BASIN CONSERVATION PLAN

for the

YAKIMA RIVER BASIN
WATER CONSERVATION PROGRAM

Yakima River Basin Conservation
Advisory Group
April 1998

Appointed by the Secretary of the Interior to provide advice and guidance on water conservation opportunities in the

Advisory Group Members:

Carroll E. Palmer
Yakama Nation

Katherine P. Ransel
American Rivers (representing Environmental Interests)

Brent D. Renfrow
Washington Department of Fish and Wildlife

Robert G. Stevens
(Appointment Pending)
Washington State University Cooperative Extension

James W. Trull
Sunnyside Valley Irrigation District (representing Non-proratable Irrigators)

Ron Van Gundy
Roza Irrigation District (representing Proratable Irrigators)

James A. Esget, Bureau of Reclamation
Designated Federal Official

c/o Bureau of Reclamation
P.O. Box 1749
Yakima, WA 98907-1749

YAKIMA RIVER BASIN CONSERVATION PROGRAM
CONSERVATION ADVISORY GROUP

Honorable Bruce Babbitt
Secretary of Interior
Main Interior Building
18th and C Street NW
Washington, DC 20240

Subject: Yakima River Basin Water Enhancement Project, Washington (YRBWEP)

Dear Secretary Babbitt:

On August 12, 1997, a draft Basin Conservation Plan (Plan) developed by the Conservation Advisory Group (CAG) was released for public review by Commissioner Eluid Martinez. CAG was directed to develop this Plan to assist in guiding the Yakima River Basin Water Conservation Program (Program) authorized by Title XII of the Act of October 31, 1994, Pub. L. 103-434 (Title XII). The goal of the Program is to improve instream flows for fish and wildlife and the reliability of the irrigation water supply by implementing water conservation measures. The Conservation Program also includes acquisition of land, water, and water rights to enhance instream flows. Participation in the Program is voluntary.

CAG was chartered July 13, 1995, and its members appointed by you October 30, 1995, for the purpose of advising you and the State of Washington on the structure and implementation of the Program. CAG is nonvoting and seeks a consensus whenever possible. The development of the Plan is one of CAG's primary responsibilities.

The public review period extended through October 31, 1997. Comments received have been reviewed and discussed by CAG and a response addressing the comments and suggestions sent to each commenter. The draft Plan has been revised to include many of these comments and suggestions.

Title XII provides that within 60 days after the close of the comment period, you are to publish the Plan. While it was our intent to complete the Plan within this period, we were unable to accomplish this because of other responsibilities and commitments. At this time we are happy to report that we are in consensus on the Plan and it is now complete and ready for you to publish.

We appreciate the opportunity to assist in this important effort in the Yakima River basin. We will be glad to respond to any questions and comments concerning the Plan.

Enclosed is a letter from Washington Department of Ecology, advising us of their active participation in the process and support of the Conservation Plan.

Sincerely,

See Attached Signature Page

Enclosures: Plan
Letter from Washington Department of Ecology

cc: Patricia Beneke, Assistant Secretary, Water and Science
Eluid Martinez, Commissioner of Reclamation
Tom Fitzsimmons, Washington Department of Ecology

Proratable Irrigators

(Ron Van Gundy)

Non-Proratable Irrigators

(James W. Trull)

Yakama Indian Nation

(Carroll E. Palmer)

Environmental Interests

(Katherine P. Ransel)

Washington State
Department of Fish and Wildlife

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Washington State University
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(Robert G. Stevens)
(Appointment Pending)

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

March 27, 1998

Yakima River Basin Conservation
Advisory Group
U.S. Bureau of Reclamation
P.O. Box 1749
Yakima, Washington 98907-1749

Subject: Submittal of the Final Yakima River Basin Water Conservation Plan to the Secretary of the Interior

Dear Conservation Advisory Group:

I would like to congratulate you on the completion of the Yakima River Basin Water Conservation Plan (Plan). I appreciate your substantial investment of time and effort in preparing the Plan, and your continued assistance to the Department of Ecology (Ecology) and the U.S. Bureau of Reclamation (Reclamation) as we implement the Basin Conservation Program.

Ecology and Reclamation are committed to the successful implementation of the Basin Conservation Program. Ecology has actively participated in the Plan preparation and revisions, and supports the final Plan.

