by those entities.

4.4 Banking of Required LWD Structures

As explained above, required LWD will be placed to satisfy the conditions of permits needed for erosion control work. The basic concept of "banking" of required LWD structures is included so

Lake Chelan Large Woody Debris Management Plan

that placement of required LWD does not have to be done concurrently with the erosion control work for which the permit is issued. Instead, placement of required LWD can be performed as suitable LWD becomes available, either before or within a reasonable time after the permitted erosion control work with which it is associated. This flexibility in timing will encourage timely and efficient placement of desirable LWD pieces, and coincidentally should help reduce risks associated with free-floating LWD.

As discussed above, the supply of LWD to the lake is sporadic. As a result, LWD may not be readily available when it is needed. To address this problem, LWD will be used, to the extent feasible, as it becomes available. Required LWD placement in off site structures or along the shoreline may run ahead of or lag behind the progress of projects for which it is required without adjustment in the amount of LWD required. This will be acceptable to WDFW and shall not affect the level of mitigation required as long as placement of required LWD does not lag behind the associated projects by more than five years unless this period is extended by renewal of the hydraulic permit authorization. In any event, 25 percent of the required mitigation shall be performed within 5 years, 50 percent shall be performed within 10 years, and 100 percent shall be performed within 15 years of completion of other erosion control work on each group of sites.

4.5 Identification of Potential Storage Sites

LWD that is collected by Chelan PUD for use on USDA Forest Service land, but which cannot be used or transported immediately, will be stored by Chelan PUD at locations and by means as agreed upon by Chelan PUD and the USDA Forest Service. LWD that is collected by the NPS, but which cannot be used immediately, will be stored by the NPS. Storage sites may be used to hold material for either the short or long term. Holding the LWD for a long period of time increases associated risks, and may entail some added cost to those agencies. Long-term storage techniques may include having logs drilled and cabled (lead-line) to a main shoreline (high-line) anchor. Short-term storage may take the form of a containment boom, without securing individual logs. Some of the material may be lost due to sinking, which may be desirable if the storage site is a small tributary cove such as those at Coyote Creek or Little Goat Creek. Alternatively, if the LWD is to be used at a specific site, temporary beaching and cabling at that site could be used. Details of storage will be chosen by the agencies responsible for collecting and storing the LWD. Responsibility for collecting and storing the LWD is defined in Chapters 1 and 2.

Potential storage locations include:

- West of Weaver Point (erosion site 71)
- USDA Forest Service land in section 28 below Hunts Bluff Bay (erosion site 40)
- A portion of Driftwood Bay at Lucerne (boat traffic is a concern at this site so that LWD will have to be carefully controlled or another site selected)
- Small bay north of Prince Creek (uplake of erosion site 54)
- Behind booms at tributary mouths at Rattlesnake Creek, Deep Harbor Creek, Coyote Creek

4.6 Funds for WDFW

To assure a controlled level of mitigation required for erosion control efforts Chelan PUD will make available to WDFW \$5,000 per year for each of the first 20 years of the New License, to be used by WDFW in obtaining, transporting, storing and distributing LWD or other

Lake Chelan Large Woody Debris Management Plan

bioengineering bank protection and in-lake fish habitat restoration, enhancement and mitigation materials (called "other materials") for use on state and private land within or adjacent to Lake Chelan. WDFW will be responsible to obtain any permits necessary for this work.

The funds may be used by WDFW to purchase or transport LWD and other materials to WDFW-provided storage sites within the Lake Chelan basin, for eventual use in bioengineered bank protection and fish habitat installation projects on state and private lands within or immediately adjacent to Lake Chelan.

If the total mitigation costs required by permits exceed the costs that would result from the one-to-one ratio described in section 4.2, Chelan PUD may reduce the funds provided to WDFW by the amount of the additional cost incurred.

4.7 Preparation for Flood Events

This plan is not intended to provide for management of all LWD in the lake, and does not address the effects of floods that may cause large inputs of LWD into the lake. Parties interested in helping to deal with such events are encouraged to plan specific actions and methods of responding to large quantities of debris and to draft a Memorandum of Understanding (MOU) that provides for the additional coordination and funding needed to address such events. Potential participants may include WDFW, USACE, USDA Forest Service, NPS, WDOE and Washington Department of Natural Resources.

SECTION 5: LITERATURE CITED

Duke Engineering & Services, Inc. (DE&S). 2000. Lake Chelan fisheries investigation – final, Lake Chelan Hydroelectric Project No. 637. Prepared by DE&S, Bellingham, Washington. Prepared for Chelan PUD. September 26, 2000. 95 pp.

CHAPTER 4: STEHEKIN AREA IMPLEMENTATION PLAN

*Stehekin Area Implementation Plan***TABLE OF CONTENTS**

CHAPTER 4: STEHEKIN AREA IMPLEMENTATION PLAN.....	4-1
SECTION 1: Introduction.....	4-1
SECTION 2: Goals of the Stehekin Management Plan	4-1
SECTION 3: Implementation	4-2
3.1 Responsibilities	4-2
3.2 Monitoring Program	4-2
3.3 Partnerships	4-3
SECTION 4: Fugitive Dust Mitigation and Abatement.....	4-3
4.1 Measurable Objective.....	4-3
4.2 Description of the Resource Problem	4-4
4.3 Management Actions Considered and Rejected.....	4-5
4.4 Management Actions for Problem Resolution	4-6
4.5 Potential Obstacles and Solutions	4-7
4.6 Timing of Management Actions.....	4-8
4.7 Cost Estimate.....	4-8
SECTION 5: Shoreline Riparian Zone Revegetation and Wildlife Habitat	4-9
5.1 Objectives	4-9
5.2 Description of the Resource Problem	4-10
5.3 Management Actions for Problem Resolution	4-11
5.4 Potential Obstacles and Solutions	4-12
5.5 Timing of Management Actions.....	4-13
5.6 Cost Estimates	4-13
SECTION 6: Monitoring and Evaluation.....	4-14
6.1 Objectives.....	4-14
6.2 Description of the Resource Problem	4-15
6.3 Management Actions for Problem Resolution	4-15
6.4 Timing of Management Actions.....	4-18
6.5 Cost Estimates	4-18
SECTION 7: Responsibilities.....	4-18
SECTION 8: Conclusions.....	4-19
SECTION 9: Literature Cited	4-19

Stehekin Area Implementation Plan

SECTION 1: INTRODUCTION

This Chapter outlines the steps to be taken to address issues relating to the Stehekin area at the northern end of Lake Chelan. The Stehekin area includes a relatively flat area of approximately 300 acres that is periodically inundated by water fluctuations due to reservoir operations, known as "the flats" or "the drawdown zone." It also includes the mouth of the Stehekin River, and the dock, store, and associated buildings known as Stehekin Landing. The issues addressed are of critical interest to the NPS in the relicensing process because of its management responsibility for land in and near the Stehekin area.

Prior to development of the Lake Chelan Project, the drawdown zone included forest, floodplain areas, small homesteads, and a hotel. Historic photos show parts of the area around the Field's Hotel, located at the head of the lake, bordered by a riparian zone. They also show the natural delta with small streams or distributor channels created by the Stehekin River and Little Boulder Creek draining into Lake Chelan. The many large diameter tree stumps still in the drawdown zone provide evidence that Stehekin Flats included forested areas before the lake level was raised. Past Chelan PUD management of the drawdown zone has included the contracted removal of many of the stumps.

The Riparian Zone Investigation prepared for Chelan PUD by Duke Engineering & Services Inc. (DE&S, 2000) identified the riparian zone at the head of Lake Chelan as the largest and most important within the boundaries of the Lake Chelan Project. Productivity, species diversity, and abundance were assessed for birds, small mammals, amphibians, and reptile species. This lakeshore habitat had the highest number of species and the greatest abundance of both birds and small mammals of all the areas studied. The study concluded that "[t]he Stehekin River had the most abundant and stable riparian habitats and was the only site studied with a significant area of emergent wetland."

SECTION 2: GOALS OF THE STEHEKIN MANAGEMENT PLAN

This plan is intended to provide strategies to reduce airborne dust events, monitor changes in the Stehekin River channel topography, restore native riparian vegetation, reduce the invasion of non-native plants, and enhance habitat for native wildlife species that use the drawdown zone, shoreline, and adjacent lands. This plan takes a holistic approach to address several NPS natural resource management goals for the drawdown zone during the period of the New License. To implement this plan, Chelan PUD, NPS, and other interested parties will attempt to:

1. Create and maintain a partnership for the implementation, assessment, and refinement of this plan;
2. Seek additional funding and in-kind partnership support for achieving goals, while minimizing the extent of commitment or burden to any single partner;

Sthekin Area Implementation Plan

3. Reduce the magnitude and duration of fugitive dust events that carry dust into the Stehekin Landing;
4. Protect existing riparian habitat along the shoreline and in the drawdown zone, and enlarge and connect it, where feasible, so that it will function as a multi-storied, diverse, riparian vegetation and wildlife corridor;
5. Reduce the current abundance, distribution, and cover of reed canary grass, and control the spread of other non-native plants along the shoreline; and
6. Monitor native plants and wildlife for species richness, abundance, and distribution, to measure the success of these measures.

SECTION 3: IMPLEMENTATION

3.1 Responsibilities

During the New License term, Chelan PUD will monitor the Stehekin River channel, at a cost not to exceed \$90,000. In addition, Chelan PUD will make available \$160,000 to the NPS for implementing all other parts of this plan. Actions taken pursuant to this Chapter (other than river channel monitoring), will be coordinated with the Historic Properties and Cultural Resources Management Plan described in Chapter 10 of the Comprehensive Plan so that they do not conflict.

Chelan PUD and the NPS will cooperate in obtaining necessary permits. This plan anticipates the NPS will take the lead in obtaining permits, with assistance from Chelan PUD in the case of permits for work on Chelan PUD land.

This plan calls for the NPS to monitor for changes in species richness, abundance, and distribution throughout the implementation period, to evaluate progress toward objectives. The Riparian Zone Investigation (DE&S, 2000) study will serve as the baseline for purposes of such monitoring.

3.2 Monitoring Program

Progress toward the goals of this plan will be monitored in order to provide a basis for reallocating resources as appropriate. Where possible, standard monitoring protocols will be used to minimize cost and increase the chance of obtaining meaningful, comparable data. Key parts of the monitoring program will be repeated each five years. This plan anticipates monitoring will be carried out by the NPS, with the exception of Stehekin River channel monitoring, which will be carried out by Chelan PUD. A team of relevant personnel from Chelan PUD and the NPS will meet every five years to evaluate the most recent monitoring results. Based on such monitoring results, the team may recommend the reallocation of resources, and such reallocations shall be made, subject to the concurrence of both the NPS and Chelan PUD.

Stehkin Area Implementation Plan

Monitoring will focus on the following questions:

- Are management actions affecting the existing habitat adversely or beneficially?
- Are we protecting existing riparian habitat, or is progressive loss of riparian habitat taking place?
- Are we reducing the magnitude and duration of fugitive dust at Stehekin Landing?
- Are we reducing the area of infestation by non-native canary reed grass?
- Are we increasing the abundance and distribution of native riparian vegetation in areas previously infested with non-native plants?
- Are the revegetated sites connected with protected riparian habitat, and are they sufficient to support greater wildlife species abundance and distribution?

3.3 Partnerships

Goals 1 and 2 of this plan are to establish partnerships and seek additional sources of funding. These goals are particularly important because there is a considerable amount of private land within the Stehekin area, and it will be important to assist those private land owners who wish to undertake steps consistent with this plan. The Chelan County Conservation District has a Resource Conservation and Development Board for riparian restoration, which can assist private property owners with grant money and work crews. The Natural Resource Conservation Service also can provide cost-sharing for private property owners who undertake restoration projects.

The natural resource problems addressed by this plan are unusual and complex. To assure that the best available science is being employed, it may be beneficial to seek outside scientific peer review of aspects of this plan. Contingent on the approval of both the NPS and Chelan PUD, the Society for Ecological Restoration, or some other non-profit, scientific organization, may be contacted to provide such peer review. The cost of such peer review services is not part of Chelan PUD's obligation.

SECTION 4: FUGITIVE DUST MITIGATION AND ABATEMENT

Goal 3 of this plan is to reduce the magnitude and duration of fugitive dust events that carry dust into Stehekin Landing.

4.1 Measurable Objective

Defining a measurable objective for the dust abatement effort has proved problematic. The intent is to substantially reduce the objectionable effects of dust, primarily impaired visibility and discomfort. Because visibility is difficult to measure objectively, and discomfort is largely subjective, Chelan PUD and the NPS simply chose to seek a 50 percent reduction in the magnitude and duration of dust events, in the expectation that such a reduction would create substantial improvements in conditions at Stehekin Landing. The goal of a 50 percent reduction assumes use of the measurements in the existing study report (ARS, 2001) as a baseline. Key data are summarized in section 6, Monitoring and Evaluation, below.

Stehkin Area Implementation Plan

More specifically, the objective is to reduce the duration of dust events and the concentration of total suspended particulates (TSP) measured at Stehekin Landing during dust events by 25 percent within the first 10 years of the New License period, and by an additional 25 percent within the second 10 years of the New License period, and then continue at the 20-year level or better for the remainder of the New License. The concentration of TSP will be represented by the mass particle concentration, in $\mu\text{g}/\text{m}^3$, collected in the monitoring equipment filter during the dust event. This measure is explained in more detail in section 6. Chelan PUD and the NPS do not know whether this objective is attainable, or how much such a reduction in dust would increase visibility and/or decrease discomfort, but they anticipate that the benefits of such a reduction would be considerable.

4.2 Description of the Resource Problem

Fine sediments that are deposited in Lake Chelan by the Stehekin River cover most of the drawdown zone. The sediments are exposed after the snow melts, which varies from late February to mid-March. They are dried by the air and, except when wetted by rain, remain dry until the lake is refilled in June. Strong down-valley diurnal winds can lift the fine sediments into the air, creating a dust cloud as much as several hundred feet in the air and several miles downlake. Some of this dust is deposited at Stehekin Landing. Dust events usually occur between mid-March and mid-June.

Chelan PUD and the NPS jointly funded an air quality study to determine the timing and duration of dust events, the magnitude (amount and size of particulates), and the chemical composition of dust in the air at Stehekin Landing (ARS, 2001). Dust concentrations were measured for three particle size ranges. These were PM2.5 (smaller than 2.5 microns), PM10 (smaller than 10 microns) and total suspended particulates (TSP). The PM2.5 and PM10 sizes are known as respirable dust and concentration limits are included in EPA standards. EPA standards no longer regulate concentrations of particles larger than PM10, since they are generally no longer considered a health threat. The study determined that dust measured at Stehekin Landing did not exceed any federal air quality standards. The measured concentrations of dust in the PM2.5 and PM10 particle size ranges were below the EPA standards for those ranges. As reflected in the TSP measurements, most of the particles were larger than the PM10 particle size range and so are not regulated.

Although the study showed that the dust does not violate any air quality standards, the NPS considers the dust to be a significant problem, and is concerned about such things as reduced visibility, respiratory irritation from the dust, increased maintenance costs and increased wear and tear on computers and other equipment.

Changes in the annual cycle of water levels and inundation period from the first license to the second license have produced some changes in the drawdown area, and have complicated efforts to understand related natural resource problems. Also, recent observations have shown that normal variations from year to year in the lake level cycle can produce substantial differences in the source area and the dust.

The NPS used photography taken during the fugitive dust events monitored by the air quality study in 2000, together with previous aerial photography and a geographic information system

Stehekin Area Implementation Plan

(GIS), to map the areas in the 300-acre drawdown zone that contribute to the airborne dust. Ninety acres of the drawdown zone appear to be of sufficient elevation to dry out when dewatered during the spring. During 2000 and 2001, only 10 to 30 acres of these 90 acres produced the bulk of airborne particulates. In 2002, the spring lake levels were lower and the source area was observed to have expanded to about 50 acres. Also, observations suggested that the frequency and severity of dust events was greater. This sort of variation should be taken into account in planning dust control efforts.

4.3 Management Actions Considered and Rejected

The Erosion Working Group (EWG) considered several possible approaches to dust control. To be effective, the EWG concluded that an approach must change one of the following factors:

- Stop or deflect wind to protect the soil surface, e.g. by means of windbreaks.
- Prevent or reverse drying of surface soil, e.g. by means of sprinklers or other irrigation.
- Decrease the exposure of the surface particles, e.g. by adding vegetative or other cover.
- Make the soils less susceptible to movement by wind, e.g. alter the grain size or cohesiveness of the surficial soils (gravel cover or dust palliative).

The following methods of dust abatement were considered:

Sprinkler System Irrigation - The use of a sprinkler system over the 50 acre fugitive dust source area was considered a promising option by the EWG. It does not produce a long-term physical, chemical, or biological solution. Its use over a large area may present some technical and logistical problems, and may be relatively expensive. Still, some form of sprinkler system may merit further consideration as part of a pilot program.

Seeding - Like the sprinkler system, seeding the flats with non-invasive cover crops is labor intensive, costly, and does not produce a self-sustaining solution to the dust problem. Seeding the drawdown zone was tested in the 1980s and was unsuccessful. Although cereal rye remains the plant of choice, its effectiveness in this situation was minimal. Given its limited growth by April and May, the cereal rye was unable to hold the fine silt with its root system, or block the wind with its stems and leaves. The grass may not have been planted thickly enough, and planting more cereal rye grass per acre is possible, but it would still not be expected to provide adequate protection because the grass will not grow tall enough within the available time frame.

Dust Palliatives - Chemical dust control solutions are intended for dry surfaces, such as dirt roads during the summer months. They typically contain chemicals that may adversely affect water quality, wildlife, and vegetation. Most are restricted from application within 100 feet of a water body. Many of these solutions contain either sodium chloride or calcium chloride. Some use a soybean-based solution, but the other ingredients are proprietary and of unknown chemical composition. These dust palliatives can pollute surface waters and cause undesired environmental impacts; thus, this method was rejected.

Stehkin Area Implementation Plan

Windbreaks - Fences or other types of windbreaks in the drawdown area were considered by the EWG, but were expected to be unsightly and possibly labor-intensive if the fences were placed and removed at the beginning and end of each spring. In the case of materials left in place from year to year, the potential hazard to boats was considered a problem.

4.4 Management Actions for Problem Resolution

It is unlikely that any single management action will completely solve the problem of fugitive dust. A combination of actions by the NPS (placement of large woody debris with rock anchors, irrigation systems, etc.) may be required to reduce airborne dust from the drawdown zone to the desired degree. The effort to reduce dust in this situation is essentially experimental. It is anticipated that the first several years of plan implementation will include investigation of options and small-scale tests of one or more possible approaches. Alternatives proposed for investigation are described below.

This plan calls for large woody debris (LWD) with rock anchors to be placed in the fugitive dust source areas (about 50 acres) to serve as windbreaks. The LWD will be placed roughly perpendicular to the prevailing wind direction, and either anchored by chains that allow the pieces to float to the surface as the reservoir rises, or anchored directly to the lake bed so that they do not move.

Floating LWD will be placed in rows or rough circles to mimic rafts of driftwood, similar to driftwood accumulations in a shallow, sheltered bay of a lake or reservoir. The surrounding log boom should consist of the largest logs available, two logs wide, to contain free-floating logs inside the boom. The perimeter logs will be chained to rock anchors, with chains long enough to allow the logs to float at the normal maximum water elevation. The floating LWD will function as rafts of driftwood when the reservoir is full. When the reservoir is drawn down in winter, the logs will re-position themselves each year atop the exposed mud flats, ready to capture blowing silt the following spring. It is anticipated that LWD will gradually rot and provide habitat for aquatic insects and fish. Rotting logs will be retained inside the boom, when possible, in hopes of eventually forming a base for grasses and shrubs, and potentially providing some nesting habitat for waterfowl.

Alternatively, LWD may be anchored directly on the lake bottom. This approach could decrease installation and maintenance costs, but should be tested before it is applied on a broad scale. Anchoring LWD to the mud flats or lake bottom has the potential drawback that the LWD could become covered by silt after several years and no longer be effective as wind barriers.

LWD will be placed generally perpendicular to the prevailing wind direction to maximize its effectiveness as a windbreak. The use of LWD and large rock is desirable because they are expected to be less visually intrusive than non-natural materials. They should function as habitat for aquatic wildlife and fish, and the LWD will add nutrients to the system as it decomposes.

LWD will be collected from the head of the lake, where it floats clear of the Stehekin River. The NPS Forest Fuel Reduction Areas in the lower Stehekin valley may be another source of LWD. To the extent feasible, log booms will be arranged and LWD collection and placement will be coordinated so that LWD is collected and placed directly, without the need for intermediate

Stehekin Area Implementation Plan

storage. LWD collection will be coordinated with the erosion control effort, and will not take woody material naturally deposited on the shoreline or within the Stehekin River. Large rock or boulders for anchors will be purchased down-lake and barged to the placement site.

Prior to placement of LWD, temporary windbreaks, such as snow fences, may be placed for one or two years in the area thought to be the primary source of the dust. This will serve as a test of the effectiveness of windbreaks in controlling or preventing the fugitive dust and may also help confirm the location of the source area. The fences should be placed in March and removed in early June. A plan with details of the arrangement, spacing, etc., should be developed prior to plan implementation.

In addition to the above, LWD may be placed by the NPS along the drawdown zone shoreline to reduce erosion while improving native plant survival and wildlife habitat at riparian habitat restoration sites.

If LWD alone does not produce the desired results, other options, such as irrigation, to supplement or replace the placement of LWD can be investigated. One approach might be placement of a fine mist sprinkler system upwind of the fugitive dust source area. The winds that carry the dust could transport the sprinkler mist over a large enough area to wet the fine silts and significantly reduce the amount of dust being lifted into the air.

4.5 Potential Obstacles and Solutions

The NPS should coordinate the collection of LWD with high lake levels. The well-timed collection of driftwood (LWD) will improve efficiency and save thousands of dollars in boat operation and labor. The LWD should be floated from the collection point to dust abatement sites in the drawdown zone while water levels are high. The placement of logs should be coordinated with lake levels in order to move the material into place as efficiently as possible. Some of the work, like the placement of large rock, may require the use of heavy equipment in the drawdown zone during the winter and spring. If so, access for this activity may be difficult.

Placement of LWD in the drawdown zone will require amassing enough LWD to create an effective wind erosion barrier to contain the fugitive dust. Collection of the amount of LWD needed for this and other plans may require several years and can take place during some initial years of testing. It is expected that permitting agencies will require placement of LWD as a condition of permits for erosion control work. To the extent feasible, such required LWD should be placed in the drawdown area to assist in dust control efforts. However, neither Chelan PUD nor the NPS know if there will be enough LWD to apply to the drawdown area after LWD has been applied to other sites as required by permits for work under the NPS Erosion Control Plan (Chapter 2).

The floating rows or circles of logs will appear as log booms interspersed with mats of logs functioning as driftwood. They should be placed strategically within the 50-acre dust source area in the reservoir drawdown zone, east of the Stehekin River channel and Weaver Point. When floating, these rows and circles of logs will be buoyed as a group hazard to navigation, to warn boaters of the danger. The buoys will be cabled to move with the rise and fall of the

Stehkin Area Implementation Plan

reservoir, and could also warn of submerged hazards during lower water levels per U.S. Coast Guard standards.

If an irrigation system is determined to be necessary to supplement or replace the LWD placement, the two systems should be constructed to optimize the effectiveness of both systems and details of the design completed before construction.

4.6 Timing of Management Actions

Actions during years 1-10 of the New License:

- Map the flats during the drawdown period, and determine the precise boundaries of the primary source of fugitive dust. Measure the land area that is affected by strong winds during the spring months of March through mid-May.
- Consult with WDFW and file a Joint Aquatic Resource Permits Application (JARPA) to obtain necessary state and federal permits.
- Install temporary snow fences to test the effectiveness of blocking or deflecting wind.
- Collect free-floating logs near the mouth of the Stehekin River and place them in a containment boom until they can be floated above submerged flats and set in place.
- Place large rock to anchor LWD in the dust source area. Buoy chains and large rock to aid in later attachment of LWD, and to alert boaters to the navigational hazard. Connect LWD to rock when a sufficient amount is collected.
- Install a small mist sprinkler system and irrigate a portion of a primary dust area as a test, and evaluate the effectiveness.
- Evaluate effectiveness of above actions after the first five years.

Actions during the remaining years of the New License:

- Every five years, evaluate the success of LWD placement - supplement LWD in areas that are experiencing wind erosion.
- Every 15 years, inspect LWD material, replace rotting logs or rusted/worn chains, and replace warning buoys.
- Assess the efficiency of the mist sprinkler irrigation, if present, for dust abatement
- If necessary and cost-effective, continue irrigation for the duration of New License.

4.7 Cost Estimate

- A three-person crew (salaries and equipment) to move LWD and large rock into place, connect logs together, anchor to large rock with chain, and anchor some LWD to the reservoir bottom. (\$60,000)
- Purchase rock for LWD anchors and contract for a barge to place rock. (\$27,000)
- Special drill bits to make the connections for LWD and rock. (\$8,000)
- Purchase hardware for connections. (\$5,000)
- JARPA for project completion; National Historic Preservation Act (NHPA) consultation with the State Historic Preservation Officer (SHPO).
- Irrigation supplies and setup (if irrigation is used) - may include well drilling, pumps, pipe, system burial, labor, and seasonal operator costs. Parts maintenance and replacement cost.

Stehekin Area Implementation Plan

Item	Cost per year	3-year install*
Crew salaries and equipment	\$20,000	\$60,000
Purchase large rock	\$5,000	\$15,000
Place LWD and rock	\$4,000	\$12,000
Misc. tools and supplies	\$12,000	\$26,000
Irrigation system	not included	not included

* 3-Years to install the log booms, LWD rafts, and anchored LWD after a sufficient amount has naturally accumulated at the head of Lake Chelan or is augmented from other sources. The LWD accumulation may take 10 years.

The total estimated cost for dust abatement is \$113,000; however, this estimate does not reflect the probable overlap between LWD placement for dust control and placement required by permits for erosion control work. This overlap in efforts could result in a substantial reduction in costs under this plan. Costs for contingency plans are not included. It is anticipated that small-scale testing and pilot programs, as discussed in section 4.4, will avoid the possibility of spending the entire estimated amount to fully implement the LWD plan and then discovering that it does not allow the objective to be reached.

Chelan PUD will make available \$100,000 for use in this effort. Any funds remaining after the stated dust control objective is reached will be available for other work under this plan. Chelan PUD will provide an additional, \$45,000 for use in dust abatement or monitoring efforts, as needed. The cost of labor and materials contributed by Chelan PUD to implementation of this work will be reimbursed from these funds.

SECTION 5: SHORELINE RIPARIAN ZONE REVEGETATION AND WILDLIFE HABITAT

5.1 Objectives

Goal 4 of this plan is to protect existing riparian habitat along the shoreline and in the inundation zone, and to enlarge and connect it where feasible, so that it will function as a multi-storied, diverse, riparian vegetation and wildlife corridor.

- Goal 4a: Protect existing shoreline riparian vegetation to prevent a decrease in total acreage, and to maintain plant species diversity, forest structure, and connectivity.
- Goal 4b: Improve the species richness, function of wildlife habitat, and diversity of forest structure within existing riparian vegetation.
- Goal 4c: Reduce shoreline riparian habitat fragmentation, and improve fish and wildlife habitat by enlarging and connecting existing riparian vegetation.
- Goal 4d: Improve riparian wildlife habitat for vertebrate and invertebrate species.

Goal 5 of this plan is to reduce the current abundance, distribution, and cover of reed canary grass and control the spread of other non-native plants along the shoreline.

Stehkin Area Implementation Plan

- Goal 5a: Reduce the cover of reed canary grass from the perimeter of areas of native riparian vegetation, and plant native vegetation to achieve 50 percent native plant cover along the drawdown zone shoreline within the first 25 years of the New License.
- Goal 5b: Reduce the total shoreline area currently covered by non-native plant species by 50 percent within the first 25 years of the New License, and avoid new invasions.

Only goals 5a and 5b appear measurable. It is unknown whether any of the above goals are attainable.

5.2 Description of the Resource Problem

Native Riparian Plants - The present shoreline of the drawdown zone includes deltas and islands that were cleared for the reservoir in the late 1920s, but were not completely inundated. Today, these deltas and islands are vegetated with native riparian plants and reed canary grass. A more detailed description can be found in the Riparian Zone Investigation study report (DE&S, 2000).

Since these low-lying areas are not submerged and have some native plants, they are prime areas for revegetation. The success of native riparian plant rehabilitation efforts is expected to depend to a great extent on the influence of the lake level on ground water levels. Also, at the highest lake levels, small channels that penetrate these low-lying areas are flooded. This appears to have a negative effect on stability and retention of the surface soils. The species diversity (richness) of native vegetation along the drawdown zone shoreline is believed to have decreased since the mid-1970s, based on evaluation of aerial photography. Proposed changes to Project operations are expected to decrease the period of inundation and encourage more plant growth in some parts of the drawdown zone, as compared with the existing baseline conditions. This will be a beneficial effect of operation under the New License, though its magnitude is presently unknown.

Non-native plants are invading disturbed and undisturbed lands along the shoreline of the reservoir, and threaten the structure and function or ecological integrity of native plant communities. Disturbed lands along the shoreline provide a conduit for invasive non-native plants.

Cereal rye and reed canary grass (*Phalaris arundinacea*) were planted in the drawdown zone during the 1980s to reduce the problem of windborne dust. These attempts were not successful and the reed canary grass spread to the wetlands at the head of the lake, across the Stehkin road, and into the Little Boulder Creek floodplain. It has advanced to inland riparian areas and onto shoreline private property. In the shoreline deltas and islands where the land was cleared for the reservoir, but not inundated, reed canary grass has become the predominate plant cover. Now, it is invading along the Stehkin River, Little Boulder Creek, and other small tributaries that feed the lake in the drawdown zone.

A variety of native grasses, sedges, shrubs, willows, and trees are necessary to create a diverse, multi-stored riparian habitat. Propagation and planting of native vegetation is needed to restore or improve the species richness, structure, and function of the shoreline riparian areas. Assuming that an assortment of selected native plant species can out-compete reed canary grass,

Stehkin Area Implementation Plan

such planting will assist in controlling this exotic grass. It will also improve the habitat for wildlife species using the riparian zone. Based on photographs taken during spring dust events and GIS modeling, it appears that the revegetation of the shoreline will have little or no effect on wind speed on the flats.

Native Riparian Wildlife - NPS Management Policies and The Natural Resources Management Guidelines (NPS-77) provide management policies pertaining to native animal management.

NPS-75, "Natural Resources Inventory and Monitoring Guidelines," directs park units to inventory and monitor natural resources as a proactive protection measure. In 1998, Congress passed the National Parks Omnibus Management Act mandating a "program of inventory and monitoring of National Park system resources to establish baseline information and to provide information on the long-term trends in the condition of National Park system resources."

The Riparian Zone Investigation (DE&S, 2000) describes the Stehekin River area as being the most extensive, diverse, and structurally developed of any of the nine areas studied on Lake Chelan. According to the study, the Stehekin River has the highest mammal, bird, and amphibian species diversity, and the highest mammal and bird species abundance of the nine areas. It is also the only location where a zone of emergent vegetation was found.

The Project will continue to inundate the drawdown zone, although for significantly less of the year than occurs under the second license. Inundation causes areas in the drawdown zone to remain unsuitable as wildlife habitat for much of the annual cycle. During spring and early summer, rising water levels flood the nests of breeding waterfowl. The current water level cycle continues to inhibit the development or repair of riparian habitat by making water unavailable when needed and available at the wrong times. This effect will be present to a significantly lesser degree under the New License.

5.3 Management Actions for Problem Resolution

The areas of the reed canary grass infestation will be mapped using GIS/GPS technology. A preliminary examination of a GIS-generated map using aerial photography shows about 10 acres of private land and 12 acres of public land along the shoreline infested with reed canary grass. It also shows 12 acres of private land and seven acres of public land with some native riparian vegetation. About four of the seven acres of public land were initially cleared for the reservoir, but have never been completely inundated and offer a prime site to begin riparian rehabilitation. The amount of similar private land is unknown.

Efforts to rehabilitate native riparian vegetation on the deltas and islands at the head of Lake Chelan are expected to be aided by some initial earthwork (regrading) to fill small channels and stop water from entering these lands at the highest water levels. This is expected to improve the conditions for riparian plant survival and growth, increase the number of species for which these sites are suited, and deepen adjacent channels. This regrading will be planned for winter and spring during times of low water levels. The rehabilitation work should be combined with efforts to reduce the distribution of reed canary grass. Grass should be removed from within and adjacent to existing stands of native riparian vegetation to encourage the native riparian area to enlarge and improve its structure and function.

Stehekin Area Implementation Plan

The objective is to eventually connect isolated stands or islands of riparian vegetation to mimic a natural condition and provide a wildlife riparian habitat corridor. Control techniques for removing reed canary grass between riparian stands should include pulling, seedhead cutting, and mowing operations. It is expected that native riparian plants such as willow, red alder, black cottonwood, big-leaf maple, red osier dogwood, western red cedar, and various sedges can be propagated at the NPS native plant nursery and planted to assist in these efforts. To be most effective this work should be coordinated with erosion control efforts.

The objective is to recreate, where feasible, a multi-storied, multi-species native riparian vegetation corridor along the lakeshore at the head of Lake Chelan. To be most effective species of native trees and shrubs (from local genetic stock) should be propagated locally to preserve their genetic integrity, and then planted at designated locations, thereby improving, expanding, and connecting existing riparian vegetation. Deciduous plants are preferred because they provide forage and cover for wildlife.

Young native plants are usually developed sufficiently to transplant after they are two years old. One or more control techniques should be used upon the reed canary grass before the nursery plants are transplanted along the perimeter of, or within areas of, existing riparian vegetation. Care and maintenance of the young native plants will be necessary for at least two years. This should consist primarily of watering, weeding, fertilizing, and protecting from voles and deer damage until the young native plants become well established. Eventually, the shrubs and trees will shade-out the reed canary grass in their immediate vicinity.

This work should be performed on adjacent private lands wherever there is a willing owner. The Natural Resource Conservation Service, with the support of Chelan PUD and the NPS, may be able to obtain one or more grants to assist private property owners with labor, transplanting and maintenance expenses.

If herbicides are used, they should be non-residual and applied very selectively to control reed canary grass at the head of the lake to insure that no harm occurs to aquatic biota and water quality. Most herbicide brands that can be used near water state that they cannot be used within a half mile of potable water sources. Several valley residents live at the head of the lake, and residual herbicide use could affect residential water sources.

The NPS anticipates using an integrated pest management approach to contain and control invasive non-native plants within Lake Chelan National Recreation Area (Lake Chelan NRA). New invasions of non-native plants will be controlled quickly and aggressively to assure success, reduce environmental impacts, and keep future costs at a minimum.

5.4 Potential Obstacles and Solutions

Measuring success in reducing the amount of reed canary grass is anticipated to require monitoring throughout the New License period. The complete control of reed canary grass is unattainable. The strategy in this plan is intended to control reed canary grass, and thereby improve and expand the structure and function of native riparian habitat. Continual vigilance and control measures are necessary to assure that previous gains are maintained.

Stehekin Area Implementation Plan

It is anticipated that use of heavy equipment in the drawdown zone to excavate soil and place it onto the deltas and islands as an initial step for rehabilitating the native riparian plant community may require consultation with the SHPO on the recommended action and the appropriate permits from several agencies, including the U.S. Army Corps of Engineers, WDFW, and possibly the Washington Department of Ecology. The proposed revegetation work at other locations along the shoreline will require little, if any, soil disturbance and will be above the high water level, and will, therefore require fewer permits.

5.5 Timing of Management Actions

Actions during years 1-10 of the New License:

- Refine the GIS map of the drawdown zone to refine existing estimates of reed canary grass infestation and existing native riparian vegetation.
- Prioritize and select native riparian vegetation areas for future maintenance and improvement.
- Test the efficacy of the proposed management actions at selected sites.
- Collect and propagate selected native plants, particularly shrub and tree species as appropriate.
- Perform regrading of selected sites.
- Concentrate initially on planting native shrub and tree species because they may be competitive against reed canary grass infestation.
- Work from existing native riparian vegetation areas outward to enlarge their perimeter and area.
- Contain the reed canary grass by mowing, trimming seedheads, and pulling along the perimeter of existing native riparian vegetation. Chemical herbicides may not be used at the head of the lake.
- Work with private landowners to control reed canary grass and plant native herbaceous species, shrubs, and trees on their shoreline property.

Actions during the remaining years of the New License:

- Practice vigilant containment of reed canary grass for the remainder of New License.
- Continue annual planting of native plants to reach the 50 percent ground cover in goal 5a.
- Plant native riparian plants on sediment islands where LWD has been anchored in shallow water for permanent windbreaks and more erosion control of the flats area.

5.6 Cost Estimates

As defined in the Wildlife Habitat Plan (Chapter 9), Chelan PUD will provide funding on an annual basis for the riparian zone revegetation work outlined in this Chapter. Chelan PUD and the NPS anticipate that for the first several years of the New License period, funding needed for the riparian revegetation work will be greater than the stream of funds provided under the Wildlife Habitat Plan. The need for funds for this work is then expected to taper off to a smaller annual expenditure. Chelan PUD and the NPS also anticipate that the \$160,000 provided for tasks related to dust control will not be needed immediately for dust control. To address the cash flow problem related to riparian restoration work, the NPS will be allowed to "borrow" funds

Stehkin Area Implementation Plan

from the \$160,000 provided for other tasks in this Chapter and "repay" those funds later from the annual stream of funds defined in Chapter 9. The total cost of riparian zone revegetation to be paid by Chelan PUD shall not exceed the funds defined in Chapter 9.

Task	Timing / Interval	Unit cost	Total cost
Collect native plant material	First 5 years	100,000 cuttings or seeds @ 5 cents/each	\$5,000
Propagate native riparian plants	First 7 years for public lands	20,000 plants total 7 yrs @ \$5,700/yr	\$39,900
Regrading of deltas and islands	First 5 years	Lump sum estimate, incl. permits	\$20,000
Contain reed canary grass & other exotics	10 yrs (3-12), $\frac{1}{4}$ acre /day/GS-4 employee	(10yrs)x(8 wks/yr)x(2 people) x (\$450/wk)	\$72,000
Plant nursery stock	7 yrs. 150 plants/day /GS-4 employee	(7 yrs)x(2 wks/yr)x(2 people) x (\$450/wk)	\$12,600
Maintain rehab. sites	Years 1-12, 4 wks/yr	Included with exotic Plant containment	Included with exotic plant containment
Work with NRCS & private prop. owners	7 years, start in year 8	NRCS grant to assist property owners	NRCS grant
Project crew leader and tech. supervision	Crew leader, 10 yrs, 10 wks/yr	Crew leader @ 10 wks/yr @ \$750/wk	\$75,000
	Plant ecologist, yrs 1, 2, 3, 5, 10, and 20	Plant ecologist @ 4 wks/yr @ \$1,200/wk	\$28,800
TOTAL EST.			\$253,300

Assumptions: Crews work four 10-hour days per week, 8 day per 2-week pay period; there are two seasonal crew members for exotic plant control; the crew leader will be a GS-7 term appt. biological technician assisting the Stehekin resource manager (35% benefits); 20 acres of public lands along the shoreline require exotic plant control and planting native riparian vegetation; a similar 20 acres of private lands will be funded by NRCS grants other sources, and is not included in this budget; out-plant 1,000 shrubs and trees per acre; plant ecologist provides technical oversight; and the maintenance crew is two employees.

SECTION 6: MONITORING AND EVALUATION

6.1 Objectives

This plan anticipates monitoring will be performed by NPS as appropriate to document progress in meeting goals 3 through 6 described in section 2.

In addition, Chelan PUD will perform monitoring for the purpose of providing information about ongoing changes at the mouth of the Stehekin River.

- Chelan PUD will monitor topographical changes in the lower Stehekin River channel during the period of the New License, as defined below.
- NPS plans to monitor the concentration of TSP blown into Stehekin Landing once every five years until the measurable objective is met.

Stehkin Area Implementation Plan

- NPS plans to monitor environmental effects of LWD placed in the drawdown zone.
- NPS plans to monitor the species richness, abundance, and distribution of native riparian vegetation and invasive non-native plants at the head of Lake Chelan.
- NPS plans to monitor the species richness and abundance of native vertebrate wildlife using riparian habitats at the head of Lake Chelan, using the methods from the DE&S study (2000).
- NPS plans to measure wildlife community patterns (total functional diversity, functional richness, and functional redundancy) and functional responses of communities (resilience, resistance, and attenuation).

Of the objectives listed above, only the first two are measurable as defined.

6.2 Description of the Resource Problem

Resource problems related to dust and native and non-native riparian plants are explained in sections 4.2 and 5.2, respectively. Explanations of resource problems related to other items to be monitored are provided in section 6.3, below.

6.3 Management Actions for Problem Resolution

Monitoring Stehekin River Channel - Chelan PUD will perform monitoring of topographical changes in the lower Stehekin River channel during the period of the New License. This monitoring will include the following:

- Up to five re-surveys of up to seven cross-sections will be performed by a licensed professional surveyor under contract to Chelan PUD. The surveying will be done at times of low flow, probably October. Surveying will follow flood events selected jointly by the NPS and Chelan PUD. Sections to be monitored are 1H, 2, 4, 5, 11, 13, and 18, from Evaluation of the Backwater Hydraulic Profile of the Lower Stehekin River (Chelan PUD, 2001).
- Chelan PUD engineers will prepare two-dimensional hydraulic models, including existing measurements and updated survey results.
- Chelan PUD staff will make arrangements for aerial photographs of the Stehekin River mouth and flats. Photographs will be taken at five to 10 year intervals during times of low lake level.
- Copies of all results will be provided to the NPS.

The purpose of the monitoring program is to provide topographical and photographic data, and computer model results to aid in documenting any long-term trends of change in the river channel. The program is expected to complement other data collection by the NPS. It is not expected to provide an understanding of all significant processes at work in the lower Stehekin River, or to allow for separation of effects of the lake level from effects of other significant influences known to be active in the area as noted in the existing analysis (Chelan PUD, 2001).

Monitoring Airborne Dust - The NPS plans to perform periodic monitoring of airborne dust at Stehekin Landing. The indicator to be used to determine the extent of success of dust abatement work is the product of the duration of dust events and the mass concentration of TSP. The NPS plans to conduct TSP monitoring on the roof of the cabana at Stehekin Landing, where the air

Sthekin Area Implementation Plan

quality monitoring equipment was located in 2000. A remote weather station should be placed with the TSP sampler to document weather conditions associated with dust events, including wind speed and direction, temperature, and humidity. The Particle and Visibility Monitoring Data Analysis Report (ARS, 2001) will serve as the baseline for comparing levels of TSP. Key data from that report are summarized in the table, below.

This plan anticipates monitoring will occur once every five years from mid-March to mid-June, using a high volume TSP sampler or other equipment that provides comparable results. The objective is to reduce the airborne dust by 25 percent in the first 10 years, and an additional 25 percent in the second 10 years, as explained under the Fugitive Dust section of this Chapter. The percent reduction achieved is calculated by comparison of a year's average product (TSP times duration) measured during dust events with the comparable number based on measurements from the 2000 monitoring period stated in the report noted above (ARS, 2001). The minimum and maximum durations and mass concentrations will also be analyzed for significant changes.

Dust Event Date (day)	Approx. Duration (hours)	TSP Mass conc. ($\mu\text{g}/\text{m}^3$)	Product: (TSP x Duration)	Lake Elevation (feet)
03/28/00	6.50	376.9	2450	1088 1
04/19/00	4.25	332.2	1412	1088 4
04/22/00	7.75	132.5	1027	1088 8
05/03/00	4.25	68.5	291	1089 6
05/05/00	8.25	69.6	574	1089 7
05/10/00	4.50	44.9	202	1090 0
05/16/00	8.75	52.4	459	1090 1
05/17/00	11.50	82.0	943	1090 4
05/21/00	7.25	93.9	681	1091 0
05/22/00	5.00	36.9	185	1091 4
Averages	6.80	129.0	822	1089 8

References: Table 4-2, Event Particulate Data, page 4-4; Table 4-3, Particulate Data Recovery and Mass Concentration Statistics, page 4-5; and Table 5-2, Summary of Parameters for Event Sampling Days, page 5-11; Stehekin, Washington, March 15 to June 12, 2000.

The NPS and Chelan PUD understand that the monitoring may be influenced by random variations between years in weather, lake level cycle, and possibly other factors. Also, a certain degree of judgment will have to be exercised to decide whether developing conditions merit monitoring as a dust event, and to determine its starting and ending times. Annual variations and the small amount of subjectivity required are unavoidable, and should be considered in evaluating results.

Monitoring LWD - The NPS plans to assess the environmental effects of placing LWD in the drawdown zone, once every 10 years for the duration of the New License period.

Stehkin Area Implementation Plan

Monitoring Native and Non-Native Plants - The NPS plans to monitor the success of efforts to establish native riparian plants and remove non-native plants. The Riparian Zone Investigation by DE&S will serve as the baseline, and as a guide for methods of monitoring vascular native and non-native plants. The data collected should describe the riparian plants currently present per site, including species composition, basal area of trees, shrubs, forbs and grass densities, and cover. The native riparian plants used for the rehabilitation effort should be monitored biannually. Mortality, plant condition, percent of browse, and signs of disease should be documented.

The effectiveness of removal of reed canary grass and other non-natives should also be monitored as part of this plan. The monitoring should document the areas of successful removal and the extent of the non-natives in the Project area. Monitoring should consist of measurement of areal extent. Reed canary grass shows up well in aerial photos, especially when it has changed to autumn gold. Currently, the infestation is one continuous area with several satellite patches adjacent to the large patch.

Monitoring Native Raptors - The riparian vegetation and wildlife habitat portions of this plan and the Fisheries Management Plan may affect Osprey (*Pandion haliaetus*) and Bald Eagle (*Haliaeetus leucocephalus*) recovery at the head of Lake Chelan. Specific NPS concerns are the existence today of only one nesting pair per species. The cause of their decline is unknown, but regionally declines have been attributable to high contaminant levels from pesticides and herbicides, and changes in their prey base. These raptors may serve as key indicators of the overall ecological 'health' or condition of Lake Chelan and its tributaries. For this reason, the NPS plans to monitor the demography (nest site occupancy and productivity) of osprey and bald eagles, and also explore the possibility of taking occasional blood samples to coincide with the existing monitoring of contaminants in osprey along the Columbia River and in British Columbia.

Osprey historically nested within the Stehekin Valley, but no pairs are known to have nested there since 1985. In 1999, an osprey pair successfully raised young at a nest near Castle Creek along the west shore of Lake Chelan, within the Lake Chelan NRA. The causes of the disappearance of nesting osprey in the Stehekin Valley are unknown.

Bald Eagles are not known to have attempted nesting in Lake Chelan NRA since its designation as a park unit in 1968; however, in 2001, a pair of eagles produced one eaglet within the Stehekin Valley near Weaver Point, and it fledged successfully.

Monitoring Native Riparian Wildlife: The Riparian Zone Investigation (DE&S, 2000) will serve as the baseline, and as a guide for methods used to monitor vertebrate species (breeding bird, small mammal, bat, amphibian, and reptile). Ninety-two species of birds were documented, ten species were considered Priority Species by the Washington Department of Fish and Wildlife, and three species were Federal Species of Concern. Of the nine tributaries sampled, the Stehekin River had the most waterbird species and best riparian habitat for breeding birds.

*Stehkin Area Implementation Plan***6.4 Timing of Management Actions**

The NPS plans to monitor wildlife populations at riparian habitat restoration sites for two consecutive years at Years 10-11, 20-21, and 40-41 of the New License. The NPS plans to monitor osprey and bald eagle demography annually for the life of the New License.

6.5 Cost Estimates

- Monitor Stehekin River channel. \$90,000
- Monitor fugitive dust at Stehekin Landing. \$15,000
- Monitor environmental effects of Large Woody Debris. \$50,000
- Provide sufficient riparian resource baseline information. \$10,000
- Monitor native riparian vegetation and non-native plants. \$15,000
- Monitor wildlife in drawdown zone (richness and abundance). \$90,000

Chelan PUD will monitor the Stehekin River channel, as described, for a cost not to exceed \$90,000, and will provide to the NPS \$3,000 each five years of the New License term for fugitive dust monitoring, until control efforts are successful, as described above. Funding for other monitoring tasks will be provided as outlined in the Wildlife Habitat Plan (Chapter 9).

Monitoring Task	Timing / Interval	Unit Cost	Total Cost
Stehekin River	Approx. each 10 years	n/a	\$90,000
Sedimentation	as specified in plan		
Airborne Dust	At 5 year intervals, 25-year minimum*	\$3,000	\$15,000
Effects of LWD	10-year interval	\$10,000	\$50,000
Collect baseline data	Year one	\$10,000	\$10,000
Native Riparian	Annually for 3 years, then 5-year interval	\$2,000 + \$1,000	\$15,000
Vegetation			
Exotic Plants	5-year interval	\$2,000	Included above.
Osprey & Bald Eagles	Annually	\$1,000	\$50,000
Riparian Wildlife	Years 10, 11, 20, 21, 40, and 41	\$15,000	\$90,000
TOTAL			\$320,000

*If the objective is not met in the first 25 years, monitoring may continue.

SECTION 7: RESPONSIBILITIES

This plan describes Chelan PUD and NPS management activities related to the Stehekin area. As described in this Chapter, Chelan PUD is responsible only for funding and/or implementing specific items under this plan. An itemization of Chelan PUD's responsibilities follows:

- Chelan PUD shall make available \$160,000 to address dust control, and monitoring and related efforts planned to be implemented by the NPS. The \$160,000 includes:

Stehkin Area Implementation Plan

- The \$100,000 commitment for dust abatement (section 4.7);
 - The \$45,000 to be provided on an as needed basis for additional dust abatement or monitoring efforts (section 4.7);
 - The \$15,000 for monitoring and evaluation of dust abatement efforts (section 6.5)
- Chelan PUD will monitor the Stehekin River channel for a cost not to exceed \$90,000 (section 6.5)

Chelan PUD's commitments for riparian revegetation are referenced in section 5.6, but funds are provided as defined in Chapter 9 of the Comprehensive Plan.

SECTION 8: CONCLUSIONS

The Stehekin Area Implementation Plan contained in this Chapter integrates airborne dust abatement, riparian vegetation rehabilitation, non-native plant control, and riparian wildlife habitat rehabilitation. There is a monitoring component to help assess the efficacy of these management actions, and to evaluate whether the desired future condition is being reached within the time frame and funds allotted.

Portions of this plan anticipated to be carried out by NPS may be changed as necessary by NPS in consultation with Chelan PUD, as a result of monitoring program review, recommendations, and refinements. Portions of this plan anticipated to be carried out by Chelan PUD may be changed as necessary by Chelan PUD in consultation with NPS, as a result of monitoring program review, recommendations, and refinements. Any modification of License Article 4 shall require the approval of the NPS and Chelan PUD.

SECTION 9: LITERATURE CITED

Air Resource Specialists, Inc., (ARS). 2001. Particle and visibility monitoring data analysis report, Stehekin, Washington. Prepared by ARS, Fort Collins, Colorado. Prepared for Chelan PUD and the U.S. Department of the Interior, National Park Service. January 10, 2001. 192 pp.

Chelan PUD. 2001. Evaluation of the backwater hydraulic profile of the lower Stehekin River - final. Lake Chelan Hydroelectric Project No. 637. Chelan PUD, Wenatchee, Washington. January 15, 2001. 166 pp.

Duke Engineering and Services (DE&S). 2000. Riparian zone investigation – final, Lake Chelan Hydroelectric Project No. 637. Prepared by DE&S, Bellingham, Washington. September 26, 2000. 230 pp.

***CHAPTER 5: SURVEY MONUMENT LOCATION AND RE-
ESTABLISHMENT PLAN***

*Survey Monument Location
and Re-establishment Plan*

TABLE OF CONTENTS

CHAPTER 5: SURVEY MONUMENT LOCATION AND RE-ESTABLISHMENT PLAN5-1

SECTION 1: Introduction.....	5-1
SECTION 2: Implementation Plan and Schedule.....	5-1
SECTION 3: Descriptive List of Corners for Lake Chelan.....	5-1

*Survey Monument Location
and Re-establishment Plan*

SECTION 1: INTRODUCTION

In carrying out surveying work around Lake Chelan, USDA Forest Service surveyors and others have noted some difficulty in locating survey control monuments at various locations near the lake. Some monuments may not have been relocated during Project development, and are now inaccessible due to the typically higher lake level. Others may have been destroyed by human activity following Project development or by erosion or other processes, natural or Project-related. The purpose of this Chapter is to provide for location and, where necessary, re-establishment of these monuments to support USDA Forest Service land management activities in the vicinity of the Project.

SECTION 2: IMPLEMENTATION PLAN AND SCHEDULE

Chelan PUD will make available funding to the USDA Forest Service of up to \$80,000 for survey work to locate, re-establish where necessary, and document the survey monuments listed below. This work will be performed by a licensed professional surveyor under the direction of the USDA Forest Service. An effort will first be made to locate each monument and associated reference points. Where a monument cannot be located, the surveyor will re-establish the survey monument and document the location in accordance with standard and accepted practice and USDA Forest Service guidelines.

Work under this plan will be initiated by the USDA Forest Service within 10 years of the effective date of the New License, and will be completed within two years of initiation.

SECTION 3: DESCRIPTIVE LIST OF CORNERS FOR LAKE CHELAN

1. Meander Corner Section 3 and 34, T.28 & 29 N. R.21 E., S.E. of Mitchell creek on east side of lake
2. Meander Corner Section 4 and 33, T.28 & 29 N. R.21 E., S.W. of Mitchell creek on west side of lake.
3. Meander Corner Section 28 and 29, T.29 N. R.21 E., N.W. of Fields point on S.W. side of lake.
4. Meander Corner Section 27 and 28, T.29 N. R.21 E., S.E. of Gold Creek on N.E. side of lake.
5. Meander Corner Section 21 and 28, T.29 N. R.21 E., S.E. of Gold Creek on N.E. side of lake.
6. Meander Corner Section 20 and 21, T.29 N. R.21 E., N.W. of Poison Creek on North side of lake.

*Survey Monument Location
and Re-establishment Plan*

7. Meander Corner Section 19 and 20, T.29 N. R.21 E., East of 25 Mile Creek on South side of lake.
8. Meander Corner Section 18 and 17, T.29 N. R.21 E., N.W. of Poison Creek on North side of lake.
9. Meander Corner Section 13 and 18, T.29 N. R.20 & 21 E., West of Grade Creek on North side of lake.
10. Meander Corner Section 12 and 13, T.29 N. R.20 E., N.W. of Grade Creek on North side of lake.
11. Meander Corner Section 23 and 24, T.29 N. R.20 E., N.W. of 25 Mile Creek on South side of lake.
12. Meander Corner Section 10 and 11, T.29 N. R.20 E., East of Deer Point on North side of lake.
13. Corner #3, Meander Corner, Homestead Entry Survey 55, Section 5, T.30 N. R.19 E., at Canoe Creek, on East side of lake.
14. U.S. Land Monument #55, a part of Homestead Entry Survey 55, Section 5, T.30 N. R.19 E., at Canoe Creek, on East side of lake.
15. Corner #1, Meander Corner, Homestead Entry Survey 55, Section 5, T.30 N. R.19 E., at Canoe Creek, on East side of lake.
16. Meander Corner Section 19 and 30, T.31 N. R.19 E., N.W. of Rattlesnake Creek on East side of lake.
17. Meander Corner Section 18 and 19, T.31 N. R.19 E., near Rex Creek on East side of lake.
18. Meander Corner Section 13 and 18, T.31 N. R.18 & 19 E., near Pioneer Creek on East side of lake.
19. Meander Corner Section 12 and 13, T.31 N. R.18 E., N.W. of Cascade Creek on North side of lake.
20. U.S. Land Monument #4, a part of Mineral Surveys in section 3, T.31 N. R.18 E., N.W. of Meadow Creek, on North side of lake.
21. Corner #6 Happy Thought Fractional Lode, Mineral Survey 705, in section 3, T.31 N. R.18 E., N.W. of Meadow Creek, on North side of lake.
22. Corner #3 Happy Thought Fractional Lode, Mineral Survey 705, in section 3, T.31 N. R.18 E., N.W. of Meadow Creek, on North side of lake.
23. Corner #4 Omega Fractional Lode, Mineral Survey 705, in section 3, T.31 N. R.18 E., N.W. of Meadow Creek, on North side of lake.
24. Corner #2 Lighting Lode, Mineral Survey 1087A, in section 5, T.31 N. R.18 E., At Lighting Creek, on West side of lake.
25. Corner #1 Lighting Lode, Mineral Survey 1087A, in section 5, T.31 N. R.18 E., At Lighting Creek, on West side of lake.
26. Meander Corner Section 20 and 21, T.32 N. R.18 E., South of Hunts Creek, on East side of lake.

***CHAPTER 6: LAKE CHELAN COMPREHENSIVE
FISHERY MANAGEMENT PLAN***

*Lake Chelan Comprehensive Fishery Management Plan***TABLE OF CONTENTS****CHAPTER 6: LAKE CHELAN COMPREHENSIVE FISHERY MANAGEMENT PLAN 6-1**

SECTION 1: Introduction.....	6-1
SECTION 2: Comprehensive Fishery Management Plan Goals	6-2
SECTION 3: Fish Species in Lake Chelan.....	6-4
3.1 Westslope Cutthroat Trout	6-4
3.2 Rainbow Trout.....	6-5
3.3 Kokanee.....	6-6
3.4 Landlocked Chinook Salmon	6-7
3.5 Bull Trout	6-9
3.6 Lake Trout	6-10
3.7 Burbot.....	6-11
3.8 Smallmouth Bass.....	6-12
3.9 Eastern Brook Trout	6-12
3.10 Other Native Fish Species	6-13
3.11 Other Non-native Introductions.....	6-13
SECTION 4: Implementation	6-13
4.1 WDFW	6-14
4.2 USDA Forest Service	6-14
4.3 NPS	6-15
4.4 USFWS	6-15
4.5 LCSA.....	6-15
4.6 Chelan PUD.....	6-15
SECTION 5: Monitoring and Evaluation Program.....	6-18
SECTION 6: Literature Cited	6-20

Lake Chelan Comprehensive Fishery Management Plan

LIST OF TABLES

Table 6-1: Information on Trout Populations, Habitat Availability and Potential Migration Barriers for Selected Tributaries to Lake Chelan (excluding the Stehekin system).....	6-16
---	------

LIST OF FIGURES

Figure 6-1: Lake Chelan Hydroelectric Project Area.....	6-3
---	-----

Lake Chelan Comprehensive Fishery Management Plan

SECTION 1: INTRODUCTION

The relicensing of the Lake Chelan Hydroelectric Project brought fishery Agencies together in a forum that provided an opportunity for comprehensive review of current and future management priorities for Lake Chelan fisheries. Representatives from various stakeholders in the relicensing process formed the Natural Sciences Working Group (NSWG), principally NOAA Fisheries, the WDFW, the USFWS, the USDA Forest Service, the NPS, the WDOE, the Lake Chelan Sportsman's Association (LCSA), the City of Chelan, the People for Lake Chelan, and Chelan PUD. These stakeholders used the relicensing process as an opportunity to develop a Comprehensive Fishery Management Plan (CFMP) for Lake Chelan, now contained in this Chapter. For more information on Lake Chelan fisheries and management alternatives, see Viola and Foster (2002).

The WDFW has primary responsibility for fishery management in Lake Chelan, as provided under RCW 77.04.012. However, other stakeholders have significant roles in managing the Lake Chelan fishery. These include:

- The USDA Forest Service, as a manager of large tracts of land adjacent to Lake Chelan, and of tributaries to the Lake, has fishery management responsibilities regarding habitat.
- The NPS manages the natural resources of the national parks in accordance with NPS-specific statutes, including the National Park Service Organic Act and the National Parks Omnibus Management Act of 1998. In addition, it is bound by general environmental laws, such as the Clean Air Act, the Clean Water Act, the Endangered Species Act of 1973, NEPA, the Wilderness Act, relevant Executive Orders, and applicable regulations.
- The USFWS, particularly through the Endangered Species Act, has an interest in the restoration of Westslope cutthroat and bull trout to the Lake Chelan watershed
- The WDOE has responsibility for maintaining water quality and quantity
- Native American tribes, especially the Yakama Nation, are interested in exploring the feasibility of introducing sockeye salmon into Lake Chelan.
- LCSA seeks to protect and maintain a viable sport fishery on the lake. To support this effort, it seeks cooperative efforts with other stakeholders to educate sport fishers. It also contributes funds and volunteer labor for stocking and habitat improvement efforts.

The responsibilities of various resource managers and others currently involved in managing some portion of Lake Chelan waters and/or its tributaries, biological resources, and surrounding lands sometimes overlap or conflict with one another. A major objective of the CFMP is to coordinate the plans and actions of these stakeholders in developing and implementing fishery management measures in Lake Chelan.

Lake Chelan Comprehensive Fishery Management Plan

SECTION 2: COMPREHENSIVE FISHERY MANAGEMENT PLAN GOALS

The CFMP is designed to: 1) provide guidance for the management of the fishery resources in Lake Chelan; 2) maintain a healthy recreational sport fishery in Lake Chelan; 3) and develop a monitoring and evaluation program to assess the efficacy of management actions.

It describes a set of proposed management actions for each species currently inhabiting Lake Chelan, and a process for developing a monitoring and evaluation program, which will ultimately lead to the development of specific species management goals and objectives. The CFMP will be reviewed on a periodic basis to allow for planning and future adjustments over the term of the license.

The primary management objectives of the CFMP for Lake Chelan are to:

1. Emphasize restoration/enhancement of native species, where feasible;
2. Support the recreational sport fishery;
3. Manage the lake elevation to enhance tributary production and recreation (see section 3.1 and Figure 1);
4. Determine compatibility of management actions with potential future bull trout re-introduction;
5. Develop a monitoring and evaluation program that provides flexibility for future changes (see section 5).
6. Monitor and address entrainment of fish from Lake Chelan into the Project intake per section 4.6.4.

The Lake Chelan Hydroelectric Project Area is shown in Figure 6-1.

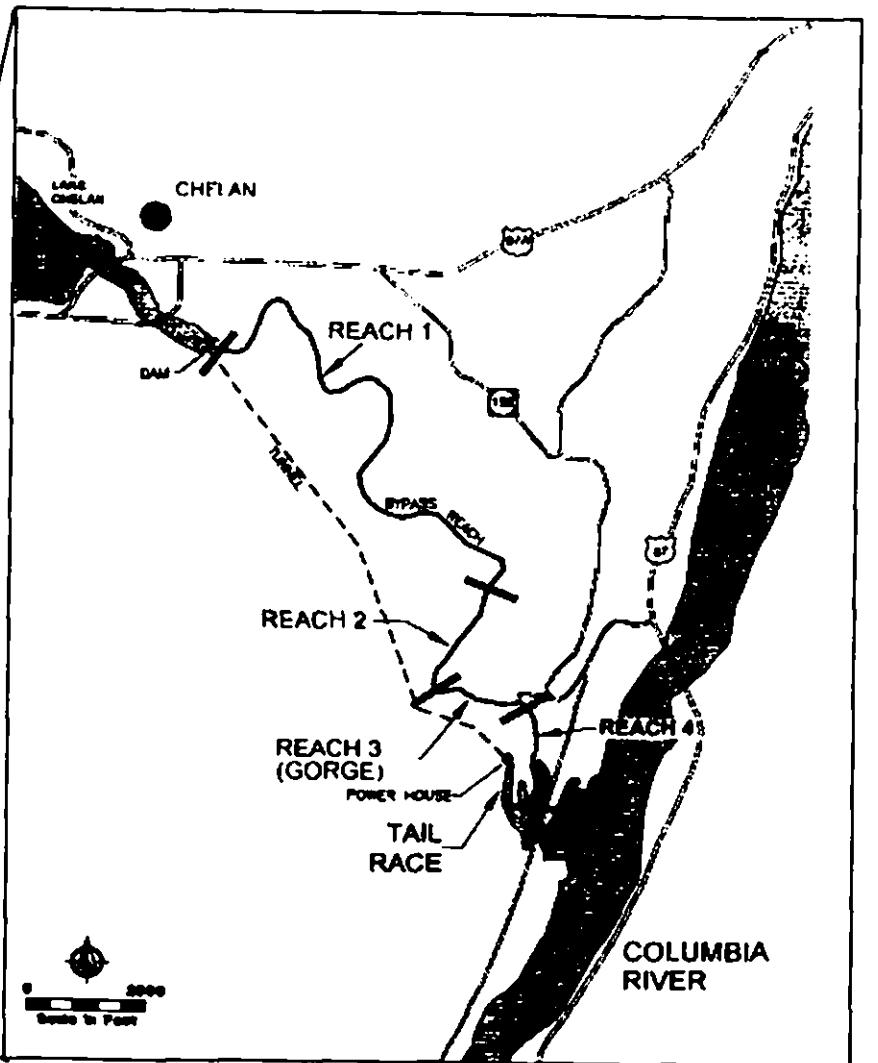
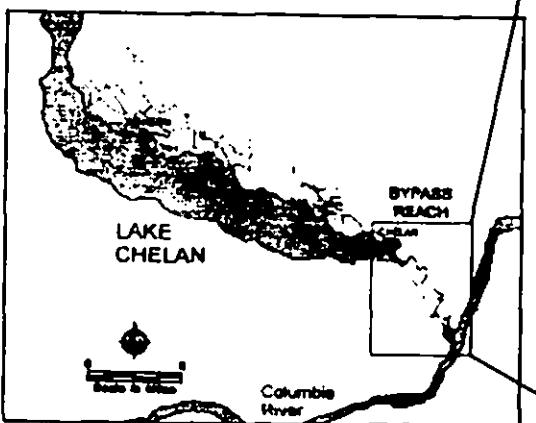
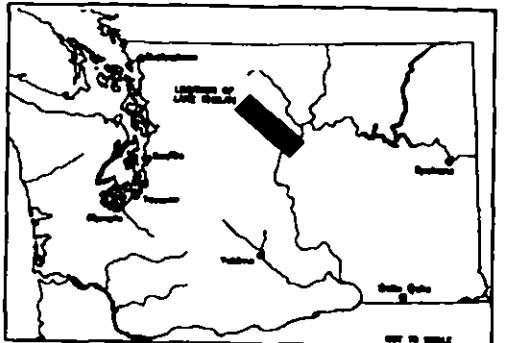


Figure 6-1: Lake Chelan Hydroelectric Project Area

Lake Chelan Comprehensive Fishery Management Plan

SECTION 3: FISH SPECIES IN LAKE CHELAN

The CFMP is based on relicensing studies that were conducted in 1999, 2000, and 2001 to determine the current status of fishery resources in Lake Chelan. The studies investigated: (1) sport catch through a creel survey; (2) the incidence of barriers to upstream spawning migration in lake tributaries; (3) timing of fry emergence; (4) tributary spawning and rearing habitat availability; (5) tributary fish populations; (6) limnological conditions; (7) habitat availability, fish species and use, and recreational fishing in the Stehekin River; and (8) the role of large woody debris (LWD). Much of the relicensing work repeated studies conducted by Brown (1984), so that current conditions could be compared with conditions that existed in 1982 and 1983.

This section provides an overview of the history and significance of each Lake Chelan fish species, and then lists the management issues considered important by one or more fishery agencies or organizations regarding that species. Alongside each issue is the acronym identifying the agency or organization that raised that issue. Following the issue list for each species is a list of management recommendations regarding that species, based on areas of agreement among all of the Agencies and organizations participating in the development of the CFMP. These management recommendations form the starting point for implementation of the CFMP. Based on the monitoring and evaluation program created by the CFMP, it is expected that modifications will be made to these management recommendations over the course of the license period. The Lake Chelan Fishery Forum (LCFF), consisting of most of the same Agencies and organizations that helped develop the CFMP, will be responsible for making those recommendations (section 4).

Although the CFMP was developed as part of the Lake Chelan relicensing process, it is important to note that ultimate authority for fishery management activities on Lake Chelan rests with each of the relevant resource agencies. Agency authorities and obligations regarding the CFMP are outlined in sections 4.1 through 4.4. Chelan PUD's obligations regarding implementation of specific items are detailed in section 4.6.

3.1 Westslope Cutthroat Trout

Few Westslope cutthroat trout (WSCT) were captured during relicensing studies, either in the creel survey or tributary investigations (DES 2000). The few WSCT caught in the creel survey indicates that the current juvenile WSCT stocking effort, approximately 90,000 annually from 1980 to 1999, is not contributing to the WSCT population in the Chelan Basin. Tributary trout populations estimated during relicensing studies, particularly WSCT, are lower than those estimated by Brown (1984). Barriers to upstream spawning migration were identified in most tributary mouths investigated (DES 2000). Barriers identified were in the form of depth, gradient, and/or velocity barriers. The NSWG concluded that these barriers were created as a result of Project operations since 1981 (when the second license was issued), and are, most likely, contributing to trout population decline in the Lake Chelan tributaries. The fishery Agencies have stated a strong desire to restore native species in the Chelan Basin, particularly

Lake Chelan Comprehensive Fishery Management Plan

WSCT, as part of the relicensing process. Local community representatives have also stated a strong desire to maintain the existing recreational trout fishery.

Primary Issues Raised by Stakeholders

- Phase out rainbow trout (RBT) stocking - WDFW, USDA-FS, LCSA, NPS
- Re-establish/supplement tributary populations where suitable – USDA-FS, WDFW
- Maintain present angling restrictions for WSCT - USDA FS, NPS, WDFW
- Restrictive harvest of WSCT until population rebuilds – USDA-FS, NPS, WDFW
- Manage water levels to optimize spawning, incubation and rearing - NPS, USDA-FS, WDFW
- Monitor levels of hybridization between WSCT and rainbow trout - NPS, WDFW
- Minimize loss from entrainment/spills - NPS, LCSA, WDFW
- Support habitat enhancement - WDFW
- Delay stocking until spill completed - LCSA
- Develop a monitoring and evaluation program - WDFW, USDA-FS, LCSA, NPS

Management Recommendations

1. Over a four-year period, with careful monitoring and evaluation, replace the current allotment of 100,000 rainbows with increasing proportions of Twin Lakes WSCT until only WSCT are stocked. WSCT from Twin Lakes, Washington, is the preferred donor stock because WSCT from Lake Chelan were planted in Twin Lakes in the early 1900s. Thus, Twin Lakes WSCT are genetically very similar to the WSCT that originally inhabited Lake Chelan.
2. Eliminate, immediately, stocking of rainbow trout in high lakes and tributaries of the Chelan watershed.
3. Move toward stocking WSCT of Twin Lakes origin. Accomplish through:
 - stocking catchable-size Twin Lake WSCT
 - planting Twin Lake WSCT eyed eggs in tributaries
 - maintain recreational trout fishery with Twin Lake WSCT
 - fish management needs of Lake Chelan will take priority over other waters throughout the state in the allocation of Twin Lake WSCT eyed eggs
 - locate an alternative source of Twin Lakes WSCT or other stocks of WSCT to be used in other waters throughout the state.
4. Manage lake water levels and conduct mechanical barrier removal to provide tributary access for spawning, incubation, and rearing.
5. Develop a monitoring and evaluation program to assess the efficacy of management actions.
6. Close fishing season at mouths of lake tributaries to protect spring spawning adult salmonids until the WSCT population recovers.
7. Delay stocking of catchable WSCT until after spill is terminated, to allow stocked fish to survive the winter in the lake, return to Lake Chelan tributaries to spawn, and contribute to natural reproduction.

3.2 Rainbow Trout

Rainbow trout have been stocked in Lake Chelan since the early 1900s (DES 2000). Recent stocking efforts, since 1990, have been conducted to make up for a shortfall in kokanee

Lake Chelan Comprehensive Fishery Management Plan

production, and to support a recreational fishery in the Wapato Basin of Lake Chelan. However, it has been well documented in other systems that introduction of rainbow trout has detrimental effects on WSCT populations, due to competition and hybridization. The NSWG concluded that reducing, and eventually eliminating, rainbow trout stocking would be an important step in restoring WSCT populations in the Chelan Basin.

Primary Issue Raised by Stakeholders

- Phase out rainbow trout stocking - WDFW, USDA-FS, LCSA, NPS

Management Recommendations

1. Over a four-year period, with careful monitoring and evaluation, replace the current allotment of 100,000 rainbow trout with increasing proportions of Twin Lakes WSCT until only WSCT are stocked.
2. Eliminate, immediately, stocking of rainbow trout in high lakes and tributaries in the Chelan Basin, and in the Lucerne Basin of Lake Chelan.
3. Investigate feasibility of stocking triploid rainbow trout to support recreational fishery if fish in addition to WSCT are needed.

3.3 Kokanee

Kokanee are the most popular recreational fish in Lake Chelan (DES 2000). Recreational fishers have indicated a strong desire to maintain the size and number of fish at current levels. Spawning surveys conducted in recent years show that the Lake Chelan kokanee population is as high or higher than historical numbers (Fielder 2000). Expanding kokanee populations in the Stehekin River are a growing concern among NPS managers, particularly in light of continued stocking. Major NPS and USFWS concerns regarding kokanee include impacts to native fish and invertebrate communities, alteration of natural nutrient levels in the Stehekin system, bear/human interactions related to use of kokanee carcasses as a food source, changes in the distribution of other wildlife species that feed on kokanee carcasses or derive benefits from enhanced nutrient levels related to carcass decomposition, and transfer of metals and pesticides from the lake to the Stehekin River via movement of the large numbers of kokanee into the river.

The NSWG recognized the need to re-evaluate the effectiveness of kokanee and landlocked chinook stocking in light of the potential biological benefits (i.e. WSCT establishment; increased kokanee survival) that will result from the discontinuation of lake trout stocking in the lake. However, population objectives and methods for monitoring population size, species interactions, competition, and other factors first need to be developed for Lake Chelan for all species.

Lake Chelan Comprehensive Fishery Management Plan

Primary Issues Raised by Stakeholders

- Conduct annual spawning ground surveys - WDFW, NPS
- Adjust stocking numbers to balance population with other species - WDFW
- Develop Lake Chelan strain of kokanee for planting - WDFW, USDA-FS
- Adjust stocking methods: scatter release from barge - WDFW, LCSA
- Remove 25 Mile Creek barrier and rehabilitate spawning channel - WDFW, USDA-FS, LCSA
- Remove tributary mouth barriers - WDFW, USDA-FS
- Develop population management objective compatible with recovery/protection of native species - NPS, USDA-FS, WDFW
- Supplement population if objective is not met, and only if it can be shown that stocking increases population - NPS, USDA-FS, WDFW
- Improve tributary habitat - USDA-FS
- Rely on natural production - USDA-FS
- Manage as principal sport fish species - USDA-FS
- Delay stocking until spill is completed - LCSA
- Reduce predation loss by discontinuing stocking of lake trout - NPS, WDFW
- Balance chinook and kokanee abundance to provide an optimal number of kokanee of an acceptable size and as many salmon as needed for this balance -WDFW, USDA-FS, LCSA
- Minimize loss from entrainment/spills - NPS, LCSA
- Develop monitoring and evaluation program - WDFW, USDA-FS, LCSA, NPS

Management Recommendations

1. The first priority of the LCFF is to develop an Interim Stocking Plan for all species stocked in Lake Chelan and its tributaries, with particular emphasis on addressing the issue of stocking kokanee. It is expected that this Interim Stocking Plan will remain in place until the monitoring and evaluation program can be implemented, thereby providing better information upon which to make longer term management decisions.
2. Develop population size objectives compatible with recovery and protection of native fish species, and compatible with NPS management goals for the Stehekin River.
3. Monitor population:
 - stock when a population declines below the established population objective use locally adapted or "naturalized" Lake Chelan stock for supplementation, instead of Kootenai or Whatcom stocks
 - maintain a recreational kokanee fishery
 - develop a monitoring and evaluation program to assess the efficacy of management actions, particularly whether the stocking of kokanee increases the kokanee population in the lake, and whether it increases the kokanee spawning population in the Stehekin basin.
4. Stocked fish should be released after spill has stopped (September/October).

3.4 Landlocked Chinook Salmon

Landlocked chinook salmon are considered the trophy fish in Lake Chelan. Landlocked chinook supported a very strong recreational and commercial (guided) fishery in the late 1980s and early 1990s. The LCSA depends heavily on the annual Chinook Derby on Lake Chelan to raise funds

Lake Chelan Comprehensive Fishery Management Plan

for implementing fishery enhancement projects in the Lake Chelan basin. Additionally, the Chinook Derby is a significant economic event for the community of Chelan, as it draws participants from all parts of Washington and adjoining states. The LCSA and the Chelan community strongly desire to rebuild the chinook fishery and maintain the annual Chinook Derby.

Conversely, the NPS and USFWS believe that chinook, like kokanee, lake trout, and rainbow trout have been stocked in Lake Chelan in spite of continuing declines in native fish populations, and without careful evaluation of primary and secondary trophic level impacts. The NPS and USFWS believe that the LCFF should develop an Interim Stocking Plan, which would remain in effect until the effects of stocking can be further evaluated.

The population of chinook has declined over the past several years, according to harvest statistics (DES 2000). The NSWG examined many possible causes of decline, such as low survival of stocked fish, low natural reproduction, changes in race/deme of stocked fish, changes in rearing conditions of stocked fish, smolt emigration from the lake, and excessive harvest. As with other Lake Chelan species, an important part of the CFMP is development of a monitoring and evaluation program to assess species interactions and the affects of management actions.

Primary Issues Raised by Stakeholders

- Rear 19-20 months prior to release - WDFW, LCSA
- Release no earlier than mid to late September (after spill terminated) - LCSA
- Stock identified spawning areas with eyed eggs - WDFW, LCSA
- Reduce daily limit - WDFW, LCSA
- Experiment with different stock - WDFW
- Employ coded wire tag (CWT), ventral clip - WDFW
- Balance kokanee and chinook population - WDFW
- Reduce stocking of chinook by 50 percent - USDA-FS
- Limit future stocking to triploid chinook only - WDFW, NPS, USDA-FS
- Collect data on species interactions during the monitoring and evaluation period (perhaps 5 yrs.), and then use the results as the basis for future management decisions - USDA-FS, WDFW, NPS
- Allow natural production to sustain fishery long-term - USDA-FS
- Significantly reduce stocking until evaluation of impacts to native species is completed - NPS
- Monitor natural production and evaluate effects on native fish - NPS

Management Recommendations

1. The first priority of the LCFF is to develop an Interim Stocking Plan for all species stocked in Lake Chelan and its tributaries, with particular emphasis on addressing the issue of stocking landlocked chinook. It is expected that this Interim Stocking Plan will remain in place until the monitoring and evaluation program can be implemented, thereby providing better information upon which to make longer term management decisions.
2. Focus on landlocked chinook as primary predator species:
 - investigate feasibility of stocking triploid chinook
 - set interim harvest restrictions to protect population size

Lake Chelan Comprehensive Fishery Management Plan

- support recreational fishery
- 3. Evaluate impacts of chinook on native fish species in Lake Chelan, and investigate management actions that would limit potential impacts. Support recreational fisheries for chinook if impacts on native fish populations are minimal.
- 4. Discontinue lake trout stocking:
 - discontinue stocking juveniles
 - reduce adult population
 - study presence/absence of natural reproduction of lake trout in Lake Chelan and associated tributaries
- 5. Develop monitoring and evaluation program to assess efficacy of management actions.

3.5 Bull Trout

Bull trout have not been observed in Lake Chelan or its tributaries since the early 1950s. The causes of decline, and apparent demise, of the bull trout population, have been speculated to be a catastrophic epizootic event (disease outbreak), unsuccessful spawning and loss of spawning habitat during floods in the late 1940s and early 1950s, excessive harvest, or a combination of the above (Brown 1984).

Several relicensing stakeholders, and primarily the USFWS, want to investigate the feasibility of restoring bull trout to the Chelan Basin. The USFWS is currently preparing a Bull Trout Recovery Plan, which may address Chelan Basin recovery efforts. However, NSWG members expressed serious concern about Chelan Basin perturbations i.e., non-native species introductions, remaining presence of pathogens, availability of bull trout donor stock, etc., that may preclude bull trout re-introduction. Due to these concerns, the CFMP focuses, initially, on conducting a bull trout restoration feasibility assessment before actually attempting to re-introduce the species into the basin.

If feasible, the ultimate goal of the state and federal Agencies is to attempt to reintroduce self-sustaining populations of bull trout in waters they historically inhabited in the tributaries that drain into the Stehekin River or directly into Lake Chelan. The first step will be to conduct a survey designed to locate any bull trout population that might still exist in the system. If a fluvial bull trout population is found, the second step will be to determine if habitat conditions exist which have limited their re-colonization of the system. The next step would be to eradicate the factor(s) that have been limiting bull trout or determine if enough fish exist to use as a brood stock, so we could avail them the survival advantage of the hatchery system. If no bull trout population is found, then, if feasible, an appropriate stock of fluvial fish from another river may be chosen to use for reintroduction. Possibly bull trout from the Chiwawa River stock, which are adfluvial, could be used.

Lake Chelan Comprehensive Fishery Management Plan

Primary Issues Raised by Stakeholders

- Reintroduce fluvial bull trout - WDFW, USFWS
- Conduct survey to locate possible remaining population in Lake Chelan and the Stehekin watershed - WDFW, USFWS
- If feasible, attempt to reintroduce using identified stock - WDFW, USFWS, City of Chelan
- Determine appropriate donor stock - WDFW, USFWS
- Delay re-introduction until the following issues are resolved - USDA-FS, NPS, USFWS, WDFW:
 - Determine interactions between bull trout and brook and lake trout;
 - Determine fish pathogens present;
 - Identify and evaluate bull trout donor source(s);
 - Determination for the potential of angling restrictions affecting sport fishing;
 - Identify appropriate locations for re-introduction.
- Maintain recreational fishing opportunities for other species as a high priority (similar to Lake Wenatchee mgt.) - USDA-FS, NPS, LCSA, WDFW, City of Chelan
- Do not attempt bull trout re-introduction - LCSA, PFLC
- Phase out stocking of RBT and discontinue stocking of lake trout - NPS, WDFW
- Manage kokanee and chinook populations at levels to minimize interference with potential bull trout recovery efforts - NPS, USDA-FS, WDFW
- Disease screening of hatchery fish - NPS, WDFW
- Manage water levels for fish - NPS
- Minimize loss from entrainment/spills – NPS, LCSA, WDFW
- Develop monitoring and evaluation program - WDFW, USDA-FS, LCSA, NPS, USFWS

Management Recommendations

1. Investigate feasibility of re-introducing fluvial and adfluvial bull trout.
2. Maintain recreational fishing opportunities for other species as a high priority (Lake Wenatchee mgt.)
3. Develop management and evaluation program to assess efficacy of management actions.
4. Discontinue stocking brook and lake trout;
5. Reduce adult population of brook and lake trout;

3.6 Lake Trout

Lake trout have also contributed significantly to the trophy fish fishery in Lake Chelan. The Washington State record, a 35.7 oz. fish, was caught in December 31, 2001. Additionally, a 33 lb. 6.5 oz. fish was caught in August 2001; a 31 lb. 2.5 oz. fish was taken in May 2000; and another 30 + lb. fish was taken in May 2000. Popularity of the lake trout fishery has increased in recent years as the landlocked chinook salmon fishery has declined. A primary concern of the CFMP is restoration of native species. Management objectives are aimed at minimizing the impacts of non-native apex predators on native species and to provide additional sportfishing opportunity. Literature acquired from other systems that include lake trout indicate strong potential for adverse species interactions between lake trout, kokanee, landlocked chinook, WSCT, and bull trout. Due to the potential adverse effects on native species and landlocked chinook salmon, continued stocking of lake trout is being questioned at this time. However, an

Lake Chelan Comprehensive Fishery Management Plan

important aspect of the monitoring and evaluation program is to investigate these potential impacts and develop appropriate management actions for lake trout.

Studies conducted in 1999 and 2000 for relicensing support indicate that lake trout are reproducing naturally in Lake Chelan (DES 2000). A lake trout fry, approximately 32 mm in length, was observed off the mouth of First Creek during snorkel surveys conducted in July 2000. This fish was much smaller than the lake trout planted on June 15, 2000. The two biologists who observed the fry were confident that the fish was not any of the *Oncorhynchus* species or a bull trout. Additional evidence supporting lake trout natural reproduction in Lake Chelan is observation of three lake trout juveniles (75-100 mm) in a side channel in lower mainstem Stehekin River on September 12, 2000 during snorkel surveys.

Primary Issues Raised by Stakeholders

- Discontinue stocking program - WDFW (Alt. 1), USDA-FS, NPS
- Continue stocking program - LCSA
- Survey to determine number and origin of fish - WDFW, LCSA
- Increase limit - WDFW
- Explore the need for active removal programs - NPS
- Assess kokanee population - WDFW, LCSA
- Attempt to balance kokanee and lake trout populations - WDFW, LCSA
- Develop monitoring and evaluation program - WDFW, USDA-FS, LCSA, NPS
- Do not support any efforts to significantly reduce population of lake trout - LCSA, City of Chelan

Management Recommendations

1. Discontinue lake trout stocking program.
2. Evaluate population size, recruitment, distribution, spawning areas and investigate feasibility of potential eradication methods.
3. Develop monitoring and evaluation program to assess efficacy of management actions.
4. Study presence/absence of natural reproduction in Lake Chelan and associated tributaries.

3.7 Burbot

Little is known of the burbot biology and population characteristics in Lake Chelan. The only data currently available are harvest data. Burbot population dynamics need to be investigated more thoroughly in order to develop better management actions.

Primary Issues Raised by Stakeholders

- Assess burbot population trends via index sampling - WDFW, LCSA, NPS
- Use otoliths for age structure - WDFW
- Routine sample gonads - WDFW, USDA-FS, LCSA
- Angling restrictions if population continues to decline - USDA-FS, NPS
- Disease screening - NPS
- Investigate life history requirements of burbot in the Chelan watershed - NPS
- Assess hydro Project related impacts - NPS

Lake Chelan Comprehensive Fishery Management Plan

Management Recommendations

1. Develop monitoring and evaluation program to assess efficacy of management actions.
2. Monitor trends in abundance, survival, recruitment and evaluate effects of angling regulations and disease screening.

3.8 Smallmouth Bass

Smallmouth bass were introduced illegally into Lake Chelan some time around 1990. The smallmouth population has increased in the lake and supports an active sport fishery. This species will require some management to maintain control/confinement of the population. The CFMP recommends no enhancement measures for this species at this time.

Primary Issues Raised by Stakeholders

- No change in angling regulations - WDFW
- Monitor isolation to Wapato Basin - USDA-FS, LCSA, NPS, WDFW
- Remove any developing populations in the Lucerne Basin - NPS, WDFW
- WDFW will not direct any enhancement measures toward smallmouth bass
- Develop enforcement efforts necessary to ensure population is controlled and no further "illegal relocations" take place

Management Recommendations

1. Develop monitoring and evaluation program to assess efficacy of management actions.
2. No enhancement measures for this species is recommended at this time.
3. Conduct water temperature and smallmouth distribution and abundance monitoring in the Lucerne Basin and Stehekin Flats.
4. Implement management actions to remove smallmouth if found in the Lucerne Basin.

3.9 Eastern Brook Trout

Eastern brook trout have become established in Twenty-five Mile Creek and the Stehekin River from historic stocking efforts. The NSWG had a strong desire to remove brook trout from the Chelan Basin due to adverse impacts from this species through competition and disease on native salmonids. Any recovery efforts for WSCT and bull trout populations would be hampered by the presence of Eastern brook trout in the Chelan Basin.

Primary Issues Raised by Stakeholders

- Eradicate, if possible, Eastern brook trout from Twenty-five Mile Creek and Stehekin River – USDA-FS, NPS, WDFW, USFWS
- Angling regulations should be adopted to encourage selective harvest of Eastern brook trout, unless bull trout restoration is pursued and there is a possibility of incidental catch of bull trout due to misidentification – USDA-FS, NPS, USFWS

Management Recommendations

1. Take all feasible actions to eradicate Eastern brook trout from Twenty-five Mile Creek and the Stehekin River.
2. Monitor success of eradication efforts.

Lake Chelan Comprehensive Fishery Management Plan

3.10 Other Native Fish Species

- Pygmy whitefish
- Mountain whitefish
- Threespine stickleback
- Peamouth chub
- Chiselmouth
- Northern pikeminnow

The effects of non-native fish stocking on these native species is unclear. Pygmy whitefish, of particular concern, are listed as a Washington State species of concern. Additional data collection on Pygmy whitefish and other native species need to be included in CFMP monitoring and evaluation program in order to develop sound management actions.

Primary Issues Raised by Stakeholders

- Periodic surveys to assess population trends and to evaluate status of populations - USDA-FS, NPS
- Avoid management actions that would push these species to extirpation - USDA-FS

Management Recommendations

1. Develop monitoring and evaluation program to assess efficacy of management actions.

3.11 Other Non-native Introductions

Primary Issue Raised by Stakeholders

- No new introductions of non-native species - USDA-FS, NPS, WDFW, LCSA
- Investigate feasibility of sockeye introduction - YN

Management Recommendations

1. No new introductions of non-native species.
2. No introductions of anadromous fish to the lake - USDA-FS, NPS, WDFW, LCSA (CRITFC/YN dissenting).

SECTION 4: IMPLEMENTATION

The WDFW has primary responsibility for implementing the CFMP. However, the LCFF, which will be created and function as provided in section 18 of the Agreement, will provide guidance and recommendations to WDFW and other resource agencies with management authority.

A number of low risk actions have been identified by WDFW for immediate implementation. Some of these actions do not require Chelan PUD funding (e.g., eliminate stocking of lake trout, eyed-egg plants of WSCT into tributary creeks) and are currently being implemented by WDFW. Actions that are within the scope of measures identified in the current license and funded by

Lake Chelan Comprehensive Fishery Management Plan

Chelan PUD (e.g., conversion of stocked catchable trout from rainbow to WSCT) also are being implemented immediately.

Actions requiring funding or action by Chelan PUD, but not within the scope of the current license, will be implemented as soon as possible after Chelan PUD has accepted the New License. These actions could include development of an Interim Stocking Plan for kokanee, barrier removal at tributary mouths, and initiation of the monitoring and evaluation program. Other actions not requiring funding or action by Chelan PUD (chinook stocking, habitat work on federal lands, fishing regulations) may be implemented at any time by the relevant management agencies.

The LCFF may compile a list of these and other actions, based on results from the monitoring and evaluation program, as recommendations to the management Agencies. These and other management actions, which may evolve from the results of the monitoring and evaluation program, will be reviewed by the LCFF as necessary.

As noted in section 1, the CFMP resulted from a need to coordinate management authorities over fishery resources in Lake Chelan. The following provides an overview of individual management agency commitments under the CFMP. Chelan PUD's license obligations are identified in section 4.6.

The extent to which the federal and state Agencies may be able to raise funds through cost-sharing in order to implement the monitoring and evaluation program may be limited by budgetary constraints. These agency funding limitations will not affect Chelan PUD's funding of the monitoring and implementation program, as provided in sections 4.6.1 (1) and (2), below. Chelan PUD's funding under these sections may not be sufficient without substantial agency cost-sharing, particularly with respect to the estimated cost of the Food Web Model. In addition, Chelan PUD's matching obligation under section 4.6.1 (3) does not apply unless there is a dollar-for-dollar match (either in funds, in-kind services, or a combination of the two) from one or more agencies.

4.1 WDFW

WDFW intends to continue funding all programs at the Chelan Falls Hatchery other than those that Chelan PUD is required to fund in this Chapter. WDFW will also diligently pursue cost-sharing opportunities with federal, state, and private entities in order to fund the monitoring and evaluation program.

4.2 USDA Forest Service

The USDA Forest Service will also diligently pursue cost-sharing opportunities with federal, state, and private entities in order to fund the monitoring and evaluation program. The USDA Forest Service will continue to provide data as part of its ongoing monitoring and evaluation program on its lands. It will also seek grants to provide additional funding for CFMP implementation.

Lake Chelan Comprehensive Fishery Management Plan

4.3 NPS

The NPS will also diligently pursue cost-sharing opportunities with federal, state, and private entities in order to fund the monitoring and evaluation program. The NPS will continue to provide data as part of its ongoing monitoring and evaluation program on its lands, particularly in the lower Stehekin River. The NPS will also diligently pursue grants to provide additional funding for CFMP implementation.

4.4 USFWS

The USFWS will also diligently pursue cost-sharing opportunities with federal, state, and private entities in order to fund the monitoring and evaluation program. The USFWS will provide data sharing and bull trout monitoring in the Stehekin drainage. The USFWS will seek grants to provide additional funding for CFMP implementation.

4.5 LCSA

The LCSA has provided funding for projects in the past, such as First Creek culvert replacement, eyed WSCT egg plants, fish stocking programs, funding and labor to improve docks, an annual kids fishing program, and continued community efforts to raise awareness about the Lake Chelan fishery. LCSA members have stated that they are willing to fund measures that provide enhancement to Lake Chelan fisheries. The LCSA has also been a strong proponent of developing a sound monitoring and evaluation program to determine effectiveness of management decisions, and could provide funding for a portion of the monitoring and evaluation program.

4.6 Chelan PUD

Chelan PUD will implement the following in accordance with Proposed License Article 6:

4.6.1 CFMP Monitoring and Evaluation (M&E) Program

- 1) Chelan PUD shall make available \$100,000 for developing a Food Web Model.
- 2) Chelan PUD shall provide annual funding of \$20,000 for monitoring and evaluation.
- 3) Chelan PUD shall make available an additional \$20,000 per year, for matching funding.

4.6.2 Tributary Barrier Removal

Chelan PUD, in consultation with the resource Agencies, will be responsible for:

- 1) Mechanical excavation of existing tributary barriers in up to 10 high priority tributaries over the first five years of the New License;
- 2) Monitoring of up to 10 tributaries (paired test) with existing barriers to determine if the new lake level operating regime is sufficient to naturally remove existing barriers;
- 3) Monitoring of up to 10 selected tributaries (post-treatment), with modified barrier analysis methodology,¹ every two years or frequency as recommended by LCFF to determine if barriers are present or have reformed; and

¹ This methodology is being developed by the consultant, Framatome ANP DE&S, which conducted the original barrier analyses, and will be approved by the LCFF.

Lake Chelan Comprehensive Fishery Management Plan

- 4) Treatment of up to two tributaries within the drawdown zone annually to remove barriers (re-formed or previously untreated) for the life of the license, unless barriers are clearly non-Project related (e.g., fire, earthquake, landslides, etc.).

The Estimated Cost of these activities is \$100,000.

The USDA Forest Service has developed Table 6-1 of Lake Chelan tributary status, which can be used as a compilation of current information, and as a potential prioritization tool for barrier removal efforts.

Table 6-1: Information on Trout Populations, Habitat Availability and Potential Migration Barriers for Selected Tributaries to Lake Chelan (excluding the Stehekin system)

Stream	Trout Population Estimate ¹	Density: Trout per square meter ¹	Habitat accessible: square meters ^{1,2}	Cutthroat present? ^{1,2}	Barrier Analysis Needed? ²	Reason*
Bear	67	0.21	319	Y	Y	H,CT
Big	236	0.85	278	Y	Y	P,D,H,CT
Cascade	453	1.63	278	Y	Y	P,D,H,CT
Castle	3	0.13	23	Y	N	
Coyote	18	0.37	49	N	N	
Deep Harbor	130	2.36	55	N	Y	P,D
First	2483	0.46	5398	N		
Fish	773	0.36	2147	Y		
Four Mile	431	0.48	898	Y	Y	P,D,H,CT
Gold	1478	2.10	704	N		
Grade	824	0.49	1682	N		
Graham Harbor	109	1.52	72	N	Y	P,D
Lightning	26	0.22	118	Y	Y	H,CT
Little Big	9	0.07	129	Y	Y	H,CT
Lone Fir	24	0.37	65	N	N	
Mitchell	480	0.36	1333	N		
Poison	234	1.60	146	N	Y	P,D,H
Prince	1146	0.68	1685	Y		
Pyramid	522	0.53	985	Y	Y	P,D,H,CT
Railroad	430	0.06	7167	Y		
Riddle	77	0.32	241	Y	Y	H,CT
Safety Harbor	1032	0.85	1214	Y		
25 Mile	7776	0.50	15552	N		

1 - From: Brown (1984)

2 - From: USDA Forest Service sources and other relicensing studies (USDA Forest Service, 2000b)

* - P = Population D = Density H = Habitat CT = cutthroat present

Streams in bold: High priority streams for study and barrier analysis

Shaded Areas: Study streams included in Lake Chelan Fisheries Investigation (Chelan PUD 2000)

4.6.3 Fish Stocking in Lake Chelan and its Tributaries

For stocking in Lake Chelan and its tributaries during the term of the New License, including any subsequent annual licenses, Chelan PUD shall make available to WDFW for the Chelan Falls Hatchery site sufficient funding adequate to rear annually approximately 5,000 pounds of

Lake Chelan Comprehensive Fishery Management Plan

salmonid fingerlings (for example: 500,000 fish at 100 fish/lb., presently kokanee) and 33,000 pounds of catchable-sized salmonids (for example: approximately 100,000 fish at 3 fish/lb., presently rainbow/WSCT). Rearing includes costs of egg collection, pathology, and marking and release.

The Estimated Cost of these activities is \$30,000 per year.

If WDFW, after coordination with the NPS, USDA Forest Service, and USFWS, and after consultation with the LCFF, decides, at any time during the term of the New License or any subsequent annual licenses, to reduce or eliminate fish stocking into Lake Chelan, the resulting savings shall be available to WDFW for other Lake Chelan fish management activities. Funds to be made available from reductions in fish production shall be determined as equivalent to the proportion of fish production poundage reduced. The funds saved shall be calculated as follows: take the number of pounds of fish production reduced, divide by the 38,000 pounds of fish initially to be produced, and multiply by the \$30,000 (as adjusted under section 19 of the Agreement up to the year of the decision to reduce production). For example, if 5,000 pounds of kokanee production was eliminated, \$3,950 would be available for other fish management activities ($5,000/38,000 \times \$30,000$ escalated = \$3,950 escalated).

4.6.4 Entrainment

Chelan PUD shall conduct no more than 140 days of entrainment sampling over four sampling years, using the same methodology used during the 2000 and 2001 field seasons, or another methodology of comparable cost recommended by the LCFF, and approved by WDFW, USFWS, and WDOE. Upon request of WDFW, Chelan PUD shall develop a sampling plan in consultation with USFWS, WDOE, and the LCFF, subject to approval by WDFW. The plan shall specify the sampling years and the allocation of sampling days among such years. The first sampling year shall be not be prior to year seven of the effective date of the New License, and the last sampling year shall be no later than year 35 of the effective date of the New License. The purpose of the sampling is to determine if significant numbers of adult spawnable age/size adfluvial westslope cutthroat trout are entering the power tunnel entrance.

If less than 500 adult spawning age/size adult adfluvial westslope cutthroat trout are captured within any calendar year prior to completion of the four years of sampling, Chelan PUD in consultation with LCFF, shall prepare an evaluation of the results of the entrainment monitoring and the method used. Chelan PUD, WDFW, USFWS, and WDOE shall determine whether the remainder of the four years of sampling should be conducted, at what intervals and what method should be used.

If more than 500 adult spawnable age/size adult adfluvial westslope cutthroat trout are physically captured within a calendar year in the immediate vicinity of the power tunnel entrance, the WDFW, USFWS, or the WDOE may request that Chelan PUD install fish protection or exclusion devices for the power tunnel entrance, or that Chelan PUD implement other actions recommended by the LCFF and approved by WDFW, USFWS, and WDOE. Chelan PUD may object to the request on the grounds that such fish protection or exclusion devices, or such other actions, as the case may be, are not necessary. To assist in the determination of whether such fish protection or exclusion devices, or other actions, are necessary, Chelan PUD may conduct

Lake Chelan Comprehensive Fishery Management Plan

entrainment sampling in the power tunnel. If Chelan PUD so objects, and it cannot reach agreement with the agency or agencies making the request, the matter shall be referred to dispute resolution under section 16 of the Agreement. If Chelan PUD does not object, or the dispute resolution process results in a decision to install fish protection or exclusion devices, Chelan PUD shall seek recommendations from the LCFF regarding the design of fish protection or exclusion devices or such other actions. Chelan PUD shall conduct such tests as necessary to determine the effectiveness of such fish protection or exclusion devices or such other actions. Upon development of a successful design, Chelan PUD shall install such fish protection or exclusion devices or implement such other actions.

For purposes of this Chapter, "adult" is defined as naturally-produced (non-stocked), spawnable age or size adfluvial westslope cutthroat trout. The size of adult westslope cutthroat is defined as 9-12 inches in total length, based on current Twin Lakes stock spawner size, but such definition may be adjusted upon a recommendation by the LCFF to WDFW, USFWS, WDOE, and Chelan PUD.