I am looking forward to receiving the final Plan after its publication by the Secretary of the Interior, as provided by section 1203 (h) of Title XII.

Sincerely,

Keith E. Phillips

Keith E. Phillips, Manager
Water Resources Program

KP:blt

cc: Stan Isley, Ecology Liaison, USBR ✓
Walt Fite, Upper Columbia Area Manager, USBR
Jim Esget, YRBWEP Manager, USBR

THE SECRETARY OF THE INTERIOR

WASHINGTON

OCT 14 1999

Yakima River Basin Conservation Advisory Group
c/o Bureau of Reclamation
Upper Columbia Area Office
PO Box 1749
Yakima, Washington 98907

Dear Conservation Advisory Group:

I am pleased to advise you that I am directing the Commissioner of the Bureau of Reclamation to publish your Basin Conservation Plan (Conservation Plan). I have also received your plan, "Establishment of a Permanent Plan for Measuring and Reporting" (Measurement Plan). Your efforts in developing both plans are greatly appreciated and your consensus is especially gratifying.

As you are aware, the Conservation Plan was prepared to help guide the Yakima River Basin Water Conservation Program, authorized by Title XII of the Act of October 31, 1994, P.L. 103-434. The purpose of Title XII is to protect, mitigate and enhance fish and wildlife, and to improve the reliability of the water supply for irrigation through improving water management in the basin. The Department, acting through Reclamation and other departmental agencies, will use the Conservation Plan to generally guide its efforts as we move forward to implement conservation measures.

Several comments were made by the Department during the review of the Conservation Plan. Those comments were related to the determination of baseline irrigation requirements, the protection of conserved water, monitoring of conservation measures, tiered pricing of water, evaluation of economic and environmental benefits, water brokerages, and water acquisition. More details on these comments are included in the attached memorandum.

There are no legislated requirements to publish the Measurement Plan. However, I can assure you that its recommendations will be an important part of the Department's considerations as we begin implementing measures under Title XII.

Again, I appreciate your work on developing these Plans and look forward to your continued efforts to improve instream flows and the reliability of water supply for irrigation in the Yakima River.

Sincerely,

Enclosure

United States Department of the Interior

BUREAU OF RECLAMATION
Washington, D.C. 20240

OCT 20 1999

MEMORANDUM

To: Regional Director, Boise, Idaho
Attention: PN-1000

From: Eluid L. Martinez
Commissioner

Subject: Basin Conservation Plan, Yakima River Basin Water Enhancement Project, Washington

The Yakima Basin Conservation Plan (Plan) is an excellent document for providing overall guidance for the implementation of water conservation efforts in the basin and should be published as such. Several comments were made in the Department's review of the Plan prepared by the Yakima River Basin Water Conservation Advisory Group. These comments should serve to enhance and clarify the measures discussed in the Plan. In the material below I elaborate on some of the Department's comments I believe are important to moving forward on the implementation of P.L. 103-434 in the context of the Plan. Reclamation, acting for the Department, will give due consideration to these comments in implementing measures related to the plan.

P.L. 103-434 states that conserved water from the Yakima River Basin Water Conservation Program "shall not be used to expand irrigation in the Yakima Basin . . ." The Act's stated goal is that two-thirds of water savings will be applied to protect and enhance fish and wildlife resources, and that one-third will be available for existing proratable irrigation in years of shortage. In order to meet the requirement and goal a baseline determination of actual irrigation is required and shall be conducted.

One of the critical components of achieving increases in instream flows is the ability to protect those flows from subsequent diversion. In its ongoing implementation efforts Reclamation will work to ensure that water conserved for instream flows is protected and used for such purposes. Reclamation will consider a variety of tools to achieve this result. These could include modified Total Water Supply Available (TWSA) allocation procedures for irrigation districts participating under the 1945 Consent Decree.

As the Plan acknowledges, long term off- and on-farm monitoring of implemented conservation measures is very important. Reclamation will actively work with surface and ground water users and others to identify appropriate monitoring measures, associated costs, and develop mechanisms to ensure that accurate monitoring occurs and continues. Reclamation will also establish a position in the Enhancement Program to coordinate, monitor, and enforce agreements to conserve water in the basin.

Reclamation will also place a priority on ensuring that appropriate institutional changes such as tiered pricing of water are considered on an equal footing with structural approaches in any efforts to conserve water. Primary among these measures will be the requirement that tiered pricing be a part of all conservation plans. Tiers need to be structured carefully to ensure that the objective of more efficient water use is achieved.

The Plan adopts a very broad notion of "benefits" in the context of evaluating alternative water conservation investments. In moving forward and implementing this notion, Reclamation will rank alternative conservation investments using the criteria of *the net present value of benefits* (i.e., the present value of total benefits less the present value of total costs) associated with each potential conservation investment over the expected life of the investment. Benefits obviously include environmental benefits as well as benefits associated with the development of more reliable water supplies in dry years. All benefits (including benefits resulting from reductions in flow fluctuations, flow augmentation, and habitat improvements) will not necessarily be quantified in monetary terms, but will at least be quantified in physical or biological terms in order to compare different water conservation proposals. Costs will include capital and ongoing operations, maintenance, and monitoring costs. Reclamation will annually rank all of the potential water conservation proposals according to net benefits provided by each. Selection of proposals, up to the amount of available funding, will be based on the proposals that provide the highest level of net benefits. Reclamation will not implement any significant construction of water conservation systems until satisfactory results are available from on-going biological studies in the basin.

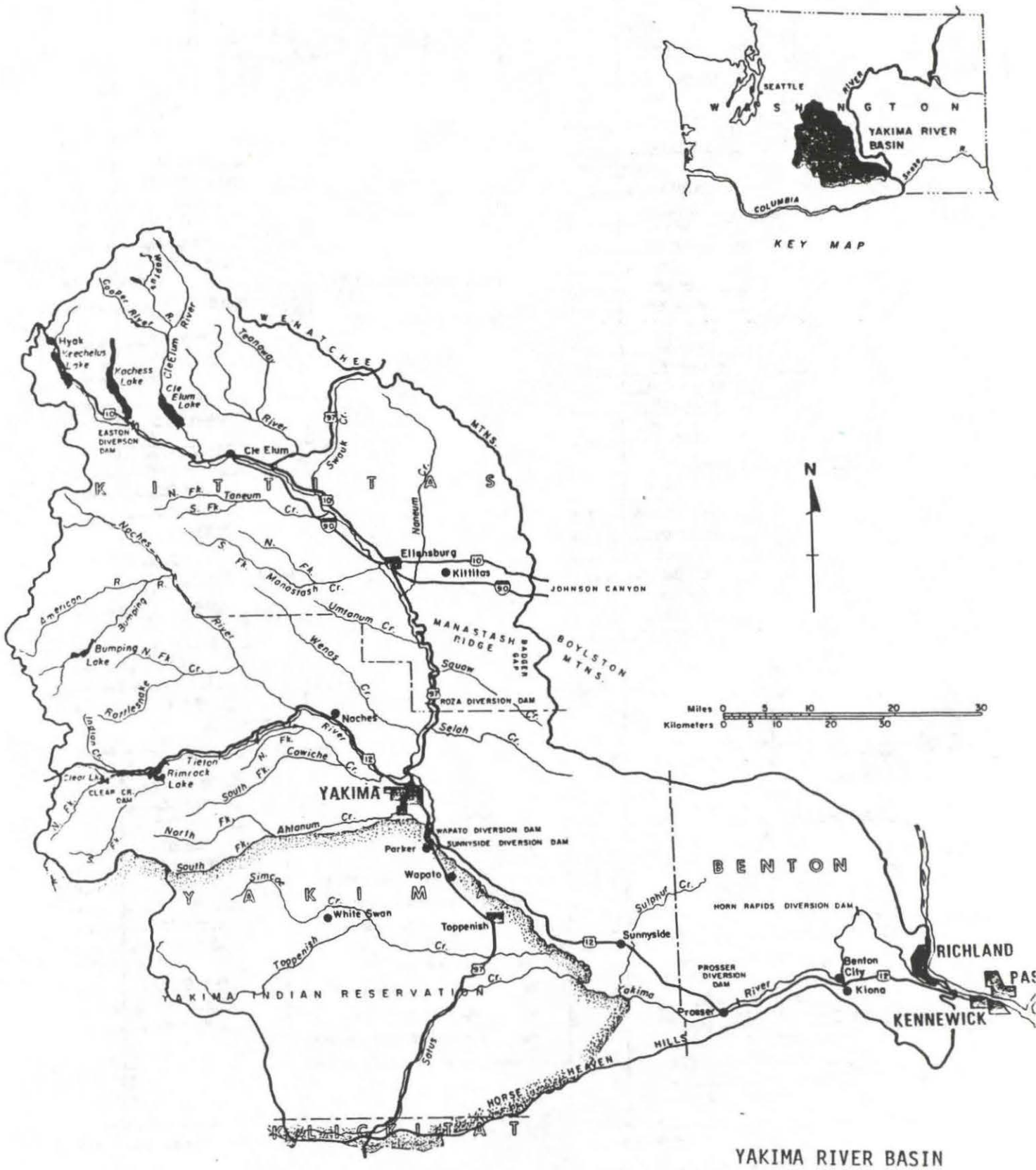
The Plan suggests that Reclamation should consider engaging or creating a neutral "water brokerage" to facilitate water right transfers, banking, dry year leases, and other measures. This may be quite useful in efforts to acquire water and will be tested in a "pilot" manner in subsequent years.