As of the date of this Agreement, the species identified in this Chapter are not listed species under the ESA. If any identified species become a listed species under the ESA, this Chapter may be superceded by the ESA.

SECTION 5: MONITORING AND EVALUATION PROGRAM

A monitoring and evaluation program is necessary to assess the efficacy of management actions, and to allow for changes to the plan as future conditions and data analyses dictate. One option is to develop a bioenergetically-based food web model for Lake Chelan. The model can be used as a tool for evaluating the potential impacts of species interactions, production potential, and environmental conditions (i.e., inter-annual changes in temperature regimes) within a temporal, spatial, and size-structured framework. The model, ultimately, would be used to support development and evolution of this plan. This approach would allow fishery managers to evaluate current and/or proposed fish stocking strategies and management regulations within the context of ecological feedback from the lake food web. The ultimate goal of the monitoring and evaluation program is to provide information to fishery managers with which to develop biological objectives and make effective management decisions that will provide for sustainable fishery resources in Lake Chelan and its tributaries.

Another important component of the monitoring and evaluation program is monitoring tributary mouth access after alluvial barriers are mechanically removed. Monitoring would involve surveying the tributary mouths on an as-needed basis (once every three to five years) to identify formation of new depth, velocity, or gradient barriers. The goal is to ensure channel integrity sufficient to maintain upstream and downstream fish passage.

Development of the monitoring and evaluation program is incumbent upon the interested Parties participating in the relicensing process, particularly the members of the LCFF. The food-web

Lake Chelan Comprehensive Fishery Management Plan

would be a good start toward developing a monitoring and evaluation program. Objectives of the monitoring and evaluation program are to:

- Gather data for input into fishery management decisions to protect, conserve, and restore native fish populations, and to maintain quality recreational fishing opportunities;
- Evaluate whether measures implemented are providing desired results; and
- Maintain future options and prevent making any irreversible decisions regarding ecosystem function.
- Prepare annual report of monitoring and evaluation results and provide future recommendations.

Summary of Chelan PUD obligations for monitoring and evaluation program
(Attachment A, Proposed Article 6)

- Food Web Modeling (The Chelan PUD share of this cost is not to exceed \$100,000)

To assist in conducting a monitoring and evaluation program, Chelan PUD shall make available \$20,000 annually and up to \$20,000 in matching funds (section (b)(1 and 2)). Measures in the monitoring and evaluation program may include but are not limited to the following:

- Kokanee surveys
 - current effort (20 days/year)
 - expanded effort (60 days/year)
- Creel surveys (144 days every 3 years)
- Tributary indexing
 - 10 representative reaches
 - WSCT spawning surveys (12 days/year)
 - WSCT recruitment and abundance surveys (40 days every 3 years)
 - Genetic analysis
 - Barrier analysis (4 days/year)

Lake Chelan Comprehensive Fishery Management Plan

SECTION 6: LITERATURE CITED

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***CHAPTER 7: CHELAN RIVER BIOLOGICAL EVALUATION AND
IMPLEMENTATION PLAN***

*Chelan River Biological Evaluation
and Implementation Plan*

TABLE OF CONTENTS

CHAPTER 7: CHELAN RIVER BIOLOGICAL EVALUATION AND IMPLEMENTATION PLAN.....	7-1
EXECUTIVE SUMMARY	7-1
SECTION 1: Introduction	7-6
SECTION 2: Background.....	7-8
2.1 Current Operations.....	7-8
2.2 Lake Chelan - Water Quality	7-10
2.3 Lake Chelan – Lake Levels.....	7-11
2.4 Lake Chelan – Recreation	7-12
2.5 Chelan River – Recreation	7-12
2.6 Chelan River Biological Evaluation and Implementation Plan.....	7-12
2.6.1 Instream Flow Incremental Methodology (IFIM)	7-12
2.6.2 Limiting Factors	7-13
2.6.3 Barrier Analysis	7-15
2.6.4 Considerations and Investigations of the Working Group	7-15
2.6.5 Working Group Flow Proposal	7-18
2.7 Discussion of Temperature Relationships in the Chelan River.....	7-19
2.7.1 Chelan River Thermodynamics – Site Potential	7-20
2.7.2 Other Major Influences	7-25
2.7.3 Temperature Modeling.....	7-26
2.8 Review of Biological Objectives and Site Limitations	7-28
SECTION 3: Management Considerations and Options Investigated	7-30
3.1 Habitat and Flow Options Considered	7-30
3.1.1 Sub-reach 4.1	7-30
3.1.2 Sub-reach 4.2	7-30
3.1.3 Sub-reach 4.3	7-31
3.1.4 Sub-reach 4.4	7-31
3.2 Habitat Modifications in the Tailrace.....	7-33
3.3 Water Temperature - Options Considered	7-36
3.3.1 Temperature Effects of Powerhouse Diversion.....	7-36
3.3.2 Stream Channel Modification - Thalweg Formation.....	7-38
3.3.3 Minimum Flow Diversion Structure	7-40
3.3.4 Site Potential Shade.....	7-40
3.3.5 Cutthroat Habitat and Potential Thermal Refugia in Reaches 1-3	7-41
3.3.6 Pumping of Tailrace Water into Reach 4	7-41
Tailwater	7-41

***Chelan River Biological Evaluation
and Implementation Plan***

Pumping from Columbia River - Feasibility Analysis	7-42
3.3.7 Increase Flow During Daytime	7-42
3.3.8 Other Options Considered to Improve Temperature Conditions.....	7-43
Providing Project Inflow During Summer Months – Feasibility Analysis.....	7-44
Pipeline to Lake Chelan Thermocline - Feasibility Analysis	7-45
Ground Water Pumping for Upper Reaches - Feasibility Analysis.....	7-45
3.4 Riparian Vegetation - Limited Opportunities.....	7-46
3.5 Macroinvertebrate Community - Limiting Factors	7-46
3.6 Summary of Management Options	7-47
SECTION 4: Achievement of biological objectives	7-51
4.1 Functional Aquatic Ecosystem.....	7-51
4.1.1 Macroinvertebrate Community	7-57
4.1.2 Fish Community - Reaches 1-3.....	7-57
Native Cool Water Species.....	7-57
Cutthroat.....	7-58
4.1.3 Fish Community - Reach 4 and Tailrace.....	7-59
Salmon and steelhead Spawning Habitat.....	7-59
Redd Protection.....	7-59
Prevent Dewatering	7-60
Prevent Low Oxygen, Have Adequate Metabolite Flushing	7-60
4.1.4 Other Ecological Considerations.....	7-61
SECTION 5: Implementation Plan	7-62
5.1 Construct Flow Release Structure.....	7-62
5.2 Construct Reach 4 Pump Station and Channel Modifications	7-62
5.3 Initiate Chelan River Comprehensive Management Plan Flow Releases	7-63
5.4 M&E Program.....	7-63
5.4.1 Benthic Community Analysis	7-63
5.4.2 Fish Community - Reaches 1-3	7-64
Fish Population - Fall-Spring	7-64
Fish Population - Summer	7-64
Cutthroat Presence/Condition.....	7-64
Use of Thermal Refugia	7-64
Potential M&E Outcomes Affecting Decisions.....	7-64
If cutthroat successful or leave before Project affects the temperature	7-64
If cutthroat stay but show harm at peak temperatures	7-65
5.4.3 Fish Community - Reach 4.....	7-65
Salmon/Steelhead Spawning	7-65
Salmon/Steelhead Rearing.....	7-65
Fry Presence/Absence.....	7-65
Habitat Use	7-66
5.4.4 Water Quality	7-66
Temperature and Flow.....	7-66
Other Parameters	7-66
5.4.5 Reports in years 4, 6, 8 and 10	7-67
5.5 Assessment of Biological Objectives.....	7-67
5.5.1 Management Decisions	7-67
Flow Security Options For Tailrace - Decision Triggers	7-67

*Chelan River Biological Evaluation
and Implementation Plan*

Temperature Management for Summer Rearing	7-67
Pumping into Reach 4 - Decision Triggers.....	7-67
Habitat Use - Modify Habitat Types	7-67
Flow or Channel Changes - Decision Triggers.....	7-67
Additional Actions for Reaches 1-3	7-68
Site-potential Shade.....	7-68
Evaluation of Refugia.....	7-68
Evaluation of Daytime Flow Increases.....	7-68
5.5.2 Biological Objectives Achieved.....	7-68
5.5.3 Biological Objectives Not Achieved.....	7-68
SECTION 6: Conclusion.....	7-71
SECTION 7: Literature Cited.....	7-72
APPENDIX A: Chelan River Stream Network Temperature Model – Lake Chelan Hydroelectric Project FERC Project No. 673.....	7-75

*Chelan River Biological Evaluation
and Implementation Plan*

LIST OF TABLES

Table 7-1: Average lake levels (feet, USGS) for the original license, existing license, and proposed lake level cycle (Chelan PUD 2001b)	7-11
Table 7-2: Total habitat area (acres) versus flows in Chelan River	7-13
Table 7-3: Natural Sciences Working Group Chelan River Flow Proposal (Chelan PUD 2001a)	7-19
Table 7-4: Monthly average of increase (°C) above initial temperature in daily mean water temperature at the end of Reach 1 of the Chelan River for 80 and 200 cfs releases (Chelan PUD 2002).	7-28
Table 7-5: Rearing habitat (acres) for adult or juvenile fish under different flow recommendations (Source: R2 and IA, 2000).....	7-35
Table 7-6: Natural Sciences Working Group Ramping Rate Proposal	7-36
Table 7-7: Estimated Costs of Providing Project Inflow	7-44
Table 7-8: Matrix of management considerations and options considered for accomplishment of the biological objectives for the Chelan River	7-49
Table 7-9: Criteria for Achievement of Biological Objectives in the Chelan River	7-52
Table 7-10: Other Criteria for Achievement of Biological Objectives in the Chelan River	7-53
Table 7-11: Habitat Modifications Implementation Plan Development.....	7-62

LIST OF FIGURES

Figure 7-1: Bypass Reach Location Map	7-10
Figure 7-2: Water temperature measurements obtained at the Lake Chelan Hydroelectric Project powerhouse from 1994 through 1998 (R2 and IA 2000).....	7-21
Figure 7-3: Water temperatures recorded in the Chelan River during monthly water quality sampling (USGS Database).	7-22
Figure 7-4: Water temperatures recorded in the Chelan River in 2000 (combination of measurements at the spillway and at the powerhouse)	7-22
Figure 7-5: Water temperatures recorded in the Chelan River at the spillway in 2001 (as measured at the powerhouse).....	7-23
Figure 7-6: Water temperatures recorded in the Chelan River in 2002 (combination of measurements at the spillway and at the powerhouse)	7-24
Figure 7-7: Predicted temperature response of daily maximum temperature of the Chelan River at flows of 80 cfs and 200 cfs.....	7-24
Figure 7-8: Temperature response in the Chelan River (during the warmest two-week period on record) at minimum flow of 80 cfs compared to a higher flow of 1,500 cfs, representing natural conditions (Chelan PUD 2002).	7-27
Figure 7-9: Schematic diagram of the subreaches of Reach 4, including an example of the trapezoidal channel	7-32
Figure 7-10: Braid bar emphasizing spawning and rearing habitat in the modified tailrace	7-34
Figure 7-11: Thermal energy delivered to the Columbia River at different minimum flows to the Chelan River	7-38
Figure 7-12: Sensitivity analysis of daily mean temperatures in the Chelan River with changed channel morphology in Reaches 1 and 4.....	7-39
Figure 7-13: Chelan River Biological Evaluation and Monitoring Plan Flow Chart	7-69

*Chelan River Biological Evaluation
and Implementation Plan*

EXECUTIVE SUMMARY

Chelan County Public Utility District No. 1 (Chelan PUD) has filed an application for a new license for the Lake Chelan Hydroelectric Project (Project) (FERC No. 637). The license application included several comprehensive plans for specific resource areas that were developed with the regulatory resource agencies and a number of other stakeholders through the collaborative Alternative Licensing Procedure (ALP). A number of the agencies and stakeholders filed with FERC as intervenors in the licensing process. All intervenors were invited to participate in a Settlement Group, with the intent of developing a long-term settlement agreement for the Project. The Lake Chelan Hydroelectric Project Settlement Agreement (Agreement) will be submitted to FERC for approval and incorporation into the New License. The individual comprehensive plans have been consolidated into a single document, the Lake Chelan Comprehensive Plan (Comprehensive Plan). The Comprehensive Plan is a key element of the proposed Agreement, with the intent to document the measures that will be employed to protect and enhance natural and social resource values within the area affected by the Project.

Section 401 of the Clean Water Act requires that license applicants apply for state certification of compliance with water quality standards and other appropriate requirements of state law. The purpose of the Section 401 process is to protect and enhance the beneficial use of state waters. The State of Washington Department of Ecology (WDOE) is responsible for issuing the Section 401 certification for the Project, or waiving such certification. WDOE is a participant in the Settlement Group, and has requested that Chelan PUD provide the biological basis for the portion of the Comprehensive Plan that protects water quality and the beneficial uses of Lake Chelan and the Chelan River. This document, Chelan River Biological Evaluation and Implementation Plan (CRBEIP), is in response to that request.¹ The CRBEIP has been incorporated as Chapter 7 of the Comprehensive Plan.

Chelan PUD's pending license application to FERC will be the third license for operation of the Project, and the second Section 401 certification. In the previous two licenses and Section 401 certification, the Project was not required to provide a minimum flow to the Chelan River. The bypassed reach (i.e., the portion of the Chelan River between the intake structure at the dam and the confluence of the river and the powerhouse tailrace), has been dry for most of the year for the past 76 years. Although the Chelan River is classified as a Class A waterbody (by virtue of that fact that all streams in Washington are designated as Class A unless specifically designated otherwise), this river has not supported Class A designated uses since before the enactment of the Clean Water Act and Washington State's water quality standards.

The CRBEIP would restore flows to the bypassed reach of the Chelan River, thereby supporting the beneficial uses that are typical of Class A waterbodies. The Comprehensive Plan, including the CRBIEP and other chapters, would protect both the existing beneficial uses of Lake Chelan (fish and wildlife, recreation, and power production), and provide new beneficial uses in two

¹ The CRBEIP is also submitted as a "mitigation plan" pursuant to the Washington State "Aquatic Resources Mitigation Act" (RCW 90.74.005 to RCW 90.74.030)

*Chelan River Biological Evaluation
and Implementation Plan*

distinct portions of the bypassed reach. The intent of the CRBEIP is to a) evaluate the biological effects of the minimum flows and other actions from all perspectives, seeking a balance between the biological requirements and other beneficial uses of the Lake Chelan watershed; and b) maintain, support and protect existing beneficial uses as required by state and federal laws.

In the upper portions of the bypassed reach, the proposed minimum flows would provide an opportunity for aquatic species of fish and other organisms to inhabit what has been a dry river bed. In the lowest portion of the bypassed reach, the CRBEIP would significantly enhance salmon and steelhead trout spawning habitat. This enhanced habitat would be immediately adjacent to an area below the confluence of the bypassed reach and the tailrace, where salmon and steelhead trout currently spawn. The net effect of the CRBEIP is to provide significantly improved biological functions and values compared to existing conditions, restoring aquatic life uses to the bypassed reach of the Chelan River.

The Chelan River is classified as a Class A surface water under Washington State's water quality standards. However, this classification was made by default under a provision in the water quality standards which provides that "[a]ll other unclassified surface waters within the state are hereby classified Class A." Thus, the Class A designation of the Chelan River is arbitrary in the sense that it is not based on any examination of the environmental conditions in the river, or the existing beneficial uses of the river.

Water temperatures recorded (1994 – 2002) in the Chelan River, upstream from the Project, are often in excess of temperatures that typically are expected in a water body classified as a Class A surface water. The Washington State water quality standard for the Class A waterbodies (WAC 173-201A-030) states that: "Temperature shall not exceed 18.0°C (freshwater) or 16.0°C (marine water) due to human activities. When natural conditions exceed 18.0°C (freshwater) and 16.0°C (marine water), no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3°C. Incremental temperature increases resulting from point source activities shall not, at any time, exceed $t=28/(T+7)$ (freshwater) or $t=12/(T-2)$ (marine water). Incremental temperature increases resulting from nonpoint source activities shall not exceed 2.8°." The 18°C numerical temperature criterion for freshwater is a biological benchmark that signifies when water temperatures begin to exceed the preferred temperature range for cold water salmonid fish species. These fish species can tolerate water temperatures well above 18°C for periods of time and many surface waters that support salmonid populations routinely reach higher temperatures during the day in summer. However, these warmer temperatures can reduce growth and disease resistance and, in the extreme, can be lethal to salmonid fish if they occur too frequently or persist for too long.

A primary beneficial use of Class A surface waters is habitat for salmonid fish. This beneficial use currently exists in the lower portion of the Chelan River at and below the confluence with the tailrace. Rainbow trout from hatchery releases have also been observed in the upper Chelan River above the dam. However, there is no historical documentation of native salmonid (cutthroat trout) populations in the Chelan River below the dam site prior to construction of the Project. Based on current temperature measurements in Lake Chelan and the Chelan River above the Project, and the results of temperature modeling, it is probable that water temperatures during summer in the Chelan River were substantially warmer than 18°C prior to construction of

*Chelan River Biological Evaluation
and Implementation Plan*

the Project. Historically, cutthroat trout populations may have been limited to seasonal or transitory use of the Chelan River by these warm temperature conditions. Water temperatures recently recorded (1994 – 2002) in the Chelan River exceed 18°C for most of June through September, with temperatures recorded as high as 24°C in some years. Clearly, this temperature regime does not constitute ideal habitat for cold water fish species, such as cutthroat trout. However, the CRBEIP includes the biological objective of providing habitat for cutthroat trout, to the extent feasible, given the high water temperatures coming from Lake Chelan and the need to maintain and protect the existing beneficial uses of Lake Chelan and the Chelan River.

The flow regime in the CRBEIP is the preferred alternative of a number of flow options considered for preservation of existing beneficial uses (fish populations in Lake Chelan, recreation, salmonid spawning below the tailrace, hydroelectric power generation), as well as providing opportunity for beneficial uses that currently do not exist (salmonid spawning and rearing in the lower Chelan River, cutthroat trout and native cool water species in the upper Chelan River, aquatic ecosystem, and wildlife habitat). A number of habitat enhancement measures are included in the CRBEIP to increase the likelihood of achieving these biological objectives. These measures include actions to increase the amount of physical habitat for fish and to moderate the warming of water temperatures in the Chelan River to the extent feasible while maintaining and protecting existing beneficial uses.

The CRBEIP's flow regime for the Chelan River rests on a strong scientific basis. As demonstrated by temperature modeling, the water temperatures under any flow regime will greatly exceed the preferred temperature zone for cutthroat trout in the upper Chelan River, and for chinook salmon and steelhead trout in the lowest reach of the river. Thus, the biological impact of marginally reducing those relatively high water temperatures could be limited (R2 and IA 2000; Sternberg 1987; Wydoski and Whitney 1979; Scott and Crossman 1974; Milstein 2000; WDFW 1992; NOAA Fisheries 1996). In addition, the high flows that would be necessary to limit temperature increases to 0.3°C, as allowed in the water quality standard, would provide less useable area of physical habitat with the depths and velocities preferred by target fish species than will be provided by the flow regime proposed in the CRBEIP.

Put another way, limiting temperature increases to 0.3°C could diminish, rather than enhance, the overall value of the aquatic habitat for fish and would also dramatically impair existing beneficial use of these waters for power production and lake recreation. Based on information collected to date, the lower flows provided under the CRBEIP provide useable physical habitat area for fish, the ability to maintain plant cover for shade and food sources, greater cooling at night under the proposed flows, and a potentially greater likelihood of cool water refugia forming where sub-surface flows and ground water enter the river channel. Also, the adverse effect of the CRBEIP's flow regime on other existing beneficial uses (primarily recreation and power generation) is significantly less than a regime of higher flows. The evidence suggests that the CRBEIP will provide greater biological benefits than would occur if temperature fluctuations were further limited by providing substantially higher flows in the Chelan River.

The temperature modeling determined that flows in the range of 1,500 cfs - 2,000 cfs (the hydraulic capacity of the powerhouse) would be required to limit temperature increases above "natural" to not exceed 0.3°C. In order to provide this level of flow from June through

*Chelan River Biological Evaluation
and Implementation Plan*

September, the Project would be forced to reduce generation or shut down entirely for most of this period, except in high flow years when the Project could continue to operate in June and July. This would be a dramatic impairment of the existing beneficial use of the waters of Lake Chelan for power production and recreation. For example, a 2,000 cfs flow during these four months was modeled and resulted in an average energy loss of 70,656 MWh/year. The net present value of such a loss, over a 50 year period, would be approximately \$50,000,000. The provision of this flow in June also has the potential to delay refill, with impairment of the existing beneficial use of the lake for recreation by limiting utility of docks and launches. Lesser amounts of flow would have reduced costs, but would exceed the 0.3°C allowance.

Model predictions indicate that even with flow releases of 1,500 – 2,000 cfs, the temperature would still exceed 23°C during a significant period of time each year. The daily maximum temperature exceeded 23°C on 14 percent of 2125 data points modeled for flows of 1,500 cfs – 2,000 cfs (Appendix A). These data points included 5 locations in the Chelan River, covering the period from May 1 – September 30, 2000 – 2002 and 14 hot summer days in 1998. At 1,500 cfs for the days from May 1 – September 30, 2000-2002 (411 days), the model predicts that daily maximum temperatures at the bottom of Reach 3 would exceed 25°C on five days, 24-25°C on fourteen days and 23-24°C on 58 days (total 77 days). Natural inflow to the Chelan River averages less than 1,500 cfs by the middle of August, thus natural conditions could be warmer in low flow years, as predicted by the model. Due to high velocities and hydraulic action, there would be no thermal refugia and the model predicts insignificant nighttime cooling at these higher flows, thus limiting the biological benefit to aquatic life of higher flows.

The CRBEIP includes a number of options that could be employed to reduce peak temperatures, if needed and feasible. The CRBEIP also includes an extensive monitoring and evaluation program to determine if biological objectives are achieved and, if not, trigger decisions to implement options to remedy specific causes of failure to meet biological objectives. For example, the CRBEIP provides for flow increases during extremely hot weather if increased flows are necessary to achieve the biological objectives. With the benefit of nighttime cooling, during much of the summer the aquatic community would spend fewer hours in temperatures in the upper tolerance zone under the CRBEIP than would occur with higher flows, which the model predicts would yield constantly high water temperatures 24 hours per day.

Implementation of the CRBEIP is designed to support, maintain and protect the designated and existing beneficial uses of the Chelan River Basin, pursuant to applicable federal and state law. The CRBEIP defines the biological objectives that constitute protection of the designated and existing aquatic life beneficial uses in the Chelan River. At or before year 10 of implementation of the CRBEIP, if WDOE determines that the biological objectives have been met but non-compliance with water quality standards exists, WDOE intends that it will initiate a process, if necessary, to modify the applicable standards through rulemaking or such alternative process as may otherwise be authorized under applicable federal and state law. If WDOE determines that some or all of the biological objectives have not been met and that Chelan PUD has undertaken all known, reasonable, and feasible measures to achieve those objectives consistent with supporting, protecting, and maintaining the designated and existing beneficial uses, WDOE intends to initiate a process to modify the applicable water quality standards to the extent necessary to eliminate any non-compliance with such standards.

*Chelan River Biological Evaluation
and Implementation Plan*

The scientific data clearly shows that the 18°C temperature preference for salmonids is not attainable in the summer under any flow condition. As shown with modeling, temperatures at natural inflow would exceed 23°C during much of the summer. The consequence of trying to meet the water quality standard (natural temperature plus 0.3°C) would be that essentially no hydroelectric generation would be allowed during much of the summer, when power demand for air conditioning and industrial use is high. The economic consequences and impairment of existing beneficial uses would be high, yet the biological benefit of meeting the water quality standard, considering the naturally high water temperatures, is predicted to be no greater than provided under the CRBEIP. The instream flows, habitat enhancements and other actions in the CRBEIP are predicted to provide considerably greater biological benefits, while protecting other beneficial uses, than would a flow regime that merely meets the numeric temperature criteria.

*Chelan River Biological Evaluation
and Implementation Plan*

SECTION 1: INTRODUCTION

The Lake Chelan Project is located on the Chelan River near the city of Chelan, Chelan County, Washington. The 48-megawatt Project has a total average annual generation of 380,871 megawatt hours. It occupies 465 acres of land managed by the USDA Forest Service and the National Park Service (NPS). The license for the Project will expire on March 31, 2004. On July 6, 1998, FERC granted Chelan PUD's request to use ALP for the development and submission of an application for a new Project license. The ALP provides for early stakeholder involvement in decision-making related to protection, mitigation and enhancement measures (PMEs) for ongoing Project impacts.

As part of the collaborative process, a total of 115 working group meetings and 39 full relicensing team meetings were held between April, 1998 and March, 2002. In accordance with the ALP, Chelan PUD, federal and state agencies, local tribes and the public formed the Natural Sciences Working Group (NSWG)² and the Social Sciences Working Group (SSWG) to develop management plans for the natural and recreational resources of Lake Chelan and the Chelan River. The SSWG developed a Recreation Resources Management Plan (RRMP, December 7, 2001) and the NSWG developed two proposals: the Lake Chelan Comprehensive Fishery Management Plan (CFMP, December 7, 2001) and the Chelan River Comprehensive Management Plan (CRCMP, December 7, 2001).

Chelan PUD filed an application for a New License with FERC on March 28, 2002. Subsequently, a Settlement Group³, representing the intervenors to the FERC licensing process, has developed a long-term Agreement for the Project. Signatories to the Agreement will be the Parties. The Agreement is intended to document a strong commitment by all of the Parties to achieve consensus regarding the relicensing of the Project. The Agreement will be submitted to the FERC for approval and incorporation into the New License. In addition to the Agreement, the Settlement Group has updated and combined the various comprehensive plans into a single document titled the Lake Chelan Comprehensive Plan (Comprehensive Plan). Each of the previous comprehensive plans has been updated to reflect changes resulting from the ongoing settlement negotiations. This CRBEIP is Chapter 7 of the Comprehensive Plan.

Section 401 of the Clean Water Act requires that license applicants apply for state certification of compliance with water quality standards and other appropriate requirements of state law. The purpose of the Section 401 process is to protect and enhance the beneficial use of state waters. The State of Washington Department of Ecology (WDOE) is responsible for issuing the Section

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- ² The broad-based working group includes the NOAA Fisheries; the Washington Department of Fish and Wildlife; the U.S. Fish and Wildlife Service; the USDA Forest Service; the National Park Service, the Washington Department of Ecology, the Colville Confederated Tribes and Yakama Nation, the Lake Chelan Sportsman's Association, the People for Lake Chelan, Chelan County PUD, and other interested parties.
 - ³ All intervenors were invited to participate in the Settlement Group including the Department of Agriculture (USDA Forest Service), Department of Interior (NPS and USFWS), Department of Commerce (NOAA Fisheries), Washington State Attorney General Office (WDFW and WDOE), city of Chelan, American Rivers and the Columbia River Inter-Tribal Fish Commission

*Chelan River Biological Evaluation
and Implementation Plan*

401 certification for the Project, or waiving such certification. The certification process considers the Project's compliance with the Clean Water Act and other appropriate requirements of state law, including what measures can be employed to protect, restore and enhance the existing beneficial use of the waters associated with the Project. These uses include propagation of fish and wildlife species, recreation, generation of electricity, and irrigation. WDOE, through the Section 401 certification, may require that certain specific actions or measures be included in the Project's license to achieve that objective.

Chelan PUD applied for Section 401 certification in a letter dated March 26, 2002. This request was submitted to FERC with the license application. WDOE provided public notice in December 2002 of its intent to provide FERC with a Section 401 certification for the Project. This CRBEIP provides the basis for WDOE's analysis of the measures in the Agreement that are intended to preserve, restore and enhance the beneficial use of the waters of Lake Chelan and the Chelan River bypassed reach. WDOE issued a Section 401 certification and Order, using implementation of the CRBEIP as one component for compliance in the Order, on March 24, 2003.

*Chelan River Biological Evaluation
and Implementation Plan*

SECTION 2: BACKGROUND

2.1 Current Operations

Chelan PUD operates the Project between water surface elevations of 1,100 and 1,079 USGS, although the lake is maintained above elevation 1,098 for most of the summer recreation period. The lake is drawn down annually to allow flood control and for storage of spring snowmelt. The drawdown typically begins in early October, and the lowest lake level typically occurs in April. The lake is refilled through May and June, with a goal to reach elevation 1,098 on or before June 30. The lake is maintained above elevation 1,098 through September 30. Of the 677,400 acre-feet of usable storage, 65,000 acre-feet is reserved for irrigation and municipal and domestic water supplies. When inflows exceed the hydraulic capacity of the powerhouse units (2,300 cfs), water may be spilled over the spillway into the bypassed reach of the Chelan River. Spills usually occur during May, June and July. The Project historically has been operated to reduce peak flood flows in the Chelan River. The existing license and Section 401 certification for the Project does not require instream flow releases into the bypassed reach.

The Chelan River extends from the dam downstream to the Columbia River for approximately 3.9 miles. The Chelan River can be divided into four reaches based upon gradient, confinement, and fluvial geomorphologic characteristics (Figure 7-1). These are described as follows.

- ◆ *Reach 1.* This upper-most section extends from the diversion dam (Lake Chelan outlet) downstream for 2.29 miles (Figure 7-1). The bed of this low gradient (1%) section is primarily composed of large cobbles and small boulders, with gravels generally limited to the margins of the river channel. This reach of the Chelan River is moderately confined by hillslopes composed of glacial moraine deposits. These deposits are easily erodible, and represent a substantial source of sand and gravel to the river channel. Most of these fine bed materials are flushed out of the river during annual spill events. Streamside vegetation is scarce along this reach of the river, and is mainly present as patches of cottonwoods and alders and isolated conifer stands. The upper reaches of this channel are relatively wide, with average channel widths between 100 and 140 ft. The channel becomes narrower in the middle of Reach 1. The channel becomes considerably wider in the lower most reach, spreading into multiple channels.
- ◆ *Reach 2.* This 0.75-mile long section is located in the upper end of the Chelan River Gorge (Figure 7-1). The gradient in this section is similar to Reach 1. This section of the river, however, is confined by steep hillslopes. Consequently, the river channel in Reach 2 is much narrower than in Reach 1. Substrates are dominated by large cobbles and boulders, and are larger than those in Reach 1. There is very little streamside vegetation present in this reach of the Chelan River.
- ◆ *Reach 3.* This is the gorge section of the Chelan River (Figure 7-1). Reach 3 is 0.38 miles in length, and is characterized by a steep gradient (9%) channel that is located in a narrow canyon confined by steep bedrock walls. The river channel becomes as narrow as 15 to 20 ft wide through the gorge section. The high water velocities produced in this steep and narrow canyon flush through all bed materials except for large boulders. Consequently, much of the

*Chelan River Biological Evaluation
and Implementation Plan*

river bottom is bedrock, resulting in generally poor habitat conditions. There are several deep plunge pools (20 ft to 30 ft depth) found below waterfalls and steep bedrock cascades. These pools retain water and provide some aquatic habitat. At least five physical features (waterfalls) in this section block anadromous fish access to Reaches 1 and 2 (see section 2.6.3).

- ◆ *Reach 4.* This 0.49-milelong section of the Chelan River extends from the mouth of the gorge to the powerhouse tailrace (Figure 7-1). Reach 4 has a low gradient of 0.4 percent. As a result of its low gradient and relatively unconfined channel, Reach 4 is an active alluvial zone where gravels and cobbles originated from the highly erosive banks in Reaches 1 and 2 are deposited after being flushed through the gorge. Substrates in Reach 4 are mainly composed of small and large cobbles and large gravels. The river channel in this reach widens rapidly as it exits the gorge and enters the Columbia River floodplain. Reach 4 becomes very wide, splitting into multiple channels, about 1,000 ft upstream of the backwater of the Columbia River. The Chelan River stream bed is very dynamic in this multiple-channel section during the annual spill period in the spring.

Under present operations, the bypassed reach of the Chelan River provides no year-round fish habitat for resident or anadromous species, except for a few groundwater-fed pools in Reaches 1, 2, and 3.

Chelan River Biological Evaluation and Implementation Plan

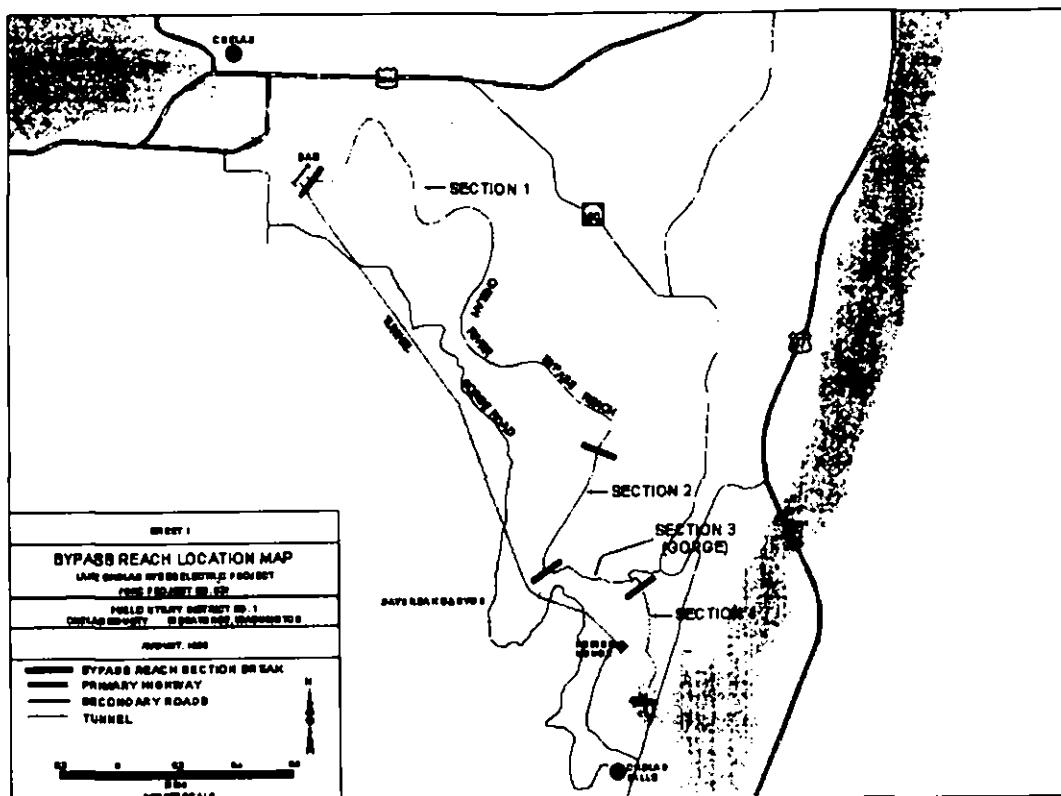


Figure 7-1: Bypass Reach Location Map

2.2 Lake Chelan - Water Quality

Lake Chelan is an ultra-oligotrophic lake characterized as nearly pristine, with few identified water quality limitations. In order to maintain this high-level water quality, Lake Chelan has a Total Maximum Daily Load (TMDL) for phosphorus, the primary nutrient limiting factor for algal growth. Other water quality concerns previously noted in earlier studies included localized water quality effects attributed to non-point sources of bacterial input and pesticides. Information collected during monitoring of Lake Chelan in 1999 suggests that water quality conditions in the lake have been very stable since baseline monitoring began in 1987. Phosphorus loading into the Wapato Basin "appears to have remained fairly constant between 1987 and 1999" (Anchor Environmental 2000). The report also indicated that lake level fluctuations resulting from current Chelan PUD operations appear "unlikely to have a direct or indirect effect on TP or fecal coliform levels in Lake Chelan" (Anchor Environmental 2000).

Early in the relicensing process, the NSWG approved a plan for the study of baseline water quality conditions in Lake Chelan, the Chelan River, and the Project tailrace. The intent of the study, conducted in 1999, was to evaluate the Project's effects on water quality parameters in the watershed. The parameters measured in this study were compared to baseline studies conducted in 1987 (Patmont et al. 1989), and follow-up investigations (Congdon 1996; Sergeant 1997). In 2000, Anchor Environmental presented its findings in a report to the NSWG.

*Chelan River Biological Evaluation
and Implementation Plan*

The study found that water quality parameters in Lake Chelan are within Washington State water quality standards, and are not adversely affected by operation of the Project.

2.3 Lake Chelan – Lake Levels

In preparation for the New License, both the NSWG and the SSWG focused on lake level operations in terms of its relation to recreational objectives and protection and enhancement of native fish species. Protection of native species and management of the lake level to enhance tributary fish production and recreation have direct bearing on the issue of water quality certification. Chapter 8 of the Comprehensive Plan sets forth a proposal for lake level management, a primary goal of which is to enhance habitat for the native species of primary interest, the Westslope cutthroat trout. Provision of suitable habitat for this species is also a primary desired beneficial use for the upper two reaches of the Chelan River.

The lake level management regime balances the needs of the native fish resources with the social benefits of recreation and electricity generation. Under the proposal (summarized in Table 7-1), the lake would remain full during the prime recreation season of July into September. The draw down of the lake would begin in September in order to expose alluvial deposits at the mouths of lake tributaries to the channel carving action of tributary flows during the fall rainy period in November and early December. The spring refill schedule is designed to provide access to the tributaries for spring spawning cutthroat trout, and to achieve usable lake levels for recreational boating in June. It is also intended to maintain sufficient storage capability to moderate high runoff releases into the Chelan River, preventing scouring of fish habitat that can occur at very high flow levels. The refill schedule and maintenance of full lake levels during summer affect both power generation and flow releases into the Chelan River.

Table 7-1: Average lake levels (feet, USGS) for the original license, existing license, and proposed lake level cycle (Chelan PUD 2001b)

Day	Original License (1927-1981)	Existing License (1981-2000)	Working Group Proposal ¹
January 1	1090.7	1091.7	1089.2
February 1	1088.4	1089.2	1087.1
March 1	1086.6	1087.1	1085.7
April 1	1085.6	1086.3	1085.4
May 1	1087.6	1088.0	1087.8
June 1	1094.8	1094.4	1095.2
July 1	1099.3	1099.2	1099.3
August 1	1099.7	1099.7	1099.7
September 1	1098.8	1099.5	1098.9
October 1	1096.9	1098.3	1097.4
November 1	1094.7	1095.8	1094.3
December 1	1092.9	1094.2	1091.8

¹ Natural Sciences Working Group (PME14)

The lake level management approach is intended to moderate high runoff. The proposed approach will prevent excessively high spill levels and provide a number of advantages,

*Chelan River Biological Evaluation
and Implementation Plan*

including: 1) reduced impacts on aquatic biota in the bypassed reach of the Chelan River from high peak spill levels; 2) benefits to aquatic biota by providing conditions in the bypassed reach of the Chelan River that more closely mimic the natural hydrograph; 3) more flow in the tailrace in early spring (April and May) for steelhead egg incubation and fry emergence; and 4) reduced impacts on power generation.

2.4 Lake Chelan – Recreation

Recreation is a major designated, existing use of Lake Chelan, and Chapter 11 of the Comprehensive Plan contains a number of recreational improvements and enhancements for public access and use of Lake Chelan during the prime recreation season. Other than short-term effects of construction (dock repairs, shoreline stabilization, etc.), most of the recreation enhancements on the lake have no relationship to water quality, with the exception of commitments to refill the lake earlier in the summer.

2.5 Chelan River – Recreation

An additional recreational component, trail access to the Chelan River, relates directly to the beneficial uses and water quality of the Chelan River. Chelan PUD will provide access to the Chelan River through the development and implementation of a non-motorized, non-paved, multi-use trail just below the dam (Reach 1) in the Chelan River bypassed reach. The trail will be constructed out of the high water and shoreline zone, thus preventing any adverse effects to water quality from the construction. The trail will improve the opportunities for recreational use and enjoyment of the aesthetic improvements to the Chelan River resulting from the flows and channel enhancements being proposed.

2.6 Chelan River Biological Evaluation and Implementation Plan

The CRBEIP has been developed by Chelan PUD in cooperation with the NSWG as a balanced approach to restoring the Chelan River to provide a functional riverine ecosystem capable of supporting native fish species while maintaining the existing beneficial uses of the waters of Lake Chelan and the Chelan River by the Project for lake recreation and generation of electricity. As outlined in the above description of current Project operations, there is currently no year-round instream flow in the bypassed reach of the Chelan River. Under the CRBEIP, a year round instream flow would be provided for the first time in approximately 75 years.^{*}

In coordination with the NSWG, Chelan PUD funded a number of studies in the Chelan River bypassed reach to examine the effects of various flow regimes on instream habitat for native and introduced fish species. The studies included an analysis of limiting factors such as water temperature, food resources, and barriers to anadromous fish.

2.6.1 Instream Flow Incremental Methodology (IFIM)

The Instream Flow Incremental Methodology was used to compare the amount of usable habitat for various native species at different flows through the Chelan River (R2 and IA 2000). In general, the instream flow analysis found that habitat availability in the upper two reaches of the Chelan River was greatest at flows between 60 cfs and 240 cfs for cutthroat trout and suckers (representative of native cool-water species) (Table 7-2). The habitat area for suckers was higher

* The existing dam and powerhouse were completed by 1927.

*Chelan River Biological Evaluation
and Implementation Plan*

at the lower end of the flow range, while cutthroat habitat area was greater at the upper end of the range. Total useable habitat area for both cutthroat and suckers was optimized at flows in the range of 80 cfs – 160 cfs. Flows at higher levels resulted in substantial reductions in useable habitat area, with the combined habitat area for cutthroat and suckers reduced to 80% of maximum area when flows were 600 cfs. The habitat area for cutthroat in Reach 1 was estimated for flows up to 5,000 cfs (R2 and IA, 2000), but useable habitat area for cutthroat was reduced to 20% of maximum at that flow level.

Table 7-2: Total habitat area (acres) versus flows in Chelan River

Flow (cfs)	Reach 1		Reach 2		Total	% of Maximum
	Cutthroat	Sucker	Cutthroat	Sucker		
40	2.59	4.53	1.12	1.68	9.92	73%
60	3.58	5.30	1.43	1.62	11.93	88%
80	4.34	5.58	1.59	1.47	12.98	95%
100	5.00	5.51	1.66	1.30	13.47	99%
120	5.51	5.30	1.67	1.14	13.62	100%
140	5.88	4.98	1.64	0.96	13.46	99%
160	6.09	4.68	1.59	0.79	13.15	97%
180	6.22	4.41	1.52	0.66	12.81	94%
200	6.31	4.18	1.44	0.57	12.50	92%
220	6.34	4.00	1.35	0.50	12.19	90%
240	6.33	3.87	1.28	0.46	11.94	88%
260	6.31	3.74	1.21	0.43	11.69	86%
280	6.32	3.64	1.16	0.42	11.54	85%
300	6.30	3.58	1.12	0.40	11.40	84%
400	5.98	3.55	0.96	0.17	10.66	78%
500	5.71	3.89	0.89	0.15	10.64	78%
600	5.71	4.22	0.86	0.16	10.95	80%
1,000	4.18	—	—	—	4.18 ¹	66% ¹
2,000	3.16	—	—	—	3.16 ¹	50% ¹
5,000	1.65	—	—	—	1.65 ¹	26% ¹

¹The estimated habitat area for flows above 650 cfs was not reported in R2 and IA, 2000. The total and percent of maximum habitat at flows of 1,000 - 4,000 is limited to habitat area for cutthroat trout in Reach 1. Source: R2 and IA 2000.

In Reach 4, the primary management interest of the NSWG was to provide habitat for spawning, incubation, and early rearing of anadromous chinook salmon and steelhead trout. In the existing channel, estimated usable area for spawning of these species was highest at a flow of 650 cfs. The total usable habitat area is scattered in small pockets and estimated to amount to no more than 2.8 acres for chinook and 2.2 acres for steelhead (R2 and IA 2000). Useable spawning habitat in the tailrace, where chinook currently spawn, was estimated to be 2.1 acres for chinook and 1.3 acres for steelhead at a powerhouse discharge of 2200 cfs.

2.6.2 Limiting Factors

The limiting factors analysis (R2 and IA 2000) indicated that natural conditions would be limiting to salmonid fish production in the Chelan River. These factors included unfavorable water temperatures entering the Chelan River from Lake Chelan in the summer; low nutrient

*Chelan River Biological Evaluation
and Implementation Plan*

levels in the water coming into the River from ultra-oligotrophic Lake Chelan and limited input of terrestrial organic matter; low abundance of invertebrates as a result of the low fertility and warm summer water temperatures; low availability of spawning gravel; and high potential for gravel scour during high flow spill events. The Chelan River receives water from Lake Chelan at temperatures that exceed the temperature that results in zero net growth (19°C) for trout and salmon from July through the early part of September (R2 and IA 2000).

Baseline data was collected by Anchor Environmental at four locations in the Chelan River: 1) upstream of the Project's intake; 2) discharge through the powerhouse; 3) water spilled into the bypassed reach of the Chelan River; and 4) mixed tailrace and bypassed reach water entering the Columbia River.

The study determined that water quality in the Chelan River upstream of the intake exceeds temperature criteria for Class A waterbodies during the summer months due to natural conditions at the lake outlet. These warm water temperatures resulted from natural lake stratification and associated seasonal warming of the epilimnion. Water temperatures at the lake outlet located upstream of the Project's structures ranged from 15.3°C to 21.0°C during the summer of 1999. During seven of the eight sampling events from June 2 through August 17 of that year, water temperatures entering the bypass reach exceeded 18°C (Anchor Environmental 2000).

The study compared water temperatures at the lake outlet to temperatures in the lower reach of the bypassed Chelan River and at the tailrace. During the seven sampling events, there was no significant change in temperature for water passing through the powerhouse into the tailrace. In other words, water passing through the intake, penstock, powerhouse, and into the tailrace was found to be the same temperature as water entering the intake. The study indicates that power generation does not adversely affect water quality discharged from the powerhouse. In fact, during the periods of the year when water temperature was greater than 18°C, water passing through the powerhouse remains cooler during the warmest parts of the day than would water passing through the bypassed reach of the Chelan River, which would be subject to further warming from solar radiation and contact with warm air (Anchor Environmental 2000).

Under these natural limiting conditions, the temperature of water spilled into the bypassed reach increased in seven of the sample flow levels (ranging from 80 to 3,600 cfs.) tested as part of the studies commissioned by the NSWG. The mixed temperature of the Chelan River below the confluence of the tailrace discharges and the bypassed reach was calculated using simple heat balance models and a constant total outflow (tailrace + bypass) of 2,000 cfs. The lowest temperature of the Chelan River below the confluence occurs when no water is diverted through the bypassed reach (Anchor Environmental).

The water temperature monitoring conducted in 1999 presents a brief "snapshot" of water temperature in the Chelan River. Additional data from the Project powerhouse (continuous samples from 1994-1998 (Figure 7-2) and monthly samples from 1960-1994 (Figure 7-3)) illustrates that water temperature at the lake outlet has historically been a limiting factor. This water temperature information was extensively supplemented in 2002, when baseline information was collected for calibration of the temperature model. Water temperatures were collected every 30 minutes from seven locations, the Chelan River at the upstream face of the

*Chelan River Biological Evaluation
and Implementation Plan*

dam, at the end of the spill apron, at the ends of reaches 1, 2, 3 and 4 of the bypassed reach and in the powerhouse discharge. The water temperatures were collected over a broad range of flows (80 cfs – 6,000 cfs) between June 11 and August 20. This temperature data is summarized in Appendix A of the CRBEIP. Additional continuous water temperature information will be conducted throughout the monitoring and evaluation period of the CRBEIP, which will be used to assess the interaction between water temperature, Project operations and biological response of the aquatic organisms in the Chelan River.

2.6.3 Barrier Analysis

The barrier analysis study by R2 and IA (2000) concluded that five natural barriers evaluated in the study would be impassable to steelhead trout and other anadromous salmonid species at most flows. Three of the barriers were impassable at all flows based on passage criteria for steelhead trout. Based on these results and the lack of historic evidence indicating the presence of anadromous fish in Lake Chelan (Hillman and Giorgi 2000), the Chelan River is only suitable for anadromous fish in Reach 4. For this reason, the NSWG decided to manage the upper three reaches of the Chelan River for native, non-anadromous species, and to focus the management of Reach 4 on the anadromous species.

2.6.4 Considerations and Investigations of the Working Group

The NSWG debated at length the benefits and detriments of two alternative concepts for restoration of the Chelan River. One option was to provide flow levels that maximized useable habitat area in the existing flood-scoured river channel while recognizing that the area had poor habitat characteristics. The second option was to use a lower flow while enhancing physical habitat and constructing a new streambed (side channel) protected from high flow scour.

The NSWG sought the services of Stillwater Sciences, a consulting firm experienced in fluvial geomorphology and watershed and river restoration projects, to conduct an independent evaluation of the potential for restoration of the Chelan River. The NSWG directed the consultant to develop a contractor-recommended alternative for instream flows and stream habitat restoration after reviewing the alternative concepts, information gathered from relicensing studies pertinent to the issue, and scientific literature. The NSWG (with principal direction from the regulatory agency caucus¹) developed six objectives for restoration of the Chelan River. The objectives presented to Stillwater Sciences were:

- Establishment of Westslope cutthroat trout populations in the upper reaches;
- Establishment of instream flow;
- Development of ecosystem parameters that reflect seasonal variations in flow;
- Establishment of summer steelhead and summer/fall chinook salmon populations in the lower reach;
- Physical habitat modifications in the lower reach; and
- Assurance that physical habitat modifications and perennial flows result in negligible effects on lake fisheries and lake elevations while continuing to provide flow for power production.

¹ The regulatory agencies formed a caucus committee to deliberate on instream flow issues as they related to their respective management responsibilities. The "caucus" reported joint regulatory agency positions on flow recommendations to the NSWG.

*Chelan River Biological Evaluation
and Implementation Plan*

The caucus put the highest priority on maintaining a perennial flow regime that reestablishes naturally functioning ecosystems in the Chelan River. The second priority was management of Reach 4 for summer/fall chinook and steelhead. The third priority was management of Reaches 1, 2 and, 3 for cutthroat trout and other indigenous species.

Stillwater Sciences performed an extensive review of the hydrological, geological, water quality and biological factors that will influence the restoration of the Chelan River and the attainment of the objectives stated. It determined the most significant factors to be the following:

- The mean monthly flow of the river under natural conditions ranged from 641 cfs in winter to peak flows in June-July of 6,462 cfs (1.5 year frequency) to 15,174 cfs (10 year frequency);
- The effect of storage and winter generation reduced the magnitude of peak annual flows in low flow years (34% from 6,462 cfs to 4,262 cfs). However, the Project had less of an influence on the magnitude of peak flows in high runoff years;
- The bedload properties of the Chelan River are anomalous relative to other rivers because it has the flow regime of a 924 square mile basin, but only derives sediment from the lower 4.0 miles of the river. Sediment is very coarse and transported only during very high flow events. It is delivered to the channel via local mass wasting events or erosion of the bed and banks;
- Reach 4 is a braided alluvial fan, potentially very unstable and characterized by large cobbles and boulder substrate constituting 94 percent of the wetted area during moderate flows (650 cfs);
- Mean monthly temperatures in Lake Chelan range from 4°C in the winter to over 20°C in July, and the water temperatures in the Chelan River follow the same trend, which is a function of the morphology of Lake Chelan;
- Water entering the Chelan River is low in phosphorous and other nutrients;
- The majority of vegetation in the Chelan River corridor is not riparian, but rather dry land adapted shrub steppe community. Pre-Project historical photographs indicate the composition, extent, and condition of riparian vegetation are substantially unchanged since the pre-Project period;
- The potential width of the riparian zone and density of riparian vegetation independent of baseflow conditions is constrained. The arid climate, steep moisture gradient in the soil at the active channel/floodplain boundary, and high scouring forces during peak flows likely exceed the physiological limits of long-term survival for most riparian plants.
- Macroinvertebrate production will likely be limited by a combination of low nutrient levels, limited allochthonous inputs of organic material due to limitations to development of riparian vegetation, and high water temperatures;

*Chelan River Biological Evaluation
and Implementation Plan*

- Long-term data from powerhouse records indicate that the water temperatures in the tailrace (representative of water entering the Chelan River from Lake Chelan) often exceed the optimal growth threshold for chinook and cutthroat from May through mid-October, and regularly exceed the level for zero net growth of fish. These temperatures are the result of lake conditions, not an effect of the Project.

As directed by the NSWG, Stillwater Sciences investigated three flow levels for rearing (80, 115 and 150 cfs) and four flow levels for spawning (160, 200, 275, and 350 cfs), with spawning flows provided to Reach 4 from either the dam (flow down the Chelan River) or flow pumped from the tailrace to Reach 4. Reaches 1 and 2 were evaluated for cutthroat trout rearing and spawning habitat in the existing river channel. Reach 4 was evaluated for potential spawning and rearing habitat for chinook salmon and steelhead trout if the channel was mechanically altered to enhance the habitat potential above the capabilities of the existing channel.

Under these conditions, total rearing habitat for cutthroat trout ranged from 5.8 acres at 80 cfs base flow to 7.6 acres at 150 cfs, while spawning habitat changed from 0.49 acres at 80 cfs to 0.79 acres at 150 cfs. Increasing flows in the fall for salmon spawning in Reach 4 was shown to decrease rearing habitat for cutthroat trout in Reach 2, while not substantively improving rearing habitat in Reach 1. Water temperatures and food availability limits the suitability of the habitat for cutthroat trout, and may play a greater role than flow levels in Reaches 1 and 2 (Stillwater Sciences).

In Reach 4, Stillwater Sciences (2001) analyzed the potential of various trapezoidal channel widths (30, 40, 50, 60 and 70 feet) at the different rearing flows (80, 115, and 150 cfs) and spawning flows (160, 200, 275 and 350 cfs) using Manning's equation to assess average hydraulic conditions. Although the channel would not maintain its trapezoidal form, it will adjust itself to a stable condition once flows are added and the method is suitable for comparison of alternative widths and flows.

The Stillwater Sciences (2001) study recommended a stream channel configuration that would provide good spawning gravel and velocities for chinook salmon in some areas and somewhat steeper gradient boulder and riffle in others (section 3.1). Stillwater Sciences concluded that the overall gradient through Reach 4 would require the higher velocity, higher gradient sections in order to provide the more preferred conditions in the spawning area. The goals of increasing habitat diversity and sinuosity in Reach 4 also led to the recommendation that the reconfigured channel have different gradient sections. The higher gradient sections, including the uppermost 700 feet of Reach 4, will be too steep in gradient (0.011) to provide rearing or spawning habitat for chinook salmon, but will be within the preferred range for steelhead trout. The 400-foot segment of Reach 4 just above the backwater effect of the Rocky Reach reservoir was also too high in gradient (0.010) to provide optimal conditions chinook salmon spawning and rearing habitat (Stillwater Sciences). However, localized pockets of habitat in the lee of boulders or at the stream margins could develop as the stream stabilizes. For steelhead trout, the higher gradient sections of Reach 4 could provide rearing habitat with suitable velocity cover from large cobbles and boulders, with gravel patches also likely to be suitable for steelhead spawning.

*Chelan River Biological Evaluation
and Implementation Plan*

In the middle 500-foot section of Reach 4, the lower gradient (0.0039) produced more moderate velocities. The velocity requirements for chinook salmon spawning could be met at some combination of flow for all channel widths except at 350 cfs. At 350 cfs, the channel width would need to be greater than 70 feet to reduce velocity. The relationship between channel width, velocity and depth at the different flows did not produce an ideal combination for the simple trapezoidal channel. There were no flow/channel width combinations that satisfied both depth and velocity criteria because velocities slow enough for spawning occurred at depths that were too shallow for spawning (Stillwater Sciences). However, results indicated that with inclusion of boulder placements, and as the channel stabilizes over time, water depth will vary somewhat and it is likely that there will be areas with adequate depth, velocities, and substrate for chinook salmon and steelhead spawning (Stillwater Sciences). For example, average velocities in this section of Reach 4 are too high for rearing emergent fry, but velocity cover behind boulders and in large cobble or other cover along the channel margin will provide rearing habitat for chinook salmon and steelhead trout.

Stillwater Sciences also evaluated the stability of spawning-sized gravels in Reach 4 using Shields stress analysis and a flow of 4,500 cfs, which is slightly higher than the 1.5-year recurrence flow. The analysis determined that the gravels will be stable at 4,500 cfs, but may need to be replaced following higher flows.

The lower 480 feet of Reach 4 is backwatered by the Columbia River and could not be modeled. This reach is low gradient with suitable substrate and at spawning flow levels will likely increase chinook and steelhead spawning habitat.

Stillwater Sciences concluded that adding suitable substrate to the Project tailrace upstream of the spawning habitat currently used by chinook salmon would be the most feasible, durable, and effective approach to increasing production of chinook salmon and steelhead in the Chelan River. It recommended that the tailrace modification have a varied morphology with alternate bars, rather than a uniform morphology and depth. This morphology would provide a range of velocities and depths and is the design most likely to increase spawning and rearing habitat for both chinook and steelhead. The water surface elevation at the tailrace would increase by less than one foot with a constructed channel.

2.6.5 Working Group Flow Proposal

The NSWG, using the fundamental recommendations made by Stillwater Sciences (2001), reached agreement and set forth a proposed flow level of 80 cfs for the bypassed reach of the Chelan River. In addition, the NSWG provided for an annual spring runoff flow to simulate a natural hydrograph in all but low flow years. The NSWG selected spawning flows of 320 cfs, to be provided by the flow coming through the Chelan River and supplemented by pumping from the tailrace.

The year-round minimum flow level is 80 cfs with a spring/early summer flow increase to mimic the natural hydrograph e.g., provide flushing flows. The spring/early summer flow increase is variable, depending on the level of winter snow deposition and runoff forecast. In dry years, when the runoff is predicted to be less than normal (within the 80% exceedance range of historical runoff volumes), then only the 80 cfs minimum flow would be released. In average

***Chelan River Biological Evaluation
and Implementation Plan***

water years, when the runoff is predicted to be normal (within the 21% - 79% exceedance range or 60% of the years based on historical records), then a 200 cfs minimum flow would be released from May 15 through July 15. The exact timing of the flow increases could change depending on climatic conditions (spring temperatures or rain) and biological evaluations. In wet years, when runoff is predicted to be greater than normal (within the 20% exceedance level), then a 320 cfs minimum flow would be released from mid-May through mid-July. Minimum flows greater than 80 cfs would be subject to the ramping schedule specified in section 3.2.

Table 7-3: Natural Sciences Working Group Chelan River Flow Proposal (Chelan PUD 2001a)

Reach	Dry year (cfs)	Average year (cfs)	Wet year (cfs)
1, 2 & 3 ¹	80 all months	80 July 16-May 14	80 July 16-May 14
		May 14 ramp up to 200	May 14 Ramp up to 320
		200 May 15-July 15	320 May 15-July 15
		July 16- ramp down to 80	July 16- Ramp down to 80
4 ² Spawning flow	80 + 240 pumped March 15 to May 15 and Oct. 15 to Nov. 30	320 by combination of spill & pumping March 15 to May 15 and Oct. 15 to Nov. 30 Incubation flow, as needed	320 by combination of spill & pumping March 15 to May 15 and Oct. 15 to Nov. 30 Incubation flow, as needed

¹ Flows measured at the dam by calibrated gate rating.

² Flows measured at the dam or through calibrated pump discharge curves.

In addition to these minimum flows, the CRBEIP includes criteria to define wet, dry, and average water years (above); ramping rates necessary to prevent stranding of aquatic organisms (section 3.2; Table 7-6); criteria for physical modifications to the stream channel and tailrace (section 3); and a monitoring and evaluation program (section 4). Chapter 8 of the Comprehensive Plan includes criteria for lake level refill management to avoid excessive spill levels and scouring flows in the Chelan River.

The Parties determined that this instream flow regime would establish a functional aquatic ecosystem supportive of native fish species in Reaches 1 and 2, and provide enhanced conditions for salmon spawning and rearing in Reach 4. In addition, the 80 cfs instream flow level would provide these ecological benefits while preserving other beneficial uses. Anchor Environmental also measured total dissolved gas, pH, and total suspended solids in the Chelan River, and found these parameters to be within the range specified by Washington State's water quality standards.

2.7 Discussion of Temperature Relationships in the Chelan River

Under the existing license and Section 401 certification, there is no minimum flow required. The Chelan River is currently dry from the end of the spring spill, which does not occur in all years, through summer, winter, and until the next spring. During years with spill, the flows in the Chelan River have ranged from a few hundred cubic feet per second to over 10,000 cfs during years with high runoff volumes. Past practices under the current license have focused on refilling the lake quickly to reach elevation 1098 by July 1 for recreation purposes. Once the lake is at 1098, all flow excess to the hydraulic capacity of the turbines (2200 cfs) has been spilled. In years with very large snowpacks or delayed runoff conditions, spill has been initiated prior to the

*Chelan River Biological Evaluation
and Implementation Plan*

lake reaching the 1098 fill level in order to limit the potential for bank erosion in the Chelan River channel. Spill flows are held to 8,000 cfs or less when feasible. Spillway flows have exceeded 9,000 cfs on 5 days since 1990, with all 5 of those days occurring in 1995. Spillway flows have occurred on 18 percent (832) of the days from January, 1990 through August, 2002 (4635 days).

Water from Lake Chelan enters the Project's influence at the Chelan Dam, located on the upper end of the Chelan River. The Chelan River has a natural shallow area near the outlet to Lake Chelan that controls the depth of water from the lake that enters the Chelan River. The penstock for the Project draws water from the Chelan River at a depth of 1068 (top of intake tunnel) to 1061 (bottom of tunnel).

2.7.1 Chelan River Thermodynamics – Site Potential

Lake Chelan water entering the Chelan River is naturally warm in the summer, generally exceeding the salmonid preference limit of 18°C from June through September. Water temperature information from 1994 – 2002 shows that the water temperatures in Lake Chelan increase substantially from May – August. The initial temperature coming in from the lake is generally below 18°C in May, and ranges from 15°C - 20°C in June, 17°C - >24°C in July, 20°C - >24°C in August, and 17°C - 23°C in September (Figures 7-2 to 7-6). Temperature data collected from cooling water intakes at the powerhouse (Figure 7-2, Figures 7-4 to 7-6) track the water temperature. The temperature measured at this location represents the temperature of water entering the penstock intake from upstream of the Project's influence since water does not change in temperature within the penstock. Independent temperature measurements from the USGS water quality database show that maximum temperatures in the Chelan River upstream from the Project's influence can exceed 25°C, and will exceed 23°C in most years at some point during summer (Figure 7-3). The water temperature in the upper section of the Chelan River, upstream from the spillway, is the result of natural warming in the relatively shallow Wapato Basin of Lake Chelan.

As water flows through the Chelan River above and below the spillway, the water will either warm or cool, depending on ambient weather conditions. Lower flows are more responsive to weather than higher flows, and maximum daily water temperatures are generally higher under lower flows. During the summer months, water warms as it passes through the upper Chelan River. The temperature model predicts some warming would occur, even during discharges of several thousand cubic feet per second. Thus, water temperatures in the Chelan River are subject to some daytime warming under natural inflow levels (Appendix A, Figure 27), as well as under flow levels provided in the CRBEIP.

At flows above 1,500 cfs, water temperature varies on a diurnal cycle by a moderate amount, ranging from a few tenths of a degree up to 0.5 degrees C under extreme climatic conditions (temperature model results, Appendix A). At lower flows, diurnal changes in temperature are greater, with the water heating during the day and cooling during the night. At 80 cfs, the temperature difference between daytime high and nighttime minimum ranges from 2 C - 5 C during hot weather from June through August. The aquatic community experiences a more or less constant temperature regime at high (above 1,500 cfs) flows, whereas at lower flows the temperature is significantly cooler at night and experiences a temperature spike in the afternoon.

*Chelan River Biological Evaluation
and Implementation Plan*

Thus, at higher flows the river temperature would be near the temperature of the water exiting Lake Chelan throughout the 24-hour period, while at lower flows the water temperature would be significantly cooler at night and warmer during the afternoon. Water temperatures at lower flows would be significantly cooler than the temperature at higher flows in the fall (Figure 7-7) due to the cooling effect as air temperatures and solar radiation decrease.

The site potential for water temperature in the Chelan River is primarily determined by the initial temperature at the spillway and the configuration of the river channel. The daily mean temperature is primarily controlled by these factors, and is relatively consistent over a broad range of flows (4.2 in Appendix A). As previously noted, the Chelan River can never attain the salmonid preference limit of 18°C because the water coming from Lake Chelan exceeds this temperature by several degrees C for much of the summer and early fall. The degree of the daily heating and cooling cycle in response to climatic conditions and solar radiation can be manipulated to some extent through regulation of flows, limiting heating during June and July with higher flows while increasing cooling in late summer-fall by reducing flows (section 5 in Appendix A). However, other factors besides flow can influence temperature response. The main influence on heating is exposure to solar radiation. This is a function of the width/depth ratio of the river channel and shade. In addition, the biotic community, particularly fish, may find refuge from daytime temperature spikes if groundwater discharges are significant in relation to the total river flow. These factors are discussed below.

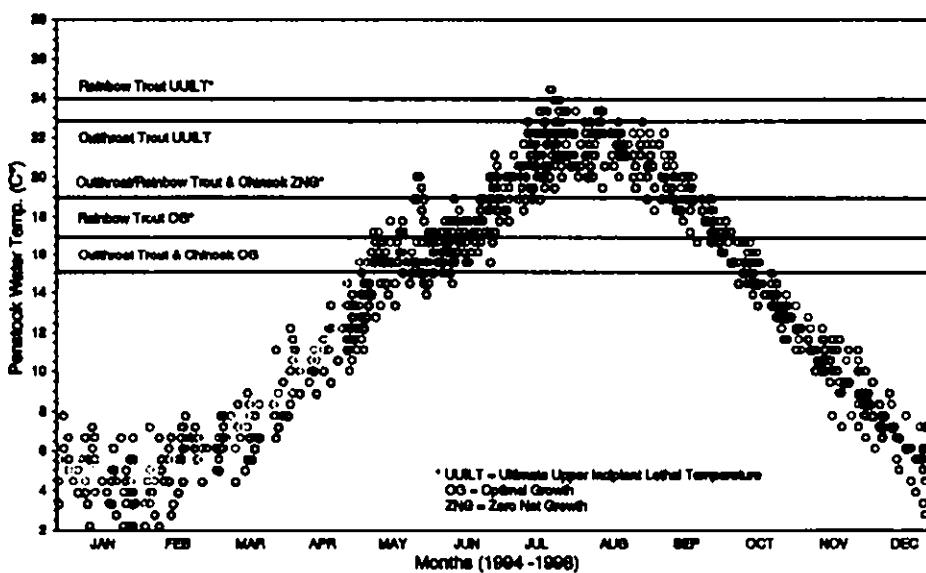


Figure 7-2: Water temperature measurements obtained at the Lake Chelan Hydroelectric Project powerhouse from 1994 through 1998 (R2 and IA 2000)

*Chelan River Biological Evaluation
and Implementation Plan*

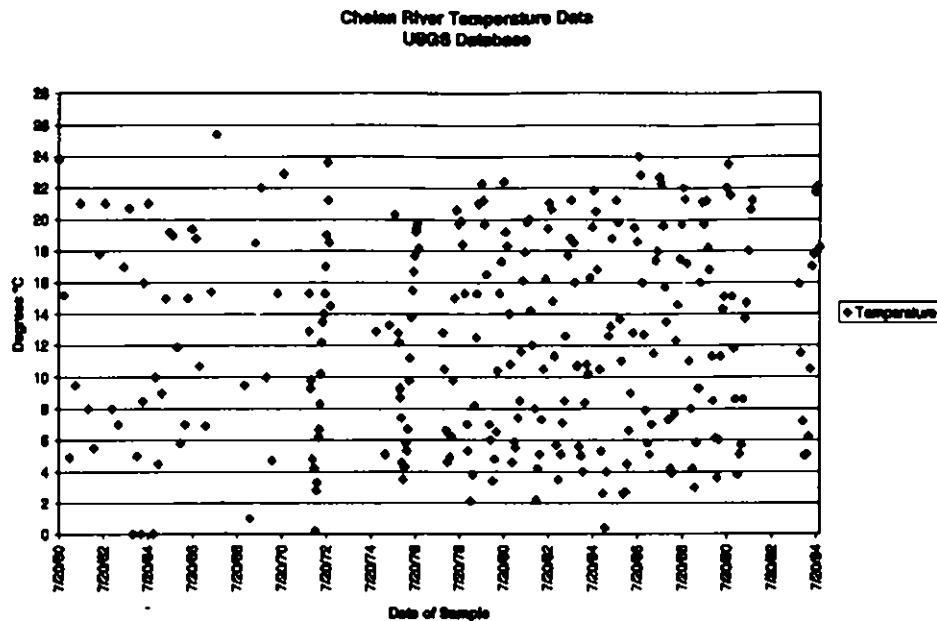


Figure 7-3: Water temperatures recorded in the Chelan River during monthly water quality sampling (USGS Database).

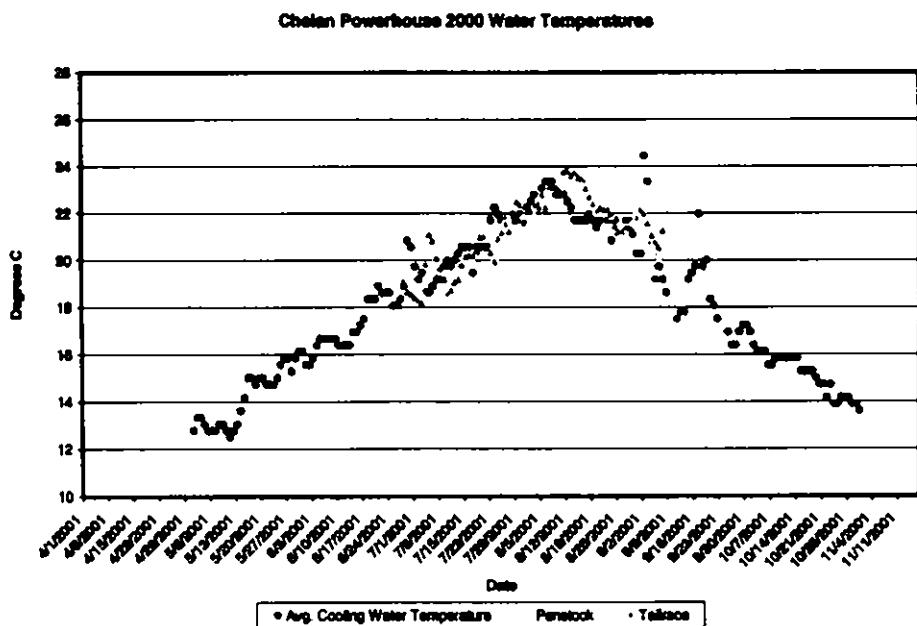


Figure 7-4: Water temperatures recorded in the Chelan River in 2000 (combination of measurements at the spillway and at the powerhouse)

*Chelan River Biological Evaluation
and Implementation Plan*

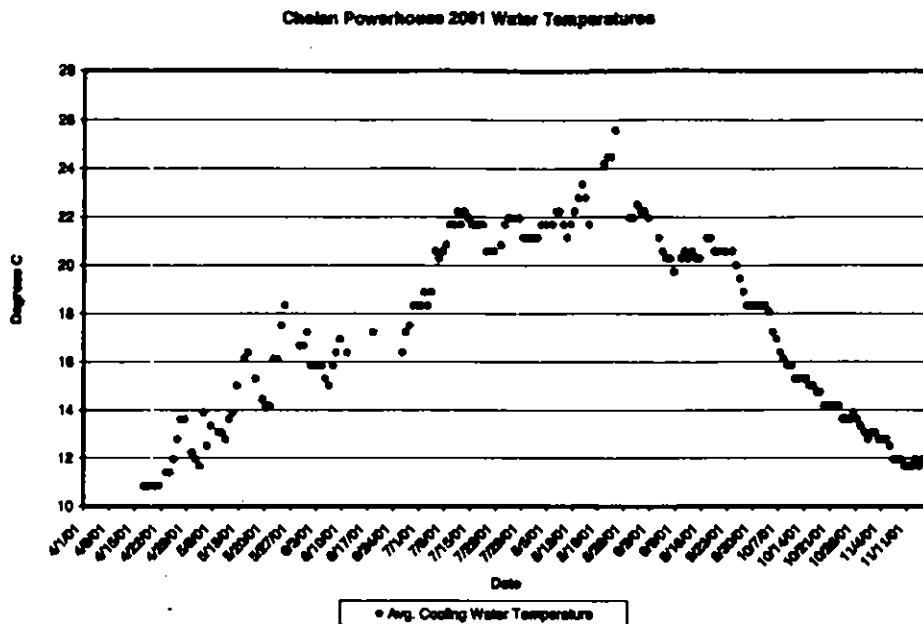


Figure 7-5: Water temperatures recorded in the Chelan River at the spillway in 2001 (as measured at the powerhouse).

*Chelan River Biological Evaluation
and Implementation Plan*

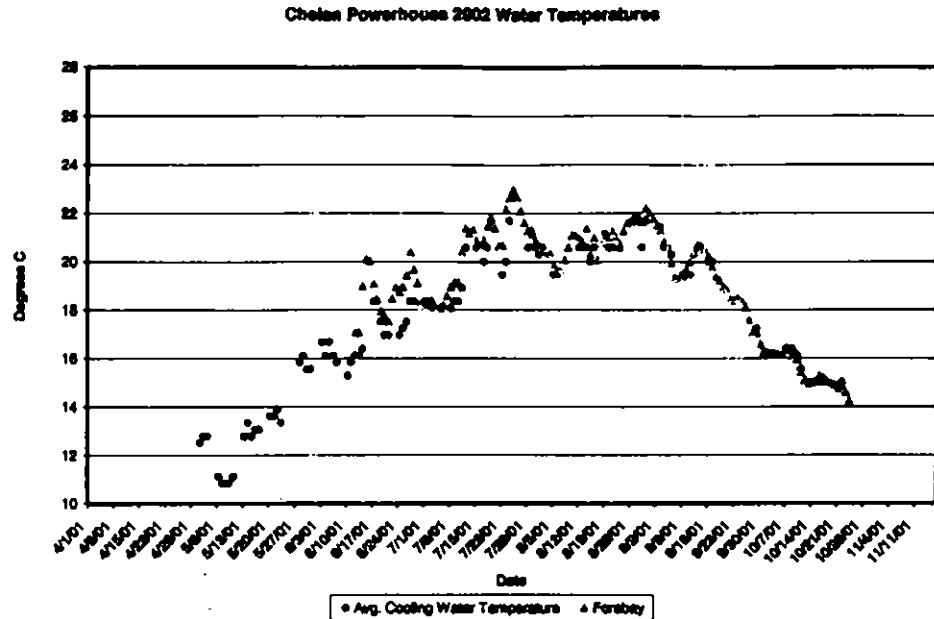


Figure 7-6: Water temperatures recorded in the Chelan River in 2002 (combination of measurements at the spillway and at the powerhouse).

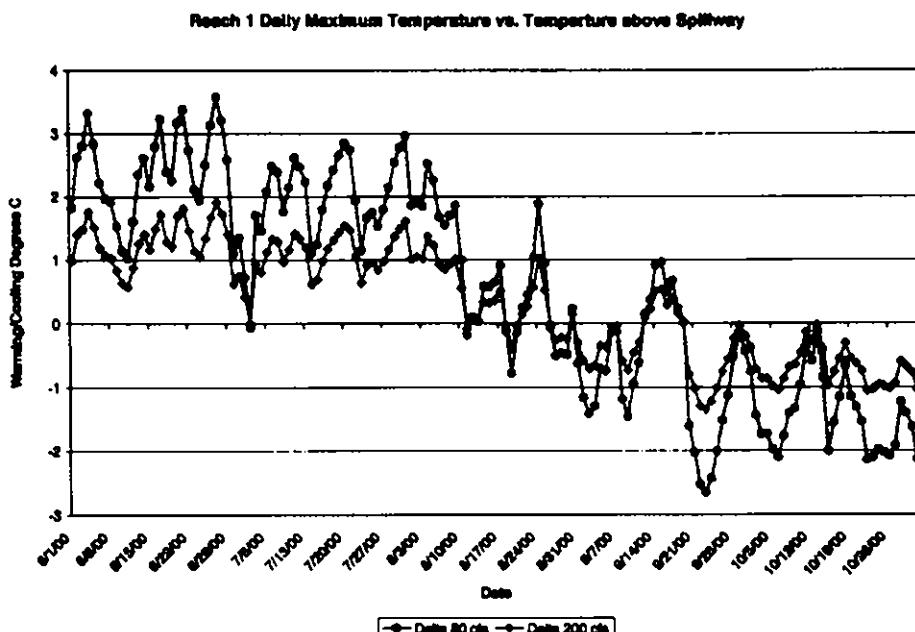


Figure 7-7: Predicted temperature response of daily maximum temperature of the Chelan River at flows of 80 cfs and 200 cfs.

*Chelan River Biological Evaluation
and Implementation Plan***Influence of Fluvial Process on Thermodynamics**

The existing Chelan River channel has been formed by high flow events, on the order of 15,000 – 20,000 cfs. The channel in Reaches 1 and 2 is a relatively flat-bottomed U-shaped channel. For the past 75 years, the Chelan River has not experienced the continuous flows throughout the year that lead to definition of a low flow channel thalweg. Consequently, the current condition causes water at low flows to be spread across a broad area, particularly in the riffles and glides. The channel width/depth ratio will slowly decrease due to natural bed load movement once year-round minimum flows are established. The rate of low flow thalweg formation can be accelerated through use of hydraulic channel structures, boulder placement, and other established techniques. Also, the proximity of the low flow thalweg to steep, southern banks of the river channel can be increased through use of in-channel structures that direct the thalweg toward these sources of topographical shading. In Reach 4, the habitat enhancement channel reconfiguration proposed in the CRBEIP will greatly reduce the width-to-depth ratio in this section of the Chelan River, as compared to current conditions.

2.7.2 Other Major Influences

The Chelan River flows through a rocky, arid landscape that does not readily support riparian vegetation. Further, the extreme volatility in the annual hydrograph, with periodic floods exceeding 15,000 cfs, has scoured the soils from the stream margins. Shade from riparian vegetation will always be minor, which is a major contributing factor to the temperature response of the river in summer.

The Chelan River flows through a combination of glacial deposits and bedrock. Moraine and outwash remains from the glaciation of the area are found throughout Reach 1, while bedrock predominates in Reach 3. The glacial deposits in Reach 1, although somewhat consolidated and slightly cemented in many areas, are permeable in many areas, and sub-surface flow is observable in many locations in Reach 1 and Reach 2. After the cessation of spill, the river channel in the lower end of Reach 1 and in Reach 2 continues to have flows of 2-3 cfs for several weeks, and deep pools persist throughout the year in Reaches 2 and 3. At higher river flows, these sources of groundwater are immediately diluted by turbulence from the streamflow. However, at low flows the groundwater and sub-surface river flow may provide zones of cooler water where fish could find refuge during the daytime peak temperatures. Nighttime temperatures in the Chelan River will be cooler at low flows than at high flows. Thus, since the water temperature naturally occurring in the Chelan River from June through September is unfavorable for cold water species, the low flow combination of cooler nighttime water temperatures and groundwater refugia during the day could be advantageous for cutthroat trout in Reaches 1-3.

In Reach 4, the proposed reconfiguration of the river channel discussed in section 3.3 will reduce the heat load that comes from solar radiation. Daytime temperatures can also be moderated, if necessary, through use of the pumping station, which will have water from the penstock that has not been heated since being drawn from the upper Chelan River. In the late summer and fall, the greater cooling that will occur at lower flows will be beneficial to chinook salmon that are spawning in a declining temperature regime. The 80 cfs entering Reach 4 will be 1-2 degrees cooler than water coming from Lake Chelan in early October, when the water temperature at the

*Chelan River Biological Evaluation
and Implementation Plan*

spillway can still be 16-18 degrees C. Chinook spawning success is greater when water temperatures are below 16°C.

2.7.3 Temperature Modeling

A thermodynamic stream temperature model, SNTEMP, was developed for the NSWG in order to evaluate temperatures that will occur in the Chelan River under different climatic conditions and at different flows. The SNTEMP model has been fully calibrated with empirical measurements collected in 2002. Predictions of Chelan River temperatures have been made for a variety of flows and climatic conditions. Simulations using ambient climatic conditions and initial water temperatures from 2000, 2001 and 2002 were also generated. The SNTEMP model could not be used to predict the temperatures for the proposed habitat modification in Reach 4 because the channel geometry has not been defined. Thus, predictions of temperatures in Reach 4 are based on water flowing through the existing channel, without modification. Similarly, the temperatures predicted for Reaches 1 and 2 are for the existing channel condition. A sensitivity analysis of channel width, to determine or estimate the potential value of channel modifications to improve temperature conditions was also evaluated (Chelan PUD 2002). A detailed analysis of potential water temperatures at different flow regimes is contained in Appendix A.

In summary, the SNTEMP model predicts that stream temperatures in the Chelan River increase in the daytime and cool at night in proportion to the difference between the ambient climatic conditions and the temperature of water arriving at the spillway. The greatest increases in daily maximum water temperature occur in Reach 1.

The temperature response of the Chelan River to lower or higher flows depends primarily on the initial temperature entering the river from Lake Chelan, the climatic conditions and flow. In general, the initial temperature coming from Lake Chelan is cooler than the daily average air temperature in June and early July, but tends to be warmer than the air temperature in August and September. Consequently, the Chelan River will tend to have increases in water temperature in early summer and water temperatures will tend to cool in late summer and fall. The quantity of flow in the Chelan River influences the amount of heating or cooling that occurs and the range of daily fluctuations in temperature.

During extremely warm climatic conditions, the temperature response in Reach 1 at high flows (1,500 cfs and above) is limited from a few tenths of a degree to 1/2 a degree centigrade above and below the temperature of water leaving the lake. The large water mass at high flows absorbs considerable heat without a corresponding temperature change and the water velocity carries the water mass past the areas in Reach 1 fast enough to limit exposure to solar radiation.

As flows decrease, daily fluctuations in temperature become more pronounced. The amount of daily temperature change at 600 cfs is roughly 0.3°C greater than at 1,500 cfs. At flows of 300 cfs, 200 cfs and 80 cfs, the temperature response predicted by the model for the highest recorded two weeks of extremely warm weather averaged 0.7°C, 1.0°C, and 2.2°C, respectively, at the end of Reach 1 (Figure 7-8).

*Chelan River Biological Evaluation
and Implementation Plan*

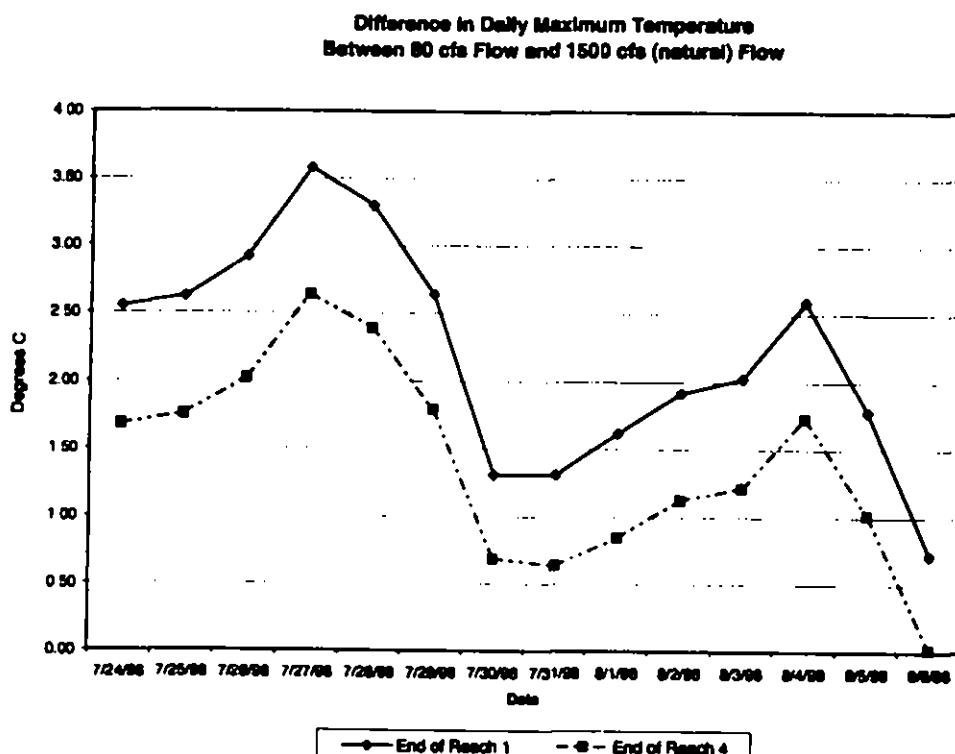


Figure 7-8: Temperature response in the Chelan River (during the warmest two-week period on record) at minimum flow of 80 cfs compared to a higher flow of 1,500 cfs, representing natural conditions (Chelan PUD 2002).

The effect of the proposed flow regime in the CRBEIP is to limit heating during the early summer by providing increased flow (200 cfs in average years, 320 cfs high flow years). In many years, there will be additional flow from the spillway in late June - July that will further reduce heating in the Chelan River during the month preceding and following the summer solstice. The summer solstice is the time of year when heating from solar radiation is greatest because azimuth of the sun is higher. The water entering the Chelan River is cooler in June and early July. Thus, although the potential for heating is high, the greater flows and cooler initial temperatures result in Chelan River water temperatures that are well within the tolerance range for cutthroat trout and cool water species.

In the late summer and fall, the 80 cfs minimum flow allows considerable cooling to take place in the Chelan River as the water temperature responds to cooler nighttime temperatures (Table 7-4). At this time of year the initial water temperature received from Lake Chelan is much warmer than the preferred temperatures of cutthroat trout. However, the 80 cfs minimum flow will result in significant cooling of water temperatures, beginning in the evening and continuing through mid-morning. This cooling effect provides several hours of water temperatures that are cooler than would be experienced with higher minimum flows. Water temperatures at the higher flows would remain near the initial temperature throughout the day.

*Chelan River Biological Evaluation
and Implementation Plan*

Table 7-4: Monthly average of increase (°C) above initial temperature in daily mean water temperature at the end of Reach 1 of the Chelan River for 80 and 200 cfs releases (Chelan PUD 2002).

Month	2000		2001	
	80 cfs	200 cfs	80 cfs	200 cfs
June	0.99	0.56	0.66	0.39
July	0.56	0.34	0.46	0.29
August	-0.55	-0.23	-0.34	-0.13
September	-1.74	-0.84	-1.28	-0.61
October	-2.15	-1.04	-2.21	-1.07

The proposed flow regime for the Chelan River avoids heating when natural temperatures are cooler and promotes cooling when natural temperatures are warmest. The NSWG flow proposal provides higher flows in June and July when heating from solar radiation is at its greatest level, then takes advantage of the greater cooling potential of lower flows in August and September, when water temperatures coming from Lake Chelan are at their peak levels.

2.8 Review of Biological Objectives and Site Limitations

The biological objectives developed by the NSWG for the Chelan River include the following:

- Establish a functional aquatic ecosystem throughout the Chelan River
- Provide spawning and rearing habitat for chinook salmon in Reach 4 and the tailrace
- Provide spawning and rearing habitat for steelhead trout in Reach 4 and the tailrace
- Provide rearing habitat suitable for cutthroat trout and other native species in Reaches 1-3, consistent with natural site potential (natural water temperatures may be a limiting factor).

These biological objectives have a number of potential natural limiting factors that could influence the species diversity of benthic organisms, the success of cutthroat populations in the summer months, and the population size of the various fish species. An extensive list of the potential limiting factors has been presented in section 2 (Background). Those limiting factors that are related to the operations of the Project or are the focus of section 3 (Management Considerations and Options Considered) are specifically discussed here.

Water temperature is a significant, naturally occurring limiting factor for the objectives of establishing a functional aquatic ecosystem and for establishing cutthroat trout habitat in Reaches 1-3. The high water temperatures in summer are likely to limit the species diversity of benthic organisms and could prevent cutthroat trout from persisting or prospering in the summer. Ultimately, the initial water temperature coming from Lake Chelan will be the determining factor for species diversity of the benthic community, independent from the Project's operations, because the incoming temperature is the greatest determinant of daily mean temperature. Water temperatures exceed the temperature of zero net growth of cutthroat trout for over three months every year. The water temperature is also unfavorable for production of preferred cutthroat food organisms from the benthic community. In addition, the water temperature entering the Chelan River is known to exceed the ultimate upper incipient lethal temperature for cutthroat in a significant number of years (Figure 7-2 and Figure 7-3).

*Chelan River Biological Evaluation
and Implementation Plan*

The natural landscape, which is arid, rocky and erosional, prevents establishment of significant riparian vegetation. The Project's use of storage capacity and spill management will greatly decrease the erosion and bedload instability that is the natural condition for the Chelan River. However, the flood-scoured river channel, poor soils and arid climate will likely prevent the establishment of a significant riparian plant community. The lack of a riparian corridor, with resultant leaf litter and other organic input to the river will further limit the species diversity and density of the benthic community.

The reconfiguration of Reach 4 of the Chelan River will likely provide good spawning habitat and fry rearing habitat for steelhead, but the Chelan River is not likely to produce steelhead smolts. Steelhead in the mid-Columbia River watersheds typically rear for 2-4 years in freshwater prior to smoltification and migration to the ocean. In their final year prior to smoltification, these fish are commonly over 6 inches in length. They require swift water habitats with deep pools, runs and riffles. Reach 4 is too short to provide habitat for a large population of steelhead pre-smolts and the summer water temperature regime is also unfavorable for their growth and survival. Steelhead production will likely be dependent on emigration of parr to the Columbia River for rearing to smolt size. Rearing habitat for emergent fry will be available in Reach 4 and success may be achieved if the fry can attain sufficient size to escape predators prior to migrating to the Columbia River.

Chinook salmon have been spawning in the Chelan tailrace for over two decades. Although success of this spawning is unknown, a spawning population has been evident every year since the 1980s. The fry currently migrate to the Columbia River within a short time after emergence. The survival rate of these fish is unknown, but the spawning population is increasing (although tag recoveries indicate that a high proportion of the spawning population is from returning hatchery fish). The proposed actions should increase both spawning habitat area and provide rearing habitat for newly emerged fry. The limited benthic food sources, particularly in the tailrace, may be the main limiting factor for rearing chinook fry.

*Chelan River Biological Evaluation
and Implementation Plan*

SECTION 3: MANAGEMENT CONSIDERATIONS AND OPTIONS INVESTIGATED

3.1 Habitat and Flow Options Considered

As stated previously in section 2.6.1, the IFIM analysis for Reaches 1 and 2 demonstrated, in general, that habitat availability in the upper reaches of the Chelan River was greatest at flows between 60 cfs and 240 cfs for cutthroat trout and suckers and that the total combined useable habitat area in Reaches 1 and 2 for both cutthroat and suckers was optimized at flows in the range of 80 cfs – 160 cfs, 95-100 percent of maximum.

Habitat area evaluations for Reach 4 included additional species, chinook salmon and steelhead. The key consideration for these species was the relationship between flow and spawning habitat. Spawning habitat in Reach 4 is primarily limited by lack of suitable substrate, regardless of flow. In the existing channel, a flow of 650 cfs provided the highest estimated useable area. However, a number of options for channel modification in both Reach 4 and the Project's tailrace offered more promise for enhancement of chinook salmon and steelhead trout spawning habitat than could be obtained by providing the 650 cfs flow to the existing channel. The NSWG selected an independent consultant (Stillwater Sciences) with expertise in fluvial geomorphology to evaluate a number of alternatives to provide habitat for spawning and rearing of chinook salmon and steelhead trout in both Reach 4 and the tailrace. The development of concepts and subsequent evaluations was done interactively between Stillwater Sciences and the NSWG.

The existing river channel in Reach 4 and the tailrace both currently lack habitat diversity necessary to support rearing of juvenile salmonids and other functions of a natural aquatic ecosystem. The CRBEIP includes habitat modifications to the river channel in Reach 4 and the tailrace. Reach 4 currently has little sinuosity and no large boulders or structure to create gravel catchments, scour pools and other habitat features. The CRBEIP proposes to use standard river habitat restoration techniques to accomplish the goals of providing and maintaining gravel areas for spawning, boulder placements for cover and pool formation, and increased sinuosity to moderate velocities and provide additional area and habitat diversity. Habitat modifications to Reach 4 are shown conceptually in Figure 7-9. Most of the modifications proposed in Reach 4 will be done by a bulldozer. The following are specific modifications proposed for Reach 4 sub-reaches identified in Figure 7-9:

3.1.1 Sub-reach 4.1

1. Create narrower/steeper channel
2. Use large boulder placement
3. Move channel away from road
4. Add/move gravel to channel

3.1.2 Sub-reach 4.2

1. Create wider (100' avg.)/flatter channel
2. Use large boulder placement
3. Add sinuosity of ~1.2
4. Move channel away from road

*Chelan River Biological Evaluation
and Implementation Plan*

5. Add/move gravel to channel

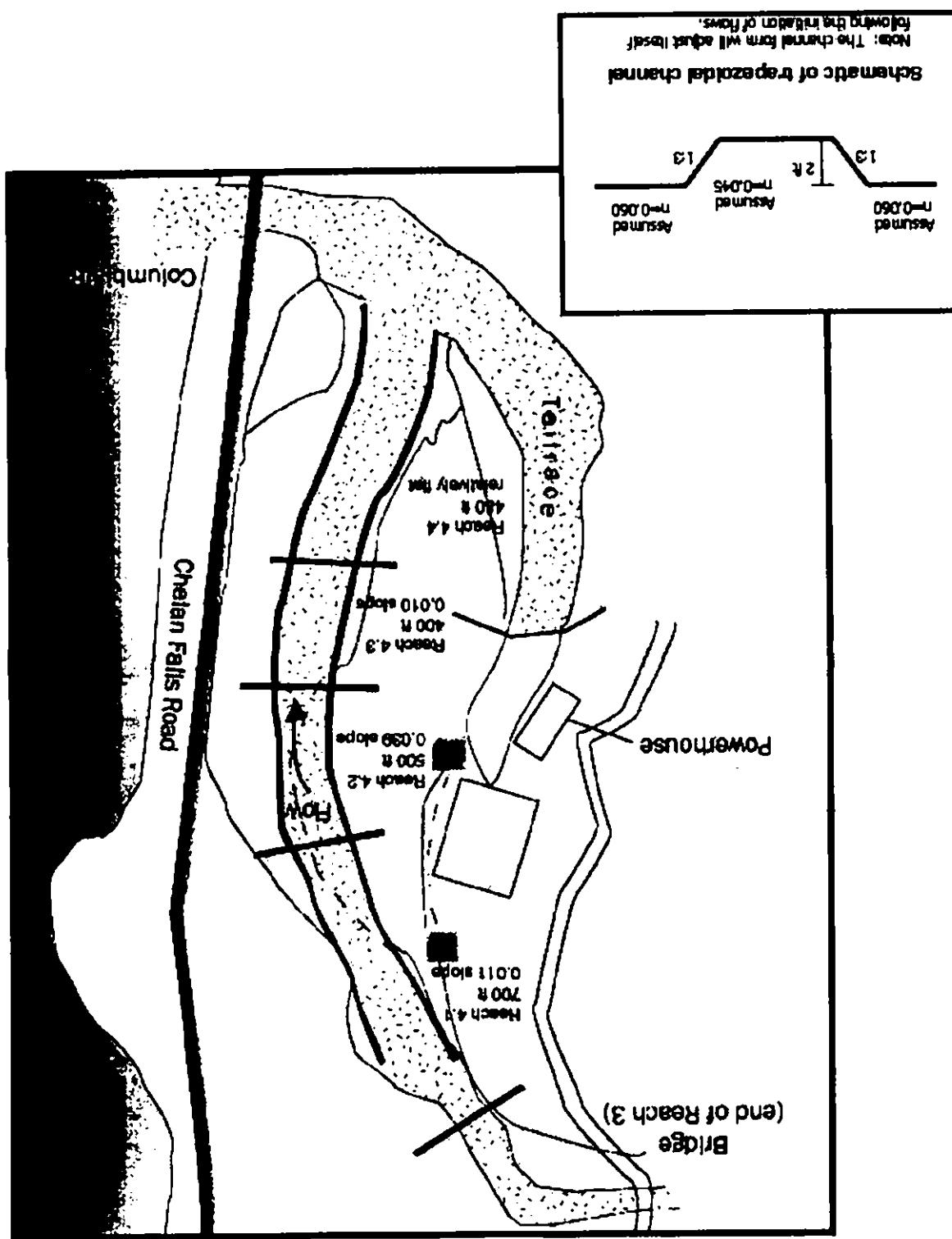
3.1.3 Sub-reach 4.3

1. Continue 100' channel width
2. Use large boulder placement
3. Add sinuosity of ~1.2
4. Add/move gravel to channel

3.1.4 Sub-reach 4.4

1. Continue 100' channel width
2. Use large boulder placement
3. Add sinuosity of ~1.2
4. Add/move gravel to channel
5. Align the downstream end of Reach 4 to provide constant flow across accessible spawning gravel in the confluence area to prevent redd dewatering during changes in river and powerhouse discharges.

Figure 7-9: Schematic diagram of the subreaches of Reach 4, including an example of the trapezoidal channel.



*Chelan River Biological Evaluation
and Implementation Plan*

3.2 Habitat Modifications in the Tailrace

The tailrace area upstream from the confluence with the bypassed reach of the Chelan River, will be modified with suitable sized substrate material to create braided bars with low velocity rearing and spawning habitat. This proposed modification is shown conceptually in Figure 7-10.

Maintenance of suitable spawning flows and adequate intra-gravel flow for incubation in the tailrace, if needed, will be maintained through operation of the powerhouse at minimum flow levels or through water pumped into the spawning gravel through perforated pipe laid into the tailrace streambed. The success of spawning and incubation through emergence will be addressed through the monitoring and evaluation program (see section 5).

*Chelan River Biological Evaluation
and Implementation Plan*

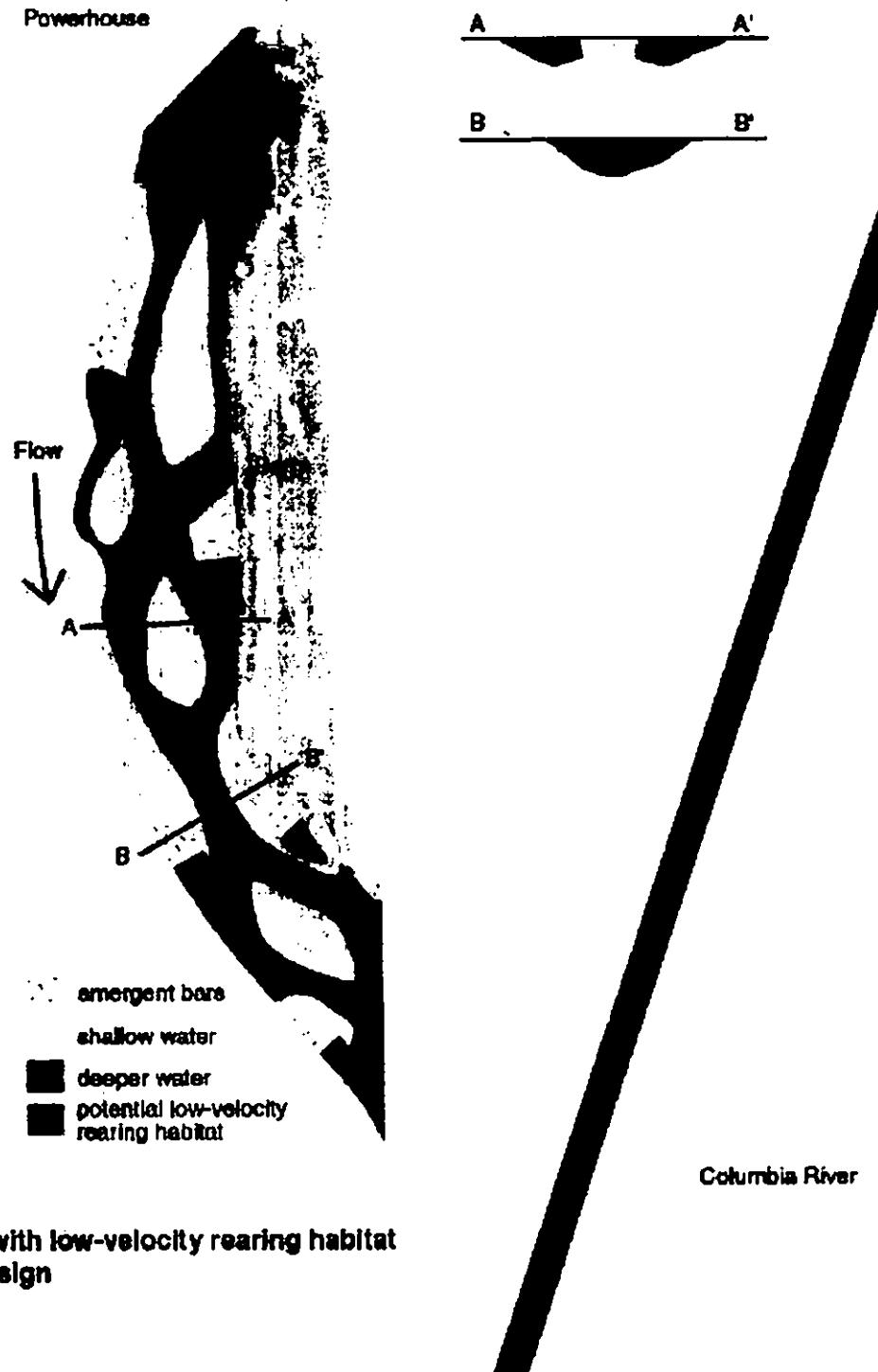


Figure 7-10: Braid bar emphasizing spawning and rearing habitat in the modified tailrace

***Chelan River Biological Evaluation
and Implementation Plan***

The minimum flow of 80 cfs through Reaches 1, 2 and 3 provides a balance between optimal habitat for native cool-water species (suckers and minnows), while providing adequate habitat availability for cutthroat trout (Table 7-5). Based on the instream flow studies and habitat utilization curves (IA and R2, 2000), the 80 cfs minimum flow in Reaches 1-3 provides 6.75 acres of adult cutthroat habitat (76% of maximum), 2.18 acres of sucker spawning habitat (80% of maximum) and 9.12 acres of adult sucker habitat (100 % of maximum). The 80 cfs flow is also sufficient to provide continuity between the reaches and promote establishment of riparian vegetation and a streambed benthic community. The plan to provide a spring period of higher flows in 80 percent of the years is also intended to restore natural aquatic ecosystem functions that are related to annual variations in the hydrograph. The higher flows will increase soil moisture during the spring growing season when riparian species are adapted to spread and multiply. In years when spill would not occur or comes too late to match the requirements of riparian species, the spring flow releases will ensure habitat continuity and provide for downstream movement of plant material and other food resources.