In considering various approaches to securing additional water for instream flows over the longer term, Reclamation will give a high priority to funding of the acquisition of water and/or land with appurtenant water rights, either on a permanent or temporary basis. One way Reclamation can do this is by allocating available funding for acquisitions, when appropriate, from the Basin Conservation Program. Reclamation will continue to seek out and negotiate sales with interested sellers. However, Reclamation will also seek to implement other innovative approaches, such as "reverse" auctions. In allocating available funding between acquisitions and structural water conservation investments, one of Reclamation's goals will be to attempt to ensure that there is parity in the price of water acquired across the various means of acquisition. That is, the unit price of water should be roughly similar whether it is acquired by direct acquisition, lease, or by funding structural water conservation measures.

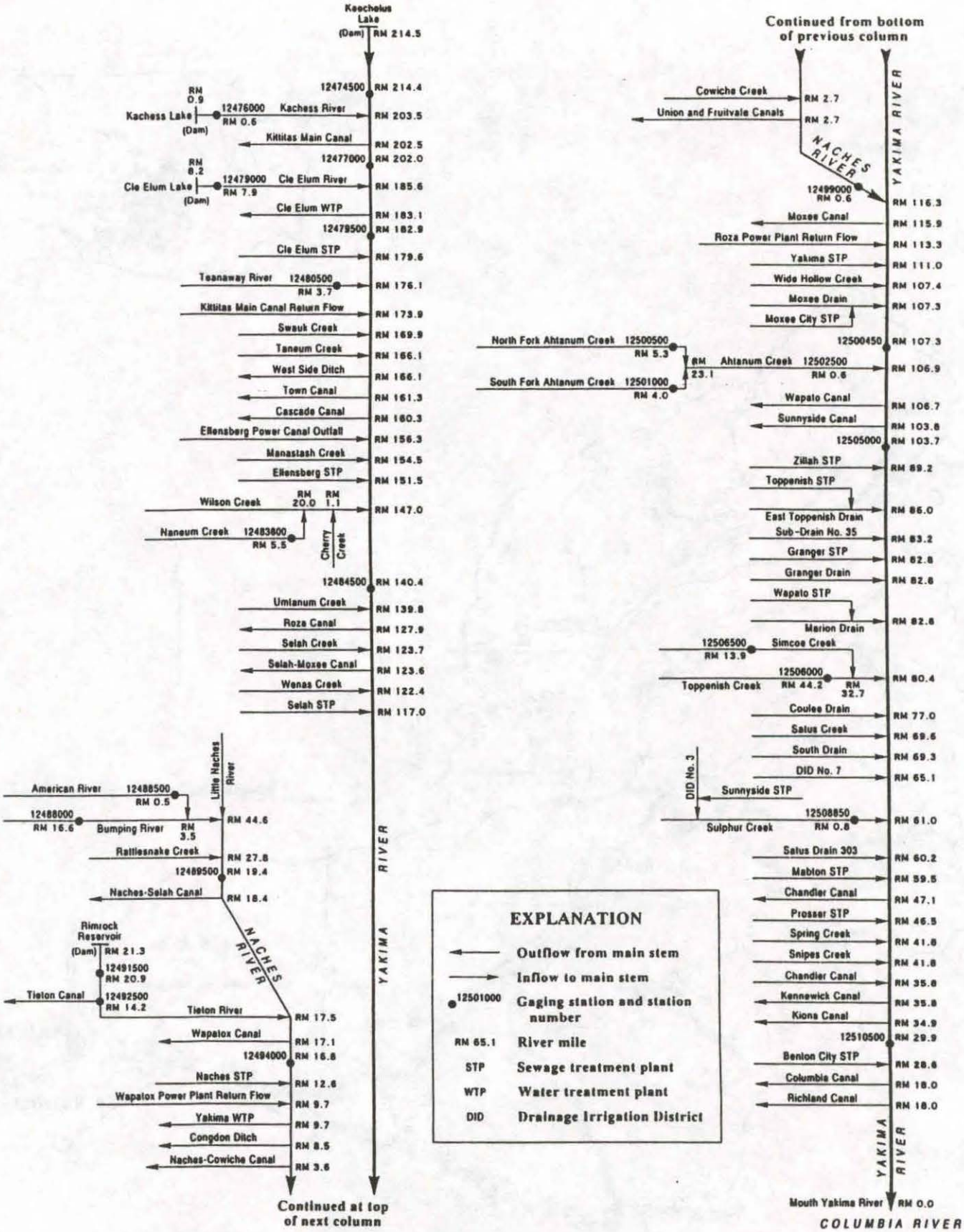
cc: Area Manager, Upper Columbia Area Office, Yakima, Washington
Attention: UCA-1000, 1200

ABBREVIATIONS AND ACRONYMS

BPA	Bonneville Power Administration
CAG	Yakima River Basin Water Conservation Advisory Group
CFS	Cubic Feet Per Second
Conservation Plan	Basin Conservation Plan
Conservation Program	Yakima River Basin Water Conservation Program
FIT	Feasibility Investigation Team
Ecology	Washington Department of Ecology
Enhancement Project	Yakima River Basin Water Enhancement
EQIP	Environmental Quality Incentives Program
Habitat Plan	Yakima River Basin Wetlands and Floodplain Habitat Plan
HGM	Hydrogeomorphic Methodology
ISG	Independent Scientific Group
NPPC	Northwest Power Planning Council
NRCS	Natural Resources Conservation Service
O&M	Operation and Maintenance
Operating Plan	Interim Comprehensive Basin Operating Plan
PAWS	Public Agricultural Weather System
PP&L	Pacific Power and Light Company
RCW	Revised Code of Washington
Reclamation	Bureau of Reclamation
RM	River Mile
Secretary	Secretary of the Interior
SOAC	System Operations Advisory Committee
State	State of Washington
Title XII	Title XII of the Act of October 31, 1994 (Pub. L. 103-434)
TMDL	Total Maximum Daily Load
TWSA	Total Water Supply Available
USGS	U.S. Geological Survey
Wetlands Enhancement Project	Yakima River Basin Wetlands Enhancement Project
WSU	Washington State University
YVCOG	Yakima Valley Conference of Governments



YAKIMA RIVER BASIN



Schematic diagram showing relative positions of selected tributaries, diversion canals, return flows, and stream-gaging stations in the Yakima River Basin, Washington.

Yakima River Basin Schematic

EXECUTIVE SUMMARY

BASIN CONSERVATION PLAN
for the
YAKIMA RIVER BASIN WATER CONSERVATION PROGRAM
April 1998

Purpose, Scope, and Authority

The purpose of this Basin Conservation Plan is to provide recommendations to the Secretary of the Interior and the State of Washington on the structure and implementation of the Yakima River Basin Water Conservation Program. This Basin Conservation Plan outlines objectives, problems and needs, and potential water conservation solutions and provides guidelines, processes, and procedures to make the Yakima River Basin Water Conservation Program functional.

Authority for the development of this Basin Conservation Plan is provided by Title XII of Public Law 103-434 (Title XII) enacted October 31, 1994, authorizing Phase II of the Yakima River Basin Water Enhancement Project.[1] The Secretary of the Interior chartered the Yakima River Basin Conservation Advisory Group on July 13, 1995, under the Federal Advisory Committee Act. He subsequently appointed the six members on October 30, 1995.

This Basin Conservation Plan was prepared by the Conservation Advisory Group, with the Bureau of Reclamation (Reclamation) acting as a representative of the Secretary of the Interior and the Washington Department of Ecology representing the State.