Table 7-5: Rearing habitat (acres) for adult or juvenile fish under different flow recommendations (Source: R2 and IA, 2000)

<u>Species</u>	<u>Flow Proposal</u>					
	<u>Working Group Proposal¹</u>		<u>Initial Agency Proposal²</u>		<u>Initial Chelan PUD Proposal³</u>	
	<u>Reaches 1,2 &3</u>	<u>Reach 4</u>	<u>Reaches 1,2 &3</u>	<u>Reach 4</u>	<u>Reaches 1,2&3</u>	<u>Reach⁴</u>
Smallmouth	11.0	2.0-3.0	6.6-5.9	0.8-0.5	10.1	3.8
Sucker	9.1	2.0-3.0	5.3-4.7	0.8-0.7	7.8	3.8
Rainbow	7.9	2.0-3.0	12.2-11.1	1.6-1.4	4.9	3.8
Cutthroat	6.8	2.0-3.0	8.0-7.4	1.0-0.8	4.3	3.8
Chinook Juvenile		2.0-3.0		1.4-1.0		3.8
Steelhead Juvenile		2.0-3.0		1.7-1.6		3.8

¹ Habitat area at flows of 80 cfs guaranteed.

² Natural habitat area at flows of 400 cfs and 650 cfs.

³ Flow during growth season (March 15 – November) of 40 cfs.

⁴ Assumes total wetted area of the enhanced stream is usable rearing habitat

In order to protect aquatic organisms from rapid fluctuations in water levels, ramping rates are generally established to allow fish to move into and out of shallow zones without being stranded when flows decrease. During the period when fry may be present, ramping rates will be set at approximately 2 inches per hour, until biological evaluations have determined the ramping rates necessary to prevent stranding of fish in the Chelan River. Water elevations at various flows and locations were recorded during the instream flow studies in the bypassed reach of the Chelan River (Bypass Reach (Gorge) Flow Releases Study – R2 and IA, 2000). As shown in Table 7-6, in Reaches 1 and 2, a flow increase of 179 cfs from the base minimum flow of 80 cfs changed the average water elevation in the channel by .69 feet (8 inches). In Reach 4, a change in flow of 422 cfs raised the water elevation by slightly more than one foot.

*Chelan River Biological Evaluation
and Implementation Plan*

Ramping rates do not apply when the hydraulic capacity of the Project has been exceeded by natural inflows and the lake is within one foot of being full (elevation 1099 feet).

Table 7-6: Natural Sciences Working Group Ramping Rate Proposal

Discharge (cfs)	Reach 1 Water Elevation (feet)	Discharge (cfs)	Reach 2 Water Elevation (feet)	Discharge (cfs)	Reach 4 Water Elevation (feet)
81	88.04	81	91.12	117	87.87
260	88.73	260	92.09	539	88.93
Difference	0.69	Difference	0.98	Difference	1.06

The approximately 8 – 12 inch difference in average water elevation measured closely approximates the changes that will actually occur in the bypassed reach of the Chelan River with the proposed minimum flows (e.g. 320 cfs to 80 cfs). Ramping flows down to minimum flow levels shall be done gradually over a period of a few hours, which will be adequate to prevent water elevations from increasing or decreasing by more than 2 inches per hour in the bypassed reach of the Chelan River. The effect of flow changes and appropriate ramping rates will be developed during the monitoring and evaluation period in the CRBEIP.

3.3 Water Temperature - Options Considered

The NSWG considered the impact of the various minimum flows on water temperatures in four main areas. As previously discussed, the relationship between initial temperatures, climatic conditions and minimum flows on water temperatures in Reaches 1 - 3 were balanced with the other physical aspects of fish habitat (velocity, depth, cover and substrate). The NSWG solicited the development of a model to explore these relationships and develop options that could improve the temperature regime without sacrificing the other habitat characteristics provided by specific flow levels. In Reach 4, the development of a pumping station, coupled with significant stream channel modification provides additional options for temperature management. The current temperature regime of the powerhouse discharge replicates the initial water temperatures coming from Lake Chelan, with no additional warming beyond naturally occurring warm water conditions. The final consideration was the effect of the flow regime on the thermal load to the receiving water, the Columbia River. The fact that water passing through the penstock does not warm is a key factor in the options available for temperature management of the habitat that will be provided in Reach 4. The temperature regime of the Project under the existing license has not been discussed previously. Therefore, that discussion begins below, with the additional options considered for temperature management in Reach 4 and Reaches 1-3 to follow.

3.3.1 Temperature Effects of Powerhouse Diversion

The diversion of water through the penstock provides water temperatures in the tailrace and below the confluence that are cooler in summer than would be water coming from the Chelan River under natural flows. This is because water passing through the Chelan River bypassed reach absorbs thermal energy from solar radiation and exposure to warm air temperatures, while water used for hydroelectric generation at the Project is not subjected to thermal loading. Overall, mixed flows from the bypassed reach and the powerhouse tailrace are below the temperature that would occur with natural flows during the summer (Anchor Environmental

*Chelan River Biological Evaluation
and Implementation Plan*

Thermal Energy Delivered to Columbia River at Different Bypassed Reach Flows
Two Weeks Hot Weather (7/24 - 8/5, 1998)

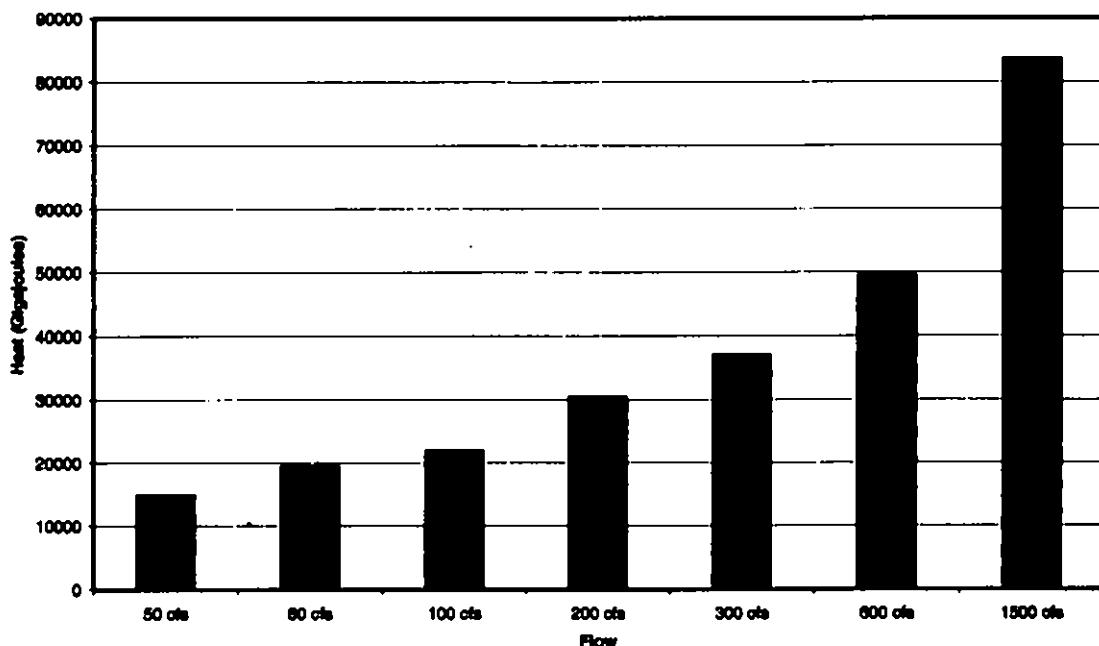


Figure 7-11: Thermal energy delivered to the Columbia River at different minimum flows to the Chelan River

3.3.2 Stream Channel Modification - Thalweg Formation

Temperature will increase in the Chelan River, regardless of flow level, when the river channel is broad and shallow. Since a main objective of the CRBEIP is to construct a new stream channel in Reach 4 for the purposes of enhancing spawning and rearing habitat for chinook salmon and steelhead trout, the width of the new channel will be different than the existing channel. In Reach 1 there are sections of the channel that are very broad and shallow. There is potential to use instream hydraulic modifications to reduce the channel width and increase depth and velocity at the minimum flow levels in this reach. The SNTEMP model was reset with a 50 percent reduction in channel width in Reaches 1 and 4 and the effect of the different channel width on water temperature was predicted, using the warmest day of the 1998 period previously modeled. The predicted temperature increases were much less than with the existing channel width (Figure 7-12). A 50 percent reduction in the width/depth ratio is equivalent to approximately a 1.0°C reduction in daily maximum temperatures on a hot day (air temp >30°C)(Chelan PUD 2002).

*Chelan River Biological Evaluation
and Implementation Plan*

2000; Chelan PUD 2002). Fish that spawn and rear in the tailrace and below the confluence during the summer have a cooler temperature regime than would be the case if there were no discharge from the powerhouse. These lower temperatures will thus benefit salmon and steelhead in Reach 4 by providing a thermal refuge from warmer water that comes from the Chelan River during hot weather in summer.

The receiving waterbody, the Columbia River, is known to exceed the preference zone for migrating salmon and steelhead during the months of July - September. The EPA is proceeding with a TMDL for water temperature control on the Columbia River, with the stated goal of lowering water temperatures by reducing the thermal load to the river. The thermal loading to the Columbia River in the June through August period will be lower with the NSWG flow proposal than would occur under natural, pre-Project conditions. The lower thermal load is a result of the reduced mass of heated water coming from the bypassed reach of the Chelan River. Water at any flow level would receive additional thermal loading while passing through the Chelan River during the months of June – mid-August, and this thermal load is carried to the Columbia River. The larger the mass of water passing through the Chelan River, the greater amount of thermal energy that will be absorbed from solar radiation and exposure to warm air temperatures. Since the water used for hydroelectric generation is shielded from thermal loading, the mixture of water entering the Columbia River will only carry the thermal energy received from Lake Chelan and the additional thermal energy from the portion of flow that passed through the bypassed reach. Thus, minimizing the amount of flow passing through the bypassed reach and picking up heat energy will also minimize the thermal load delivered to the Columbia River.

Thermal loading to the Columbia River under natural flow conditions in the Chelan River would add a significant amount of heat during the hot periods in summer. This is illustrated by comparing the total heat energy that would be retained by water passing through the bypassed reach under different flow levels. Even though the increase in temperature experienced by higher flows is smaller than for lower flows, the total heat contained within the much greater mass of water at natural flow levels is nearly five times greater than the heat energy carried to the Columbia River at the 80 cfs instream flow proposed by the NSWG (Figure 7-11).

*Chelan River Biological Evaluation
and Implementation Plan*

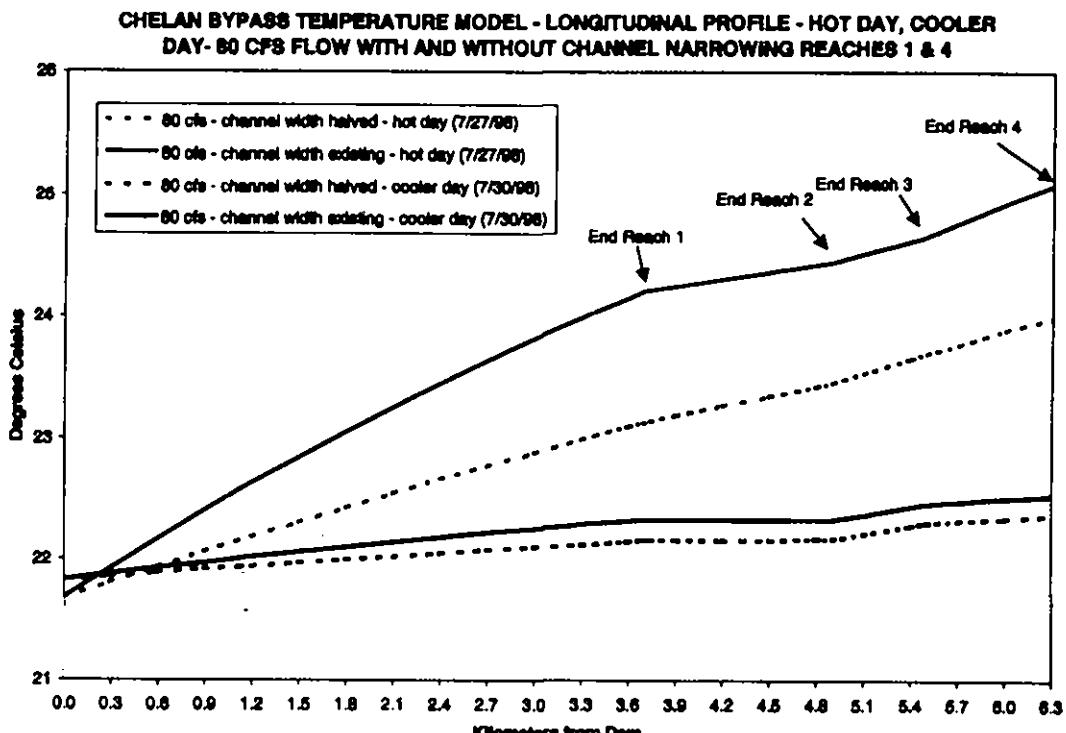


Figure 7-12: Sensitivity analysis of daily mean temperatures in the Chelan River with changed channel morphology in Reaches 1 and 4.

The existing river channel in Reach 4 and the tailrace both currently lack habitat diversity necessary to support rearing of juveniles and other functions of a natural aquatic ecosystem. The NSWG proposal included recommended morphological modifications to the river channels in both Reach 4 and the tailrace. Reach 4 currently has little sinuosity and no large boulders or structure to create gravel catchments, scour pools and other habitat features. The NSWG proposed to use standard river habitat restoration techniques to accomplish the goals of providing and maintaining gravel areas for spawning, boulder placements for cover and pool formation, and increased sinuosity to moderate velocities and provide additional area and habitat diversity. This stream channel work will also reduce temperature response below the existing channel in Reach 4.

Alternatives for temperature control in Reaches 1-3 include actions that would reduce the thermal load delivered to the Chelan River (deep water withdrawal at the dam rather than over spillway crest, reduce width/depth, move channel to maximize topographic shade, add riparian enhancement). These actions would be in effect at all times during minimum flows. Additional actions, such as daytime flow increases, cool water discharge from lake, ground water flow augmentation (pumping from wells) could be used, subject to feasibility, when necessary to prevent daily maximum temperatures from exceeding 24°C, which could be lethal to cold water species. These actions are discussed below.

*Chelan River Biological Evaluation
and Implementation Plan*

3.3.3 Minimum Flow Diversion Structure

Currently, water can be released from the Project spillway between elevation 1100 ft. and 1087 ft., which is the elevation of the top of the spillway ogee. Water then spreads across the entire spillway apron before entering the Chelan River. A new flow diversion structure will be constructed at the Project in order to provide minimum flow releases at all lake elevations. The new diversion structure will ensure that minimum flows and augmented flows for Reach 4 can be released from the dam for emergency purposes in case of pump failure in the tailrace.

The diversion structure will tap off the existing penstock and release water in the Chelan River below the existing stilling basin apron. The diversion structure will be capable of releasing up to 320 cfs, the maximum flow that may be provided to Reach 4 in wet years for salmon and steelhead spawning. Temperature studies indicate substantial warming of water can occur as it passes over the apron due to shallow depth and large surface area. Temperature increases of 0.2°C were observed between the forebay of the spillway and a thermograph placed below the spillway apron. The new diversion structure will eliminate warming of water as it passes over the apron and, in addition, about 200 feet of broad, shallow river channel below the apron will be bypassed with a deeper and narrower channel.

3.3.4 Site Potential Shade

The Chelan River is a broad, U-shaped valley through much of Reach 1. However, due to the highly erosional characteristics of the river bed, there are a number of locations where the river channel has created steep banks exceeding 20 feet in height. These locations provide substantial shade, except at dates near the vernal solstice in June and July. The amount of profile shade can be increased in association with the thalweg formation process. Instream hydraulic structures and large boulder placement along some of these southern river banks could be used to encourage the thalweg to migrate close to the cliff-like topography, thus increasing the amount of shade provided by these landscape features.

The Chelan River currently has little riparian vegetation. Historical photographs demonstrate that this was always the case. The arid environment and soils in the area prevent the establishment of vegetation, and the high flow conditions in the past have also scoured riparian vegetation from most of the shoreline. Riparian shade could be increased by a limited amount where the river is near a south bank with insufficient height for topographic shade. Shade will have a greater effect in late July and August, when the azimuth of the sun's position is lower on the horizon. In order to accomplish the establishment of cottonwood and other trees with sufficient height to provide significant quantities of shade will require irrigation and protection from erosion. There are some locations in Reach 1 where this could be accomplished, in combination with hydraulic structures to encourage thalweg formation.

In Reach 4, opportunities may exist to increase shade in locations protected from high flow scouring by pulling together appropriate sized toe rock, woody debris and soils to create vegetated zones of stabilized banks for shade and food supply for aquatic organisms. The model can be used to evaluate the potential improvement in water temperatures that could be gained with riparian enhancement through bank projects and gravity irrigation from the Chelan River.

*Chelan River Biological Evaluation
and Implementation Plan*

3.3.5 Cutthroat Habitat and Potential Thermal Refugia in Reaches 1-3

The NSWG recognized that cutthroat trout and other salmonid species are noted for their ability to seek out thermally buffered areas of streams and rivers where ground water flows into the river through the bank or riverbed. A small amount of ground water seeps sustain a number of deep pools and flow in Reaches 2 and 3 of the bypassed reach of the Chelan River, even when no surface flow from Lake Chelan has been provided for months. The temperature of this ground water is expected to be about 12°C, based on the temperature of other groundwater sources in the general area. These seeps could provide thermal refuge for cutthroat trout during the periods in July and August when daily maximum temperature is approaching lethal levels.

The low quantity of groundwater flow will not be able to form thermal buffers in conditions with turbulent mixing, thus at high flows it is unlikely that fish would benefit from thermal refugia. At the NSWG proposed 80 cfs flow level, however, the warmer water flowing through the river channel may glide past pockets of cool groundwater collected in the bottom of the pools without flushing it out. The studies planned for implementation through the CRBEIP will further determine if there are refugia and if cutthroat trout find and use such areas to offset the adverse temperatures in the summer months.

Under the CRBEIP, a monitoring and evaluation program will be implemented to determine the presence of cutthroat trout and other fish species and the production of benthic and other food organisms. Chelan PUD will evaluate the success of the CRBEIP in meeting the biological objectives and will report results to the Chelan River Fishery Forum (CRFF). Chelan PUD will make recommendations for implementation of optional components of the CRBEIP or other actions, if necessary, to support achieving the biological objectives. Chelan PUD will provide the CRFF with a draft of such reports and will consult with CRFF members prior to issuing final reports. The intent is for Chelan PUD and the CRFF to reach consensus regarding the evaluation and recommendations. If a CRFF member is not in agreement with the draft report or recommendations and has an alternative evaluation or recommendation, Chelan PUD shall include a discussion of that alternative evaluation or recommendation in the final report. Recommended actions to improve support of cutthroat trout within the seasons of use may include channel modifications, flow management and enhancement of thermal refugia.

3.3.6 Pumping of Tailrace Water into Reach 4

Tailwater

The CRBEIP includes the provision of additional flow into Reach 4 during the steelhead and late-run chinook spawning period to provide greater depths and velocities that will improve spawning habitat conditions for these species. The CRBEIP proposes to supply the additional flow by pumping from the tailrace, rather than providing this flow from lake storage (Table 7-3). The flow proposed in the CRBEIP is 320 cfs total, of which up to 240 cfs would be provided by pumps. Releases of 320 cfs from storage at the dam would reduce habitat availability for some species in Reaches 1 and 2 and would have adverse effects on lake levels and/or power generation. The additional pumped flow would be released into Reach 4 just upstream of the existing substation. The discharge location would be protected from damage during high flow periods. Spawning flows would provide optimal spawning potential in Reach 4. Depending on the location of redds that may be created by spawning salmon or steelhead in Reach 4, the pumps

*Chelan River Biological Evaluation
and Implementation Plan*

may also be used to prevent dewatering of redds during incubation. However, the NSWG anticipated that the 80 cfs guaranteed minimum flow will be adequate for incubation in most cases, and the pumps would only be used for redd protection on an as-needed basis. Should pump failure occur during spawning activity or when needed for protection of incubating redds, the water supply will be maintained by providing the needed flow from a backup pump or from lake storage until the pump system is returned to service.

The design of this pumping station and discharge facility has been evaluated in a feasibility analysis, including an intake structure that meets state and federal fish screen requirements. The cost estimate for this pump station is \$2,500,000. Annual operating costs for this option are estimated to be \$15,000 for operation and maintenance and \$5,000 for energy costs. The design for the tailrace would take advantage of the relative freedom from debris.

This pumping station may be used, if needed, to manage temperatures in Reach 4 during the rearing period of juvenile salmon and steelhead. Water temperatures in the tailrace are no warmer than the water temperature at the dam, thus during hot periods in the summer the addition of water from the pumping station could be used to reduce temperatures during the day and evening. Use of the full 240 cfs of pump flow could reduce water temperature in Reach 4 by up to 2.5°C at times when water temperatures entering Reach 4 are high due to heating within Reaches 1-3. For example, if water entering Reach 4 is 24°C and the tailrace is 21°C, the resulting Reach 4 temperature with pumped flow would be 21.25°C. This level of temperature reduction could be used to prevent temperatures in Reach 4 from exceeding critical levels, such as the ultimate upper incipient lethal temperature (UULT).

Pumping from Columbia River - Feasibility Analysis

The temperature of water in the Project's tailrace is warmer than water in the Columbia River during the summer. Additional temperature moderation in Reach 4 could be obtained if the pumping station were located on the Columbia River. However, in the fall, when chinook salmon are spawning in Reach 4 and the tailrace, the water temperature in the tailrace is lower than the Columbia River. Water temperature cools rapidly in Lake Chelan in October, dropping below 16°C during the first week in October. The water temperature in the Columbia River is 19°C-20°C during this same period, when chinook spawning is initiated in the Chelan River. Thus, the potential benefit to juvenile rearing conditions in July and August would be offset by higher temperatures during chinook spawning. Also, the feasibility of locating the pumping station on the Columbia River is questionable. The issues of water rights, increased debris loading on the fish screens, biological concerns about mixing of water sources and the need to cross a highway and railroad line with the pipe, all contribute to the complexity of this option.

3.3.7 Increase Flow During Daytime

The naturally occurring peak summer water temperatures entering the Chelan River provide the basis for setting a threshold requirement for temperature management. In every year modeled (2000-2002), the temperature model predicted that the Chelan River would experience daily average and daily maximum temperatures surpassing 23.0°C (daily mean) and 24.0°C (daily maximum) in the bypassed reach under natural flow conditions. In 2000, the temperature of the Chelan River under natural flows was predicted by the model to exceed 25.0°C. These temperatures could be a natural limiting factor, in the absence of thermal refugia, which cutthroat

*Chelan River Biological Evaluation
and Implementation Plan*

trout and other fish populations would need to tolerate in order to establish viable populations. If cutthroat trout are demonstrated to persist in the Chelan River during these natural temperature extremes (>23°C daily mean, up to 25°C daily maximum), but are demonstrated to be unable to persist at higher temperatures, then the daytime peak temperature could be controlled to prevent lethal conditions through release of additional flow during the daytime.

Increasing flows above 1,500 cfs does not significantly decrease the water temperature because the mass of water at 1,500 cfs absorbs the available heat. For example, a flow of 2,000 cfs does not produce a measurably lower water temperature than a flow of 1,500 cfs. The daily maximum temperatures predicted by the temperature model were only 0.07°C lower at 2,000 cfs than at 1,500 cfs (Appendix A, Table 7). Below 1,500 cfs, however, varying the flow does affect water temperature. At night, lower flows result in cooler water temperatures because a smaller body of water cools more quickly than a larger body of water. During a warm day, the reverse is true. Higher flows result in cooler water temperatures because a larger body of water warms more slowly than a smaller body of water. Therefore, increasing flows from 80 cfs to something below 1,500 cfs would significantly lower the water temperature on hot summer days.

However, increasing flows up to 1,500 cfs on hot summer days has two detrimental effects. First, it could hurt the fish because it would likely destroy areas of cool water refugia and reduces usable habitat. In some cases, these refugia may provide cooler water than is achieved by increasing flows up to 1,500 cfs. Second, increasing flows up to 1,500 significantly reduces the electrical output of the Project, particularly on hot summer days when power use peaks.

If determined necessary to protect a viable cutthroat population, Chelan PUD is prepared to release additional flow during daytime hours to prevent fish mortality from heat stress. The daytime flow releases will have a maximum flow of 1,500 cfs or natural inflow, whichever is less. The total annual volume of additional flow releases will be limited to 5,000 cfs-days. The effect of changes in flow on thermal refugia will be explored during the monitoring and evaluation actions that will be part of this biological evaluation and implementation plan. If necessary, additional flow releases will be reduced to preserve thermal refugia when a conflict between these measures exists. This approach limits the impairment of the existing beneficial use of these waters for maintenance of lake levels and power generation and, if necessary, significantly enhances beneficial use of the Chelan River for fish.

3.3.8 Other Options Considered to Improve Temperature Conditions

Additional actions to reduce thermal input may be pursued in Reaches 1, 2 and 4 under the CRBEIP. These actions could include promotion of the establishment of riparian vegetation in Reach 4 and adjustment of flows during the warmest periods of the summer. Temperature monitoring at several locations, snorkel surveys to monitor use and condition of fish species using the Chelan River, and aquatic macroinvertebrate sampling to evaluate ecosystem function would also be utilized.

The results of these surveys, particularly whether cutthroat trout will remain in the Chelan River during the summer months or migrate downstream, will determine if additional actions are necessary to prevent temperature conditions that exceed 25.3°C. In Reach 4, the presence of rearing steelhead or chinook juveniles will be determined and pumped water from the tailrace

*Chelan River Biological Evaluation
and Implementation Plan*

could be used, when needed, to prevent lethal water temperatures during very hot summer afternoons. In Reach 4, opportunities may exist to increase shade in locations protected from high flow scouring by pulling together appropriate sized toe rock, woody debris and soils to create vegetated zones of stabilized banks for shade and food supply for aquatic organisms. The model can be used to evaluate the potential improvement in water temperatures that could be gained with riparian enhancement through bank projects and gravity irrigation from the Chelan River.

The NSWG also examined the feasibility of more flow and structurally intensive means to reduce water temperatures in the Chelan River. These included the feasibility of developing a deep water intake to provide colder water for the minimum flows and the potential of increasing groundwater inflow within Reach 1 for temperature moderation and thermal refugia.

Providing Project Inflow During Summer Months – Feasibility Analysis

The WDOE recommended investigating passing inflow to Lake Chelan into the Chelan River as an option for addressing the situation when Chelan River water temperatures exceed the 0.3°C standard during warm, summer months. The flow required to achieve the 0.3°C standard is estimated to range between 1,500 and 2,000 cfs, based on temperature modeling data. This magnitude of flow would eliminate generation at the Project from approximately mid-June through September during years with normal runoff volume and climatic conditions. The time period generation would be eliminated would vary between years: longer in years with higher than normal temperatures and/or lower runoff volume; shorter in years with lower than normal temperatures and/or higher runoff volume. Estimated costs (foregone revenue due to loss of generation) associated with providing a range of inflows is shown in Table 7-7.

Table 7-7: Estimated Costs of Providing Project Inflow

Flow Level	Annual Production MWh/Yr.	Reduction in MWh/Yr.	Annual Cost ¹ (loss)
0 cfs (base)	365,366	0	0
500 cfs	353,334	12,032	\$601,600
1,000 cfs	335,965	29,401	\$1,470,050
1,500 cfs	315,133	50,233	\$2,511,650
2,000 cfs	294,710	70,656	\$3,532,800

¹ Value of energy = \$50/MWh

Daily temperatures in the Chelan River at flows ranging between 1,500 cfs and 2,000 cfs would remain relatively constant and within 0.3°C of water temperatures measured at the spillway. This would meet the current temperature criteria for Class A waters. However, even if this temperature criterion were achieved, biological objectives could have a high probability of not being met. Useable habitat area at 1,500 cfs would decrease from 13 acres to about 9 acres (Table 7-2). Water entering the Chelan River would continue to follow the natural temperature warming cycle of Lake Chelan, which results in water temperatures that consistently exceed 22°C during late July and August, and can reach 24°C during the warmest period of the summer. Maintenance of Chelan River temperatures within 0.3°C would not prevent temperatures from approaching or exceeding the UUILT for cutthroat trout (Figure 7-2). Additionally, water temperatures would exist in the Chelan River exceeding the Zero Net Growth (ZNG) level for

*Chelan River Biological Evaluation
and Implementation Plan*

cutthroat trout for most of the summer period. While actual cutthroat trout reaction to these conditions is unknown at this time, and will be investigated through the M&E program (section 5.4), the vast body of literature on this species indicates that predicted conditions would be adverse to developing and maintaining a viable population of cutthroat trout in the Chelan River (R2 and IA 2000; Sternberg 1987; Wydoski and Whitney 1979; Scott and Crossman 1974; Milstein 2000; WDFW 1992; NOAA Fisheries 1996).

This option has been removed from consideration by the NSWG due to: 1) the predicted inability to achieve biological objectives; 2) loss of useable habitat area; and 3) extremely high cost. The NSWG determined that other options discussed previously in section 3 have the ability to achieve biological objectives in a much more cost efficient manner.

Pipeline to Lake Chelan Thermocline - Feasibility Analysis

A feasibility study was conducted early in the Lake Chelan relicensing process to investigate withdrawing cooler water from below the thermocline in the lake to reduce temperatures in the Chelan River. Based on the 1999 Water Quality Monitoring report (Anchor Environmental 2000), the location closest to the Project where water in the Wapato Basin of Lake Chelan stratifies during summer months is approximately five miles up the lake from the Project's intake. Downlake from this point, the water quality monitoring showed no thermocline, thus there would be less of a temperature benefit. A pipeline of at least this length would be required to provide cooler water from the lake to the Chelan River. In order to lay a pipe, capable of 24 cfs at 2 feet per second velocity, the required pipe diameter would be 48 inches. Assuming that a perforated pipe would meet fish entrainment standards, the head end of the pipe would be capped and water would enter the pipe through a series of holes, 2 inches in diameter, spread over the first 80 lineal feet of pipe. The pipe could be floated into place, then sank and anchored to the bottom. The pipe could be constructed of either ball-joint ductile iron or high density polyethylene (HDPE) plastic. The estimated cost for materials and installation, not including any mitigation for aquatic habitat for the pipe and installation process, is \$2,500,000 per mile. Thus, a 5 mile long pipe would cost an estimated \$12,500,000 for 24 cfs of water at the thermocline temperature of 10°C - 12°C in summer. A pipe with a 90 inch diameter could provide 80 cfs, at an estimated cost of \$5 million per mile, for a total of \$25 million. The NSWG determined that this option was not feasible due to the limited ability to provide cooler water to the Chelan River and the excessively high cost.

Ground Water Pumping for Upper Reaches - Feasibility Analysis

Pumped groundwater to reduce temperature at minimum flows, or alternatively provide cool water refugia, is a potential option for temperature control. Assuming a minimum flow of 80 cfs, a ground water source of 5 cfs (at 12°C) would be sufficient to reduce the temperature of the total flow by 0.7°C when the water temperature reached 24°C. Well sites in the local area are not noted for producing this volume of water. The Beebe springs, which provides part of the water supply for the Chelan Hatchery is only about 20% of this flow and the natural groundwater seeps in Reach 3 are on the same order of volume. The wells that supply the Chelan Hatchery, which draw from a large aquifer in the "wettest" part of the groundwater path from Lake Chelan to the Columbia River, also individually produce less than 0.3 cfs. Thus, it would require a substantial well field to produce 5 cfs for temperature control. The hard, competent till that the dam is built upon is unlikely to produce enough leakage to support a 5 cfs well field.

*Chelan River Biological Evaluation
and Implementation Plan*

3.4 Riparian Vegetation - Limited Opportunities

The majority of vegetation in the Chelan River corridor is not riparian, but rather dry land adapted shrub steppe community. Pre-Project historical photographs indicate the composition, extent and condition of riparian vegetation are substantially unchanged since the pre-Project period. The arid climate, high scouring forces during peak flows, and the assumed steep moisture gradient in the soil at the active channel/floodplain boundary likely exceed the physiological limits of long-term survival for most riparian plants and constrain the potential width of the riparian zone and density of riparian vegetation, independent of base-flow conditions (Stillwater Sciences 2001). Some near-shore riparian vegetation would be expected to be established in the Chelan River if minimum flows are sustained throughout the river. However, the extent of this vegetation may be somewhat limited, since historical photographs indicate riparian vegetation was relatively sparse along the river before the Project was constructed (R2 and IA 2000).

3.5 Macroinvertebrate Community - Limiting Factors

Studies indicated that natural conditions would be limiting to salmonid fish production in the Chelan River. These factors included unfavorable water temperatures in the summer; low nutrient levels in the water coming into the river from ultra-oligotrophic Lake Chelan and limited input of terrestrial organic matter; low abundance of invertebrates as a result of the low fertility and warm summer water temperatures; low availability of spawning gravel; and high potential for gravel scour during high flow spill events. Principal among these limiting factors was the summer water temperature regime which exceeds the salmonid preference limit of 18°C. The Chelan River receives water from Lake Chelan at temperatures that exceed the temperature of zero net growth (19°C) for trout and salmon from July through the early part of September (R2 and IA 2000).

The production of benthic macroinvertebrates in the Chelan River lower tailrace can be considered to be extremely low (R2 and IA 2000). The density of benthic macroinvertebrates at the shallow sites ranged from 0 to 27 individuals per sq-m, while the density of benthic macroinvertebrates at deep sites ranged from 27 to 231 individuals per sq-m. In comparison, benthic invertebrate densities in moderately productive rivers in the Northwest typically range from 3,000 to 5,000 individuals per sq-m, while densities in productive rivers (such as the Deschutes) can exceed 10,000 individuals per sq-m (personal communication, E. Connor, R2, to J. Homa, IA, April 25, 2000). These results suggest that the amount of benthic invertebrate food organisms potentially available to fish in the bypass reach is very low.

The productivity of aquatic insects is low in the Chelan River for several reasons. The production of aquatic insects in rivers is largely driven by two sources of energy: allochthonous and autochthonous inputs. Both sources of productivity can be considered to be low in the Chelan River. Allochthonous materials include coarse particulate organic matter (CPOM) such as leaves, and fine particulate organic matter (FPOM) which is derived from the breakdown of CPOM by aquatic invertebrates and mechanical processes. Inputs of CPOM are very limited in the Chelan River, as most of these materials are trapped by Lake Chelan from their source areas in the Lake Chelan drainage basin. The scarcity of riparian vegetation along the Chelan River channel is also a reason for the low inputs of CPOM into this river system. Most FPOM originating from the upper watershed also settles into Lake Chelan. The only major source of seston (i.e., organic matter available as a food source to aquatic invertebrates) are zooplankton released from the

*Chelan River Biological Evaluation
and Implementation Plan*

Lake Chelan outlet. Zooplankton densities are sufficient to establish filter feeding insect communities, including black fly larvae (*Simuliidae*) and net-spinning caddisflies (*Hydropsychidae*), in the river channel immediately downstream of the Lake Chelan outlet, provided that minimum flows are provided in the river channel over a sustained period. These organisms have some food value to fish, albeit limited compared to the rich diversity of stonefly, mayfly, and caddisfly species present in rivers having adequate inputs of FPOM and CPOM.

3.6 Summary of Management Options

The NSWG considered a number of alternatives and options to promote accomplishment of the biological objectives for the Chelan River. These deliberations are summarized in matrix format (Table 7-8) and discussed in this section.

Upon the effective date of the New License, and in accordance with the time periods described in Proposed License Article 7, Chelan PUD will implement management options necessary to initiate the flow regime established in section 2.6.5. These include the flow release structure and associated stream channel to connect to Reach 1 (estimated cost \$350,000), Reach 4 pumping station (estimated cost \$2,500,000), stream channel habitat enhancements in Reach 4, spawning and rearing habitat enhancement in the tailrace (estimated cost \$500,000 for Reach 4 and tailrace habitat), redd protection monitoring and evaluation, and the monitoring and evaluation program, which includes temperature monitoring.

A number of management options may be implemented, pending biological outcomes and success criteria evaluated in the monitoring and evaluation program. These include pumping of tailrace water into Reach 4 for rearing salmonids, powerhouse flow security for redd protection, tailrace under-gravel flow pipes, Reach 4 stream channel habitat structure changes, and temperature reduction actions for Reaches 1-3 (site-potential shade, refugia enhancement, flow increases during hot weather or daytime).

Management options that were evaluated, but found infeasible or inordinately costly for low or uncertain biological benefit, have been eliminated from consideration at this time. These options, and the reason they were eliminated at this time, include:

- Increase flow to keep Chelan River water temperatures within 0.3°C of natural temperatures when water temperature exceeds 18°C: This option was eliminated at this time because it is not expected to contribute significantly to meeting the biological objectives, it diminishes the useable habitat area in the Chelan River, and it has a significant negative impact to other existing beneficial uses (hydroelectric generation, early refill of Lake Chelan for recreation). The reduction in powerhouse discharge that would be required to provide the additional flow to the Chelan River could result in a degradation of habitat in the tailrace and below the confluence of Reach 4 with the tailrace. The cooler water that comes from the powerhouse would be replaced with water at a higher temperature coming from the Chelan River. Chelan River flows of 1,500 cfs or natural flows, when less than 1,500 cfs, would be required to keep water temperatures within 0.3°C of natural temperatures. Model predictions (Appendix A), for flows of 1,500 cfs during the summers of 2000, 2001 and 2002, determined that the daily maximum temperatures at bottom of Reach 3 would exceed 25°C on five days, 24-25°C

*Chelan River Biological Evaluation
and Implementation Plan*

on fourteen days and 23-24°C on 58 days (total 77 days). Natural inflow to the Chelan River averages less than 1,500 cfs by the middle of the month, thus natural conditions could be still warmer than this prediction during low flow years. The temperature of water from the powerhouse only exceeded 23°C on 12 days during the same time period.

- Pipeline for minimum flow release structure to withdraw cool water from Lake Chelan thermocline: This option was eliminated at this time because the lower end of the Wapato Basin of Lake Chelan does not have a thermocline, water withdrawal from the nearest point with cooler temperatures would be two to five miles into Lake Chelan from the lake outlet, the environmental consequences of a very large pipeline on the lake bottom would likely be significant, the cost of the structure was excessive and the biological benefit uncertain.
- Ground water pumping into Reach 1: This option was eliminated at this time based on the low likelihood of being able to extract sufficient amounts of groundwater to influence temperatures or create thermal refugia with high volume wells. Other options for temperature control (site-potential shade, hot weather or daytime flow increases) had higher likelihood of success.
- Pumping into Reach 4 from the Columbia River: This option was eliminated at this time because the temperature benefits for summer fish rearing would be negated by less favorable temperatures in the Columbia River during the spawning period of chinook salmon. Also, the issues of ecological effects of mixing water supply sources, and the location of a pumping facility on the Columbia River raised significant doubt about the feasibility of this option.

Table 7-8c: Matrix of management considerations and options considered for accomplishment of the biological objectives for the Chelan River

Option(s) / Flow	Provides habitat in Reach 4, provides Reach 4 spawning and rearing habitat, compatible with low level diversion issues	Relatively low flow, quantifiable design channel use by channel, construct diversion structures	Moderately High	The Agency/Tribal Council (ATC) did not particularly like this option due to the diversion structures component, quantifiable use of design channel, low flow, limited habitat availability	Chelan PLD initial proposal. Used to negotiate Preferred Alternative.
Agency/Tribal Council (ATC) maximum flow proposed, 30 cfs December 1 - May 15; 40 cfs May 15-November 30, Reach 4 design channel.	Maximum habitat in Reach 4	Reduces habitat available in Reach 4 from lower flows, impacts late elevation/recreation, extremely expensive.	Extremely High	The Agency/Tribal Council (ATC) developed proposal based on studies (Dykes Reach Flow Releases, IPBD) to provide maximum habitat, flow, and minimal human intervention	Agency/Tribal Council (ATC) initial proposal. Used to negotiate Preferred Alternative.
Natural Sciences Working Group Potential; see sections 2.5.3, Table 4; minimum flow, pumped flow in Reach 4, habitat enhancement in Reach 4 and upriver, spawning rates	Preferred Alternative vs. Achieves biological objectives while limiting adverse impacts on power generation and lake level management for recreation		High	The Natural Sciences Working Group originated this Preferred Alternative, over many years, as the best balance of natural and social resources	Preferred Alternative
Option A (Chelan PLD, 20% draft, A1x; Construct Reach 4 low flow temporary diversion, engineered side channel, provide pumping from tailrace to mid-engineered channel, use Reach 4 as high flow channel)	Provides Reach 4 spawning and rearing habitat	Unnatural diversion structures, artificial bars to protect engineered channel, quantifiable use of small channel by channel width	Moderate	The Agency/Tribal Council (ATC) did not particularly like this option due to the diversion structure component	Carried forward to the 80% design stage by the Agency/Tribal Council (ATC) for additional analysis
Option B (40% draft, A2x; Construct Reach 4 high flow bypass channel, engineer Reach 4 channels, and provide pumping from tailrace to mid-Reach 4)	Provides Reach 4 spawning and rearing habitat	Structures would need to be excessively large to accommodate flows	High		Removed from consideration by the Agency/Tribal Council (ATC) due to high flow bypass channel flexibility, minimal impact (small), and high cost
Option C (40% draft, A3); Provide reach 1 and 2 channel narrowing and Reach 4 engineered channels	Reduces erosion in upstream reaches and deposition in Reach 4	Reduces aquatic habitat, potential riparian habitat, Reach 4 gravel supplementation required, high risk	High		Removed from consideration by the Agency/Tribal Council (ATC) due to adverse impacts, minimal habitat benefit, and high cost
Option D (40% draft, B1; Increase tailrace spawning habitat)	Provides additional tailrace spawning habitat		Moderate	The Agency/Tribal Council (ATC) was highly favorable of this option due to benefits for nonnative fish and high likelihood of success	Carried forward to 80% design stage by the Agency/Tribal Council (ATC) for additional analysis
Option E (40% draft, C1; Highway bridge modification)	Provides water for high flows to upper Columbia River, prevents scour in Reach 4	Significant re-construction of highway and railroad grade, minimal habitat benefit	Extremely High		Removed from consideration by the Agency/Tribal Council (ATC) due to significant adverse environmental impacts, minimal habitat benefit, and high cost
Option F (40% draft, D1; Construct a re-regulating dam in Reach 3 and engineered channels in Reach 4)	Creates high Chelan River flows, provides more spawning and rearing habitat in Reach 4	Significant environmental impacts: bank gravel removal, inundate reaches 1, 2, and 3, etc.	Extremely High		Removed from consideration by the Agency/Tribal Council (ATC) due to significant adverse environmental impacts, minimal habitat benefit, and high cost
Option G (40% draft, E1; Construct Reach 4 high flow bypass channel and engineered Reach 4 channel)	Provides protection for, and additional, Reach 4 spawning habitat	Structures would need to be very large to accommodate high flows	High		Removed from consideration by the Agency/Tribal Council (ATC) due to minimal habitat benefit, and high cost
Option H (40% draft, F1; Increase tailrace spawning habitat and use existing Reach 4)	Provides additional tailrace and uses Reach 4 spawning and rearing habitat	Provides little usable Reach 4 spawning and rearing habitat	Moderate	The Agency/Tribal Council (ATC) was favorable of this option due to benefits for nonnative fish and high likelihood of success in the tailrace	Carried forward to final design stage by the Agency/Tribal Council (ATC) for additional analysis (tailrace habitat)
Option I (40% draft, G1; Within tailrace spawning habitat and use existing Reach 4)	Provides greater tailrace and uses Reach 4 spawning and rearing habitat	Moving berm eliminates riparian vegetation, provides little usable Reach 4 spawning/rearing habitat	Moderate	The Agency/Tribal Council (ATC) was concerned with moving the berm between the tailrace and Reach 4 due to destruction of best available riparian vegetation in the Project area	Removed from consideration by the Agency/Tribal Council (ATC) due to impact to riparian vegetation
Option J (40% draft, H1; Within tailrace spawning habitat, add tailrace channel, spawning habitat, and use existing Reach 4)	Provides greater amount of additional spawning habitat, provides surface habitat	Moving berm would eliminate 1 st riparian vegetation	Moderate	The Agency/Tribal Council (ATC) was concerned with moving the berm between the tailrace and Reach 4 due to destruction of best available riparian vegetation in the Project area	Removed from consideration by the Agency/Tribal Council (ATC) due to impact to riparian vegetation
Option K (40% draft, I1; Increase tailrace spawning habitat, create single design channel, provide pumping to mid-design channel, and use Reach 4 as high flow channel)	Provides greater tailrace and Reach 4 spawning and rearing habitat	Unnatural diversion structures, unnatural design channel, quantifiable use of design channel	Moderate	The Agency/Tribal Council (ATC) favored diversity certain components (pumping, tailrace habitat modifications, Reach 4 design channel)	Potential components (pumping, tailrace habitat modifications, Reach 4 design channel) carried forward by the Agency/Tribal

*Chelan River Biological Evaluation
and Implementation Plan*

SECTION 4: ACHIEVEMENT OF BIOLOGICAL OBJECTIVES

4.1 Functional Aquatic Ecosystem

The overall achievement criterion for establishment of a functional aquatic ecosystem is to demonstrate that the community of organisms inhabiting the river is healthy and diverse, given natural limiting factors and the feasibility of implementing measures. As discussed above, there are a number of natural limiting factors that determine the site-potential for the bypassed reach biotic community. This implementation plan for the Chelan River addresses a number of these natural limiting factors, in addition to the Project's effects. The biological objectives, used to evaluate the effectiveness of this implementation plan, are structured to allow for the natural limiting factors. In brief, Table 7-9 and Table 7-10 list the criteria for achievement of the biological objectives with the monitoring and evaluation components that will be used to determine achievement or need for alternative actions to the extent they are feasible.

*Chelan River Biological Evaluation
and Implementation Plan*

Table 7-9: Criteria for Achievement of Biological Objectives in the Chelan River

Fish species and use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions If Biological Objective Achieved	Actions If Biological Objective Not Achieved
Chinook Adult use of habitat Reach 4/Tailrace	Adult Production from fish produced in Chelan River	Ratio of Chelan River origin/other origin adult carcasses in spawning population	Years 1 - 10.	Maintain actions. No additional actions needed.	Continue until all feasible and reasonable habitat measures to achieve the objectives identified in 7-10 are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented.
Steelhead Outmigrant success	Adult Production from fish produced in Chelan River – net benefit to the ESU	Best professional judgment of CRFF and/or new technology showing adult origin	Years 5 - 10	Maintain actions. No additional actions needed.	Continue until all feasible and reasonable habitat measures to achieve the objectives identified in 7-10 are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented.
Cutthroat Create habitat to support a viable population of cutthroat trout in Reaches 1-3	200 resident fish	Number of fish via snorkeling surveys as specified in Table 7-10	Years 5 - 10.	Maintain actions. No additional actions needed.	Continue until all feasible and reasonable habitat measures to achieve the objectives identified in 7-10 are implemented. When no further feasible and reasonable actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented.

Table 7-10: Other Criteria for Achievement of Biological Objectives in the Chelan River

Fish Species and Use	Biological Objectives	Measured Parameters	Evaluation Timeframe	Actions If Objective Achieved	Actions If Objective Not Achieved
Chinook Spawning Habitat Reach 4 and Tailrace	Areas developed to support spawning meet design habitat characteristics (depth, velocity, and substrate) at the design flow (as-built functionality).	Field measurement to confirm achievement of physical parameters.	Years 1 - 10, as needed to set flows or further modify channel.	Must be met.	Must be met.
Chinook Spawning Habitat Use Reach 4 and Tailrace	Distribution of spawning use should reflect distribution of constructed spawning habitat.	Spawning use, numbers, distribution and habitat characteristics of selected redds. Qualitative judgment	Years 1 – 10, as needed to set flows.	Maintain actions. No additional actions needed.	Determine if Project effect. Continue until all feasible and reasonable habitat measures to achieve this objective are implemented. When no further feasible and reasonable actions exist, CRFF will recommend whether or not Chelan PUD should continue measures implemented.
Chinook Spawning Habitat Quality Reach 4/ Tailrace Conditions suitable for survival from egg to emergence.	Intragravel Dissolved Oxygen $\geq 8.0 \text{ mg/l}$.	During all scheduled (non-emergency) powerhouse shutdowns, tailrace Intragravel DO monitored hourly. During egg incubation, tailrace and Reach 4 Intragravel DO monitored each week hourly for at least one 24-hour period.	Years 1-5. Extend if additional measures needed or as recommended by CRFF.	Must be met unless determined not a Project effect.	Must be met unless determined not a Project effect.
Chinook Spawning Success Reach 4/ Tailrace. Conditions suitable for survival from egg to emergence.	Egg to emergence success equal to $\geq 80\%$ of Methow River average or 70% survival, whichever is less.	At least 10% of redds capped and studied for egg to emergence success or other method recommended by CRFF.	Years 1 - 5.	Maintain actions. No additional actions needed.	Determine if Project effect. Continue until all feasible and reasonable habitat measures to achieve this objective are implemented. When no further feasible and reasonable actions exist, CRFF will recommend whether or not Chelan PUD should continue measures implemented.

*Chelan River Biological Evaluation
and Implementation Plan*

Table 7-10: Other Criteria for Achievement of Biological Objectives in the Chelan River

Fish Species and Use	Biological Objectives	Measured Parameters	Evaluation Timeframe	Actions If Objective Achieved	Actions If Objective Not Achieved
Chinook Juvenile Rearing Habitat Use Reach 4/Tailrace	Presence and use of available habitat.	Snorkel surveys from emergence until fish move into Columbia River (emergence ~June). Qualitative judgment.	Years 1-5. Extend for next 5 years if fry use is low.	Maintain actions. No additional actions needed.	Determine if Project effect. Continue until all feasible and reasonable habitat measures to achieve this objective are implemented. When no further feasible and reasonable actions exist, CRFF will recommend whether or not Chelan PUD should continue measures implemented.
Steelhead Spawning Habitat Reach 4 and Tailrace	Areas developed to support spawning meet design habitat characteristics (depth, velocity, and substrate) at the design flow (as-built functionality).	Field measurement to confirm achievement of physical parameters.	Years 1 - 10.	Must be met.	Must be met.
Steelhead Spawning Habitat Use Reach 4 and Tailrace	Distribution of spawning use reflects distribution of constructed spawning habitat.	Spawning use, numbers, distribution and habitat characteristics of selected redds Qualitative judgment. Spawning Surveys years 1 - 2 biweekly, weekly years 3 - 10, March - May or as needed to set flows	Years 1 - 10. Extend if additional measures needed.	Maintain actions. No additional actions needed.	Determine if Project effect. Continue until all feasible and reasonable habitat measures are implemented. If can't reach use objective, maintain habitat achieved.
Steelhead Spawning Habitat Quality Reach 4/ Tailrace Conditions suitable for survival from egg to emergence.	Intragravel Dissolved Oxygen > 6.0 mg/l	During all scheduled (non-emergency) powerhouse shutdowns, tailrace intragravel DO monitored hourly During egg incubation, tailrace and Reach 4 Intragravel DO monitored each	Years 1-5. Extend if additional measures needed or as recommended by CRFF	Must be met, unless determined not a Project effect.	Must be met, unless determined not a Project effect.

Table 7-10: Other Criteria for Achievement of Biological Objectives in the Chelan River

Fish Species and Use	Biological Objectives	Measured Parameters	Evaluation Timeframe	Actions If Objective Achieved	Actions If Objective Not Achieved
		week hourly for at least one 24-hour period.			
Steelhead Spawning Success Reach 4/Tailrace. Conditions suitable for survival from egg to emergence.	Egg to emergence success equal to ≥ 80 % of Methow River or 70%, whichever is larger	At least 10% of redds capped and studied for egg to emergence success or other method recommended by CRFF.	Years 1-5	Maintain actions. No additional actions needed.	Determine if Project effect. Continue until all feasible and reasonable habitat measures are implemented. If can't reach use objective, maintain best habitat achieved.
Steelhead Juvenile Rearing Habitat Use Reach 4/Tailrace	Fry presence and use of available habitat.	Snorkel surveys from emergence until fish move into Columbia River. 8 times per year, only when redds observed in area Qualitative judgment	Years 3 - 10	Maintain actions. No additional actions needed.	If steelhead rearing extensive and extended, evaluate habitat enhancement opportunities. Determine if Project effect. Continue until all feasible and reasonable habitat measures are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented.
Cutthroat Habitat Reaches 1-3	Presence of 200 fish including various age classes. Habitat improvements for cutthroat, as related to water temperatures, may include: <ul style="list-style-type: none">- New, naturally evolved stream channel- Riparian shade- Thermal refugia/pumping studies- Increased flows	Snorkeling surveys, number, distribution, age of resident fish. Cross-sectional and average stream temperature measurements. Flow measurements.	Years 1-5 will serve as establishment of baseline. If 200 fish not achieved in year 5, then either continue studies for: A - 10 years beyond year 5 of New License to allow natural cutthroat colonization from Lake Chelan; or B - 5 years beyond year 5 of New License if no natural colonization is evident and test sample of cutthroat is deemed necessary by CRFF.	Maintain actions.	Determine if Project effect. Continue until all feasible and reasonable habitat measures are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented.

*Chelan River Biological Evaluation
and Implementation Plan*

Table 7-10: Other Criteria for Achievement of Biological Objectives in the Chelan River

Fish Species and Use	Biological Objectives	Measured Parameters	Evaluation Timeframe	Actions If Objective Achieved	Actions If Objective Not Achieved
Water Temperature and Flow Monitoring	The achievement of specific water temperatures is not a criterion for achievement, rather providing a water temperature regime that facilitates biological achievement as defined above.	Water temperature will be monitored hourly at the forebay, in Reaches 1, 2, 3 and 4, and at the tailrace from March 15 to Nov 30. Flow will be measured hourly to determine flows through the penstock, into Reach 1 of the Chelan River, and into Reach 4 of the Chelan River. Additional temperature monitoring to determine emergence dates will be conducted as needed to accomplish monitoring objectives for chinook and steelhead spawning redd success.	Years 1 through 10 for this biological evaluation.	Not applicable Minimum flows must be met	Not applicable Minimum flows must be met

*Chelan River Biological Evaluation
and Implementation Plan*

4.1.1 Macroinvertebrate Community

The limiting factors for development of the benthic, macroinvertebrate community are predominately natural conditions not related to the Project. The temperature regime is warm, which limits the species diversity, and the nutrients in the water are low because Lake Chelan is an ultraoligotrophic lake. The naturally poor conditions for establishment of riparian vegetation further limit food supply.

The potential of the Chelan River to develop an abundant and diverse population of aquatic macroinvertebrates was discussed in section 3, section 4 and the limiting factors analysis of the Bypassed Reach (Gorge) Flow Releases Study Report (R2 and IA, 2000). Observations in several eastern Washington streams indicate the optimum water temperature for prominent stream macroinvertebrates (i.e., mayflies, stoneflies and caddis flies) to be 10° C (50°F), with substantial decline in abundance and species diversity on either side of the apex (i.e., 4.4°C (40°F), and 15.6°C (60°F) (Tony Eldred, letter of 8/25/00 referencing statement of Rob Plotnikoff, Department of WDOE stream ecologist). The pool and riffle areas in the tailrace are representative areas with temperature and nutrient levels that represent the conditions that will exist in the Chelan River. Samples taken from this area had a low abundance and diversity of aquatic invertebrates. The majority of invertebrates collected were zooplankton produced in Lake Chelan that passed downstream through the penstock. The site potential for the macroinvertebrate community will likely be a low species diversity and density.

Methods for determining the health of a stream by sampling the benthic community have been defined by Washington State Department of Ecology in Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams - 2001 Revision (Plotnikoff and Wiseman, 2001). They recommend using a reference site as the basis for comparison to determine if a stream's benthic community is healthy. Reference site information is used as a measure of biological potential for particular stream settings. Identifying a response in the biological community to environmental degradation is determined by comparison to a reference site. Appropriate reference sites for the Chelan River evaluation are the tailrace and the Chelan River upstream from the spillway. Establishment of a benthic community with comparable or greater density and species diversity than the references areas is the criterion for achievement. Over time, with establishment of site potential riparian vegetation, the food supply for benthic organisms is expected to increase, thus leading to improvement in the abundance and diversity of aquatic macroinvertebrates. However, the low fertility of the water from Lake Chelan will always be a limiting factor to establishing higher densities of aquatic invertebrates.

4.1.2 Fish Community - Reaches 1-3

The objective is to establish populations of native fish species, with emphasis on cutthroat trout.

Native Cool Water Species

The instream flows and stream channel conditions that will form with continuous flow are expected to be favorable to native cool water species, such as suckers, chubs, sculpins, mountain whitefish and other species that are resident in Lake Chelan. These species are expected to colonize the Chelan River over time. Some species are expected to appear immediately, based on their presence in the annual fish rescue operations that follow the end of spill under the current

*Chelan River Biological Evaluation
and Implementation Plan*

license. These species include northern pikeminnow and rainbow trout. Other species that don't frequent the area near the spillway will populate the Chelan River more slowly. There are no plans to transplant native cool water species into the Chelan River, except if needed to reach conclusions in the monitoring and evaluation program.

The success criteria for achievement are to document that native species successfully colonize the Chelan River and establish populations that remain in the river throughout the year. Snorkel surveys will be conducted in years 1, 3, 5, and 9, with surveys at different seasons (April, August and November). In years 5 and 9, surveys will be conducted monthly. The CRFF may modify the years and timing of these surveys, as needed based on results from the M&E surveys. These surveys are highly effective in determining the presence of different species, including life stage. Habitat preferences will also be generally noted. The M&E surveys will detect any evidence of mortality or morbidity due to heat stress, which will provide the information needed to evaluate the need for additional temperature control activities. Habitat preference information may also be used in future management decisions regarding stream channel and shoreline actions.

Cutthroat

The provision of minimum flows and other actions taken to manage water temperature are expected to provide suitable habitat for adult cutthroat trout. Snorkel surveys will determine if cutthroat trout colonize the habitat and their behavior during the summer, when water temperatures will generally be above their preference zone. The very low population density of cutthroat trout in Lake Chelan is likely to make colonization very slow for this species, unless the stocking of catchable-sized cutthroat seeds the Chelan River from downstream movement of these fish. Based on the behavior of stocked rainbow trout, downlake movement of the stocked fish could result in fish entering the Chelan River during spill or through the minimum flow release structure.

The criteria for achievement of biological objectives (Tables 7-9 and 7-10) are documentation that development of a viable cutthroat trout population is not limited by Project operations, including implementation of the CRBEIP. A viable cutthroat population in Reaches 1-3 is defined as naturally produced (not stocked) fish, viable (population has representatives of several age classes), healthy (fish condition better than starvation), and of reasonable density (200 fish of various ages) consistent with the habitat conditions. If a viable population has not been achieved after the 10-year monitoring and evaluation program, then establishment of cutthroat trout population will no longer be a biological objective of the CRBEIP. Implementation of temperature control measures will not be required for populations that are artifacts of stocking programs. If a viable cutthroat trout population is not established, then long-term temperature control measures may not be required in Reaches 1-3.

The natural temperature regime of the Chelan River is not conducive to propagation of cutthroat trout. Thus, should a viable cutthroat trout population develop, but not maintain growth and health, or decline in density during the summer, separation of Project effects from the consequences of natural limiting factors could be difficult. High flow years will provide opportunities to observe the behavior and success of the cutthroat population when spill continues through July and into August. In these years, water temperatures will be the same as

*Chelan River Biological Evaluation
and Implementation Plan*

they would be without the Project's influence. If the cutthroat trout population fails to maintain density during these spill conditions, then natural conditions will be the cause of failure.

4.1.3 Fish Community - Reach 4 and Tailrace

One objective of the NSWG is to promote suitable habitat conditions for successful spawning and rearing of chinook salmon and steelhead trout in Reach 4 and the tailrace of the Project. Criteria for achievement of biological objectives are contained in Tables 7-9 and 7-10. Rearing habitat will be created in Reach 4 and the tailrace, but it is unknown if the fish will use this habitat for extended periods or rapidly move into the more extensive rearing habitat in the Columbia River. Snorkel surveys will document the presence and habitat preferences of rearing chinook and steelhead fry. The criterion for achievement is documentation that habitat areas are created that fall within the predicted preference zone for velocity, substrate and cover. Presence of rearing chinook and steelhead fry will also be a demonstration of achievement, but absence of fish will not be termed a failure without evidence that a Project effect prevented fish from using the habitat.

Salmon and steelhead Spawning Habitat

Salmon and steelhead spawning habitat will be created in Reach 4 and in the tailrace, as described previously. The objective of the minimum flows and Reach 4 pumped flows are to create suitable depth, cover, velocity and substrate conditions for these fish. Objectives for the habitat that will be created by filling part of the tailrace with spawning substrate are the same. These physical parameters can be measured independently of fish use, although fish use is the best evidence of achievement. The criteria for achievement are to document that habitat was created and maintained, in accordance with the preference curves established in the IFIM study. Alternatively, if adult fish runs are strong and colonization occurs during the evaluation period, then the presence and success of spawning fish will also be considered in the determination of achievement. Achievement will be evident if spawning fish are distributed in suitable areas in the tailrace, Reach 4 and below the confluence of Reach 4 and the tailrace. Lack of use by spawning fish will not be termed a failure without evidence that a Project effect prevented fish from using the habitat.

Redd Protection

In addition to providing the habitat conditions that will attract and support spawning by chinook salmon and steelhead trout, the achievement of adequate survival of the eggs and alevins through incubation to emergence must be demonstrated. The survival rate of eggs and alevins in salmon redds is extremely variable under natural conditions, even in the best spawning habitat. The causes of poor survival range from conditions in the habitat to poor fertilization, disease, genetic disorders and pre-spawning temperature or other stress experienced by the fish during migration. A potential Project effect that has been identified is related to curtailment of powerhouse flows during the incubation period. A reduction or the cessation of powerhouse flows, which occurs in many years at some point during the refill cycle for Lake Chelan, could have an adverse impact on survival of eggs or alevins in the habitat created in the tailrace. Interruption of flows to Reach 4, from pump failure or other causes could also affect the success of redds in that section. The objective of the M&E program is to assure that redds are protected during the incubation and emergence periods.

*Chelan River Biological Evaluation
and Implementation Plan*

Prevent Dewatering

The M&E program includes spawning surveys that will identify redds, with follow-up monitoring for those redds deposited in areas that could be dewatered by changes in Project flows. The criteria for achievement is to prevent dewatering of redds, to the extent feasible within control of the Project. Redds deposited below the confluence of Reach 4 and the tailrace are subject to flow and river stage fluctuations in the Columbia River, in addition to changes in flows from the Project. Alternative actions to correct dewatering, should it be detected, include deepening of spawning gravels when it can be accomplished without reducing the habitat characteristics that lead to selection by spawning fish. Flow from the pumping station will be maintained at the levels necessary to prevent dewatering of redds in Reach 4 (See Tables 7-9 and 7-10).

Prevent Low Oxygen, Have Adequate Metabolite Flushing

Powerhouse shutdowns are an unavoidable necessity in many years during the refill period for Lake Chelan. The change in flow and hydraulic gradient across the redds spawned in the tailrace could have an adverse effect on survival of eggs and alevins if intra-gravel flow is insufficient to maintain oxygen levels and flush out waste products. The gravel that will be placed in the tailrace to create the habitat will be free of fine sediments and highly permeable, which minimizes the hydraulic gradient necessary to maintain intra-gravel flow. Also, the continual water level fluctuations that occur in the Columbia River transmit up to the powerhouse as well. This constant rise and fall in Columbia River water levels results in consequent movement of flow into and out of the tailrace when the powerhouse is not operating. This water movement, coupled with the very permeable substrate, may be capable of maintaining intra-gravel flow. The M&E program will monitor dissolved oxygen levels in a representative sample of redds in and below the tailrace. This measurement will determine if redds in the tailrace fare any worse than redds below the confluence, where the minimum flows from Reach 4 will maintain a hydraulic gradient. The objective is to achieve egg-emergence survival of 70 percent, or levels of survival equivalent to 80 percent of the egg-emergence survival of summer chinook redds in the Methow River, whichever is less.

Criteria for achievement (Table 7-10) are the demonstration of successful spawning and survival of eggs and alevins at rates comparable to redds spawned in reference areas that are not affected by the Project. These reference areas are spawning sites below the confluence of Reach 4 and the tailrace, where spawning has occurred for over two decades, and in the Methow River (chinook). Monitoring of dissolved oxygen will detect if serious oxygen depletion is occurring in the redds in the tailrace, which provides for proactive triggering of decisions to protect the redds before survival is seriously affected. The objective is to maintain oxygen levels in the redds at or above 6.0 mg/l. Additional monitoring to determine survival, the result of all potential causative factors, including those beyond the Project's influence, will be done to establish a complete basis for evaluating achievement. This additional monitoring includes ratios of dead/live eggs and dead/live alevins and snorkel surveys for fry presence during the emergence period.

Several alternatives for redd protection will be evaluated and potentially implemented based on decision points during the M&E period. Detection of low dissolved oxygen in redds in the tailrace could trigger a decision to implement periodic operation of the powerhouse, as opposed to complete shutdown, during refill of Lake Chelan. Poor success of live/dead ratios in comparison to the reference area could trigger other options, including flow release pipes buried

*Chelan River Biological Evaluation
and Implementation Plan*

into the gravel in the tailrace. An iterative approach is developed in the M&E portion of the implementation plan.

4.1.4 Other Ecological Considerations

The main water quality parameter that is affected by the Project is water temperature in the Chelan River. The natural temperatures are much higher than the preference zone for cold-water species (R2 and IA 2000; Sternberg 1987; Wydoski and Whitney 1979; Scott and Crossman 1974; Milstein 2000; WDFW 1992; NOAA Fisheries 1996). The Project affects temperature in both a positive and a negative manner, depending on the location and time of year. Water issuing from the powerhouse is cooler than natural conditions in the summer, which could be a positive effect in the tailrace and lower Chelan River. However, minimum flows in the Chelan River will allow a greater range of daily temperature fluctuations than would the flows in the Chelan River without the Project. This can be a negative effect in June, July and early August, when the climatic conditions cause the water temperature to rise, but the minimum flows can have a positive effect for cold water fish when the Chelan River cools more rapidly than it would with natural flows. The potential for creation of cool water refugia at the lower minimum flows is also a possible positive effect. The M&E program is designed to evaluate the biological effects of the minimum flows from all perspectives, seeking a balance between the biological requirements and other beneficial uses of the Lake Chelan watershed. Temperature monitoring will be conducted annually at the forebay, in Reaches 1, 2, 3 and 4, and in the tailrace (Table 7-10). This monitoring will be used to guide decisions, in conjunction with the biological monitoring, to achieve the biological objectives of the CRBEIP. The achievement of specific water temperatures or numerical criteria is not a determinant of achievement because the natural conditions fail to meet those same criteria. The purpose of the temperature criteria is the protection of beneficial uses. Therefore, the criterion for achievement is to manage water temperature so that Project effects do not prevent the attainment of the biological objectives.

Water quality and biological objectives can also be adversely affected by oil and hazardous chemical spills. The Project has relatively few sources for spills, compared to other hydroelectric projects in the area, but oil, solvents and other hazardous materials are used in the powerhouse, at the spillway and in the transformer yard. The Chelan Powerhouse uses Francis turbines, which have no underwater oil reservoirs for hydraulic functions. The fact that the powerhouse and transformer yard are away from the Chelan River channel also reduces the potential for contaminant spills that could affect water quality. A Spill Prevention Control and Countermeasure Plan (SPCC) will be developed, as required in WDOE's 401 certification. Achievement is defined as employing best management practices as defined in the 401 certification. In the course of the New License, when equipment is refurbished or replaced, the potential of design improvements to reduce the likelihood of contaminant spills, improve spill detection and containment and reducing the number of contaminants used in normal operations will be given high priority.

*Chelan River Biological Evaluation
and Implementation Plan*

SECTION 5: IMPLEMENTATION PLAN

5.1 Construct Flow Release Structure

The design and construction of the flow release structure will begin after Chelan PUD accepts a New License, which is expected to be in 2003. Design may be initiated following completion of the Agreement between the Parties, but construction cannot begin until the New License is accepted by Chelan PUD. Design of the flow release structure discussed in section 3.3.3 will be coordinated through the Chelan River Fishery Forum (CRFF).

5.2 Construct Reach 4 Pump Station and Channel Modifications

The primary intent of the CRBEIP is to guide development of final designs from the conceptual designs currently contained in section 3 (Management Considerations and Options Investigated) for proposed Reach 4 and tailrace habitat modifications.

The Natural Sciences Working Group (NSWG) developed habitat modifications in the Project tailrace and Reach 4 of the Chelan River to provide additional spawning and rearing habitat for anadromous salmonids (Figures 7-9 and 7-10). These conceptual habitat modification designs need to be developed into final designs in order to proceed with implementation and construction of habitat modifications, and provide assurance to parties participating in Agreement negotiations that these measures will be implemented. The CRFF will be responsible for reviewing the development and finalization of the habitat modifications. The process for developing final habitat modification design is outlined in Table 7-11.

Table 7-11: Habitat Modifications Implementation Plan Development

STEP	SCHEDULE (months following effective date of license)	LEAD ENTITY	M & E (Conceptual)
Develop Request for Proposal (RFP) (develop qualifications, budget, schedule, milestones, deliverables, selection criteria, etc)	Two	Chelan PUD ¹	
Issue RFP to selected consultants	Three	Chelan PUD ¹	
Review RFP's, select consultant	Four	Chelan PUD ¹	
Execute contract	Five	Chelan PUD	
Apply for Required Permits	Five	Chelan PUD ²	
Initial kick-off meeting with consultant	Five	Chelan PUD ¹	Begin Plan Development
30% Review	Seven	Chelan PUD ¹	Continue M&E Development
60% Review	Eight	Chelan PUD ¹	Continue M&E Development
90% Review	Nine	Chelan PUD ¹	Finalize M&E Development
Final Report	Ten	Chelan PUD ¹	Final M&E Plan

***Chelan River Biological Evaluation
and Implementation Plan***

Table 7-11: Habitat Modifications Implementation Plan Development

STEP	SCHEDULE (months following effective date of license)	LEAD ENTITY	M & E (Conceptual)
Educational Opportunities	Ten	Chelan PUD ³	Begin Plan Development
Implementation Reach 4 Tailrace	During construction window before 2 years from effective date of the New License		

¹ Chelan PUD will be the responsible lead entity, but will require input from the CRFF.

² Chelan PUD will be the responsible lead entity, but requests technical assistance from the CRFF.

³ Chelan PUD will be the responsible lead entity, but will require input from the CRFF.

The objective for Reach 4 is creation of approximately 2 acres (the amount available for chinook spawning at 320 cfs per the Bypassed Reach Flow Releases Study Report, IA and R2, 2000) of useable spawning and rearing habitat based on studies that have been conducted (Preference Curve Development for Fall Chinook Salmon, 2001) on water depth, velocity, and substrate size and permeability, and results of the ongoing temperature studies. The objective for the tailrace is to increase/expand existing habitat by between 1 and 2 acres (Stillwater Sciences report, 2001) of useable spawning and rearing habitat, based on the same studies conducted previously used for Reach 4 habitat modifications. Chelan PUD will fund maintaining Reach 4 habitat modifications throughout the life of the New License unless determined otherwise by the CRFF. Best management practices will be incorporated into final design specifications to ensure minimal environmental impact during construction of the habitat modifications.

Sufficient time period for testing and evaluating the Reach 4 habitat modifications will be provided to determine if fish are using the available habitat. If, after a period of time determined by the CRFF, the improvements do not appear to be having the desired effect, then the CRFF may recommend the reallocation of appropriated funding to other enhancements they determine may be more effective.

5.3 Initiate Chelan River Comprehensive Management Plan Flow Releases

Flow releases can begin as soon as the flow release structure and Reach 4 pumping station and habitat modifications have been completed. Tailrace habitat modifications must either be completed prior to chinook spawning in 2003 or postponed until emergence of the 2003 chinook spawning has been completed (June 2004).

5.4 M&E Program

The M&E program will provide the basis for determination that criteria for achievement of biological objectives have been met. The M&E program will also provide the information needed to make decisions on changes to the initial in the event that the criteria for achievement are not accomplished. The timing of the M&E activities is displayed in a flow chart at the end of this section (Figure 7-13).

5.4.1 Benthic Community Analysis

The benthic community will be sampled, following the methods in Plotnikoff and Ehinger (1997) and Plotnikoff and Wiseman (2001), in years 3, 5, 7 and 9. D-style kick net samplers will be used, with other methods as appropriate. Samples will be taken once per year between August 15

*Chelan River Biological Evaluation
and Implementation Plan*

and September 15. Analysis will compare index sections in Reaches 1, 2 and 4 to index samples from above and below the bypassed reach of the Chelan River. Decisions that could be triggered by this M&E component relate to temperature management and possible introduction of organic material to provide food.

5.4.2 Fish Community - Reaches 1-3

Fish Population - Fall-Spring

Fish populations in Reaches 1-3 will be assessed by snorkel surveys. April and November surveys will be conducted to assess the presence and habitat use by fish during these periods with no temperature stress. Surveys will be in April and November in years 3, 5, 7 and 9. Surveys in years 7 and 9 will be monthly (12 per year). No decision triggers are expected to result from spring and fall surveys. These surveys are primarily for documentation of colonization.

Fish Population - Summer

Fish populations in Reaches 1-3 will be assessed by snorkel surveys. These surveys will be in August in years 3 and 5. Monthly surveys will be conducted in years 7 and 9. However, should significant cutthroat presence be detected in April in years 1 or 3, additional surveys through the summer may be initiated to observe response to increasing water temperatures.

Cutthroat Presence/Condition

Surveys in summer will monitor presence and condition of cutthroat trout as seasonal increases in temperature progress. Decision points that could be triggered by these surveys are the options for stream channel modifications (thalweg formation, site potential shade) and flow releases for temperature control.

Use of Thermal Refugia

Surveys in summer will monitor habitat use and determine if thermal pockets of cool water exist and are used by cutthroat trout. Decision points that will be addressed by these surveys are actions that could improve, protect or enhance thermal refugia. If no refugia exist or they aren't used, then other options for temperature control may be used. Increased flows for temperature control may conflict with protection and enhancement of thermal refugia, thus these surveys will help prioritize alternative actions between these options.

Potential M&E Outcomes Affecting Decisions

If cutthroat successful or leave before Project affects the temperature

Cutthroat may respond to temperature increases in the Chelan River that result from the natural temperature regime in Lake Chelan by migrating out of Reaches 1 and 2 before minimum flows have affected the daily temperature regime. Alternatively, the biological objective of cutthroat establishing a year-round population in the Chelan River may be achieved with no apparent impairment of their biological success during the temperature regime created by the minimum flows. In either case, these results would likely move temperature control actions to low priority, unless adverse effects in Reach 4 dictated otherwise. Management actions to address other resource needs would take higher priority.

*Chelan River Biological Evaluation
and Implementation Plan*

If cutthroat stay but show harm at peak temperatures

Cutthroat may establish a viable population in Reaches 1-3, but show signs of impaired success during the summer period when minimum flows determine the temperature regime in the Chelan River. In this case, the monitoring and evaluation results would lead to implementation actions to moderate peak temperatures or increase thermal refugia. Management actions that could be implemented include daytime flow releases and stream channel modifications.

5.4.3 Fish Community - Reach 4

The fish community in Reach 4 is prioritized for chinook salmon and steelhead trout production. M&E is intended to document what has met expectations and define any deficiencies that are correctable. Primary focus is on successful spawning of chinook salmon, then steelhead trout.

Salmon/Steelhead Spawning

Spawning surveys will be done weekly from October 15 - November for chinook (years 2-9) and March - May for steelhead (years 3-9). Survival measurements of redds will be measured in the tailrace for chinook in years 2-7. Steelhead redd survival will be evaluated in Reach 4 and the tailrace in years 3, 5 and 7. Measurements of redd survival will be made in the reference areas (below Reach 4/tailwater confluence and Methow River for chinook) in the same years.

Redd Locations: Measurements of depth, velocity and substrate will be made in years 2-7 for chinook and 3-7 for steelhead. This data will be used to assess the amount of useable spawning habitat created for each species. Decision points based on this data include changes to the stream channel configuration to provide more habitat area within the preference zone. Flow decisions for the pumping station use during incubation and emergence will be based on this data.

Redd Survival: Measurements will include dissolved oxygen and redd capping, ratios of dead/live eggs and dead/live alevins or other methods determined by the CRFF. Decision points relying on these data will include powerhouse operation during chinook incubation in the tailrace, use of flow pipes within the gravel, and pump station use during incubation.

Salmon/Steelhead Rearing

Chinook and steelhead snorkel surveys will be done monthly from April - September, late November and early March for steelhead and during emergence for chinook, with some of these surveys done concurrently. Chinook surveys will be in years 3-7, while steelhead surveys in years 3-7. Decisions made based on these surveys could include changes to habitat characteristics in Reach 4 and the tailrace and use of the pumping station for temperature control during the summer.

Fry Presence/Absence

Fall – Spring: Presence of steelhead fry over the winter would indicate the potential need to provide habitat for age 1 and older steelhead juveniles. Absence of fry during winter would indicate migration to the Columbia River following emergence and post-emergent early rearing.

Summer: Presence of steelhead and/or chinook fry in the summer would trigger monitoring of temperature effects and fish condition. Use of the pumping station for temperature control is a likely decision based on observations of fry rearing in the summer. Modifications to the habitat in Reach 4 and the tailrace could also be triggered based on preferences observed by rearing fry.

*Chelan River Biological Evaluation
and Implementation Plan*

Reach 4/Tailrace: Extensive presence of chinook fry in Reach 4 could lead to a decision to modify habitat types in Reach 4, which initially will be constructed to provide more habitat in the higher velocity range that steelhead prefer. Similarly, high concentrations of steelhead fry in the tailrace could lead to a decision to add boulder type habitat placements in the tailrace.

Habitat Use

Habitat preferences for depth, velocity, substrate and cover will be observed during snorkel surveys. Decisions regarding fine-tuning of habitat types in Reach 4 and the tailrace could result from these observations (add LWD, more or fewer pools, etc.).

5.4.4 Water Quality

Temperature and Flow

Water temperature and flows will be monitored hourly. Monitoring for temperature will be done in the forebay and tailrace, and Reaches 1, 3 and 4. Monitoring for flows will be from gauged discharge from the spillway and minimum flow release structure for the Chelan River and from the powerhouse discharge for the tailrace. Water temperature and flow monitoring are being done to provide information to help in decisions based on biological outcomes and for management of day-to-day operations. Monitoring data for flows and temperature will be available and posted on the Chelan PUD website on a monthly basis from July through September, and quarterly for the rest of the year. Measures that might be implemented based on temperature data are channel modifications in Reach 1 (thalweg formation, site potential shade), use of pumping station during summer in Reach 4, and daytime flow increases in Reach 1.

Other Parameters

Water quality sampling for other physical, chemical and biological parameters of Lake Chelan and the Chelan River currently meet the water quality standards for these water bodies. The Project is not known to affect these parameters (nutrients, pH, dissolved oxygen, total dissolved gas, coliform bacteria). However, to confirm that the Chelan River complies with water quality standards for parameters important to support aquatic life, two general assessments of water quality will be conducted in years 3 and 5, with results reported in years 4 and 6, following acceptance of the New License. The parameters and measurement locations are dissolved oxygen, turbidity, and pH, measured in Reach 4, and total dissolved gas, measured below the spillway. Lake Chelan is on the 303(d) list for pesticide residue in fish tissues, but this is not affected by the Project.

The Project has a Spill Prevention Control and Countermeasure Plan (SPCC) to establish precautionary measures to prevent spills of oil and hazardous substances (Appendix 1). The plan includes procedures to expeditiously control and remove any harmful quantity of oil or hazardous substances discharged. The Lake Chelan Project has not had spills in "harmful quantities" as defined in 40 CFR Part 110 – (a) Quantities "that violate applicable state water quality standards" or (b) "Cause a film or sheen upon or discoloration of the surface of the water or adjoining shoreline or cause a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines" or (c) "a discharge of more than 1,000 U.S. Gallons of Oil in a single event." However, the SPCC has been developed to address the storage and management of petroleum products at the Project. The plan is designed to fulfill the requirements of 40 CFR 112,

*Chelan River Biological Evaluation
and Implementation Plan*

U.S. Environmental Protection Agency (EPA) Oil Pollution Prevention Regulations. The plan describes practices, procedures, structures, and equipment at the facility to prevent spills and to mitigate or preclude any adverse impact on the environment.

5.4.5 Reports in years 4, 6, 8 and 10

Biological Objectives Status Reports will be issued that summarize the results of the M&E program, evaluating achievement in meeting the biological objectives, and review of management decisions taken to meet biological objects. These reports will (1) summarize the results of the monitoring and evaluation program, and evaluate the need for modification of the program, (2) describe the degree to which the biological objectives have been achieved, and the prospects for achieving those objectives in the next reporting period, (3) review measures implemented to meet those biological objectives, and (4) recommend any new or modified measures, including monitoring and evaluation needed to achieve the biological objectives, to the extent practicable. These reports will be issued in years 4, 6, 8 and 10 following the effective date of the New License; draft reports will be issued by February 28th; final reports by April 30th. These reports will be prepared by Chelan PUD in consultation with the CRFF and will make recommendations for modifications to the implementation plan and M&E plan, when needed, to meet biological objectives of the CRBEIP.

5.5 Assessment of Biological Objectives

5.5.1 Management Decisions

Flow Security Options For Tailrace - Decision Triggers

Decision triggers for flow security options are low dissolved oxygen (below 6.0 mg/l) related to powerhouse shutdowns, dewatering of redds, ratios of dead/live eggs and alevins that are worse than for redds in reference areas. M&E would be used to test the concepts for effectiveness in meeting physical indicators and biological improvements.

Temperature Management for Summer Rearing

Pumping into Reach 4 - Decision Triggers

Decision triggers for summer pumping into Reach 4 are: concurrent observations of high peak temperatures, exceeding natural peak temperatures, at minimum flows; presence of steelhead fry before peak temperatures; reduced density or condition of steelhead fry during or after peak temperatures, and a temperature differential between the tailrace and Reach 4. M&E would be used to evaluate benefits of pumped flow over minimum flow.

Habitat Use - Modify Habitat Types

Flow or Channel Changes - Decision Triggers

Decision triggers would be selective use by steelhead or chinook of habitat types that were less abundant than other habitat types that were more abundant. The feasibility of modifying the habitat type to achieve the biological objective will be evaluated with M&E on an incremental basis.

*Chelan River Biological Evaluation
and Implementation Plan*

Additional Actions for Reaches 1-3

These measures will be implemented, based on demonstrated Project effects and biological necessity, to the extent feasible.

Site-potential Shade

Decision triggers would include high daytime temperatures that exceed natural peak temperatures, evidence of adverse reaction by the fish or benthic community to the temperature spikes, and model results (sensitivity analysis) that shows a significant decrease in the peak temperature after implementing actions.

Evaluation of Refugia

Decision triggers would include determination that cutthroat are heavy users of cool water pocket thermal refugia, indications that certain flows enhance or destroy the refugia, and biological indications of benefit. Most likely decision would be related to conflict between increasing daytime flow and maintenance of cool water refugia.

Evaluation of Daytime Flow Increases

Decision triggers would be M&E observations of adverse cutthroat trout reaction to daytime peak temperatures, model predictions on the efficacy of increased daytime flow, and M&E evaluation of the benefits to the cutthroat trout community in the Chelan River.

5.5.2 Biological Objectives Achieved

Based on the studies performed under this CRBEIP and the results presented in the reports prepared under section 5.4.5, WDOE, after conferring with the CRFF, no later than 10 years after the effective date of the Agreement, is expected to make a determination on whether the biological objectives in the CRBEIP and state water quality standards have been achieved. If it is determined that the biological objectives have been met but non-compliance with water quality standards exists, it is expected that WDOE will initiate a process, as necessary, to modify the applicable standards through rulemaking or some other alternative process authorized under federal and state law.

5.5.3 Biological Objectives Not Achieved

If WDOE determines that some or all of the biological objectives have not been met and that Chelan PUD has undertaken all known, reasonable, and feasible measures to achieve those objectives consistent with supporting, protecting, and maintaining the designated and existing beneficial uses, WDOE intends to initiate a process to modify the applicable water quality standards to the extent necessary to eliminate any non-compliance with such standards. Following the issuance of the final Biological Objectives Status Report in year 10, if Chelan PUD concludes that one or more biological objectives cannot be met in whole or in part despite its having undertaken all known, reasonable, and feasible measures to meet those objectives consistent with supporting, protecting, and maintaining the designated and existing beneficial uses, Chelan PUD may consult with the CRFF regarding whether to modify or eliminate a biological objective and/or associated implementation measure, consistent with Proposed License Article 7.

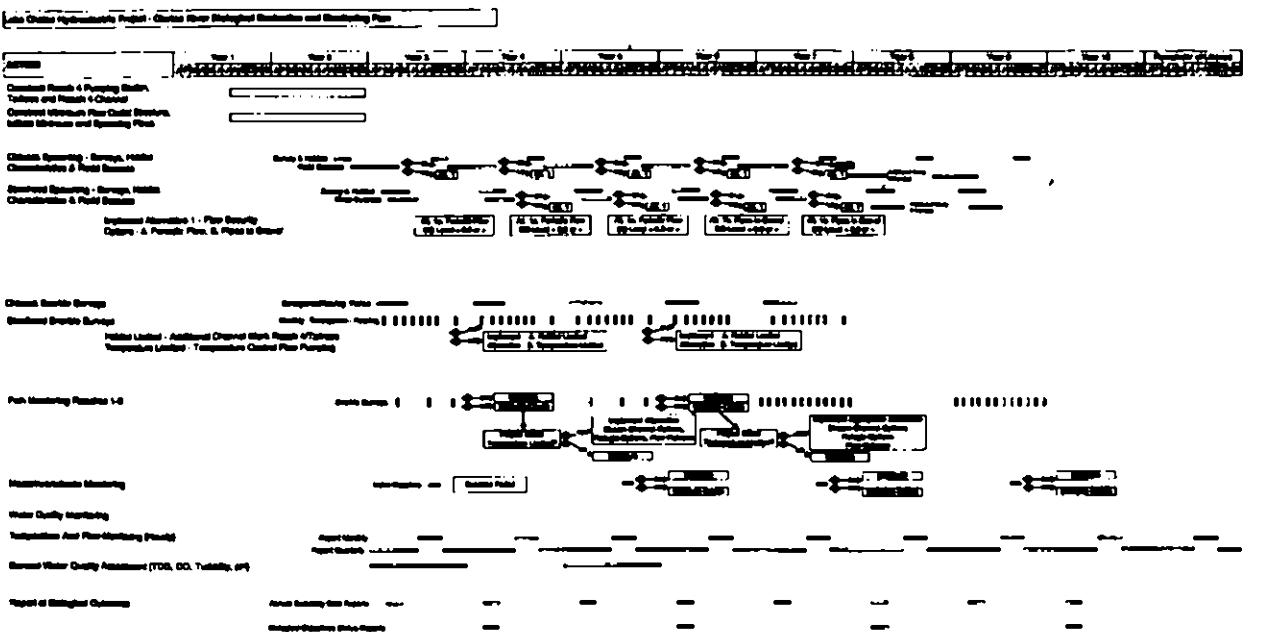


Figure 7-13: Chetco River Biological Evaluation and Monitoring Plan Flow Chart

*Chelan River Biological Evaluation
and Implementation Plan*

SECTION 6: CONCLUSION

The CRBEIP and the other chapters in the Comprehensive Plan provide for the protection and enhancement of existing beneficial uses of the Lake Chelan Basin that are affected by the Project, while substantially restoring a significant number of environmental values associated with the Chelan River. The CRBEIP is designed to achieve certain biological objectives concerning restoration and/or enhancement of biological resources in four separate reaches of the river and to support, maintain and protect the designated and existing beneficial uses of the Chelan River Basin, pursuant to applicable federal and state law. The M&E program in the CRBEIP is designed to evaluate the biological effects of the minimum flows and other actions from all perspectives, seeking a balance between the biological requirements to support fish populations and the protection of other beneficial uses of the Lake Chelan watershed. The net effect of the CRBEIP is to provide significantly improved biological functions and values compared to existing conditions. This CRBEIP is supporting material for Chelan PUD's application (March 26, 2002) to WDOE for state certification of compliance with water quality standards and other appropriate requirements of state law (Section 401 certification) in regard to Chelan PUD's license application for the Project. This CRBEIP is also submitted as a "mitigation plan" pursuant to the Washington State "Aquatic Resources Mitigation Act".

The Chelan River receives water from Lake Chelan that is quite warm in the summer due to natural conditions. The water temperature is further affected as it passes through the Chelan River from natural causes, with the temperature response of the river closely related to the instream flow and physical characteristics of the channel and shoreline. The relationship of these physical factors to the flow regime is a principal focus of the measures contained in the CRBEIP. These measures balance the use of stream channel and riparian habitat improvements, flow releases from the dam and flow augmentation with pumping from the tailrace to provide protection for existing beneficial uses of the Lake Chelan Basin, while increasing the net ecological benefit for aquatic species in the Chelan River. The CRBEIP includes an implementation plan, providing for staged implementation of alternative actions based on the results of an extensive biological monitoring and evaluation program. The measures implemented pursuant to this Chapter, and the resulting river conditions, are expected to be the basis for modifying water quality standards, if necessary, for the Chelan River.

*Chelan River Biological Evaluation
and Implementation Plan*

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*Chelan River Biological Evaluation
and Implementation Plan*

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*Chelan River Biological Evaluation
and Implementation Plan*

**APPENDIX A: CHELAN RIVER STREAM NETWORK
TEMPERATURE MODEL – LAKE CHELAN
HYDROELECTRIC PROJECT FERC PROJECT NO. 673**

Draft Final

Chelan River Stream Network Temperature Model Lake Chelan Hydroelectric Project FERC Project No. 637

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EXECUTIVE SUMMARY

As part of relicensing the Lake Chelan Hydroelectric Project, FERC No. 637, a stream temperature modeling study was applied to the 3.9-mile long bypassed section of the Chelan River between Lake Chelan Dam and the confluence with the Columbia River. Using the Stream Network Temperature Model (SNTEMP), stream temperatures within the bypass were simulated under variable conditions of flow, weather, and channel configuration. The purpose of this study was to generate information useful in the evaluation of alternative project management scenarios for enhancement of fish populations.

The StreamTemp computer model (a variation of SNTEMP) was calibrated and validated with measured hydrological and meteorological data from June 19 to August 20, 2002. In these temperature model analyses, calibration of the temperature model utilized one-half of a partial year of data followed by validation testing of the calibrated model with the second half of the data. The available data set allowed for a reasonable calibration and validation of the model. Temperature predictions and conclusions for simulation runs (gaming scenarios) can be viewed as approximating conditions during similar flow, weather and seasonal parameters.

The gaming scenario data consisted of 425 days from May through September, 2000 to 2002, plus an extreme hot-weather pattern from July 24 to August 6, 1998. Weather data originated from the U.S. Forest Service Chelan Ranger Station, and flows and water temperatures were taken from forebay, penstock and powerhouse data sensors.

Results show that downstream mean daily water temperatures will either cool or warm depending on ambient weather conditions, lower flow releases are more responsive to weather than higher flows, and maximum daily water temperatures are generally higher with lower flows. A comparison of the air temperature with the upstream water temperatures within the calibration data file shows that the mean daily input water temperatures in the forebay of Lake Chelan are already approaching equilibrium with the air temperature, even prior to entering the Chelan River channel. This is likely because the top surface of Lake Chelan (and hence the channel input water) has had time to acclimate to the weather regime. Consequently, on hot days, relatively hot water is entering the channel.

The predicted average daily water temperatures at downstream locations did not vary significantly under a wide range of flows. Generally, on warmer days, larger discharges of cooler water kept the stream from warming as much as smaller volumes. However, on some cooler days and at higher flows, the downstream water was actually warmer than at lower flows because the thermal mass of the larger volume of water was less capable of cooling as quickly.

While 24-hour average temperatures generally followed the input water temperatures over a wide range of flows, the calculated maximum temperatures followed a pattern where the smaller flows had a much greater diurnal range of temperatures than larger flows. Average 24-hour temperatures rarely exceeded 24 degrees, but maximum 24-hour temperatures often exceeded 24 degrees in low flow scenarios.

Prediction results followed the same patterns but were more exaggerated under extremely hot weather. Chelan River water warms through the bypassed reach even under very high flows. A seasonal trend is evident when the model is applied using late spring (May) to early fall (September) data for the three modeled years, with lower flows warming more (both mean daily and maximum daily) prior to mid

August, and cooling more than higher flows thereafter. Temperature simulation by study reach within the Chelan River bypass showed that the greatest temperature increases occur within the uppermost reach. However, the temperature of water released at the dam into the uppermost reach in the summer is already consistently higher than standard temperature criteria for salmonids.

TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	1
1. INTRODUCTION.....	1-1
1.1 LOCATION	1-1
1.2 BACKGROUND.....	1-1
1.3 SALMONID TEMPERATURE THRESHOLD	1-2
2. STUDY AREA	2-1
2.1 STUDY REACHES.....	2-1
3. CALIBRATION PROCESS.....	3-1
3.1 INPUT DATA: STREAM TEMP MODEL DATA ACQUISITION	3-1
3.1.1 Water Temperature and Recording Thermographs	3-1
3.1.2 Thermograph Installation Locations	3-1
3.1.3 Temperature Data Handling And Reduction.....	3-2
3.1.4 Hydrology	3-3
3.1.5 Meteorology	3-4
3.1.6 Shade Measurements.....	3-6
3.1.7 Stream Geometry.....	3-7
3.2 CALIBRATION AND VALIDATION PROCEDURES.....	3-8
3.2.1 Data Sets.....	3-8
3.2.2 Calibration.....	3-8
3.2.3 Validation.....	3-9
3.2.4 Goodness-of-fit	3-9
3.3 CALIBRATION RESULTS.....	3-10
3.3.1 24-Hour Average Temperatures	3-10
3.3.2 Maximum Daily Water Temperature Calibration.....	3-14
3.4 CALIBRATION CONCLUSIONS.....	3-16
4. GAMING SIMULATIONS.....	4-1
4.1 SIMULATION INPUT DATA	4-1
4.1.1 Meteorology	4-1
4.1.2 Hydrology	4-1
4.2 GAMING RESULTS.....	4-1
4.3 THRESHOLD TEMPERATURE ANALYSIS.....	4-14
4.4 EXCEEDANCE PERCENTILES.....	4-18
5. DISCUSSION AND CONCLUSIONS.....	5-1
5.1 SALMONID TEMPERATURE THRESHOLD IMPLICATIONS.....	5-1

TABLE OF CONTENTS (Continued)

6. LITERATURE CITED	6-1
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LIST OF FIGURES

1A Chelan River Water Temperature Monitoring Locations	2-2
1B Topographic Map of Study Area	2-3
2 Average Daily Forebay Water Temperatures in °C in 2002	3-3
3 Average Daily Release Flows in Cubic Feet per Second from Lake Chelan in 2002	3-4
4 Air Temperature in °C and Solar Radiation in Kilojoules/square meter/second.....	3-5
5 Air Temperatures at Town of Chelan and the Chelan Powerhouse, 2002	3-6
6 Graph of Observed vs. Predicted Temperatures in °C, End of Reach 1, in 2002.....	3-10
7 Graph of Observed vs. Predicted Temperatures in °C, End of Reach 2, in 2002.....	3-11
8 Graph of Observed vs. Predicted Temperatures in °C, End of Reach 3, in 2002.....	3-11
9 Graph of Observed vs. Predicted Temperatures in °C, End of Reach 4, in 2002.....	3-12
10 Scatterplot of Observed vs. Predicted Temperatures in °C, End of Reach 1.....	3-12
11 Scatterplot of Observed vs. Predicted Temperatures in °C, End of Reach 2.....	3-13
12 Scatterplot of Observed vs. Predicted Temperatures in °C, End of Reach 3.....	3-13
13 Scatterplot of Observed vs. Predicted Temperatures in °C, End of Reach 4.....	3-14
14 Maximum Temperature Calibration – Observed Versus Predicted in °C, 2002	3-15
15 Observed and Predicted Mean Daily and Predicted Maximum Temperatures in °C, 2002.....	3-16
16 Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 40 c.f.s.....	4-2
17 Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 80 c.f.s.....	4-2
18 Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 100 c.f.s.....	4-3
19 Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 200 c.f.s.....	4-3
20 Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 300 c.f.s.....	4-4
21 Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 400 c.f.s.....	4-4
22 Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 600 c.f.s.....	4-5
23 Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 800 c.f.s.....	4-5
24 Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 1000 c.f.s.....	4-6
25 Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 1500 c.f.s.....	4-6
26 Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 2000 c.f.s.....	4-7

TABLE OF CONTENTS (Continued)

27	Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 4000 c.f.s.....	4-7
28a	Maximum Daily Temperatures in °C, Node 8 (Near Middle of Reach 1)	4-7
28b	Maximum Daily Temperatures in °C, End of Reach 1.....	4-7
29	Maximum Daily Temperatures in °C, End of Reach 2	4-7
30	Maximum Daily Temperatures in °C, End of Reach 3.....	4-7
31	Maximum Daily Temperatures in °C, End of Reach 4.....	4-7
32	Percent Exceedance, Threshold Temperature of 22 °C.....	4-15
33	Percent Exceedance, Threshold Temperature of 23 °C.....	4-15
34	Percent Exceedance, Threshold Temperature of 24 °C.....	4-16
35	Degree Days, Threshold Temperature of 22 °C	4-16
36	Degree Days, Threshold Temperature of 23 °C	4-17
37	Degree Days, Threshold Temperature of 24 °C	4-17
38	Average Temperature Exceedance Percentiles.....	4-19
39	Maximum Temperature Exceedance Percentiles.....	4-20

LIST OF TABLES

1	Locations of Study Nodes.....	2-4
2	Chelan River Bypass - Parametrix Hobo and Tidbit Temperature Monitoring Locations	3-2
3	Calculated Shade by Study Reach on Selected Dates – Chelan River	3-7
4	Derived wetted widths (meters) at selected flows	3-7
5	Calibration and Validation Statistics – Chelan Stream Temperature Model.....	3-9
6	Average Temperature Exceedance Percentiles.....	4-18
7	Maximum Temperature Exceedance Percentiles.....	4-21

APPENDICES

- A Calibration Input Data**
- B Calibration Data Statistics**
- C Simulation Run Input Data**
- D Simulation Run Statistics**

1. INTRODUCTION

The Lake Chelan Hydroelectric Project (FERC No. 637) is located on the Chelan River near the City of Chelan in Chelan County, Washington. The Project is licensed to the Public Utility District No. 1 of Chelan County whose central offices are 32 miles south, in Wenatchee, Washington. The existing FERC license is due to expire at the end of March 2004 and this water temperature modeling study is being completed as a requirement for the environmental portion of the relicensing process.