This Basin Conservation Plan does not cover activities on the Yakama Indian Reservation specifically authorized by Section 1204. However, parts of the Basin Conservation Plan, such as the Guidelines for Preparation of Water Conservation Plans, may be useful to the Yakama Nation.

Need for Yakima River Basin Water Conservation Program

The Federal Government has the responsibility in the Yakima River basin for providing water supplies for irrigation and maintaining and enhancing the anadromous fishery which is a part of the trust assets of the Yakama Nation. The Federal Yakima Project consists of an extensive storage system and water delivery facilities to supply water to about 460,000 acres of irrigated

[1]Phase I, the installation of fish passage and protective facilities, was authorized in 1984.

lands.[1] In addition, facilities owned and operated by water companies, municipalities, and individuals, also supply irrigation water in the Yakima River basin. Many of these facilities and the associated water right predate the Yakima Project. Also located in the basin is the Yakama Indian Reservation which contains about 1.5 million acres of land.[2] The Treaty of 1855, between the United States and the 14 Confederated Tribes of the Yakama Nation reserved the exclusive right of taking fish in all the streams, where running through or bordering the reservation, as well as at all usual and accustomed places, in common with the citizens of the Territory, and of erecting temporary buildings for curing them; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land.

Inadequate water supplies for irrigation during drought years and declining anadromous fish populations prompted Congress to authorize the Yakima River Basin Water Enhancement Project study in 1979. Recognizing that immediate action was necessary to preserve the anadromous fishery, implementation of Phase I of the Yakima River Basin Water Enhancement Project was authorized in 1984. This phase focused on an immediate improvement of fish passage and protective facilities to reduce the loss of anadromous fish. Improvement of the water supply for irrigation and enhancement of anadromous fish populations was left for later implementation phases.

Several years of drought and deficient water supplies for irrigation and instream flows have highlighted the need to improve the water supply. In 1994, some irrigation water right holders received only 37 percent of their entitlement, and chinook salmon and steelhead are now being considered for listing under the Endangered Species Act.

Phase II of the Yakima River Basin Water Enhancement Project was authorized in 1994. Among other things, Title XII directed that the Yakima Project be operated to provide instream target flows of 300-600 cubic feet per second (cfs) in the Yakima River over Sunnyside and Prosser Diversion Dams. It also authorized the Yakima River Basin Water Conservation Program as a means to increase these instream flows and to improve the reliability of irrigation water supplies through the implementation of water conservation measures resulting in decreased diversions from the Yakima River and its tributaries.

[1] The Yakima Project, now one of the largest projects of the Bureau of Reclamation, was authorized in 1905.

[2] A part of the Yakama Indian Reservation lies within the Klickitat River basin.

EXECUTIVE SUMMARY

Yakima River Basin Water Conservation Program Goal and Participation

The goal of the Yakima River Basin Water Conservation Program is to realize sufficient reductions in irrigation water diversions through implementation of water conservation measures so that additional water is available for instream flows for fish and wildlife and the water supplies for irrigation in dry years are improved.

Participation in the Yakima River Basin Water Conservation Program is voluntary. Title XII specifies four program phases:

- Development of participant water conservation plans.
- Feasibility investigations of specific water conservation measures being considered for implementation.
- Implementation of selected structural and non-structural water conservation measures.
- Post-implementation monitoring and evaluation.

Participants can acquire Federal and State funds in varying amounts and in the form of grants for each program phase; repayment is not required. However, some of the cost of the Yakima River Basin Water Conservation Program must be funded by the participants.

Recognized water rights and other rights and agreements are not to be altered or impaired by the provisions of Title XII and activities implemented thereunder (Section 1212). Further, any proposed water conservation measures in the Yakima River basin tributaries will be contingent upon agreement of appropriate water right owners to participate, the execution of appropriate agreements, and a finding that implementation will not impair the water rights of any person or entity in the affected tributary (Section 1207).

A Programmatic Environmental Impact Statement to evaluate the environmental impacts of implementing Title XII has been prepared by Reclamation. It is a broad scope document that provides "umbrella" coverage for implementing Title XII, with subsequent tiering of project specific actions, as appropriate, to meet National Environmental Policy Act compliance requirements. As a part of the National Environmental Policy Act analysis, Reclamation will evaluate the environmental impacts of proposed conservation measures during the feasibility investigation phase. In accordance with National Environmental Policy Act, State

Environmental Policy Act compliance will also be an integral part of the feasibility investigation process.