1.1 LOCATION

From the dam that maintains Lake Chelan at its current elevation, 3.9 miles of the Chelan River is bypassed down to a powerhouse near the confluence with the Columbia River. Water is diverted at the dam through a 2.2-mile long tunnel and penstock and returned to the Chelan River approximately 400 feet upstream of the Columbia River at the project powerhouse.

1.2 BACKGROUND

In most years, the bypassed section of the Chelan River is generally dry as a result of project operations and lake level management under the FERC license. Only during wet years or during project maintenance does the river channel receive substantial flow. When flow is not being released into the river below the dam, fish habitat is restricted to a few isolated pools in the gorge section of the bypassed reach and a short section of river below the powerhouse tailrace. Summer and fall chinook salmon (*Oncorhynchus tshawytscha*) have been observed utilizing the tailrace and lower river for spawning under the right conditions, while smallmouth bass (*Micropterus dolomieu*) and suckers (*Catostomus spp.*) use the available habitat for rearing.

If flow releases are specified under a new license, additional fish habitat could be created and maintained within river bypassed reach in most years. Depending on flow, channel configuration, weather, and water temperatures, various fish species might occupy the habitat. Given the proper conditions (primarily suitable water temperature), even stream habitat necessary for the West Slope cutthroat trout (*Salmo clarki*) might be achieved in the Chelan River. Providing suitable habitat in the upper three miles of the river for this species is a primary desired beneficial use designated by the Natural Sciences Working Group, a project re-licensing committee.

This study was performed to provide an evaluation of flow release alternatives and possible habitat enhancement options. The process-oriented temperature model StreamTemp (based on SNTEMP, Theurer et al. 1984) was used to predict water temperatures in this reach under various simulated flow regimes and weather conditions. This model has the benefit of being peer-reviewed, published, and widely applied. Measurements of stream temperature, flow, geometry, and localized meteorology were used in the construction and calibration of the temperature model. StreamTemp incorporates (1) a complete solar model that includes both topographic and riparian vegetation shade; (2) a meteorological correction model to account for the change in air temperature, relative humidity, and atmospheric pressure as a function of elevation; (3) a complete set of heat flux components to account for all significant heat sources; (4) a heat transport model to determine longitudinal water temperature changes; (5) regression models to smooth or complete known water temperature data sets; (6) a flow mixing model at tributary junctions; and (7) calibration equations to help eliminate bias and reduce errors at calibration nodes (Theurer et al. 1984). The StreamTemp program, running under Microsoft Windows, enhances the usability of the SNTEMP algorithms by providing simplified data input into a single data file, and multiple graphs and tables for ease in checking data and results.

Development of an accurate temperature model for a river such as the Chelan involves acquiring as much real, measured data as available for calibration. Hogan et al. (1973) found that analysis of data for a period of two years leads to the same general distribution of equilibrium temperatures as does a ten year period. However, with the Chelan River, there is no required minimum flow below the dam and there has been a recent sequence of dry years. Consequently, prior to 2002, no calibration data were available except for a brief period (13 days) in 1999. A rough, un-validated temperature model based on these 13 days was developed in 2001. In 2002, from June through August, various test flows were passed below the dam to specifically allow stream temperature data collection. The previous model was discarded after collection of this larger data set from which a more rigorous temperature model was developed. Following model calibration and validation from this data set, other months and years of weather and forebay water temperatures were added for gaming simulations. As with any other model, daily temperature predictions at specific locations should not be considered as absolutes, but as comparative temperatures for use in evaluating potential management alternatives.

1.3 SALMONID TEMPERATURE THRESHOLD

A threshold of 20°C (68°F) is identified in this report as the approximate upper temperature limit of suitable salmonid habitat, according to standard guidelines for thermal tolerance of salmonid species (McAfee 1966, Reiser and Bjornn 1979, Raleigh et al. 1984 and 1986, Armour 1991). The ultimate upper incipient lethal temperature (UULT) above which 50% mortality is expected to occur, ranges between 23°C to 25°C for chinook salmon, cutthroat and rainbow trout (Bell 1986, Eaton et al. 1995). These salmonid temperature criteria are noted only as reference points and are considered relative indexes rather than absolute limits due to other factors that may control suitability. These factors include the range of diurnal temperature variation, availability of thermal refuges (e.g. deep pools or springs), water quality, fish size, sex, life cycle stage, and possible genetic variation in thermal tolerance of salmonid species and strains.

2. STUDY AREA

2.1 STUDY REACHES

For the purpose of this and other related environmental studies, the Chelan River has been segmented into four study reaches based on gradient, channel confinement, and fluvial geomorphologic characteristics (Figure 1a). A more detailed description of the reaches is available in the Bypass Reach (Gorge) Flow Releases Study Report (R2 Resource Consultants and Ichthyological Associates, Inc. 2000).

Reach 1 – Starting from the dam and extending down 2.29 miles, the river channel in this 1% gradient reach is generally wide (averaging 85 feet), is partially confined by the glacial moraine hillsides, and has little or no riparian vegetation. The upper section of Reach 1 is more confined to a single channel while the lower section widens into one or two very shallow braided channels. Since reach azimuth is important for the shading algorithm, unlike the remaining reaches, Reach 1 was broken into twelve sections corresponding to section azimuth.

Reach 2 – Even lower gradient than Reach 1, this 0.75 miles of river is more confined by steep, non-vegetated hillsides with a narrower average channel width of less than 50 feet. Stream shading is provided by the steep hillsides.

Reach 3 – Varying between 5 to 10% gradient, this gorge section is 0.38 miles long and has a channel width of only about 35 feet. Steep bedrock walls confine and shade this portion of the river when the sun is low in the south (fall, winter and spring.) The east-west aspect of the reach allows much greater solar radiation during mid summer.

Reach 4 – Ending at the confluence with the powerhouse tailrace, this 0.49 mile long reach is generally less than 2% in gradient and has an average stream channel width of 108 feet. Minimum shading is provided by the topography with little or no established riparian vegetation.

Figure 1b is a topographic map of the study area, identifying azimuth section nodes within each reach. Table 1 lists the latitude, longitude and upstream distance (from end of Reach 4 near Chelan Powerhouse) for each study node.



Figure 1A Chelan River Water Temperature Monitoring Locations

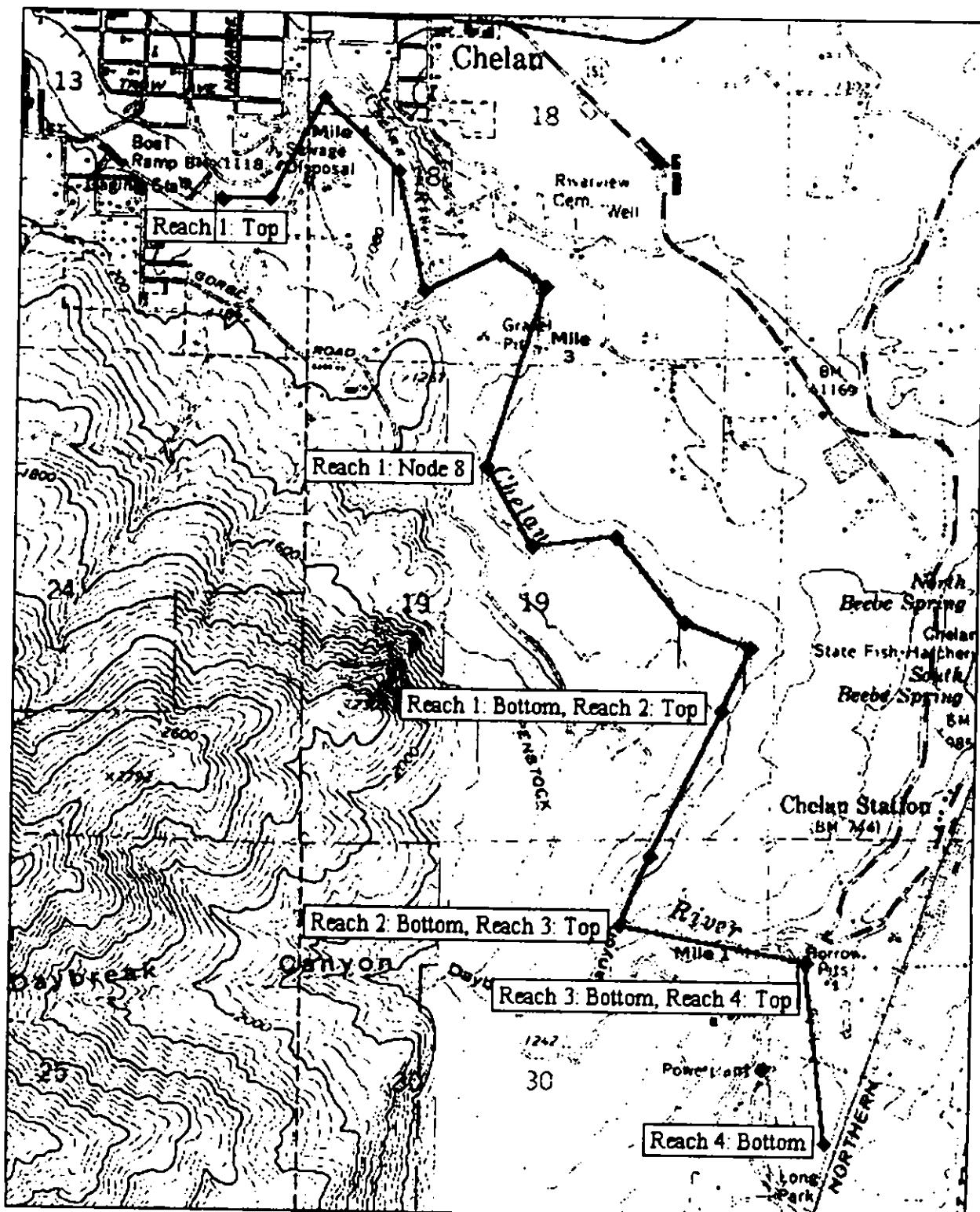


Figure 1B. Topographic Map of Study Area

Table 1. Locations of Study Nodes

Chelan River Study Locations					
Node	Title	Latitude	Longitude	Upstream Distance (km)	Azimuth Downstream
1	Reach 1, Top of Study, dam apron	47.83408	-120.011	6.10	85.8
2	Reach 1, Node 2	47.83413	-120.009	5.90	25.8
3	Reach 1, Node 3	47.83715	-120.007	5.50	131.5
4	Reach 1, Node 4	47.83500	-120.003	5.10	164.5
5	Reach 1, Node 5	47.83149	-120.002	4.68	62.3
6	Reach 1, Node 6	47.83256	-119.999	4.41	126.2
7	Reach 1, Node 7	47.83164	-119.997	4.22	199.2
8	Reach 1, Node 8	47.82622	-119.999	3.59	150.6
9	Reach 1, Node 9	47.82392	-119.997	3.29	86.7
10	Reach 1, Node 10	47.82416	-119.994	3.01	142.1
11	Reach 1, Node 11	47.82167	-119.990	2.65	113.2
12	Reach 1, Node 12	47.82094	-119.988	2.43	205.1
13	End of Reach 1, Top of Reach 2	47.81909	-119.989	2.20	207.2
14	Reach 2, Node 2	47.81489	-119.992	1.61	204.9
15	End of Reach 2, Top of Reach 3, top of gorge	47.81259	-119.993	1.35	103.1
16	End of Reach 3, Top of Reach 4, bottom of gorge	47.81152	-119.985	0.60	175.0
17	End of Reach 4, near Powerhouse	47.80615	-119.984	0.00	

3. CALIBRATION PROCESS

3.1 INPUT DATA: STREAM TEMP MODEL DATA ACQUISITION

3.1.1 Water Temperature and Recording Thermographs

StowAway® Tidbit® thermographs, manufactured by Onset Computer Corporation, were used in the water temperature study. The operating temperature of these thermographs is -4° to + 37°C to, with a stated accuracy of $\pm 0.2^\circ\text{C}$ and resolution of 0.16°C . They are waterproof to 1000 feet and can be set to record in intervals of 0.5 seconds to 9 hours. The internal battery will operate for 5 years but length of deployment depends on the time interval selected for recording temperature measurements.

An Onset Computer Corporation HOBO® measuring device was used to record ambient air temperature and relative humidity in the area of the bypassed reach. The HOBO thermograph has a measurement range of -30°C to $+50^\circ\text{C}$. Manufacturer specifications report an accuracy of $\pm 0.2^\circ\text{C}$ for this thermograph in high-resolution mode (resolution = 0.02°C) and an accuracy of 0.4°C in standard resolution mode (resolution = 0.38°C).

Each thermograph was triggered prior to deployment and deployed on June 11 or 12, 2002. The actual time the thermographs were installed was recorded in the field notes. The thermographs recorded water temperature every 30 minutes. For protection against debris that might be carried by the current and damage during deployment and retrieval, each thermograph was fastened inside a copper pipe cap ($1\frac{1}{2}$ in) with holes drilled in it to allow free access to the river water. The caps with the thermographs and radio tags inside were then mounted on small boulders in the riverbed. A single hole was drilled in the boulders with a rechargeable drill and masonry bits. Stainless steel anchor bolts were driven into the holes and used to secure the thermograph packages to the boulders. The copper caps were mounted with the open end against the boulders, thus encapsulating the thermographs and radio tags. This anchoring method also provided stability in the high velocity currents of the bypassed reach and helped camouflage the thermographs against tampering.

The Onset HOBO® was installed on the underside of a birdhouse that had been modified to permit free airflow around the device while protecting it from rainfall. The HOBO was mounted on a tree, about 1.5 meters above ground and 2 meters into the riparian zone from the edge of the tailrace pool, and in a location shaded from direct sunlight.

3.1.2 Thermograph Installation Locations

The thermographs locations were recorded in the field notebook with sketches and descriptions of the area to aid in relocating the units. GPS coordinates were also recorded for some of the units (Table 2). Unfortunately, some locations in the gorge were not open enough to the sky to allow an adequate GPS fix. All temperature-monitoring locations, indicated on the aerial photograph of the Chelan Bypass Reach (Figure 1a), are approximate (+or- 50 feet in any direction). The Onset HOBO® was located just below the powerhouse on the east bank of the tailrace pool.

Table 2. Chelan River Bypass - Parametrix Hobo and Tidbit Temperature Monitoring Locations

Monitoring Locations	Latitude	Longitude
Air temperature near Power House - Hobo Serial # 479639	NO Data	
End Of Reach 4 - Serial # 484752	NO Data	
End of Reach 3, Start of Reach 4 - Serial # 484751	47°48.687'	119°59.085'
End of Reach 2, Start of Reach 3 - Serial # 484753	47°48.804'	119°59.430'
End of Reach 1, Start of Reach 2 - Serial # 484750	47°49.167'	119°59.234'
Dam Apron or Start of Reach 1 - Serial # 484749	NO Data	
(WGS 1984)		

3.1.3 Temperature Data Handling And Reduction

The raw data files collected by the StowAway® TidbiT® thermographs were exported into Excel (Microsoft®, 1985-1999). Raw data collected from any fixed temperature monitoring station during two or more sequential sampling events were then combined into a single data set. Each data set (one per thermograph) was examined for outliers that were recorded during retrieval, download, and re-deployment periods. These outlier values were not removed from their respective data sets but were marked with color blocks and comments in a column adjacent to the temperature values. The resulting data files were saved in Excel workbooks, ready for reporting and/or analysis.

Discharge and spill data and additional forebay temperature data for the Chelan River dam and powerhouse were received from the Chelan County PUD. These data were added to the worksheets containing the thermograph data. The temperature data for each thermograph and reach were matched to the discharge/spill data and forebay temperature data by date and time. Each resulting data set was marked, with color blocks and comments, to highlight suspect data that might need to be removed prior to inclusion of the data sets in the model. Examples of questionable data include temperature extremes that may have resulted from exposure of the thermograph to air during retrieval and downloading or during no-spill periods. The modeler made the final decision on the validity and use of thermograph data.

Site-specific water temperature data in the study reaches were obtained through the placement of temperature loggers. From June 19 through August 20, 2002, OnSet Computer Corporation Optic Stowaway temperature loggers were deployed at the end of each primary reach and at the top of Reach 1 (dam apron) to monitor water temperatures hourly. A water temperature sensor was also placed in the forebay of Lake Chelan. Since the model requires daily average input temperatures and the top of Reach 1 sensor missed some data (due to exposure to air, and times when the sensor was removed for downloading) the forebay temperatures were used as input temperatures to the model to maximize the number of days for calibration. Figure 2 shows the average daily temperature pattern for the forebay input water temperatures in 2002.

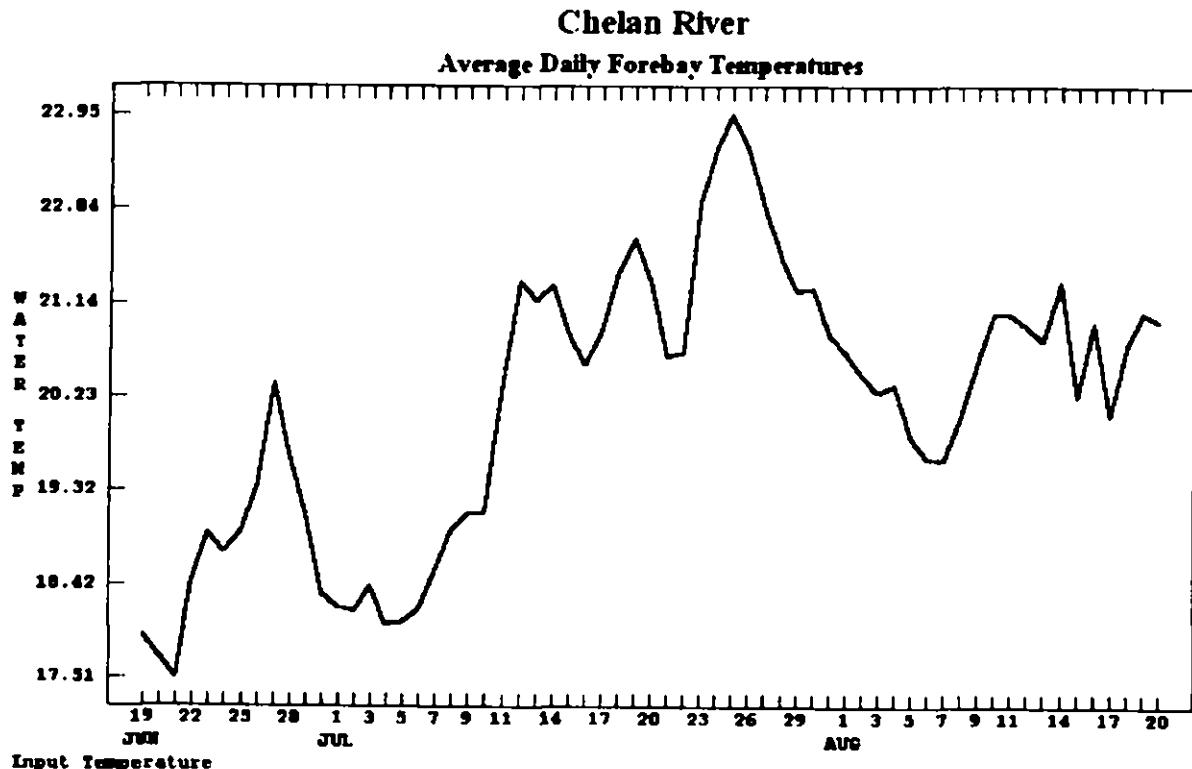


Figure 2. Average Daily Forebay Water Temperatures in °C in 2002

3.1.4 Hydrology

Various test flows were passed below the dam from June 19 through August 20, 2002, to specifically allow stream temperature data collection. Data on flow releases from Chelan Dam were provided by the Chelan PUD (Figure 3). These flow data, together with the recorded temperature data, served as the basis for the hydrology data input file within the SNTEMP model. No lateral accretion flows were included.

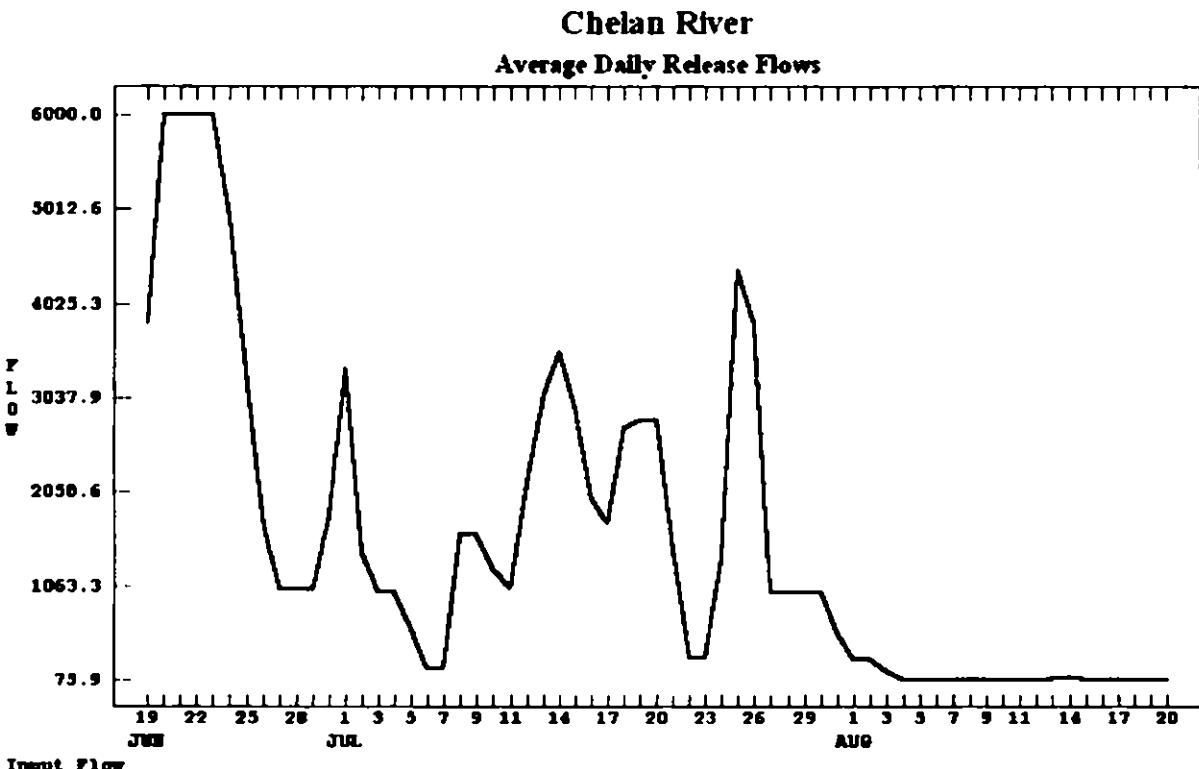


Figure 3. Average Daily Release Flows in Cubic Feet per Second from Lake Chelan in 2002

3.1.5 Meteorology

Daily air temperature data were obtained from the National Oceanographic and Atmospheric Agency meteorological station at Chelan. Relative humidity was measured at the powerhouse. These values served as the meteorological database for the temperature model (Figure 4). Wind speed was set to an average constant of 1.788 meters per second since the local microclimates along the Chelan River reaches are likely different from the nearest available weather station (Wenatchee.) Solar radiation was calculated using the StreamTemp model algorithm and adjusted by modifying percent sunshine, when known cloudy or rainy days occurred at Chelan and Wenatchee.

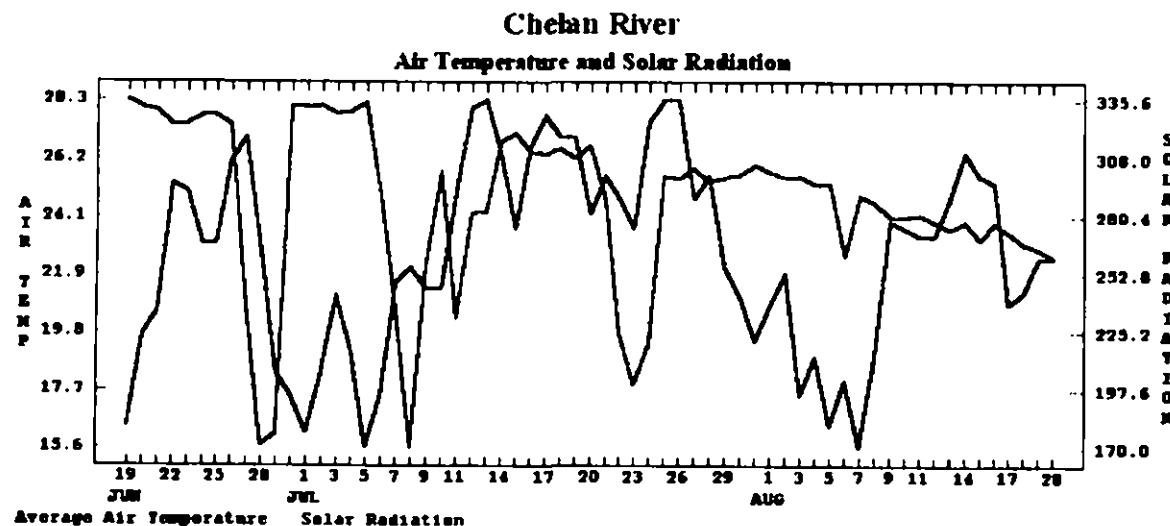
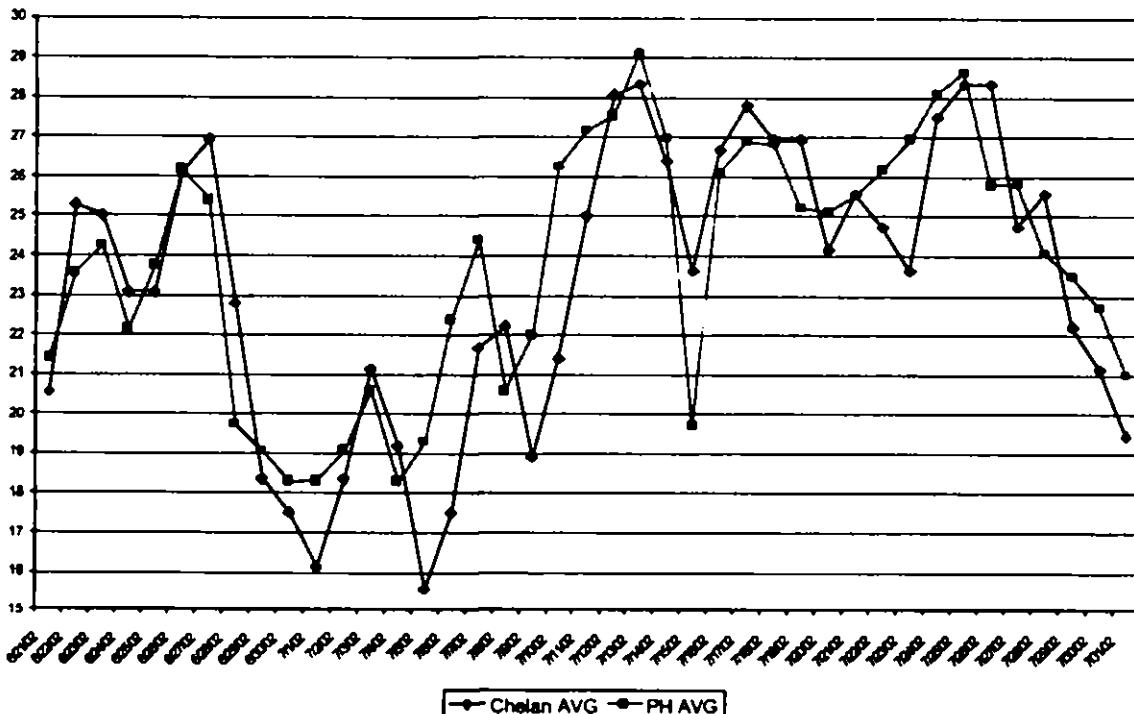


Figure 4. Air Temperature in °C and Solar Radiation in Kilojoules/square meter/second

Air temperatures were measured at the Chelan Powerhouse, but only during the 2002 season. Consequently, they were not used in the calibration since the simulation runs included 2000 and 2001, in addition to 2002. Instead, only the Chelan weather station data was used in the calibration and simulation process. As a quality control measure, for the period of overlap, Chelan and powerhouse air temperatures were compared (Figure 5.). For this period of time, Chelan data is an average of -0.43 degrees Celsius cooler than that of the powerhouse (this difference reflects the adiabatic lapse rate based upon the difference in elevation between the two meteorological station locations).

Chelan vs. Powerhouse Average Daily Air Temperatures**Figure 5. Air Temperatures at Town of Chelan and the Chelan Powerhouse, 2002**

3.1.6 Shade Measurements

An insignificant amount of shading is provided to the Chelan River by streamside vegetation within the bypass reach. Topographic shading varies from minimal shading in the open valley to extensive shading in the gorge during winter months. Initial shade values were obtained in the field on June 9, 2001. Readings of topographic altitude were also made using the seamless USGS topographic map software program TOPO! (National Geographic Holdings, 2000). Numerous readings of rise over run were used to generate an average value of topographic altitude for each bank of the four reaches (east and west banks are fixed by convention based on river segment azimuth). These readings compared favorably to those measured on site using a hand-held clinometer. The mean topographic altitude values for each reach used in the shade sub-component portion of the StreamTemp model are as follows:

- Reach 1 – North bank 15° to 20° (avg = 16.8°), South bank 16.57° to 25° (avg = 18.6°)
- Reach 2 – West bank 40°, East bank 30°
- Reach 3 – North bank 55°, South bank 50°
- Reach 4 – East bank 21°, West bank 25°

Using these angles and reach azimuths, the model calculated daily shade percentages. Table 3 shows the range of shading for the reaches from the beginning of the study (June 19) until the end (August 20).

Since shading increases dramatically during the autumn, included are calculated shade values for September 30 (the end of the simulation period.)

Table 3. Calculated Shade by Study Reach on Selected Dates – Chelan River

Reach	% Shade June 19	% Shade August 20	% Shade September 30
1	3.84	4.56	7.25
2	19.45	22.63	28.59
3	7.56	3.18	91.69
4	12.46	14.87	18.97

Note that calculated shade for Reach 3 (the gorge) is rather low through the calibration period, but then increases dramatically by the end of the simulation period. This is due to the east-west orientation of the reach that allows sunlight to enter in the summer, but blocks sun after the declination of the sun lowers below the 50° horizon.

3.1.7 Stream Geometry

Stream elevations and distances are fundamental stream geometry measurements required in StreamTemp. Elevation and distance values for the Chelan River model were derived from the TOPO! program. Stream width can be a very sensitive parameter in modeling stream temperatures (Bartholow 1989). StreamTemp employs width as a function of discharge in the form:

$$W = a Q^b$$

where W = width (meters), Q = discharge (cms), and a and b are empirically derived coefficients. This allows the model to increase or decrease the width of the river as the flow increases or decreases.

The following are the reach a and b coefficients used in the study

Reach 1 a = 5.0 to 10.0, b = 0.30 to 0.35

Reach 2 a = 6.0, b = 0.3

Reach 3 a = 6.0, b = 0.2

Reach 4 a = 8.0, b = 0.3

Derived wetted widths (in meters) for these coefficients for selected flows are shown in Table 4.

Table 4. Derived wetted widths (meters) at selected flows

Reach	40 c.f.s.	-350 c.f.s.	1000 c.f.s.
Upper Reach 1	8.35	18.03	25.78
Lower Reach 1	10.44	22.54	32.23
Reach 2	6.22	12.04	16.36
Reach 3	6.15	9.55	11.71
Reach 4	8.35	18.03	25.78

3.2 CALIBRATION AND VALIDATION PROCEDURES

Calibration of the temperature model is the process by which certain parameters are adjusted to allow the model to more accurately predict observed water temperatures. Adjustments are often needed to correct for differences in physical conditions between the water surface where temperature change occurs and the sites of data collection. For instance, the air temperature data were collected near the bypassed reach at the City of Chelan. Even with the air temperature location being as close as Chelan, the city is located on the shore of a lake and may have slightly different air temperatures than the Chelan River canyon. A global modification of a particular meteorological parameter such as air temperature might allow for a more accurate prediction model.

Any differences in conditions could affect the ability of the model to reproduce observed water temperatures and warrant calibration adjustments. These calibrations should be within reasonable limits, as defined in the documentation for the models (Bartholow 1989). The input data to these parameters are modified globally (the entire input data set of the specified parameter) by the application of a constant and coefficient modifier to each daily input value. The global calibration factors were used in the computer program to modify the meteorological parameters according to the general form of:

$$Y = a_0 + a_1 y$$

where:

Y is the modified meteorological parameter
y is the original input meteorological parameter
a₀ is the calibration constant factor
a₁ is the calibration coefficient factor.

3.2.1 Data Sets

The Chelan Bypass Temperature Model was calibrated by first dividing the available data (June 19, 2002 through August 20, 2002) into two sets. Set 2 was comprised of 124 data pairs (observed versus predicted water temperatures at the bottom of four reaches for 31 days) when stream flows were less than or equal to 1,000 c.f.s.. This set of data was used for model calibration. Set 1 was comprised of 124 data pairs when stream flows exceeded 1,000 c.f.s., and was reserved for a test of model validation.

3.2.2 Calibration

Through the process of iterative gaming, no global calibration constants and coefficients were deemed necessary to enhance model prediction accuracy. However, some less critical input data were not available for all of the period or only available from distant sources. Because of this, certain data were set to a constant as follows:

Percent Sunshine: Set to 90% for all dates except where rainfall and cloud cover data warranted adjustment down.

Humidity: Calibration (and validation) data used mean daily values measured by the Hobo sensor at the Chelan Powerhouse. (Simulation-run data were set to 30% for all dates except where rainfall and cloud cover data warranted upward adjustment.)

Wind Speed: Set to 1.788 meters per second as a global average.

Dust Coefficient: Set to 10. (Note - a value of 20 produced slightly better calibration statistics, possibly due to generally smoky air during the calibration period – a period of extensive wildfires in the locale. However, this higher number was not appropriate for the “normal” simulation period.)

Ground Reflectivity: Set to 20%.

Table 5 shows the summary calibration statistics of the Chelan River Temperature Model’s performance at the four downstream Chelan River calibration nodes for the 31 days.

Table 5. Calibration and Validation Statistics – Chelan Stream Temperature Model

Data Set	Correlation Coefficient (R^2)	Mean Error ($^{\circ}\text{C}$)	Probable Error ($\pm \text{ }^{\circ}\text{C}$)	Maximum Error ($^{\circ}\text{C}$)	Bias ($\pm \text{ }^{\circ}\text{C}$)	% Errors >1.0
#2 - Calibration	0.9326	0.2404	0.1888	1.0154	0.0170	0.8
#1 - Validation	0.9907	0.0586	0.1095	0.5774	0.0098	0.0

3.2.3 Validation

Typically, to have confidence that a calibrated stream temperature model will predict accurately over a wide range of flows and climate conditions, the model will be validated. Validation is generally accomplished by applying the global calibration factors to another independent set of data, or by splitting the available data set into two equal-sized sets, and running the model as a test of the calibration. Statistics for the validation data that are comparable to those for the initial calibration provide confidence in the calibration.

The second set of available data (Set 1) was modeled under the same calibration criteria applied to Set 2 data in the calibration of the model. Table 5 shows the validation statistics for this simulation.

3.2.4 Goodness-of-fit

As a test of the predictive capabilities of the calibrated model, the observed temperatures are predicted under those conditions in which they were observed. Figures 6 through 9 illustrate the mean daily temperatures predicted, together with the mean daily observed water temperatures at the ends of Reach 1 through 4, respectively. Since not all variables affecting the water temperature are accounted for in any model, and because measurement error almost always exists, all models predict with some error. In a well calibrated model, this error is minimal and is randomly distributed. For a calibrated StreamTemp model, the rule-of-thumb goodness-of-fit criteria for an acceptable calibration are as follows (Bartholow 1989):

- 1 - Simultaneously maximizing the R^2 value while minimizing the mean error to near zero.
- 2 - No more than 10% of the simulated temperatures are greater than 1°C from measured temperatures.
- 3 - No single simulated temperature is greater than 1.5°C from measured temperatures.
- 4 - The mean of the absolute values of measured minus simulated is less than 0.5°C .
- 5 - There is no trend in spatial, temporal, or “temperature” error.

3.3 CALIBRATION RESULTS

3.3.1 24-Hour Average Temperatures

Model runs showed a high degree of correlation between observed and calculated 24-hour daily average temperatures. The following graphs show the results at the end of each reach.

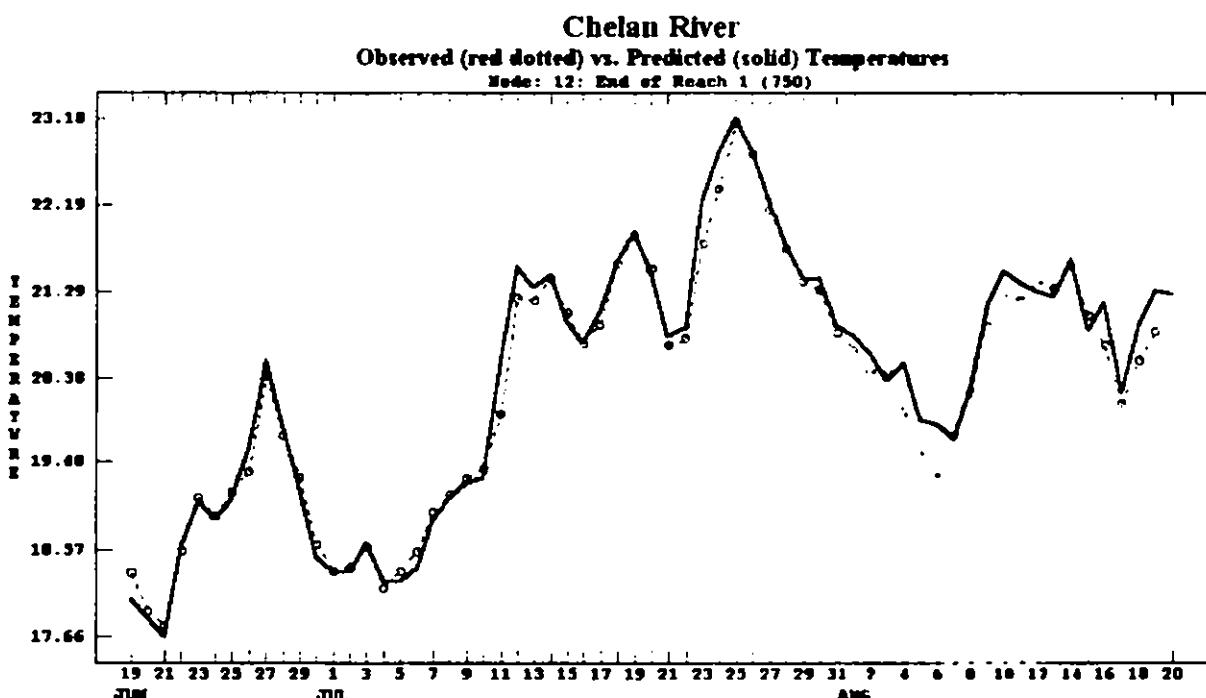


Figure 6. Graph of Observed vs. Predicted Temperatures in °C, End of Reach 1, in 2002

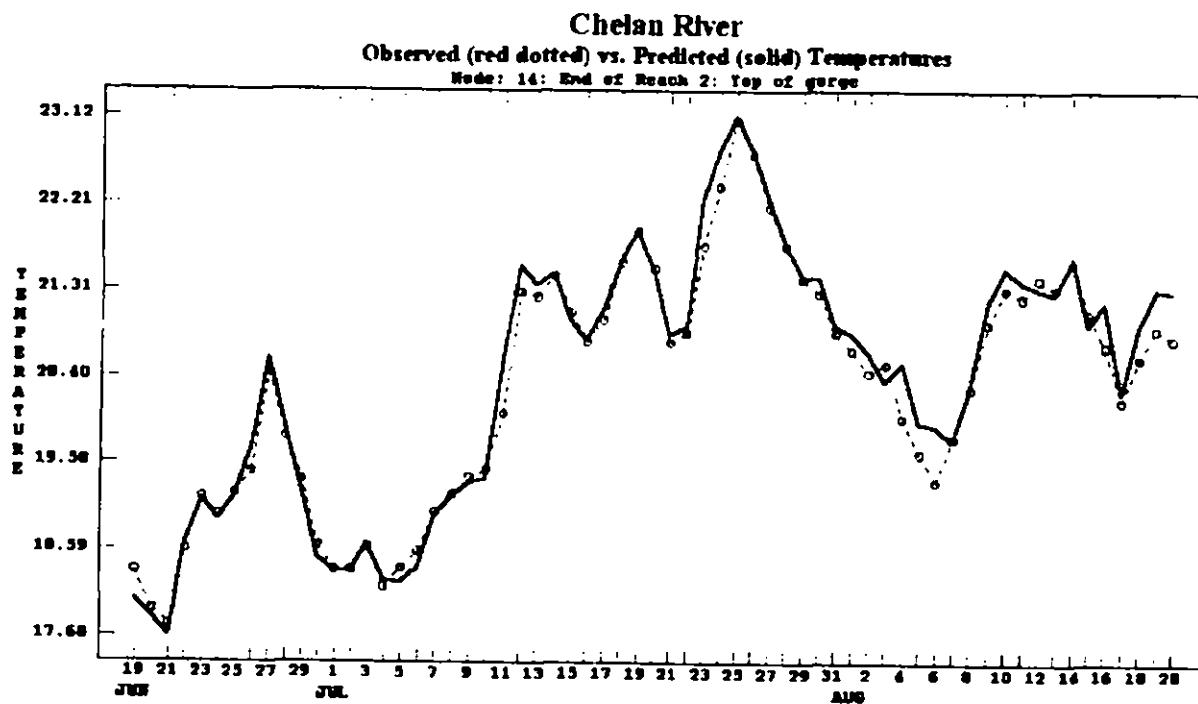


Figure 7. Graph of Observed vs. Predicted Temperatures in °C, End of Reach 2, in 2002

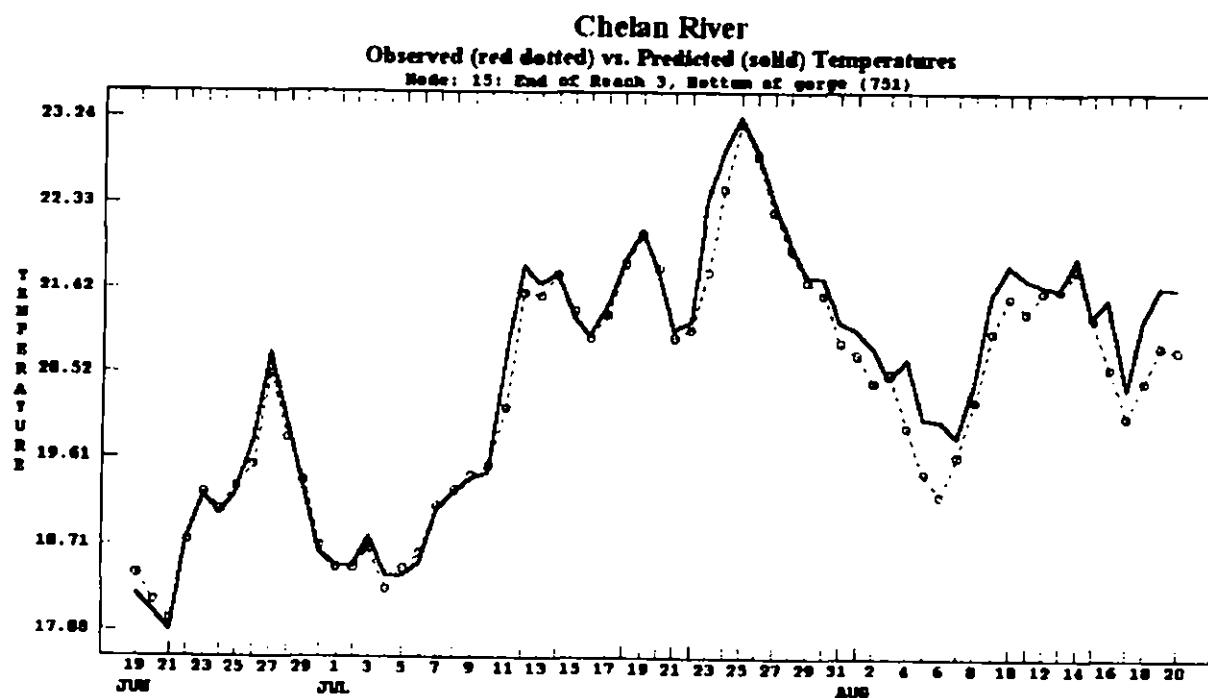


Figure 8. Graph of Observed vs. Predicted Temperatures in °C, End of Reach 3, in 2002

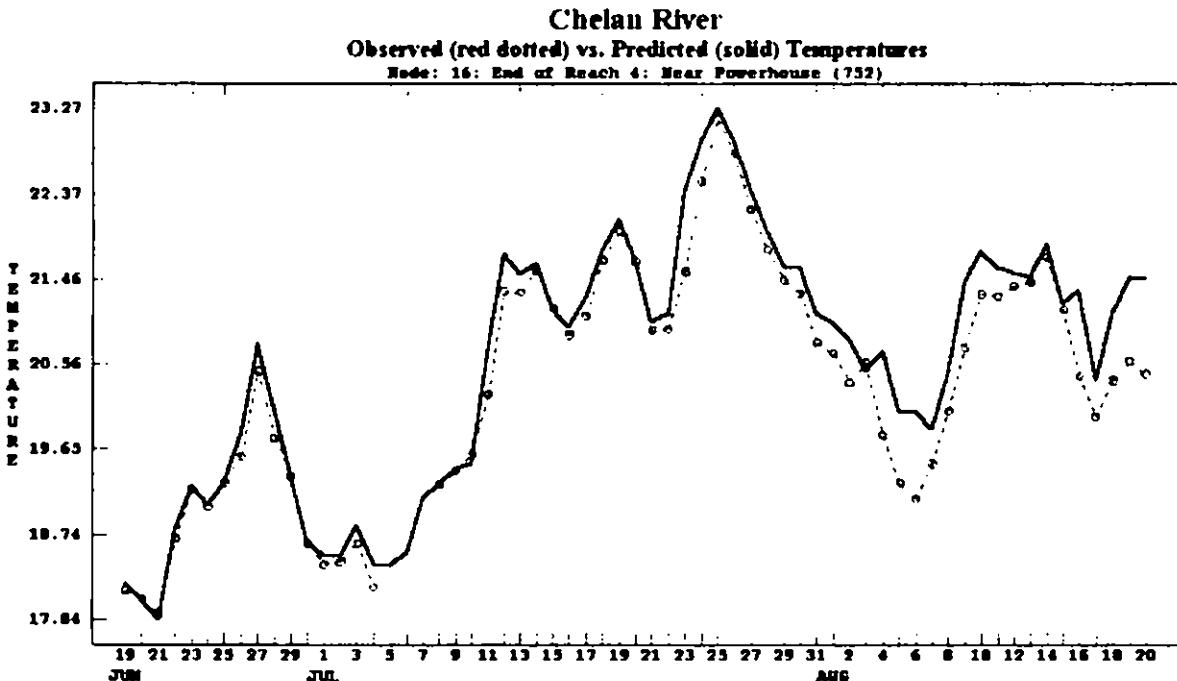


Figure 9. Graph of Observed vs. Predicted Temperatures in °C, End of Reach 4, in 2002

Figures 10 through 13 show the scatterplots of observed vs. predicted temperatures. No systematic error is in evidence that might suggest a problem with the model calibration.

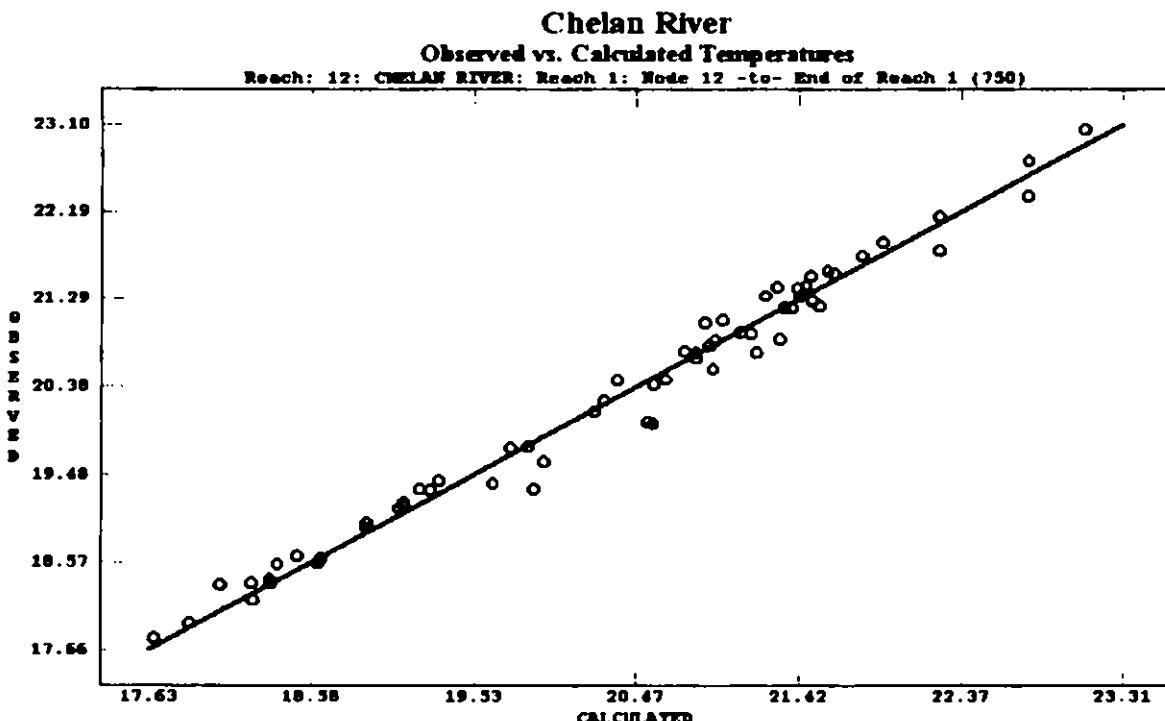


Figure 10. Scatterplot of Observed vs. Predicted Temperatures in °C, End of Reach 1

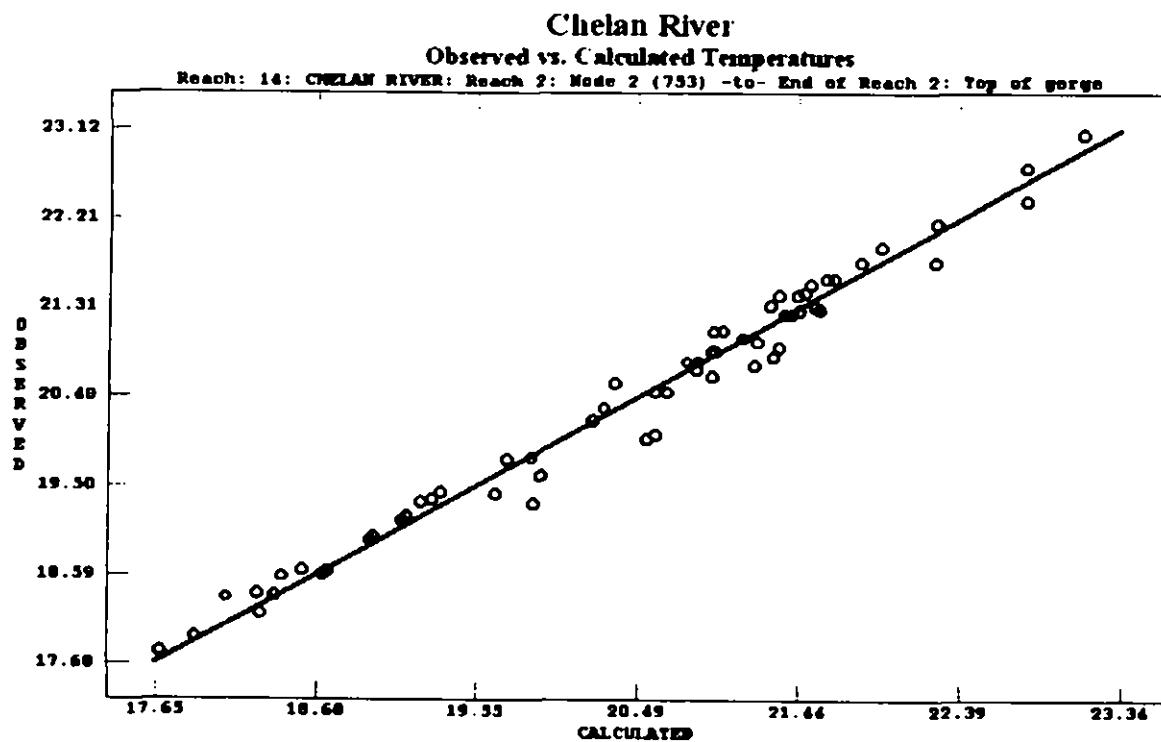


Figure 11. Scatterplot of Observed vs. Predicted Temperatures in °C, End of Reach 2

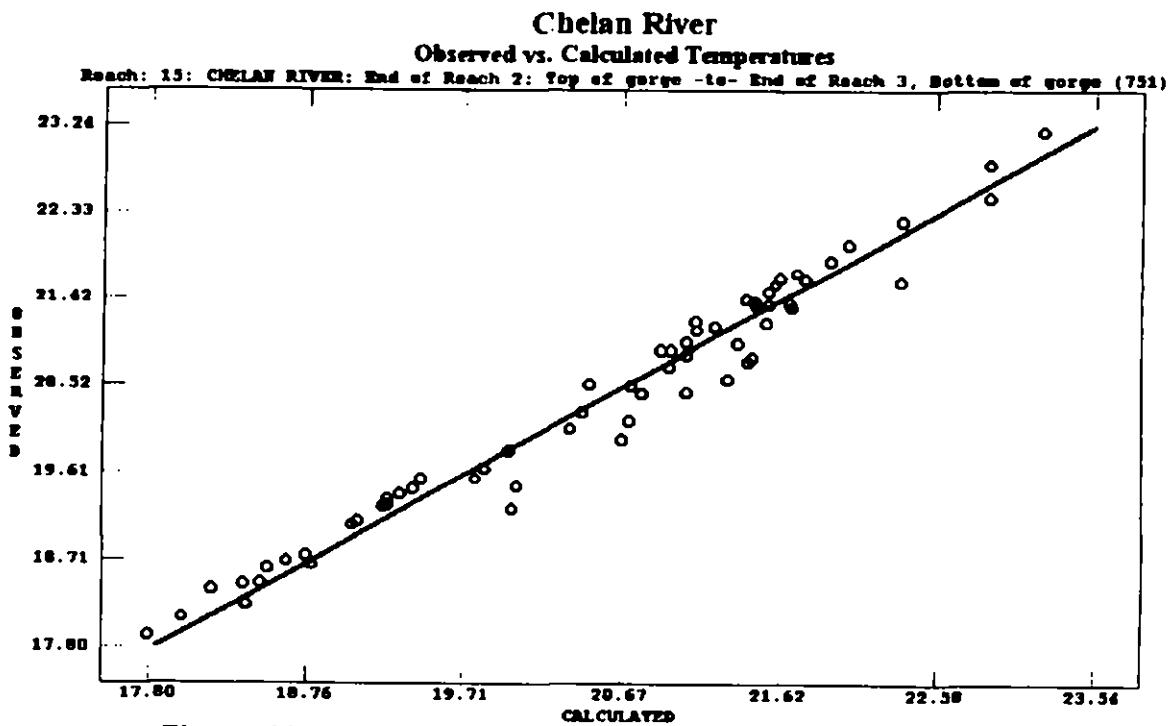


Figure 12. Scatterplot of Observed vs. Predicted Temperatures in °C, End of Reach 3

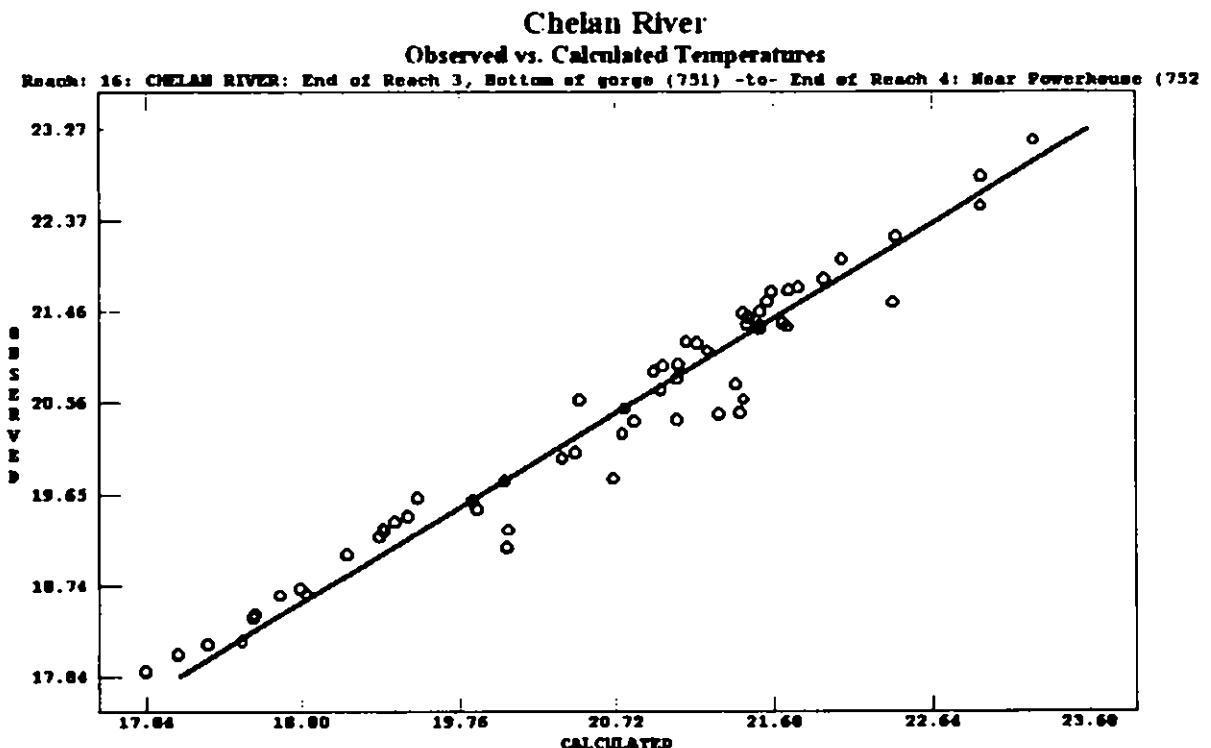


Figure 13. Scatterplot of Observed vs. Predicted Temperatures in °C, End of Reach 4

3.3.2 Maximum Daily Water Temperature Calibration

The StreamTemp model was written to simulate mean daily temperatures well, but it uses an empirical simplification rather than a theoretical calculation in predicting maximum daily water temperatures. For this reason and others (Bartholow 1989), StreamTemp may not simulate daily maximum water temperatures as well as daily mean. To calibrate maximum daily water temperatures, the Reach Manning N (and hence travel time) is varied iteratively until the predicted temperatures match the pattern of the observed maximum daily stream temperatures. Changes to Reach Manning N do not affect mean daily computations.

Figure 14 shows the optimized model for estimating maximum daily stream temperatures. Although the predicted maximum temperatures do not exactly fit the observed stream temperatures, the overall pattern follows and the maximum temperature calibration is judged acceptable within its acknowledged limits.

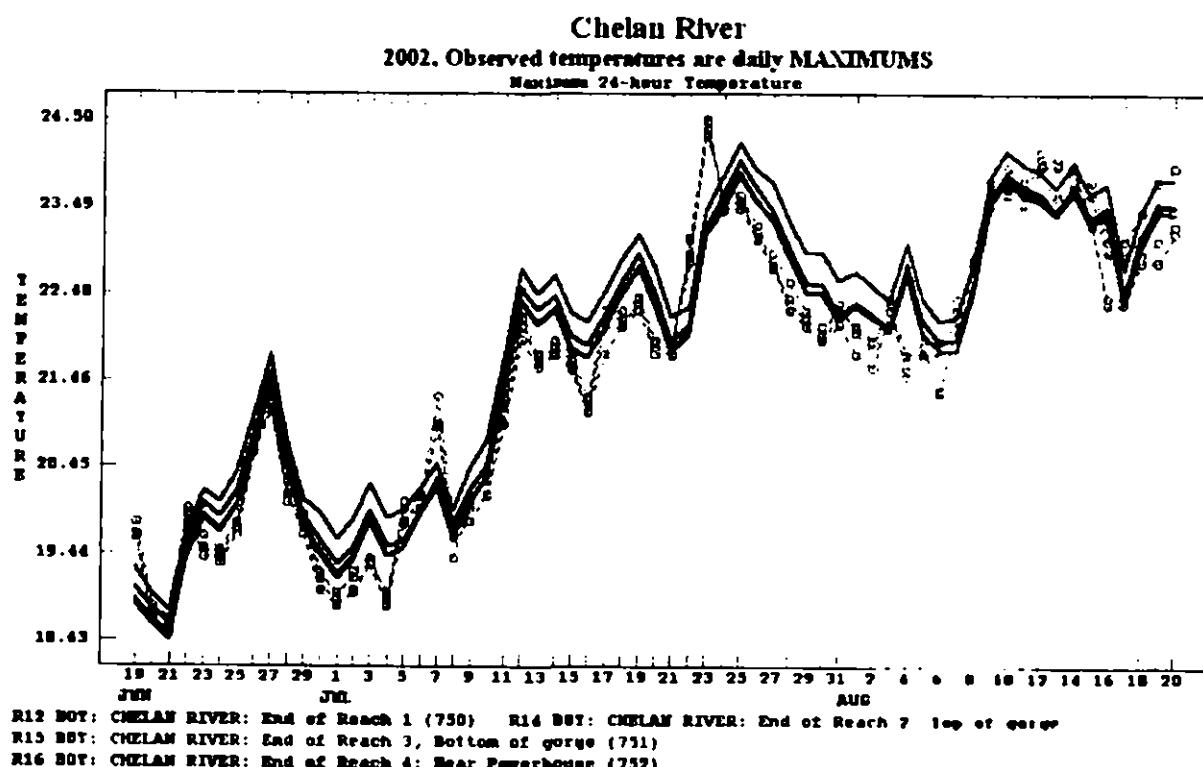


Figure 14. Maximum Temperature Calibration – Observed Versus Predicted in °C, 2002

The following graph (Figure 15) summarizes the final 24-hour average and maximum temperatures at the end of the four Chelan River study reaches. The pattern of increasing divergence between the mean daily stream temperature and the daily maximum temperatures toward the end of the study period (August) are likely due to the lower flows in that time period, rather than weather conditions.

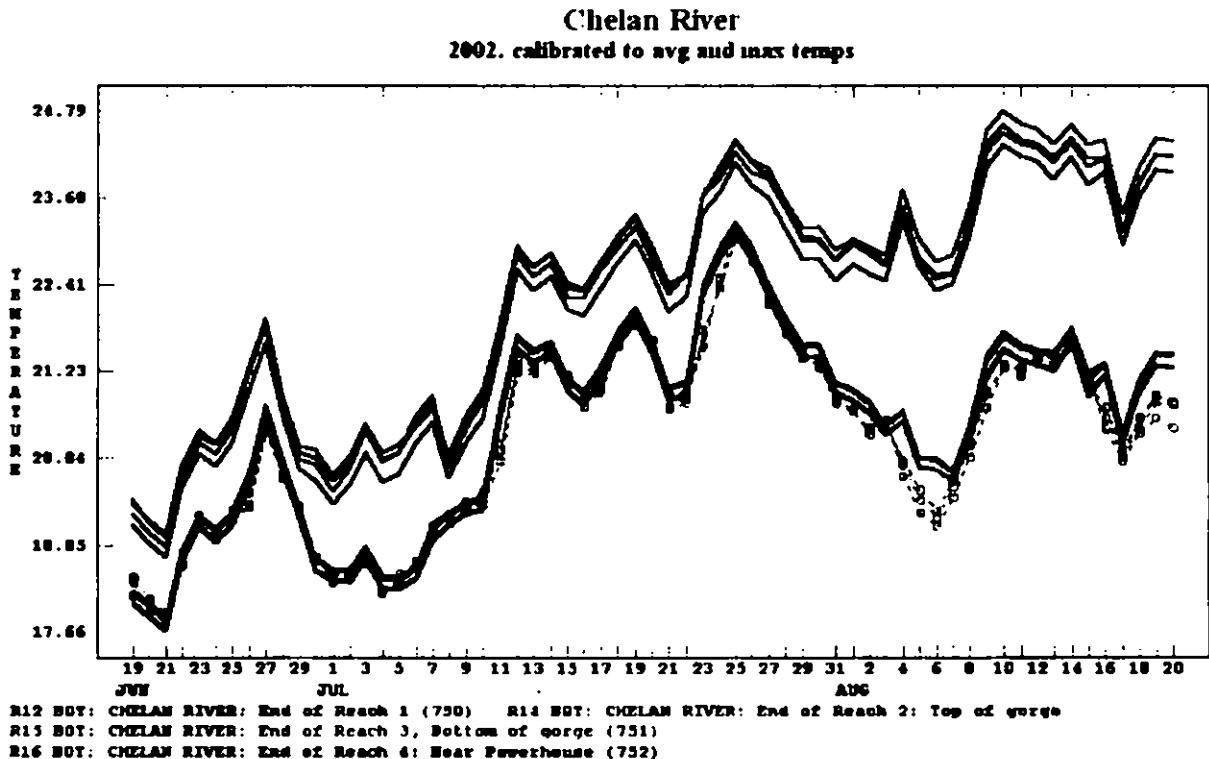


Figure 15. Observed and Predicted Mean Daily and Predicted Maximum Temperatures in °C, 2002

3.4 CALIBRATION CONCLUSIONS

- 1) The calibration was successful in closely matching the observed and calculated mean daily stream temperatures for the study period.
- 2) The calibration was moderately successful in matching the observed and calculated maximum daily temperatures for the study period.
- 3) The average daily temperatures at the calibration sites (ends of reaches) was similar to the daily average input temperatures over a wide range of flows due to the input temperatures having already being warmed/cooled by the weather conditions.
- 4) Daily temperature fluctuations (average vs. maximum temperatures) were greater during low flows, especially at the downstream end of the study (i.e., higher flows = lower maximum temperatures on very warm days.)

4. GAMING SIMULATIONS

4.1 SIMULATION INPUT DATA

The calibrated StreamTemp file was expanded to include data from three years, 2000, 2001 and 2002 and the months of May through September. An extreme weather scenario was added from the Manson weather station (located on the north shore of Lake Chelan seven miles from the dam) from July 24 – August 6, 1998. A total of 425 days were included in the model, with simulation of varying amounts of stream flow released below the dam. In addition to mean daily stream temperature, maximum daily stream temperatures were also predicted for the end of each reach under the same set of flow releases and climate conditions.

4.1.1 Meteorology

Air temperatures were obtained from the Chelan Ranger Station (except for the extreme weather scenario). For dates with precipitation, humidity was increased above the 30% default, and percent sunshine was reduced below the 90% default. Wind was set at a default of 1.788 m.p.s.

4.1.2 Hydrology

Input water temperatures were obtained from the Chelan Powerhouse cooling water and penstock monitors.

To assess the effect of increased flows in the bypass reach, the model was gamed by altering the amount of flow in the river while leaving all other parameters unchanged. The following flows were gamed: 40 c.f.s., 80 c.f.s., 100 c.f.s., 200 c.f.s., 300 c.f.s., 400 c.f.s., 600 c.f.s., 800 c.f.s., 1000 c.f.s., 1500 c.f.s., 2,000 c.f.s., and 4000 c.f.s..

4.2 GAMING RESULTS

Figures 16 through 27 are scatterplots of average daily and maximum temperatures for each of the gaming flow scenarios at the end of each reach, plus Node 8 near the middle of Reach 1 (five total locations). Since up to four years (2000, 2001, 2002 and two weeks of extreme weather in 1998) of data are included, each date may have up to 20 values for each temperature.

Generally, the higher flow releases result in slightly lower mean daily temperatures, with less daily fluctuation. For example, 19.464 °C is the mean of the 425 days 24-hr average temperature predicted at the bottom of Reach 4 (near Chelan Powerhouse) under a release of 40 c.f.s.. For a release of 4000 c.f.s., 19.258 °C is the mean for the 425 predicted days modeled. The single greatest 24-hr average value under the 40 c.f.s. release is 24.405 °C with 24.046 °C under the 4000 c.f.s. release (Figure 27 and Appendix D).

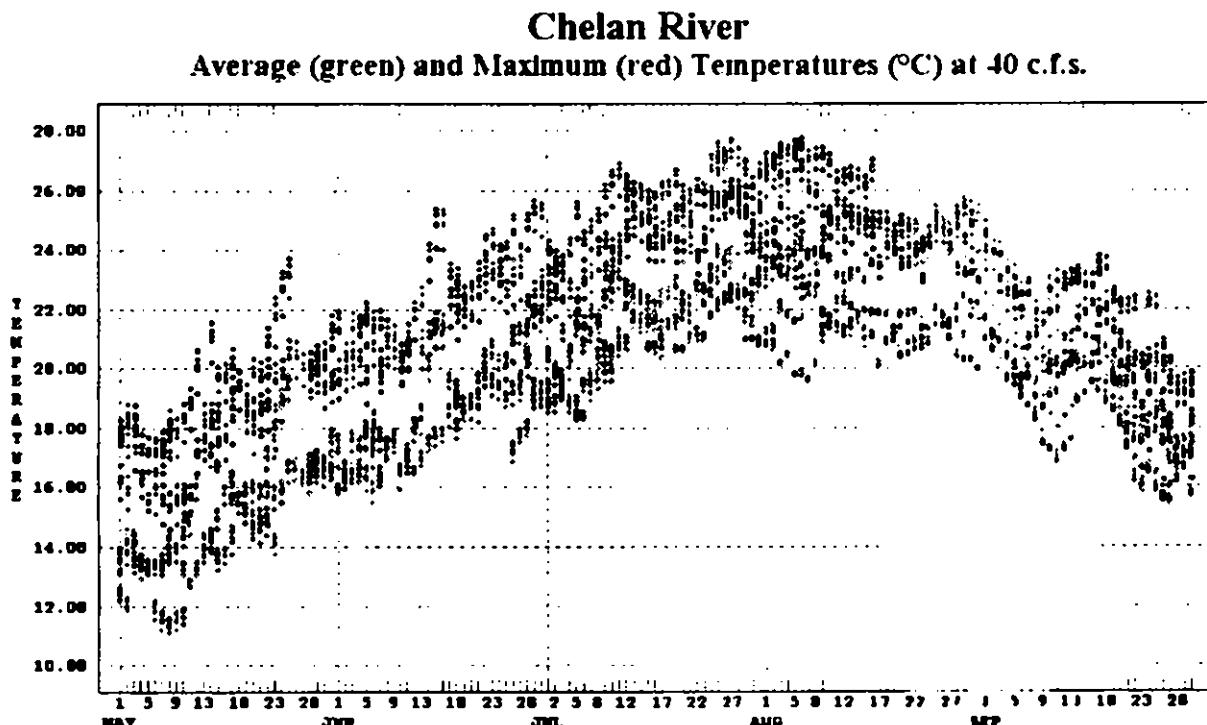


Figure 16. Gamed Daily Average (green) and Maximum (red) Temperatures in $^{\circ}\text{C}$ at 40 c.f.s.

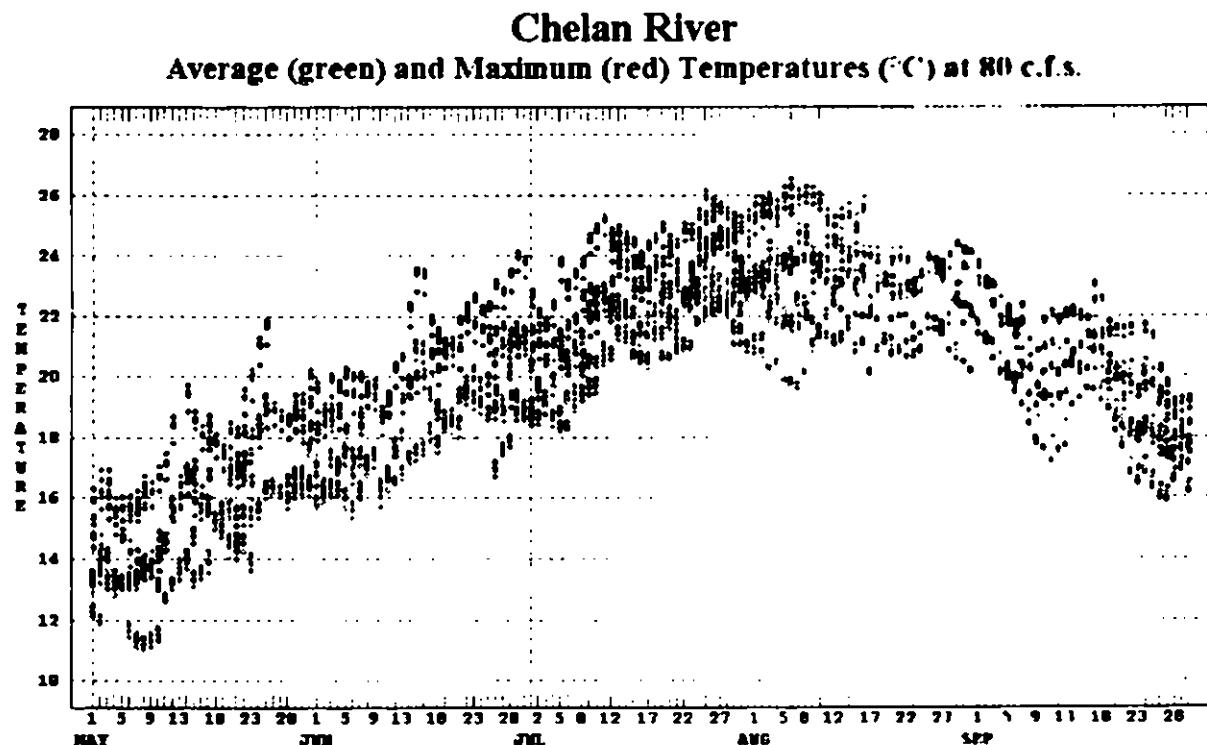


Figure 17. Gamed Daily Average (green) and Maximum (red) Temperatures in $^{\circ}\text{C}$ at 80 c.f.s.

Chelan River
Average (green) and Maximum (red) Temperatures (°C) at 100 c.f.s.

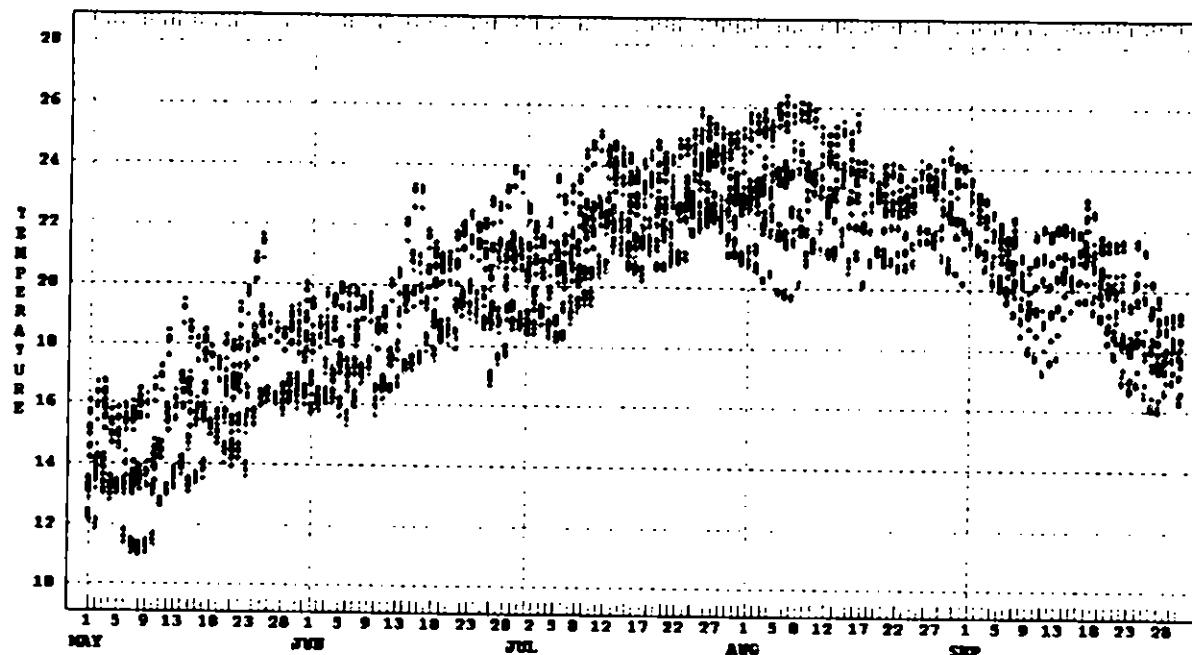


Figure 18. Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 100 c.f.s.

Chelan River
Average (green) and Maximum (red) Temperatures (°C) at 200 c.f.s.

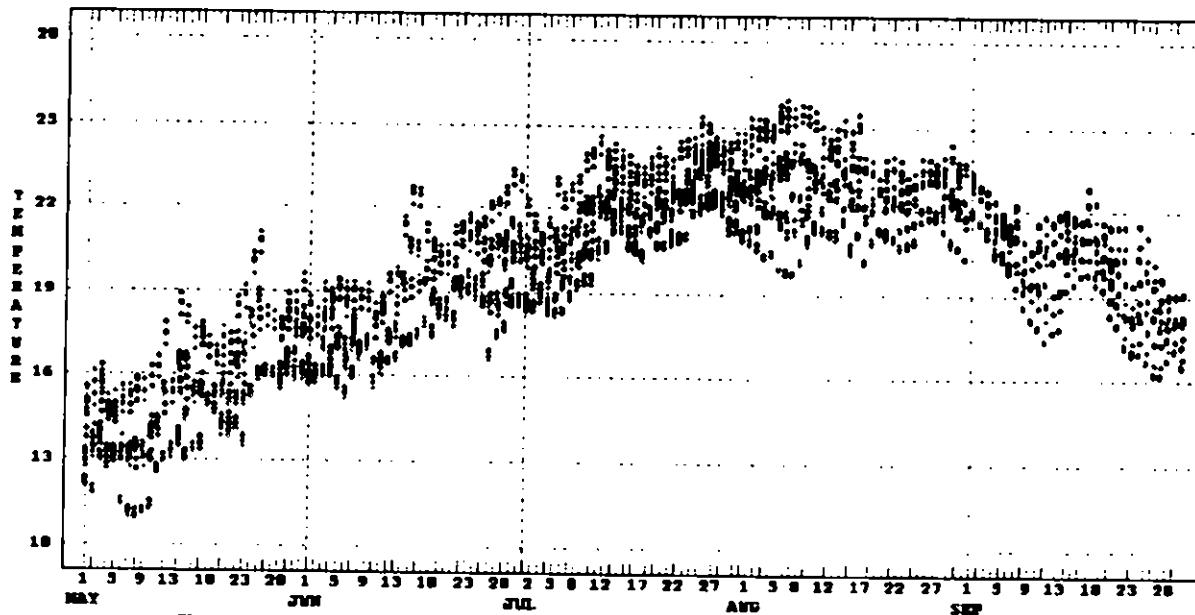


Figure 19. Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 200 c.f.s.

Chelan River
Average (green) and Maximum (red) Temperatures (°C) at 300 c.f.s.

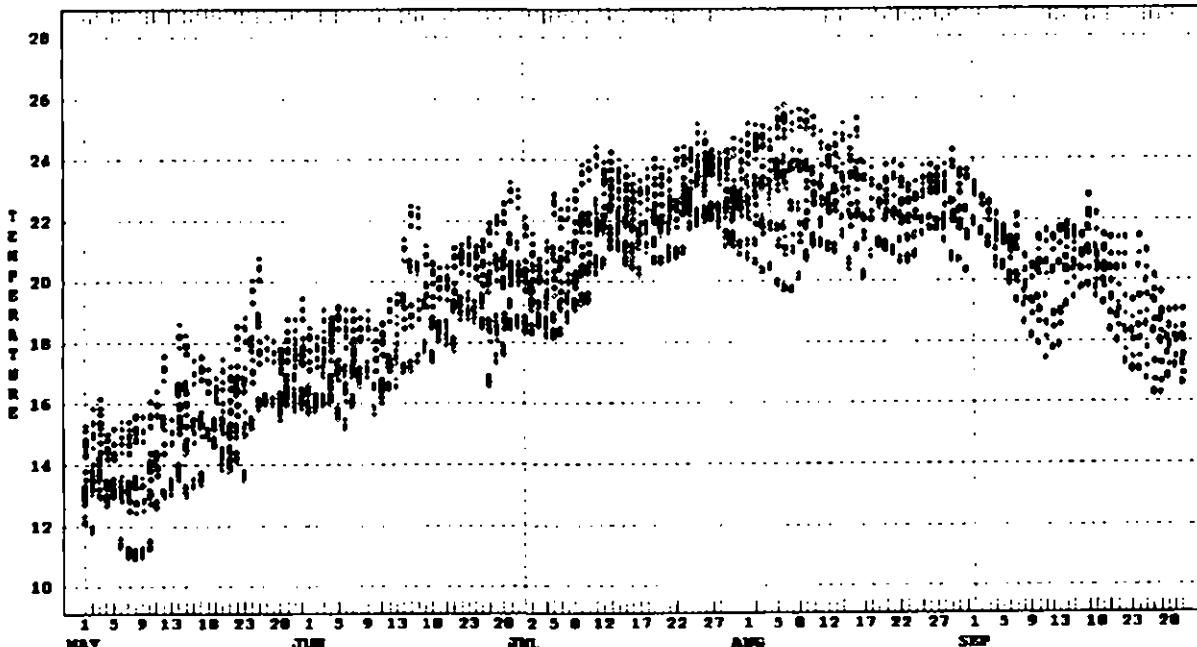


Figure 20. Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 300 c.f.s.

Chelan River
Average (green) and Maximum (red) Temperatures (°C) at 400 c.f.s.

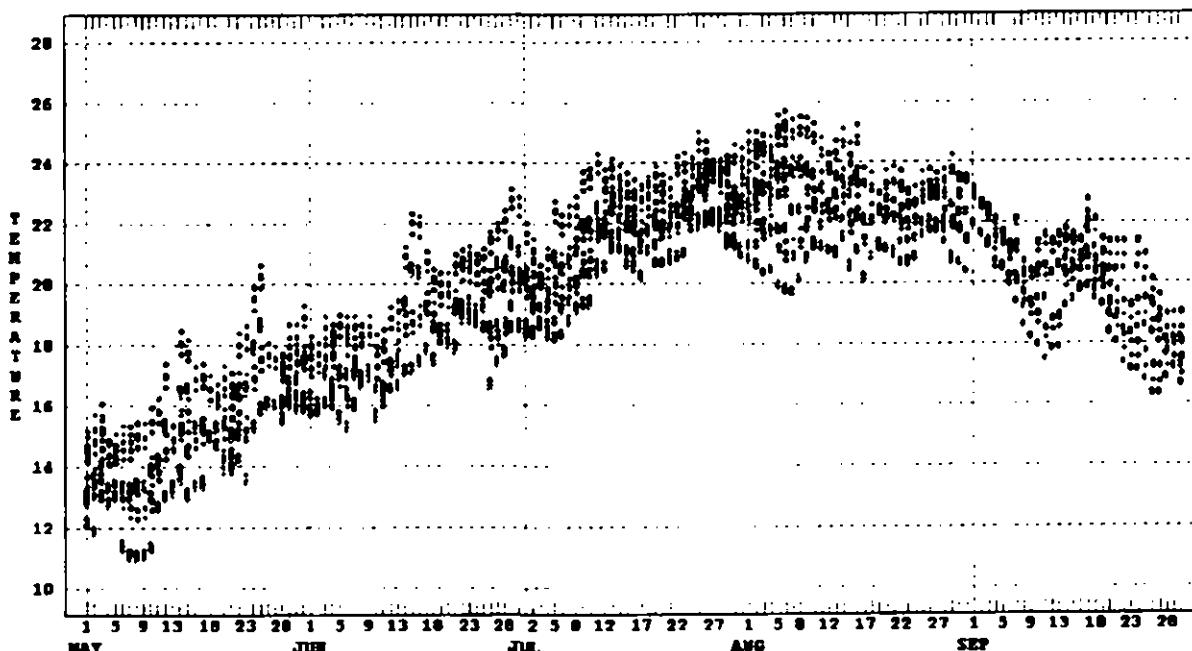


Figure 21. Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 400 c.f.s.

Chelan River
Average (green) and Maximum (red) Temperatures (°C) at 600 c.f.s.

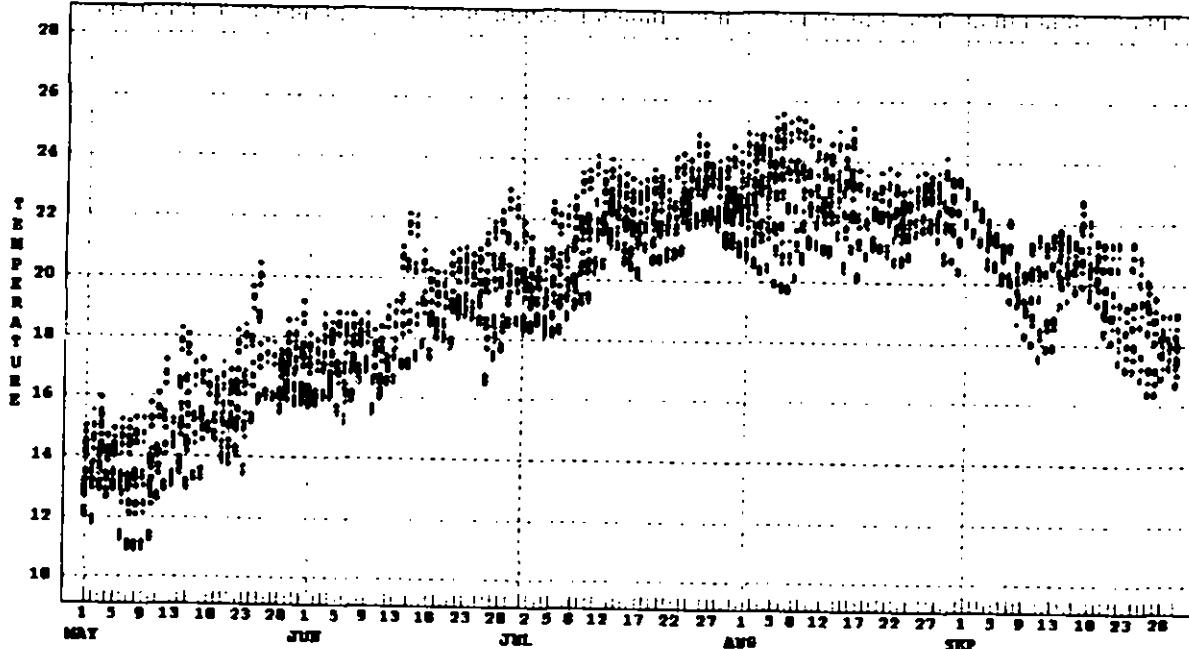


Figure 22. Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 600 c.f.s.

Chelan River
Average (green) and Maximum (red) Temperatures (°C) at 800 c.f.s.

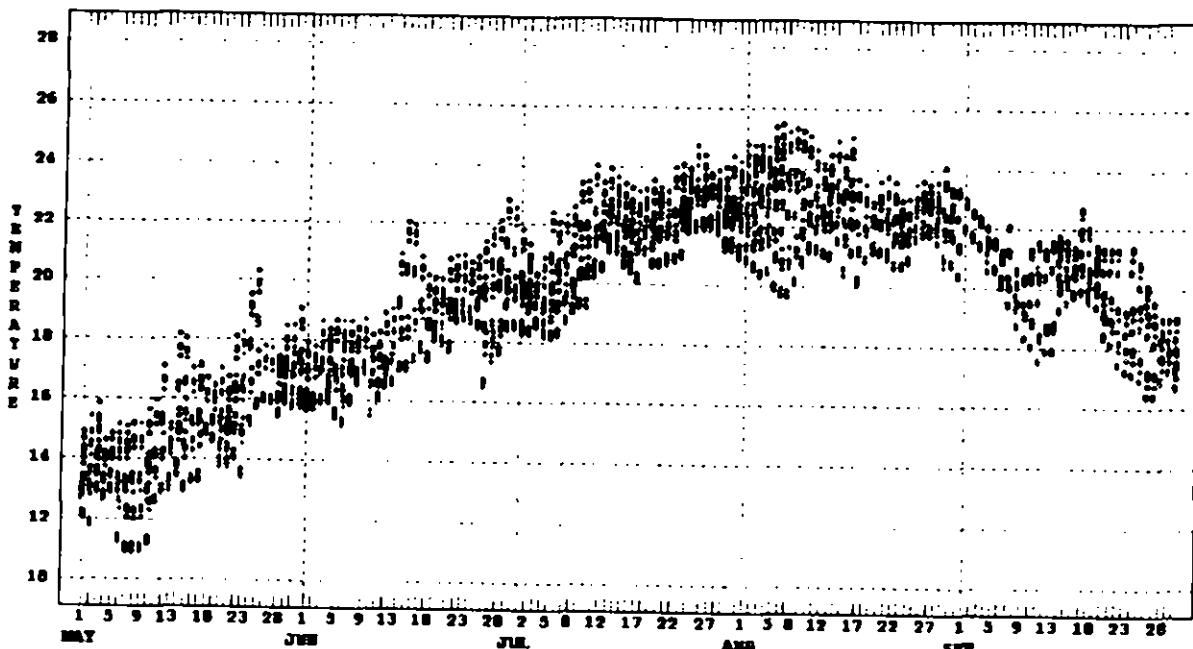


Figure 23. Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 800 c.f.s.

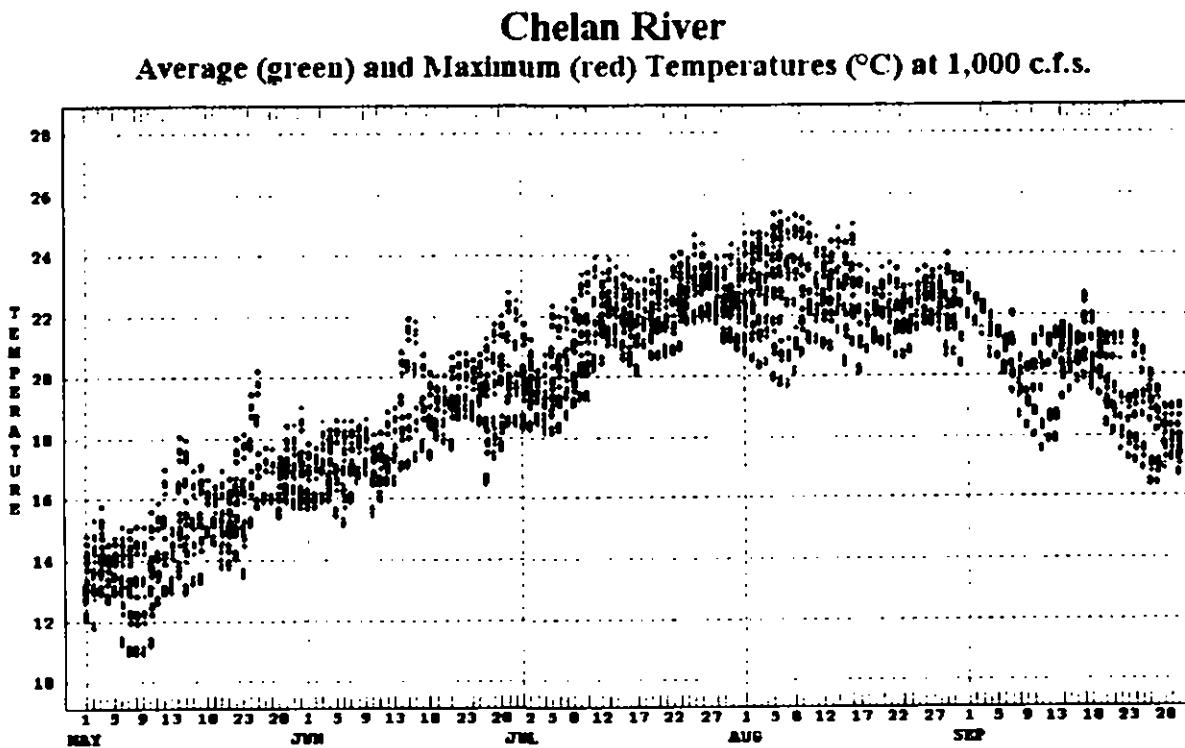


Figure 24. Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 1000 c.f.s.

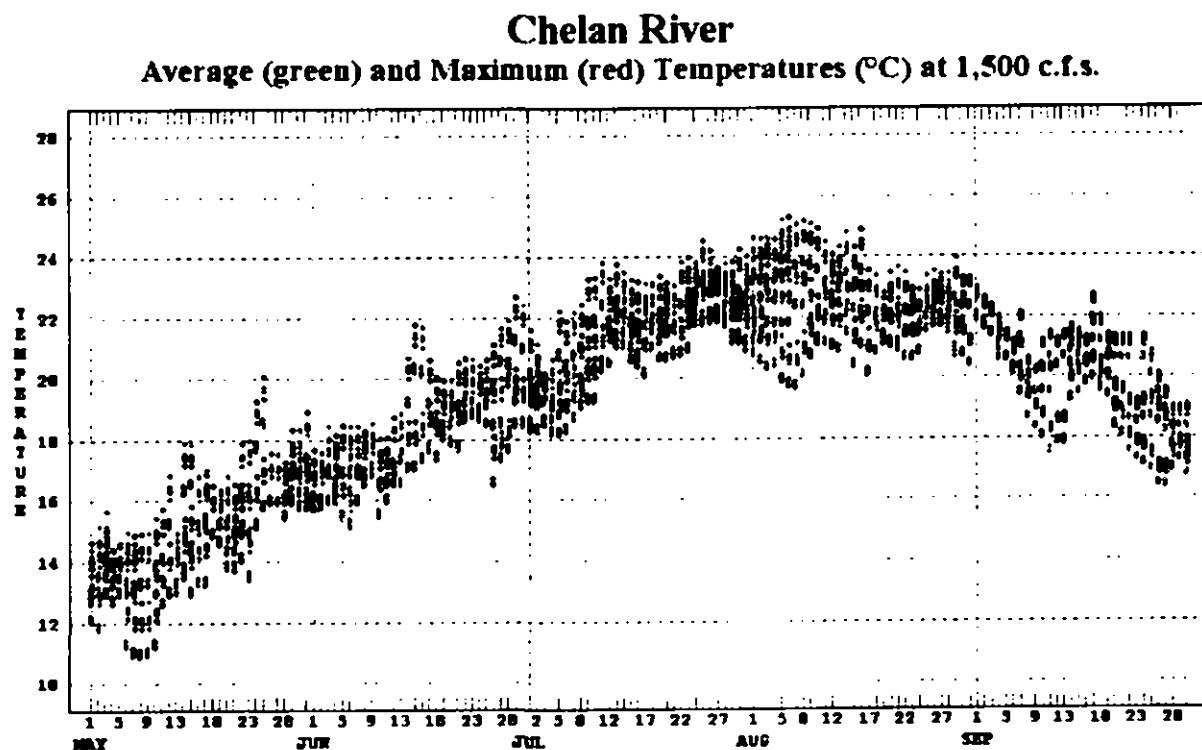


Figure 25. Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 1500 c.f.s.

Chelan River
Average (green) and Maximum (red) Temperatures (°C) at 2,000 c.f.s.

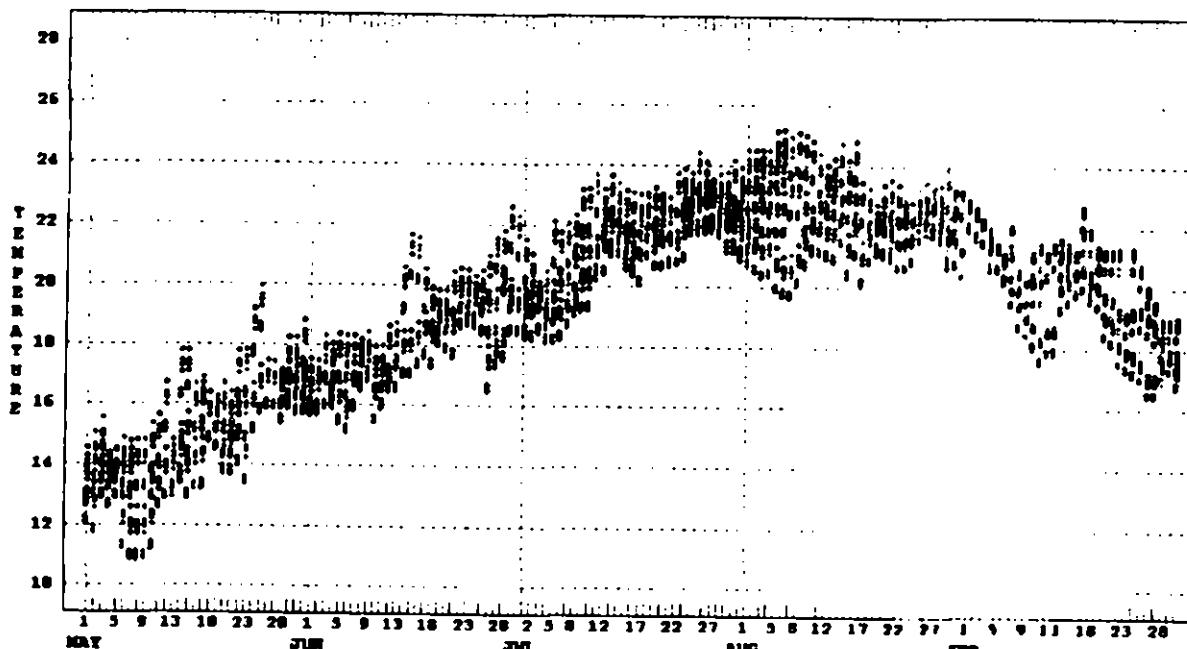


Figure 26. Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 2000 c.f.s.

Chelan River
Average (green) and Maximum (red) Temperatures (°C) at 4,000 c.f.s.

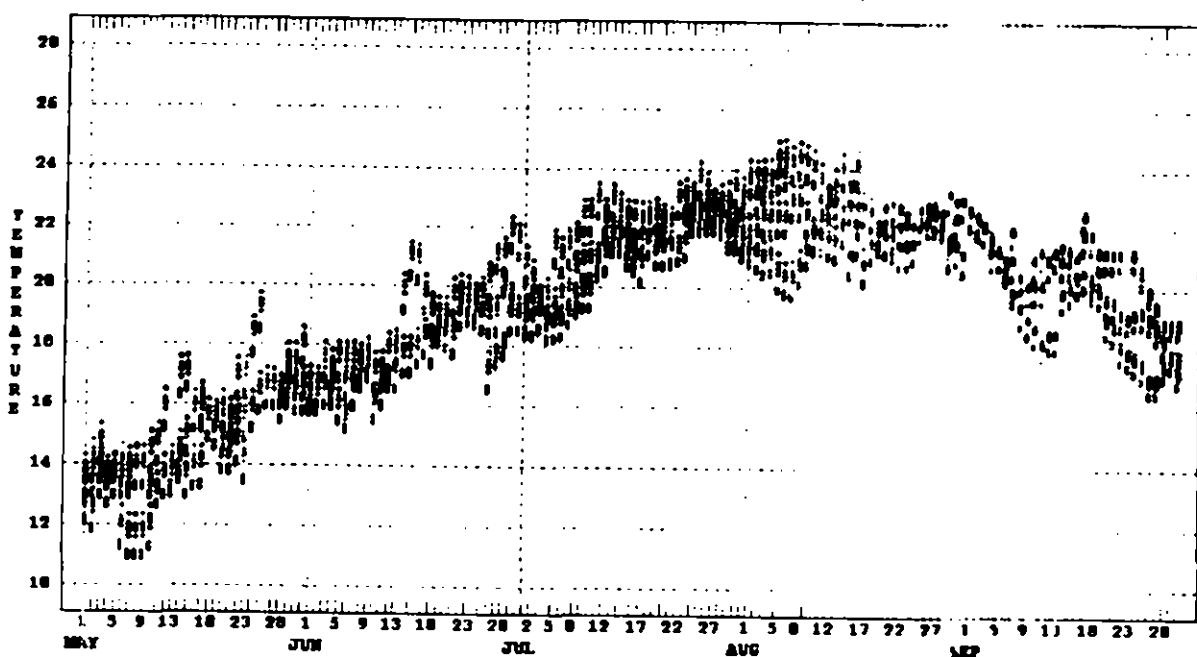
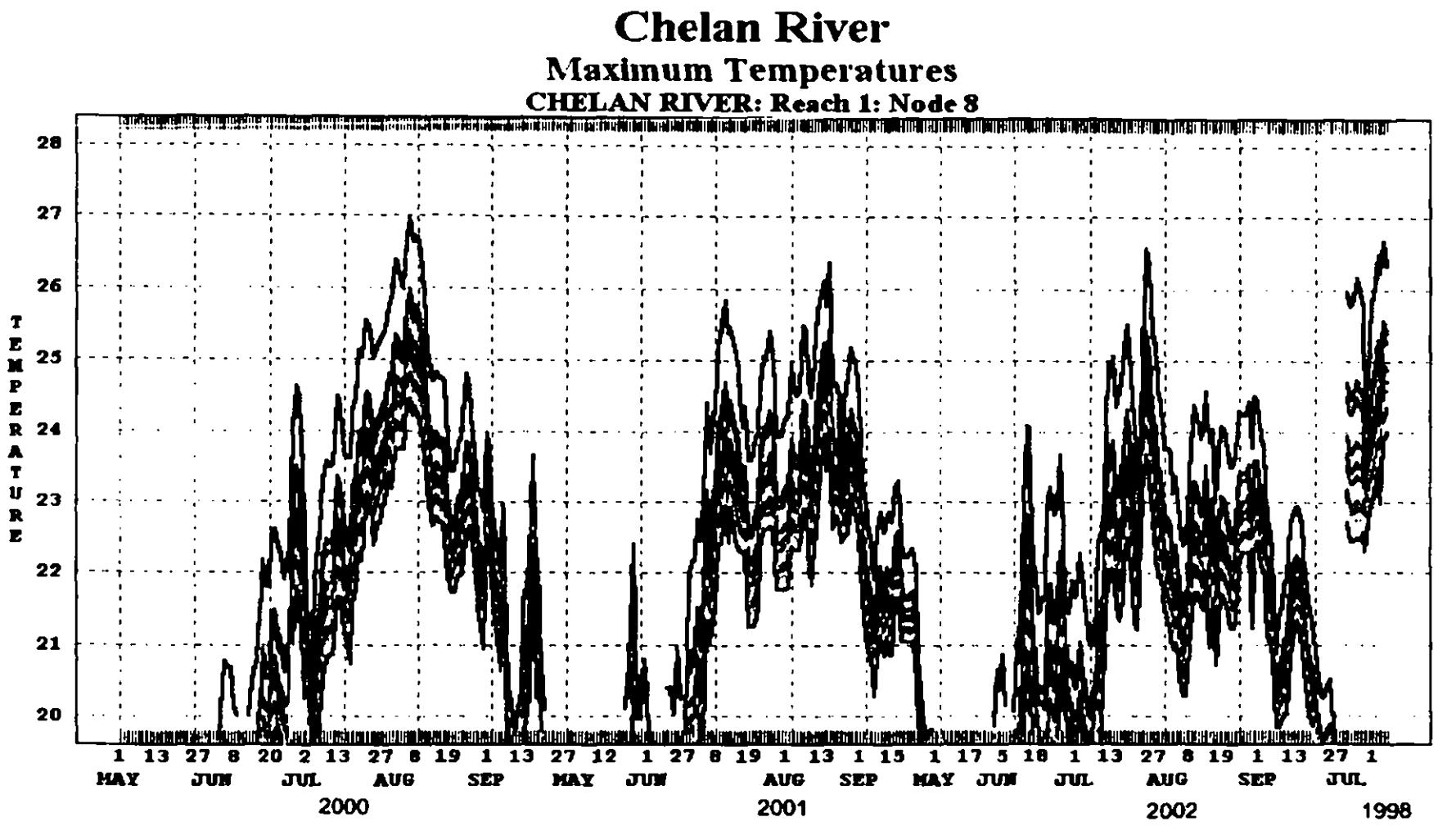


Figure 27. Gamed Daily Average (green) and Maximum (red) Temperatures in °C at 4000 c.f.s.

While the differences between average daily water temperatures were minimal at a range of flows (due to the channel input water temperatures being already warmed or cooled by the prevalent weather conditions), the maximum daily water temperatures showed a greater degree of divergence. In general, lower flows had a stronger reaction to the daily high air temperatures, while higher flows fluctuated less. The following graphs illustrate the reaction of the daily maximum temperatures to flow levels and weather. The scale for the graphs has been set from 20 to 28 degrees (C) to better view the differences during hot weather conditions.



40 c.f.s. 80 c.f.s. 100 c.f.s. 200 c.f.s. 300 c.f.s. 400 c.f.s.
 800 c.f.s. 1,000 c.f.s. 1,500 c.f.s. 4,000 c.f.s.

Figure 28a. Maximum Daily Temperatures in °C, Node 8 (near middle of Reach 1.)

Chelan River

Maximum Temperatures

CHELAN RIVER: End of Reach 1 (750)

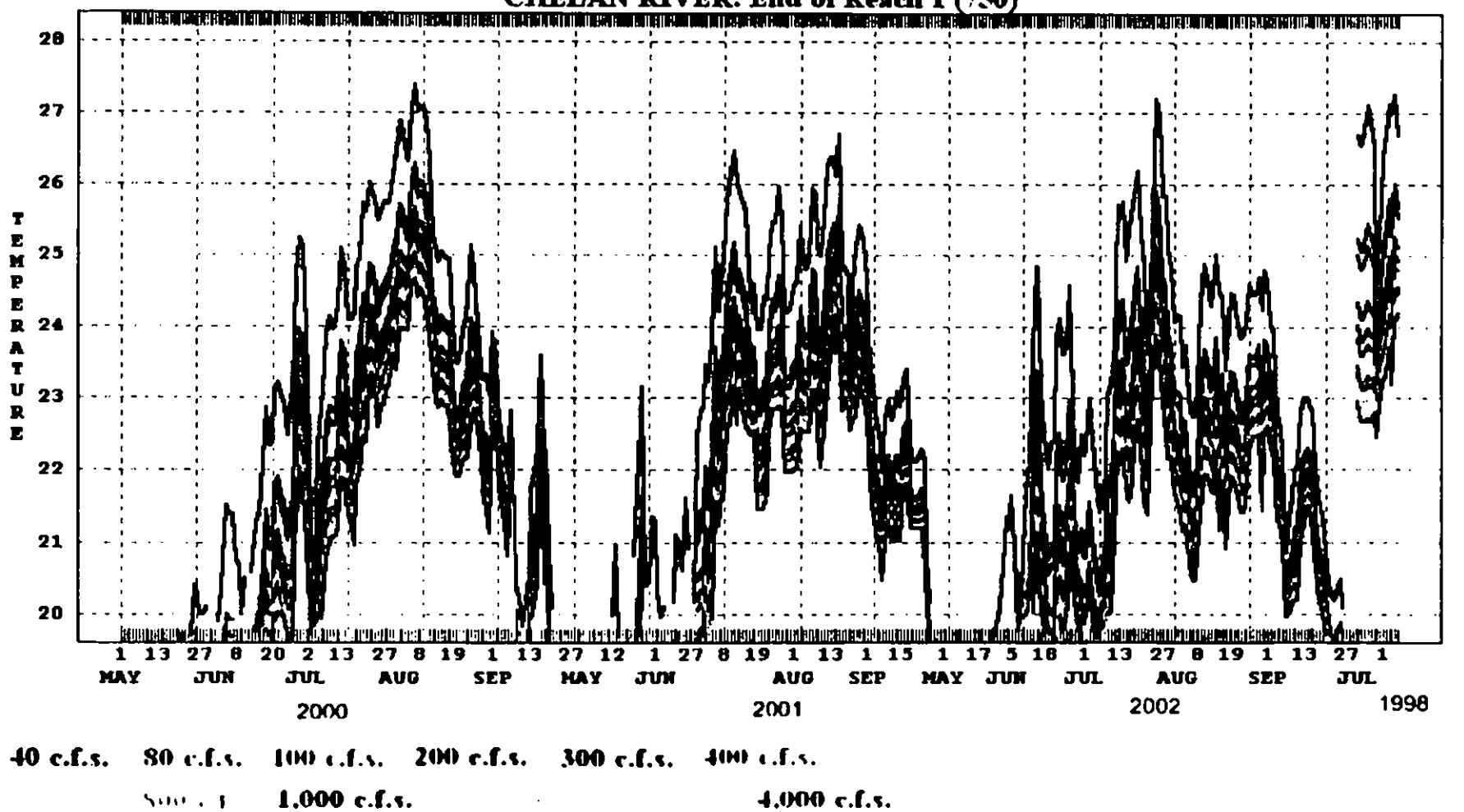


Figure 28b. Maximum Daily Temperatures in °C, End of Reach 1.

Chelan River

Maximum Temperatures

CHELAN RIVER: End of Reach 2: Top of gorge

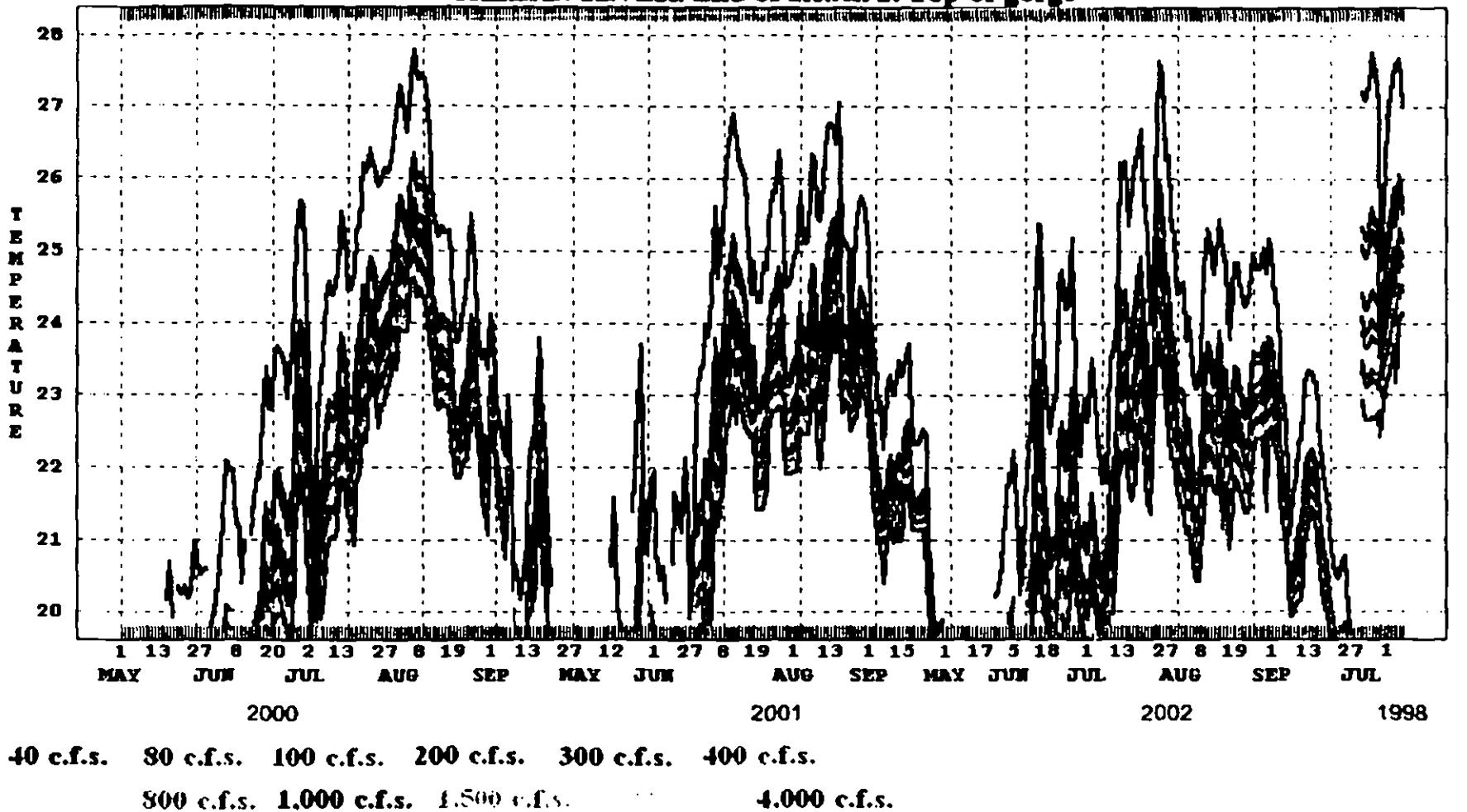
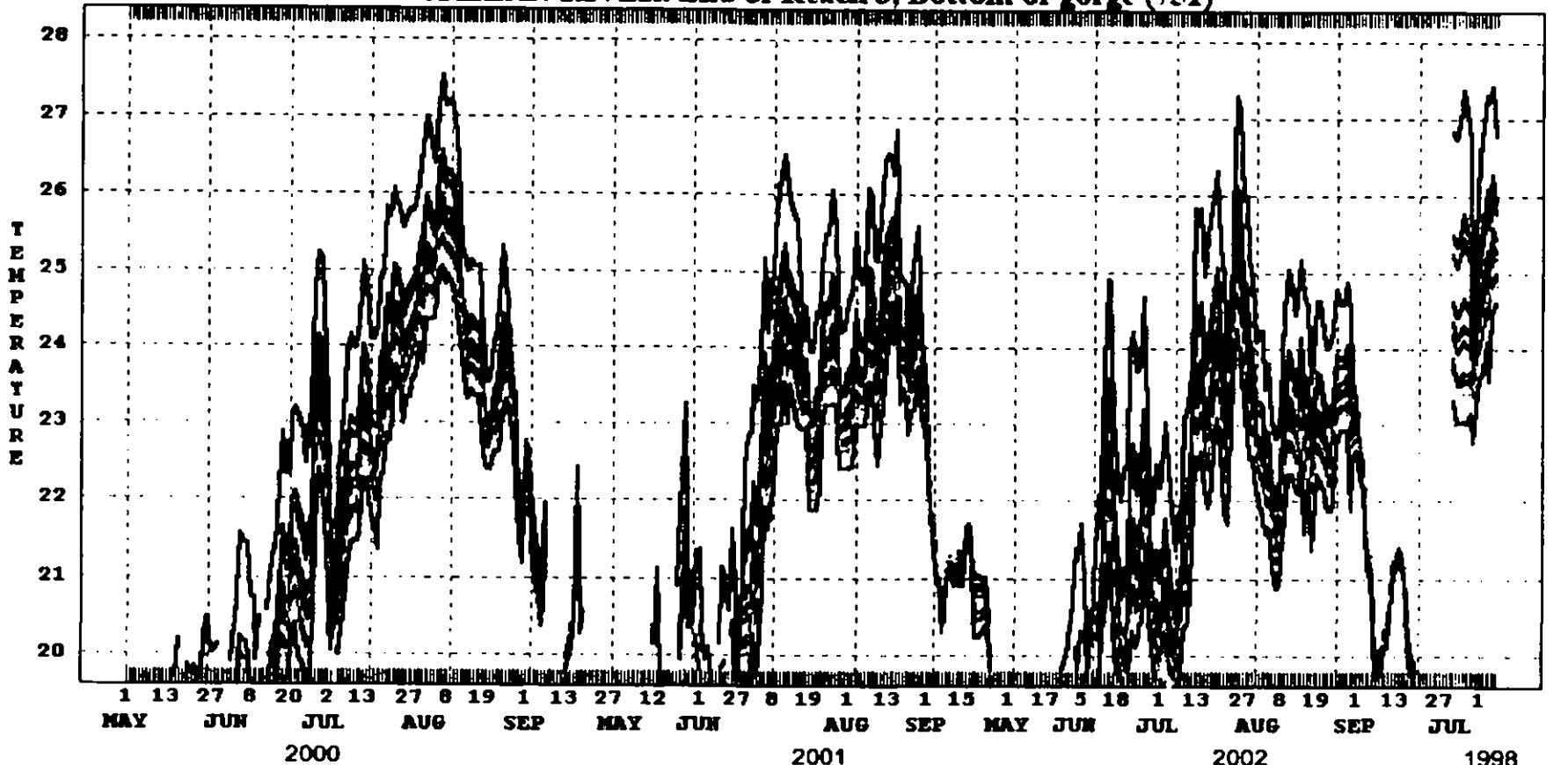


Figure 29. Maximum Daily Temperatures in °C, End of Reach 2.

Chelan River

Maximum Temperatures

CHELAN RIVER: End of Reach 3, Bottom of gorge (751)



40 c.f.s. 80 c.f.s. 100 c.f.s. 200 c.f.s. 300 c.f.s. 400 c.f.s.
800 c.f.s. 1,000 c.f.s. 1,500 c.f.s. : 4,000 c.f.s.

Figure 30. Maximum Daily Temperatures in °C, End of Reach 3.

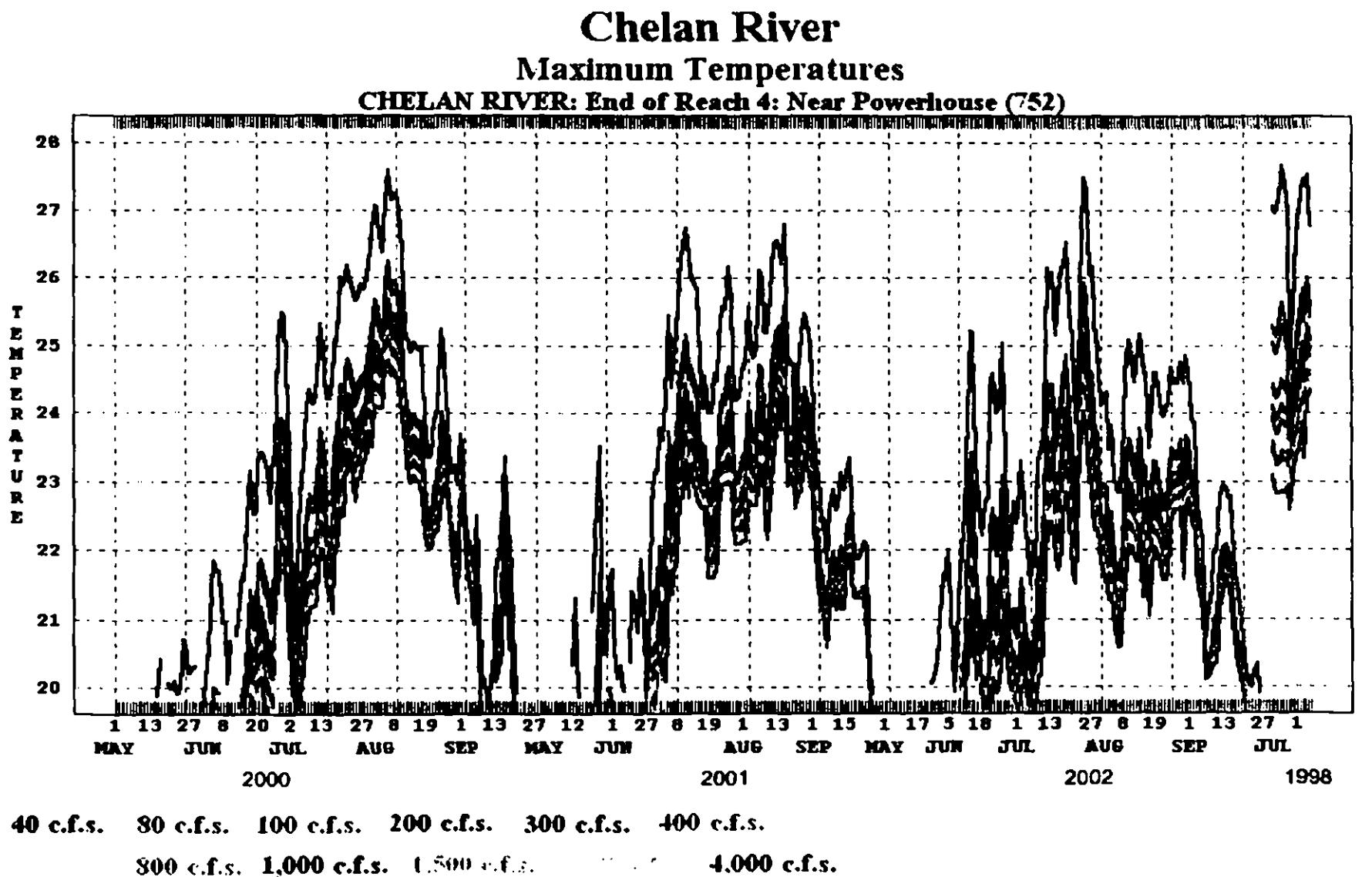


Figure 31. Maximum Daily Temperatures in °C, End of Reach 4.

4.3 THRESHOLD TEMPERATURE ANALYSIS

Threshold temperature analysis for temperatures of 22, 23 and 24 ($^{\circ}\text{C}$) were conducted.

Figures 32 to 34 show the percent exceedance for each of the temperatures, while Figures 35 to 37 show the Degree Day results. Degree Days are similar to National Weather Service Cooling Degree Days, (daily maximum temperature - threshold temperature) * time period. For example, with a threshold temperature of 24 degrees, a value of 24.5 would equal 0.5 Degree Days, while a value of 26.5 would equal 2.5 Degree Days for that date. These daily values are summed to provide the final result.

Data from five nodes were used in the threshold temperature analyses. These were Node 8 (approximately half way down Reach 1), and the bottoms of Reaches 1, 2, 3, & 4 (Figure 1b). Node 8 was included to result in more balanced results by distance because Reach 1 is by far the longest. A total of 2125 data points were included in the analyses (5 nodes times 425 days.)

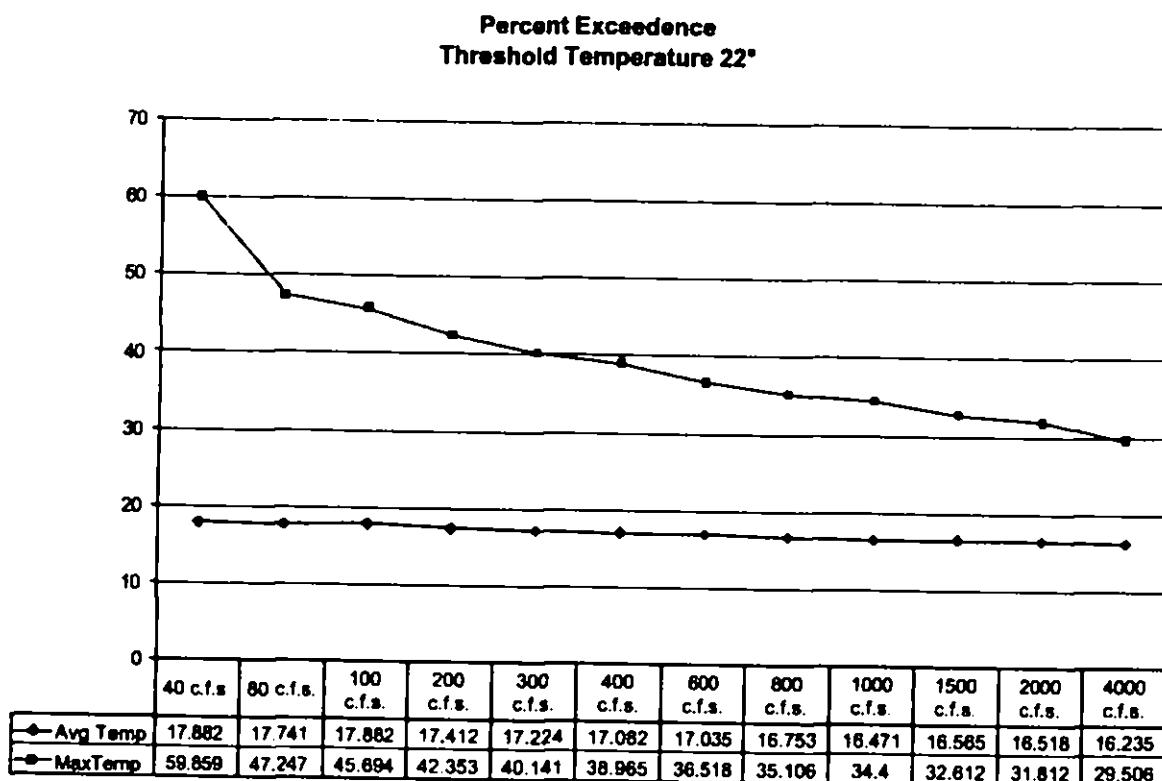


Figure 32. Percent Exceedance, Threshold Temperature of 22 °C
**Percent Exceedance
Threshold Temperature 23°**

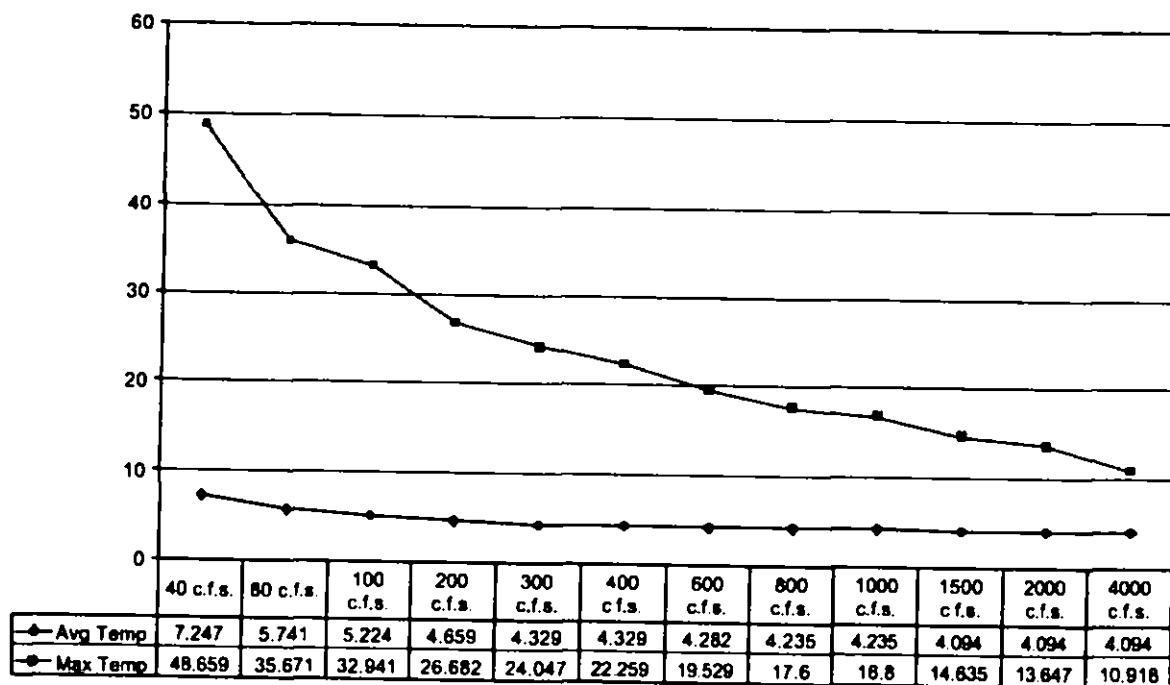
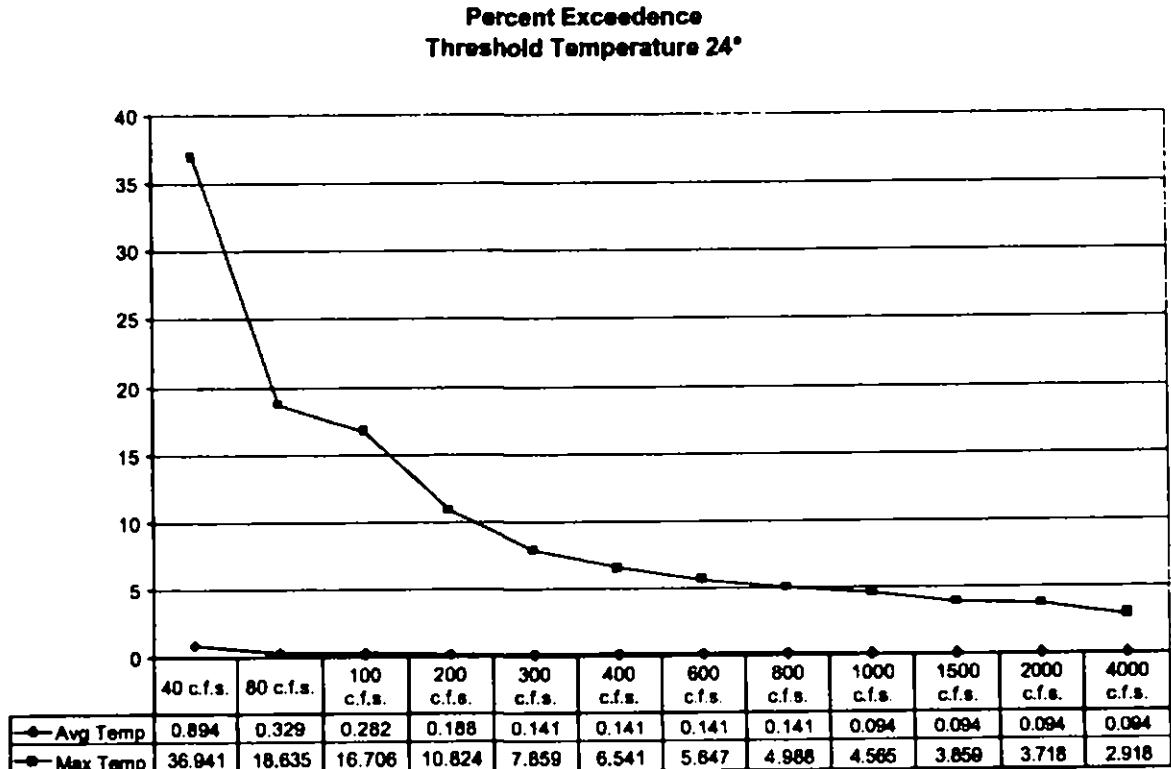
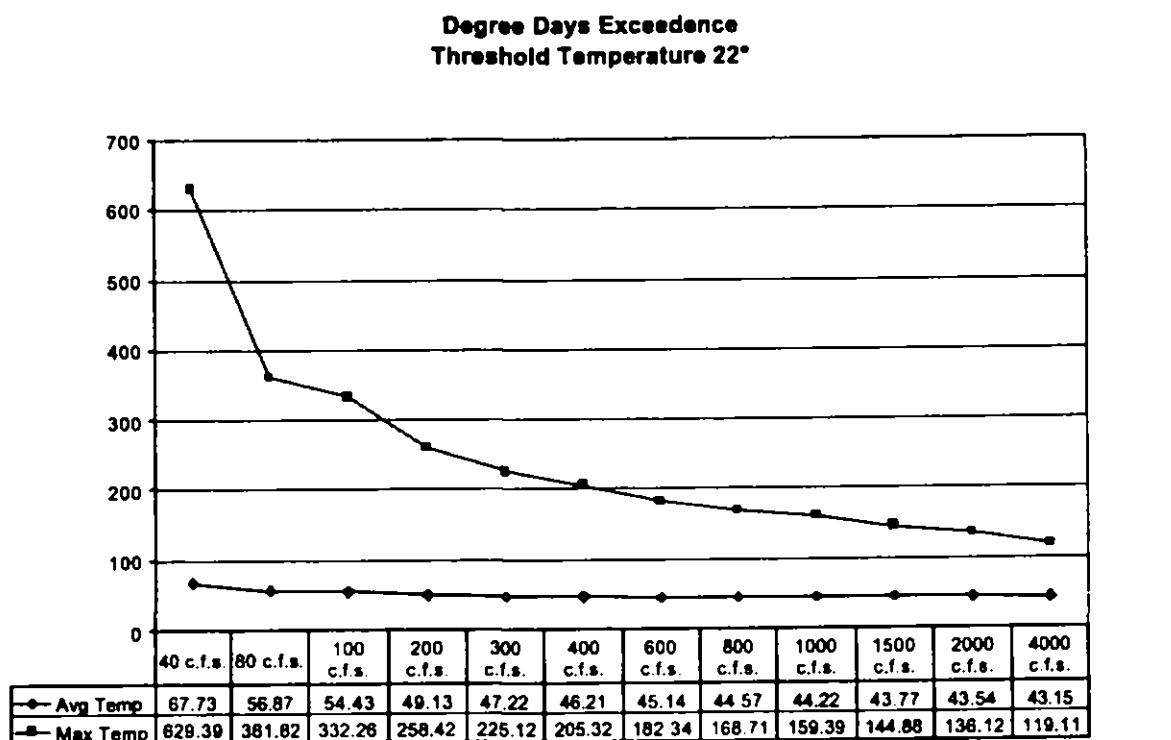
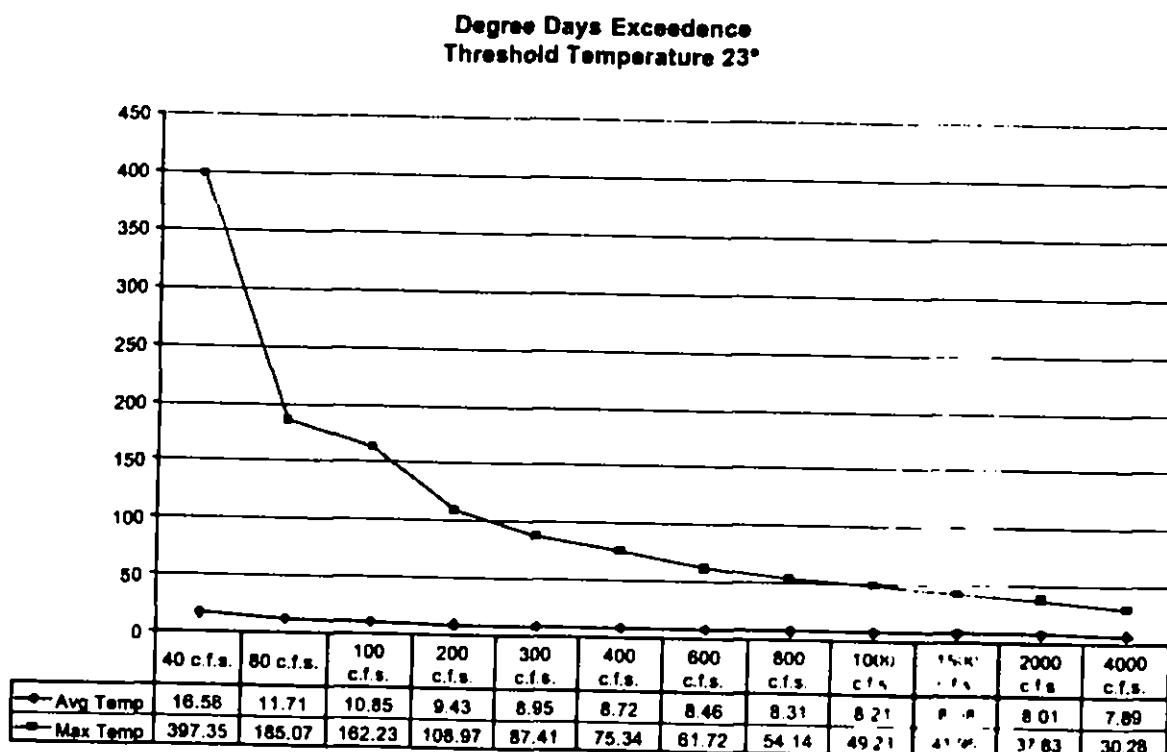
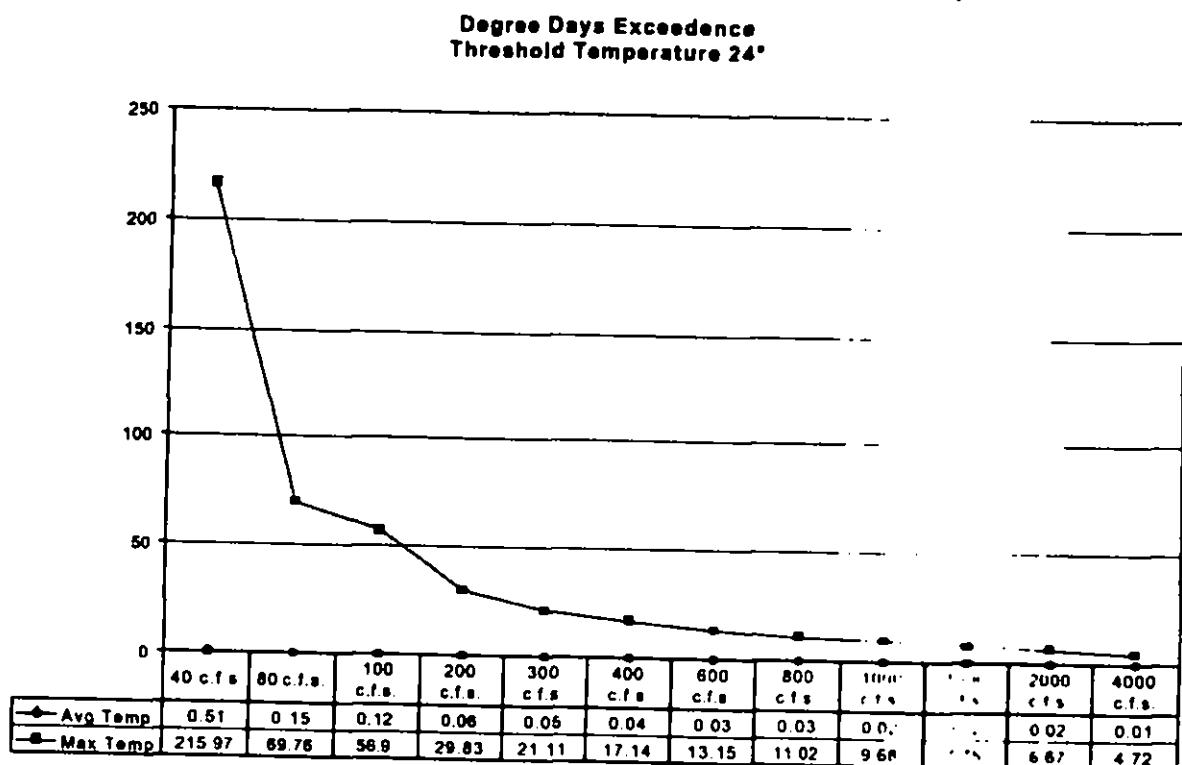


Figure 33. Percent Exceedance, Threshold Temperature of 23 °C

**Figure 34. Percent Exceedance, Threshold Temperature of 24 °C****Figure 35. Degree Days, Threshold Temperature of 22 °C**

**Figure 36. Degree Days, Threshold Temperature of 23 °C****Figure 37. Degree Days, Threshold Temperature of 24 °C**

4.4 EXCEEDANCE PERCENTILES

Exceedance percentiles (at increments of 5 percent) were calculated for daily average and maximum temperatures for each set of flows. Figure 38 shows the Average Temperature Exceedance Percentiles with Table 6 showing the data. Figure 39 shows the Maximum Temperature Exceedance Percentiles with Table 7 showing the data.

Table 6. Average Temperature Exceedance Percentiles

Percentile	40 c.f.s.	80 c.f.s.	100 c.f.s.	200 c.f.s.	300 c.f.s.	400 c.f.s.	600 c.f.s.	800 c.f.s.	1000 c.f.s.	1500 c.f.s.	2000 c.f.s.	4000 c.f.s.
0.05	24.40	24.28	24.25	24.17	24.14	24.12	24.10	24.08	24.08	24.06	24.06	24.05
5.04	23.31	23.09	23.04	22.91	22.87	22.86	22.84	22.82	22.81	22.81	22.81	22.78
10.02	22.64	22.50	22.47	22.40	22.37	22.35	22.33	22.33	22.32	22.32	22.32	22.32
15.01	22.24	22.16	22.14	22.10	22.09	22.09	22.08	22.08	22.08	22.07	22.06	22.06
20.00	21.87	21.87	21.88	21.87	21.87	21.86	21.86	21.86	21.85	21.86	21.85	21.84
25.04	21.60	21.57	21.55	21.55	21.58	21.56	21.56	21.55	21.55	21.56	21.55	21.56
30.02	21.27	21.25	21.24	21.24	21.23	21.22	21.22	21.22	21.22	21.22	21.22	21.22
35.01	20.99	20.97	20.97	20.98	20.98	20.97	20.96	20.95	20.95	20.95	20.94	20.94
40.00	20.67	20.67	20.68	20.67	20.67	20.66	20.66	20.66	20.67	20.68	20.69	20.68
45.04	20.23	20.31	20.31	20.38	20.42	20.45	20.46	20.46	20.45	20.45	20.45	20.46
50.02	19.86	19.95	19.97	20.00	20.04	20.04	20.03	20.05	20.06	20.07	20.07	20.09
55.01	19.53	19.49	19.45	19.43	19.41	19.40	19.41	19.40	19.39	19.38	19.39	19.39
60.00	19.09	19.06	19.04	18.94	18.90	18.87	18.85	18.83	18.84	18.82	18.82	18.81
65.04	18.56	18.48	18.49	18.47	18.49	18.48	18.48	18.48	18.47	18.46	18.47	18.48
70.02	17.75	17.74	17.75	17.81	17.83	17.84	17.81	17.81	17.80	17.82	17.81	17.79
75.01	17.25	17.16	17.15	17.10	17.09	17.08	17.09	17.07	17.05	17.04	17.03	17.00
80.00	16.71	16.64	16.62	16.56	16.53	16.51	16.48	16.49	16.48	16.47	16.46	16.44
85.04	16.19	16.10	16.06	16.01	15.97	15.95	15.92	15.90	15.90	15.89	15.88	15.87
90.02	15.02	14.74	14.69	14.54	14.49	14.46	14.42	14.40	14.39	14.37	14.36	14.34
95.01	13.65	13.49	13.45	13.35	13.30	13.28	13.26	13.24	13.22	13.20	13.19	13.18
100.00	11.12	11.03	11.01	10.96	10.94	10.92	10.91	10.90	10.90	10.89	10.88	10.88
Minimum	11.12	11.03	11.01	10.96	10.94	10.92	10.91	10.90	10.90	10.89	10.88	10.88
Maximum	24.40	24.28	24.25	24.17	24.14	24.12	24.10	24.08	24.08	24.06	24.06	24.05
Mean	19.33	19.27	19.25	19.21	19.19	19.19	19.17	19.17	19.16	19.16	19.15	19.15
Median	19.86	19.95	19.98	20.00	20.04	20.04	20.04	20.05	20.07	20.08	20.07	20.09

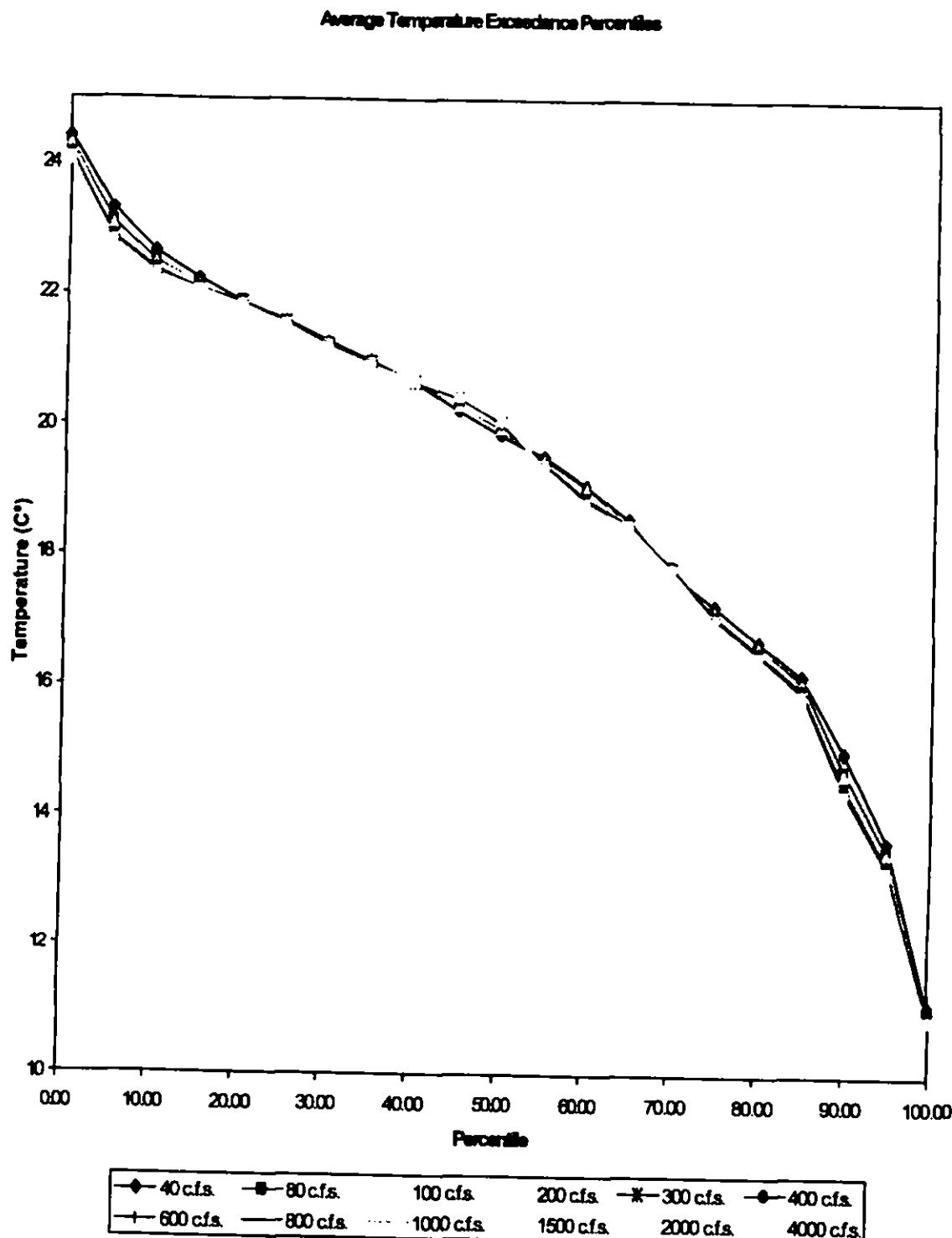


Figure 38. Average Temperature Exceedance Percentiles

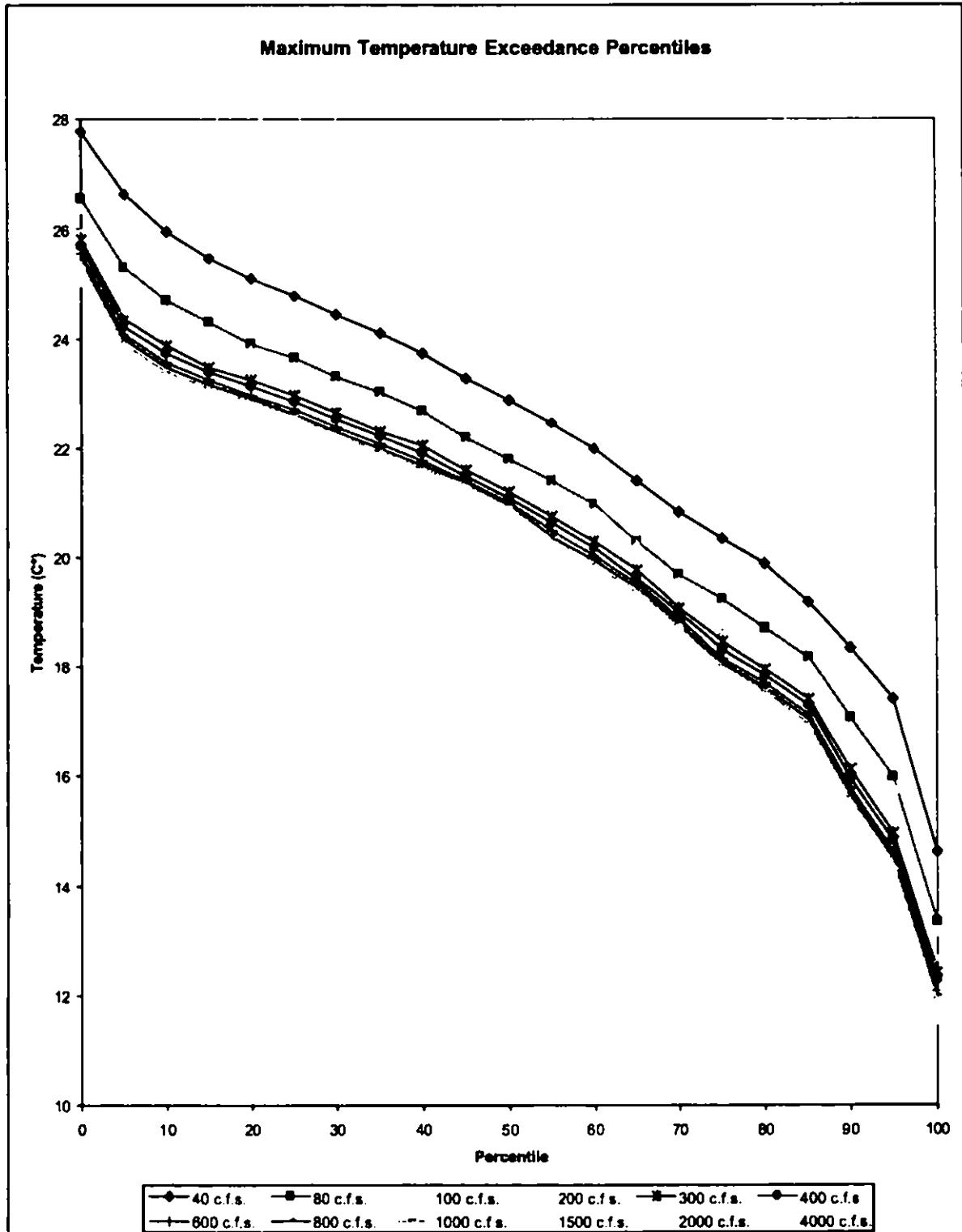


Figure 39. Maximum Temperature Exceedance Percentiles

Table 7. Maximum Temperature Exceedance Percentiles

Percentile	40 c.f.s.	80 c.f.s.	100 c.f.s.	200 c.f.s.	300 c.f.s.	400 c.f.s.	600 c.f.s.	800 c.f.s.	1000 c.f.s.	1500 c.f.s.	2000 c.f.s.	4000 c.f.s.
0.05	27.78	26.55	26.38	25.98	25.80	25.69	25.55	25.47	25.40	25.29	25.22	25.04
5.04	26.62	25.31	25.12	24.60	24.35	24.23	24.07	23.98	23.92	23.82	23.75	23.58
10.02	25.95	24.69	24.51	24.06	23.87	23.74	23.57	23.47	23.38	23.28	23.22	23.08
15.01	25.47	24.31	24.14	23.71	23.49	23.38	23.26	23.16	23.11	22.98	22.92	22.80
20.00	25.09	23.92	23.78	23.41	23.24	23.13	22.98	22.90	22.84	22.74	22.68	22.57
25.04	24.78	23.64	23.50	23.11	22.96	22.85	22.71	22.64	22.59	22.49	22.43	22.30
30.02	24.46	23.32	23.17	22.82	22.65	22.54	22.41	22.32	22.25	22.14	22.08	21.97
35.01	24.11	23.03	22.90	22.51	22.32	22.23	22.09	22.01	21.95	21.87	21.81	21.68
40.00	23.73	22.68	22.55	22.20	22.05	21.92	21.77	21.68	21.63	21.53	21.47	21.36
45.04	23.28	22.19	22.05	21.74	21.61	21.50	21.41	21.36	21.31	21.25	21.20	21.11
50.02	22.89	21.80	21.68	21.37	21.21	21.09	21.01	20.98	20.94	20.87	20.83	20.72
55.01	22.47	21.40	21.27	20.92	20.76	20.63	20.48	20.39	20.34	20.22	20.16	20.06
60.00	22.00	20.97	20.84	20.47	20.31	20.18	20.03	19.94	19.88	19.78	19.70	19.58
65.04	21.41	20.31	20.23	19.93	19.77	19.61	19.52	19.44	19.38	19.28	19.24	19.12
70.02	20.85	19.69	19.57	19.16	19.05	18.96	18.85	18.77	18.72	18.67	18.63	18.50
75.01	20.35	19.22	19.07	18.66	18.46	18.31	18.15	18.06	18.02	17.92	17.86	17.75
80.00	19.89	18.67	18.50	18.12	17.95	17.82	17.68	17.61	17.54	17.41	17.33	17.19
85.04	19.16	18.17	18.03	17.60	17.41	17.27	17.13	17.03	16.95	16.84	16.76	16.61
90.02	18.33	17.05	16.88	16.36	16.11	15.95	15.77	15.67	15.60	15.45	15.37	15.25
95.01	17.41	15.99	15.77	15.22	14.95	14.80	14.61	14.50	14.42	14.30	14.22	14.05
100.00	14.61	13.33	13.15	12.66	12.43	12.28	12.10	11.99	11.92	11.79	11.72	11.58
Minimum	14.61	13.33	13.15	12.66	12.43	12.28	12.10	11.99	11.92	11.79	11.72	11.58
Maximum	27.78	26.55	26.38	25.98	25.80	25.69	25.55	25.47	25.40	25.29	25.22	25.04
Mean	22.48	21.32	21.17	20.78	20.59	20.48	20.33	20.24	20.18	20.08	20.02	19.89
Median	22.90	21.80	21.68	21.38	21.21	21.10	21.01	20.98	20.95	20.87	20.83	20.73

5. DISCUSSION AND CONCLUSIONS

The end-of-reach mean daily temperatures simulated under the different flow regimes produced results that differed by weather and by reach. Some days showed a relatively large response to weather and flow while others showed very little. The pattern of heating or cooling also changed, depending on whether the air temperature (primarily) was warmer or colder than the starting water temperature for each reach. Lower flow releases generally responded more strongly to the meteorology than higher flow releases, whether heating or cooling. Still, since input water temperatures had nearly approached equilibrium with the prevalent weather conditions (primarily air temperature) due to the effect of Lake Chelan, the range of daily average stream temperatures was quite similar for low and high flows.

The end-of-reach maximum daily temperatures simulated under the different flow regimes were more consistent in response, with the lower flows producing higher daily maxima on warm days. This result would be expected because the higher daily maximum air temperatures would cause the lower flows to respond and warm more quickly, without the offset of nighttime cooling.

During mid-summer, ending temperatures are generally higher in all years under the lower flow release. This condition begins to change, however, in August, when lower flows result in lower daily mean water temperatures downstream. The crossover occurs when the weather starts to cool and the temperature of flow released from Lake Chelan starts out high and drops more rapidly at lower flow levels. If the objective of flow management in the Chelan bypass is to maintain the lowest possible summer mean daily temperatures, then this would be accomplished with higher flows early in the season and lower flows later.

5.1 SALMONID TEMPERATURE THRESHOLD IMPLICATIONS

Application of the standard salmonid temperature thresholds discussed earlier to the Chelan River bypass indicates unsuitable water temperatures under any combination of weather or release flow during mid- and late-summer. Dam release temperatures start out higher than 20°C between early- to mid-July and persist until about mid-September in both years. Any amount of exposure to the prevalent meteorological conditions in the area will either maintain or increase these temperatures until late summer. Lower release flows will warm to a greater extent, while flows of 1,500 cfs or even higher would warm slightly and still remain above the threshold.

Only putting the Chelan River in a closed riparian canopy to enable development of a localized evaporative microclimate is likely to create cooling in the bypass, and recurring high scouring flow events through the bypass eliminate this option. If establishment of a salmonid population is to remain a management goal, success would most likely require a combination of staged flow release targets, channel morphology management, selection of temperature tolerant fish stocks, and acceptance of cold water temperature standard excursions.

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APPENDIX A

Calibration Input Data

INPUT FLOWS AND TEMPERATURES: TOP OF STUDY

Floss are c.f.s, Temperatures are Centigrade

MO	DY	TOP Flow	TOP Temp
6	19	3814	17.91
6	20	6000	17.72
6	21	6000	17.51
6	22	6000	18.44
6	23	6000	18.92
6	24	4917	18.73
6	25	3175	18.93
6	26	1687	19.39
6	27	1025	20.36
6	28	1025	19.65
6	29	1025	19.09
6	30	1803	18.33
7	1	3333	18.20
7	2	1417	18.16
7	3	1000	18.40
7	4	1000	18.03
7	5	633	18.06
7	6	200	18.18
7	7	200	18.54
7	8	1600	18.94
7	9	1600	19.10
7	10	1256	19.12
7	11	1050	20.38
7	12	2144	21.34
7	13	3070	21.16
7	14	3516	21.30
7	15	2935	20.83
7	16	2000	20.55
7	17	1733	20.86
7	18	2725	21.42
7	19	2800	21.74
7	20	2800	21.35
7	21	1449	20.62
7	22	325	20.66
7	23	314	22.11
7	24	1350	22.60
7	25	4380	22.95
7	26	3833	22.61
7	27	1000	22.07
7	28	1000	21.57
7	29	1000	21.24
7	30	1000	21.28
7	31	563	20.83
8	1	300	20.66
8	2	300	20.44

8	3	179	20.27
8	4	77	20.34
8	5	76	19.85
8	6	76	19.65
8	7	76	19.62
8	8	76	20.03
8	9	77	20.56
8	10	77	21.03
8	11	77	21.03
8	12	77	20.91
8	13	103	20.77
8	14	113	21.33
8	15	77	20.23
8	16	78	20.95
8	17	78	20.04
8	18	78	20.71
8	19	78	21.05
8	20	78	20.96

WEATHER DATA

Daily Data at Chelan Weather Station

Temperature is Centigrade, Wind Speed is Meters per second, Solar Radiation is Julians per Square Meter per Second.

MO	DAY	Length	High	Low	Avg	%	Wind	%	SOLAR	
			Day	Air	Air					
MO	DAY	Length	Day	Air Temp	Air Temp	Air Temp	Humidity	Wind Speed	Sun	RAD.
6	19	15.815	19.44	13.33	16.39	41.8	1.8	90.0	335.64	
6	20	15.817	27.78	11.67	19.72	42.1	1.8	90.0	332.20	
6	21	15.818	27.78	13.33	20.56	44.5	1.8	90.0	330.09	
6	22	15.817	33.33	17.22	25.28	43.6	1.8	90.0	324.02	
6	23	15.815	31.67	18.33	25.00	42.9	1.8	90.0	324.77	
6	24	15.812	28.89	17.22	23.05	41.4	1.8	90.0	328.22	
6	25	15.807	30.00	16.11	23.06	40.1	1.8	90.0	328.73	
6	26	15.801	35.56	16.67	26.11	40.4	1.8	90.0	324.08	
6	27	15.793	35.00	18.89	26.94	35.6	1.8	50.0	237.64	
6	28	15.784	28.33	17.22	22.78	60.1	1.8	25.0	171.53	
6	29	15.774	21.11	15.56	18.33	53.8	1.8	25.0	176.57	
6	30	15.762	21.11	13.89	17.50	43.0	1.8	90.0	332.14	
7	1	15.749	21.11	11.11	16.11	44.5	1.8	90.0	332.53	
7	2	15.735	23.33	13.33	18.33	36.4	1.8	90.0	333.17	
7	3	15.719	27.78	14.44	21.11	38.0	1.8	90.0	329.21	
7	4	15.702	25.00	13.33	19.17	37.9	1.8	90.0	330.73	
7	5	15.684	20.56	10.56	15.56	35.0	1.8	90.0	334.29	
7	6	15.665	24.44	10.56	17.50	30.5	1.8	70.0	290.31	
7	7	15.644	28.89	14.44	21.67	44.1	1.8	50.0	235.82	
7	8	15.622	28.89	15.56	22.22	57.8	1.8	25.0	170.00	

7	9	15.599	28.89	13.89	21.39	42.9	1.8	60.0	258.36
7	10	15.574	28.33	14.44	21.39	41.3	1.8	80.0	302.21
7	11	15.549	33.33	16.67	25.00	41.0	1.8	50.0	231.65
7	12	15.522	36.11	20.00	28.06	41.2	1.8	75.0	281.72
7	13	15.494	35.56	21.11	28.33	36.7	1.8	75.0	283.31
7	14	15.465	31.67	21.11	26.39	36.1	1.8	90.0	316.09
7	15	15.435	28.89	18.33	23.61	34.1	1.8	90.0	319.64
7	16	15.404	35.00	18.33	26.67	39.8	1.8	90.0	311.45
7	17	15.372	35.56	20.00	27.78	38.1	1.8	90.0	309.90
7	18	15.339	31.67	22.22	26.94	34.4	1.8	90.0	312.45
7	19	15.304	32.78	21.11	26.94	39.2	1.8	90.0	308.32
7	20	15.269	28.33	20.00	24.17	33.9	1.8	90.0	313.88
7	21	15.233	32.78	18.33	25.56	38.8	1.8	80.0	288.56
7	22	15.196	32.78	16.67	24.72	39.1	1.8	50.0	224.62
7	23	15.158	29.44	17.78	23.61	44.5	1.8	40.0	200.37
7	24	15.119	36.11	18.89	27.50	41.0	1.8	50.0	219.14
7	25	15.079	35.00	21.67	28.33	38.2	1.8	90.0	299.78
7	26	15.039	35.00	21.67	28.33	38.9	1.8	90.0	298.00
7	27	14.997	29.44	20.00	24.72	35.2	1.8	90.0	303.67
7	28	14.955	31.11	20.00	25.56	43.1	1.8	90.0	296.81
7	29	14.912	26.67	17.78	22.22	45.5	1.8	90.0	298.61
7	30	14.868	25.56	16.67	21.11	41.8	1.8	90.0	300.13
7	31	14.824	25.56	13.33	19.44	31.2	1.8	90.0	304.67
8	1	14.778	28.89	12.78	20.84	32.6	1.8	90.0	301.43
8	2	14.733	29.44	14.44	21.94	32.2	1.8	90.0	299.06
8	3	14.686	23.33	11.67	17.50	35.4	1.8	90.0	299.71
8	4	14.639	25.00	12.78	18.89	39.0	1.8	90.0	295.60
8	5	14.591	22.22	10.56	16.39	40.0	1.8	90.0	295.63
8	6	14.543	24.44	11.67	18.06	48.9	1.8	75.0	261.24
8	7	14.494	20.56	10.56	15.56	48.2	1.8	90.0	290.23
8	8	14.444	26.11	11.67	18.89	43.0	1.8	90.0	287.22
8	9	14.394	30.56	17.22	23.89	42.6	1.8	90.0	280.23
8	10	14.343	30.00	17.22	23.61	41.1	1.8	90.0	279.49
8	11	14.292	30.00	16.67	23.34	34.9	1.8	90.0	280.93
8	12	14.241	31.11	15.56	23.34	37.1	1.8	90.0	278.01
8	13	14.189	33.33	16.11	24.72	38.0	1.8	90.0	274.15
8	14	14.136	35.56	17.22	26.39	24.2	1.8	90.0	277.99
8	15	14.083	35.00	16.11	25.56	38.0	1.8	90.0	269.36
8	16	14.030	33.33	17.22	25.28	20.3	1.8	90.0	276.97
8	17	13.976	29.44	12.22	20.83	31.8	1.8	90.0	272.73
8	18	13.922	30.00	12.50	21.25	38.5	1.8	90.0	267.61
8	19	13.868	31.11	13.89	22.50	38.5	1.8	90.0	264.40
8	20	13.813	28.89	16.11	22.50	41.9	1.8	90.0	260.87

APPENDIX B

Calibration Data Statistics

Filename: C:\DLG\STRMTEMP\CHELAN\STRMTEMP\DONE\C2002C.STR
 Chelan River
 2002, calibrated to avg and max temps
 Temperatures: Centigrade

Dam Apron: TOP OF STUDY (749) -to- Reach 1: Node 2

	Input	Avg24hr	Max24hr
MEAN:	20.153	20.161	21.171
MINIMUM:	17.510	17.516	18.086
DATE:	6/21	6/21	6/21
MAXIMUM:	22.950	22.956	23.518
DATE:	7/25	7/25	7/25

Reach 1: Node 2 -to- Reach 1: Node 3

	Input	Avg24hr	Max24hr
MEAN:	20.161	20.177	21.188
MINIMUM:	17.516	17.528	18.127
DATE:	6/21	6/21	6/21
MAXIMUM:	22.956	22.968	23.554
DATE:	7/25	7/25	7/25

Reach 1: Node 3 -to- Reach 1: Node 4

	Input	Avg24hr	Max24hr
MEAN:	20.177	20.194	21.231
MINIMUM:	17.528	17.541	18.151
DATE:	6/21	6/21	6/21
MAXIMUM:	22.968	22.980	23.580
DATE:	7/25	7/25	7/25

Reach 1: Node 4 -to- Reach 1: Node 5

	Input	Avg24hr	Max24hr
MEAN:	20.194	20.216	21.531
MINIMUM:	17.541	17.558	18.318
DATE:	6/21	6/21	6/21
MAXIMUM:	22.980	22.997	23.746

DATE: 7/25 7/25 7/25

Reach 1: Node 5 -to- Reach 1: Node 6

	Input	Avg24hr	Max24hr
MEAN:	20.216	20.233	21.720
MINIMUM:	17.558	17.569	18.390
DATE:	6/21	6/21	6/21
MAXIMUM:	22.997	23.008	23.896
DATE:	7/25	7/25	8/10

Reach 1: Node 6 -to- Reach 1: Node 7

	Input	Avg24hr	Max24hr
MEAN:	20.233	20.245	21.691
MINIMUM:	17.569	17.576	18.372
DATE:	6/21	6/21	6/21
MAXIMUM:	23.008	23.015	23.853
DATE:	7/25	7/25	8/10

Reach 1: Node 7 -to- Reach 1: Node 8

	Input	Avg24hr	Max24hr
MEAN:	20.245	20.282	21.703
MINIMUM:	17.576	17.602	18.397
DATE:	6/21	6/21	6/21
MAXIMUM:	23.015	23.040	23.870
DATE:	7/25	7/25	8/10

Reach 1: Node 8 -to- Reach 1: Node 9

	Input	Avg24hr	Max24hr
MEAN:	20.282	20.296	21.588
MINIMUM:	17.602	17.613	18.331
DATE:	6/21	6/21	6/21
MAXIMUM:	23.040	23.051	23.765
DATE:	7/25	7/25	7/25

Reach 1: Node 9 -to- Reach 1: Node 10

	Input	Avg24hr	Max24hr
MEAN:	20.296	20.314	21.789
MINIMUM:	17.613	17.625	18.434
DATE:	6/21	6/21	6/21
MAXIMUM:	23.051	23.062	24.061
DATE:	7/25	7/25	8/10

Reach 1: Node 10 -to- Reach 1: Node 11

	Input	Avg24hr	Max24hr
MEAN:	20.314	20.335	21.783
MINIMUM:	17.625	17.640	18.448
DATE:	6/21	6/21	6/21
MAXIMUM:	23.062	23.076	24.036
DATE:	7/25	7/25	8/10

Reach 1: Node 11 -to- Reach 1: Node 12

	Input	Avg24hr	Max24hr
MEAN:	20.335	20.350	21.938
MINIMUM:	17.640	17.650	18.560
DATE:	6/21	6/21	6/21
MAXIMUM:	23.076	23.087	24.290
DATE:	7/25	7/25	8/10

Reach 1: Node 12 -to- End of Reach 1 (750)

	Input	Avg24hr	Max24hr
MEAN:	20.350	20.367	21.997
MINIMUM:	17.650	17.664	18.682
DATE:	6/21	6/21	6/21
MAXIMUM:	23.087	23.101	24.318
DATE:	7/25	7/25	8/10

End of Reach 1 (750) -to- Reach 2: Node 2

Input	Avg24hr	Max24hr
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MEAN:	20.367	20.380	22.215
MINIMUM:	17.664	17.677	18.761
DATE:	6/21	6/21	6/21
MAXIMUM:	23.101	23.113	24.712
DATE:	7/25	7/25	8/10

Reach 2: Node 2 -to- End of Reach 2: Top of gorge (753)

	Input	Avg24hr	Max24hr
MEAN:	20.380	20.387	22.280
MINIMUM:	17.677	17.683	18.833
DATE:	6/21	6/21	6/21
MAXIMUM:	23.113	23.119	24.786
DATE:	7/25	7/25	8/10

End of Reach 2: Top of gorge -to- End of Reach 3, Bottom of gorge (751)

	Input	Avg24hr	Max24hr
MEAN:	20.387	20.512	22.293
MINIMUM:	17.683	17.801	18.948
DATE:	6/21	6/21	6/21
MAXIMUM:	23.119	23.237	24.499
DATE:	7/25	7/25	8/10

End of Reach 3, Bottom of gorge (751) -to- End of Reach 4: Near Powerhouse (752)

	Input	Avg24hr	Max24hr
MEAN:	20.512	20.553	22.277
MINIMUM:	17.801	17.838	18.998
DATE:	6/21	6/21	6/21
MAXIMUM:	23.237	23.273	24.592
DATE:	7/25	7/25	8/10

STUDY SUMMARY STATISTICS
Data Points: 1008

	Input	Avg24hr	Max24hr
MEAN:	20.288	20.313	21.775
MINIMUM:	17.510	17.516	18.086
DATE:	6/21	6/21	6/21
MAXIMUM:	23.237	23.273	24.786
DATE:	7/25	7/25	8/10

APPENDIX C

Simulation Run Input Data

MO	DAY	YEAR	Input		AVG		Wind	%	SOLAR
			Water	Air	%	Speed			
5	1	2000	12.80	14.44	30.0	1.8	90.0		292.40
5	2	2000	13.30	16.67	30.0	1.8	90.0		293.03
5	3	2000	13.30	16.39	30.0	1.8	90.0		295.02
5	4	2000	13.10	11.67	60.0	1.8	50.0		212.69
5	5	2000	12.80	11.39	30.0	1.8	90.0		301.14
5	6	2000	12.80	11.11	30.0	1.8	90.0		303.00
5	7	2000	12.80	10.56	30.0	1.8	90.0		304.95
5	8	2000	13.10	13.06	30.0	1.8	90.0		305.49
5	9	2000	13.10	13.61	30.0	1.8	90.0		306.85
5	10	2000	12.80	11.11	70.0	1.8	40.0		196.61
5	11	2000	12.50	8.61	50.0	1.8	60.0		246.35
5	12	2000	12.80	10.00	30.0	1.8	90.0		313.24
5	13	2000	13.10	11.94	30.0	1.8	90.0		313.89
5	14	2000	13.60	12.78	30.0	1.8	90.0		314.95
5	15	2000	14.20	15.83	40.0	1.8	70.0		270.59
5	16	2000	15.00	16.39	30.0	1.8	90.0		315.76
5	17	2000	15.00	19.44	30.0	1.8	90.0		315.04
5	18	2000	14.70	15.83	30.0	1.8	90.0		318.77
5	19	2000	15.00	16.39	60.0	1.8	50.0		225.51
5	20	2000	15.00	17.22	30.0	1.8	90.0		320.41
5	21	2000	14.70	17.78	30.0	1.8	90.0		321.24
5	22	2000	14.70	18.33	30.0	1.8	90.0		322.02
5	23	2000	14.70	17.22	30.0	1.8	90.0		323.90
5	24	2000	15.00	16.67	30.0	1.8	90.0		325.35
5	25	2000	15.60	18.33	30.0	1.8	90.0		325.27
5	26	2000	15.80	17.22	30.0	1.8	90.0		327.05
5	27	2000	15.80	14.44	30.0	1.8	90.0		329.75
5	28	2000	15.30	16.94	30.0	1.8	90.0		329.14
5	29	2000	15.80	15.00	30.0	1.8	90.0		331.26
5	30	2000	16.10	15.28	60.0	1.8	50.0		234.70
5	31	2000	16.10	14.72	50.0	1.8	60.0		261.28
6	1	2000	15.60	11.67	30.0	1.8	90.0		335.53
6	2	2000	15.60	14.44	30.0	1.8	90.0		334.79
6	3	2000	15.80	16.67	30.0	1.8	90.0		334.12
6	4	2000	16.40	19.17	30.0	1.8	90.0		333.00
6	5	2000	16.70	20.28	30.0	1.8	90.0		332.74
6	6	2000	16.70	19.44	30.0	1.8	90.0		333.98
6	7	2000	16.70	19.44	30.0	1.8	90.0		334.52
6	8	2000	16.70	16.39	40.0	1.8	80.0		312.20
6	9	2000	16.70	17.50	50.0	1.8	70.0		286.01
6	10	2000	16.40	10.56	30.0	1.8	90.0		341.33
6	11	2000	16.40	14.44	30.0	1.8	90.0		339.67
6	12	2000	16.40	13.33	80.0	1.8	20.0		161.70
6	13	2000	16.40	15.00	30.0	1.8	90.0		339.99
6	14	2000	16.90	16.11	30.0	1.8	90.0		339.55
6	15	2000	16.90	18.33	30.0	1.8	90.0		338.23
6	16	2000	17.20	16.67	30.0	1.8	90.0		339.58
6	17	2000	17.50	20.56	30.0	1.8	90.0		336.80
6	18	2000	18.30	21.67	30.0	1.8	90.0		335.93
6	19	2000	18.30	18.06	30.0	1.8	90.0		338.91
6	20	2000	18.30	18.61	30.0	1.8	90.0		338.52
6	21	2000	18.90	20.56	30.0	1.8	90.0		336.95
6	22	2000	19.03	20.56	30.0	1.8	90.0		336.89

6	23	2000	18.58	21.67	30.0	1.8	90.0	335.82
6	24	2000	18.50	21.11	30.0	1.8	90.0	336.17
6	25	2000	18.35	18.89	30.0	1.8	90.0	337.79
6	26	2000	18.24	21.94	30.0	1.8	90.0	335.03
6	27	2000	18.29	23.33	30.0	1.8	90.0	333.46
6	28	2000	20.26	25.00	30.0	1.8	90.0	331.45
6	29	2000	21.07	24.72	30.0	1.8	90.0	331.41
6	30	2000	20.77	25.28	30.0	1.8	90.0	330.44
7	1	2000	20.02	20.83	30.0	1.8	90.0	334.30
7	2	2000	19.55	18.33	30.0	1.8	90.0	335.82
7	3	2000	19.12	16.39	60.0	1.8	40.0	213.73
7	4	2000	18.51	15.83	80.0	1.8	30.0	184.90
7	5	2000	18.64	16.39	30.0	1.8	90.0	335.54
7	6	2000	18.98	18.89	30.0	1.8	90.0	333.17
7	7	2000	19.21	19.17	30.0	1.8	90.0	332.30
7	8	2000	19.79	21.94	30.0	1.8	90.0	329.31
7	9	2000	20.08	22.22	30.0	1.8	90.0	328.34
7	10	2000	20.14	20.83	30.0	1.8	90.0	328.78
7	11	2000	20.12	21.94	30.0	1.8	90.0	327.01
7	12	2000	20.33	22.50	30.0	1.8	90.0	325.67
7	13	2000	20.93	24.72	30.0	1.8	90.0	322.64
7	14	2000	20.93	23.06	30.0	1.8	90.0	323.31
7	15	2000	20.49	20.28	30.0	1.8	90.0	324.61
7	16	2000	20.32	21.11	30.0	1.8	90.0	323.14
7	17	2000	19.98	23.61	30.0	1.8	90.0	319.87
7	18	2000	20.86	23.61	30.0	1.8	90.0	318.81
7	19	2000	21.06	23.61	30.0	1.8	90.0	317.71
7	20	2000	21.52	26.67	30.0	1.8	90.0	313.41
7	21	2000	21.42	26.39	30.0	1.8	90.0	312.11
7	22	2000	22.28	25.28	30.0	1.8	90.0	312.11
7	23	2000	22.45	23.89	30.0	1.8	90.0	312.11
7	24	2000	22.28	23.89	30.0	1.8	90.0	311.41
7	25	2000	21.67	24.72	30.0	1.8	90.0	304.11
7	26	2000	22.01	24.17	30.0	1.8	90.0	308.41
7	27	2000	22.02	25.00	30.0	1.8	90.0	304.11
7	28	2000	22.25	23.89	30.0	1.8	90.0	305.11
7	29	2000	22.33	24.17	30.0	1.8	90.0	304.11
7	30	2000	22.74	24.44	30.0	1.8	90.0	302.11
7	31	2000	22.45	28.06	30.0	1.8	90.0	297.11
8	1	2000	23.06	28.06	30.0	1.8	90.0	294.11
8	2	2000	23.04	28.06	30.0	1.8	90.0	294.11
8	3	2000	23.08	26.11	30.0	1.8	90.0	294.11
8	4	2000	23.08	24.72	30.0	1.8	90.0	294.11
8	5	2000	23.73	26.67	30.0	1.8	90.0	290.71
8	6	2000	23.76	28.89	30.0	1.8	90.0	286.11
8	7	2000	23.54	27.50	30.0	1.8	90.0	286.11
8	8	2000	23.67	27.50	30.0	1.8	90.0	284.71
8	9	2000	23.57	28.06	30.0	1.8	90.0	282.31
8	10	2000	23.41	27.50	30.0	1.8	90.0	281.11
8	11	2000	22.98	25.83	30.0	1.8	90.0	280.91
8	12	2000	22.64	20.56	30.0	1.8	90.0	283.51
8	13	2000	22.34	21.67	30.0	1.8	90.0	280.74
8	14	2000	22.03	21.39	30.0	1.8	90.0	279.01
8	15	2000	22.15	21.94	30.0	1.8	90.0	276.65
8	16	2000	22.08	21.94	30.0	1.8	90.0	274.65
8	17	2000	22.07	21.94	30.0	1.8	90.0	272.63

8	18	2000	21.86	23.06	30.0	1.8	90.0	269.71
8	19	2000	21.33	19.44	30.0	1.8	90.0	270.24
8	20	2000	21.14	16.67	30.0	1.8	90.0	269.78
8	21	2000	21.15	17.22	30.0	1.8	90.0	267.32
8	22	2000	21.35	19.44	30.0	1.8	90.0	263.83
8	23	2000	21.37	20.56	30.0	1.8	90.0	260.93
8	24	2000	21.38	23.06	30.0	1.8	90.0	256.94
8	25	2000	21.85	25.56	30.0	1.8	90.0	252.69
8	26	2000	22.06	22.50	30.0	1.8	90.0	252.92
8	27	2000	21.85	18.06	30.0	1.8	90.0	253.53
8	28	2000	21.48	15.83	30.0	1.8	90.0	252.41
8	29	2000	20.96	17.78	30.0	1.8	90.0	249.09
8	30	2000	20.68	20.00	30.0	1.8	90.0	245.47
8	31	2000	20.33	20.00	30.0	1.8	90.0	243.14
9	1	2000	22.00	18.06	30.0	1.8	90.0	241.91
9	2	2000	21.80	16.67	30.0	1.8	90.0	240.25
9	3	2000	21.40	14.17	30.0	1.8	90.0	239.00
9	4	2000	20.90	13.89	30.0	1.8	90.0	236.70
9	5	2000	20.60	14.44	30.0	1.8	90.0	234.03
9	6	2000	20.10	14.72	30.0	1.8	90.0	231.47
9	7	2000	21.30	15.00	30.0	1.8	90.0	228.90
9	8	2000	18.60	18.06	30.0	1.8	90.0	225.01
9	9	2000	18.30	13.61	30.0	1.8	90.0	224.53
9	10	2000	18.00	14.44	30.0	1.8	90.0	221.71
9	11	2000	17.50	14.44	30.0	1.8	90.0	219.22
9	12	2000	17.80	15.83	30.0	1.8	90.0	216.14
9	13	2000	17.80	18.61	30.0	1.8	90.0	212.35
9	14	2000	19.20	20.28	30.0	1.8	90.0	208.99
9	15	2000	19.40	21.11	30.0	1.8	90.0	206.03
9	16	2000	19.70	22.22	30.0	1.8	90.0	202.90
9	17	2000	21.90	20.28	30.0	1.8	90.0	201.51
9	18	2000	19.70	22.22	30.0	1.8	90.0	197.93
9	19	2000	20.00	21.39	30.0	1.8	90.0	195.92
9	20	2000	18.30	20.56	30.0	1.8	90.0	193.87
9	21	2000	18.10	16.11	30.0	1.8	90.0	193.40
9	22	2000	17.50	11.11	30.0	1.8	90.0	192.61
9	23	2000	17.30	10.00	30.0	1.8	90.0	190.39
9	24	2000	17.10	16.11	30.0	1.8	90.0	185.86
9	25	2000	16.90	12.78	30.0	1.8	90.0	184.52
9	26	2000	16.40	13.61	30.0	1.8	90.0	181.74
9	27	2000	16.40	13.06	30.0	1.8	90.0	179.41
9	28	2000	16.90	15.56	30.0	1.8	90.0	176.08
9	29	2000	17.20	17.22	30.0	1.8	90.0	172.98
9	30	2000	17.20	19.17	40.0	1.8	70.0	145.12
5	1	2001	11.94	9.72	30.0	1.8	90.0	294.52
5	2	2001	11.67	8.33	30.0	1.8	90.0	296.92
5	3	2001	13.89	11.67	30.0	1.8	90.0	297.43
5	4	2001	12.50	13.61	30.0	1.8	90.0	298.32
5	5	2001	13.33	8.61	60.0	1.8	40.0	194.15
5	6	2001	13.20	8.61	30.0	1.8	90.0	304.01
5	7	2001	13.06	11.11	30.0	1.8	90.0	304.71
5	8	2001	13.06	15.83	30.0	1.8	90.0	304.01
5	10	2001	13.61	14.44	30.0	1.8	90.0	308.02
5	11	2001	13.89	16.39	30.0	1.8	90.0	308.47
5	12	2001	15.00	19.44	30.0	1.8	90.0	307.97
5	14	2001	16.11	20.56	30.0	1.8	90.0	310.07

5	15	2001	16.39	12.78	60.0	1.8	70.0	267.62
5	17	2001	15.28	12.22	30.0	1.8	90.0	319.41
5	19	2001	14.44	14.17	30.0	1.8	90.0	321.01
5	20	2001	14.17	11.67	30.0	1.8	90.0	323.53
5	21	2001	14.17	13.06	30.0	1.8	90.0	324.05
5	22	2001	16.11	18.89	30.0	1.8	90.0	321.62
5	23	2001	16.11	24.72	30.0	1.8	90.0	317.68
5	24	2001	17.50	24.44	30.0	1.8	90.0	319.03
5	25	2001	18.33	23.89	30.0	1.8	90.0	320.62
5	29	2001	16.67	12.50	30.0	1.8	90.0	332.64
5	30	2001	16.67	13.06	30.0	1.8	90.0	333.21
5	31	2001	17.22	16.67	30.0	1.8	90.0	331.90
6	1	2001	15.83	22.78	30.0	1.8	90.0	327.86
6	2	2001	15.83	16.39	30.0	1.8	90.0	333.60
6	3	2001	15.83	13.61	30.0	1.8	90.0	335.96
6	4	2001	15.83	14.72	30.0	1.8	90.0	335.99
6	5	2001	15.28	17.22	50.0	1.8	70.0	284.51
6	6	2001	15.00	15.83	70.0	1.8	40.0	211.58
6	7	2001	15.83	15.00	30.0	1.8	90.0	337.57
6	8	2001	16.39	18.89	30.0	1.8	90.0	335.44
6	9	2001	16.94	16.94	40.0	1.8	80.0	312.17
6	11	2001	16.39	15.28	30.0	1.8	90.0	339.17
6	18	2001	17.22	18.33	30.0	1.8	90.0	338.65
6	26	2001	16.39	17.50	30.0	1.8	90.0	338.59
6	27	2001	17.22	15.83	80.0	1.8	30.0	186.53
6	28	2001	17.50	16.39	70.0	1.8	40.0	212.71
6	29	2001	18.33	18.89	30.0	1.8	90.0	336.66
6	30	2001	18.33	21.39	30.0	1.8	90.0	334.25
7	1	2001	18.33	21.94	30.0	1.8	90.0	333.33
7	2	2001	18.89	23.06	30.0	1.8	90.0	331.84
7	3	2001	18.33	24.17	30.0	1.8	90.0	330.25
7	4	2001	18.89	25.44	30.0	1.8	90.0	328.37
7	5	2001	20.56	26.28	30.0	1.8	90.0	326.87
7	6	2001	20.28	21.67	30.0	1.8	90.0	330.90
7	7	2001	20.56	23.06	30.0	1.8	90.0	328.98
7	8	2001	20.83	24.31	30.0	1.8	90.0	327.06
7	9	2001	21.67	25.83	30.0	1.8	90.0	324.72
7	10	2001	21.67	28.33	30.0	1.8	90.0	321.00
7	11	2001	22.22	27.78	30.0	1.8	90.0	320.90
7	12	2001	21.67	27.50	30.0	1.8	90.0	320.41
7	13	2001	22.22	24.44	30.0	1.8	90.0	322.92
7	14	2001	21.94	24.72	30.0	1.8	90.0	321.73
7	15	2001	21.67	25.00	30.0	1.8	90.0	320.49
7	16	2001	21.67	19.44	30.0	1.8	90.0	324.46
7	17	2001	21.67	15.00	30.0	1.8	90.0	326.39
7	18	2001	21.67	18.06	30.0	1.8	90.0	323.36
7	19	2001	20.56	19.17	30.0	1.8	90.0	321.45
7	20	2001	20.56	19.17	30.0	1.8	90.0	320.31
7	21	2001	20.56	22.50	30.0	1.8	90.0	316.42
7	23	2001	20.83	21.11	30.0	1.8	90.0	315.15
7	24	2001	21.67	21.67	30.0	1.8	90.0	313.40
7	25	2001	21.94	23.33	30.0	1.8	90.0	310.62
7	26	2001	21.94	23.33	30.0	1.8	90.0	309.27
7	27	2001	21.94	26.67	30.0	1.8	90.0	304.55
7	28	2001	21.94	23.89	30.0	1.8	90.0	305.96
7	29	2001	21.11	18.89	30.0	1.8	90.0	308.58

7	30	2001	21.11	19.17	30.0	1.8	90.0	306.88
7	31	2001	21.11	19.44	30.0	1.8	90.0	305.15
8	1	2001	21.11	21.67	30.0	1.8	90.0	301.89
8	2	2001	21.11	22.50	30.0	1.8	90.0	299.62
8	3	2001	21.67	25.00	30.0	1.8	90.0	295.73
8	4	2001	21.67	22.78	30.0	1.8	90.0	296.11
8	5	2001	21.67	21.11	30.0	1.8	90.0	295.78
8	6	2001	21.67	22.22	30.0	1.8	90.0	293.18
8	7	2001	22.22	26.39	30.0	1.8	90.0	287.62
8	8	2001	22.22	25.83	30.0	1.8	90.0	286.43
8	9	2001	21.67	23.89	30.0	1.8	90.0	286.46
8	10	2001	21.11	25.56	30.0	1.8	90.0	283.10
8	11	2001	21.67	26.67	30.0	1.8	90.0	280.15
8	12	2001	22.22	28.89	30.0	1.8	90.0	275.89
8	13	2001	22.78	27.50	30.0	1.8	90.0	275.53
8	14	2001	23.33	25.28	30.0	1.8	90.0	275.81
8	15	2001	22.78	26.11	30.0	1.8	90.0	273.06
8	16	2001	23.40	27.22	30.0	1.8	90.0	269.99
8	20	2001	22.00	22.22	30.0	1.8	90.0	266.19
8	21	2001	22.20	21.11	30.0	1.8	90.0	264.87
8	22	2001	22.10	21.67	40.0	1.8	80.0	241.71
8	23	2001	22.10	18.33	60.0	1.8	30.0	146.35
8	27	2001	21.94	22.22	30.0	1.8	90.0	250.87
8	28	2001	21.94	25.56	30.0	1.8	90.0	246.00
8	29	2001	22.50	25.28	30.0	1.8	90.0	243.97
8	30	2001	22.22	25.83	30.0	1.8	90.0	241.22
8	31	2001	22.22	25.56	30.0	1.8	90.0	239.15
9	1	2001	21.94	23.61	30.0	1.8	90.0	238.36
9	4	2001	21.11	19.44	30.0	1.8	90.0	233.97
9	5	2001	20.56	20.83	30.0	1.8	90.0	230.74
9	6	2001	20.28	18.33	30.0	1.8	90.0	229.75
9	7	2001	20.28	18.89	30.0	1.8	90.0	227.02
9	8	2001	19.72	17.50	30.0	1.8	90.0	225.28
9	10	2001	20.28	20.56	30.0	1.8	90.0	218.73
9	11	2001	20.56	21.11	30.0	1.8	90.0	215.94
9	12	2001	20.28	20.83	30.0	1.8	90.0	213.63
9	13	2001	20.56	21.39	30.0	1.8	90.0	210.84
9	14	2001	20.28	24.17	30.0	1.8	90.0	206.61
9	15	2001	20.28	23.06	30.0	1.8	90.0	204.87
9	17	2001	21.11	21.94	30.0	1.8	90.0	200.58
9	18	2001	21.11	23.33	30.0	1.8	90.0	197.26
9	19	2001	20.56	19.72	30.0	1.8	90.0	196.80
9	20	2001	20.56	17.50	30.0	1.8	90.0	195.34
9	21	2001	20.56	17.78	30.0	1.8	90.0	192.70
9	22	2001	20.56	18.61	30.0	1.8	90.0	189.82
9	24	2001	20.56	20.00	30.0	1.8	90.0	184.17
9	25	2001	20.00	21.94	30.0	1.8	90.0	180.70
9	26	2001	19.44	17.78	50.0	1.8	60.0	140.13
9	27	2001	18.89	14.17	30.0	1.8	90.0	179.05
9	28	2001	18.33	12.22	30.0	1.8	90.0	177.17
9	29	2001	18.33	13.33	30.0	1.8	90.0	174.34
9	30	2001	18.33	14.44	30.0	1.8	90.0	171.50
5	1	2002	12.50	16.94	30.0	1.8	90.0	291.01
5	2	2002	12.80	16.94	30.0	1.8	90.0	292.87
5	3	2002	12.80	12.22	30.0	1.8	90.0	297.18
5	6	2002	11.10	10.83	30.0	1.8	90.0	303.12

5	7	2002	10.80	9.72	30.0	1.8	90.0	305.30
5	8	2002	10.80	7.78	30.0	1.8	90.0	307.72
5	9	2002	10.80	9.44	30.0	1.8	90.0	308.74
5	10	2002	11.10	8.06	30.0	1.8	90.0	310.88
5	13	2002	12.80	17.50	30.0	1.8	90.0	310.80
5	14	2002	13.30	15.56	30.0	1.8	90.0	313.45
5	15	2002	12.80	12.50	30.0	1.8	90.0	316.52
5	16	2002	13.10	11.67	30.0	1.8	90.0	318.31
5	17	2002	13.10	16.94	30.0	1.8	90.0	316.77
5	20	2002	13.60	17.78	50.0	1.8	60.0	249.98
5	21	2002	13.60	15.56	30.0	1.8	90.0	322.66
5	22	2002	13.90	15.00	30.0	1.8	90.0	324.16
5	23	2002	13.30	13.33	30.0	1.8	90.0	326.21
5	28	2002	15.80	18.33	50.0	1.8	60.0	256.18
5	29	2002	16.10	17.78	50.0	1.8	60.0	257.39
5	30	2002	15.60	16.11	30.0	1.8	90.0	331.44
5	31	2002	15.60	20.00	30.0	1.8	90.0	329.48
6	3	2002	16.70	19.17	30.0	1.8	90.0	332.34
6	4	2002	16.10	20.83	30.0	1.8	90.0	331.66
6	5	2002	16.70	21.11	30.0	1.8	90.0	332.04
6	6	2002	16.10	18.89	30.0	1.8	90.0	334.40
6	7	2002	15.80	12.22	30.0	1.8	90.0	339.12
6	10	2002	15.30	18.33	30.0	1.8	90.0	336.73
6	11	2002	15.80	20.28	30.0	1.8	90.0	335.60
6	12	2002	17.00	20.00	30.0	1.8	90.0	336.17
6	13	2002	17.10	22.50	30.0	1.8	90.0	334.29
6	14	2002	19.00	23.89	30.0	1.8	90.0	333.19
6	15	2002	20.10	26.39	30.0	1.8	90.0	330.70
6	16	2002	20.00	26.67	30.0	1.8	90.0	330.54
6	17	2002	19.00	20.00	30.0	1.8	90.0	337.26
6	18	2002	18.40	18.61	30.0	1.8	90.0	338.44
6	19	2002	17.91	16.39	41.8	1.8	90.0	335.64
6	20	2002	17.72	19.72	42.1	1.8	90.0	332.20
6	21	2002	17.51	20.56	44.5	1.8	90.0	330.09
6	22	2002	18.44	25.28	43.6	1.8	90.0	324.02
6	23	2002	18.92	25.00	42.9	1.8	90.0	324.77
6	24	2002	18.73	23.06	41.4	1.8	90.0	328.22
6	25	2002	18.93	23.06	40.1	1.8	90.0	328.73
6	26	2002	19.39	26.11	40.4	1.8	90.0	324.08
6	27	2002	20.36	26.94	35.6	1.8	50.0	237.64
6	28	2002	19.65	22.78	60.1	1.8	25.0	171.53
6	29	2002	19.09	18.33	53.8	1.8	50.0	238.73
6	30	2002	18.33	17.50	43.0	1.8	90.0	332.14
7	1	2002	18.20	16.11	44.5	1.8	90.0	332.53
7	2	2002	18.16	18.33	36.4	1.8	90.0	333.17
7	3	2002	18.40	21.11	38.0	1.8	90.0	329.21
7	4	2002	18.03	19.17	37.9	1.8	90.0	330.73
7	5	2002	18.06	15.56	35.0	1.8	90.0	334.29
7	6	2002	18.18	17.50	30.5	1.8	70.0	290.31
7	7	2002	18.54	21.67	44.1	1.8	50.0	235.82
7	8	2002	18.94	22.22	57.8	1.8	25.0	170.00
7	9	2002	19.10	21.39	42.9	1.8	75.0	291.50
7	10	2002	19.12	21.39	41.3	1.8	80.0	302.21
7	11	2002	20.38	25.00	41.0	1.8	50.0	231.65
7	12	2002	21.34	28.06	41.2	1.8	75.0	281.72
7	13	2002	21.16	28.33	36.7	1.8	75.0	283.31

7	14	2002	21.30	26.39	36.1	1.8	90.0	316.09
7	15	2002	20.83	23.61	34.1	1.8	90.0	319.64
7	16	2002	20.55	26.67	39.8	1.8	90.0	311.45
7	17	2002	20.86	27.78	38.1	1.8	90.0	309.90
7	18	2002	21.42	26.94	34.4	1.8	90.0	312.45
7	19	2002	21.74	26.94	39.2	1.8	90.0	308.32
7	20	2002	21.35	24.17	33.9	1.8	90.0	313.88
7	21	2002	20.62	25.56	38.8	1.8	80.0	288.56
7	22	2002	20.66	24.72	39.1	1.8	50.0	224.62
7	23	2002	22.11	23.61	44.5	1.8	40.0	200.37
7	24	2002	22.60	27.50	41.0	1.8	50.0	219.14
7	25	2002	22.95	28.33	38.2	1.8	90.0	299.78
7	26	2002	22.61	28.33	38.9	1.8	90.0	298.00
7	27	2002	22.07	24.72	35.2	1.8	90.0	303.67
7	28	2002	21.57	25.56	43.1	1.8	90.0	296.81
7	29	2002	21.24	22.22	45.5	1.8	90.0	298.61
7	30	2002	21.28	21.11	41.8	1.8	90.0	300.13
7	31	2002	20.83	19.44	31.2	1.8	90.0	304.67
8	1	2002	20.66	20.84	32.6	1.8	90.0	301.43
8	2	2002	20.44	21.94	32.2	1.8	90.0	299.06
8	3	2002	20.27	17.50	35.4	1.8	90.0	299.71
8	4	2002	20.34	18.89	39.0	1.8	90.0	295.60
8	5	2002	19.85	16.39	40.0	1.8	90.0	295.63
8	6	2002	19.65	18.06	48.9	1.8	75.0	261.24
8	7	2002	19.62	15.56	48.2	1.8	90.0	290.23
8	8	2002	20.03	18.89	43.0	1.8	80.0	268.84
8	9	2002	20.56	23.89	42.6	1.8	80.0	262.29
8	10	2002	21.03	23.61	41.1	1.8	90.0	279.49
8	11	2002	21.03	23.34	34.9	1.8	90.0	280.93
8	12	2002	20.91	23.34	37.1	1.8	80.0	260.21
8	13	2002	20.77	24.72	38.0	1.8	90.0	274.15
8	14	2002	21.33	26.39	24.2	1.8	90.0	277.99
8	15	2002	20.23	25.56	38.0	1.8	90.0	269.36
8	16	2002	20.95	25.28	20.3	1.8	90.0	276.97
8	17	2002	20.04	20.83	31.8	1.8	90.0	272.73
8	18	2002	20.71	21.50	38.5	1.8	90.0	267.38
8	19	2002	21.05	22.50	38.5	1.8	90.0	264.40
8	20	2002	20.96	22.50	41.9	1.8	90.0	260.87
8	21	2002	20.84	22.50	30.0	1.8	90.0	263.86
8	22	2002	20.56	22.50	30.0	1.8	90.0	261.72
8	23	2002	20.56	23.34	30.0	1.8	90.0	258.91
8	24	2002	20.73	23.62	30.0	1.8	90.0	256.51
8	25	2002	21.46	23.89	30.0	1.8	90.0	254.09
8	26	2002	21.67	22.22	30.0	1.8	90.0	253.13
8	27	2002	21.67	22.23	30.0	1.8	90.0	250.87
8	28	2002	21.67	24.17	30.0	1.8	90.0	247.15
8	29	2002	20.56	26.39	30.0	1.8	90.0	243.01
8	30	2002	21.67	25.28	30.0	1.8	90.0	241.68
9	1	2002	21.84	23.89	30.0	1.8	90.0	238.15
9	2	2002	21.56	21.39	30.0	1.8	90.0	237.55
9	3	2002	21.39	21.67	30.0	1.8	90.0	235.00
9	4	2002	20.56	16.95	30.0	1.8	90.0	235.31
9	5	2002	20.56	17.78	30.0	1.8	90.0	232.47
9	6	2002	20.28	16.39	30.0	1.8	90.0	230.72
9	7	2002	19.42	16.39	50.0	1.8	50.0	162.44
9	8	2002	19.30	15.28	30.0	1.8	90.0	226.32

9	9	2002	19.44	16.39	30.0	1.8	90.0	223.35
9	10	2002	19.44	19.72	30.0	1.8	90.0	219.20
9	11	2002	19.44	20.56	30.0	1.8	90.0	216.27
9	12	2002	20.28	21.95	30.0	1.8	90.0	212.97
9	13	2002	20.56	21.94	30.0	1.8	90.0	210.51
9	14	2002	20.79	21.11	30.0	1.8	90.0	208.52
9	15	2002	20.64	21.11	30.0	1.8	90.0	206.03
9	16	2002	20.37	22.50	30.0	1.8	90.0	202.73
9	17	2002	19.90	19.45	30.0	1.8	90.0	201.94
9	18	2002	19.52	18.89	30.0	1.8	90.0	199.71
9	19	2002	19.35	18.06	30.0	1.8	90.0	197.60
9	20	2002	19.05	16.67	30.0	1.8	90.0	195.69
9	21	2002	18.95	15.28	30.0	1.8	90.0	193.73
9	22	2002	18.58	15.28	30.0	1.8	90.0	191.21
9	23	2002	18.45	15.56	30.0	1.8	90.0	188.59
9	24	2002	18.58	16.67	30.0	1.8	90.0	185.64
9	25	2002	18.63	17.50	30.0	1.8	90.0	182.80
9	26	2002	18.45	15.83	30.0	1.8	90.0	180.96
9	27	2002	18.18	12.78	30.0	1.8	90.0	179.50
9	28	2002	17.68	15.83	30.0	1.8	90.0	175.98
9	29	2002	17.22	15.28	50.0	1.8	70.0	147.27
9	30	2002	16.74	13.34	30.0	1.8	90.0	171.86
7	24	1998	21.94	28.23	38.0	1.8	98.0	313.65
7	25	1998	21.67	26.71	50.0	1.8	98.0	307.02
7	26	1998	21.67	27.48	53.0	1.8	97.0	301.44
7	27	1998	21.67	30.76	45.0	1.8	95.0	296.48
7	28	1998	21.67	29.86	46.0	1.8	92.0	291.33
7	29	1998	21.83	27.41	50.0	1.8	90.0	288.39
7	30	1998	21.83	23.54	62.0	1.8	41.0	190.69
7	31	1998	22.22	22.88	68.0	1.8	59.0	225.46
8	1	1998	22.32	24.53	50.0	1.8	93.0	293.91
8	2	1998	22.41	24.58	60.0	1.8	96.0	291.54
8	3	1998	22.78	25.52	59.0	1.8	96.0	288.74
8	4	1998	22.22	27.40	54.0	1.8	96.0	286.43
8	5	1998	23.19	26.48	49.0	1.8	93.0	284.96
8	6	1998	23.33	23.14	43.0	1.8	97.0	296.94

APPENDIX D

Simulation Run Statistics

AVERAGE 24-hour Temperatures Summary:
Differences are comparisons with 40 c.f.s.