The Basin Conservation Plan

The Conservation Advisory Group believes that a certain amount of basic background is important to provide perspective to the Basin Conservation Plan. To achieve this, the Basin Conservation Plan includes information on the Yakima River Basin Water Conservation Program, the setting, the institutional and legal framework, and an explanation of how the river/reservoir system is operated (see Sections 1.0 - 3.0). Information on problems and needs that should be addressed by the Yakima River Basin Water Conservation Program (Section 4.0) and potential water conservation solutions that could be implemented to address them (Section 5.0) are also included.

The central part of the Basin Conservation Plan was development as a process to guide Yakima River Basin Water Conservation Program implementation. This process includes definitions of eligibility for participation and funding of program phases, guidelines for preparing water conservation plans and conducting feasibility investigations, and criteria for obtaining funds for feasibility investigations and implementation of entity water conservation plans (see Section 6.0). Water conservation plan guidelines developed for the Yakima River Basin Water Conservation Program are compatible with those currently used by Reclamation and Washington Department of Ecology.

The process for the four phases of the Yakima River Basin Water Conservation Program is shown schematically in Figure I.

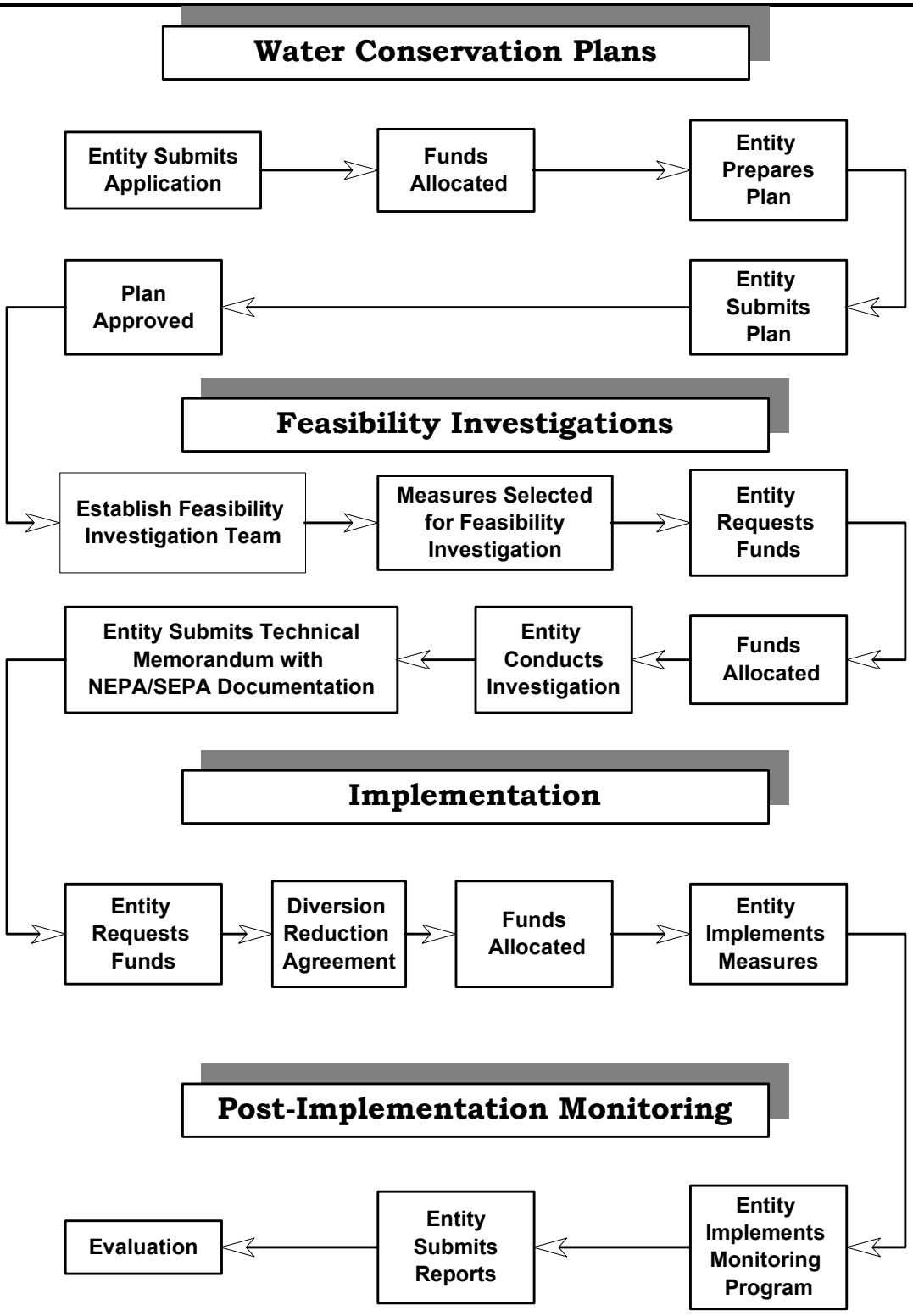


Figure 1 —Basin Conservation Program process Flow Chart

Administration of the Yakima River Basin Water Conservation Program requires cost sharing, coordination, and funding agreements (see Section 7.0). A cost sharing agreement between Reclamation and Washington Department of Ecology setting forth the cooperative funding of actions under the Yakima River Basin Water Conservation Program was signed on May 25, 1995, as provided for in Section 1203(d)(2) of Title XII. Further, a Coordination Plan was prepared between Washington Department of Ecology and Reclamation describing agency roles and responsibilities and identifying the time allotted for completing each activity. The Coordination Plan was approved by Washington Department of Ecology on May 29, 1997. Sample agreements to be executed with program participants for the disbursement of funds and work accomplishments including (1) preparing water conservation plans, (2) conducting feasibility investigations, and (3) implementing selected water conservation measures were prepared.

The final part of the Basin Conservation Plan includes roles and responsibilities of agencies and the Conservation Advisory Group for oversight of the Yakima River Basin Water Conservation Program (see Section 8.0), and the Conservation Advisory Group recommendations (section 9.0)

Conclusions and Recommendations

Pre-Implementation Water Measuring Program