CHELAN RIVER: Reach 1: Node 7 -to- Reach 1: Node 8

Flows	Mean Temp	Max Temp	Min Diff	Max Diff	Mean Diff
40 c.f.s.	19.174	24.021	---	---	---
80 c.f.s.	19.128	23.952	0.001	-0.345	-0.046
100 c.f.s.	19.117	23.936	0.001	-0.429	-0.057
200 c.f.s.	19.091	23.896	0.001	-0.628	-0.013
300 c.f.s.	19.080	23.879	0.002	-0.710	-0.094
400 c.f.s.	19.074	23.870	0.002	-0.757	-0.100
600 c.f.s.	19.067	23.859	0.002	-0.810	-0.107
800 c.f.s.	19.063	23.853	0.002	-0.840	-0.111
1000 c.f.s.	19.061	23.849	0.002	-0.866	-0.113
1500 c.f.s.	19.057	23.843	0.002	-0.894	-0.117
2000 c.f.s.	19.055	23.840	0.002	-0.906	-0.119
4000 c.f.s.	19.051	23.834	0.002	-0.937	0.123

AVERAGE 24-hour Temperatures Summary:
Differences are comparisons with 40 c.f.s.

CHELAN RIVER: Reach 1: Node 12 -to- End of Reach 1 (75)

Flows	Mean Temp	Max Temp	Min Diff	Max Diff	Mean Diff
40 c.f.s.	19.295	24.184	---	---	---
80 c.f.s.	19.224	24.076	-0.001	-0.41	0.071
100 c.f.s.	19.206	24.050	-0.002	-0.44	0.089
200 c.f.s.	19.164	23.985	-0.002	-1.11	0.131
300 c.f.s.	19.146	23.958	-0.003	-1.11	0.149
400 c.f.s.	19.136	23.943	-0.003	-1.11	0.159
600 c.f.s.	19.125	23.925	-0.003	-1.11	0.170
800 c.f.s.	19.118	23.915	-0.003	-1.11	0.177
1000 c.f.s.	19.114	23.908	-0.004	-1.11	0.181
1500 c.f.s.	19.108	23.899	-0.004	-1.11	0.188
2000 c.f.s.	19.104	23.893	-0.004	-1.11	0.191
4000 c.f.s.	19.098	23.883	-0.004	-1.11	0.198

AVERAGE 24-hour Temperatures Summary:
Differences are comparisons with 40 c.f.s.

CHELAN RIVER: Reach 2: Node 2 (753) -to- End of Reach 1; of gorge

Flows	Mean Temp	Max Temp	Min Diff	Max Diff	Mean Diff
40 c.f.s.	19.302	24.202	---	---	---
80 c.f.s.	19.234	24.095	0.001	-0.44	0.067
100 c.f.s.	19.217	24.068	0.001	-0.45	0.084
200 c.f.s.	19.177	24.003	0.001	-1.11	-0.125
300 c.f.s.	19.159	23.975	0.001	-1.27	-0.142

400 c.f.s.	19.150	23.959	0.001	-1.359	-0.152
600 c.f.s.	19.138	23.941	0.000	-1.459	-0.163
800 c.f.s.	19.132	23.931	0.000	-1.515	-0.170
1000 c.f.s.	19.128	23.924	0.000	-1.553	-0.174
1500 c.f.s.	19.121	23.914	-0.000	-1.608	-0.180
2000 c.f.s.	19.118	23.908	-0.000	-1.640	-0.184
4000 c.f.s.	19.112	23.898	0.000	-1.696	-0.190

AVERAGE 24-hour Temperatures Summary:
Differences are comparisons with 40 c.f.s.

CHELAN RIVER: End of Reach 2: Top of gorge -to- End of Reach 3, Bottom of gorge (751)

Flows	Mean Temp	Max Temp	Min Diff	Max Diff	Mean Diff
40 c.f.s.	19.424	24.354	---	---	---
80 c.f.s.	19.355	24.234	-0.001	-0.671	-0.070
100 c.f.s.	19.337	24.203	-0.001	-0.839	-0.087
200 c.f.s.	19.294	24.130	0.002	-1.242	-0.130
300 c.f.s.	19.276	24.099	0.002	-1.410	-0.148
400 c.f.s.	19.266	24.081	0.002	-1.506	-0.158
600 c.f.s.	19.254	24.061	0.002	-1.615	-0.170
800 c.f.s.	19.248	24.050	0.002	-1.677	-0.176
1000 c.f.s.	19.243	24.042	0.002	-1.718	-0.181
1500 c.f.s.	19.237	24.031	0.001	-1.778	-0.187
2000 c.f.s.	19.233	24.025	0.001	-1.812	-0.191
4000 c.f.s.	19.227	24.014	0.001	-1.872	-0.198

AVERAGE 24-hour Temperatures Summary:
Differences are comparisons with 40 c.f.s.

CHELAN RIVER: End of Reach 3, Bottom of gorge (751) -to- End of Reach 4: Near Powerhouse (752)

Flows	Mean Temp	Max Temp	Min Diff	Max Diff	Mean Diff
40 c.f.s.	19.464	24.405	---	---	---
80 c.f.s.	19.393	24.280	-0.001	-0.719	-0.072
100 c.f.s.	19.374	24.248	-0.002	-0.901	-0.090
200 c.f.s.	19.330	24.170	-0.004	-1.339	-0.135
300 c.f.s.	19.311	24.137	-0.005	-1.524	-0.154
400 c.f.s.	19.300	24.119	-0.005	-1.629	-0.164
600 c.f.s.	19.288	24.097	-0.006	-1.749	-0.177
800 c.f.s.	19.281	24.085	-0.006	-1.818	-0.184
1000 c.f.s.	19.276	24.077	-0.007	-1.862	-0.188
1500 c.f.s.	19.269	24.065	-0.007	-1.929	-0.195
2000 c.f.s.	19.265	24.058	-0.007	-1.967	-0.199
4000 c.f.s.	19.258	24.046	-0.008	-2.034	-0.206

MAXIMUM 24-hour Temperatures Summary:

Differences are comparisons with 40 c.f.s.
 CHELAN RIVER: Reach 1: Node 7 -to- Reach 1: Node 8

Flows	Mean Temp	Max Temp	Min Diff	Max Diff	Mean Diff
40 c.f.s.	22.091	26.962	---	---	---
80 c.f.s.	21.081	25.952	-0.316	-1.517	-1.010
100 c.f.s.	20.937	25.803	-0.343	-1.757	-1.154
200 c.f.s.	20.549	25.398	-0.426	-2.389	-1.542
300 c.f.s.	20.359	25.200	-0.473	-2.689	-1.732
400 c.f.s.	20.240	25.075	-0.505	-2.875	-1.851
600 c.f.s.	20.092	24.919	-0.546	-3.104	-1.999
800 c.f.s.	20.000	24.822	-0.573	-3.245	-2.091
1000 c.f.s.	19.936	24.753	-0.593	-3.343	-2.156
1500 c.f.s.	19.832	24.643	-0.625	-3.499	-2.259
2000 c.f.s.	19.768	24.575	-0.645	-3.595	-2.323
4000 c.f.s.	19.645	24.442	-0.685	-3.780	-2.447

MAXIMUM 24-hour Temperatures Summary:
 Differences are comparisons with 40 c.f.s.

CHELAN RIVER: Reach 1: Node 12 -to- End of Reach 1 (750)

Flows	Mean Temp	Max Temp	Min Diff	Max Diff	Mean Diff
40 c.f.s.	22.518	27.406	---	---	---
80 c.f.s.	21.407	26.301	-0.273	-1.773	-1.111
100 c.f.s.	21.242	26.129	-0.284	-2.074	-1.276
200 c.f.s.	20.801	25.665	-0.328	-2.862	-1.717
300 c.f.s.	20.590	25.441	-0.358	-3.230	-1.928
400 c.f.s.	20.460	25.302	-0.378	-3.454	-2.059
600 c.f.s.	20.301	25.131	-0.406	-3.725	-2.218
800 c.f.s.	20.204	25.027	-0.423	-3.889	-2.314
1000 c.f.s.	20.138	24.955	-0.436	-4.001	-2.381
1500 c.f.s.	20.034	24.841	-0.455	-4.177	-2.484
2000 c.f.s.	19.972	24.773	-0.467	-4.281	-2.546
4000 c.f.s.	19.856	24.643	-0.489	-4.480	-2.662

MAXIMUM 24-hour Temperatures Summary:
 Differences are comparisons with 40 c.f.s.

CHELAN RIVER: Reach 2: Node 2 -to- End of Reach 2: Top of gorge (753)

Flows	Mean Temp	Max Temp	Min Diff	Max Diff	Mean Diff
40 c.f.s.	22.938	27.776	---	---	---
80 c.f.s.	21.431	26.331	-0.438	-2.344	-1.507
100 c.f.s.	21.268	26.161	-0.440	-2.657	-1.670
200 c.f.s.	20.822	25.695	-0.467	-3.482	-2.116
300 c.f.s.	20.603	25.464	-0.491	-3.872	-2.335
400 c.f.s.	20.467	25.319	-0.510	-4.112	-2.471
600 c.f.s.	20.297	25.139	-0.537	-4.404	-2.641

800 c.f.s.	20.193	25.027	-0.556	-4.582	-2.745
1000 c.f.s.	20.120	24.949	-0.570	-4.704	-2.818
1500 c.f.s.	20.005	24.825	-0.593	-4.897	-2.933
2000 c.f.s.	19.936	24.749	-0.608	-5.013	-3.002
4000 c.f.s.	19.806	24.605	-0.635	-5.233	-3.132

MAXIMUM 24-hour Temperatures Summary:

Differences are comparisons with 40 c.f.s.

CHELAN RIVER: End of Reach 2: Top of gorge -to- End of Reach 3, Bottom of gorge (751)

Flows	Mean Temp	Max Temp	Min Diff	Max Diff	Mean Diff
40 c.f.s.	22.213	27.526	---	---	---
80 c.f.s.	21.375	26.545	0.002	-1.636	-0.838
100 c.f.s.	21.245	26.384	-0.002	-1.940	-0.967
200 c.f.s.	20.924	25.977	-0.002	-2.704	-1.289
300 c.f.s.	20.783	25.796	-0.001	-3.056	-1.429
400 c.f.s.	20.699	25.686	-0.002	-3.266	-1.514
600 c.f.s.	20.593	25.552	0.007	-3.517	-1.619
800 c.f.s.	20.525	25.467	0.008	-3.670	-1.688
1000 c.f.s.	20.473	25.404	0.006	-3.778	-1.740
1500 c.f.s.	20.379	25.294	-0.006	-3.955	-1.833
2000 c.f.s.	20.313	25.218	-0.004	-4.069	-1.900
4000 c.f.s.	20.150	25.038	0.004	-4.316	-2.063

MAXIMUM 24-hour Temperatures Summary:

Differences are comparisons with 40 c.f.s.

CHELAN RIVER: End of Reach 3, Bottom of gorge (751) -to- End of Reach 4: Near Powerhouse (752)

Flows	Mean Temp	Max Temp	Min Diff	Max Diff	Mean Diff
40 c.f.s.	22.653	27.675	---	---	---
80 c.f.s.	21.313	26.239	-0.303	-2.177	-1.340
100 c.f.s.	21.174	26.087	-0.277	-2.481	-1.479
200 c.f.s.	20.802	25.681	-0.216	-3.266	-1.851
300 c.f.s.	20.624	25.485	-0.177	-3.627	-2.029
400 c.f.s.	20.513	25.363	-0.159	-3.847	-2.140
600 c.f.s.	20.377	25.214	-0.143	-4.111	-2.276
800 c.f.s.	20.294	25.122	-0.136	-4.270	-2.359
1000 c.f.s.	20.237	25.058	-0.132	-4.378	-2.416
1500 c.f.s.	20.147	24.957	-0.127	-4.548	-2.506
2000 c.f.s.	20.093	24.896	-0.124	-4.650	-2.560
4000 c.f.s.	19.990	24.779	-0.119	-4.842	-2.663

CHAPTER 8: LAKE LEVEL MANAGEMENT

Lake Level Management

TABLE OF CONTENTS

CHAPTER 8: LAKE LEVEL MANAGEMENT	8-1
SECTION 1: Introduction	8-1
SECTION 2: Background	8-1
SECTION 3: Implementation.....	8-2
3.1 Lake Level Operation – Normal Conditions	8-2
3.2 Lake Level Operation – Late and High Runoff Conditions	8-5

LIST OF TABLES

Table 8-1: Proposed Lake Elevations (PME14)	8-3
Table 8-2: Average Lake Levels (Feet, USGS) for the Original License, Existing License, and Agreed Lake Level Cycle	8-4
Table 8-3: Operations Model Results.....	8-6

LIST OF FIGURES

Figure 8-1: Comparison of Averages for Lake Chelan Elevations.....	8-4
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Lake Level Management

SECTION 1: INTRODUCTION

The lake level operating regime described in this Chapter will attempt to raise average lake elevations in the spring and summer, compared to the existing regime, and lower lake elevations in the late summer and fall. Tourism and recreation are the socioeconomic factors most influenced by lake elevations and operating regimes. Higher lake levels earlier in the spring may result in more water-based recreation facilities being operational and accessible earlier in the year, potentially providing benefit to the local economy. Lowering the lake slightly earlier in the year will address fishery management agencies concerns regarding the buildup of sediment barriers at tributary mouths that may inhibit fish access to certain habitat areas.

This lake level management plan is intended to strike a balance between the needs of fish (see Chapters 6 and 7) and recreational needs (see Chapter 11).

Beginning within one year of the effective date of the New License, and for the term of the New License, including any subsequent annual licenses, Chelan PUD shall make every reasonable effort to comply with the lake level management practices described in this Chapter.

SECTION 2: BACKGROUND

The timing and volume of snowmelt inflow to Lake Chelan is highly variable from year to year, dependent on both the annual snowfall and the weather in spring and early summer. The operation of the Project has been managed to meet license conditions regarding the timing of refill since the Project began operation. Today, snow surveys and remote sensors gauge the accumulation of snow and water content in the drainage on a monthly basis, with the most accurate forecast becoming available in April.

Chelan PUD has accumulated 70 years of records, and has developed statistical curves for accumulated inflow during early, average, and late runoff conditions. These curves provide a predictive tool for inflow volumes and lake refill timing, based on the April runoff forecast. Chelan PUD uses these predictive curves to manage power generation to avoid drafting more water from the lake than can be replaced by snowmelt inflow.

Under the present FERC license, Chelan PUD also manages power generation and lake level very conservatively to insure that Lake Chelan, even during a cold spring and summer, will refill by June 30, the date specified in the license. The cumulative inflow, lake level, and weather forecasts are checked several times a week and power generation is reduced or curtailed during years with late runoff to be sure that the lake will be full by June 30.

Refilling the lake on time takes precedence over power generation. The refilling process is managed to guarantee meeting the refill date even when the unexpected occurs, such as the

Lake Level Management

failure of a forecasted heavy runoff to materialize. Warm weather usually arrives in June, and the lake refills before June 30 most of the time. In many cases, early refill occurs because powerhouse use was cut back to assure refill in case of late snowmelt. When this happens, water is spilled earlier in the season, and in greater quantities, than would have happened with some flexibility in management of the refill date.

The terms of the New License for the Project include a requirement for minimum instream flows into the bypassed reach of the Chelan River. This additional flow, which will take precedence over both refill timing and power generation, increases the uncertainty in refill timing in years with late runoff.

Fixed, inflexible dates, such as those contained in the existing license, for reaching full lake level increases the amount of spill in late June and July in some years. High spill levels are not beneficial to the fish populations in the Chelan River, and impact power generation. A minor degree of flexibility in the timing of lake refill, such as contained in the new operating regime, can prevent or reduce spilling.

The following describes the agreed-upon operation of the Project to meet the lake level requirements contained in Proposed License Article 8.

SECTION 3: IMPLEMENTATION

3.1 Lake Level Operation – Normal Conditions

Chelan PUD will manage the elevation of Lake Chelan from October 1 through May 1 based on monitoring of snowpack water content, lake level, and projected precipitation and runoff timing. Minimum elevations for Lake Chelan will be managed by Chelan PUD with the following objectives in mind:

1. Maintaining minimum flows in the Chelan River (this objective has priority over lake levels)
2. Reducing high flows in the Chelan River (this objective has priority over lake levels)
3. Satisfying regulatory requirements for flood control (adjusting lake level)
4. Providing usable lake levels for recreation (which varies between elevation 1,090 and 1,098 ft depending on the slope of the shoreline and boat dock configurations)
5. Reducing shoreline erosion
6. Preventing fish passage blockages (due to tributary barriers)
7. Minimizing the effect of refill on attainment of flow objectives for salmon in the mainstem Columbia River

Chelan PUD will make every reasonable effort to operate the Project to meet the above objectives. Additionally, Chelan PUD will operate the Project, to the extent practicable, to obtain minimum elevations by the dates specified in Proposed License Article 8 (within reasonable predictive probability):

*Lake Level Management***Table 8-1: Proposed Lake Elevations (PME14)**

Day	Minimum Elevation (ft)
May 1	1,087.6
June 1	1,094.0
July 1	1,098.0
August 1	1,099.0
September 7	1,098.7
October 1	1,097.2

Except for circumstances beyond its control (such as droughts and high runoff), Chelan PUD will maintain year-round minimum flows and minimize high flows in the Chelan River. Chelan PUD will control the lake levels to avoid spilling flows greater than 6,000 cfs, to the extent feasible.

In the spring (May 1 through June 30), the averages shown in Table 8-2 will be higher in those years in which the timing of the runoff is early to average. These higher lake level elevations earlier in the year will help make recreational facilities more usable. Examples of the benefit of higher, earlier lake elevations are: 1) a lake elevation of 1,098 ft level is needed to make all fixed docks usable; 2) public marinas, such as Don Morse Park and Twenty-five Mile Creek State Park, need an elevation of 1,094 ft for boat slips to be usable, and 1,091 ft for the boat launch to be usable; and 3) most private marinas need a minimum elevation of 1,091 ft to be 25-35 percent usable. During early to average runoff conditions in early May¹, a lake elevation of 1,090 ft or above is likely.

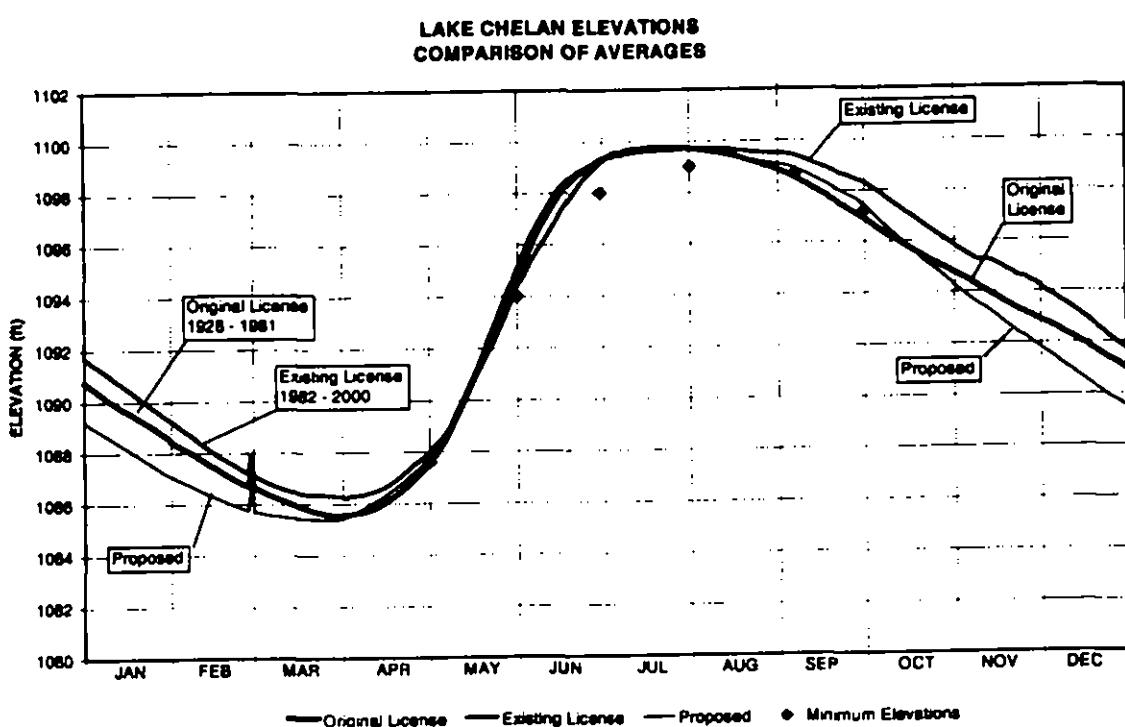
In the fall (Sept. 1 to Nov. 1), the average lake elevations shown in Table 8-1 will be maintained to reduce erosion and to prevent barriers from forming at tributary mouths. In October, average elevations may be higher due to conservative Project operation and occasional fall rain events.

Operation in accordance with the conditions and minimum elevations described above is expected to result in the average elevations and lake level shown in Table 8-2 and illustrated by Figure 8-1.

¹ The difference between how the model simulates Project operation and how the operators will run the Project makes precise comparisons difficult, since the model works with perfect hindsight and the operators managing the Project will work with a significant amount of uncertainty. Average elevations (operators) on May 1 are expected to be higher than the model shows (e.g., 4 inches to 18 inches). The exact difference will depend on runoff timing and amounts and will depend on the operators' ability to predict runoff conditions.

*Lake Level Management***Table 8-2: Average Lake Levels (Feet, USGS) for the Original License, Existing License, and Agreed Lake Level Cycle**

Day	Original License (1927-1981)	Existing License (1981-2000)	Agreed for New License ¹
January 1	1,090.7	1,091.7	1,089.2
February 1	1,088.4	1,089.2	1,087.1
March 1	1,086.6	1,087.1	1,085.7
April 1	1,085.6	1,086.3	1,085.4
May 1	1,087.6	1,088.0	1,087.8
June 1	1,094.8	1,094.4	1,095.2
July 1	1,099.3	1,099.2	1,099.3
August 1	1,099.7	1,099.7	1,099.7
September 1	1,098.8	1,099.5	1,098.9 ²
October 1	1,096.9	1,098.3	1,097.4
November 1	1,094.7	1,095.8	1,094.3
December 1	1,092.9	1,094.2	1,091.8

¹ Average elevation derived from 1952-1995 period of record² September 7**Figure 8-1: Comparison of Averages for Lake Chelan Elevations**

*Lake Level Management***3.2 Lake Level Operation – Late and High Runoff Conditions**

Lake refill in the spring is affected by both the volume and timing of runoff. As part of the New License for the Lake Chelan Project, Chelan PUD is required to provide minimum instream flows to the Chelan River. Another requirement is to minimize high flows (greater than 6,000 cfs) in the Chelan River bypassed reach to protect modified habitat measures to be implemented at the lower end of the Chelan River to enhance anadromous fish production. These requirements will tend to increase the uncertainty for lake refill. As a result, the determination of early/late runoff years to adjust Project operations will need to be performed even more carefully than it is currently. The following sections discuss the definition of late runoff years and operations for lake refill timing.

3.2.1 Proposed Operating Regime – Late Runoff Conditions

The February 1, March 1, and April 1 runoff volume forecasts and the lake level elevation are used to establish the level of releases for April, May, and June. The volume of runoff needed to refill the lake is calculated from the lake elevation. The proportion of the runoff volume forecasts expected to occur prior to May 1, June 1, and July 1 is estimated, and the volume in excess of the refill requirement is used for power generation. Three predictive curves, one each for early, average, and late runoff timing, are generated based on the forecast. These curves are then used to manage generation.

On average, approximately 81 percent of the runoff entering the lake occurs before July 1 (average runoff). In years with cold spring weather, approximately 71 percent of the runoff occurs by July 1 (late runoff), whereas in warm years, as much as 87 percent occurs by July 1 (early runoff). For purposes of lake level management, early runoff is defined as a year in which at least 80 percent of the predicted runoff occurs before July 1, and late runoff is defined as a year in which less than 80 percent of the predicted runoff occurs before July 1.

The lake is currently managed assuming average to late runoff conditions, which can be defined also as operating to 95-100 percent probability of refill by July 1. In most years, the cold spring weather breaks by early June and the lake refills before July 1, which results in substantial levels of spill. The agreed upon approach assumes early to average runoff conditions, also defined as operating to 80 percent probability of refill by June 30, (see Section 3.3), and includes minimum flow releases into the bypassed reach of the Chelan River. This level of flexibility will help reduce spill levels that would provide: 1) reduced impacts on aquatic biota in the bypassed reach of the Chelan River from high peak spill level; 2) benefits to aquatic biota by providing conditions in the bypassed reach of the Chelan River that more closely mimic the natural hydrograph; 3) more flow in the tailrace in early spring (April and May) for steelhead egg incubation and fry emergence; and 4) reduce impacts on power generation.

Operations model analyses were conducted, based on historic data, to forecast lake refill under the agreed upon management approach. Model results show that minimum elevations can be met in most years by the specified dates, even with conflicts between runoff volume and timing, providing minimum flows, desired higher spring lake elevations, and controlling spring spill levels. For example, the May 1 minimum elevation, 1,087.6 ft, was achieved in 35 of 44 years (9 misses). However, in the years when the May 1 elevation was not achieved, the lake was filling

Lake Level Management

rapidly and was not far below the minimum elevation. Specifically, the average delay to reach elevation 1,087.6 ft was 4 days (May 5), and the maximum delay was nine days (May 10). Similar results are shown for the June 1 and July 1 dates. Results from 1977 were omitted from the tabular results because it was such an extreme low flow year and skewed results significantly.

Results of model runs for the 44-year period of record (1952-1995) are shown in Table 8-3.

Table 8-3: Operations Model Results

Date	No. Years Missed	Average Delay {w/o 1977}(days)	Maximum Delay {w/o 1977} (days)
May 1	9	4	9
June 1	11	2	6
July 1	2	1	1

3.2.2 Proposed Operating Regime - High Runoff Conditions (PMF)

FERC regulations require the Project to be able to pass the outflow from the probable maximum flood (PMF) without failure of the dam. From October through mid-November, the Project's PMF is based on a maximum probable precipitation event in the watershed, but does not include significant amounts of snow in place. From late November through February, the PMF would be produced by maximum probable precipitation falling on an unusually large (100-year) snowpack.

To maintain the ability to pass the PMF without dam failure, the Project must be operated in a way that provides enough storage to capture part of the PMF inflows. The amount of available storage required varies with the water content of the snow present in the watershed. The effect of this requirement is that the lake must be kept at lower levels when larger snowpack exists in the watershed. This coincides with the current approach (which would be continued under the New License) of drawing the lake down through the winter to accommodate the amount of runoff anticipated the next spring.

CHAPTER 9: WILDLIFE HABITAT PLAN

*Wildlife Habitat Plan****TABLE OF CONTENTS***

CHAPTER 9: WILDLIFE HABITAT PLAN	9-1
SECTION 1: Introduction	9-1
SECTION 2: Wildlife Habitat Plan Goals.....	9-2
SECTION 3: Potential Habitat and Wildlife Enhancement Measures.....	9-2
3.1 Range	9-2
3.2 Agronomy	9-3
3.3 Tree and Shrub Plantings	9-3
3.4 Erosion Control.....	9-3
3.5 Water Developments.....	9-3
3.6 Irrigation	9-3
3.7 Wildlife Feeding	9-3
3.8 Nesting and Raptor Perching Structures	9-3
3.9 Wildlife Re-establishment	9-4
3.10 Habitat Connectivity	9-4
3.11 Ecosystem Processes.....	9-4
SECTION 4: Implementation.....	9-4
4.1 Lake Chelan Wildlife Measures.....	9-5
4.2 Rocky Reach Wildlife Measures.....	9-6

Wildlife Habitat Plan

SECTION 1: INTRODUCTION

Chelan PUD initiated the alternative relicensing process for the Lake Chelan Project in 1998, and for the Rocky Reach Project in 1999. A Natural Sciences Working Group (NSWG) was then established for each Project. The NSWG for the Lake Chelan Project consisted of the U.S. Department of Agriculture Forest Service (USDA Forest Service), National Park Service (NPS), U.S. Fish and Wildlife Service (USFWS), NOAA Fisheries, WA Department of Ecology (WDOE), WA Department of Fish and Wildlife (WDFW) and other interested Parties. The Rocky Reach NSWG consisted of same organizations, except for the Lake Chelan Sportsman's Association (LCSA), People for Lake Chelan (PFLC), and the City of Chelan, and includes the U.S. Bureau of Land Management (BLM).

The NSWGs decided that the wildlife resources associated with the two Projects should be managed on a coordinated basis. Accordingly, they prepared a comprehensive Wildlife Habitat Plan (WHP), now contained in this Chapter, to address the impacts of the Projects on wildlife resources.

Short-term and long-term wildlife habitat goals associated with both Projects are included in the WHP. It is intended to encourage a high degree of flexibility for funding resource needs within and between the two Projects, particularly since migrating wildlife are not confined to one Project Area. Moreover, Chelan PUD and the wildlife management agencies recognize that future needs of the wildlife resources may be difficult to predict. Therefore, a Lake Chelan Wildlife Forum (LCWF) will be established pursuant to section 18 of the Agreement. The LCWF is intended to provide recommendations to the relevant management agencies about the direction of the WHP, based on the highest needs and best use of funds in response to a crisis or other specific resource issue. The members of the LCWF are described in section 4 of this Chapter.

State lands included in the WHP are those of the WDFW and the Washington Department of Natural Resources (DNR). Federal lands include those of the USDA Forest Service and the BLM. The primary areas of concern include: 1) public lands in Chelan County within approximately 6 miles of Rocky Reach Reservoir (including WDFW's Swakane, Entiat, and Chelan Butte Wildlife Management Areas (WMAs)); 2) USDA Forest Service lands in the Lake Chelan Basin between the lake and the 3500 ft elevation; and 3) NPS lands in the Lake Chelan National Recreation Area (see Chapter 4). The LCWF will have the flexibility to recommend undertaking projects beyond these boundaries when it is demonstrated that there is an important wildlife/habitat link to primary areas (e.g., migration corridor, limiting factor).

The Lake Chelan Project license application was submitted to the FERC in March of 2002. As part of the Lake Chelan Project relicensing proceeding, Chelan PUD shall provide funding for high priority items for the Lake Chelan basin, as detailed in section 4.1 of this Chapter. Specific funding and priorities associated with the Rocky Reach Project will be determined in that licensing proceeding. The Rocky Reach Project application is due in June 2004.

Wildlife Habitat Plan

SECTION 2: WILDLIFE HABITAT PLAN GOALS

Chelan PUD intends that funds allocated under the WHP will be expended on resources that are most valuable to wildlife and most compatible with wildlife land use in Chelan County. Those lands will include key habitat types, migration corridors, and shrub steppe, grassland, and riparian/wetland habitats that offer restoration or improvement opportunities. The primary goal of the WHP is to enhance wildlife habitat within portions of Chelan County bordering Rocky Reach Reservoir and Lake Chelan to:

1. Restore, maintain, or improve ecological quality and diversity;
2. Restore, maintain, or increase habitat for key indicator wildlife species; and
3. Provide for public use compatible with the ecological quality, diversity, and carrying capacity for key wildlife species goals.

Primary wildlife indicator species for purpose of the WHP include mule deer and bighorn sheep; threatened, endangered, sensitive, species of concern, or survey and management species; and riparian and wetland indicator bird and amphibian species.

SECTION 3: POTENTIAL HABITAT AND WILDLIFE ENHANCEMENT MEASURES

To meet the goals summarized in section 2, Chelan PUD and the wildlife management agencies that participated in development of this plan (WDFW, USDA Forest Service, BLM, and USFWS) anticipate that habitat and wildlife enhancement activities could include, but are not limited to, the general management recommendations provided below. Several of these items are addressed through the Lake Chelan relicensing proceeding (section 4.1), while others may be funded through the Rocky Reach Project relicensing proceeding (section 4.2). Detailed protection, mitigation and enhancement measures for Rocky Reach will be developed in 2003. A potential enhancement alternative described below that is not specifically funded as an item under either relicensing may be a candidate to receive funds redirected by the LCWF, in accordance with section 18 of the Agreement.

3.1 Range

- Identify the needs and habitat types that address the biology of each of the indicator or key species.
- Use existing habitat inventories, to the extent possible, to guide habitat management on public lands in Chelan County adjacent to Rocky Reach Reservoir and Lake Chelan.
- Re-establish shrub steppe habitat and/or herbaceous cover in present agricultural fields and other suitable sites.

Wildlife Habitat Plan

- Monitor and control noxious weeds, and re-establish competitive permanent, native vegetative cover.
- Plant shrubs in steppe habitat.
- Develop additional deer winter range using native and fire resistant browse species.
- Apply fertilizer, prune, and/or use controlled burns to maximize forage production and palatability.

3.2 Agronomy

- Establish annual and perennial irrigated wildlife plantings in Swakane Canyon.
- Establish dry-land wildlife/cover plots in suitable areas.

3.3 Tree and Shrub Plantings

- Plant shrub and trees to develop riparian strips, wetland areas, shorelines, and lands in irrigated and sub-irrigated areas.
- Establish corridors of evergreen trees to provide large mammal travel lanes and thermal cover.

3.4 Erosion Control

- Construct a series of erosion control structures in selected canyons.
- Plant herbaceous and woody vegetation in sediment basins and sub-irrigated areas associated with these structures.

3.5 Water Developments

- Optimize availability of water from springs and streams, improve developed springs, and develop new springs.
- Install water guzzlers where needed.
- Replace livestock tanks with wildlife watering basins.
- Maximize pond construction and water storage throughout the area to create wetlands, riparian habitat, and provide water for wildlife use, fire fighting, irrigation, and noxious weed control at strategic locations.

3.6 Irrigation

- Maximize irrigation water availability in Swakane Canyon by improving existing irrigation system.
- Develop irrigation systems at other locations.

3.7 Wildlife Feeding

- Optimize winter deer and bird feeder distribution throughout the area, as needed.
- Replace, repair, and or modify existing feeders.
- Provide and maintain wildlife feeders during severe winters as needed.

3.8 Nesting and Raptor Perching Structures

- Provide artificial nesting structures throughout the area, as needed.
- Increase kestrel population with nest boxes to control rodent population, especially in newly seeded areas.

Wildlife Habitat Plan

- Provide raptor perch structures to control rodent population in newly seeded areas.
- Provide brush piles to offer dense escape cover during riparian habitat development stage.

3.9 Wildlife Re-establishment

- Re-introduce native wildlife that no longer exist in area vicinity (e.g., sharp-tailed grouse) or exist in low numbers.
- Transplant wildlife within an area as determined desirable.

3.10 Habitat Connectivity

- Restore, enhance, maintain, or protect habitat or key species corridors that provide landscape linkages, especially migration corridors.

3.11 Ecosystem Processes

- Provide for various ecological processes (fire, riparian large woody debris jams, cavities) that provide various "renewal" age classes, site condition changes, or development of natural features beneficial to wildlife.

SECTION 4: IMPLEMENTATION

Chelan PUD shall provide funding per section 4.1.1 of this Chapter. To ensure better comprehensive assessment of short and long term wildlife habitat activities and needs, the LCWF will meet at least annually to coordinate efforts, and to make recommendations regarding the expenditure of funds and other resources. The work of the LCWF will be guided by criteria that it establishes in its initial meeting or meetings. Such criteria may include the following:

- Projects should address wildlife concerns on lands lying within the Lake Chelan basin or approximately within 6 miles west of Rocky Reach Reservoir.
- The WHP could address lands outside this general Project Area if the LCWF determines that those outside lands are directly related to the Project Area lands.
- Projects must be on publicly owned lands or privately-owned lands with conservation easements.
- Projects will only occur on lands for which livestock grazing control is available.
- Projects must have a responsible lead agency (federal, state or local organization).
- Projects must incorporate sound conservation and management principles.
- Habitat projects should be self-sustaining (e.g., not cultivated crops).
- The completed project should result in significant benefit to wildlife habitat or populations.
- Project results should be measurable and monitored for effectiveness.
- Project funding for materials, equipment, supplies, contracted services, etc. will be at 100 percent.
- Projects should meet or move toward goals described in the WHP.
- Wages, benefits, and expenses for labor required to address WHP goals.

Wildlife Habitat Plan

WHP funds shall not be spent on projects that are inconsistent with the management plans of the affected state and federal land managers, or on lands outside the Project Area that are not directly related to the Project Area lands.

It is anticipated that in some years agencies could pool resources for mutually beneficial projects. Usually, resources would be spent on both state and federal lands, but in varying proportions each year. The primary goal of the LCWF should be to ensure that funds are spent where they will best meet goals of the WHP.

4.1 Lake Chelan Wildlife Measures

4.1.1 Wildlife Habitat Restoration

(a) **Wildlife Habitat Restoration.** (1) Chelan PUD shall make available \$220,000 to the Chelan-Douglas Land Trust, for the acquisition of conservation easements in perpetuity on privately-owned lands located on the north shore of Lake Chelan. For purposes of this Chapter, all references to the Chelan-Douglas Land Trust refer to the Chelan-Douglas Land Trust or another organization selected pursuant to paragraph (a)(6) of Proposed License Article 9. The goal is to secure easements on 400 acres of land, and priority shall be given to easements on lands between elevations 1,100 and 1,400 ft.

(2) Chelan PUD shall make available additional funding of up to 15 percent of the cost of easement acquisition (not to exceed \$33,000) to the Chelan-Douglas Land Trust, for fees associated with easement acquisition. Associated fees include administrative costs, appraisals, baseline inventories, escrow fees, hazardous substance assessments, legal fees, recording fees, stewardship fees, surveys, and fees relating to title reports and insurance.

(3) Chelan PUD shall make available \$32,000 to the Chelan-Douglas Land Trust, for shrub-steppe/mule deer winter-range habitat restoration efforts on the lands, if any, for which an easement is acquired under paragraph (a)(1) of this subsection. Beyond making the \$32,000 available, Chelan PUD shall have no responsibility for the success of the restoration efforts to be carried out by the Chelan-Douglas Land Trust, in coordination with WDFW. In its contract with the Chelan-Douglas Land Trust, Chelan PUD shall require the Chelan-Douglas Land Trust to coordinate with WDFW in order to assure the highest likelihood of habitat restoration success.

(4) Chelan PUD and WDFW recognize the uncertainty of acquiring conservation easements on 400 acres, due to the variability of landowner participation. If less than 400 acres of conservation easements can be acquired, the funds remaining available under paragraphs (a)(1) and (a)(3) of this subsection shall be made available by Chelan PUD to WDFW for habitat restoration within the Chelan basin.

(5) If easements on 400 acres of land can be acquired for less than the \$220,000 made available under paragraph (a)(1) of this subsection, 50 percent of any funds remaining available shall become available to WDFW for habitat restoration within the Chelan basin, and 50 percent of the funds remaining available shall no longer be available.

Wildlife Habitat Plan

(6) To implement this section, Chelan PUD shall enter into a contract with the Chelan-Douglas Land Trust or another organization that Chelan PUD and WDFW find suitable. The contract shall provide that any easements under (a)(1) be acquired and maintained by the Chelan-Douglas Land Trust or other organization. If the organization with whom Chelan PUD initially contracts either dissolves or becomes unsuitable to Chelan PUD and WDFW, Chelan PUD shall enter into a contract with another organization that Chelan PUD and WDFW find suitable.

4.1.2 Upland Habitat Improvements

(b) **Upland Habitat Improvements.** (1) Chelan PUD shall make available to the USDA Forest Service \$20,000 per year during the term of the New License, and any subsequent annual licenses, for habitat and wildlife enhancement measures identified in section 3 of this Chapter.

(2) Chelan PUD shall make available to the USDA Forest Service \$5,000 per year for years one through three of the New License for noxious weed control at Threatened, Endangered, and Sensitive (TES) plant locations.

(3) Chelan PUD, in coordination with WDFW, shall continue to conduct wildlife surveys similar to those conducted during the second FERC license for the Project, maintain upland bird feeders, and/or conduct habitat improvement projects for a cost not to exceed \$10,000 per year during the term of the New License, and any subsequent annual licenses. Chelan PUD shall provide an annual wildlife survey report to WDFW.

4.1.3 Riparian Habitat Improvements

(c) **Riparian Habitat Improvements.** (1) Chelan PUD shall make available to the NPS \$20,000 per year for the first five years of the New License, then \$10,000 per year for the remainder of the New License term, and any subsequent annual licenses, for Stehekin area habitat improvements.

(2) Chelan PUD shall make available:

- (A) \$50,000 to the USDA Forest Service to enhance riparian habitat in the Chelan basin;
- (B) \$50,000 to the NPS to enhance riparian habitat in the Chelan basin; and
- (C) \$35,000 to the WDFW to enhance habitat in the Chelan basin.

(d) **Transferability of Funds.** Upon the recommendation of the Chelan-Douglas Land Trust to the WDFW, and with the concurrence of WDFW, or upon the initiative of WDFW, Chelan PUD shall transfer available funds among paragraphs (a)(1), (a)(3), and (c)(2)(C) of section 4. If paragraph (a)(5) is applicable, only 50 percent of the remaining (a)(1) funds shall be transferred, and 50 percent of the remaining (a)(1) funds shall no longer be available.

4.2 Rocky Reach Wildlife Measures

This section of the Wildlife Habitat Plan will be developed in 2003 through the Rocky Reach relicensing process.

Ownership Retention. Chelan PUD shall retain ownership of, and shall take no action to significantly impact current condition of, Chelan PUD properties near Sun Cove (Sun Cove, Brays/Bairds landing/Bird Canyon), until an agreement is reached regarding a new Rocky Reach

Wildlife Habitat Plan

Hydroelectric Project license, or until a New License is issued for that Project, whichever comes first. For the purpose of preserving the existing condition of the property, Chelan PUD will provide signage to indicate Chelan PUD ownership of the properties.

***CHAPTER 10: LAKE CHELAN HISTORIC PROPERTIES AND
CULTURAL RESOURCES MANAGEMENT PLAN***

*Historic Properties and Cultural Resources
Management Plan*

TABLE OF CONTENTS

CHAPTER 10: LAKE CHELAN HISTORIC PROPERTIES AND CULTURAL RESOURCES MANAGEMENT PLAN	10-1
SECTION 1: Purpose	10-1
1.1 Goals and Objectives of the Historic Properties and Cultural Resources Management Plan	10-1
1.2 Project Setting and Area of Potential Effects (APE).....	10-1
1.3 Legal and Regulatory Context	10-5
1.4 Agencies and Indian Tribes.....	10-5
1.5 The Cultural Resources Working Group.....	10-6
1.6 Cultural Resource Management Objectives and Constraints	10-6
SECTION 2: Context Statements and References.....	10-6
2.1 Environmental Context	10-6
2.2 Cultural Context and Investigation History	10-7
2.3 Previous Archaeological Research.....	10-8
2.4 Ethnographic Research	10-12
2.5 Historical Research	10-14
2.6 Archaeological Site Inventory	10-19
2.7 Inventory Gaps.....	10-21
2.8 Traditional Cultural Properties Studies.....	10-21
2.9 National Register of Historic Places	10-22
SECTION 3: Management Considerations.....	10-22
3.1 Issues and Concerns	10-22
3.2 Protection Options	10-23
3.3 Additional Management Options	10-27
3.4 Public Interpretation.....	10-27
3.5 Native American Consultation.....	10-28
3.6 Agency Coordination	10-28
3.7 Assignment and Coordination of Responsibilities	10-28
3.8 Chelan PUD Cultural Resources Coordinator.....	10-29
SECTION 4: Site Specific Management Measures.....	10-29
4.1 Archaeological Sites	10-29
4.2 Traditional Cultural Properties.....	10-32
4.3 Results of Historic Document Research	10-32
4.4 Hydroelectric Facilities	10-34
4.5 Evaluation Status of Archaeological Sites in the Lake Chelan APE.....	10-34
SECTION 5: Project-Wide Management Measures and Continuing Procedures.....	10-38
5.1 Completion of Inventory	10-38
5.2 Completion of Evaluation	10-39
5.3 Site Monitoring	10-39
5.4 Discovery Provisions	10-40
5.5 Resource Evaluation	10-41
5.6 Emergency Responses	10-42
5.7 Procedures for Review of Proposed Actions/Coordination with Other Agencies.....	10-42
5.8 Curation of Archival Materials and Artifacts.....	10-43
5.9 Information Management.....	10-43

*Historic Properties and Cultural Resources
Management Plan*

SECTION 6: Implementation and Schedule	10-43
6.1 Implementation	10-43
SECTION 7: Literature Cited	10-45
APPENDIX A: Federal Cultural Resource Mandates	10-53
APPENDIX B: Previous Archaeological Studies	10-55
APPENDIX C: Prehistoric and Historic Cultural Resources in the Lake Chelan APE.....	10-59
APPENDIX D: List of Categorical Exclusions.....	10-61

LIST OF TABLES

Table 10-1: Project Effects and Alternative Treatment Measures.....	10-24
Table 10-2: Known Archaeological Sites and Evaluation Rating.....	10-35
Table 10-3: Schedule for Implementing Management Measures.....	10-45

LIST OF FIGURES

Figure 10-1: Map of the Lake Chelan Project Area	10-3
Figure 10-2: Map of the Lake Chelan Project Bypassed Area	10-4
Figure 10-3: Comparison of Columbia Plateau Cultural Chronologies (from Hartmann 2000)	10-9

*Historic Properties and Cultural Resources
Management Plan*

GLOSSARY

ACHP	Advisory Council on Historic Preservation
AIRFA	American Indian Religious Freedom Act
Alluvium	Sediments laid down in riverbeds, flood plains, lakes, fans at the foot of mountains and in estuaries.
Altithermal	Period of post-glacial thermal optimum
AMSL	Above mean seal level
Archaic	Archaeological time period spanning 9000 to 4000 years ago
APE	Area of Potential Effect
Archaeological	Of or pertaining to material remains of past human life, activities, and culture
ARPA	Archaeological Resources Protection Act
BP	Before present – used for radio carbon dating, present is 1950.
CFR	Code of Federal Regulations
Colluvium	Loose, incoherent deposits, usually at the foot of a slope
HPCRMP	Historic Properties and Cultural Resources Management Plan
CRWG	Cultural Resources Working Group
ECPA	Electric Consumers Protection Act
Evaluation	The process whereby a site or property is determined eligible/ineligible for inclusion in the National Register of Historic Places
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
Geoarchaeological	Of or pertaining to geomorphology and sedimentation as they apply to archaeology
Geomorphological	Of or pertaining to landforms and related processes
GLO	General Land Office
Historic-era	Any property greater than fifty (50) years old
Historic Property	Any pre-contact or historic-era site, building, structure, object, or district included in or eligible for inclusion in the National Register of Historic Places
Holocene	Geologic time interval referring to the last 10,000 years or more recently
LCCF	Lake Chelan Cultural Forum
Human Remain	Any material remain, such as bone, that can be demonstrated to have come from a human body
Integrity	In archaeology, the status of a site's disturbance or lack thereof
Lanceolate	Having a lance shape, tapering to a point; generally the shape of a spear point
LCCF	Lake Chelan Cultural Forum
Loess	A homogeneous, non-stratified, unindurated deposit consisting predominantly of silt, usually wind-deposited
NAGPRA	Native American Graves Protection and Repatriation Act
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
PA	Programmatic Agreement

*Historic Properties and Cultural Resources
Management Plan*

Paleoindian	Archaeological time period spanning 13,000 to 9000 years ago
Pleistocene	Geologic time known as the glacial epoch or Ice Age dating from about 1.6 million to approximately 10,000 years ago.
Pre-Contact	In the Americas, the time before the entry of Europeans into a given geographic area
Professional Archaeologist	As defined in the Secretary of Interior's Standards for Historic Preservation Qualifications Standards
Project	As defined for this document, the boundaries surrounding Lake Chelan for which Chelan Public Utility District No. 1 has management responsibilities
Projectile Point Qualifications	An "arrowhead" or other formed and tapered projectile
Quaternary	Professional qualifications as defined in 36 CFR Part 61
SHPO	Geologic time period containing the Pleistocene and Holocene Epochs
Significance	State Historic Preservation Officer
Survey	The narrowly defined basis for inclusion of properties into the National Register of Historic Places as set forth in 36 CFR 60.6
TCP	In cultural resources management, a broad term for the archival research, inventory, pedestrian reconnaissance leading to the identification of cultural resources that will later be evaluated for inclusion in the National Register of Historic Places
Terrace	Traditional Cultural Property
	A flat, horizontal or gently inclined surface bounded by a steeper ascending slope on one side and a steeper descending slope on the other side

Historic Properties and Cultural Resources Management Plan

SECTION I: PURPOSE

I.1 Goals and Objectives of the Historic Properties and Cultural Resources Management Plan

The purpose of the Historic Properties and Cultural Resources Management Plan (HPCRMP) contained in this Chapter is to guide FERC and Chelan PUD in meeting their cultural resource obligations under the National Historic Preservation Act (NHPA). The HPCRMP will serve as an aid to Chelan PUD personnel in preserving and treating cultural resources in the Area of Potential Effect (APE) during the term of the New License. The application for the New License is for a period of 50 years. The HPCRMP will give the highest priority to the management of properties that are most likely to be affected by the operations of the Project. The HPCRMP lays out standardized approaches, plans, and procedures that will allow the Chelan PUD to operate the Project in a manner that complies with the laws and regulations governing the management of cultural resources.

The HPCRMP was developed by Chelan PUD from initial cultural resource studies conducted at Lake Chelan in consultation with the Cultural Resources Working Group (CRWG). The CRWG consists of representatives from the Washington State Office of Archaeology and Historic Preservation (SHPO), the Washington State Parks and Recreation Commission (WSP), the National Park Service (NPS) for the Lake Chelan National Recreation Area (Lake Chelan NRA), the USDA Forest Service for the Wenatchee National Forest, FERC, the Bureau of Indian Affairs (BIA), the Confederated Tribes of the Colville Reservation (CCT), the Confederated Tribes and Bands of the Yakama Nation (YN), and the Chelan PUD.

Appropriate treatment plans are proposed in this Chapter for cultural resources that are eligible for the National Register of Historic Places (NRHP). It is a high priority of Chelan PUD to avoid impacting these resources. Native American concerns and public interpretive values are also addressed within the HPCRMP.

Although the HPCRMP is as specific as possible, it also retains the flexibility to meet the changing need for the protection of cultural resources over the term of the license.

I.2 Project Setting and Area of Potential Effects (APE)

Lake Chelan is a natural body of water that developed in a broad glacial trough on the eastern flanks of the Cascade Mountains (Figure 10-1). Oriented northwest-southeast, the lake is roughly 50.4 miles long and averages a mile in width (Hartmann 2001). With a maximum depth in excess of 1485 feet, it is the third deepest lake in the United States; the lake floor is almost 400 feet below sea level.

The Lake Chelan basin includes about 925 square miles, almost half of which is above 5,500 feet in elevation. Terrain surrounding the upper lake is a series of rugged, steep ridges with peaks to 9,000 feet. Slopes terminate abruptly at the lake margin on the northwest portion, with relatively few level beaches or other landforms that typically invite extensive settlement. In contrast, the topography in the southeastern portion of the basin is much less constraining. The slopes around the lake are not as steep, and there are broad, relatively level areas, particularly east of Manson, that have been used extensively for settlement in both ancient and modern times.

*Historic Properties and Cultural Resources
Management Plan*

The Project boundary extends along the 1100-foot contour line from the upper end of Lake Chelan near Stehekin to the City of Chelan (Figure 10-1). The Project boundary continues down both sides of the bypass reach (Figure 10-2) to the confluence of the Chelan and Columbia Rivers. Approximately 1600 acres of land lie within the Project boundary.

The Area of Potential Effect (APE) for the Lake Chelan Hydroelectric Project includes lands within the Project boundary, as it is delineated in the current FERC license. This includes the operational limits of the reservoir drawdown zone between 1,079 feet to 1,100 feet above mean sea level elevation. The APE also includes lands outside the Project boundary where project operations may affect the character or use of historic properties and/or traditional cultural properties. For example, the APE includes areas of Project-induced erosion that extend outside the Project boundary.

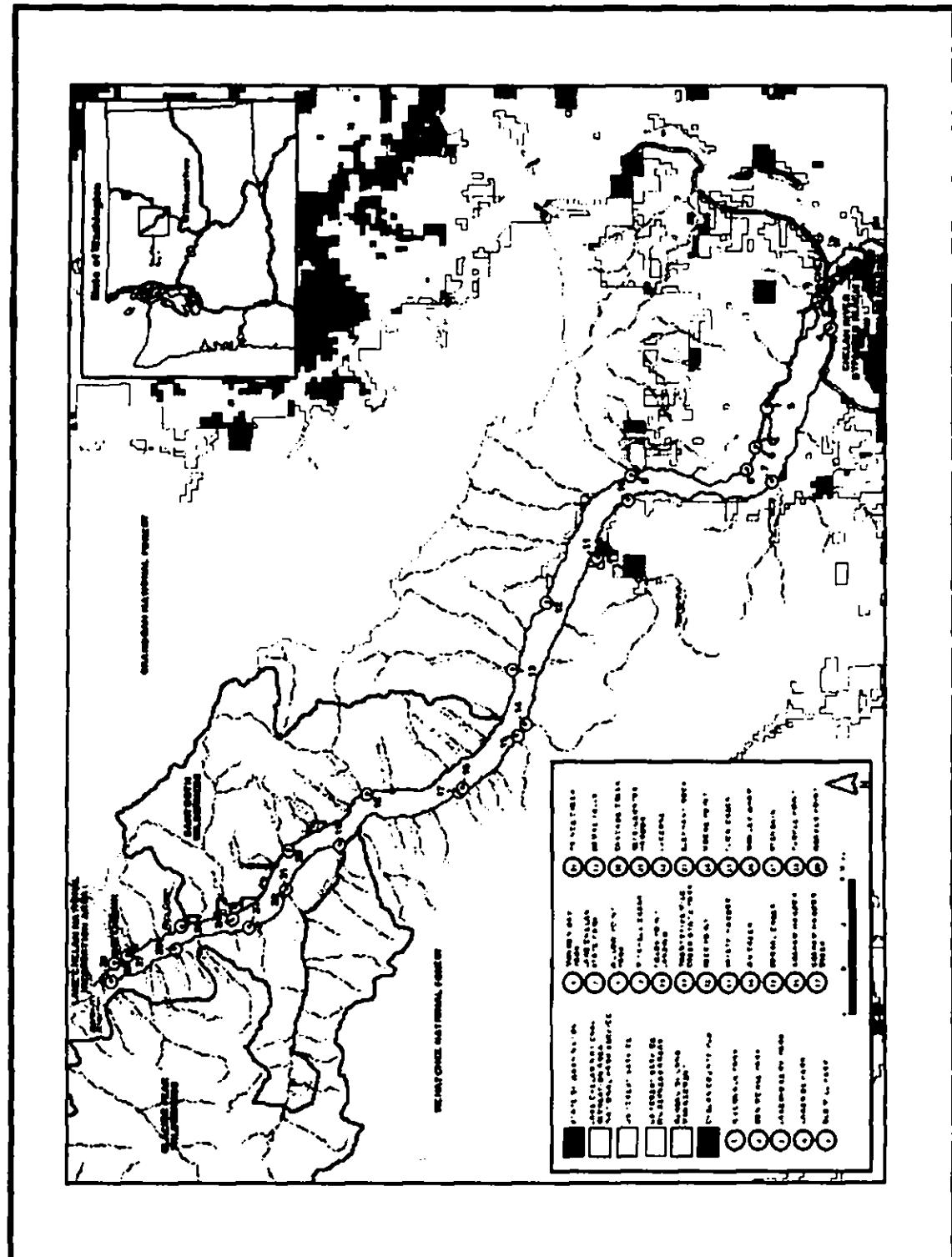


Figure 10-1: Map of the Lake Chelan Project Area

**Comprehensive Plan
October 8, 2003**

Page 10-3

Lake Chelan Project No. 637
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*Historic Properties and Cultural Resources
Management Plan*

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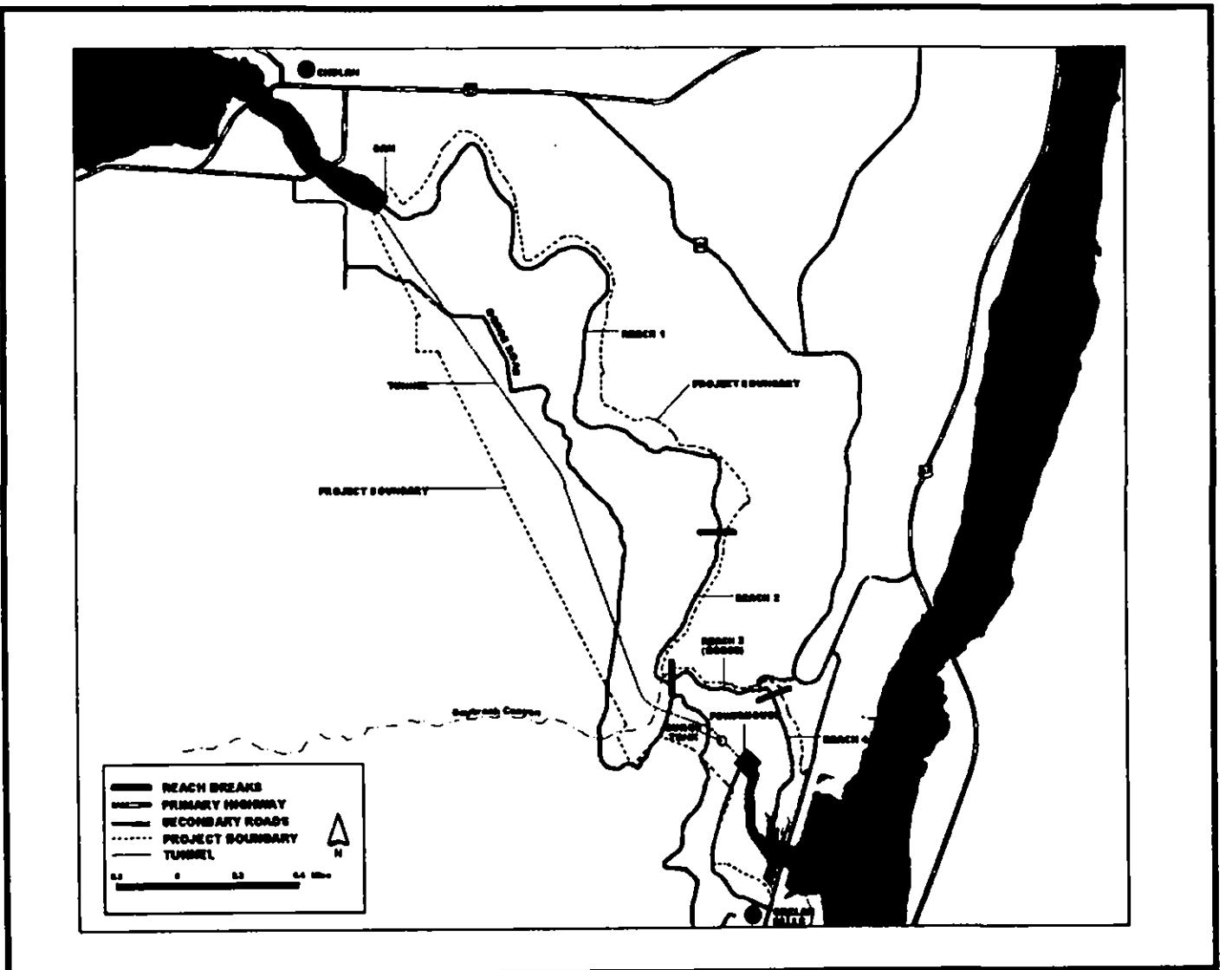


Figure 10-2: Map of the Lake Chelan Project Bypassed Area

*Historic Properties and Cultural Resources
Management Plan*

1.3 Legal and Regulatory Context

The statutes and regulations for applying the HPCRMP define the research, evaluation, and reporting procedures to be followed for projects under federal jurisdiction. A complete listing of these laws is provided in Appendix A. Chelan PUD has pursued cultural resource studies for the relicensing of the Project in compliance with federal and state law.

Because the relicensing of non-federal hydroelectric projects is conducted by a federal agency, FERC, the relicensing process is considered a federal undertaking (36 CFR §800.16(y)), and the National Historic Preservation Act and its implementing regulations are applicable.

Federal statutes and regulations provide protection to archaeological sites and other cultural resources for projects that are subject to federal jurisdiction. In addition, Washington State has specific laws addressing cultural resources on public and private lands.

1.4 Agencies and Indian Tribes

FERC has the primary oversight for the Project, and is the lead agency with regard to compliance with the National Historic Preservation Act. FERC maintains its own cultural resources staff that consults with the Advisory Council on Historic Preservation (AHP) on matters affecting historic properties. FERC has delegated day-to-day consultation with concerned Indian tribes to Chelan PUD. The concerned Indian tribes are the Confederated Tribes of the Colville Reservation (CCT) and the Confederated Tribes and Bands of the Yakama Nation (YN). The CCT also has a designated Tribal Historic Preservation Officer (THPO) who represents tribal interests on cultural resource matters, in the same way as the SHPO represents state interests.

The Office of Archaeology and Historic Preservation (OAHP) is the Washington State agency with primary responsibility for this Project. The director of this office is the State Historic Preservation Officer (SHPO). The SHPO and the state archaeologist provide review and technical expertise. The THPO has primary responsibility on tribal trust lands.

Two federal agencies, the NPS and the USDA Forest Service, have ongoing cultural resource management responsibilities and programs, which are not altered by this HPCRMP. The HPCRMP only pertains to Project-related actions and activities within the Project APE. Chelan PUD is only responsible for cultural sites that are affected by Project operations on lands within the APE.

The NPS manages approximately 10 miles (16 km) of shoreline at the northwestern end of Lake Chelan; the USDA Forest Service manages approximately 30 miles (48.28 km) of shoreline; and the CCT maintains two allotments on the northern shoreline of Lake Chelan. There are several American Indian groups having traditional-use associations with the project area. Moses-Columbia, Chelan, Entiat, Methow, and Wenatchi peoples currently reside on both the Colville and Yakama reservations. Members of these reservation communities maintain an on-going interest in the cultural resources of the project area.

The Washington State Parks and Recreation Department owns and operates two state parks covering 362 acres within the APE. Lake Chelan State Park is located on the south shore of

*Historic Properties and Cultural Resources
Management Plan*

Lake Chelan, approximately nine miles from the town of Chelan. Twenty-five Mile Creek State Park is located on the south shore of Lake Chelan, about 18 miles north of the town of Chelan. The City of Chelan also owns and operates parks within the APE. The Manson Park and Recreation District owns and operates the Willow Point Park.

1.5 The Cultural Resources Working Group

As part of the alternative licensing process, Chelan PUD consulted with various parties interested in the cultural resources of the region and created a Cultural Resources Working Group (CRWG) to represent those interests. The purpose of the CRWG was to provide Chelan PUD with guidance concerning the management of cultural resources within the Project area during the relicensing process. Over 30 meetings of the CRWG were held during the relicensing process. A list of the pertinent consultation meetings and field trips that have involved the CRWG is available in Chelan PUD's consultation record.

1.6 Cultural Resource Management Objectives and Constraints

The HPCRMP is designed to satisfy both the letter and spirit of the laws regarding the identification, evaluation, and treatment of cultural resources affected by the Project. However, because land ownership in the APE is diverse, Chelan PUD does not control much of the activities within the APE, but instead must rely on cooperative and collaborative efforts of other landowners and land managers. As noted earlier, the NPS owns and manages about 10 miles of shoreline, the USDA Forest Service owns and manages about 30 miles of shoreline, the CCT has allotments at Wapato Point, Washington State owns and manages two parks along the shoreline, the cities of Manson and Chelan own and manage shoreline property, and there are numerous private holdings along the shoreline.

SECTION 2: CONTEXT STATEMENTS AND REFERENCES

A cultural resources overview has been prepared as part of the relicensing studies for the Lake Chelan Project (Hartmann 2001a). This overview is part of a series of technical volumes for the Project that detail the contextual relationships of the natural and cultural environments in the Project Area. Other documents from which data for the HPCRMP have been summarized include the pedestrian survey and testing reports (Hartmann et al. 2001b; Ozbun et al. 2001) and the Traditional Cultural Properties studies provided by the CCT and the YN (Griffin 2001; and Cook 2001). The data provided in this Chapter are summarized or adapted from these and other documents.

2.1 Environmental Context

The Paleoenvironmental history of the Lake Chelan landscape is complex. Bedrock in the Lake Chelan basin consists predominantly of granite, gneiss and sedimentary rocks of Tertiary and Miocene age in the northern portion of the lake while the southern portion is comprised primarily of fine-grained igneous intrusives, schists, and slates (Runner 1921:87). Surficial sediments range from late Pleistocene to Recent in age. Pleistocene glacial events and subsequent flood episodes are responsible for much of the topography as viewed today (Rooke 2001). Sediments

*Historic Properties and Cultural Resources
Management Plan*

range from late Pleistocene to Recent in age, and are dominated within the research area by wind-deposited loess. Well-drained, sandy loams that are deeper on the north-facing slopes characterize soil development along the margins of the lake. These soils have formed from parent materials of glacial till and outwash, and from weathered igneous, sedimentary, and metamorphic rocks. Volcanic ash, pumice, loess, alluvium, and lacustrine deposits have contributed to soil formation processes.

The physical environment is central to documenting pre-contact settlement and subsistence landscape. Lake Chelan is a unique physical environment that produced specialized pre-contact settlement and subsistence patterns. Access to water, subsistence resources, the availability of suitable lithic materials for tool manufacture, and topography are important considerations that influence settlement location. The extent and temporal ranges of landforms available for occupation following the Pleistocene Period is unknown (Hartmann 2001).

Three major episodes of regional climatic change have influenced temperatures, sediment accumulation, and vegetation development and change (Mehringer 1985). Vegetation development is closely associated with the amount of effective precipitation, topography, and temperature. Due to its location between two diverse physiographic regions, four ecological zones have developed within the APE, ranging from grand fir-Douglas fir/pine associations in the western portions of the lake, to sagebrush/wheatgrass associations along the Columbia River.

Historically, Lake Chelan was a relatively rich environment for resource procurement, with abundant plants, animals, fish, and lithic raw material (Rooke 2001: 2-11-2-14). Although a wide variety of native plants were available to pre-contact inhabitants of the region, important food species available in proximity to the lake include camas (*Camassia* spp.), bitterroot (*Lewisia* spp.), cow parsnip (*Heracleum lanatum*), a variety of lomatiums, and berries. Indian hemp, used to make rope and string, and willow and tules for making baskets and containers, were also available. A more complete listing of available plants and their common uses is found in Rooke (2001:2-9-2-13).

Mammals, such as deer, elk, mountain sheep, and mountain goats, are among the faunal resources available within the APE to pre-contact peoples. Other big game species, including bear, moose, and cougars, were found in the region, although their importance as local food resources has yet to be documented. Migratory birds and fish also were dominant in the diets of pre-contact Lake Chelan inhabitants. Salmon, although not available in Lake Chelan, was obtained from the Columbia River. Other freshwater fish would have been available for exploitation year round.

2.2 Cultural Context and Investigation History

Cultural resource studies conducted within the APE prior to the relicensing studies were primarily archaeological in nature. The relicensing effort has resulted in intensive archaeological survey and some testing of archaeological sites within the APE. This work also included historic-era cultural resource and traditional cultural properties studies.

*Historic Properties and Cultural Resources
Management Plan*

2.3 Previous Archaeological Research

Systematic archaeological investigations in the Lake Chelan basin began in the early 1970s, although explorers and other visitors to the lake had made observations of cultural resources (especially the rock art) in the late 1800s. However, systematic research along the eastern foothills of the Cascade Mountains has only recently begun in any detail (Schumacher 2001: 3.3). Extensive research along the middle Columbia and the Okanogan River valley have resulted in the development of cultural chronologies for central-Washington that have relevance to the APE. Comprehensive descriptions of approximately 13,000 years of human occupation of the Columbia Plateau have been discussed in summary volumes (see Ames et al. 1998). While it is possible that occupation within the Lake Chelan area may have occurred at this time, it is more likely that post-glacial conditions were more amenable for occupation of the Lake Chelan shoreline by about 10,000 years ago (Mierendorf 2001, personal communication).

Research within the Columbia Plateau has focused more on human adaptation to riverine environments (Galm et al. 1981; Schalk and Mierendorf 1983; Chatters 1986; Galm 1994), or to adaptations within mountainous localities (Grabert and Pint 1978; Mierendorf 1986). Regional chronologies that have been developed are thus focused more on riverine adaptations through time and it is apparent that a "montane" chronology (Schumacher 2001:3.5).

Most cultural resource studies conducted near the shoreline of the lake have been small-scale studies completed as part of public and private developments. A listing of previous cultural resources studies in the Chelan area is presented as Appendix B.

Chronologies utilized by archaeologists within the region are shown in Figure 10-3. The Lower Snake River Chronology has been included due to its use as a synthetic Plateau-wide scheme charting cultural development and has been the subject of critique within the upper Plateau regions (Schumacher 2001:3-5). A synthesis, employing the Southern Plateau cultural sequence has been adapted for the Lake Chelan region and is summarized in the following paragraphs.

2.3.1 Period IA (11,500 - 11,000 B.P.)

This time period represents the earliest documented archaeological evidence for human occupation in the region, and is represented by a technological adaptation referred to as Clovis. This technology has been demonstrated to represent mobile and broad-spectrum foraging subsistence strategies with a focus on large game animals (Ames 1988).

Distinctive, thin, lanceolate chipped stone projectile points represent the Clovis technology and are found throughout the Americas. Although projectile points of this age have not been found within the APE, they have been excavated from buried locations south of the APE near East Wenatchee. Clovis points also have been collected from surface locations near Cle Elum (Hollenbeck and Carter 1986), and at Crab Creek in the Priest Rapids Reservoir. Whether groups of this time period may have occupied the Lake Chelan basin remains unknown. It is possible that the Lake Chelan basin may not have been ice-free at this early time period.

Historic Properties and Cultural Resources Management Plan

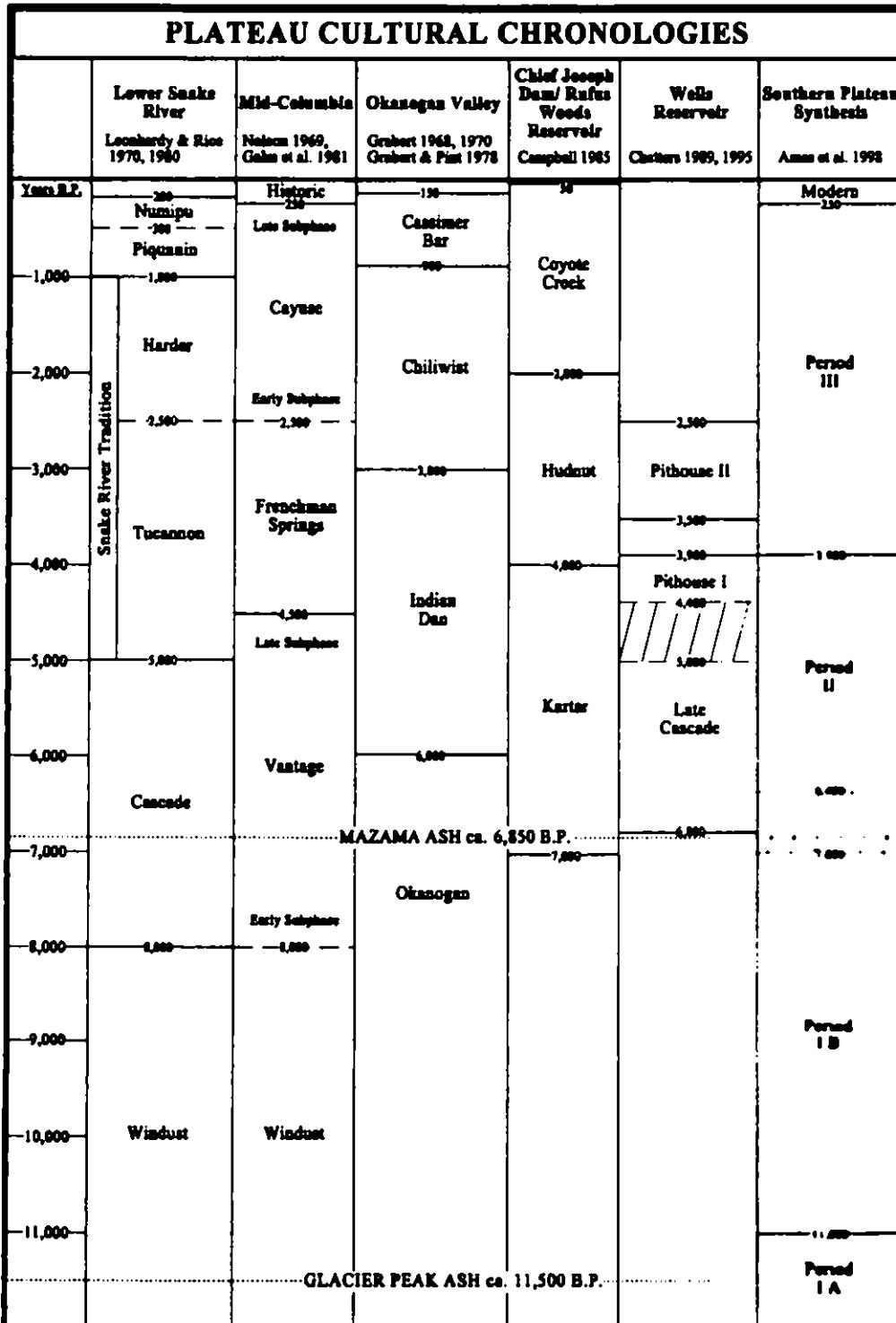


Figure 10-3: Comparison of Columbia Plateau Cultural Chronologies (from Hartmann 2000)

2.3.2 Period IB (11,000 - 7000/6400 B.P.)

By 9500 B.P., the tree line in the Cascades had risen approximately 200 meters higher than in previous times, suggesting that climate and environmental conditions had ameliorated to a point

*Historic Properties and Cultural Resources
Management Plan*

where vegetation could take hold. Tephras from Mount St. Helens and Glacier Peak eruptions dating between 12,000 and 11,500 B.P. have been found in archaeological sites and have been used as chronological markers in these sites. Sites outside the Lake Chelan Basin have contained evidence of occupations, termed "Windust" dating between 11,000 and 9000 B.P. Windust projectile points characterized by a stemmed shape are predominant early in this time period, but leaf-shaped projectile points termed "Cascade" are more abundant later in the period. A broad-spectrum foraging subsistence system, perhaps emphasizing wetland biomes, was possibly used during this time period. Hunting efforts were focused on large game, such as elk, deer, bison, and antelope (on the steppe). The Lind Coulee site in Central Washington is one site representative of this time period.

A small site at Lucerne Bar, tested in 1979, contained projectile point fragments similar to the Cascade typology and, based on these chipped stone tool remains, the site was estimated to have been occupied around 8,000 years ago (Hartmann 1979). Rock art found near Stehekin indicates distinct layers of glyphs painted on the rock face. Many of these glyphs are high above the current lake levels and suggest that the uppermost glyph panels may have been painted when lake levels were normally much higher than in modern times.

2.3.3 Period II (7000/6400 - 3900 B.P.)

By 7000 years ago, a long period of warmer and dryer times, called the Altithermal, is documented within the Columbia Plateau and throughout the western United States. A general trend towards a decrease in precipitation contributed to the shrinking of lakes and ponds and to a reduction in river and stream flows. Grasslands on the Plateau thinned and were largely replaced by semi-arid sagebrush (Daubenmire 1970). Forests persisted in the Cascades but conifers or pine species would have expanded to lower elevations and grasslands would have expanded their upper margin, resulting in open forest margins (Barnosky 1985).

About 6850 B.P., Mt. Mazama (Crater Lake) erupted, distributing more than 30 cubic miles of ash across the Northwest (Bacon 1983). Ash from this eruption has been found in numerous sites, including some in the Lake Chelan region (Mierendorf 1986; Gough 1995). The effects of so much ash in the atmosphere may have intensified the general warming trend toward aridity and also may have resulted in the aggregation of populations around lakes, rivers, and wetlands where resources would have been more productive.

Increases in regional population and changes in subsistence strategies have been marked in the Columbia Plateau after about 4500 years B.P. This time period is marked by a change in climate such that winter and summer temperatures had decreased from the earlier portions of this cultural time period. Shrub vegetation became denser and forest cover expanded (Chatters 1998).

Changes in population and subsistence strategies are referred to as the Frenchman Springs phase. Archaeological evidence suggests a generalized trend towards increasing sedentism, reoccupation of sites, and intensive exploitation of riverine resources (Ames et al. 1998). Pithouses representing longer-term occupations than in prior periods are reported, and for upland areas such as Lake Chelan and the Okanogan Highlands, a model for settled year-round residential bases with selective foraging has been developed (Chatters 1995; Campbell 1985).

*Historic Properties and Cultural Resources
Management Plan*

Period II is characterized by the predominance of Cascade projectile points that first appeared in Period I. Along the mid-Columbia, these projectile points are referred to as Vantage phase artifacts. An increase in tool diversity indicated by the presence of microblades, ground stone tools, large side-notched projectile points, and worked bone artifacts, suggests diversity in subsistence patterns. This time period is also characterized by high mobility populations, but later in the period there is increased evidence for a decrease in mobility by people in the Okanogan watershed that may also be found in other upland forested biomes (Chatters 1995, 1998).

Sedentism is suggested as an adaptive decision that was enhanced by local resource abundance and diversity combined with increased developments in regional exchange and communication networks (Galm 1994; Hess 1997). The presence of stone circles that may relate to residential structure have been found near Purple Point and housepit depressions have been found at Moore Point in the APE. Although these locations have not produced documented radiocarbon dates, it is possible that they date to this time period.

2.3.4 Period III (3900-ca 200 B.P.)

Winters had become much colder than the preceding time period by about 3900 years B.P. Summers were also much cooler, resulting in an increase in precipitation and an increase in steppe vegetation east of Lake Chelan. After 3500 B.P., temperatures appeared to increase, approaching modern conditions. Populations remained low, but storage and patterned exploitation of specific resource zones appears to have increased (Ames and Marshall 1980; Chatters 1995). The winter village pattern, noted in ethnographic literature, appears to have begun by this time, though there is some evidence that in the northern portion of the Columbia Plateau this pattern may have started earlier (Campbell 1985). The Plateau subsistence model indicates a pattern of riverine settlement, a reliance on riverine and root resources, the development of complex fishing technologies; the extension of trading patterns and extension of apparent political links (Walker 1998). Although this model appears to have utility for the mid-Columbia region as a whole, its use in forested and upland biomes such as at Lake Chelan may be limited in value.

Period III projectile points are generally smaller and more diverse in form than seen previously. It has been suggested that atlatl dart shafts may have been shorter as bow and arrow technologies increased in use (Lohse 1985:358). This period is known as the Cayuse phase in the mid-Columbia sequence, and is marked by the presence of Nespelem Bar, Quilomene Bar, Rabbit Island Stemmed, and Columbia Corner-notched projectile points. Small rectangular side-notched points are also well represented within archaeological site collections. Bow and arrow technology appears to be widespread by about 2000 years B. P., based on the morphology of projectile points from this time period.

The illustration of an atlatl in use in the pictograph at Domke Falls, may indicate that this site, located within the APE, dates prior to 2000 years B.P. This is only a hypothesis because this rock art has not been radiometrically dated.

*Historic Properties and Cultural Resources
Management Plan*

Cultural traditions established by Period II appear to persist with little variation to the contact era, about 200 years ago, when disruptions associated with the Euro-American presence in the region resulted in a breakdown of traditional social patterns.

It is possible that further excavation within the APE will disclose archeological evidence that resembles the overall chronological patterns described for the Columbia Plateau. However, it is highly probable that very different adaptive processes were present within the lacustrine and intermontane area. Lake Chelan archaeological sites may illuminate our understanding of intermontane biome land use and regional interactions in a manner not documented elsewhere in the mid-Columbia region (Schumacher 2001:3-31).

2.4 Ethnographic Research

The first detailed accounts of Indian life in the Chelan area come from the diaries and journals of Euro-Americans moving into Washington Territory in the late 1800s (Chelan PUD 1998). However detailed studies of the ethnographic people occupying the region did not begin until the mid-twentieth century. References to ethnographic discussions of the mid-Columbia people, and especially the Chelan people, may be found in Ray (1932, 1936, 1939, 1942, 1974a, 1974b), Spier (1938), and Teit (1928).

More recently, Allan H. Smith of Washington State University prepared an ethnographic study for the Rocky Reach Reservoir, with discussion of the Middle Columbia Salish that included the Chelan, Entiat, Wenatchi, and Columbia peoples (Smith 1983a, b; Boxberger 1996). In 1988, Dr. Smith produced an in-depth ethnographic summary of the North Cascades for the North Cascades National Park Service Complex and Cultural Resources Division (Smith 1988).

In an ethnographic overview produced for the Wenatchee National Forest, Hollenbeck and Carter (1986) also discuss the lifeways of the people who inhabited areas within the region. As part of the relicensing studies, data concerning the ethnographic and ethnohistoric periods have been summarized in the cultural resources overview (Deaver et al. 2001: Chapter 4). A summary of this detail is provided in the following paragraphs.

Ray identified at least fourteen villages in the Chelan territory, most of which were located at the mouths of major drainages such as the Columbia River and along the northern shoreline of Lake Chelan (Ray 1936). The largest four of these villages, located near Wapato Point and Willow Point, reportedly had populations of between 100 and 500 people who lived in semi-subterranean houses. During the summer, small trading and task groups departed the villages to establish temporary camps in the upper basin and other areas where plants, animals, and other resources were gathered.

The Chelan were a lake-adapted people who exploited the streams and timbered slopes adjacent to the lake, but also utilized the resources of the Chelan and Columbia rivers (Smith 1983b, 1988). Traditional Chelan territory extended from the mouth of Antoine Creek along the Columbia River to an area just below Navarre Coulee, and also included the entire Lake Chelan area (Smith 1983b:166-168). They also apparently made use of the steppe regions east of the Columbia where they collected roots in the Badger Mountain region (Ray 1974a:423).

*Historic Properties and Cultural Resources
Management Plan*

It has been hypothesized that hunting may have been more important than fishing in terms of available protein, especially because salmon did not enter Lake Chelan from the Columbia River. At least three villages on the lake and one on the Columbia River were situated to provide good access to hunting grounds (Ray 1974:419-423). Lake Chelan was an important goat hunting area, and deer, elk, and other game were also hunted in the area.

Important local root grounds included shoreline areas near Manson and Willow Point on the north side of the lake, and Green's Landing on the south side of the lake. (Ray 1974a; Smith 1988; Turner 1978). The Chelan used dugout canoes to access plant and hunting resources on both sides of the lake (Smith 1988:281). Pictographs near Stehekin were apparently painted by people in canoes, and depict mountain goats, bighorn sheep, and humans (Symons 1882; Cain 1950).

The Protohistoric Period, dating from about A.D. 1600-1750, marks a time of great change to indigenous lifeways resulting from an introduction of both ideas and cultural material from Euro-Americans. Western trade items (e.g., beads, guns, metal objects), horses, and new diseases all made their appearance in the region prior to the first direct contact with Euro-Americans. The horse was introduced from tribes to the south of the Columbia Plateau in the mid-1700s, and was an important asset in that it increased mobility and transportation. The introduction of Euro-American diseases such as measles, smallpox, flu, cholera and others resulted in the death of as much as two-thirds of the population between 1775 and 1875 (Boyd 1985:324-398).

With the establishment of fur trading markets following initial Euro-American incursions into the northwest, additional changes were imposed on the traditional subsistence patterns of the local indigenous populations. The focus on exploiting fur-bearing mammals resulted in less time for procurement of other resources necessary for sustenance during the winter months. Native American populations living near forts and trading posts also became increasingly dependent upon Euro-American goods.

Following the creation of Washington Territory in 1853, and as part of the doctrine of manifest destiny, politicians felt that the Indians needed to be assimilated into Euro-American culture. To achieve the transition, the U.S. government negotiated or attempted to negotiate treaties, and established Indian reservations (Luttrell 1994:3.6). The Indians were forced into "trading land for a living". Conflicts between the Indians and Euro-Americans developed because the tribes wanted to maintain their culture and right to self-determination.

Conflicts continued in the mid-1800s with the increase of Euro-American settlement of the West. By 1877, most of the tribes understood that armed struggle would not be effective in stemming the tide of white intrusion. In 1879, the Moses Reservation was established at Lake Chelan for the Moses Columbia and many of their neighbors, including the Chelan, Entiat, and Wenatchi people. The Chelan people benefited the most from the new reservation because they continued to live on their ancestral homeland (Hackenmiller 1995:114), while most of the Moses Columbia people chose to stay on the Colville Reservation, especially after dissolution of the Moses Reservation in 1883.

*Historic Properties and Cultural Resources
Management Plan*

The establishment of the General Allotment Act of 1887 was a mechanism used to spur quick assimilation of Native Americans into the "mainstream" of American society by undermining the ties of tribal loyalty and affiliation. Wapato John, Peter Wapato, Sylvester Wapato, Louie Ustah, Johnny Abraham, Yokesil, Pdoi, Ameno, Lakayuse, and Makai obtained allotments within the Lake Chelan Basin. Cultus Jim and Chelan Bob obtained allotments along the Columbia River near the mouth of the Chelan River. The Chelans, under the leadership of Long Jim, initially refused to obtain allotments but continued to occupy the area from roughly Wapato Point to the Columbia River and upriver for 15 miles (Hackenmiller 1995:122; Cook 2001). Unallotted lands were then considered surplus lands and opened up to homesteaders. By 1906, 60 percent of reservation lands in the APE were in non-Indian hands (Luttrell 1994:3.13).

2.5 Historical Research

The history of the Lake Chelan region has been documented in cultural resource management studies. These studies have been summarized in the cultural resource overview (Lentz and Dugas 2001: 5-1- 5-143) and other cultural resource studies (Schalk and Mierendorf 1983; Luxenberg 1986; Holstine et al. 1994; and Ethnoscience 2000) conducted at the request of the Chelan PUD or other land managing agencies. Several themes were identified in the most recent study, and are briefly summarized in the following paragraphs.

2.5.1 Exploration and Fur Trade

Although Lewis and Clark entered the Pacific Northwest in 1804, they did not explore the Lake Chelan region. They did encounter Chelan and Entiat peoples however, in the Walla Walla River area (Hackenmiller 1995). It was not until 1811, when David Thompson explored the region for the NorthWest Company, that non-native people entered the mid-Columbia region. Although his travels brought him to the confluence of the Chelan and Columbia rivers, Thompson did not spend any time in the Lake Chelan area (Lentz and Dugas 2001:5-4). Alexander Ross, an employee of the Pacific Fur Company, recorded information on the Wenatchi and Chelan, and many other tribes as he traveled across the region.

Other explorations included the survey of the Wilkes exploring expedition in the 1840s (Hackenmiller 1995). Later surveys included the Pacific Railroad Surveys led by Captain George McClellan, whose team crossed the Lake Chelan outlet on its way to Fort Okanogan. Of most interest was the survey conducted by Lt. Colonel Merriam and Lt Symons who traveled up Lake Chelan for about 24 miles before returning to the outlet where Camp Chelan was established in 1880. Lt. Colonel Merriam later canoed the entire length of the lake and was the first to document the Stehekin "hieroglyphics" (Luxenberg 1986). As reported in the cultural resources overview (Hartmann 2001) this period of exploration and fur trade had more negative than positive impacts on indigenous populations in the Project area.

2.5.2 Settlement

The settlement period is divided into two eras; early settlement and homesteading. Euro-American settlement in the Lake Chelan area did not occur until the late 1880s due in part to the rugged terrain, the lack of established transportation and, most importantly, the existence of the Moses Reservation, which contained lands between the Methow and Chelan Rivers. The dissolution of the Moses Reservation spurred local settlement in the Lake Chelan basin (Lentz and Dugas 2001:5-11).

*Historic Properties and Cultural Resources
Management Plan*

Ignatius Navarre and his family were the first Euro-Americans to settle on the south shore of Lake Chelan near present-day Lakeside in 1886. By 1888, the lower end of the lakeshore was heavily settled and newcomers were forced to go uplake to find suitable homesteads. By 1891, the town of Chelan had over 300 residents, while mining camps with few permanent residents developed in the Stehekin area (Lentz and Dugas 2001:5-12).

Early homesteads were self-sufficient and concentrated around the south shore creeks and rivers. Farmers raised livestock and maintained gardens and orchards. A key factor to the continued settlement of the lake basin into the twentieth century was the development of transportation networks on and around the lake.

2.5.3 Transportation

Trails and wagon roads generally followed the paths of game and horse trails established by the indigenous occupants of the lake basin. The first wagon road constructed in the Lake Chelan area was associated with the military establishment of Camp Chelan at the lower end of the lake in 1879 (Lentz and Dugas 2001:5-21). Wherever terrain permitted, settlers built short wagon roads to link farms and communities around the perimeter of the lake. Although a railroad was planned for the region to transport ore from mines uplake to Chelan, it never materialized.

Boats proved to be the most advantageous method of transportation on Lake Chelan. Canoes, provided by the Chelan Indians, were the initial mode of water transportation. The first steamboat service along Lake Chelan began in 1889 and continued until 1916, when the *Lady of the Lake* was retired (Lentz and Dugas 2001:5-28). Gasoline-driven boats began traversing the lake in 1910 and continue today. Boat landings sprang up all around the lake shoreline and included both small private crib docks and larger public landings. A listing of the variety of boats that operated in Lake Chelan is provided in the cultural resources overview (Hartmann 2001).

The advent of the automobile and mechanized trucking necessitated the construction of improved roads. Highway construction in the region began as early as 1920, and by 1930, the old wagon road from Chelan to Manson was paved (Lentz and Dugas 2001:5-33).

2.5.4 Mining

Intensive mining in the Lake Chelan area began during the 1850s, following the discovery of gold deposits along a tributary of the Wenatchee River (Holstine et al. 1994). By the early 1860s, both Euro-American and Chinese miners had invaded the region looking for gold placer deposits. Chinese miners are credited with initiating the first major mining activity near Lake Chelan between 1855 and 1870. The Chinese miners profited from working placer claims, but were subjected to persecution due to territorial legislation and the racial prejudices of Euro-American and Native Americans. Racial tensions, discriminatory legislation, and dwindling gold profits caused a dramatic decrease in the Chinese population by the latter part of the 1880s (Holstine et al. 1994:5.23).

*Historic Properties and Cultural Resources
Management Plan*

When the placer deposits began to dwindle, hard-rock mining became the dominant extractive industry around Lake Chelan. Mining claims were concentrated near Lightning Creek, Meadow Creek, Cascade Creek, and Railroad Creek. The Lake Chelan valley contained two primary mining districts, the Chelan Mining District and the Stehekin Mining District (Lentz and Dugas 2001:5-37). By the late 1890s, over 80 individual claims had been staked along the four main creek systems. The best-known mining property in the Chelan district was the Holden Mine, which closed in 1957 due to exhaustion of ore (Penberthy 1997). Mining in the Chelan Valley contributed a great deal to local settlement, community development, and regional economics.

2.5.5 Logging

Logging east of the Cascade Mountains did not occur until the 1880s when the land opened for settlement. Early logging was characterized by timber cutting for settlement and to meet local demands. Large-scale timber harvesting and processing did not become established until the late 1880s, when the first commercial sawmill was constructed in what became the community of Lakeside. Individuals also used portable sawmills for small-scale logging or land clearing projects.

The timber industry in the Lake Chelan Valley greatly benefited by the booming fruit-growing industries that developed in the region. Much of the timber produced during the early 1900s was used for the manufacture of fruit boxes and shipping containers. One of the last sizable logging operations took place along Lake Chelan in the 1920s, when timbers were needed for the construction of the hydroelectric dam on the Chelan River. Commercial logging in the Lake Chelan and Stehekin Valley continued until the late 1930s. The success of the logging industry in the Chelan Valley during the early and mid-20th century was directly related to the rise of commercial agriculture in the region (Lentz and Dugas 2001:5-54).

2.5.6 Agriculture

Diversified farming and stock raising were among the early agricultural practices within the Lake Chelan area. Both sheep and cattle were grazed in the Lake Chelan basin. Chelan valley residents practiced mixed-farming processes, growing a wide variety of fruits and vegetables, with excesses sold to the local and regional resorts. Indians planted the earliest fruit orchards at Lake Chelan on allotments along the north shore, and most of the early settlers incorporated orchards into their diversified agricultural scheme. By the early 1900s there was experimentation with a variety of fruits, including apples, peaches, pears, plums, figs, and grapes.

Several distinctive cultural resource property types evolved in conjunction with the apple industry in the Lake Chelan basin. Apple packing sheds were found at many of the family homesteads around the lake. These declined in use after the advent of large co-operative warehouse operations, and few survive today. Picker cabins, characterized as wood-frame, gable-roofed shelters, were usually aligned in a row at one corner of the orchard, often in proximity to the road. The tiny cabins offered no amenities, and in some instances were used for many decades. These cabins have been replaced with larger cement block shelters with lighting and plumbing.

***Historic Properties and Cultural Resources
Management Plan***

2.5.7 Recreation and Tourism

Recreation and tourism in the Lake Chelan Valley began during the early 1890s as word spread regarding the beauty of Lake Chelan and the surrounding wilderness areas. Tourists were drawn to Lake Chelan because of the fishing, boating, camping, and hiking available during the temperate summers. Lodging was available to tourists along the shores of Lake Chelan beginning in 1892, following the construction of the Argonaut (later renamed the Field Hotel) at Stehekin.

The Field Hotel remained in operation until the late 1920s, when construction of Chelan Dam resulted in increased lake levels. Building parts were salvaged and reused elsewhere, leaving only remnants of the foundation, which can still be seen at low water levels. Moore's Inn, located about eight miles below Stehekin was constructed in the early 1900s and operated as a tourist facility until 1957, when a fire destroyed the main building.¹ The Forest Service acquired the property in 1972 and removed all remaining buildings (Lentz and Dugas 2001:5-63).

Other lodges, inns, and hotels sprang up along the lakeshore. Campgrounds were abundant and are used still today. With the advent of the automobile, tourism uptake changed drastically and the need for overnight accommodations lessened. Today, Lake Chelan and the surrounding areas continue to be a major tourist destination.

2.5.8 Town Building

The emergence of towns in the Lake Chelan basin in the latter part of the nineteenth century coincided with the spread of local settlement and the development of economic enterprises. Between 1890 and 1937, seventeen villages were assigned post offices; however, only four remain today (Lentz and Dugas 2001:5-80). The most substantial communities today are Chelan, Lakeside, Chelan Falls, Stehekin, and Manson.

2.5.9 Water and Power Development

Irrigation played a major role in the agricultural development of the Lake Chelan Basin. Private irrigation systems, consisting of simple, gravity-flow diversion ditches were part of the early settlement patterns of the region in the 1870s. The Wapato Irrigation Project was formed in 1906 in response to private land speculation needs, but water was not delivered through the system until 1911. By 1920, the system included 4,359 acres of irrigable land, a wood flume supply line, and an earthen dam located at Antilon Reservoir (Lentz and Dugas 2001:5-97). The Lake Chelan Reclamation District was formed in 1920 after the earlier project owners declared bankruptcy. The Reclamation District expanded the irrigation system despite numerous problems over the years. Today, multiple structural remnants of this extensive irrigation works survive on the landscape and constitute an important cultural resource of the Lake Chelan Basin (Holstine et al. 1994: 6.7-6.8).

The first dam constructed on the Chelan River was privately built near the outlet of Lake Chelan in 1892. The purpose of the dam was to raise the level of the lake allowing development of hydroelectric power for the newly platted townsite of Chelan. However, the dam failed within months and was replaced by another sturdier structure in 1893. A major flood in 1894 destroyed

¹ The hotel had been relocated to higher ground in the 1920s when the Chelan Dam was constructed.

*Historic Properties and Cultural Resources
Management Plan*

this dam (Holstine et al. 1994:6.6). Another dam was constructed in 1901, and by 1903, the citizens of Chelan enjoyed electric lighting for the first time (Lentz and Dugas 2001:5-100).

The Washington Water Power Company constructed the existing dam between 1925 and 1927. The Lake Chelan Hydroelectric Project improved the quality of life for residents of the Lake Chelan basin, and positioned the area for 20th century economic advancement. The Project also altered the natural landscape and built-environment at a scale that far exceeded the impact of earlier human endeavors in the region (Lentz and Dugas 2001:5-112). This facility is described in later sections of this Chapter.

2.5.10 Civilian Conservation Corps (CCC)

The Civilian Conservation Corp (CCC) was established in 1933 in an attempt to halt widespread unemployment encountered during the Great Depression². The CCC was a great success, providing work and training to thousands of men. There were two CCC camps established along Lake Chelan; Camp Chelan located 33 miles northwest of Chelan in the Coyote Creek Basin, and Camp 25 Mile Creek located on the southern shore of Lake Chelan (Holstine et al. 1994:9.17). Numerous CCC structures in the Lake Chelan valley, including administrative buildings, lookouts, campground- and trail-shelters, roads, and trails are still in use today (Lentz and Dugas 2001:5-114). The Chelan Ranger Station, the Lucerne Guard Station, the Moore Point trail shelter, the North Fork Fish Creek trail shelter, and other features at Big Creek, Graham Harbor Creek, and Mitchell Creek campgrounds have been either listed or determined eligible for listing on the NRHP (Holstine et al. 1994:9-7).

2.5.11 Government in the Lake Chelan Basin

Both the USDA Forest Service and the NPS manage public lands adjacent to Lake Chelan. The Wenatchee National Forest has lands on both the north and south shores of Lake Chelan. USDA Forest Service resources within the APE consist of standing and remnant structures, administrative buildings, trails, shelters, campgrounds, and archaeological sites.

Although the NPS has been in existence since 1915, it was not until 1968 that the North Cascades National Park was created. This park complex was divided into two recreation areas; the Ross Lake National Recreation Area and the Lake Chelan NRA. The northernmost portion of the APE is located within the Lake Chelan NRA, which is comprised of 62,000 acres. The community of Stehekin is at the center of the Lake Chelan NRA, and is considered a central point of contact for visitors to the Park. No NPS structures are within the APE; however, the Golden West Lodge Historic District, listed on the NRHP in 1989, abuts the Project boundary and should be considered part of the APE (Lentz and Dugas 2001:5-125).

The Washington State Fish and Game Department managed the Stehekin fish hatchery³ within the APE until the 1930s, when the state terminated its operations there. The department resumed fish planting in Lake Chelan during the 1950s in an effort to repopulate fish runs uplake (Lentz and Dugas 2001:5-125). Remnants of the original fish hatchery and water conveyance system may be evident during periods of low water.

² Refer to the cultural resources overview (Hartmann 2001) for details of this program and its development.

³ The hatchery was moved two times before operations ceased (Luxenberg 1986).

*Historic Properties and Cultural Resources
Management Plan*

Washington State Parks and Recreation owns and manages Lake Chelan State Park located along the southwestern shore, approximately nine miles north of the town of Chelan, and Twenty-five Mile Creek State Park located along the southwestern shore, approximately 18 miles north of the town of Chelan. These parks include over 200 campsites, day-use areas, boat launches, and other facilities. A grocery store, a marine gasoline pump, three garages, a storage shed pump house, a shop building, and staff residence are located at Twenty-five Mile Creek State Park.

2.6 Archaeological Site Inventory

A pedestrian inventory was conducted in the spring of 1999 as part of the relicensing efforts for the Project (Ethnoscience 2000). The CRWG developed the scope of work and field methods that were utilized to document cultural resources. Although much of the APE was examined during this inventory, several parcels were not included in the surveyed area: areas of steep terrain considered hazardous or inaccessible were not surveyed, approximately 1.5 miles of the Chelan River channel were not surveyed due to lack of accessibility, and nearly 11 miles of NPS shoreland in the vicinity of Stehekin were not surveyed¹.

Shovel probes were included as a survey technique to determine the nature and extent of buried cultural deposits. Shovel probes were excavated only on federal or tribal lands where erosion or other impacts posed an imminent danger to site materials. All shovel-probed sediment was screened through 1/8-in hardware cloth to separate cultural materials from sediment. All shovel probes were back-filled, and their locations noted on site sketch maps.

A total of 71 archaeological sites and 14 new isolated finds were documented as a result of the 1999 survey. Previous surveys in the Lake Chelan basin had resulted in the earlier documentation of an additional 22 archaeological sites, for a total of 93 archaeological sites. A table of these sites and their characteristics is presented in Appendix B to this Chapter. There are 25 pre-contact sites and 68 historic-era sites identified. Five categories of pre-contact sites have been identified in the APE. These include campsites or villages, rock art, burials, lithic scatters, and rock features.

Campsites or village locations are the most numerous ($n=9$) pre-contact sites in the APE. Lithic scatters are also common ($n=9$), and may represent specific resource procurement or production activities. There are three sites recorded in the APE that contain or contained burials. All three of these sites have had burials removed from the primary locations, either as part of archaeological projects or as a result of amateur activities. However, it is unknown whether there are additional burial remains at any of these sites. Because it is preferred that potential burial sites remain undisturbed, it is highly unlikely that archaeological investigations will occur within areas where burials are anticipated or known to occur. However, at least one of these sites (45CH310) also contains evidence of other activities that may be of significance to understanding past human activities within the Lake Chelan basin.

Based on pre-project photos, there may be three or more rock art locations within the APE. Two of these sites have been recorded and are on file with the Washington SHPO. Chelan PUD shall be responsible for the evaluation of sites within the APE that have been identified, but not

¹ Survey of NPS lands did not occur because of the lack of an appropriate research design to accompany the ARPA permit application.

*Historic Properties and Cultural Resources
Management Plan*

evaluated, for possible inclusion in the NRHP, as provided in section 5.2. For publicly owned lands, the relevant land management agency is responsible for nominating any sites for listing on the National Register. For tribal allotments, the Colville Confederated Tribes reserve the authority to approve the adequacy of NRHP nominations. The remaining sites are most likely submerged and may be identified and recorded in the event of an extreme drawdown.

The two known rock features are probably associated with food preparation or storage facilities; but investigation and evaluation of the two rock feature sites needs to be undertaken by Chelan PUD to clearly define site features. Rock feature sites are within the Lake Chelan NRA and the Wenatchee National Forest. Chelan PUD will coordinate with the NPS and USDA Forest Service as appropriate prior to treatment of these sites.

Historic-era site categories include hotels or lodges, structures or structural remains, homesteads, debris or dumpsites, irrigation features, logging-related features, transportation features, built-property features, and mine adits. Transportation features are the most numerous ($n=16$) historic-era site type, consisting of 15 crib docks and one bridge.

There are twelve sites that contain historic-era structures or remnants of historic-era structures. Many of these were dismantled or moved during the dam construction era. There are also seven homesteads recorded that may include structural elements and also gardens or orchards or other features associated with the homestead era. There are five debris or dumpsites that have been identified during the 1999 survey (Ethnoscience 2000). These primarily consist of can or mixed-trash-debris piles that generally appear to be associated with recreation activities during the historic or recent era. Three hotels or lodges have been identified; and all three are located in the uplake region of the APE. All three structures were dismantled as part of the construction of the Project. However, foundations, gardens, docks, trenches, roads, orchards, and debris are present at these sites. The hotels and lodges provide significant insight into the early recreation era at Lake Chelan.

Irrigation sites ($n=5$) are represented by pump houses or pump house foundations and irrigation flumes or other features. Most of these sites contain only partial elements of irrigation systems. Logging sites ($n=4$) are represented by two mill sites, one tramway remnant, a cribdock for loading logs, and a tramway and flume system. These sites have all been dismantled and only remnants remain. There are six mine adits, most of which are located uplake in the vicinity of the Holden Mine, and probably represent individual attempts at mining rather than formal mine claims. There is also a gravel-mining site that is associated with the dam construction era. Built properties ($n=7$) include Forest Service trail shelters ($n=2$), the Lucerne Guard Station, the Chelan Ranger Station, the Golden West Lodge (a historic district), a portion of Highway 10, and the Lake Chelan Hydroelectric Power Plant. Six of these properties (all but the highway segment) have been evaluated and determined eligible for listing or are listed on the NRHP.

Several sites were prioritized for archaeological testing or for archival research during the 2001 field season. Archaeological Investigations Northwest (AINW) was retained to conduct testing of 17 sites, and to conduct additional document research on 22 historic-era properties to evaluate the need for testing or other treatments of these locations. The evaluation report has been

*Historic Properties and Cultural Resources
Management Plan*

reviewed by the CRWG and finalized by AINW. The sites that were investigated are included in table presented in Appendix B.

2.7 Inventory Gaps

The pedestrian inventory of the Lake Chelan basin is not complete. The present inventory is lacking information from a number of different areas. The Lake Chelan NRA has not been surveyed for historic-era properties as extensively as the other portions of the APE. There are some property owners that declined to permit access to survey teams along several portions of the lake shoreline where archaeological sites appeared to extend onto private properties outside of the Project boundary. Some areas of shoreline along the northern and western end of the lake include steep canyon walls and rugged landscapes that were not covered by survey crews because of safety issues or inaccessibility.

Even in the areas systematically surveyed, some sites are likely to be buried beneath sediment or vegetation cover, with little or no trace on the ground surface. Recordation of 100 percent of those resources with visible traces is unreasonable. Additionally, the cultural resource significance threshold of 50 years allows more features of the "recent" past to be included in the inventory for historic properties. Section 4.1 of this document contains provisions to carry out periodic cultural resource inventories over the life of the New License.

All future Chelan PUD Project-specific cultural resource surveys should adhere, at a minimum, to the same standards for site definition that were established for the 1999 inventory. This will insure that data collected in future inventories will be comparable to the 1999 baseline. This does not mean that improved or new procedures that are developed in future years should not be utilized, but that the site definition established by the CRWG should be adhered to in all future Chelan PUD-contracted investigations conducted in the Lake Chelan basin¹. Site definitions within the APE were provided for both pre-contact sites and for historic-era deposits as follows:

A prehistoric site is defined as any cultural feature or two artifacts within a 50 square meter area. An historic site is defined by the presence of any cultural feature (e.g., foundation) or five or more historic cultural materials of at least two different artifact types within a 50-square meter area (Chelan PUD 1998).

Survey transects also should not exceed interval spacing of 15 meters in width. This allows for intensive survey coverage of the broad landforms that exist in some areas and yet may accommodate most draw down areas with a single transect by two people.

2.8 Traditional Cultural Properties Studies

Two traditional cultural properties studies have been conducted; one by the YN and one by the CCT. The YN report identified six potentially significant Traditional Cultural Properties (TCPs), including the five pictograph sites and a power site as being of significance. Only two pictographs have been recorded and officially documented with the OAHP. The remaining pictographs and the power site are currently inundated. The YN recommends that if the other sites are exposed, they should be recorded and evaluated for future management. The CCT will

¹ Both the NPS and the USDA Forest Service have their own survey strategies and site definitions that Chelan PUD will comply with when projects are conducted on federal lands.

*Historic Properties and Cultural Resources
Management Plan*

consider recommendations from the draft reports, as well as other information, to make future recommendations for management of TCPs.

2.9 National Register of Historic Places

An important part of the relicensing studies for cultural resources is determining which of the cultural resources identified within the APE are eligible for listing on the NRHP. Federal guidelines for National Register eligibility (36 CFR 60.4) provide the criteria for listing:

The quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, material, workmanship, feeling, and association, and that are associated with events that have had a significant contribution to the broad patterns in our history; or that are associated with the lives of persons significant in our past; or that embody the distinctive characteristics of a type, period, method of construction or that represents the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or that have yielded, or may be likely to yield, information important in prehistory or history.

Two approaches have been utilized to date to determine which cultural resources within the Project APE are eligible for listing on the NRHP. The first approach has been for archaeologists and historians to identify and evaluate cultural resources using scientific techniques (Hartmann et al. 2000; Ozburn et al. 2001). The second approach has been to conduct traditional cultural properties studies (Griffin 2001; Cook 2001). To be considered eligible for listing on the NRHP, TCPs must meet the definitions and criteria outlined in the National Register of Historic Places Bulletin 38 (Parker and King 1990).

SECTION 3: MANAGEMENT CONSIDERATIONS

The HPCRMP is based on the potential Project effects on cultural resources, the nature of those potential effects, the available options to address those potential effects, the natural and social environment of the Project, the responsibilities of the land-managing agencies holding lands within and adjacent to the Project APE, and the need for coordination with the affected American Indian Tribes. These considerations are discussed in this Chapter, which forms a foundation for the HPCRMP measures and procedures described in subsequent sections.

3.1 Issues and Concerns

Chelan PUD must take into account the anticipated effects on cultural resources of Project operations and other actions related to the Project. In addressing other issues in this Comprehensive Plan, such as erosion and recreation, Chelan PUD and the relevant Resource Forums will all have to consider the effects their planned actions may have on cultural resources.

There are a number of historic properties identified within the APE. These includes Project historic structures and buildings, which are listed on the NRHP, but require additional

*Historic Properties and Cultural Resources
Management Plan*

documentation to determine whether any categorical exclusions may apply for routine maintenance or changes in the facilities.

Categorical exclusions include those actions that do not require consultation with the SHPO. A list of potential categorical exclusions is provided in Appendix D of this Chapter. The potential Project effects were those considered at the time this document was drafted, and is not intended to imply that a conceivable effect necessarily will occur or that there may be other effects that have yet to be considered. These effects are listed in Table 10-1. Activities that are undertaken as categorical exclusions will be included in an annual report to the SHPO.

There are a number of Project effects that may harm cultural resources. Erosion of the Lake Chelan shoreline due to fluctuating lake levels caused by Project operation is the most obvious. Such fluctuation in lake level may expose buried cultural resources, impair data recovery, or may impact native species or natural environments that have traditional value to the tribes. Vandalism can occur wherever public visitation is permitted and encouraged without regular surveillance. Acts of vandalism range from artifact collection to unauthorized excavation of cultural deposits or traditional cultural properties, and defacement of rock art panels. Chelan PUD will implement reasonable measures to minimize vandalism of known cultural resources at Chelan PUD-owned recreational facilities (Chelan PUD-owned recreation sites: Riverwalk Park, FS Shore Access, Manson Bay Park, and Old Mill Park) or in areas of vandalism caused by project operations.

Chelan PUD access roads within the project area generally are unimproved dirt roads without engineered roadbeds. Major ground disturbing activities such as road building or major improvements may result in the exposure of previously unidentified cultural deposits or may cause damage to previously recorded historic properties. Chelan PUD will implement reasonable measures to address affects of construction of new roads or major improvements to existing roads on cultural resources.

3.2 Protection Options

Within 180 days of the effective date of the New License, Chelan PUD shall begin implementing site protection measures for historic properties within the APE. Appropriate treatment procedures in response to Project effects shall be guided by the directives presented in 36 CFR §800.6, which states:

The Agency Official (FERC in this case) shall consult with the SHPO/THPO and other agencies and consulting parties, including Indian tribes, to develop and evaluate alternatives or modifications to the undertaking that could avoid, minimize, or mitigate adverse effects on historic properties and cultural resources.

Table 10-1: Project Effects and Alternative Treatment Measures.

Project Effect	Treatment Alternatives		
	Preferred Option	Second Option	Third Option
Erosion on reservoir shorelines and stream banks	Engineered erosional control and bank stabilization	Data Recovery, systematic surface collection, and documentation	
Maintenance of dam, powerhouse, and other related structures	Control of maintenance activities except where categorical exclusions may apply	Protection through HABS/HAER documentation and development of a list of categorical exclusions	Cancel Proposed Action
Any ground-disturbing action related to Project management or operation	Design to minimize effects	Data Recovery, systematic surface collection, and documentation	Cancel Proposed Action
Trail development	Additional survey prior to development of the trail to determine if there are any previously unidentified cultural resources within the bypass reach where the trail will be constructed	Development of scientific plans designed to address the adverse effects of trail development on any previously unrecorded cultural resources	Cancel Proposed Action
Vandalism associated with recreational visitation	Protection through restricted access by use of fencing or other means of avoidance.	Public interpretation in highly visible locations, such as signage or other educational materials.	Limited subsurface sampling of key areas followed by Data Recovery through limited subsurface excavations, systematic surface collections and documentation
Recreational use (i.e., campgrounds)	Engineered erosional control in key areas. This	Public interpretation, signing, fencing of dangerous or	Data Recovery through limited subsurface

*Historic Properties and Cultural Resources
Management Plan*

Project Effect	Treatment Alternatives		
	Preferred Option	Second Option	Third Option
	action needs to be considered in cooperation and coordination with land-managing agencies	destabilized cuts	excavations, systematic surface collections, and documentation
Recreation facilities developments	Development restrictions	Cancel or relocate planned developments	Data Recovery through limited subsurface excavations, systematic surface collections, and documentation
Other new construction	Development restrictions	Relocation planned new construction or cancel project	Data Recovery through limited subsurface excavations, systematic surface collections, and documentation
Visual intrusion	Development restrictions	Relocation of activities that may result in lowering of visual intrusion onto certain cultural resources	

*Historic Properties and Cultural Resources
Management Plan*

The following protection options shall be considered by Chelan PUD in consultation with the CRWG when developing treatment plans for historic properties. These include protection of the resource from Project effects, if practical measures exist to prevent Project effects from occurring. Where Chelan PUD cannot assure complete protection, then actions shall be taken to limit Project effects or address adverse effects through data recovery or other measures. Data recovery may be appropriate when the affected resource may lose interpretive information. Chelan PUD shall consider agency and Tribal recommendations when considering data recovery measures, and when addressing adverse effects on traditional cultural properties.

In cases where Project-caused shoreline erosion is a principal concern but where it is not yet affecting a cultural resource, Chelan PUD, in consultation with the Lake Chelan Cultural Forum (LCCF), will first consider engineered protection of the shoreline such as erosion control measures similar to those used in Chapters 1 and 2 of the Comprehensive Plan. In some cases data recovery will need to be considered at sites where erosion is already a major factor. Careful consideration of alternative protection systems will be needed on a case-by-case basis in order to select a protection system that will be long lasting and will only minimally disturb historic properties. Where protection can be provided with minimal damage to cultural deposits, the extent of data recovery should be limited to a representative sample of the cultural features and deposits in order to provide a permanent record of the excavated site area. Where protection is less complete or more intrusive, the data recovery sample should be larger to address the adverse effects and to recover as much information about the historic property as possible.

In those areas where vandalism is a principal concern, Chelan PUD, in consultation with the LCCF, will consider protection through restricted access to the historic sites on Chelan PUD property. As to privately-owned lands, finding means to protect historic sites will be more difficult. It is possible that interpretive signs or other measures, such as public education, may be instituted to discourage vandalism.

Recreational activities, including campground development, can have adverse effects on cultural deposits and features. Planned and coordinated campground design can limit the effects of public recreational activities on cultural properties, but in many cases cannot prevent effects to these resources without closure of some areas to public access. At Chelan PUD recreation facilities, where site protection cannot be practically conducted, data recovery may be a preferred option. These efforts would need to be coordinated not only with the federal and state agencies that maintain and construct parks but also with the local city and county park directors. Chelan PUD, in consultation with the LCCF, will consider data recovery at these locations. Chelan PUD, in consultation with the LCCF, will also consider development of interpretive facilities at parks or trails to educate visitors about the need for protection of sites affected by the recreational facility.

Any planned ground-disturbing activity related to Project operation or management has the potential to affect cultural resources. Chelan PUD actions will be designed to avoid or limit effects on cultural properties. Where adverse effects cannot be avoided, then redesign of these actions, cancellation of the planned action, or data recovery will need to be considered. Damage to cultural resources through maintenance activities and erosion associated with improved access roads can be limited by restricting the maintenance activity, and through development of

*Historic Properties and Cultural Resources
Management Plan*

engineered erosion control. However, Chelan PUD, in consultation with the LCCF, will consider data recovery in some areas where it is more practical than developing protective measures to avoid cultural properties. PUD shall monitor historic properties every three to five years or on a schedule agreed to by the LCCF.

3.3 Additional Management Options

The inventory and evaluation of cultural resources within the Project APE, required by Section 106 of the NHPA, is still not complete. As noted earlier, a number of areas were not surveyed during the relicensing inventory, for a variety of reasons. A high priority for continuing management of cultural resources must be the completion of the inventory to the extent possible. It is the licensee's obligation to protect cultural resources over the long term, including currently unevaluated resources and sites not yet recorded. The HPCRMP makes provisions to accomplish this task (see site-specific measures below).

In addition, 10 sites, identified for testing or archival research, were not evaluated during the 2001 field season (these are listed in the table in Appendix C). These sites, although in the APE, were not considered to be of the highest priority for immediate testing and evaluation. Chelan PUD has begun testing of these sites, and plans to complete testing in 2003. Completion of the evaluation work is an essential part of this HPCRMP, and provisions are outlined in the following section to conduct this work.

Even the most thorough inventory effort cannot prevent the chance discovery of previously undocumented archaeological sites. Such discoveries may include human remains or objects or items of traditional Tribal cultural patrimony. Responsible management planning by Chelan PUD should include provisions to facilitate the reporting of such finds to SHPO/THPO, and other relevant agencies. Guidelines for inadvertent discoveries are provided in section 5.4 of this Chapter.

3.4 Public Interpretation

The public nature of the Project and the public values that are fundamental to the realm of protective regulations for cultural resources require that the licensee share the benefits of the Project's cultural heritage and resources with the public. Chelan PUD will monitor cultural resource investigations in the project area and make reasonable efforts to include study reports in the Chelan PUD cultural resources library. Chelan PUD in consultation with the LCCF will make reports available depending upon the sensitivity of the information presented, the intended purpose of the report, and the audience to whom the reports may be distributed.

Interpretive and education programs will be developed and implemented by the LCCF within 36 months of the effective date of the New License. The plan may include provisions such as development of interpretive signs at Chelan PUD trails and parks, development of elementary school teaching aids, contributions to short publications for general audiences, and other cooperative measures within the constraints of the HPCRMP. Chelan PUD shall provide annual funding of \$1000 for educational and interpretive activities.

*Historic Properties and Cultural Resources
Management Plan*

3.5 Native American Consultation

Chelan PUD has implemented a process to enable proactive and meaningful participation by both the YN and the CCT. Chelan PUD has included both the YN and the CCT, along with the BIA, in its LCCF in developing the HPCRMP, in reviewing the APE, in discussions and planning approaches to inventorying sites within the APE, in the evaluation of these sites for their eligibility to the NRHP, and in the preparation of TCP studies for the APE. As part of the HPCRMP, both the YN and the CCT, along with the BIA, will be participants in an ongoing Forum (described in section 3.7) to coordinate activities involving cultural resources.

Chelan PUD shall contact the CCT THPO and the cultural resources manager of the YN during the third quarter of each year to discuss the status of Chelan PUD's historic properties management within the Project APE. These discussions shall include plans for management activities during the upcoming year, and any specific changes or other issues regarding cultural resource management within the APE. Chelan PUD shall notify the CCT and YN of any planned meetings it may have with other federal agencies dealing with cultural resources, so that tribal representatives may attend. Chelan PUD shall include the State Archaeologist as a representative from OAHP in the annual discussions and any meetings with the CCT THPO and the cultural resources manager of the YN for these planning sessions.

Chelan shall provide data on the dates of their planned cultural resource projects within the APE so that the CCT and YN representatives may participate in or provide recommendations for planned projects. Chelan PUD will encourage their cultural resource contractors to employ CCT and YN trained cultural resources technicians whenever appropriate. Within one year after issuance of the license Chelan PUD, in consultation with the YN and CCT, shall develop and implement a TCP management plan.

3.6 Agency Coordination

Chelan PUD shall provide data on the dates of their planned cultural resource projects within the Project APE so that federal and state agencies will be aware of projects that may include lands they manage. Each agency will continue to manage cultural resources on land it administers, using its established protocols. Chelan PUD shall coordinate its activities with federal agencies if its projects occur on or have potential to affect cultural resources on public lands.

3.7 Assignment and Coordination of Responsibilities

Within 180 days of the effective date of the settlement Agreement, Chelan PUD shall form the Lake Chelan Cultural Forum (LCCF). The membership and procedures of the LCCF are governed by section 18 of the settlement Agreement. The following entities are eligible for membership in the LCCF: the OAHP, WSP, the NPS, BIA, the USDA Forest Service, CCT, YN, Chelan PUD, FERC, and the Lake Chelan Historical Society. Chelan PUD shall convene a meeting of the LCCF within 180 days after the effective date of the settlement Agreement. The LCCF then shall adopt a schedule for subsequent meetings. Chelan PUD shall also consult with the YN and CCT yearly.

The LCCF will be headed by a Cultural Resources Coordinator, a position that Chelan PUD will establish to oversee and coordinate implementation of the HPCRMP, in consultation with the LCCF. This committee shall meet regularly to review the needs and requirements of the

*Historic Properties and Cultural Resources
Management Plan*

HPCRMP. Two meetings shall be scheduled annually, with the option to waive meetings by concurrence of a majority of LCCF members.

This committee, regardless of changes in personnel throughout the period of the New License, will work to assure that all aspects of work on cultural resources are conducted properly. It is essential to specify the standards to be followed in fieldwork, evaluation, record keeping, curation, and reporting. The HPCRMP provides explicit standards and allows for amendments of these procedures, as standards are refined over the next 50 years. It will be necessary to update the HPCRMP periodically to reflect updates in standards and procedures as new cultural resource regulations and laws are implemented. The LCCF shall meet every five years for the purpose of reviewing and revising the HPCRMP and may reallocate funding to accommodate new laws and regulations or revised LCCF priorities. PUD shall be responsible for complying with applicable new cultural resource laws and regulations.

3.8 Chelan PUD Cultural Resources Coordinator

Within 180 days of the effective date of the New License, Chelan PUD shall appoint a Cultural Resources Coordinator who will be responsible overseeing and coordinating implementation of the HPCRMP in consultation with the LCCF. The Cultural Resources Coordinator shall be the primary point of contact for all cultural resource tasks undertaken by Chelan PUD. The Cultural Resources Coordinator shall be provided necessary training in cultural resources laws and regulations so as to be familiar with the programs and procedures necessary for undertaking this position. Training may include but not be limited to sessions on cultural resource management basics, laws and regulations, curation, conservation, and stewardship, and the preparation of management documents. The Cultural Resource Coordinator shall be expected to attend seminars and regional or national meetings as part of the ongoing educational process. The Cultural Resources Coordinator shall be expected to develop and maintain a working relationship with the SHPO.

SECTION 4: SITE SPECIFIC MANAGEMENT MEASURES

4.1 Archaeological Sites

During the relicensing process, Chelan PUD employed professional archaeologists to complete a survey and evaluation of cultural resources in the Lake Chelan APE. All site recommendations were reviewed and approved by the LCCF. Seventeen sites, six historic-era and 11 pre-contact sites, were designated for evaluation through limited testing following review and acceptance of the cultural resources overview and inventory reports. Additional research also was conducted on 22 historic-era sites as part of the evaluation phase, to determine if archaeological testing would be necessary or if the additional research would provide sufficient evaluation on some of these historic-era sites. The testing phase was initiated in the spring of 2001, and eight of the 17 sites were tested. However, due to higher than normal water levels, evaluation at six of the sites was postponed until 2003 or when conditions are favorable. Three of the sites were inaccessible due to private landowner denials of entry.

*Historic Properties and Cultural Resources
Management Plan*

One of the tested sites, 4-20, was found to be ineligible for the NRHP (see Appendix C for detailed site names). The boundary of this site was enlarged as a result of the testing efforts. No further work is recommended at this site. Two of the sites, 45CH217 and 45CH480, were tested and cultural materials were found in some of the test holes. The LCCF has decided that additional testing at both 45CH217 and at 45CH480 may be necessary prior to a determination of ineligibility for these two sites. At the present time, Chelan PUD is awaiting concurrence on these findings from the LCCF and the SHPO/THPO offices. Federal regulations require consideration of currently ineligible sites in the future (36CFR 800.4(c)(1)). Efforts that may be directed to currently ineligible sites in the future are outlined in a later section of the HPCRMP.

The remaining five sites, 4-22, 4-49, 45CH214, 45CH310, and 45CH481 were tested and found to be eligible for inclusion in the NRHP. These sites are discussed in the following paragraphs. Recommendations for treatment or additional investigations are also included, but final measures will be determined by Chelan PUD in consultation with the LCCF.

Cultural resource sites have been identified on both public and private lands. Chelan PUD shall coordinate with landowners and land managers prior to conducting survey or protection measures on those lands. In cases where landowners or managers deny appropriate access to cultural resource locations, Chelan PUD shall not be responsible for addressing impacts to the site. However, Chelan PUD will continue to monitor these locations and will make reasonable efforts to gain future access to the site.

4.1.1 Site 4-22 (FS-06-17-02-78)

Site 4-22 is considered significant because of its association with the Holden Mine in the early to mid 1900s. The lodge constructed at this site served as a brothel in the late 1930s. Archaeological testing also indicates that intact deposits of historic-era cultural materials are preserved in a portion of the site, and investigation of the trash dump and footprint of the lodge is recommended. Reservoir operations subject portions of the site to erosive actions that will cause further loss of the cutbank in the vicinity of the trash dump. It is recommended that data recovery be conducted in this area prior to bank stabilization. Agreements with the private landowner will need to be established prior to any work on this site.

4.1.2 Site 45CH214

Site 45CH214 is the location of a large permanent ethnohistoric Chelan Village reported by Vern Ray (1974) as *Pi pi ku lu* ("lots of sunflowers").^{*} Testing at this site produced 175 artifacts, including flaked stone tools,debitage,mammal bone, and shell from the surface and from buried intact deposits on the terrace above the reservoir draw down zone. This site has the potential to produce important information on cultural chronology, subsistence and settlement patterns, paleoenvironments, and human ecology. In addition, three radiocarbon dates suggest the site was occupied between 2750 and 1940 B.P. Diagnostic projectiles points also indicate the possibility of older deposits.

* According to Adeline Fredin, CCT THPO, this word is not a Chelan word and was incorrectly applied by the ethnographer.

*Historic Properties and Cultural Resources
Management Plan*

The site is partially protected from reservoir wave action by riprap along the cutbank. However, the riprap is deteriorating and damage to intact cultural deposits may occur. Concrete seawalls on adjacent private property provide some protection.

Because the site is within Manson City property, Chelan PUD will coordinate with the city manager to insure that this site is protected. Coordination will include the possibility of data recovery excavations prior to additional bank stabilization efforts.

4.1.3 Site 45CH310

Site 45CH310 has been examined on at least two occasions by archaeological investigations (Smith and Stratton 1976; Galm and Fredin 1987), and most recently during the testing phase (Ozbun et al. 2001). Human remains were removed from the site (Galm and Fredin 1987) and it is known that portions of the landform functioned as a cemetery during pre-contact/ethno-historic periods. Results of analysis of obsidian from recent testing suggest the site was occupied between 2964 and 2156 years B.P., and a village was occupied in the Protohistoric or historic time period (Smith 1988).

Recommendations for this site include data recovery along the terrace edge. However, recommendations from the CCT and the landowner will be considered by Chelan PUD prior to archaeological investigations.

4.1.4 45CH481

Site 45CH481 has been reported as an ethnographic/historic-era Chelan warm-season village site called *loqtci'n*, noted as a hunting camp (Smith 1988:279). Testing at this site resulted in the documentation of 16 stone tools on the surface of the site and the excavation of nine shovel tests and one one-by-one meter test unit. Cultural materials were identified from excavations above the cutbank, as well as from test units below the cutbank. Although obsidian debitage was too small to source, a hydration rind date suggests the site to be in the range of 2000 years old. Faunal analysis indicates medium-sized animals, such as deer and sheep, and small mammals, such as rodents and rabbits, formed part of the assemblage at this site. Blood residue analysis corroborated the fact that deer, sheep, and birds were butchered at this location. The large number of ground stone tools (n=9) would suggest that milling activities also occurred at this site.

The site is subject to active erosion and the Project has a detrimental effect on the cultural resources at this location. Although protection is recommended for this site, data recovery would need to be considered by Chelan PUD prior to any bank stabilization procedures.

4.1.5 Other Eligible Sites

In addition to the sites that were tested in 2001, there are seven other archaeological sites that are potentially eligible for the NRHP. These include sites 45CH66, 45CH493, FS-06-17-02-30 [SHPO number WF-677], FS-06-17-02-03, FS-06-17-02-57, 45CH460, and 45CH467.

Site FS-06-17-02-03 and FS-06-17-02-30 are threatened by erosion that is currently affecting this site. Site FS-06-17-02-30 is also being affected by shoreline erosion. These sites have been tested but DOEs have not been completed. Chelan PUD should consider recommendations from the

*Historic Properties and Cultural Resources
Management Plan*

USDA Forest Service and the Tribes about treatment plans for these two sites. Data recovery may need to be conducted prior to any bank stabilization efforts.

Site FS-06-17-02-57 has not been evaluated. This site must be tested by Chelan PUD in consultation with the LCCF so that site significance can be determined. Coordination between Chelan PUD and the USDA Forest Service will be needed prior to any archaeological investigations at this site.

Amateur collectors have removed materials from site 45CH460 in the past. The present location of the human remains is in question. Another site, 45CH467 also had human remains removed from it through scientific excavations. It is not known if additional burials are located at these sites. According to CCT and YN traditional beliefs, it is inappropriate to conduct testing or data recovery within known cemeteries or burial sites. However, these two site locations should be monitored on an annual basis to evaluate whether additional human remains are being exposed during periods of low water. If human remains are exposed, then the cultural resources or environmental manager with Chelan PUD will need to consider recommendations from the CCT and the YN about appropriate protection measures.

Sites 45CH66 and 45CH493 are potentially eligible for inclusion on the NRHP. Site 45CH66 may be impacted due to fluctuating pool levels since dam construction in the early twentieth century. Also these two sites are at risk due to increased public access and the potential for vandalism. There is no way to prohibit public visitation to these two sites. However, interpretative facilities around the reservoir may educate the public about the need to protect this endangered site type. Treatment plans for evaluation of these pictographs should be developed by Chelan PUD in coordination with federal agencies and tribes.

4.2 Traditional Cultural Properties

The CCT and YN both maintain a number of programs designed to promote the preservation and transmittal of traditional knowledge. Within one year of the effective date of the New License, Chelan PUD shall initiate development and implementation of a Traditional Cultural Property (TCP) management plan. Chelan PUD's treatment plans for identified TCPs within the APE that are affected by Project operations are subject to the approval of the land management agency responsible for the property on which the TCPs are located. Chelan PUD will consider recommendations from the tribes regarding treatment plans.

4.3 Results of Historic Document Research

Historic document research was conducted during the 2001 testing phase for twenty-two historic-era sites where information was insufficient to determine eligibility of these properties for listing on the NRHP. These sites are listed in the table found in Appendix C and additional discussion is provided below.

Archival research resulted in a finding of ineligibility for sites (FS 06-17-02-76, FS 06-17-02-81, FS 06-17-02-74, FS 06-17-02-73, FS 06-17-02-77, and FS 06-17-02-73). Site (FS 06-17-02-79) and site (4-21) were both recommended for archaeological testing as a result of archival research.

*Historic Properties and Cultural Resources
Management Plan*

4.3.1 Buildings, Structures, and Linear Resources

Archival research found one tramway and crib dock site (FS 06-17-02-82) to be eligible for listing in the NRHP based on its association with the Holden Mine (Criterion A). The tramway is gone but the footprint is visible. The associated crib dock and access ramp are still present and not affected by Project operations. It is recommended that the crib dock and access ramp be photo-documented and that a professional archaeologist visit the site to identify any remains of the tramway or its footprint.

Several building foundations that include the Lucerne Hotel (FS 06-17-02-83), the Ida E. Mill Site (4-21), 4-64 (a site that includes a pumphouse foundation and a circular stone foundation), 4-68 (a pump and pumphouse foundation), and 4-59 (irrigation pumphouse) are ineligible. A concrete pier foundation (4-62) was found not to be associated with any documented history of dam construction and was found to be ineligible. None of these sites is affected by Project operations.

Building foundations at Moore's Inn (FS-06-17-02-29) [SHPO number WF-676] have been dismantled and hold little integrity. However, this site is eligible for the NRHP for its association with John Moore (Criterion B), and its important role in the development of mining and tourism in the upper Lake Chelan (Criterion A). The orchard associated with the Moore's Inn may contain some of the earliest apple varieties in the region and is considered potentially significant for its association with the orcharding industry. It is also possible that testing of some of the apple trees in the orchard may provide evidence for early apple varieties no longer marketed in the region. Protection and photo documentation are recommended. A CCC-era USDA Forest Service trail shelter is the only remaining standing structure at this site. This shelter (FS 06-17-02-9) is eligible for the NRHP under Criteria A and C. Protection is recommended for this site.

Building foundations at 4-21 (Larson's Orchard) remain along with an orchard, a wood-frame building, and an artifact scatter. The site is recommended for testing and additional documentation, as there is currently not enough information to evaluate site significance. Testing may produce important data on understanding the agricultural practices and daily life of a small rural homestead. Testing of apple trees at the orchard also may produce valuable information on early apple varieties.

The Wapato John site (45CH473) contains a concrete foundation, pumphouse, and an artifact scatter. This site is significant because of its association with Wapato John (Criterion B). The foundation remnant is not a contributing element. The artifact scatter may contain significant information about adaptation by of John and his family to non-native intrusion. Archaeological testing is recommended at this site.

In addition to the sites that were investigated during the 2001 field season, there are four structures and one historic district that are eligible for listing in the NRHP. These include the Chelan Ranger Station (FS-06-17-02-06), the Golden West Lodge Historic District (TR24-HD54) that includes eight buildings, the Mitchell Creek CCC shelter (FS-06-17-02-15), the Lucerne CCC Guard Station (FS-06-17-02-01), and the Moore Point CCC Trail Shelter (FS-06-17-02-09). None of these sites are affected by Project operations and are managed by the NPS or USDA Forest Service.

*Historic Properties and Cultural Resources
Management Plan*

One linear structure, the Highway 10 Bridge (4-53), is found within the Project APE. The Highway 10 Bridge is located between Highway 151 and the Chelan PUD powerhouse crossing the Chelan River. It was built in 1922 and is a single-span, double ribbed open-spandrel reinforced concrete arch bridge. It represents the transition from nineteenth century to twentieth century design. This structure is within the Project APE and should be evaluated by Chelan PUD in consultation with the LCCF for its significance.

4.4 Hydroelectric Facilities

As detailed in the cultural resources overview, the Lake Chelan dam was constructed over a three-year period by the Washington Water Power Company beginning in 1925 (Washington Water Power 1928). Most of the facilities were constructed in 1927. The Chelan PUD acquired the Project in 1955 from the Washington Water Power Company. For the first forty years, all power generated by the Project was sold to the Washington Power Company. When that contract expired in 1995, all electricity generated at the Chelan Falls plant became available to homes and businesses in Chelan County.

The hydroelectric facilities include the Lake Chelan Dam, the water conveyance system (intake tubes, power tunnel, penstocks and branches), the surge tank, and the powerhouse. The hydroelectric facility was listed on the NRHP in 1988 under criteria A and C, as part of a multiple listing of hydroelectric power plants in Washington State (NRHP 1988). At that time, one building (the powerhouse) and five structures were evaluated as contributing resources (Soderberg 1986). However, the access roads, tailrace, and irrigation pumps were not considered. The NRHP nomination needs to be modified to incorporate additional features and structures not originally considered. Historic American Buildings Survey / Historic American Engineering Record (HABS/HAER) documentation of the hydroelectric facilities may be conducted if any major alterations are planned. These facilities are described in the license application.

4.5 Evaluation Status of Archaeological Sites in the Lake Chelan APE

A number of previously recorded sites in the Lake Chelan APE have been evaluated by the LCCF during the relicensing process; many are eligible or are listed on the NRHP. Others have been evaluated and are potentially eligible pending preparation of the DOEs and concurrence from the SHPO and/or THPO. A number of other archaeological sites have yet to be evaluated. The evaluation status of the archaeological sites discussed in this Chapter is presented in Table 10-2.

Priorities for Evaluation are rated 1 through 5. Priority 1 indicates the site work is planned immediately following license acceptance. Priority 2 indicates that evaluation or a treatment plan is necessary, but will be implemented on a timed schedule following license acceptance. Priority 3 sites are those sites that have insufficient data to make a determination. These sites will be scheduled on a long-term basis and incorporated into the LCCF annual review of sites to be evaluated. Priority 4 is attached to sites that need to be evaluated for eligibility but delay is involved. The primary reason for sites given this priority rating is due to property owners denying access. These sites will be scheduled on long-term (5- or 10-year intervals) to check for changes in ownership or changes in attitude. Priority 5 sites are those sites that are currently ineligible for NRHP listing. These sites will be scheduled for review initially at the first APE

***Historic Properties and Cultural Resources
Management Plan***

resurvey. Changes in scheduling may occur on an annual basis at LCCF management review meetings.

Table 10-2: Known Archaeological Sites and Evaluation Rating.

Site No.	Description	Owner	NRHP Eligibility ¹	Anticipated Effects	Evaluation Priority ²
FS 06-17-02-30	House Pits; village/camp	USDA Forest Service	PEL	Erosion; Vandalism	4
FS-06-17-02-03	Campsites	USDA Forest Service	EL (Criterion 4)	Erosion; Recreation; Vandalism	1
45CH65	Campsites	NPS	ID	Erosion; Recreation; Vandalism	1
45CH67	Campsites	Private/PUD	ID	Erosion	1
45CH422	Campsites	NPS	NE	Erosion	5
45CH411	Campsites	NPS	NE	Erosion; Vandalism; Recreation	5
45CH423	Campsites; submerged site	NPS	ID	Erosion	1
45CH214	Campsites	Private	PEL/Tested 2001 ²	Erosion; Recreation, Vandalism	1
45CH432		NPS	PEL	Erosion	1
FS-06-17-02-57	Lithic scatter	USDA Forest Service	ID	Erosion; construction	3
45CH468	Multi-component	Private	ID/Access Denied	Erosion; Collection	4
45CH482 FS-06-17-02-58	Lithic Scatter	USDA Forest Service	NE	Erosion	5
45CH217	Lithic Scatter	State Parks	PEL/Tested 2001 ²	Construction activities; Erosion	1
45CH464	Lithic Scatter	Private	ID/Access Denied	Construction activities; Erosion, Vandalism	4
45CH469	Lithic Scatter	Private	ID	Erosion; Construction Activities	3
45CH477	Lithic Scatter	Private	ID/Access Denied	Erosion	4
45CH480	Lithic Scatter	Private	PEL/tested 2001 ²	Construction activities; Erosion, Vandalism	1
45CH481	Lithic Scatter	Private	EL (Criterion D)	Erosion	1
45CH310A	Cemetery/campsites	CCT Allotment	PE/tested 2001	Erosion	2
45CH460	Burials	Private	NE	None/inundated (Burials reported removed)	5
45CH467	Burials	Private	PEL/ID	Erosion; Vandalism	4
45CH410	Cairns	Private/PUD	ID	Erosion	3
45CH453	Stehekin Boulder Field Rock Features	NPS	ID	Vandalism; Erosion; Recreation	3

*Historic Properties and Cultural Resources
Management Plan*

Site No.	Description	Owner	NRHP Eligibility ¹	Anticipated Effects	Evaluation Priority ²
45CH66	Stehekin Pictographs	NPS	PEL	Erosion; Vandalism	2
45CH493	Domke Falls Pictographs	USDA Forest Service	PEL	Erosion; Vandalism	2
FS 06-17-02-79	debris	USDA Forest Service	ID	Erosion	1 / 2
4-63	Debris	PUD	NE	None	5
4-48	Debris	PUD	NE	Erosion	4
4-75	Debris	PUD	NE	Natural deterioration	5
4-74	Debris	PUD	NE	Erosions	5
FS 06-17-02-80	Structural remains	USDA Forest Service	NE	Erosion	5
4-64	Structural remains	Private	NE	Natural deterioration; Erosion	5
4-61	Structural remains	PUD	NE	Erosion	5
4-62	Structural remains	PUD	NE	None	5
4-49	Chelan Dam Gravel Plant	PUD	EL (Criterion A)	Erosion	5
4-51	Structural remains	PUD	ID	Erosion	3
4-52	George Brown Water System	PUD	NE	Displaced structure	5
4-76	Structural Remains	PUD	ID	Natural deterioration	3
LP-27 (state number unassigned)	Structural remains	PUD	ID	Natural deterioration	3
4-55	Structural remains	PUD	ID	Natural deterioration	3
4-60	Structural remains	Private	NE	Natural deterioration; Erosion	5
45CH452	Weaver Point structural remains	NPS	ID	Natural deterioration	1
FS-06-17-02-38	Fields Point Homestead	USDA Forest Service	NE	Erosion	5
FS-06-17-02-78	Homestead	USDA Forest Service	EL (Criterion A)	Modern construction; Erosion; Vandalism	2
45CH473	Wapato John Homestead	Private	ID	Erosion	2
4-21	Larsons Orchard	Private	ID	Erosion	2
4-57	Homestead	Private	NE	Erosion	5
4-67	Homestead	Private	NE	Erosion	5
FS 06-17-02-29	Moore's Inn	USDA Forest Service	EL (Criterion B)	Vandalism; Erosion	2
FS-06-17-02-83	Lucerne Hotel	USDA Forest Service	NE	Modern construction; Recreation; Erosion	5
45CH424	Field Hotel	NPS	ID	Erosion/inundated	2 / 3
4-59	Pump house	Private	NE	Natural deterioration	5

*Historic Properties and Cultural Resources
Management Plan*

Site No.	Description	Owner	NRHP Eligibility ¹	Anticipated Effects	Evaluation Priority ²
4-66	Pump house	Private	NE	Natural deterioration	5
4-69	Pump house	Private	NE	Natural deterioration	5
4-56	Irrigation flume	PUD	ID	Natural deterioration	3
4-68	Pump house	Private	NE	None	5
FS 06-17-02-81	Logging Mill	USDA Forest Service	NE	None	5
FS 06-17-02-82	Logging tramway/crib dock	USDA Forest Service	EL (Criterion A)	Erosion	3
FS 06-17-02-84		USDA Forest Service	NE	Erosion	5
FS 06-17-02-85	Coyote Creek Flume	USDA Forest Service	NE	None	5
FS 06-17-02-72	Mine adit	USDA Forest Service	NE	None	5
FS 06-17-02-73	Mine adit	USDA Forest Service	NE	None	5
FS 06-17-02-74	Mine adit	USDA Forest Service	NE	None	5
FS 06-17-02-75	Mine adit	USDA Forest Service	NE	None	5
FS 06-17-02-76	Mine adit	USDA Forest Service	NE	None	5
FS 06-17-02-77	Mine adit	USDA Forest Service	NE	None	5
4-50	Gravel Mine	PUD	ID	Natural deterioration	3
FS-06-17-02-86	Railway	USDA Forest Service	NE	Natural deterioration	5
4-54	Bridge	PUD	NE	Natural deterioration	5
FS-06-17-02-87	Crib dock	USDA Forest Service	NE	Erosion	5
4-65	Crib dock	Private	NE	Erosion	5
4-45	Crib dock	Private	NE	Erosion	5
4-46	Crib dock	Private	NE	Erosion	5
4-42	Crib dock	Private	NE	Erosion	5
4-44	Crib dock	Private	NE	Erosion	5
4-41	Crib dock	Private	NE	Erosion	5
FS-06-17-02-88	Crib dock	USDA Forest Service	NE	Erosion	5
FS-06-17-02-89	Crib dock	USDA Forest	NE	Erosion	5

*Historic Properties and Cultural Resources
Management Plan*

Site No.	Description	Owner	NRHP Eligibility ¹	Anticipated Effects	Evaluation Priority ²
		Service			
FS-06-17-02-90	Crib dock	USDA Forest Service	NE	Erosion	5
FS-06-17-02-91	Crib dock	USDA Forest Service	NE	Erosion	5
FS-06-17-02-92 (4-28)	Crib dock	USDA Forest Service	NE	Erosion	5
4-37	Crib dock	Private	NE	Erosion	5
4-58	Crib dock	Private	NE	Erosion	5
4-47	Crib dock	Private	NE	Erosion	5
4-23	Ship gun whale	Private	NE	Erosion	5
4SCH271	Lake Chelan Hydroelectric Power Plant	PUD	Listed (Criteria A & C)	Maintenance; Upgrades	2
FS-06-17-02-06	Chelan Ranger Station	USDA Forest Service	Listed	None	2
TR24-HDS4	Golden West Lodge Historic District	NPS	Listed	Deterioration	2
FS-06-17-02-01	Lucerne Guard Station	USDA Forest Service	Listed	None	2
FS-06-17-02-09	Moore Point Trail Shelter	USDA Forest Service	Listed	None	2
4-53	Highway 10 Bridge	PUD	ID	None	2/3

¹ Key: PEL = pending eligibility; not formally evaluated; EL = formally evaluated as eligible (pending concurrence from SHPO); ID = insufficient data; NE = formally evaluated as not eligible (pending concurrence from SHPO); Listed = listed in the NRHP

² See section 4.5, paragraph 2, for definitions of Priorities of Evaluation.

SECTION 5: PROJECT-WIDE MANAGEMENT MEASURES AND CONTINUING PROCEDURES

5.1 Completion of Inventory

About 10 shoreline miles of the APE within the Lake Chelan NRA, property owned and managed by the NPS, remains to be surveyed for historic-era properties. The NPS has completed a prehistoric survey of their property within the Lake Chelan area and has made recommendations on the treatment of these sites. DOE on the prehistoric sites within the NPS properties within the APE shall be completed as stated in section 6.2 below. Chelan PUD shall implement a survey of the NPS lands for historic-era properties immediately (2003). The survey methods shall adhere to those used for the 1999 inventory conducted as part of the relicensing efforts.

*Historic Properties and Cultural Resources
Management Plan*

Because the New License will cover a 50-year period, it will be necessary to conduct resurvey of the Project APE at intervals through the life of the license. Chelan PUD shall resurvey the APE for cultural resources every 15 years or when the LCCF determines surveys and monitoring are needed after high flow events or unusual low water.

5.2 Completion of Evaluation

Some identified sites have not been evaluated for NRHP eligibility. Additional sites may be identified through additional survey or inadvertent discoveries. Chelan PUD shall immediately (2003) begin evaluation of all known sites that have not been evaluated. Chelan PUD shall provide information to the relevant land management agency or tribe for nominations of potentially eligible sites. For publicly owned lands, the relevant land management agency is responsible for nominating any sites for listing on the National Register. For tribal allotments, the Colville Confederated Tribes reserve the authority to approve the adequacy of NRHP nominations.

All future surveys and site documentation completed by Chelan PUD shall meet federal and state agency protocols and satisfy the following requirements:

1. Necessary permits shall be obtained from the federal land-managing agencies or private landowners.
2. Survey team leaders shall meet the Secretary of Interior's Standards for a Professional Archaeologist and shall be on site for the duration of the project.
3. Survey teams shall be fully briefed on safety considerations and on the traces of cultural resources that may be expected.
4. Archaeological survey shall cover 100 percent of the APE at intervals no wider than 15 m (preferably at 10 m), excluding only areas that cannot safely be examined. All exceptions will be fully documented in field notes and mapped on 7.5 minute USGS quadrangles.
5. Surveys shall be designed to discover and record all surface-visible and potentially significant cultural resources, both pre-contact and historic within the APE. The record should reflect all prehistoric cultural items encountered, whether defined as sites or isolates. Historic-era items shall be documented only if the items are 50 years of age or older.
6. Survey teams shall use the Washington State Archaeological Site forms, isolate forms, and protocols approved by the Washington SHPO and/or THPO and/or the federal agencies.
7. All site forms shall include site location maps, site sketch maps, and site photographs.
8. Site recording procedures shall include written or photo documentation of all pre-contact and historic-era remains encountered within the APE.
9. Site documentation shall include descriptions and assessments of ongoing impacts, to provide data needed for proper evaluation of Project effects and management needs.
10. Sites shall be defined as per the protocols listed in section 3.7 of the HPCRMP.

5.3 Site Monitoring

The conditions of cultural properties in the APE are subject to change through natural processes and human interference. Changes in a site's condition may affect its NRHP eligibility. Current assessments of Project effects are based on existing knowledge and judgments that have not been confirmed by systematic long-term evaluation. In addition, there are several sites that are of sensitive nature and need to be monitored as opposed to other treatment alternatives.

Historic Properties and Cultural Resources Management Plan

Chelan PUD shall maintain current information on site conditions through a monitoring plan designed to update site information on a regular basis using a rotation system that prioritizes sites on the basis of current assessments of Project effects. Annual revisits and monitoring shall be conducted by a monitoring team selected by Chelan PUD in consultation with the LCCF at those sites subject to the most severe and sustained Project effects (i.e., erosion), and those sites documented as containing burials. Monitoring teams shall be comprised of professional archaeologists and archaeological technicians (following the guidelines provided in section 5.2 of the HPCRMP).

Every three to five years, Chelan PUD shall monitor historic properties on a schedule agreed to by the LCCF those sites thought to be subject to Project effects to a lesser degree (not threatened by Project effects). Site-by-site priorities will be reviewed annually by the LCCF.

During site revisits, archaeological monitoring teams shall update site records by comparing surface-visible traces with the existing site record and to provide supplementary information not included in the prior record. Any errors in the prior record must be corrected during the site revisit. Also, changes in site conditions must be documented. Photographs at each revisit must be included in the site form and should be taken at the same general location at each visit. Monitoring data shall be recorded on a standard form and appended to the existing site record and provided by the monitoring teams to the SHPO/THPO, all appropriate federal land-managing agencies, and to Chelan PUD.

Monitoring results shall be documented after each monitoring session in an Annual Report on Cultural Resources to be reviewed by SHPO/THPO and the LCCF.

5.3.1 Deposits of natural origin

The occurrence or exposure of volcanic ash lenses (tephras) could provide paleoenvironmental and chronological data important in evaluating archaeological sites within the Lake Chelan APE. Chelan PUD employees or contractors shall notify the Chelan PUD Cultural Resources Coordinator of any such exposures.

5.4 Discovery Provisions

Archaeological investigation methods are designed to discover material evidence of past cultural activities. Generally, discovery is initiated by the occurrence of cultural materials observed during professional pedestrian survey or notification of surface exposures by concerned citizens. Subsurface examination is designed to systematically occur during the evaluation process. However, it is always possible that deeply buried archeological deposits may remain undetected, only to be exposed by later erosion or other ground disturbing activities.

In the event that archaeological deposits are encountered during any Project-related activity, all actions must stop at that location and the Chelan County PUD Cultural Resources Coordinator shall be notified immediately. Because of the potential of each archaeological deposit to contain Native American human remains or cultural materials, failure to report discovery of archaeological deposits may result in violation of ARPA and other related federal and state laws resulting in fines and penalties.

*Historic Properties and Cultural Resources
Management Plan*

When notified of the possible discovery of archaeological deposits, security shall be provided at the site until the Cultural Resources Coordinator determines the appropriate short-term treatment of the site. The Chelan PUD Cultural Resources Coordinator and a professional archaeologist shall visit the location within one (1) workday of notification to examine the discovered material and any *in situ* deposits. If the Cultural Resources Coordinator and/or the professional archaeologist determines that the site contains human remains, funerary objects, sacred objects, or objects of cultural patrimony, then all work activity at the location shall be halted until the SHPO/THPO, the affected tribe, and any federal or state land manager with jurisdiction over the lands containing the discovery have been notified and suitable arrangements have been made regarding disposition of the exposed materials.

5.4.1 Pre-contact archaeological materials other than human burials or remains

If any employee of Chelan PUD, its contractors, or subcontractors believes that he or she has found a cultural resource, all work adjacent to the discovery shall cease and the Chelan PUD Cultural Resources Coordinator shall be notified. A pre-contact cultural resource discovery may consist of an area of charcoal or charcoal-stained soil, an arrowhead, stone tool, or flaked stone chips, a cluster of bones or burned rocks associated with artifacts. Security shall be provided at the site until the Cultural Resources Coordinator determines the appropriate short-term treatment of the site.

If the Chelan PUD Cultural Resources Coordinator believes that the discovery is a cultural resource, the Coordinator shall take appropriate steps to protect the discovery site. Vehicles, equipment, and unauthorized personnel shall not be permitted to traverse the discovery site. Work in the immediate area shall not resume until treatment of the discovery has been completed.

Chelan PUD shall arrange for the discovery to be evaluated by a Professional Archaeologist. The archaeologist shall immediately contact the SHPO/THPO, Chelan PUD and the appropriate federal or state land-managing agency to seek recommendations regarding NRHP-eligibility of the discovery. If the discovery is an eligible pre-contact archaeological deposit, then the affected Indian Tribes shall be contacted regarding the appropriate treatment of the discovery. Treatment measures may include protection in place or data recovery.

5.4.2 Euro-American archaeological remains

Historic-era archaeological remains may consist of a cluster of tin cans or bottles, logging or agricultural equipment, or the remains of structures or foundations older than 50 years. The same conditions apply to historic-era cultural resources discoveries as indicated above for pre-contact discoveries.

5.5 Resource Evaluation

Archaeological sites in the Project APE have been prioritized for management attention on the basis of NRHP eligibility and Project effect concerns. Many sites at the top of the priority list have been investigated and evaluated (DOE documentation is pending). Sites lower on the priority list should be formally evaluated by Chelan PUD in consultation with the LCCF. The precise number of evaluated sites each year shall depend on overall priorities for cultural

*Historic Properties and Cultural Resources
Management Plan*

resources work. Priorities shall be updated annually and should consider recommendations from the LCCF. Priority shall be applied to sites for which Project effects or developments are perceived as immediate or potentially destructive.

All evaluations of NRHP eligibility and Project effects shall follow the regulations in 36 CFR 800 and take into account other official guidelines and regulations (i.e., National Register Bulletin 15: Guidelines for Applying the National Register Criteria for Evaluation).

As part of the formal evaluation, Chelan PUD shall meet with the appropriate land-managing agency to seek recommendations on the evaluation, update the site record forms to include any new information, and coordinate all activities with the LCCF. Copies of all update site forms shall be provided to SHPO/THPO, the affected tribe, and the appropriate land-managing agency.

New data recovered during evaluation or other research efforts are expected to be analyzed and compared against existing data within the framework of the research design developed for Lake Chelan (Hartmann 2001). All evaluations shall be written and reported on an annual basis and the document shall be reviewed by Chelan PUD and the LCCF prior to being submitted to the SHPO/THPO and land-managing agencies.

5.6 Emergency Responses

Chelan PUD may be required at different times during the course of the New License to respond to emergency situations such as unanticipated oil spills, wildfires, or other natural disasters. The Cultural Resources Coordinator shall work closely with the guidelines of Chelan PUD's Emergency Response Plan. Should any unanticipated emergency occur and cultural resources are affected, then the Cultural Resources Coordinator shall notify OAHP of the situation as soon as practicable, and request guidance in accordance with Chelan's Emergency Response Plan for evaluation and treatments for the cultural resource(s) that may be affected. The Cultural Resource Coordinator shall notify federal agencies the SHPO, THPO, the affected tribe and interested tribes as soon as practicable when cultural resources are affected or impacted by unanticipated emergencies or natural disasters so that consultation can be undertaken and a coordinated effort can be made in these cases.

5.7 Procedures for Review of Proposed Actions/Coordination with Other Agencies

Chelan PUD is obligated to identify and evaluate all historic properties within the Lake Chelan APE. Section 110 of the NHPA mandates consultation with the SHPO, THPO, federal agencies, tribes, and other interested parties for its undertakings that may affect cultural resources. These agencies and tribes shall be invited to participate in the LCCF that will be maintained for purposes of developing recommendations and coordination of projects that may affect cultural resources during the life of the New License. Chelan PUD shall consult with appropriate federal and/or state agencies regarding its undertakings that affect cultural resources on Agency lands, and shall consult with the Confederated Tribes of the Colville Reservation (CCT) and Yakama Nation (YN) regarding actions affecting cultural resources of interest to those respective tribes. Chelan PUD shall acquire landowner permission prior to any activities on private lands.

*Historic Properties and Cultural Resources
Management Plan*

5.8 Curation of Archival Materials and Artifacts

Chelan PUD, in consultation with the LCCF, will arrange for curation to preserve the Project's archaeological materials and documentation according to the guidelines of 36CFR79. Chelan PUD will coordinate with federal agencies for curation of collections from sites on federally managed lands. Chelan PUD will provide for the safety, security, and accessibility of the collections.

At the minimum, until an appropriate repository is selected, Chelan PUD will store the archaeological materials in the Rocky Reach Dam Museum or at a location approved by the federal/state agencies and the affected tribes. The chosen repository will consult with Chelan PUD and the affected Indian Tribes regarding their concerns about culturally appropriate curation as well as their concerns about any loans that are made of Project materials and the need for qualified researchers to have access to the materials. Chelan PUD shall prepare a draft curation plan within one year of the effective date of the New License, and complete a final curation plan within three years of the effective date of the New License.

5.9 Information Management

Chelan PUD shall develop an integrated cultural resource information management system that is coordinated with all other Chelan PUD projects, to the extent reasonable and practicable. This system shall be developed in coordination with the Rocky Reach Hydroelectric Project and shall be addressed in greater detail within the HPCRMP developed for that Project. The integrated Information Management System shall include cultural resource data from the Lake Chelan Hydroelectric Project, the Rocky Reach Hydroelectric Project, and the Rock Island Hydroelectric Project. Information management shall include a library system that maintains cultural resource documents prepared for all projects listed above.

Known artifacts, reports, documentation, photographs, and maps relating the APE that are scattered in collections across Washington State shall be integrated into a single system, to the extent reasonable and practicable. A database will be developed to incorporate the large amounts of data pertaining to the cultural resources programs that have been conducted by Chelan PUD. The database will contain artifact catalogs, site data, and pertinent reference materials. The Integrated Information Management system (IIMS) shall be coordinated with the curation plans developed for the hydroelectric projects under the management of Chelan PUD

SECTION 6: IMPLEMENTATION AND SCHEDULE

6.1 Implementation

The following sections briefly discuss the procedures that will be used to implement the HPCRMP, and the costs and schedule associated with implementation.

6.1.1 Procedures

Prior to issuance of a New License, FERC staff shall prepare a Programmatic Agreement (PA) that will require Chelan PUD to implement the HPCRMP after license issuance. The PA shall

*Historic Properties and Cultural Resources
Management Plan*

provide for dispute resolution and contain other standard provisions commonly found in PAs for new licenses.

Chelan PUD shall develop a planning document that incorporates the planning and budgetary processes designed to insure that elements of the HPCRMP are carried out. This document shall include a listing of task assignments for each year of the schedule that shall include estimated costs for each task.

6.1.2 Costs

Chelan PUD acknowledges that implementation of the HPCRMP may exceed the estimated total capital costs, depending on the results of ongoing evaluation studies, site protection measures, inadvertent discoveries, and an approved curation plan. Chelan PUD is responsible for all of these costs. The estimated annual costs to Chelan PUD for implementation measures (i.e. subsections 10(a) through 10(h) of the Proposed License Articles) are \$20,000. The estimated annual cost to Chelan PUD for the interpretive and education plan is \$1000.

The estimated total capital costs to Chelan PUD for cultural resource site protection for historic properties identified during relicensing, and for sites that may be identified during completion of site evaluations and surveys that were initiated during relicensing, are \$225,000. In the event that the costs to Chelan PUD relating to a single site [described in Table 10-2 of Chapter 10 of the Comprehensive Plan] exceed \$150,000, section Proposed License Article 12 [relating to unforeseen resource needs] shall apply. In the event that the funds provided in this section and the contingency fund provided in Proposed License Article 12 are exhausted, Chelan PUD shall continue to follow the procedures contained in the Programmatic Agreement.

6.1.3 Schedule

After the New License has been accepted, Chelan PUD shall implement the HPCRMP once it is has been approved by the FERC. Table 10-3 summarizes the schedule for implementing the management measures discussed in previous sections above. All of the deadlines are measured from the date that Chelan PUD accepts the new Project license.

***Historic Properties and Cultural Resources
Management Plan***

Table 10-3: Schedule for Implementing Management Measures.

Measure	Frequency	Deadline
Appoint Cultural Resources Coordinator	Once	180 days after effective date of New License
Prepare monitoring plan for Agency and Tribal review	Once	Within one year of effective date of the New License
Prepare project curation standards for artifacts and documents	Once	Within one year of effective date of the New License
Designate curation repository	Once	Within three years of the effective date of the New License
Review applicable federal and state laws and regulations	Yearly	First quarter
Convene LCCF	As determined by LCCF	Beginning 180 days of the effective date of the settlement Agreement
LCCF review of annual PME schedules and locations as they relate to cultural resources	Yearly	First quarter
Meet with CCT and YN Representatives	Yearly	Third quarter
Develop interpretive plan and educational program	Once	Within three years of the effective date of the New License
Initiate development of TCP management plan	Once	Within one year of the effective date of the New License
Review/Revise management measures	Every year	First quarter
Train project personnel	Every three years	Third quarter
Completion of inventory on NPS lands as part of relicensing	2003	During annual draw down
Completion of site testing as part of relicensing	2003	During annual draw down
Begin protection efforts at endangered sites	Once	Within 180 days of the effective date of the New License
Archaeological monitoring reservoir shoreline/draw down areas	As provided in the monitoring plan	As provided in the monitoring plan
Inventory and evaluate NRHP eligibility	Every 5 years	Beginning 2005
Resurvey of Lake Chelan APE	Every 15 years	Beginning 2014

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Management Plan***

APPENDIX A: FEDERAL CULTURAL RESOURCE MANDATES

Table A-1: Federal Cultural Resource Mandates

Federal Statute	Designation
<i>American Indian Religious Freedom Act of 1978, as amended</i>	42 USC 1996-1996a
<i>Antiquities Act of 1906</i>	16 USC 431-433; 34 Stat. 225
<i>Archaeological and Historic Preservation Act of 1974</i>	16 USC 469-469c
<i>Archaeological Resources Protection Act of 1979</i>	16 USC 470aa-470ll
<i>Historic Sites Act of 1935</i>	16 USC 461-467
<i>National Environmental Policy Act</i>	42 USC 4321-4370c
<i>National Historic Preservation Act of 1966, as amended</i>	16 USC 470-470w
<i>Native American Graves Protection and Repatriation Act of 1990</i>	25 USC 3001-3013
<i>Reservoir Salvage Act of 1960</i>	16 USC 469
Federal Regulations	Designation
<i>Cultural Resource Management, Bureau of Reclamation Policy</i>	LND P01
<i>Cultural Resource Management, Bureau of Reclamation Directives and Standards</i>	LND 02-01
<i>Curation of Federally-owned and Administered Archaeological Collections</i>	36 CFR 79
<i>Determinations of Eligibility for Inclusion in the National Register of Historic Places</i>	36 CFR 63
<i>National Historic Landmark Program</i>	36 CFR 65
<i>National Register of Historic Places</i>	36 CFR 60
<i>Native American Graves Protection and Repatriation Act</i>	43 CFR 10
<i>Preservation of American Antiquities</i>	43 CFR 3
<i>Protection of Archaeological Resources</i>	43 CFR 7
<i>Protection of Historic and Cultural Properties</i>	36 CFR 800
<i>Regulations Implementing the National Environmental Policy Act</i>	40 CFR 1500-1508
<i>Secretary of the Interior's Standards for Federal Agency Historic Preservation Programs</i>	FR 20495
<i>Secretary of the Interior's Standards for Rehabilitation (of Historic Buildings)</i>	--
<i>Secretary of the Interior's Standards for Treatment of Historic Property</i>	36 CFR 68
<i>Supplemental Regulations (per ARPA)</i>	43 CFR 7.2
<i>USACE Standards for Processing and Placing Collections into Collections Management Centers</i>	--
<i>USACE Standards for Collections Management Centers</i>	--
<i>USACE Environmental Stewardship Operations and Maintenance Policies, Chapter 6 "Cultural Resource Management"</i>	ER 1130-2-540
Executive Orders and Presidential Memoranda	Designation
<i>Protection and Enhancement of the Cultural Environment</i>	EO 11593
<i>Protection of American Indian Sacred Sites</i>	EO 13007
<i>White House Memorandum for the Heads of Executive Departments and Agencies, dated April 29, 1994</i>	--
<i>Consultation and Coordination with Indian Tribal Governments</i>	EO 13175
<i>Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations</i>	EO 12898
Agreements	
<i>Programmatic Memorandum of Agreement Between the Advisory Council on Historic Preservation; the Corps of Engineers, Walla Walla District; the Washington, Oregon, and Idaho State Historic Preservation Officers, 1992</i>	

***Historic Properties and Cultural Resources
Management Plan***

APPENDIX B: PREVIOUS ARCHAEOLOGICAL STUDIES

Table B-1: Previous Cultural Resource Studies in the Chelan Area.

AUTHOR	DATE	TITLE	PROJECT LOCATION	RESULTS
Smith, W.C. and D.H. Stratton	1976	A Cultural Resource Survey of the Wapato Point Area, Chelan County	116 acres at Wapato Point	Six structures and seven aboriginal isolates recorded.
Solland, S. O. and M. A. Duncan	1976	State Parks Capital Projects Archaeological Site Investigation	Inventory of Lake Chelan State Park for renovations.	Stevenson cabin recommended eligible to the NRHP; preservation actions recommended.
Hartmann, G.D.	1979	Archaeological Test Excavations on Lucerne Bar	North of Refrigerator Harbor	Cultural materials were recovered and protection recommended.
Benson, C. L.	1979	Archaeological Assessments of State Parks Capital Projects, 1977-79.	Lake Chelan State Park	No cultural remains in the project area.
Holley, G. A.	1980	Archaeological Assessments of State Parks Capital Projects, 1979-1981.	Lake Chelan State Park	No cultural resources reported.
Bohannon, C. F.	1980	Archaeological Assessment of Field's Point.	Field's Point, approximately 13 miles northwest of the town of Chelan.	No cultural resources were reported.
Gleeson, P.F.	1982	Cultural Resource Survey of the Proposed Wapato Beach Club Associates Development	144 acres at Wapato Point	Four areas of historic interest reported.
Thompson, G.	1982	Cultural Resources Survey of Three Recreation Areas to be Developed as Part of the Lake Chelan Hydroelectric Project.	Near the town of Chelan.	St. Andrew's Episcopal Church (45CH245H) and the East Manson site; foundations and debris associated with a historic mill and box factory.
Larson, L. L.	1986	Cultural Resources Assessment of Proposed Parking Lot at Lake Chelan State Park	Lake Chelan State Park	No cultural resources were reported.
Mierendorf, R.R.	1986	Cultural Resource Survey and Overview of National Park Service lands in the North Cascades including Lake Chelan	Lake Chelan and other NPS managed lands	Cultural resources were reported.
Reid, K.	1987	Inventory for US Postal Service facility at the east end of Chelan	Project area was .35 acre, approximately 1 mile east of Lake Chelan.	No sites were found.

*Historic Properties and Cultural Resources
Management Plan*

AUTHOR	DATE	TITLE	PROJECT LOCATION	RESULTS
Larson, L. L.	1987	Archaeological Assessments of State Parks Capital Projects, 1985-1987.	Lake Chelan State Park	Site 45CH217, an aboriginal site inundated by the Lake, and the Stevenson Cabin.
Lenz, M.	1987	Mitchell Creek Dock Reconstruction and Campground Improvement Cultural Resource Reconnaissance.	The alluvial fan of Mitchell Creek at Lake Chelan.	Mitchell Creek CCC shelter and the CCC stove/fireplace construction.
Schalk, R.	1989	A Cultural Resource Reconnaissance at Twenty-Five Mile Creek State Park.	The confluence of Twenty-Five Mile Creek and Lake Chelan.	No cultural resources were recorded.
Lenz, M.	1990	Crupina Eradication Project Cultural Resource Reconnaissance Report.	291.5 acres on the north shore of Lake Chelan, from Prince Creek to Hunt's Bluff	Moore's Inn and associated features (Site FS 02-29-677) and possible housepits (Site FS 02-30-677).
Lenz, M.	1990	Box Canyon Trail Reconstruction Project Cultural Resource Reconnaissance.	West lakeshore south of Box Canyon	No cultural resources were recorded.
Schalk, R.	1990	Cultural Resources Reconnaissance in Washington State Parks Biennial Summary for 1987-1989.	Lake Chelan State Park.	No cultural resources were recorded.
Niman, R.	1990	Grade Helo Timber Sale - Grade Creek Cultural Resource Reconnaissance Report.	Vicinity of Little Grade Creek, Coyote Creek, Falls Creek & Grade Creek. Approximately 2500 acres were surveyed	Seven historic-era sites were identified: Grade Creek Dam (FS-06-17-02-31), Grade Creek Cabin (FS-06-17-02-32), Grade Creek Flume (FS-06-17-02-33), Coyote Creek Reclam. Camp (FS-06-17-02-34), Camas Creek Reclam. Camp (FS-06-17-02-35), Falls Creek Dam (FS-06-17-02-36) and Cabin Creek Cabin (FS-06-17-02-37)
Niman, R.	1991	Grade Helo Timber Sale-Lafferty Cultural Resource Reconnaissance Report	First Creek drainage east of Lake Chelan. Approximately 500 acres were surveyed.	No cultural resources were located.
Moore, L. L.	1991	Fish Creek Bridge Reconstruction Cultural Resource Reconnaissance	On Fish Creek near Moore's Point. The project area is 0.25 acres.	No cultural resources were found in the project area.

***Historic Properties and Cultural Resources
Management Plan***

AUTHOR	DATE	TITLE	PROJECT LOCATION	RESULTS
Mierendorf, R.R. and D. Harry	1992	A Progress Statement on Archeological Survey and Testing of Lands along Lake Chelan, Lake Chelan National Recreation Area	215 acres within the North Cascades National Park	Seven sites were reported: six aboriginal and one historic site. Four of the sites were previously recorded.
Stevens, R. A.	1992	Results of a Cultural Resources Survey of the Snowcreek Development Company's Proposed 18 Hole Golf Course on Chelan Butte	165 acres on the north slope of Chelan Butte overlooking the eastern end of Lake Chelan	Three homesteads and one isolated find were recorded.
Niman, R	1992	Slide Ridge Storm Channel Cultural Resource Reconnaissance Report	South lakeshore 12 miles north of Chelan. Approximately 10 acres were surveyed	No cultural resources were reported.
Niman, R.	1993	Field's Point Small Tracts Cultural Resource Reconnaissance.	West lakeshore 19 miles north of Chelan. Approximately .1 acre was surveyed.	No cultural resources were recorded.
Holstine, C.	1998	Fish Creek Fish Passage Project (SR 971)	0.7 mile of roadway surveyed for culvert replacements	No cultural resources were recorded.
Freiberg, S.D.	1998	Heritage Resources Survey Report for the Willow Point Sewer Extension	One-half acre at Willow Point.	No cultural resources were recorded.
Freiberg, S. D.	1998	Heritage Resources Survey Report for the Chelan River Isenhart Irrigation District New Domestic Water System	3.9 acres on the east end of Chelan	No cultural resources were recorded.

*Historic Properties and Cultural Resources
Management Plan*

**APPENDIX C: PREHISTORIC AND HISTORIC CULTURAL
RESOURCES IN THE LAKE CHELAN APE**

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*Historic Properties and Cultural Resources
Management Plan*

APPENDIX D: LIST OF CATEGORICAL EXCLUSIONS

Table D-1: Categorical Exclusions (Activities that do not require consultation with SHPO/THPO) to the Lake Chelan Dam Historic Structures and Powerhouse

Structural Elements

1. Repair or replacement of trim, or hardware when done in kind to match existing material and design;
2. Replacement of glass when done in kind to match existing material and design: window panes may be double or triple glazed as long as the glazing is clear and replacement does not alter existing window material and form. This excludes the use of tinted glass, which will require construction;
3. Maintenance of features such as frames, paneled or decorated jambs and molding through appropriate surface treatments such as cleaning, rust removal, paint removal, and reapplication of protective coating systems;
4. Repair or replacement of doors, when done in kind to match existing material and form;
5. Repair or replacement of roofs or parts of a roof that are deteriorated, when done in kind to match existing material and design. Adequate anchorage for roofing material to guard against wind damage and moisture penetration shall be provided;
6. Repair or replacement of gutters and drain pipes, when done in kind to match existing material and design;
7. Repair or replacement of porches and stairs when done in kind to match existing material and design;
8. Repair of window and doorframes by patching, splicing, consolidating, or otherwise reinforcing or replacing in kind those parts that are either extensively deteriorated or are missing. The same configuration of panes will be retained;
9. Repair or replacement of window and door screens when done in kind to match existing material and design;
10. Alteration, repair, and/or modification of the interior of buildings/structures, not impacting on exterior appearance; and
11. Demolition of non-contributing buildings/structures within the Hui Creek Historic District boundaries that have been evaluated and found to be non-contributing elements of the District.

Surfaces

1. Painting or patching exterior surfaces when the new paint or patch material matches the existing or original color/material;
2. Replacement or installation of caulking and weather-stripping around windows, doors, walls, and roofs; and

*Historic Properties and Cultural Resources
Management Plan*

3. Removal of non-original intrusive surface applied elements such as exterior wall mounted conduit, pipes, wiring, junction boxes, etc.

Utility Systems

1. Installation of mechanical equipment that does not effect the exterior of the buildings/structures; and
2. Replacement, removal, or upgrading of electrical wiring.

Surrounding Features

1. Ongoing maintenance of immediately surrounding landscaping, including such modifications as removing diseased or safety-threatening vegetation;
2. Repair or replacement of street or road surfaces, curbs, driveways and walkways done in kind to match existing materials and design; and
3. Repair or replacement of fencing done in kind to match existing material and design.

New Materials

1. Installation of dry insulation;
2. Installation of securing devices, including dead bolts, door locks, window latches, and door peepholes. Damage to historic doors and windows should be minimized during installation;
3. Installation of fire or smoke detectors;
4. Installation of securing systems; and
5. Installations of screening or other like materials in order to protect the building/structure from rodents and other intrusive wildlife (e.g. bat screening).

Ground Disturbing Activities (when no prehistoric materials are present)

1. Excavations for repair or replacement of building footings or foundation work within two (2) feet of existing footings and foundations;
2. Installation of utilities, such as sewer, water, storm, electrical, and gas, where installation is restricted to areas previously disturbed by installation of these utilities;
3. Tree or shrub planting or removal in areas that have been previously disturbed by these activities; and
4. Installation of landscape sprinkler systems around the dam powerhouse.

***CHAPTER 11: LAKE CHELAN HYDROELECTRIC PROJECT
RECREATION RESOURCES MANAGEMENT PLAN***

*Recreation Resources Management Plan***TABLE OF CONTENTS**

CHAPTER 11: LAKE CHELAN HYDROELECTRIC PROJECT RECREATION RESOURCES MANAGEMENT PLAN	11-1
SECTION 1: Introduction	11-1
1.1 Purpose of this Plan	11-1
1.2 Exhibit R Summary	11-1
1.3 The Planning Process.....	11-2
SECTION 2: Existing Conditions	11-5
2.1 Existing Recreation Development and Use.....	11-5
SECTION 3: Recreation Demand, Facility Needs and Resource Capacity	11-21
3.1 Lower Chelan Basin Zone Demand and Needs Analysis.....	11-21
3.2 Middle Chelan Basin Zone Demand and Needs Analysis	11-24
3.3 Upper Chelan Basin Zone Demand and Needs Analysis	11-27
3.4 Ability of Project Area to Accommodate Needs.....	11-31
SECTION 4: Development Plan and Implementation Schedule	11-35
4.1 Development of Recreation Enhancement Options	11-35
4.2 Recreation Measures and Implementation Schedules	11-35
4.3 Recreation Use Study.....	11-48
4.4 Recreation Resources Management Plan Review Schedule	11-49
SECTION 5: Literature Cited	11-51
APPENDIX A: As-Built Drawings of Chelan PUD Recreation Sites.....	11-53

*Recreation Resources Management Plan****LIST OF TABLES***

Table 11-1: Existing Facilities at Lower Chelan Basin Zone Public Recreation Sites.....	11-10
Table 11-2: Existing Facilities at Middle Chelan Basin Zone Public Recreation Sites.....	11-13
Table 11-3: Existing Facilities at Upper Chelan Basin Zone Public Recreation Sites	11-14
Table 11-4: Estimated Average Daily Use at Lower Chelan Basin Zone Sites*	11-15
Table 11-5: Estimated Average Daily Use at Middle Chelan Basin Zone Sites*.....	11-16
Table 11-6: Estimated Average Daily Use at Upper Chelan Basin Zone Sites*	11-17
Table 11-7: Lower Chelan Basin Zone Sites - Estimated Average Daily Use By Activity.....	11-18
Table 11-8: Middle Chelan Basin Zone Estimated Average Daily Use By Activity*.....	11-19
Table 11-9: Upper Chelan Basin Zone Estimated Average Daily Use by Activity*.....	11-20
Table 11-10: Summary of Lower Chelan Basin Facilities Current and Projected Peak Day Facility Utilization ..	11-32
Table 11-11: Summary of Middle Chelan Basin Facilities Current and Projected Peak Day Facility Utilization .	11-33
Table 11-12: Summary of Upper Chelan Basin Facilities Current and Projected Peak Day Facility Utilization...	11-34
Table 11-13: USDA Forest Service Dock Measures	11-37
Table 11-14: USDA Forest Service Recreation Measures	11-37
Table 11-15: NPS Dock and Recreation Measures	11-39

LIST OF FIGURES

Figure 11-1: Lake Chelan Recreation Sites.....	11-4
Figure 11-2: Proposed Access to Chelan River	11-50

Recreation Resources Management Plan

SECTION I: INTRODUCTION

1.1 Purpose of this Plan

The plan contained in this Chapter updates the existing Recreation Plan (Exhibit R to the existing License) submitted by Chelan PUD in 1976 in conjunction with the first relicensing of the Project. It describes Chelan PUD's plans for the utilization, design, and development of Project recreation facilities and public access to the Project Area, as required by 18 CFR 4.51(f)(5). The plan was prepared in consultation with appropriate local, state and Federal recreation agencies and planning commissions, the National Park Service (NPS) and the USDA Forest Service and other Federal and state agencies with land management responsibilities for any part of the Project Area.

1.2 Exhibit R Summary

The 1976 Lake Chelan Project Exhibit R Recreation Plan identified four sites on the Lake Chelan Reservoir for recreational development. The first three, Chelan Riverwalk Park, Manson Bay Park, and Old Mill Park, were completed by Chelan PUD and opened to the public during the mid-1980s. Chelan PUD also contributed funding for a fourth site, the Lake Shore Access Site, located near downtown Chelan. That site, owned by the City of Chelan, provides public access to a swimming beach on Lake Chelan for Chelan residents and visitors. These recreation sites represent Chelan PUD's commitment to providing recreational facilities and access to Lake Chelan (as-built drawings of these the four sites are provided in Appendix A to this Chapter).

The four sites are described below. The location of these recreation sites, as well as other public recreation sites in the Project Area is shown on Figure 11-1.

Chelan Riverwalk Park

Located on the Chelan River in downtown Chelan, this 12-acre park consists of a one-mile scenic loop trail, year-round boat launch, short-term moorage, boat trailer parking, grass play field, restrooms, picnic areas, and a picnic shelter. Chelan Riverwalk Park is owned and operated by Chelan PUD.

Old Mill Park

Located two miles east of Manson, this 20-acre site includes nine acres of developed park, and features a four-lane boat launch (accessible year-round), short-term moorage, a marine dump station, boat trailer parking, picnic area, fish cleaning station, and restrooms. Access to this site is from Highway 150. Old Mill Park is owned by Chelan PUD and managed by the Manson Park and Recreation District.

Manson Bay Park

Located on the north shore of Lake Chelan, in downtown Manson, this six-acre park features a lake overview, swim area, picnic area, restrooms, boat launch (open during winter months only, to provide launching during low water conditions), and public boat docks. Access to the site is from Highway 150. Manson Bay Park is owned by Chelan PUD and is managed by the Manson Park and Recreation District.

Recreation Resources Management Plan

Shore Access Site

This is a small site located about 200 feet to the East of Chelan Riverwalk Park, and immediately adjacent to State Highway 97. The site is adjacent to the USDA Forest Service Chelan Ranger Station and is used as a shore access point for swimming and visiting the beach. The site is owned by the City of Chelan.

On May 12, 1981, FERC granted Chelan PUD a new 30-year License for the Project, retroactive to 1974 when the original 50-year License expired. That License expires on March 31, 2004.

Chelan PUD is seeking another new federal License to operate the Project, and began the relicensing process in 1998. The FERC relicensing process regarding recreation issues requires extensive planning, including environmental studies, consultation with relevant agencies, and public involvement. The following are the studies conducted as part of the relicensing process to assess and record recreational use at Project recreation facilities and other related public recreational sites:

- Recreation Use Assessment Study Report (Chelan PUD, 2000a). This report provides the results of data collection efforts and surveys regarding existing recreational use. It was conducted during the summer and fall of 1998 and spring of 1999.
- Recreation Needs Forecast and Analysis Report (Chelan PUD, 2000b). This report provides an analysis of the current and future recreation use, demand, and needs at public recreation sites and waters within the Project Area. The study was conducted in late 1999 and early 2000.

The following studies were also used in developing this Recreation Resources Management Plan contained in this Chapter.

- Socioeconomic Study Element (Chelan PUD, 2000c)
- Aesthetics Resources Assessment Study Report (Chelan PUD, 2000d)

This Chapter is based on these reports, as well as the extensive consultation effort described in the following subsection. It is also consistent with the relevant recreation management planning documents prepared by federal, state, and other local recreation management agencies.

1.3 The Planning Process

This Recreation Resources Management Plan is the result of a three-year planning process undertaken by a Social Sciences Working Group (SSWG) consisting of the USDA Forest Service, National Park Service, Washington Department of Ecology, NOAA Fisheries, United States Fish and Wildlife Service, Washington Department of Fish and Wildlife, Interagency Committee for Outdoor Recreation, American Whitewater Affiliation, Washington Department of Parks and Recreation Commission, City of Chelan, Lake Chelan Recreation Association, Lake Chelan Boat Company, US Corp of Engineers, Manson Parks and Recreation District, the People for Lake Chelan, Chelan PUD and other interested stakeholders.

The SSWG identified recreation issues, the need for recreation use monitoring, recreation needs analysis, and the identification of recreation enhancement options. Agency and public involvement has been an integral part in the identification of recreation issues, development of study plans, preparation of the Recreation Use Assessment and Recreation Needs Forecast and

Recreation Resources Management Plan

Analysis studies, and development of this Recreation Resources Management Plan. Over 30 agency, public, and recreation working group meetings (consisting of agency and public representatives) have been held during this process. Numerous meetings were held to identify recreation issues and several versions of draft and final study plans were developed in coordination with Chelan PUD, state, federal, and local agencies, and the public.

Early in the relicensing process, agencies, the public, and Chelan PUD developed an overall Recreation Study Plan to include recreation studies and information needs for the ultimate development of a Recreation Resources Management Plan. Individual study plans, scopes of work and/or outlines were developed for the Recreation Use Assessment, Recreation Needs Forecast and Analysis, and the Recreation Resources Management Plan. Additional meetings, discussions, and reviews continued as studies proceeded. Further information was obtained, and study results and reports were prepared.

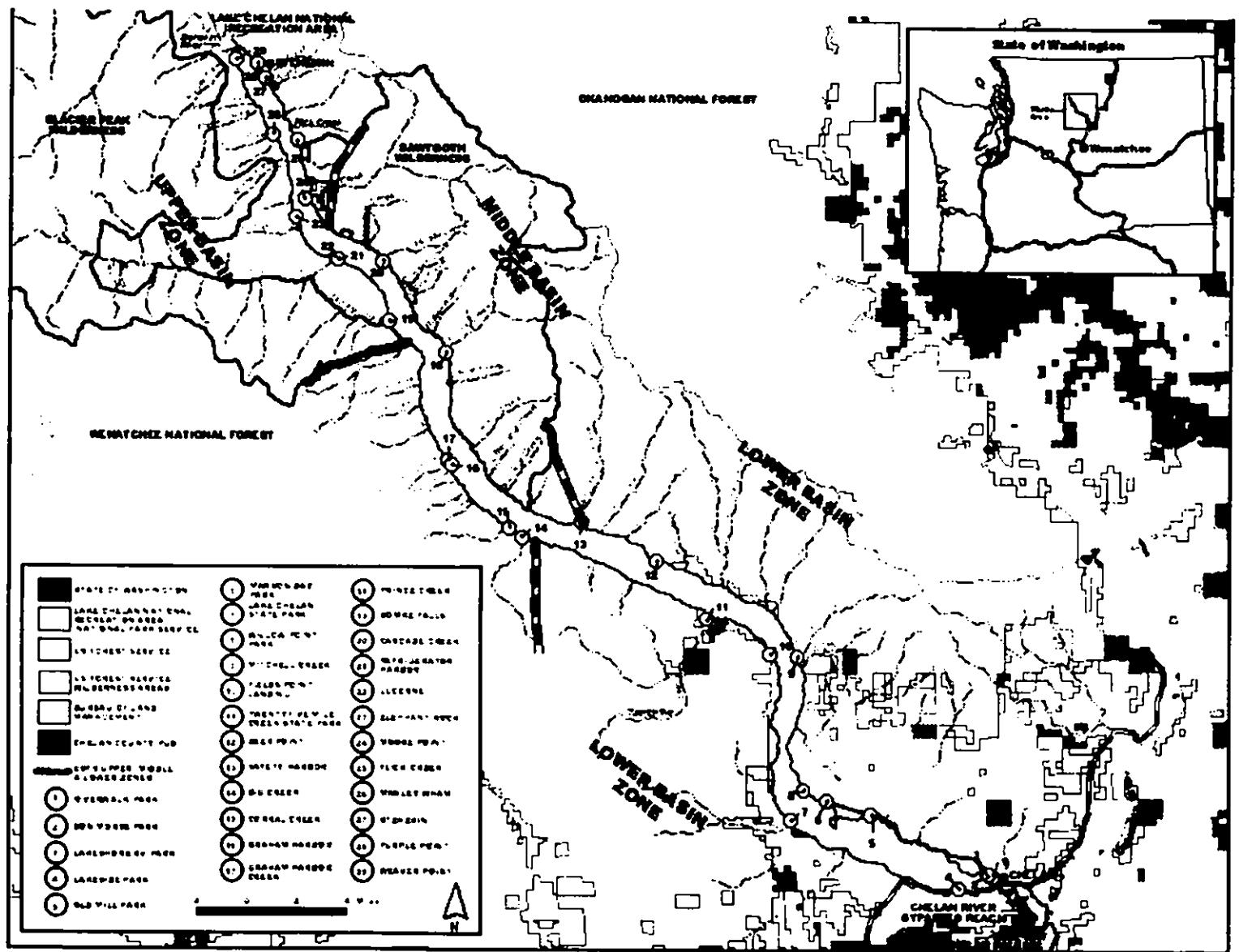


Figure 11-1: Lake Chelan Recreation Sites

*Recreation Resources Management Plan****SECTION 2: EXISTING CONDITIONS******2.1 Existing Recreation Development and Use******2.1.1 Existing Recreation Facilities*****Existing Public Recreation Facilities**

For each of the existing public recreation facilities shown on Figure 11-1, the facilities provided and site acreage is shown in Table 11-1 (for the Lower Chelan Basin Zone), Table 11-2, (for the Middle Chelan Basin Zone) and Table 11-3 (for the Upper Chelan Basin Zone).

The lower lake sites are more urban in development with irrigated lawns, hardened surfaces, paved trails, and flush toilets and can take a higher level of use. The middle and upper lake sites are more semi-private in development with native soils (no paving), native vegetation patterns, pump wells at some locations and vault toilets. The middle and upper lake sites are more limited in being able to exceed capacities without damaging natural resources. People are seeking this semi-primitive experience with a "natural appearing" landscape character, the more remote setting allowing more isolation and privacy and a higher level of rustic facilities.

In summary, existing facilities in the Lower Chelan Basin Zone include approximately 390 campsites, 11 boat launch lanes, 226 vehicle/trailer parking spaces, 134 picnic tables, 109 toilets, 3.9 acres of public beaches, and 2.1 miles of trails/walkways. Existing facilities in the Middle Chelan Basin Zone include about 41 campsites, 10 docks with capacity for about 67 boats (based on an average 21-foot boat length), 43 picnic tables, and 17 toilets. Existing facilities in the Upper Chelan Basin Zone include about 41 campsites, 8 public docks with capacity for about 43 boats (based on an average 21-foot boat length), 13 picnic tables, and 27 toilets.

Existing Private Recreation Facilities

There are a number of private resorts at the lower end of the Lake that provide access to Lake Chelan, including Campbell's Resort, Caravel Resort, Darnell's Lake Resort, Kelly's Resort, Lake Chelan Shores Resort Condominiums, Peterson's Waterfront Resort Condominiums, Wapato Point Resort, Watson's Harverenes Resort Condominiums, and Spader Bay Resort Condominiums. All of these resorts provide swimming beaches, and several, including Darnell's, Lake Chelan Shores, Wapato Point, and Watson's, have boat launches. The names and locations of significant private marinas, as well as the approximate number of boats each such marina can accommodate, is listed below. The Recreation Use Assessment and Needs Analysis studies did not attempt to analyze all the private facilities along Lake Chelan.

<u>Name</u>	<u>Location</u>	<u>Approximate # of Boats</u>
Campbell's Resort	Chelan	16
Crystal View Estates	Chelan	20
Darnell's Resort	Chelan	25
Harris Chelan Marina	Chelan	37
Lake Chelan M&M Marina	Chelan	40
Lake Chelan Shores	Chelan	15

Recreation Resources Management Plan

<u>Name</u>	<u>Location</u>	<u>Approximate # of Boats</u>
Lake Chelan Yacht Club (accessible year-round)	Chelan	40
Peterson's Resort	Chelan	12
Lake Chelan Boat Club	Manson	10
Wapato Point Resort	Manson	60
Cove Marina (accessible year-round)	Southside	60
Kelly's Resort	Southside	8
Watson's Harverenes Resort	Southside	25

2.1.2 Current Project Operation, Water Levels, and Recreation Facility Accessibility

Access to many recreational opportunities on Lake Chelan is dependent on lake elevation. Refer to Chapter 8 of the Comprehensive Plan for a full discussion of lake level management.

Public and private boat ramps on Lake Chelan generally become usable as the lake level rises to between elevations 1,090 and 1,095 feet. There are approximately 848 docks at Lake Chelan, most of which are fixed, and most of which are designed to function at the 1,098 feet level.

Public and private marinas on Lake Chelan also generally become accessible as the lake level rises to between elevations 1,090 and 1,095 feet. Some slips may be usable at lower water levels, such as 1,088 or 1,090, but in most cases the slips are fully accessible at 1,095 feet and above.

Old Mill Park boat launch, developed by Chelan PUD, is useable above lake elevation 1,082 feet. The Chelan Riverwalk and Manson Bay boat ramps are useable above lake elevation 1,079 feet, providing year-round access to Lake Chelan.

There are 22 USDA Forest Service docks located in the Upper and Middle Chelan Basin zones. are accessible year-round, including docks located at Fields Point Landing, Deer Point, Safety Harbor, Prince Creek, Corral Creek, Graham Harbor, Domke Falls, Refrigerator Harbor, Lucerne Community Dock, and Lucerne Administrative Dock. Mitchell Creek is partially accessible at 1,090 feet. At all 22 sites, the total boat capacity of the docks are available when the lake levels reach 1,096 feet.

Of the five NPS docks, only the Stehekin Marina is usable year-round. The boat landing at the Stehekin Marina is used as a portal for the Chelan Boat Company's commercial passenger ferry service, and is generally useable when the lake level is above 1,090 feet. The commercial ferry utilizes a landing area that is located a short distance from the Marina when the lake level is below 1,090 feet. Of the other NPS docks, Purple Point is accessible above 1,094 feet while Flick Creek, Manley Wham, and Weaver Point are accessible above a lake elevation of 1,096 feet.

2.1.3 Existing Recreational Use

Monitoring conducted in the Project Area in 1998 and 1999 gathered information regarding the recreation use at 29 public recreation sites, watercraft use on Lake Chelan, and dispersed use along undeveloped public shorelines.

Recreation Resources Management Plan

Field data was collected in the peak-season, from May 23 to September 7, 1998. Off-season data collection was conducted in the fall, from September 8 to Oct 3, 1998 and in the spring, from April 11 to May 23, 1999. To supplement monitoring data collection, five-year (historical) recreation visitor use statistics were collected from the National Park Service, USDA Forest Service, Washington State Parks, City of Chelan, and other recreation facility managers in the Project Area where available. Based on use data collected, most of the recreation use in the Lake Chelan area occurs during the months of July and August.

The Recreation Use Assessment Study Report contains information regarding number of visits, recreation activity type, high use locations, resource capacity, and temporal trends. The study also provided information about the level of satisfaction with the sites visited and recreation activities, as well as where people are visiting from and how often they visit, etc. The following summarizes visitor use at recreation sites and by activity, and temporal and demographic trends based on the 1998/1999 monitoring. Further information regarding resource capacity and visitors' attitudes and opinion based on surveys is summarized in section 3, below.

Estimated Number of Visits to Public Recreation Sites

The average number of visitors per day at monitored recreation sites was estimated based on observations and, where available, fee receipt and traffic counter data. Table 11-4, Table 11-5, and Table 11-6 summarize visitor use at recreation sites in the Lower Lake Zone, Middle Lake Zone and Upper Lake Zone, respectively, based on 1998/1999 monitoring results. Visitor use estimates for the peak-season (May 23 to September 7), as well as the fall (September 8 to October 3) and spring (April 11 to May 22).

Substantially more people visit down-lake public recreation sites than up-lake public recreation sites. Based on 1998 peak-season monitoring, the Lower Zone public camping and day-use recreation sites received an average of over 5,200 visitors per day, as compared to an average of approximately 280 visitors per day at up-lake (Middle and Upper zones) USDA Forest Service and NPS campground and picnic sites. Based on 1998 fall-season monitoring, down-lake sites received an estimated average of 1,400 people per day, while up-lake sites received an estimated average of 50 visitors per day. Based on 1999 spring-season monitoring, down-lake sites received an estimated average of 475 visitors per day, whereas up-lake sites received an estimated average of less than 20 visitors per day.

The down-lake sites that received the greatest number of visitors were Lake Chelan State Park, Lakeshore RV Park, Old Mill Park, Don Morse Memorial Park, and Chelan Riverwalk Park. Up-lake sites that received the greatest daily use were NPS Stehekin day-use area, Mitchell Creek, Deer Point, Safety Harbor, Graham Harbor, Weaver Point, Purple Point, and Lucerne. The use at most of the down-lake sites, and at more than half of the up-lake sites, currently exceeds their site capacities on occasion, primarily during late summer peak-season weekends and holidays. Monthly visitor use statistics are summarized in Table 4 of the 1998/1999 Recreation Use Assessment, February 2000.

Monitoring was not conducted at the City of Chelan-owned Lakeshore Marina, located next to Don Morse Memorial Park. However, conversations with Greg Moser, Park and Recreation

Recreation Resources Management Plan

Director for the City of Chelan, in October, 2000, indicated that, based on fee receipts, approximately 2,000 boats were launched in 1999 at the boat launch. Based on monitored use at Chelan Riverwalk Park Boat Launch, it can be assumed that about 80 percent of the boat launch use at Lakeshore Marina occurs during the peak-season, with approximately 67 percent of peak-season use occurring on weekends. Using the same ratios as Chelan Riverwalk Park Boat Launch and an average of three people per boat, it can be estimated that 65 people per peak-season weekend day use the Lakeshore Marina Boat Launch.

Recreation Activities at Public Recreation Sites

The average number of visitors participating in various activities at recreation sites was also estimated based on 1998/1999 monitoring. Table 11-7, Table 11-8, and Table 11-9 summarize estimated daily visitor use, by activity, at recreation sites in the Lower Lake Zone, Middle Lake Zone, and Upper Lake Zone, respectively.

Based on fee receipt data and field observations, swimming/visiting the beach was the most popular peak-season activity at Lower Chelan Basin Zone recreation sites, followed by camping, motor boating, and picnicking. During the fall season, camping was the most popular activity followed by motor boating and swimming/visiting the beach. During the spring season, most visitors were camping on weekends and motor boating on weekdays, followed by camping.

Based on field observations during the peak-season, the most popular activity of visitors to recreation sites in the Middle Chelan Basin zone during weekends was camping, followed by picnicking. On weekdays, swimming/visiting the beach and motor boating were the most popular activities observed. Based on survey questionnaires, camping was the most popular activity of fall and spring season weekend visitors to recreation sites in the Middle Chelan Basin Zone, followed by motor boating.

Based on field observations during the peak-season, camping was the most popular activity observed at Upper Chelan Basin Zone recreation sites on the weekdays, followed by motor boating, and on weekends motor boating was the most popular activity observed, followed by sightseeing and camping. Based on survey questionnaires, camping was the most popular activity of fall and spring season weekend visitors, followed by hiking in the fall and sightseeing, hiking, backpacking, and nature study/photography in the spring.

Watercraft and Dispersed Shoreline Use

Based on peak-season 1998 observations, motorized boats made up 80 percent of the watercraft use in Lake Chelan (see Table 7 of the Recreation Use Assessment Report). Personal watercraft (jetskis) made up 17 percent, and non-motorboats made up less than 4 percent of the watercraft use. Most of the peak-season motorized watercraft use was concentrated near the City of Chelan, with another hub of activity near Stehekin (see Tables 9, 10 and 11 of Recreation Use Assessment Report). Non-motorized watercraft use in the peak-season was mostly between the City of Chelan and Deep Harbor (see Tables 12, 13, and 14 of the Recreation Use Assessment Report). Few watercrafts were observed on Lake Chelan during the off-season, and 95 percent of watercraft observed was motorized. Most of the off-season watercraft use was between Wapato Point and Camas Creek, with few watercrafts observed up-lake of Deep Harbor.

Recreation Resources Management Plan

Activity observed on the undeveloped portions of the lake shoreline, which was not monitored by other methods, was minimal, with a maximum of 26 people observed during a single peak-season weekend day. No shoreline activity was observed in the off-season. Due to the steep shorelines along undeveloped areas of the lake, there are few areas, outside of developed recreation sites, that are accessible. Camping was the main activity that was observed along the shoreline. Other activities observed included swimming/visiting the beach, off-road vehicle riding, hiking, and walking. All of the activity observed along the shoreline in undeveloped areas was up-lake of Fields Point, with most of the activity occurring between Fields Point and Camas Creek. See Tables 8, 18, and 19 of the Recreation Use Assessment Study Report.

Temporal Trends and Visitor Demographics

Based on the 1998/1999 recreation monitoring, recreation sites had the greatest number of visitors during the month of July. The summer months received almost four times more visitors per day at recreation sites in the study area than the fall months. The fall months received more use than the spring months. Weekends received more visitor use than weekdays.

In the Project Area, most of the peak-season visitors are from the Seattle metropolitan area (41%) and Chelan and Douglas Counties (29%). Fall-season down-lake visitors are also mostly from the Seattle metropolitan area (47%) and other Washington cities or counties (20%). Spring-season down-lake visitors are mostly from the Seattle metropolitan area (39%) and from Chelan and Douglas counties (34%). Off-season up-lake visitors are mostly from the Seattle metropolitan area (31%) and from Chelan/Douglas counties (35%).

Table 11-1: Existing Facilities at Lower Chelan Basin Zone Public Recreation Sites

Site/Owner	Acres	Camping	Picnic & Day-Use Facilities	Boating Facilities	Swimming	Trails/Walk-ways	Interpretation Facilities	ADA Compliance
Chelan Riverwalk Park (ChelanPUD) (includes Chelan Chamber Building)	12.5	No	5 picnic tables 5 (in shelter). 90 parking spaces Benches throughout 2 fishing piers 3 restrooms/12 toilets.	Year-round accessible boat launch 2 launch lanes 18 off and on-street parking spaces 1 tie up dock @ launch site 1 tie up dock below picnic shelter area 1 tie up dock near Hwy bridge/Campbell's Resort	4462 feet of shoreline. No designated swim beach	1.08 Mi. paved walkway	Yes	Yes
Shore Access Site (city of Chelan)	.25	No	No picnic sites. Approx. 10 parking spaces on Highway. 1 flush toilet	No	Approx. .12 acres swimming beach.	No	No	Yes
Lakeside Park (city of Chelan)	10	No	12 picnic tables. shelter. 115 parking spaces. Children play area/equip. 1 volleyball ct. ½ basketball ct. 1 restroom/6 toilets	1 launch lane (off-season use only)	.4 acres sand beach and swimming area.	.25 mi. paved walkway	No	Yes
Don Morse Memorial Park and Lakeshore Marina (city of Chelan)	20	No	Park: 20 picnic tables 3 picnic shelters 130 on-site parking spaces and 30+ off-site parking spaces. Band stands 2 tennis courts. 2 volleyball cts. 2 basketball cts. Play area/equip. Bumper boat facility Putting course Race Track Restroom/7 toilets	No	2.5 acres swimming beach. 2 swim docks	.50 mi. paved walkway	No	Park: Partial (beach ramps) and parking. Restrooms

Table 11-1: Existing Facilities at Lower Chelan Basin Zone Public Recreation Sites

Site/Owner	Acres	Camping	Picnic & Day-Use Facilities	Boating Facilities	Swimming	Trails/Walk-ways	Interpretation Facilities	ADA Compliance
			Shower bldg/8 stalls Marina: 1 restroom 4 toilets	Marina: Docks for 40 boats 2 launch lanes				Marina: No
Lakeshore RV Park (city of Chelan)	20	160 RV and tent sites 3 restroom buildings w/12 toilets, 12 showers	No (however, adjacent to Don Morse Memorial Park with access to facilities)	No	No	No	No	Yes
Old Mill Park (Chelan PUD)	20	No	5 picnic tables 11 parking spaces 1 fishing pier Fish cleaning station 1 restroom/8 toilets	Year-round accessible boat launch 4 launch lanes 146 parking spaces 3 docks	No	No	No	Yes
Manson Bay Park (Chelan PUD)	6	No	Picnic/day area-no tables appr. 25 street pkg sp. 1 restroom/8 toilets	1 launch lane (winter only) 3 tie-up docks 20 boat capacity	.15 acre swimming beach Swim dock	No	No	Yes
Willow Point Park (Manson Park and Recreation District)	1.85	No	6 picnic tables Approx. 20 street parking spaces. Mostly walk-ins from neighborhood. Children's play eqp. Summer Outhouses	No	.4 acres	No	No	No
Fields Point (USDA Forest Service)	17	No	11 picnic sites 420 parking spaces 2 composting restrooms 9 toilets & 2 urinals Information Center	Dock for up-lake ferry service Capacity for 3 boats (21' boat length)	No designated	.25 Mil walkway	Yes	Yes

Table 11-1: Existing Facilities at Lower Chelan Basin Zone Public Recreation Sites

Site/Owner	Acres	Camping	Picnic & Day-Use Facilities	Boating Facilities	Swimming	Trails/Walk-ways	Interpretation Facilities	ADA Compliance
Lake Chelan State Park (Washington State)	127	144 campsites 17 w/ utilities 4 restrooms w/ 26 toilets, 5 urinals and showers	52 picnic sites 1 shelter 52 parking spaces Water-ski floats Children's playground Horseshoe/Softball 1 restroom w/ 8 toilets, 2 urinals & showers	1 launch lane 2 docks (800 ft.) 28 parking spaces. 5 docks @ waterfront campsites.	.30 acre swim beach	No	No	Yes
25-Mile Creek State Park (Washington State Parks)	235	86 campsites 23 w/ utilities group site 2 restrooms w/ 9 toilets, 2 urinals & shower	6 picnic sites 5 day-use parking spaces	2 launch lanes Boat Marina w/docks and piers 37 boat capacity 34 parking spaces	No designated beach. 1,500 feet of shoreline	No	No	Yes

Table 11-2: Existing Facilities at Middle Chelan Basin Zone Public Recreation Sites

Site	Acres	Camping	Picnic Tables and Other Facilities	Boating Facilities	Swimming	Trails/Walk-ways	Interpretation Facilities	ADA Compliance
Mitchell Creek (USDA Forest Service)	6	7 tent sites	7 picnic tables 1 shelter, 7 fire rings 2 pit toilets	Floating dock capacity about 17 boats (21' boat length)	No	No	No	No
Deer Point (USDA Forest Service)	2	5 tent sites	5 picnic tables 5 fire rings 2 pit toilets	Floating dock capacity about 8 boats (21' boat length)	Yes	No	No	No
Big Creek (USDA Forest Service)	1	4 tent sites	4 picnic tables 4 fire rings 1 shelter 2 pit toilets	Fixed dock capacity about 4 boats (21' boat length)	Yes	Trail	No	No
Safety Harbor (USDA Forest Service)	1	2 tent sites	2 picnic tables 2 fire rings 1 pit toilet	Floating dock capacity about 6 boats (21' boat length)	No	No	No	No
Corral Creek (USDA Forest Service)	1	2 tent sites	3 picnic tables 2 fire rings 1 pit toilet	Floating dock capacity about 6 boats (21' boat length)	No	No	No	No
Graham Harbor (USDA Forest Service)	2	5 tent sites	7 picnic tables 6 fire rings 2 pit toilets	Floating dock capacity about 10 boats (21' boat length)	No	Trail	No	No
Graham Harbor Cr. (USDA Forest Service)	2	5 tent sites	5 picnic tables 5 fire rings 2 pit toilets	Fixed dock capacity about 6 boats (21' boat length)	No	Trail	No	No
Prince Creek (USDA Forest Service)	3	6 tent sites	5 picnic tables 5 fire rings 3 pit toilets	Floating dock capacity about 3 boats (21' boat length)	No	Trail	No	No
Domke Falls (USDA Forest Service)	1	4 tent sites	4 picnic tables 3 fire rings 1 pit toilet	Floating dock capacity about 6 boats (21' boat length)	No	No	No	No
Cascade Cr. (USDA Forest Service)	.25	1 tent site	1 picnic table 1 pit toilet	Fixed dock capacity about 1 boat (21' boat length)	No	Trail	No	No

Table 11-3: Existing Facilities at Upper Chelan Basin Zone Public Recreation Sites

Site	Acres	Camping	Picnic Tables and Other Facilities	Boating Facilities	Swimming	Trails/Walk-ways	Interpretation Facilities	ADA Compliance
Refrigerator Harbor (USDA Forest Service)	2	4 tent sites	4 picnic tables 4 fire rings 2 pit toilets	Floating dock capacity about 8 boats (21 foot boat length)	No	Trail	No	No
Lucerne Landing/Holden Village Access	2	None	Bus access to Holden Village from Lucerne Landing 2 pit toilets	Community Floating Dock for Lady of Lake ferry	No	Partial accessible trail loop	Yes	No
Lucerne Campground (USDA Forest Service)	3	2 tent sites	2 picnic tables 2 pit toilets	Floating dock capacity about 11 boats (21 foot boat length)	No	Trail	No	No
Moore Point (USDA Forest Service)	1	4 tent sites	4 picnic tables 4 fire rings 1 shelter 2 pit toilets	Fixed dock capacity about 3 boats (21 foot boat length)	No	Trail	No	No
Flick Creek (NPS)	.5	1 tent site	1 shelter 1 pit toilet	Floating dock capacity about 1 boat (21 foot boat length)	No	Trail	No	No
Manley Wham (NPS)	.25	1 tent site	1 pit toilet	Fixed dock capacity about 1 boat (21 foot boat length)	No	No	No	No
Stehekin (NPS)	5	None	3 picnic sites 1 restroom w/8 toilets	Accessible year-round Floating dock capacity about 26 boats (21 foot boat length)	No	Trail	Yes	No
Purple Point (NPS)	2	7 tent sites	1 pit toilet	Floating dock capacity about 7 boats (21 foot boat length)	No	Trail	No	No
Weaver Point (NPS)	15	22 tent sites	1 restroom w/2 flushing toilets 8 pit toilets	Floating dock capacity about 12 boats (21 foot boat length)	No	Trail	No	No

Table 11-4: Estimated Average Daily Use at Lower Chelan Basin Zone Sites*

SITE	Peak-Season (May 23 – Sept 7) Average # People/Day			Fall (Sept 8 – Oct 3) Average # People/Day			Spring (Apr 11 – May 22) Average # People/Day		
	All Days**	Week-day	Week-end	All Days**	Week-day	Week-end	All Days**	Week-day	Week-end
Chelan Riverwalk Park Boat Launch	195	130	265	83	60	115	66	40	100
Chelan Riverwalk Park Walkway	93	94	94	43	34	55	18	23	11
Chelan Riverwalk Park Other Areas	203	102	320	13	6	23	2	2	3
Shore Access Site	19	18	21	3	5	0	0	0	0
Lakeside Park	392	355	425	30	11	55	3	3	3
Don Morse Memorial Park	651	590	680	97	97	96	17	18	16
Lakeshore RV Park	586	580	585	352	310	410	49	25	80
Old Mill Park	553	340	800	104	55	170	128	88	180
Manson Bay Park	176	170	185	6	0	13	2	3	1
Willow Point Park	60	64	52	33	53	6	0	0	0
Fields Point	337	345	315	97	80	120	50	50	50
Lake Chelan State Park Overnight	529	495	575	158	108	227	63	35	100
Lake Chelan State Park Day Use	1026	960	1100	361	255	505	51	18	94
25-Mile Cr. State Park Overnight	171	145	206	11	9	13	1	.4	2
25-Mile Cr. State Park Day Use	225	170	280	43	32	58	26	21	33
TOTAL	5216	4558	5903	1434	1115	1866	476	326.4	673

Table 11-5: Estimated Average Daily Use at Middle Chelan Basin Zone Sites*

SITE	Peak-Season (May 23 – Sept 7) Average # People/Day			Fall (Sept 8 – Oct 3)*** Average # People/Day	Spring (Apr 11 – May 22)*** Average # People/Day
	All Days**	Weekday	Weekend	Weekend	Weekend
Mitchell Creek	26	20	34	3	0
Deer Point	15	17	13	1	0
Big Creek	8	10	6	2	0
Safety Harbor	15	10	21	3	13
Corral Creek	3	.5	7	1	0
Graham Harbor	12	7	18	10	0
Graham Harbor Cr.	7	5	9	2	0
Prince Creek	8	6	11	3	0
Domke Falls	3	0	7	4	0
Cascade Cr.	0	0	1	0	3
TOTAL:	97	75.5	127	29	16

* Refer to Recreation Use Assessment Report (Chelan PUD, 2000)
** Peak-Season "All Days" calculated using weekday, weekend, and holiday data.
*** No weekday data available for fall and spring seasons.

Table 11-6: Estimated Average Daily Use at Upper Chelan Basin Zone Sites*

SITE	Peak-Season (May 23 – Sept 7) Average # People/Day			Fall(Sept 8 – Oct 3)*** Average # People/Day	Spring (Apr 11 – May 22)*** Average # People/Day
	All Days**	Weekday	Weekend	Weekend	Weekend
Refrigerator Harbor	9	7	12	0.5	2
Lucerne	11	9	12	7	0
Moore Point	10	9	12	2	0
Flick Creek	4	4	4	8	0
Manley Wham	3	3	3	0.5	0
Sthekin NPS Picnic Area	116	60	190	ND	0
Purple Point	15	9	22	3	0
Weaver Point	17	9	28	2	0
TOTAL:	185	110	283	23	2

* Refer to Recreation Use Assessment Report (Chelan PUD, 2000)

** "All Days" calculated using weekday, weekend, and holiday data.

*** No weekday data available for fall and spring seasons. No Fall weekend data available for Stehekin day-use site.

Table 11-7: Lower Chelan Basin Zone Sites - Estimated Average Daily Use By Activity
 (based on 1998/99 camping fee receipts and day-use observations)

Activity	Peak-Season (May 23 – Sept 7) Average # People/Day			Fall (Sept 8 – Oct 3) Average # People/Day			Spring (Apr 11 – May 22) Average # People/Day		
	All Days**	Weekday	Weekend	All Days**	Week-day	Week-end	All Days**	Week-day	Week-end
Camping	1286	1220	1366	521	427	650	113	60	182
Swimming/visiting beach	2278	2239	2205	219	153	318	5	6	4
Shore fishing	34	14	64	8	17	0	0	0	0
Motor boat	547	453	668	331	297	378	107	97	120
Jet skiing	75	50	107	25	0	60	0	0	0
Non-Motor Boat	8	1	16	0	0	0	3	5	0
Picnicking	397	170	603	39	26	59	9	40	4
Sightseeing	48	44	112	78	26	109	31	35	38
Walking	132	156	150	63	47	84	31	52	31
Jogging	3	5	0	8	0	17	2	0	8
Hiking	0	0	0	0	0	0	0	0	0
Backpacking	0	0	0	0	0	0	0	0	0
Rollerblading/Skating	8	7	11	0	0	0	0	0	0
Using Playgrounds	55	55	44	78	0	109	33	0	57
Bicycling, on-road	37	26	48	0	0	0	0	0	0
Bicycling, off-road	6	6	8	8	4	8	2	12	0
Nature study/Photography	1	0	1	0	0	0	0	0	0
Berry picking	1	0	3	0	0	0	0	0	0
Off-road vehicle riding	0	0	0	0	0	0	0	0	0
Hang gliding	6	0	14	0	0	0	0	0	0
Group Activity (volleyball, etc.)	133	45	213	8	81	8	35	0	61
Some other activity	162	68	270	47	38	67	104	20	168
Total:	5217	4559	5903	1433	1116	1867	475	327	673

* Based on visitor use estimates at Chelan Riverwalk Park, Shore Access Site, Lakeside Park, Don Morse Memorial Park, Lakeshore RV Park Old Mill Park Manson Bay Park, Willow Point Park and Fields Point.

** "All Days" calculated using weekday, weekend, and holiday data.

Table 11-8: Middle Chelan Basin Zone Estimated Average Daily Use By Activity*

(based on 1998 peak-season observations, and 1998 fall and 1999 spring-season box surveys)

Activity	Peak-Season (May 23 – Sept 7) Average # People/Day			Fall(Sept 8 – Oct 3)*** Average # People/Day	Spring(Apr 11 – May 22)*** Average # People/Day
	All Days**	Weekday	Weekend	Weekend	Weekend
Camping	51	10	68	14	8.0
Swimming/visiting beach	8	17	2	3	0.4
Fishing	3	1	5	1	0.8
Motor boat	19	17	21	3	1.3
Jetskiing	0	0	0	0	0
Non-Motor Boat	0	0	3	0	0
Picnicking	6	3	24	2	0
Sightseeing	0	0	0	2	1.3
Walking	5	6	5	1	0.4
Jogging	0	0	0	0	0
Hiking	0	3	0	2	1.3
Backpacking	0	0	0	0	1.3
Rollerblading/Skating	0	0	0	0	0
Using Playgrounds	0	0	0	0	0
Bicycling, on-road	0	0	0	0	0
Bicycling, off-road	0	0	0	0	0
Nature study/Photography	2	7	0	1	1.3
Berry picking	0	0	0	0	0
Off-road vehicle riding	0	0	0	0	0
Hang gliding	0	0	0	0	0
Group Activity (volleyball, etc.)	2	8	0	0	0
Some other activity	2	5	0	0	0
Total:	98	77	128	29	16.1

* Based on visitor use estimates at Mitchell Creek, Deer Point, Big Creek, Safety Harbor, Corral Creek, Graham harbor, Graham Harbor Creek, Prince Creek, Domke Falls and Cascade Creek.

** "All Days" calculated using weekday, weekend, and holiday data.

*** No weekday data available for fall and spring seasons.

Table 11-9: Upper Chelan Basin Zone Estimated Average Daily Use by Activity*
 (based on 1998 peak-season observations, and 1998 fall and 1999 spring-season box surveys)

Activity	Peak-Season (May 23 – Sept 7) Average # People/Day			Fall(Sept 8 – Oct 3)*** Average # People/Day	Spring(Apr 11 – May 22)*** Average # People/Day
	All Days**	Weekday	Weekend	Weekend	Weekend
Camping	39	42	36	8.0	1
Swimming/visiting beach	11	20	0	1.5	0.1
Shore fishing	3	0	7	1.3	0
Motor boat	54	22	94	2.0	0
Jetskiing	0	0	0	0	0
Non-Motor Boat	0	0	0	0.3	0
Picnicking	6	0	13	0.8	0
Sightseeing	32	0	74	2.2	0.2
Walking	14	18	8	1.0	0
Jogging	0	0	0	0	0
Hiking	0	0	0	2.6	0.2
Backpacking	7	0	17	0.8	0.2
Rollerblading/Skating	0	0	0	0	0
Using Playgrounds	0	0	0	0	0
Bicycling, on-road	4	0	10	0.4	0
Bicycling, off-road	0	0	0	0.2	0.1
Nature study/Photography	1	0	2	1.6	0.2
Berry picking	0	0	0	0.3	0
Off-road vehicle riding	1	0	2	0.2	0
Hang gliding	0	0	0	0	0
Group Activity (volleyball, etc.)	0	0	0	0	0
Some other activity	13	7	20	0	0
Total:	185	109	283	23.2	2

* Based on visitor use estimates at Refrigerator Harbor, Lucerne Campground, Moore Point, Flick Creek, Manley Wham, Stehekin USDA Forest Service Picnic Area, Purple Point, and Weaver Point.

** "All Days" calculated using weekday, weekend, and holiday data.

*** No weekday data available for fall and spring seasons.

Recreation Resources Management Plan

SECTION 3: RECREATION DEMAND, FACILITY NEEDS AND RESOURCE CAPACITY

State and national studies indicate that as populations grow, demand for recreation opportunities will grow. Tourism/recreation is one of the largest industries in the Lake Chelan area, and can be expected to grow in the future, creating increased demands on recreational facilities in the Project Area. The Recreation Needs Forecast and Analysis Report provided an analysis of the public recreation sites and recreation activity growth and demand in the Project Area. Current facility and reservoir capacity was examined, recreation needs were identified, and the ability of the Project Area to accommodate needs was reviewed.

Recreation demands and trends were analyzed by projecting recreation visitation based on existing conditions and future growth rates, as well as reviewing recreation planning documents and surveys that provided information regarding recreation-activity demands and trends. The Recreation Needs Forecast and Analysis Report (section 5.2, Tables 5-16 through 5-41) provide existing visitor use and projected visitor use data for public monitored recreation sites in the Lower, Middle and Upper Chelan Basin Zones, as well as watercraft and dispersed use (activities along undeveloped shoreline areas within the Project Area).

To assess the need for additional facilities, a comparison of the demand/trends with the resource capacity (or supply) is made. The following summarizes the results by Lake Zone for facility/activity categories, as presented in section 6 of the Recreation Needs Forecast and Analysis Report.

3.1 Lower Chelan Basin Zone Demand and Needs Analysis

Camping, boating, and day use areas, including picnic facilities, swimming/sunbathing beaches, and trails/walkways were analyzed. Additionally, the need for play equipment, whitewater kayaking, and community events was reviewed, as well as facilities to accommodate dispersed use. The greatest facility needs identified in the Lower Chelan Basin Zone include public trails and beach access, parking for boat-launch facilities on the south shore, and additional campsites to meet future demands. The following summarizes the analysis for the Lower Chelan Basin Zone (see the Recreation Needs Forecast and Analysis Report for more detailed information).

Visitor use estimates, based on fee receipt data and observations, indicated that swimming/visiting the beach was the most popular peak-season activity at Lower Chelan Zone recreation sites, followed by camping, motor boating, and picnicking.

Visitors appear to be satisfied with facilities and their recreation experience. All recreation sites received average ratings above 8 (on a scale of 1 to 10, with 10 being the best), except for Lakeshore RV Park and Twenty-five Mile Creek State Park, which received average ratings of 7.9 and 6.2, respectively. Recreational activities were also all given average ratings above 8, with the exception of fishing and waterskiing activities, which received average ratings of 6.2 and 7, respectively.

Recreation Resources Management Plan

Table 11-10 summarizes current and projected average peak-season weekend (or average weekday if busier due to a holiday) utilization for camping, boating facilities, and non-boating day use facilities, including day-use areas, parking, picnic tables, swimming beaches, and trails/walkways at Lower Chelan Basin Zone sites.

Camping

Current campground facilities in the Lower Chelan Basin Zone are generally meeting average peak-season demand, with an average utilization of around 70 percent, as shown on Table 11-10. Lower Zone campgrounds, however, are generally full on peak-season holidays and during late July and August. Lakeshore RV Park and Lake Chelan State Park are full more often than Twenty-five Mile Creek State Park, and more visitors are turned away from Lake Chelan State Park than the other campgrounds. Most visitors turned away from Lake Chelan State Park go to Twenty-five Mile Creek State Park.

Washington State Interagency Committee for Outdoor Recreation (IAC) State Comprehensive Outdoor Recreation Planning (SCORP) projections indicate that camping is expected to exhibit higher than average growth rates in the future. The Recreation Needs Forecast and Analysis Report (section 6.1.1, Table 6-1) indicates that campgrounds in the Lower Chelan Basin Zone are currently meeting demands, except on busy holidays and during weekends and some weekdays in July and August.

Additional campgrounds are needed in the Lower Chelan Basin Zone to meet future (2020) peak-season demands (Table 11-10). Both Lake Chelan State Park and Lakeshore Park are expected to exceed their capacity on most peak-season days by 2020. Twenty-five Mile Creek State Park Campground received the most comments regarding the need for larger and more campsites. Additional campsites will be needed to accommodate increasing peak-season demands.

Boating

For boating activities, launch lanes and vehicle/trailer parking at launch sites were analyzed. Recommended standards regarding watercraft capacity in the Lower Lake Chelan Zone was also reviewed.

Currently, boat launches in the Lower Chelan Basin Zone are generally accommodating average peak-season demand, with a average utilization of 72 percent for launch lanes and 60 percent for vehicle/trailer parking spaces at boat launches, as shown on Table 11-10. During most peak-season weekends and during many peak-season weekdays, however, parking capacity at Chelan Riverwalk Park is exceeded. The existing 226 public vehicle/trailer parking spaces in the Lower Chelan Basin Zone is more than the 205 spaces recommended for a lake the size of lower Lake Chelan under one standard, but is less than another standard that would result in 288 spaces (see the Lake Chelan Recreation Use Assessment for a discussion of the various standards for determining the appropriate number of vehicle/trailer parking spaces). The average peak-season weekend watercraft use at the Lower end of Lake Chelan is currently below recommended standards, but during holidays the recommended standards have been exceeded within the Lower Chelan Basin Zone between the City of Chelan and Wapato Point.

Recreation Resources Management Plan

Washington State (IAC SCORP) lists boating access as one of the more desired facilities in parks. Washington State projections indicate that motor boating is expected to grow at a slightly lower than average rate, whereas non-motorized boating is expected to grow at a slightly higher than average rate.

Projections indicate that peak-season boat use in 2020 will reach the public boat launch capacity in the Lower Chelan Basin Zone. Although average projected 2020 vehicle/trailer parking utilization is shown on Table 11-10 as 74 percent, observations and traffic counter data, as well as visitor comments, have indicated that additional vehicle/trailer parking spaces are needed at Chelan Riverwalk Park to meet current and future peak-season, as well as off-season demand. Additional vehicle/trailer parking spaces will also likely be needed to accommodate projected future peak-season weekend use at Lake Chelan State Park and Twenty-five Mile Creek State Park.

Non-Boating Day-Use

Day-use areas were analyzed, including the acreage, parking, picnic areas, swim beaches and trails, as shown on Table 11-10. Additionally, the demand for playground equipment, whitewater kayaking and community event facilities were reviewed.

When using an assumed design standard of 20 people per acre, with a turnover factor of three for beach activity and two for other day use activities, it appears there is sufficient space to meet current average weekend demand. However, day-use areas can get very busy during late summer months and holidays. When reviewing just the number of parking spaces to accommodate day-use areas and comparing it with estimated visitor use, parking spaces are currently 97 percent utilized. But this is assuming that all visitors park in the day-use parking areas. Existing picnic tables appear to meet current demand.

Designated swimming beaches in the Lower Chelan Basin Zone are currently about 90 percent utilized during peak-season weekends, and can become very crowded during hot summer days. Existing trails/walkways are estimated to be just over 90 percent utilized based on the number of visitors observed participating in trail/walkway activities at parks during 1998.

Washington State (IAC SCORP) lists natural areas, trails, playgrounds, beaches, picnic areas, swimming pools, water viewpoints, boating access, and sport fields and courts as the most desired facilities in parks. State, national, and local surveys have indicated demand for trails more than any other type of facility, especially trails near towns and that provide beach access. Projections indicate that the use of picnic areas, beaches, and trails will grow at a higher than average rate.

Use projections for day-use facilities in the Lower Chelan Basin Zone (Table 11-10) indicate that day-use parking spaces will be over-utilized by 2020, assuming that all day-use visitors park in day-use spaces. Manson Bay Park and Willow Point Park have limited parking and many walk-in visitors. Parking at other day-use areas is likely sufficient to meet future demands, considering the number of walk-ins from nearby neighborhoods and resorts. The overall current number of picnic tables in the Lower Zone appears to be sufficient to meet future demand. The greatest recreational facility need to meet short term and future (2020) needs at day-use areas in

Recreation Resources Management Plan

the Lower Zone include public trails and beach access. Projections indicate that current facilities will be over utilized in the near future (Table 11-10).

Other Day-Use Activities

Analysis was also conducted to determine the need for additional playground equipment, whitewater kayaking in the gorge, and community events.

The need for additional playground equipment was indicated in 1998/1999 surveys. However recent playground equipment additions and improvements have been made at several parks within the Lower Chelan Basin Zone since the survey. With these additions and improvements, it appears that playground equipment will meet current and future demands.

Interest in whitewater kayaking in the Chelan River was indicated by American Whitewater Affiliation during the relicensing process. Local, state, and national studies and surveys indicate that significantly fewer people participate in whitewater kayaking than other recreation activities. However, it is anticipated that this sport is likely to grow at rates similar to, or slightly above, other recreational activities. If kayaking is allowed in the Chelan River, it would be suitable only for expert kayakers because of the extreme danger involved, and the number of kayakers who would be able to take advantage of this opportunity would therefore be extremely small.

There appears to be a growing demand for arts and other community events in the Lake Chelan area. These events will continue to place increasing demand on several existing parks and facilities in the Lower Chelan Basin Zone, such as Chelan Riverwalk Park, Don Morse Memorial Park, and Manson Bay Park, which currently host such events.

Dispersed Use

Relatively few people were observed along undeveloped shorelines in the Lower Chelan Basin Zone. It should be noted that observations did not focus on shorelines down-lake of Fields Point since the majority of lands are privately owned, and activities on public roadways and easements were not documented. Few people were observed between Fields Point and Camas Creek, and most were observed camping. Current and projected future dispersed-activity is not expected to significantly impact the shorelines or require developed facilities to meet estimated demands.

3.2 Middle Chelan Basin Zone Demand and Needs Analysis

Camping picnicking and boating facilities, as well as beaches and trails were analyzed at the ten public USDA Forest Service recreation sites in the Middle Zone. The greatest facility needs identified in the Middle Chelan Basin Zone include improvements and maintenance of toilets and docks and expansions of some campgrounds.

The following summarizes the analysis for the Middle Chelan Basin Zone (see the Recreation Needs Forecast and Analysis Report for more detailed information).

Visitor use estimates by activity showed that the highest number of visitors in the Middle Chelan Basin Zone during peak-season weekends were camping, followed by picnicking. On peak-season weekdays, visiting the beach and motor boating activities had the highest use, followed by camping. Camping showed the highest use during fall and spring season observations.

Recreation Resources Management Plan

Visitors appear to be satisfied with facilities in the Middle Zone and their recreation experience. All recreation sites received average ratings above 8, except for Domke Falls which received average rating of 7.4. Recreation activities were all given average ratings above 8. Day-users surveyed rated recreation sites within the Middle Chelan Basin Zone an average of 8, on a scale of 1 to 10 with 10 being the highest. Responses received from survey respondents regarding what could make the sites better for them included cleaner facilities/toilets, fewer people, more and better dock space, less rocks, more grass, more tables, bathrooms, newer facilities, better cleats on docks and no fees.

Table 11-11 summarizes current and projected average peak-season weekend utilization for camping, picnicking, and boating facilities.

Campsites

Currently, the USDA Forest Service manages campgrounds using a standard of five people per campsite. However, surveys have indicated that the social capacity of campsites is less. Therefore, a design standard using both three people per campsite and five people per campsite was reviewed in the Recreation Needs Forecast and Analysis. Current campsites at Middle Chelan Basin Zone sites are generally meeting average peak-season weekend demand, with an average utilization of around 55 percent using a design standard of three people per campsite and an average utilization of 33 percent using a design standard of five people per campsite. Observations, however, indicate that campsites in the Middle Zone fill up an average of approximately 15 percent of the days during the peak-season, mostly on holidays and busy weekends.

According to Washington State (IAC SCORP) surveys, camping can be expected to exhibit growth rates slightly higher than average growth rates for recreation activities in the region; although more remote tent camping has not been broken out in these projections. Projections indicate that the current number of campsites in the Middle Chelan Basin Zone will meet the average peak-season demand through 2020; although it can be expected that campsites will continue to fill up more often on holidays and summer weekends during the months of July and August.

Camping/Day Use-Site Utilization

Because day-use activities share campground facilities (i.e. picnic tables and toilets at camp sites), total use at Middle Chelan Basin Zone recreation sites was reviewed to determine if excess capacity currently exists at recreation sites to accommodate increased camping or day use activities at those sites. Table 11-11 summarizes the current and future recreation site utilization for all activities during peak-season weekends). Both overnight and day use estimates are included in the design load estimates and compared with the existing facility capacity, based on both camping and day-use activities.

Using design standards of both three people per site and five people per site, it appears that existing facilities will be adequate to meet current and future average peak-season weekend demand. However, when looking at individual sites, the 1998 estimated use exceeded or was near estimated site capacities on occasion at Mitchell Creek, Safety Harbor, and Graham Harbor

Recreation Resources Management Plan

Creek. It can be expected that some recreation sites in the Middle Chelan Basin Zone will fill up more often in the future, especially on peak-season holidays and weekends during the months of July and August. At any given year, there is a high probability that one or more campgrounds and associated facilities such as docks, toilets, and/or trails may be closed due to fire closures, flood events, repairs or other factors that further reduces potential capacity up-lake.

Surveys have indicated demands for better maintenance of toilets and docks. Surveys have also indicated desires for fewer people at sites, and comments were also received regarding needs for more and/or larger campsites. Visitors appear to seek up-lake sites for the remoteness of the location and even though recreation sites may not be physically full, they are exceeding some visitors' social capacity.

Boating

When comparing supply and demand for boating facilities in the Middle Chelan Basin Zone, the capacity of boat docks as well as the number of boats observed at recreation sites and the estimated number of visitors at recreation sites were reviewed. The number of boats observed at recreation sites in the Middle Lake Chelan Zone was also reviewed.

The average number of boats observed during peak-season weekend and weekday observations in the Middle Chelan Basin Zone was well below the total dock capacity (see the Recreation Needs Forecast and Analysis Report). No Middle Zone USDA Forest Service recreation site docks were full during peak-season observations, and during monitoring of boat arrivals at the docks, no boats were observed turning away due to the docks being too full.

Because most visitors at Middle Chelan Basin Zone sites use docks to access the sites, the total estimated visitor use at sites was also compared with the docking capacity. When comparing the dock capacity with the estimated average peak-season weekend use, the current dock facilities appear to be meeting current demands (Table 11-11).

Monitoring in 1998 and 1999 indicated that watercraft use in the Middle Chelan Basin Zone during the busiest time of the year (average peak-season weekend) is well below half the recommended standard by the State Organization for Boating Access (SOBA). The boater capacity standards recommended by SOBA are conservative and generally applicable to rural areas. Because the Middle Chelan Basin Zone is surrounded by wilderness and primitive areas, even the more conservative SOBA standards are likely too high for this unique part of the Lake.

Washington State (IAC SCORP) projections indicate that growth in motor boating is expected to grow at a slightly lower rate, whereas non-motorized boating is expected to grow at a slightly higher rate. Comparisons of projected average peak-season weekend use at recreation sites with the current Middle Zone dock capacity (Table 11-11) also indicate that future demand will be met with existing facilities. When reviewing each site individually, it appears that most sites have adequate dock capacity to meet average peak-future demands, except for Safety Harbor and Prince Creek.

Recreation Resources Management Plan

Although the overall current dock capacity in the Middle Chelan Basin Zone appears to meet current and future demands, surveys at Middle Zone recreation sites have indicated needs for better maintenance of existing docks.

As the number of campers and day-use activities increases, boating facilities would also be affected. The main issue to address when looking at boating activities is not tied to watercraft capacity related to size of lake, but rather the facilities in place to support watercraft activities up-lake (i.e. docks, moorage, campsites, toilets, and day use facilities). The number one visitor use of the Middle Chelan Basin Zone is camping. Comments received from visitors camping in the area said better docking would improve their activity. Other comments included cleaner facilities, toilets, fewer people, more campsites, larger campsites, more dock space, better cleats, and no fees. Future watercraft use is expected to remain well below standards in the Middle Chelan Basin Zone.

Trails

Access to over 200 miles of trails is provided at two out of the ten recreation sites in the Middle Chelan Basin Zone, Prince Creek and Cascade Creek. Big Creek, Graham Harbor, and Graham Harbor Creek have trails that go up nearby drainages, and other sites have pathways within the site area, but do not provide trails outside of the site or to the expansive USDA Forest Service lands or Lake Chelan National Recreation Area trail network. Although most people that visit Middle Chelan Basin Zone sites participate in walking and hiking during their visit, these types of activities are not their primary reason for visiting the Middle Chelan Basin Zone. Based on surveys and observations, construction of additional trails within the Middle Chelan Basin Zone is not considered a high priority, although existing trails should be maintained and, in some cases, improved.

Dispersed Use

Relatively few people were observed along undeveloped shorelines in the Middle Chelan Basin Zone. No people were observed during peak-season weekdays and off-season, and only averages of four people per day were observed during peak-season weekends. The few people who were observed were sunbathing/swimming/wading, camping, and off-road vehicle riding. Current and projected future dispersed-activity is not expected to significantly impact the shorelines or require developed facilities to meet estimated demands.

3.3 Upper Chelan Basin Zone Demand and Needs Analysis

Camping, picnicking, and boating facilities, as well as beaches and trails, were analyzed at the three USDA Forest Service and five NPS recreation sites in the Upper Zone, including the NPS Stehekin day-use area. As with the Middle Zone, the greatest facility needs identified in the Upper Chelan Basin Zone include improvements and maintenance of toilets and docks and expansions of some campgrounds and/or better regulation of visitors through the fee program. Based on observations, campgrounds and docks at recreation sites in the Upper Chelan Basin zone, with the exception of Weaver Point Campground, are full more often than campgrounds and docks in the Middle Chelan Basin Zone. Visitors appear to seek up-lake sites for the remoteness of the location that provides quiet and solitude and even though recreation sites may not be physically full, they are exceeding some visitor's social capacity. Expansions or improvements to sites to meet future peak-season demands will need to ensure that the

Recreation Resources Management Plan

remoteness and unique recreation experience of the sites are preserved. The following summarizes the analysis for the Upper Chelan Basin Zone (see the Recreation Needs Forecast and Analysis Report for more detailed information).

Visitor use estimates by activity showed that the highest number of visitors in the Upper Chelan Basin Zone during peak-season weekends were motor boating, followed by sightseeing, then camping. On peak-season weekdays, camping had the highest number of visitors, followed by motor boating. Camping showed the highest use during fall and spring season observations.

Visitors appear to be satisfied with facilities in the Upper Zone and their recreation experience. All recreation sites received average ratings of over 8. Recreation activities were all given average ratings above 8.

Table 11-12 summarizes current and projected average peak-season weekend utilization for camping, picnicking and boating facilities.

Campsites

Currently, the USDA Forest Service and NPS manage campgrounds using a standard of five people per campsite. However, surveys have indicated that the social capacity of campsites is less. Therefore, design standards using both three people per campsite and five people per campsite were reviewed in the Needs Analysis. Current (1998) campsites at Upper Chelan Basin Zone sites are generally meeting average peak-season demand for the busiest days (average peak-season weekend or average weekday, whichever has the most use by activity). Average peak campsite utilization is around 34 percent using a design standard of three people per campsite and average utilization is 20 percent using a design standard of five people per campsite. However, based on observations in 1998, it is estimated that overall campsites in the Upper Chelan Basin Zone are full an average of approximately 24 percent of the time during the peak-season. When breaking out USDA Forest Service and NPS sites, average campsite utilization at USDA Forest Service sites is greater than average campsite utilization at NPS sites. For instance, the peak utilization rate of USDA Forest Service campsites is about 73 percent, compared to 22 percent at NPS campsites. (See Appendix A to the Recreation Needs Forecast and Analysis Report for more detail).

According to Washington State (IAC SCORP) surveys, camping can be expected to exhibit growth rates slightly higher than average growth rates for recreation activities in the region; although more remote tent camping has not been broken out in projections. Projections indicate that the current number of campsites in the Upper Chelan Basin Zone will meet the average peak-season demand in through 2020; with average peak utilization of 48 percent at three people per campsite and 29 percent at five people per campsite. However, when breaking out USDA Forest Service sites, estimated future (2020) peak utilization is over 100 percent at three people per campsite and at 62 percent at five people per campsite. NPS estimated future (2020) peak utilization is 30 percent at three people per campsite and 18 percent at five people per campsite.

Camping/Day Use-Site Utilization

Because day-use activities share campground facilities (i.e. picnic tables at camp sites), total use at Upper Chelan Basin Zone recreation sites was reviewed to determine if excess capacity

Recreation Resources Management Plan

currently exists at recreation sites to accommodate increased camping or day use activities at recreation sites. Table 11-12 summarizes the current and future recreation site utilization for all activities during the busiest time of the year (average peak-season weekends). Both overnight and day use estimates are included in the design load estimates and compared with the existing facility capacity, based on both camping and day-use activities.

Using design standards of both three people per site and five people per site, it appears that the existing facilities will be adequate to meet current and future average peak-season weekend demand (Table 11-12). When breaking out USDA Forest Service and NPS sites, average utilization at USDA Forest Service sites is greater than the average utilization at NPS sites. Current (1998) average peak utilization at USDA Forest Service sites, using a design standard of three people per site is around 80 percent, while utilization at NPS site is 41 percent. Future (2020) average peak utilization at USDA Forest Service sites, using a design standard of three people per site, is over 100 percent, while NPS utilization is 57 percent (see Needs Analysis, Appendix A).

Using a design standard of five people per site, future (2020) average peak utilization at USDA Forest Service sites is 67 percent and 34 percent at NPS sites. When looking at individual sites, 1998 estimated use exceeded or was near estimate site capacities on occasion at Refrigerator Harbor, Lucerne USDA Forest Service campground, Moore Point, Flick Creek, Manley Wham, and Purple Point. It can be expected that most recreation sites in the Upper Chelan Basin Zone will fill up more often in the future, especially on peak-season holidays and weekends. At any given year, there is a high probability that one or more campgrounds and associated facilities such as docks, toilets, and/or trails may be closed due to fire closures, flood events, repairs or other factors that further reduces potential capacity up-lake.

Surveys have also indicated desires for fewer people at sites and comments were also received regarding needs for more remote/private campsites. Visitors appear to seek up-lake sites for the remoteness of the location and even though recreation sites may not be physically full, they are exceeding some visitors' social capacity. Expansions or improvements to sites by the USDA Forest Service and NPS to meet future peak-season demands should ensure that the remoteness and unique recreation experience of the sites are preserved.

Boating

When comparing supply and demand for boating facilities in the Upper Chelan Basin Zone, the capacity of boat docks as well as the number of boats observed at recreation sites and the estimated number of visitors at recreation sites were reviewed. Watercraft capacity in the Upper Lake Chelan Zone was also reviewed.

The average number of boats observed during peak-season weekend and weekday observations in the Upper Chelan Basin Zone was well below the total dock capacity (see the Recreation Needs Forecast and Analysis Report). During all day arrival rate monitoring, no boats were observed turning away due to the docks being too full. However, during field monitoring at Upper Chelan Basin Zone sites, the numbers of boats observed at docks were at the estimated boat capacity of the docks on occasion at Lucerne Campground, Moore Point, Flick Creek, Manley Wham, and Purple Point.

Recreation Resources Management Plan

Because most visitors at Upper Chelan Basin Zone sites use boating facilities to access the sites, the total visitor use at sites was also compared with the docking capacity. When comparing the dock capacity with the estimated average peak-season weekend use (the busiest observed use), the current dock facilities appear to be meeting current demands (Table 3-3). However, all docks, except for Refrigerator Harbor, Stehekin, and Weaver Point, are at their estimate capacities on some peak-season weekends.

Monitoring in 1998 and 1999 indicated that watercraft use in the Upper Chelan Basin Zone during the busiest time of the year (average peak-season weekend) is well below half the recommended standards applicable to rural areas (Table 11-12).

Projected 2020 average number of boats at recreation sites in the Upper Chelan Basin Zone is below the total dock capacity (see the Recreation Needs Forecast and Analysis Report). Comparisons of projected average peak-season weekend use at recreation sites with the current Upper Zone dock capacity (Table 11-12) also indicate that future demand will be met with existing facilities. When reviewing each site individually, it appears that most sites have adequate dock capacity to meet average peak-future demands except for Moore Point, Flick Creek, and Purple Point. It can be expected that most docks in the Upper Zone will be full more often during peak-season weekends and holidays in the future.

Although the overall current dock capacity in the Upper Chelan Basin Zone appears to meet current and future demands, surveys at Upper Zone recreation sites have indicated needs for better maintenance of existing docks.

Future watercraft use is expected to remain well below standards in the Upper Chelan Basin Zone.

Trails

Access to over 200 miles of trails is provided at seven out of the eight recreation sites in the Upper Chelan Basin Zone study area. The only recreation site that does not have trails connecting to the Lake Chelan National recreation Area trail network is Manley Wham. Although most people that visit Upper Chelan Basin Zone sites participate in walking, and many visitors participate in hiking and backpacking during their visit, these types of activities are not generally their primary reason for visiting Upper Chelan Basin Zone recreation sites. Based on surveys and observations, construction of additional trails within the Upper Chelan Basin Zone is not considered a high priority, although existing trails should be maintained and in some cases improved.

Recreation Resources Management Plan

Dispersed Use

Relatively few people were observed along undeveloped shorelines in the Upper Chelan Basin Zone. No people were observed during peak-season weekdays and off-season, and only an average of four people per day was observed during peak-season weekends. The few people who were observed were sunbathing/swimming/wading, and walking. Current and projected future dispersed-activity is not expected to significantly impact the shorelines or require developed facilities to meet estimated demands.

3.4 Ability of Project Area to Accommodate Needs

All three lake use zones have and will continue to receive development pressures from outside the local area. The lake is a regional recreation resource and, as a result, receives a large increase in both tourism and seasonal population during the period from May through September. This population influx has resulted in construction of tourist resorts and motels, as well as summer homes and cabins in the Lower Chelan Basin Zone. Development of facilities for this seasonal population has put a premium on land with view or shoreline amenities and much of the land in the lower end of the lake is privately owned. Availability and cost of land will constrain large-scale tourism expansion at the lower end of the lake.

Up-lake recreation use is influenced by the road-less character and inaccessibility by car. The terrain in the Middle and Upper Zones is steep. Slopes run directly into the lake, with no flat beaches or shoreline. Recreation sites that do exist in the Middle and Upper Zones are located on alluvial fans at stream mouths, with limited developable area. Limited access, the shortness of the tourist season, limited developable area, and management objectives of the area will limit growth and expansion in these areas.

Unlike the Middle Chelan Basin Zone where development is generally limited to alluvial fans at stream mouths, sites in the Upper Chelan Basin Zone are located at broader based alluvial fans with expansion opportunities. The Stehekin Valley, for example, is a broader glaciated valley. Access in the Upper Chelan Basin Zone is limited, but the tourist season is year-round and opportunities to expand developed recreation sites are available in most of the existing campground or day use areas.

Recreation managing agencies and organizations in the Project Area, including Chelan County PUD, the City of Chelan Parks and Recreation Department, Manson Parks and Recreation District, Washington State Parks and Recreation Commission, USDA Forest Service, NPS, and the Lake Chelan Recreation Association, have identified several projects and expansion opportunities at existing recreation sites that could satisfy future demands and needs in the area. These opportunities are described in sections 4 and 5, below.

Table 11-10: Summary of Lower Chelan Basin Facilities Current and Projected Peak Day Facility Utilization

Activity	Existing Facilities	Design Standards	Turnover Factor	Existing Facility Daily Capacity	Design Load (Average Daily Peak) ¹		Facility Load (Utilization) Lower Chelan	
					Initial 1998	Future 2020	Initial 1998	Future 2020
Camping:	390 Campsites	5 people/campsite	1	1,950 people/day	1,366 people/day	1,916 people/day	70%	98%
Boating:	10 Launch Lanes ²	40 boats/ lane/day 3 persons/boat	1	1,200 people/day ²	865 people/day ²	1,200 people/day ²	72%	100%
	226 Vehicle/Trailer Parking spaces	3 people/car	2	1,356 people/day	800 people/day	1,000 people/day	60%	74%
	226 Vehicle/Trailer Parking spaces	1 trailer parking space/70 - 50 acres of water	N/A	N/A	205 - 288 parking spaces	N/A	N/A	N/A
	14,400 Surface Water Acres	33 acres/watercraft	N/A	435 watercraft at one time	212 watercraft	300 watercraft	49%	70%
Non-Boating Day-Use:	110 acres ³	20 people/acre	3-beach 2-other	5,500 people/day	3,746 people/day	5,254 people/day	68%	96%
	513 day-use Parking Spaces ^{3,4}	3 people/car	3-beach 2-other	3,850 people/day	3,746 people/day	5,254 people/day	97%	137%
	134 Picnic Tables	4 people/table	2	1072 people/day	603 people/day	846 people/day	56%	80%
	3.9 acres designated swim beaches	220 people/acres	3	2,574 people/day	2,320 people/day	3,254 people/day	90%	126%
	2.1 miles trails/walkways	90 people/mile/day	1	189 people/day ⁵	174 people/day ⁵	244 people/day ⁵	92%	129%

1. Design Load based on the busiest time of the year. For all activities, except for trail use, average peak-season weekend use estimates showed greatest use. For trail/walkway activity visitor use estimates, average peak-season weekday estimates were greater.
2. Boat launch data includes launch lanes and use estimates for Lakeshore Marina Boat Launch (not included in Needs Analysis Report).
3. For non-boating day use, the Recreation Needs Forecast and Analysis Report combines both site acres and number of parking spaces to estimated physical capacity due to the lack of parking and number of walk ins at Marion Bay Park and Wilkins Point Park.
4. Off-site parking at Don Morse Memorial Park is not included in the total number of parking spaces.
5. Trail use estimates include people observed participating in trail activity such as walking, jogging, off-road biking, rollerblading/skating within monitored parks and not necessarily on trails/walkways.

Table 11-11: Summary of Middle Chelan Basin Facilities Current and Projected Peak Day Facility Utilization

Activity	Existing Facilities	Design Standards	Turnover Factor	Existing Facility Daily Capacity	Design Load (Average Daily Peak) ¹		Facility Load (Utilization) Middle Chelan	
					Initial 1998	Future 2020	Initial 1998	Future 2020
Camping:	41 Campsites	3 people/campsite 5 people/campsite	1	123 people/day - 205 people/day	68 people/day	95 people/day	55%	77%
Picnicking	43 picnic tables	4 people/picnic table	1.5	258 people/day	92 people/day ²	129 people/day ²	33%	48%
Camping/ Picnicking	44 camp- picnic sites	3 people/site 5 people/site	1.5	198 people/day 330 people/day	127 people/day	179 people/day	64%	90%
Boating:	10 docks - 67 boats	3 people/boat	1.5	300 people/day	127 people/day	179 people/day	42%	60%
	12,000 Surface Water Acres	66 acres/watercraft	N/A	180 watercraft at one time	27 watercraft	38 watercraft	15%	21%

1. Design Load based on the busiest time of the year - For all activities, average peak-season weekend visitor use estimates are used here.

2. Includes average number of people observed picnicking as well as number of people camping.

Table 11-12: Summary of Upper Chelan Basin Facilities Current and Projected Peak Day Facility Utilization

Activity	Existing Facilities	Design Standards	Turnover Factor	Existing Facility Daily Capacity	Design Load (Average Daily Peak) ¹		Facility Load (Utilization) Upper Chelan	
					Initial 1998	Future 2020	Initial 1998	Future 2020
Camping:	41 Campsites	3 people/campsite 5 people/campsite	1	123 people/day - 205 people/day	42 people/day	59 people/day	34%	48%
Picnicking	13 picnic tables	4 people/picnic table	1.5	78 people/day	49 people/day ²	68 people/day ²	63%	87%
Camping/ Picnicking	41 camp-picnic sites ³	3 people/site 5 people/site	1.5	185 people/day 308 people/day	93 people/day ²	131 people/day ²	50% 30%	71% 43%
Boating:	8 docks - 43 boats	3 people/boat	1.5	191 people/day	93 people/day	131 people/day	49%	69%
	6,350 Surface Water Acres	66 acres/watercraft	N/A	96 watercraft at one time	32 watercraft	44 watercraft	33%	46%

1. Design Load based on the busiest time of the year - For all activities, except for camping, average peak-season weekend use estimates showed greatest use. For camping visitor use estimates, average peak-season weekday estimates were greater for National Park Service sites and were the same for USDA Forest Service site; therefore, average peak-season weekday use estimates were used.
 2. Includes average number of people observed picnicking as well as number of people camping.
 3. Not including Stehekin Day-Use Area.

Recreation Resources Management Plan

SECTION 4: DEVELOPMENT PLAN AND IMPLEMENTATION SCHEDULE

Many government agencies and numerous private owners manage and maintain the recreational facilities within the Project Area. The USDA Forest Service, National Park Service, Washington State Parks and Recreation Commission, the City of Chelan Parks Department, Manson Parks and Recreation District, and Chelan County provide plans that include policies and guidelines for recreation management and development in the Project Area. Further information regarding recreation needs and demands outlined in recreation plans, studies and surveys is provided in the Recreation Needs Forecast and Analysis Report.

Based on the efforts of the SSWG, this Chapter provides for operation and maintenance of existing Project recreation facilities to ensure public access and recreational use of Project lands and waters, as well as additional facilities and access to Project lands. This Chapter also provides for funding of Project impacts to federal docks due to fluctuations in the lake level, with respect to shoreline where Chelan PUD does not hold a damage waiver or easement. The following describes the proposed recreation development/enhancement actions, and provides costs and a schedule for the implementation of such actions.

4.1 Development of Recreation Enhancement Options

Based on the studies and other material summarized in section 4, above, the SSWG identified projects that would enhance recreation in the Project Area. Projects were placed into four groups (camping, trail use, boating and other), and then prioritized based on five primary considerations:

- 1) Ongoing Project impacts
- 2) Consistency with study results
- 3) Effectiveness of proposed measure
- 4) Costs (including cost-sharing opportunities)
- 5) Existence of mandatory conditioning authority

4.2 Recreation Measures and Implementation Schedules

The following are recreational measures to be implemented in this Plan:

- 1) Docks and recreation measures of the USDA Forest Service
- 2) Docks and recreation measures of the National Park Service
- 3) Whitewater boating in the Chelan River
- 4) Operation and maintenance of Riverwalk, Shore Access, Old Mill, Manson Bay parks
- 5) Reach 1 access trail
- 6) Riverwalk Loop Trail extension
- 7) O&M under Dan Gordon Bridge
- 8) Reservation of lands
- 9) Micro parks
- 10) Utility improvements for local trail
- 11) Trail linkage to PUD parks
- 12) Don Morse Park erosion

Recreation Resources Management Plan

4.2.1 Docks and Recreation Facilities of the USDA Forest Service

The USDA Forest Service has identified that lakeshore facilities such as docks have ongoing high maintenance costs. Chelan PUD has agreed to address ongoing Project impacts to docks due to lake level fluctuations from Project operation. Non-Project factors also contribute to the need for dock maintenance, such as weather and normal wear and tear and therefore not all maintenance needs are the responsibility of Chelan PUD. The following summarizes specific measures in Proposed License Article 11 that pertain to USDA Forest Service docks and recreation facilities within the Lake Chelan Basin.

Specific Action(s)

Docks of the USDA Forest Service. Within 180 days of the effective date of the New License, Chelan PUD shall make available to the USDA Forest Service \$700,000, for the purpose of repairing and replacing the USDA Forest Service docks listed in Table 11-13 of this Chapter. Within 180 days of the effective date of the New License, and by January 31st of each subsequent year of the New License, including subsequent annual licenses, Chelan PUD shall also make available to the USDA Forest Service an additional \$39,000 for operations and maintenance of such docks. The implementation of the repair and replacement of such docks, as well as the operation and maintenance of such docks, shall be the sole responsibility of the USDA Forest Service. At any time after the 30th anniversary of the New License, Chelan PUD shall consider any requests made by the USDA Forest Service for additional funds to repair and replace the docks listed in Table 11-13 of this Chapter, but Chelan PUD shall be under no obligation to grant any such requests.

In-Kind Engineering Services for the USDA Forest Service. Beginning not later than 180 days of the effective date of the New License, Chelan PUD shall make available to the USDA Forest Service \$100,000 to pay for consulting engineering services related to standardizing the design of USDA Forest Service docks on Lake Chelan.

Recreational Enhancements of the USDA Forest Service (Years 1-30 of the License). Within 180 days of the effective date of the New License, Chelan PUD shall make available to the USDA Forest Service \$980,000, for use by the USDA Forest Service during the first 30 years of the New License for recreational enhancements within or adjacent to the Lake Chelan Basin for USDA Forest Service recreation sites. Within 180 days of the effective date of the New License, and by January 31st of each subsequent year of the New License, Chelan PUD shall also make available to the USDA Forest Service an additional \$6,000 for the operation and maintenance of such recreational enhancements. Implementation of such recreational enhancements, and their operation and maintenance, shall be the sole responsibility of the USDA Forest Service.

Recreational Enhancements of the USDA Forest Service (Years 30 to end of the License). Chelan PUD shall make available to the USDA Forest Service a maximum of \$340,000, beginning on the 30th anniversary of the New License and ending on the date the New License expires, for the purpose of implementing recreational enhancements within or adjacent to the Lake Chelan Basin for USDA Forest Service recreation sites,

Recreation Resources Management Plan

consistent with the recommendations of the recreational use and needs assessment study funded by Chelan PUD pursuant to section 4.3 of this Chapter. Implementation of such recreational enhancements shall be the sole responsibility of the USDA Forest Service.

Table 11-13: USDA Forest Service Dock Measures

Item	Capital	Annual	Description
1	\$66,000		Includes a total amount not to exceed \$66,000 for docks needing critical maintenance. Docks include Prince Creek, Mitchell Creek, Deer Point, Safety Harbor, Corral Creek, Graham Harbor, Elephant Rock and Graham Harbor Creek.
2	\$184,000		Includes a total amount not to exceed \$184,000 for expansion or replacement of 18 docks. Docks will include Prince Creek, (2 docks), Safety Harbor (1 dock), Graham Harbor Creek (1 dock), Elephant Rock (1 dock), Lucerne (1 dock), Mitchell Creek (3 docks), Corral Creek (1 dock), Cascade Creek (1 dock), Big Creek (1 dock), Lucerne Administrative site (1 dock), Deer Point (1 dock), Graham Harbor (1 dock), Domke Falls (1 dock), Refrigerator Harbor (1 dock) and Lucerne Landing (1 dock).
3	\$450,000		Includes a total amount not to exceed \$450,000 for a contingency fund for funding replacement of 18 docks. Docks will include Prince Creek, (2 docks), Safety Harbor (1 dock), Graham Harbor Creek (1 dock), Elephant Rock (1 dock), Lucerne (1 dock), Mitchell Creek (3 docks), Corral Creek (1 dock), Cascade Creek (1 dock), Big Creek (1 dock), Lucerne Administrative site (1 dock), Deer Point (1 dock), Graham Harbor (1 dock), Domke Falls (1 dock), Refrigerator Harbor (1 dock) and Lucerne Landing (1 dock).
4		\$39,000	Includes a total amount not to exceed \$39,000 annually for operation and maintenance of 18 USDA Forest Service docks. Docks will include Prince Creek, (2 docks), Safety Harbor (1 dock), Graham Harbor Creek (1 dock), Elephant Rock (1 dock), Lucerne (1 dock), Mitchell Creek (3 docks), Corral Creek (1 dock), Cascade Creek (1 dock), Big Creek (1 dock), Lucerne Admin. site (1 dock), Deer Point (1 dock), Graham Harbor (1 dock), Domke Falls (1 dock), Refrigerator Harbor (1 dock) and Lucerne Landing (1 dock).
Total	\$700,000	\$39,000	Total Chelan PUD commitment for USDA Forest Service docks throughout the License term.

Table 11-14: USDA Forest Service Recreation Measures

Item	Capital	Annual	Description
1	\$980,000		Years 1-30. Includes a total amount not to exceed \$980,000 for recreation enhancements at non-easements sites or as needed within the Lake Chelan Basin for USDA Forest Service recreation sites.
2	\$340,000		Years 30 to end of License. Includes a total amount not to exceed \$340,000 for recreation enhancements at non-easements sites or as needed within the Lake Chelan Basin for USDA Forest Service recreation sites.
3		\$6,000	Includes a total amount not to exceed \$6,000 annually for operation and maintenance of recreation sites at non-easement sites or as needed within the Lake Chelan Basin for USDA Forest Service recreation sites.
Total	\$1,320,000	\$6,000	Total Chelan PUD commitment for USDA Forest Service recreation facilities throughout the License term.

4.2.2 Docks and Recreation Facilities of the National Park Service

The NPS has identified that lakeshore facilities such as docks have ongoing high maintenance costs. Chelan PUD has agreed to address ongoing Project impacts to docks due to lake level fluctuations from Project operation. Non-Project factors also contribute to the need for dock maintenance, such as weather and normal wear and tear and therefore not all maintenance needs

Recreation Resources Management Plan

are the responsibility of Chelan PUD. The following summarizes specific measures in Proposed License Article 11 that pertain to NPS docks and recreation facilities within the Lake Chelan Basin.

Specific Action(s)

NPS Docks and Recreation Facilities. (1) Within 180 days of the effective date of the New License, Chelan PUD shall make available to the NPS \$149,000, for the purpose of repairing, replacing, and maintaining NPS docks at sites within the Project Area, in accordance with Table 11-15 of this Chapter. Chelan PUD shall also make available to the NPS a total amount of \$871,000 to enhance and stabilize NPS recreation sites within the Project Area, and for administrative costs associated with recreation projects, in accordance with locations identified in the table below.

NPS Recreation Sites Identified For Stabilization Projects

Site Number	Location
71	Weaver Point Dock
72	Stehekin Road
73	Stehekin Landing
75	Stehekin Access Road
76	Lakeshore Trail
82	Lakeshore Trail
83	Flick Creek Dock
113	Lakeshore Trail
210	Stehekin Landing

(2) Chelan PUD shall become responsible for implementation of the recreation enhancement work described in this Chapter, but only to the extent that unanticipated circumstances limit or preclude the ability of the NPS to do so. If such unanticipated circumstances arise Chelan PUD shall employ best efforts to implement such portion of the recreation enhancement work the NPS was unable to implement, but only until the remaining portion of the funding provided by Chelan PUD is expended by Chelan PUD. Such expenditures by Chelan PUD shall include both payments to outside contractors and the cost of all work performed by Chelan PUD employees, including a reasonable allocation of overhead. Chelan shall have no obligation to perform such work unless the NPS has provided notice to Chelan PUD and FERC in writing that such unanticipated circumstances exist.

NPS Recreational Enhancements (Years 30 to end of the License). Chelan PUD shall make available to the NPS a maximum of \$130,000, beginning on the 30th anniversary of the New License and ending on the date the New License expires, for the purpose of implementing recreational enhancements within or adjacent to the Lake Chelan Basin for National Park Service recreation sites, consistent with the recommendations of the recreational use and needs assessment study funded by Chelan PUD pursuant to section 4.3 of this Chapter.

*Recreation Resources Management Plan***Table 11-15: NPS Dock and Recreation Measures**

	Capital	Annual	Description
1	\$65,000		Includes a total amount not to exceed \$65,000 for expansion, critical maintenance, or replacement of docks at Flick Creek and Manley Wham.
2	\$84,000		Includes a total amount not to exceed \$84,000 for dock replacement at Flick Creek and Manley Wham.
3	\$841,000		Includes a total amount not to exceed \$791,000 for recreation site enhancements and stabilization and \$50,000 for administrative costs.
4	\$30,000		Includes a total amount not to exceed \$30,000 for Manley Wham and Purple point toilet improvements or replacement.
5	\$130,000		Years 30 to end of License. Includes a total amount not to exceed \$130,000 for development of Riddle Creek campground and vault toilet at Purple Point.
	\$1,150,000	\$0	Total Chelan PUD commitment for NPS facilities and docks throughout the License term.

4.2.3 Whitewater Boating in the Chelan River

Through the relicensing process, Chelan PUD studied a proposal by American Whitewater Affiliation for whitewater boating in the Chelan River. Chelan PUD posed liability as a critical issue that required resolution prior to accepting the measure in the New License. Chelan PUD maintained strong opposition to whitewater boating in the Chelan River for the following reasons:

- Safety concerns associated with the dangerous nature of the Chelan River gorge and rapids (categorized as Class V, two rapids were portaged and categorized as Class VI);
- Instability of surrounding canyons and potential for landslides and sloughing;
- Extreme difficulty of a rescue, and risks to rescue personnel should a rescue be necessary;
- Concern for liability exposure to Chelan PUD and ratepayers associated with high risk factors and extreme nature of whitewater boating in the Chelan River;
- The Washington State Recreational Use statute, RCW 4.24.210, may not adequately protect Chelan PUD in the event of a lawsuit;
- The Chelan River has only been used for kayaking during the July 8-10, 2000 Controlled Flow Boating Feasibility Assessment.

American Whitewater Affiliation maintained strong support for scheduled whitewater releases in the Chelan River for the following reasons:

- Participants in the July 8-10, 2000 Controlled Flow Boating Feasibility Assessment demonstrated that whitewater boating was feasible and provided a combination of challenging rapids in a short reach, warm water, and a spectacular canyon;
- Participants in the July 8-10, 2000 Controlled Flow Boating Feasibility Assessment indicated that the whitewater opportunities on the Chelan River were among the very best in Central Washington;
- The July 8-10, 2000 Controlled Flow Boating Feasibility Assessment indicated the whitewater difficulty was rated as Class V;

Recreation Resources Management Plan

- American Whitewater Affiliation believes the rapids and surrounding terrain in the Chelan Gorge do not present unique hazards or safety issues unlike those common to other whitewater rivers of comparable difficulty;
- American Whitewater Affiliation believes that whitewater boaters are well trained in river rescue and it is standard practice for these boaters to carry rescue gear and effect rescues of fellow paddlers in reaches, such as the Chelan River, without reliance on outside rescue teams and personnel.

During 1998, American Whitewater Affiliation requested a kayaking feasibility study be conducted on the approximately four-mile-long Chelan River. Chelan PUD completed an on-land boating feasibility assessment for the Chelan River (report dated Sept 1999) and a boating feasibility assessment (report dated October 2000). The initial three miles of the Chelan River offer rapids categorized as Class II (novice). However, the river then quickly changes to Class V+ (expert) for approximately three-tenths of a mile.

A significant issue discussed through the relicensing process was the concern for public safety and liability associated with whitewater boating in the Chelan River. Chelan PUD voiced these concerns to FERC (letters dated May 3, 1999, February 18, 2000, to American Whitewater Affiliation (letters dated August 16, 1999, June 20, 2000) and to the Washington Department of Ecology (letter dated February 5, 2003). In addition, the local Sheriff's Office and Fire District (in letters dated April 29, 1999 and January 13, 2003) strongly recommended against allowing kayakers access to the gorge because of the difficult and unsafe rescue situation that would be created. American Whitewater pointed out that whitewater boaters are well trained in river rescue and it is standard practice for boaters to carry rescue gear and effect rescues of fellow paddlers in reaches such as the Chelan River without reliance on outside rescue teams and personnel.

When considering the request for access to the Chelan River for whitewater boating, Chelan PUD asked the Washington Department of Ecology (DOE) to execute an indemnity and/or hold harmless agreement that would indemnify Chelan PUD for all costs incurred by Chelan PUD as a result of the death or injury of a kayaker in the Chelan River, including rescue costs, attorney's fees and expert witness fees incurred in any threatened or actual litigation, including all resulting appeals and the cost of any money judgment entered. DOE declined to provide such indemnity, stating that it is not the policy of the state to do so. The DOE 401 Water Quality Certification for the Project was amended in a fashion that is silent on Chelan PUD's requirements for whitewater recreation (Amended Order No. DE03WQCR-5420, April 21, 2003).

Additionally, Chelan PUD is not confident that the Washington State Recreational Use statute, RCW 4.24.210, adequately protects the District in the event of a lawsuit. The statute excepts from this immunity liability of landowners for injuries sustained to a user by reason of a "known dangerous artificial latent condition for which warning signs have been not been conspicuously posted." Chelan PUD believes the release of flows from 300-450 cfs in the Chelan River could be interpreted as an artificial condition for purposes of this analysis. Also, Chelan PUD believes the adequacy and placement of warning signs is often litigated.

Recreation Resources Management Plan

Chelan PUD reviewed FERC's order issued November 21, 2002, relieving the city of Tacoma from providing whitewater boating releases for its Nisqually Project. In the order, FERC concludes that, "because of the costs of the releases in administrative expense and foregone generation and public safety concerns, we will approve Tacoma's report and will not require further releases for whitewater boating at the Nisqually Project." (See FERC Order dated November 21, 2002.) Although not the only basis for the FERC ruling, safety concerns, exemplified by the December 2, 2000 drowning of a kayaker on the Nisqually River, are cited in the FERC order. A rehearing request was filed on the FERC Order regarding items of discussion and conclusions. Presently, the FERC Commission has not issued a final ruling on the order.

Chelan PUD's concern about the safety of kayakers and rescue personnel, and regarding the resulting liability exposure to Chelan PUD ratepayers remains a critical issue. In order to facilitate whitewater releases, until the Washington State Recreational Use Statute RCW 4.24.210 is changed to Chelan PUD's satisfaction in a fashion that specifically removes whitewater releases from being classified as "known dangerous artificial latent condition" or an alternative solution is reached. Language that would meet Chelan PUD's satisfaction is provided in subsection (11) of this Chapter. Chelan PUD and American Whitewater intend to work together to secure liability insurance protecting Chelan PUD's self-insured retention (subject to a mutually agreed deductible not to exceed \$25,000) for each whitewater release event.

Specific Action(s)

Whitewater Boating. Within one year of the effective date of the New License, Chelan PUD shall file with FERC for approval, plans for a three-year whitewater boating monitoring study in the Chelan River. The whitewater boating monitoring plan shall be developed by Chelan PUD, in consultation with the American Whitewater Affiliation. Specifically:

(1) Upon FERC approval of such three-year study, Chelan PUD shall provide an annual schedule of whitewater releases for kayaks in the Chelan River during such three year period. Chelan PUD shall release flows on the second and fourth weekends in July and September, except as provided in subsection (10). Flows on Saturdays shall be between 300 cfs and 375 cfs, and flows on Sundays shall be between 400 cfs and 450 cfs.

(2) Chelan PUD shall develop a reservation system for the whitewater boating monitoring study, whereby the scheduled water releases are made only if six or more kayakers make a reservation by 5:00 P.M. on the Thursday prior to the scheduled release date, and are physically present at the designated kayak put-in location by 10:00 A.M. on the date of the release, and liability insurance protecting the Chelan PUD's liability is in place, as provided in subsection (10). Additionally, each kayaker shall be required to sign a liability waiver in a form satisfactory to Chelan PUD prior to launching his or her kayak in the Chelan River. Only non-motorized, hard-shelled kayaks suitable for Class V whitewater shall be allowed, and no kayaker less than 18 years old shall be allowed. If the conditions contained in this paragraph are met, Chelan PUD shall begin the ramping-up of releases to meet the flows specified in subsection (1) above at 11:00 A.M., and shall begin ramping-down no sooner than 6:00 P.M.

Recreation Resources Management Plan

(3) A survey tool shall be designed by Chelan PUD, in consultation with American Whitewater Affiliation, to solicit input from whitewater boaters utilizing the Chelan River whitewater releases. The survey tool should at minimum query boaters on the suitability of the following: whitewater release dates, daily schedule, whitewater difficulty, spill volumes, access, carrying capacity, reservation system, and real time flow information.

(4) Chelan PUD shall conduct an annual meeting on or before May 1 whereby Chelan PUD and American Whitewater will review the annual whitewater report, as provided in subsection (5), and make adjustments as warranted to the annual schedule and spill volume, subject to the limitations in subsection (8) and (10), reservation system, and methods for liability protection for the upcoming year.

(5) Chelan PUD shall submit annual reports to FERC on or before June 1 for the previous year's whitewater boating monitoring study in the Chelan River for the initial three years after the effective date of the New License.

(6) Chelan PUD shall submit a final report upon completion of the three year whitewater boating monitoring study by May 1 on the fourth anniversary of the effective date of the new license. The final report should at a minimum include information on the dates and volumes of each release for the three year study period, annual use patterns, and an analysis of user preferences based on survey data. The report should also include recommendations for providing whitewater releases, if any, for the remainder of the license term. These recommendations should include at a minimum an annual schedule of releases including volume and timing, reservation system and minimum number of boaters required to trigger a release, and mechanism for liability protection.

Chelan PUD shall include with the final report documentation of consultation with American Whitewater Affiliation, copies of comments and recommendations on the final report. Chelan PUD shall allow a minimum of 30 days for the American Whitewater Affiliation to comment and to make recommendations prior to filing the final report with FERC for approval. If Chelan PUD does not adopt a recommendation, the filing shall include Chelan PUD's reasons for not doing so, based on among other things, any relevant project-specific information.

In the event that FERC fails to respond to the final report recommendations, the conditions associated with the three-year whitewater boating monitoring study shall remain in effect for a maximum of two years while pending a FERC ruling.

(7) Chelan PUD shall make publicly available for the three-year whitewater boating monitoring study and for the term of the New License real-time flow information via the Internet for the Chelan River. This information may be published on the Chelan PUD Web site or a third party Web site. The Internet site shall include at a minimum the annual schedule for whitewater releases, instructions and requirements for the reservation

Recreation Resources Management Plan

system, and real-time flow data information. Adjustments to the reservation system must be posted by May 1.

(8) Upon completion of the three-year whitewater boating monitoring study and for the remainder of the New License term, except as provided in subsection (10), Chelan PUD shall provide whitewater releases on the second and fourth weekends in July and September, provided that a minimum number of kayakers make a reservation by the Thursday prior to the scheduled release, through a reservation system developed and implemented by Chelan PUD, and are physically present by 10:00 A.M. on the date of the release. Chelan PUD, in consultation with American Whitewater Affiliation, may adjust the flow levels used following the three year study, but in no event shall the number of releases exceed eight, nor do the flow levels exceed 450 cfs. Chelan PUD shall also determine, in consultation with American Whitewater, the minimum number of kayakers required for future flow releases, but in no event should the number be less than six. Chelan PUD may also make changes to the schedule and/or reservation procedures, in consultation with the American Whitewater Affiliation.

(9) Chelan PUD shall not be obligated to provide whitewater boating flow releases in the Chelan River when the previous day's average Stehekin River inflow is less than 333 cfs, or when the Mid-Columbia Index is greater than \$150/MWh (\$2001) as adjusted pursuant to section 19.1 of the Agreement.

(10) In order to facilitate whitewater releases in the Chelan River until the Washington State Recreational Use Statute RCW 4.24.210 is changed to Chelan PUD's satisfaction, including an amendment that expressly extends the immunity protections of such statute to recreational whitewater releases or an alternative non-legislative mechanism is developed, Chelan PUD and American Whitewater intend to work together to secure liability insurance protecting Chelan PUD's self-insured retention (subject to a mutually agreed deductible not to exceed \$25,000) for each whitewater release in the Chelan River. Such liability insurance policy shall; (a) have a rating of A-8 minimum, (b) be Comprehensive General Liability for special events, (c) name Chelan PUD as an additional named insured, (d) be primary to other existing collectible insurance by Chelan PUD, (e) be purchased annually to cover all whitewater boating in the Chelan River, as described in this Chapter, whether such boating be sponsored by AWA or others, and (f) be approved by Chelan PUD in advance of any whitewater release. Once such insurance is obtained, whitewater releases shall be made in accordance with the schedule contained in this Chapter.

Funding for the purchase of the insurance will be derived from foregoing a maximum of four whitewater release per year (September releases). Chelan PUD shall have no obligation to fund the purchase of insurance beyond the amount saved from the foregone releases from the preceding year. Only whitewater releases that are covered by an insurance policy shall occur. The requirement for liability insurance shall only be removed if legislation is amended acceptable to Chelan PUD or a mutually agreeable mechanism for liability protection is developed between American Whitewater and Chelan PUD.

Recreation Resources Management Plan

(11) Chelan PUD, American Whitewater and other interested parties intend to work collaboratively to seek an amendment to the above-cited statute that expressly extends the immunity protections of such statute to recreational whitewater releases of the kind that would be provided by Chelan PUD pursuant to this Chapter. An example of such wording for an amendment to the Washington State Recreational Use Statute, RCW 4.24.210 is "an owner, lessee or occupant of a hydropower or other water impoundment facility who releases water from such facility in order to, among other things, facilitate recreational use of such water (whether flowing through a rural or an urban area, or both), shall not be liable for damages alleged to have been sustained by any person by reason of such release. Water releases during daylight hours into streams that are used or useful for whitewater recreation are conclusively presumed to be made, among other things, to facilitate recreational use or such water releases."

In the event that such amendments to the statute occur, Chelan PUD shall be responsible for all eight releases described in this Chapter. In the event that such amendments to the statute do not occur within the three year whitewater boating monitoring study described in this Chapter, Chelan PUD and AWA intend to work collaboratively to resolve outstanding issues. If any outstanding issues cannot be resolved within a one year period, the parties agree to use the dispute resolution process pursuant to section 16 of the Agreement.

4.2.4 Operation and/or Maintenance of Riverwalk, Shore Access, Old Mill, Manson Bay parks

Chelan PUD will continue to address public access and recreational use of Project lands. The 1976 Exhibit R identified four areas for recreation development. Chelan PUD developed the four recreation sites demonstrating Chelan PUD's commitment towards providing recreational facilities on Lake Chelan.

Specific Action(s)

Chelan PUD shall continue, for the term of the New License, to own and operate the Riverwalk Park and Loop Trail and to maintain the shore access site, located in the City of Chelan. Chelan PUD shall continue, for the term of the New License and subsequent annual licenses, to own Old Mill Park and Manson Bay Park, and shall be responsible for oversight of related operation and maintenance agreements with Manson Parks Recreation District.

4.2.5 Reach I Access Trail

The Lake Chelan Project regulates flow in the Chelan River and currently restricts a majority of the area from public access due to safety and liability concerns about the hazardous terrain and potential necessary releases of water down the gorge without advanced warning. Chelan PUD owns a majority of the property surrounding the Chelan River.

The Recreation Needs Forecast and Analysis (Chelan PUD, July 19, 2000) identified that the greatest recreational needs in the Lower Chelan Basin Zone include access to the Chelan River

Recreation Resources Management Plan

and public trails. National, state, and local surveys have also indicated demands for trails more than any other type of facility. The addition of trails in the lower zone would meet the needs of a variety of recreational users and activities. In addition, trails would provide more year-round use than any other facility needs identified in the Project Area.

Specific Action(s)

Reach 1 Access Trail. Beginning within one year of the effective date of the New License, Chelan PUD shall design and construct a non-motorized, non-paved, multi-use trail below the Lake Chelan Dam in Reach 1 of the Chelan River Bypassed Reach. The trail shall provide managed access to the Chelan River and connect to the Riverwalk Loop Trail. Planning and development shall be conducted by Chelan PUD, in consultation with adjacent landowners, Chelan County, the City of Chelan, the Lake Chelan Trails Committee, and other interested parties. The total capital cost to Chelan PUD for the Reach 1 Access Trail shall not exceed \$250,000. The annual Estimated Cost to Chelan PUD for operation and maintenance of the trail is \$4,500 for the term of the New License.

4.2.6 Riverwalk Loop Trail Extension

Chelan PUD constructed the Riverwalk Loop Trail in Riverwalk Park. Local stakeholders have requested that Chelan PUD provide an extension of the Riverwalk Loop Trail to cross the Chelan Dam and connect with the Reach 1 Access Trail.

Specific Action(s)

Riverwalk Loop Trail Extension. Beginning within one year of the effective date of the New License, Chelan PUD shall design and construct a paved trail that links Chelan PUD's existing Riverwalk Loop Trail to the Reach 1 Access Trail. Chelan PUD shall seek approval from FERC for crossing the Lake Chelan Dam as part of the trail extension design. If FERC denies approval to cross the Lake Chelan Dam, the trail design and construction shall only include a trail from Riverwalk Loop Trail along the south shoreline of the Chelan River to link with the Reach 1 Access Trail. Planning and development shall be conducted by Chelan, in consultation with adjacent landowners, Chelan County, the City of Chelan, the Lake Chelan Trails Committee, and other interested parties. The total capital cost to Chelan PUD for the Riverwalk Loop trail extension shall not exceed \$500,000. The annual Estimated Cost to Chelan PUD for operation and maintenance of the trail is \$5,000 for the term of the New License.

4.2.7 Operation and Maintenance under Dan Gordon Bridge

Chelan PUD owns and maintains Riverwalk Loop Trail which intersects with the Dan Gordon Bridge 97/364 Alt. on SR 97A within the city of Chelan. There is disagreement between the Washington State Department of Transportation and the City of Chelan related to responsibility of the area under the northern shore of the Chelan River that passes beneath the Dan Gordon Bridge. In a letter dated July 12, 1999, Christine O. Gregoire, Attorney General of Washington, states that the Washington State Department of Transportation considers the area of sidewalk the responsibility of the City of Chelan. Chelan PUD is currently providing general park custodial

Recreation Resources Management Plan

activities at the site. The City of Chelan requested Chelan PUD also provide sidewalk maintenance and replace the handrail under the Dan Gordon Bridge.

Specific Action(s)

Operation and Maintenance Under the Dan Gordon Bridge. (1) Beginning within one year of the effective date of the New License, Chelan PUD shall implement efforts to stabilize the sidewalk and replace the handrail along the north shore of the Chelan River, under the Dan Gordon Bridge. The total capital cost to Chelan PUD for such sidewalk stabilization and handrail shall not exceed \$17,000. Chelan PUD shall not be responsible for stabilizing the right-of way area owned by the Washington State Department of Transportation, nor be responsible for rectifying any structural problems regarding the Dan Gordon Bridge. Beginning within one year and of the effective date of the a New License, Chelan PUD shall assume responsibility for annual maintenance associated with the sidewalk and landscaping along the north shore of the Chelan River, beneath the Dan Gordon Bridge.

4.2.8 Reservation of PUD owned lands

The City of Chelan identified that the community is in need of lands for future development of recreation facilities or enhancements, such as baseball or soccer fields.

Chelan PUD owns property adjacent to the Chelan River that could be utilized for recreational and/or public development, while continuing to protect and maintain Project purposes.

Specific Action(s)

Reservation of Lands. Beginning within 90 days of the effective date of the New License, Chelan PUD shall reserve by not selling or otherwise disposing of land located in Reach 1 of the Chelan River Bypassed Reach, within a portion of Parcel A of Chelan County Short Plat No. 3195 lying northeasterly of the Chelan Gorge Road. Chelan PUD shall reserve such land for future recreational development, while continuing to protect and maintain Project purposes. Development or maintenance associated with such future recreational facilities shall not be the responsibility of Chelan PUD. Pursuant to FERC regulation, Chelan PUD shall not allow permanent structures within 200 linear feet of the Chelan Project penstock's centerline.

4.2.9 Micro Parks

The City of Chelan and Lake Chelan Chamber of Commerce requested that Chelan PUD review ownership and easements at several street ends, including Boulevard Ave, Cross Street, Warf Street, Park Street, and Water Street. A review of ownership concluded Chelan PUD owns some of the fee title to land that resulted from the vacation of the streets and alleys in 1926, 1927 and 1931. Most of the points of access owned by Chelan PUD are already being utilized as public access and have been developed as parks. Additionally, Chelan PUD owns a strip of shoreline property located on Water Street and an adjacent street right of way along the lower south shore of Lake Chelan. A majority of this property is under water and on a steep bank. Providing

Recreation Resources Management Plan

access to the lake at this site was initially considered but determined difficult, with limited area for development of shoreline and parking.

Chelan PUD agreed to quit claim deed the Water Street and Park Street properties to the City of Chelan for development of public access areas or micro parks.

Specific Action(s)

Micro Parks. (1) Beginning within 90 days of the effective date of the New License, Chelan PUD shall quit claim deed to the City of Chelan Parcels #272214662242, #272214662229, and #272214662440, near Water Street. All three Parcels are owned by Chelan PUD, and are located along the south shore of Lake Chelan, approximately three miles from the City of Chelan. Chelan PUD shall include in such quit claim deed any rights it may hold to place docks and buoys in the waters immediately adjacent to such Parcels (subject to a five-year reservation of such rights for the benefit of adjacent landowners, as further specified in the quit claim deed), and subject to any easements and/or damage waivers related to Project impacts that it may hold relating to such Parcels.

(2) Beginning within 180 days of the effective date of the New License, Chelan PUD shall make available to the City of Chelan a total amount of \$20,000 toward the capital costs associated with the development of a micro park at Water Street (Parcels #272214662242, #272214662229, and #272214662440). Development, implementation, and operation and maintenance of such micro park shall be the sole responsibility of the City of Chelan.

4.2.10 Utility Improvements for Local Trail

The City of Chelan has expressed an interest in building a trail route from Don Morse Memorial Park to Riverwalk Park, along State Highway 150 and Johnson Street, in downtown Chelan. Chelan PUD owns overhead utility lines along the highway right-of-way and sidewalk along the proposed trail route.

Specific Action(s)

Utility Improvements for Local Trail. Contingent upon the City of Chelan excavating or trenching from Don Morse Memorial Park to Riverwalk Park, Chelan PUD shall install in such trench primary underground facilities and remove primary overhead lines from the right-of-way area of the sidewalk along Johnson Avenue and State Highway 150 near Campbell's Resort. Chelan PUD shall not be responsible for any costs related to trenching, asphalt or concrete work associated with roadway and sidewalk improvements or repair.

4.2.11 Trail Linkage to PUD Parks

The City of Chelan and other local stakeholders may construct trails in the future that would connect to existing Chelan PUD parks and trails.

Recreation Resources Management Plan

Specific Action(s)

Trail Linkage to PUD parks. Chelan PUD shall consult with interested organizations and individuals to integrate new trails with existing parks owned and/or managed by Chelan PUD, including Old Mill Park, Manson Bay Park, and Riverwalk Park. Specifically, Chelan PUD shall develop and construct modifications to existing Chelan PUD park entrances and exits to accommodate the integration of new trails. Chelan PUD shall not be responsible for development or operation and maintenance of such new trails.

4.2.12 *Don Morse Park Erosion*

The City of Chelan has identified the need for beach repair at Don Morse Memorial Park. Chelan PUD holds an easement at the site. Chelan PUD is constrained from funding repair of damages on sites for which easements were purchased since landowners have already been fully compensated for such damages.

Specific Action(s)

Don Morse Park Erosion. Within 180 days of the effective date of the New License, Chelan PUD shall make available to the City of Chelan in-kind services not to exceed \$60,000 for engineering and design services and provision of Chelan PUD-owned equipment, if available, for the purpose of controlling erosion at Don Morse Park beach area and marina breakwater on Lake Chelan. Prior to the provision of such services, the City of Chelan shall execute an indemnity and/or hold harmless agreement in a form satisfactory to Chelan PUD. Such agreement shall indemnify Chelan PUD for all costs incurred by Chelan PUD as a result of any future litigation regarding the Don Morse Park beach area and marina breakwater, including costs and attorneys' fees incurred in any resulting litigation, and the cost of any money judgment entered.

4.3 *Recreation Use Study*

Beginning in the 20th year of the effective date of the New License, and finishing in the 23rd year, Chelan PUD shall conduct a study assessing recreational use and needs within the Lake Chelan basin, at a cost not to exceed \$100,000.

The purpose of the Recreation Use Study is to define the existing recreational use in the Lake Chelan Basin including number of visits, recreational activity types, high use locations, and temporal trends. The Recreation Use Study will also evaluate recreation demand in the Lake Chelan Basin to determine whether demand is accommodated by existing facilities. Results from the study will aid resource agencies in developing continued concepts for the coordinated development and utilization of the lake's recreational resources.

As part of the Recreation Use Study, data will be collected in years 21 and 22 of the New License on recreation use in the Project Area from the Chelan Powerhouse to the head of Lake Chelan at Stehekin. A Recreation Use Assessment report will be completed in year 23 of the New License. The study area will include all public recreational resources within the Project boundary. The Recreation Use Study methodology may include, but is not limited to:

Recreation Resources Management Plan

- Review of existing recreation resource assessment work
- Summary of current management plans and policies of agencies
- Inventory of existing public and private recreation resources
- Analysis of recreational activities and demand for facilities
- Analysis of recreational resource capacity for recreation development
- Recreation resource mapping

4.4 Recreation Resources Management Plan Review Schedule

This Recreation Resources Management Plan will be reviewed every six years to coincide with FERC's schedule for submittal of Form 80. A Lake Chelan Recreational Forum (LCRF) shall be formed as provided in section 18 of the Agreement, and will meet within six months following submittal of Chelan PUD's FERC Form 80 to review federal, state and local recreation policies, goals and planning documents relevant to the Project Area.

The purpose of the LCRF is to exchange information related to recreation resources within the Project Area to improve future management decisions. Additionally, the LCRF will provide input and comment to the recreation use assessments plan and report conducted by a consultant chosen and funded by Chelan PUD during years 20 through 23 of the New License. Based on the results of the Recreation Use Assessment, the managing agencies and the LCRF may determine it necessary to reallocate the funds spent under this Chapter. However, in no event shall a reallocation of funds increase the funding obligation by Chelan PUD.

Recreation Resources Management Plan



Figure 11-2: Proposed Access to Chelan River

Recreation Resources Management Plan

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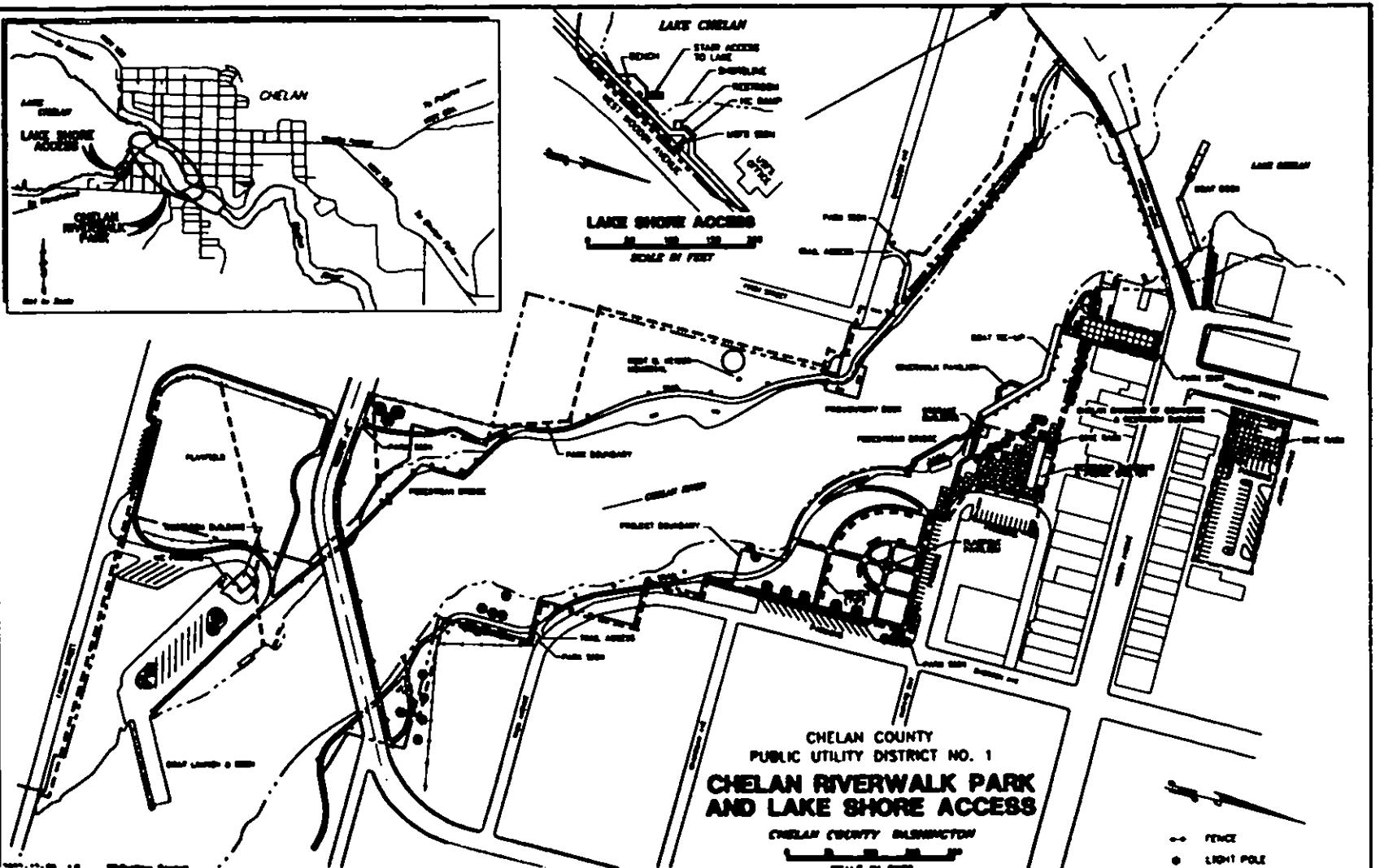
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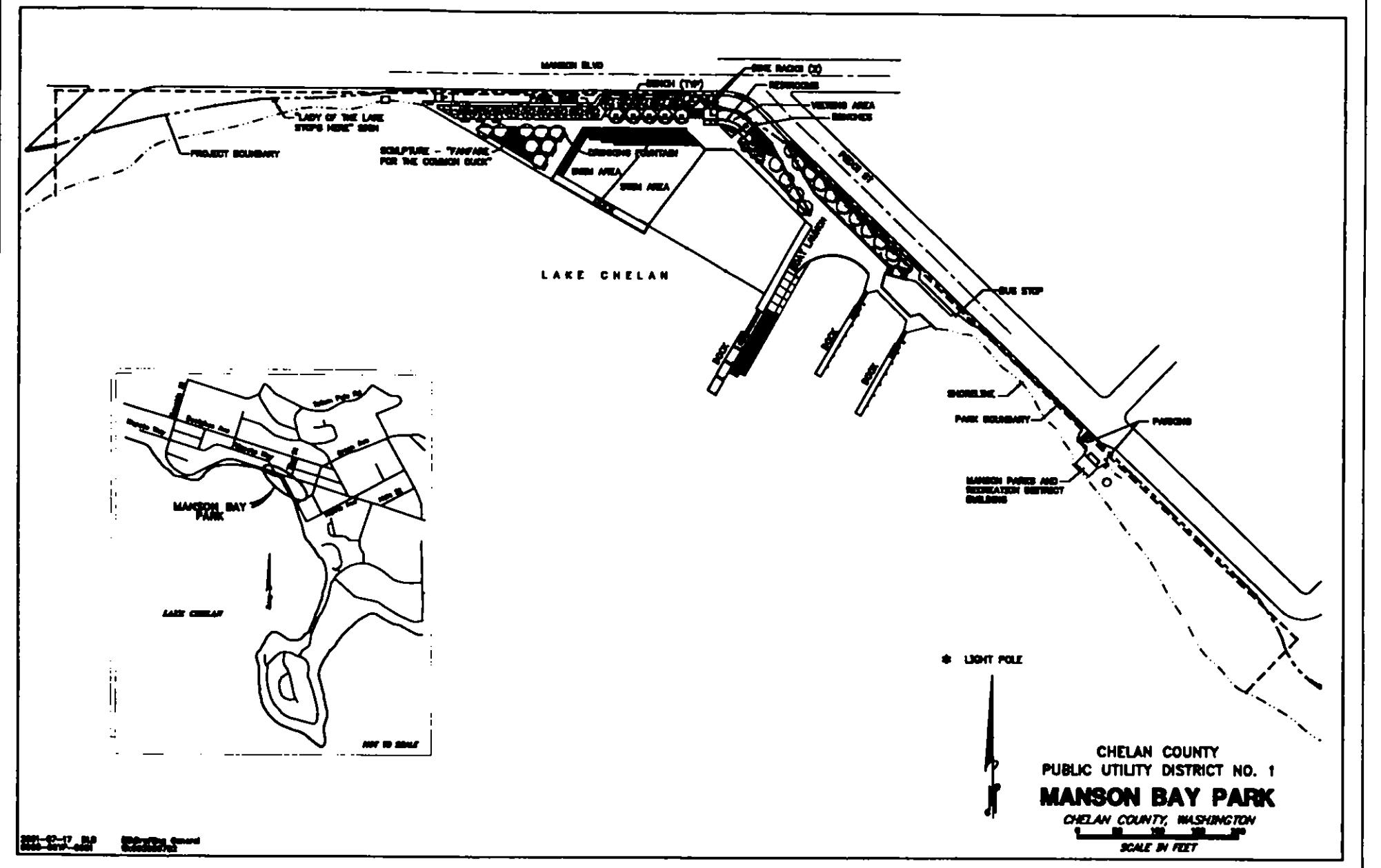
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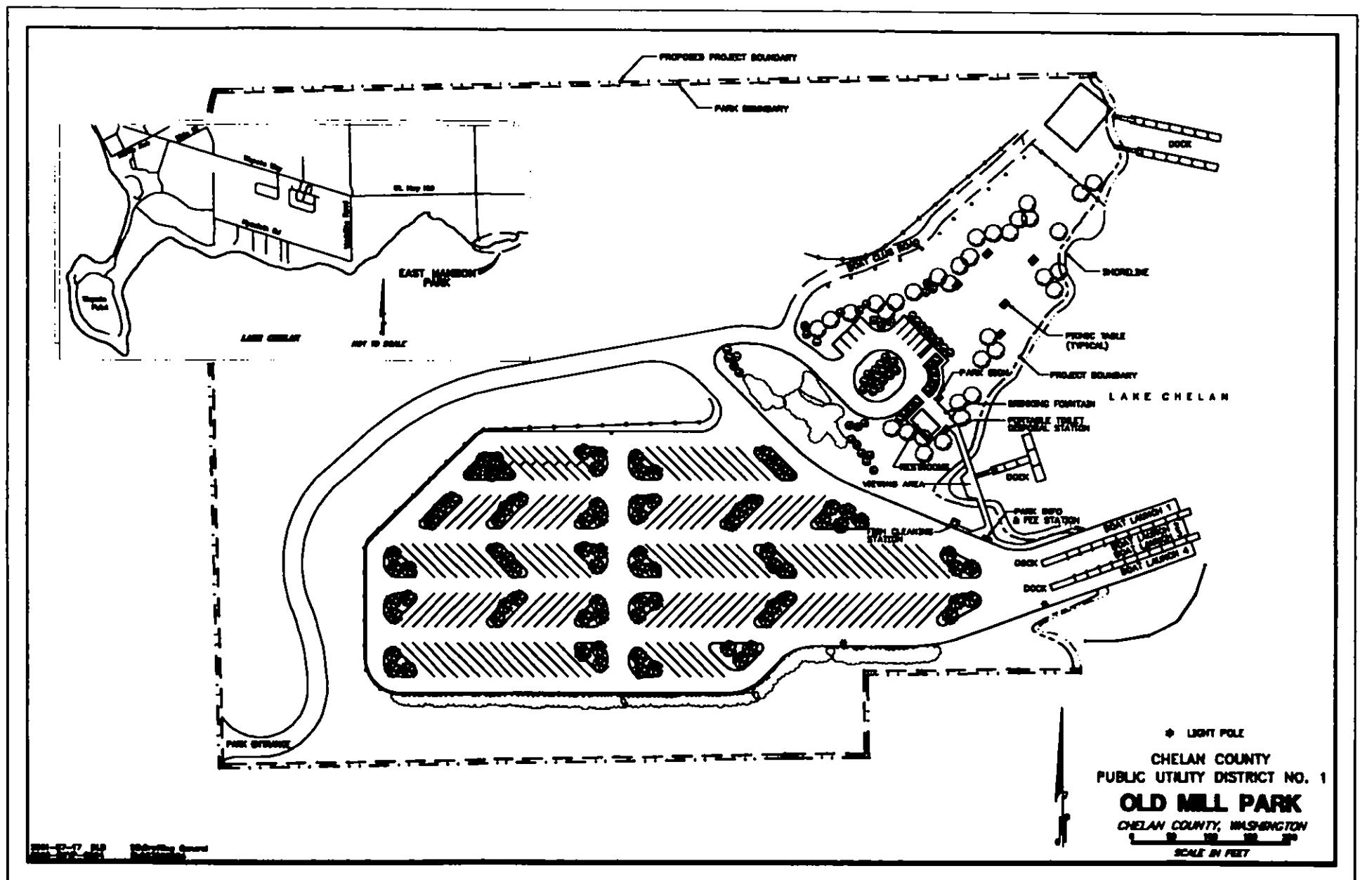
***APPENDIX A: AS-BUILT DRAWINGS OF CHELAN PUD
RECREATION SITES***



Recreation Resources Management Plan

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***CHAPTER 12: UPPER COLUMBIA RIVER SPRING-RUN CHINOOK
AND STEELHEAD CONSERVATION MEASURES***

*Upper Columbia Spring-Run Chinook and
Steelhead Conservation Measures*

TABLE OF CONTENTS

CHAPTER 12: UPPER COLUMBIA RIVER SPRING-RUN CHINOOK AND STEELHEAD CONSERVATION MEASURES	12-1
SECTION 1: Introduction	12-1
SECTION 2: Implementation Plan and Schedule	12-1

*Upper Columbia Spring-Run Chinook and
Steelhead Conservation Measures*

SECTION 1: INTRODUCTION

The operation of the Project causes a reduction in water available for management of Columbia River flows during the months of April through June. Thus, Project operations under the New License could increase the magnitude, and possibly the frequency, that the Columbia River target flows established under the 2000 FCRPS Biological Opinion are missed.¹

In 1997, NOAA Fisheries established the goal of zero net impact for federal actions that would result in the reduction of Columbia or Snake river flows (NMFS 1997).² This "zero net impact" goal was further defined as pertaining to withdrawals only during the juvenile salmon migration season, and only when the established flow objectives for the protection of juvenile salmon were not being met.

SECTION 2: IMPLEMENTATION PLAN AND SCHEDULE

In accordance with this goal, the following mitigation action is intended to help offset potential adverse effects to the survival of Upper Columbia River spring-run chinook and Upper Columbia River steelhead by improving the frequency that base flows or minimum flows are attained in tributary areas that provide critical habitat for these species. In doing so, Chelan PUD does not concede that the reduction in Columbia River flows due to Project operations would have any biological significance, or that such mitigation action is necessary in order to achieve NOAA Fisheries' goal of zero net impact.

The mitigation action will provide funding of \$20,000 per year for water conservation measures or acquisition of water rights that would be purchased or leased by either Chelan PUD or a third party, such as the Washington Water Trust. To assure that saved water or leased water rights are used for instream flows, the water rights will be administered under the Trust Water Rights program and water banking programs, which are administered by the Washington State Department of Ecology pursuant to Washington state law, or otherwise contractually bound to provide instream flows. The funds will be used only in situations where habitat for Upper Columbia River spring-run chinook and Upper Columbia River steelhead is adversely affected by low flow conditions.

¹ NOAA Fisheries, 2000. Endangered Species Act - Section 7 Consultation, Biological Opinion Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin.

² NMFS, 1997. Letter from William W. Stelle, Jr., NMFS Regional Administrator, to Brig. General Robert H. Griffin, North Pacific Division Commander, U. S. Army Corps of Engineers. Re: Mitigation requirements for new water diversions that affect spring-run and summer flow objectives established to improve the mainstem survival of listed Snake River salmon.