Measuring and accounting for water diverted and delivered is an essential component of water system operations. Knowing what is diverted and where it is delivered is the basis for structuring and maintaining a sound water management program. Title XII recognized this need by stipulating that a primary condition for participation in the Yakima River Basin Water Conservation Program is an agreement that the participants will "equip all surface water delivery systems within their boundaries with volumetric meters or equally effective measuring methods within 5 years of the date of enactment of this Act." This 5-year period ends October 31, 1999. The Conservation Advisory Group believes this measuring requirement includes points of surface water diversion and points of water delivery (farm turnouts). At present, the larger entities in the Yakima River basin have measuring devices that should meet this requirement; however, some smaller entities that desire to participate in the Program may not. The intent of this requirement of Title XII is to achieve timely implementation of measuring and accounting systems, not to exclude participation in the Yakima River Basin Water Conservation Program.

Some entities, which do not meet this requirement, may wish to install water measuring devices as a part of their water conservation elements. In these cases, it would be more economical to

equip the new system with water measuring devices than meet the requirement by installing equipment on a system that is to be replaced.

Recommendation 1: The following pre-implementation water measuring policy is recommended for participation in the Yakima River Basin Water Conservation Program.

- Measuring devices shall be operable[1] at all points of diversion of the surface water supply as a requirement for participation.

- Measuring devices shall be operable at all points of surface water delivery (farm turnouts) prior to October 31, 1999. Entities anticipating modification of distribution and lateral systems as a part of their water conservation plans may request a deferment of this requirement if a request is submitted to Reclamation not later than December 31, 1998. The request shall describe the current status of the entity's water measuring program, how water flow and volume data needed to prepare the water conservation plan and conduct the feasibility investigation will be developed, and why such a deferment is justified. Reclamation shall make a decision on the request (approve or disapprove) within 60 days.

- Entities who have not installed water measuring devices in their water delivery systems and desire to participate may be considered for crediting, as local cost-sharing, those costs which they incur in acquiring and installing such devices by October 31, 1999. Crediting is contingent upon (1) submission of a written request to Reclamation prior to acquisition and installation, but not later than December 31, 1998, (2) Reclamation approval of the proposed acquisition and installation program, and (3) completion of a water conservation plan, feasibility investigation, and implementation of water conservation measures.

Guidelines for Water Conservation Plans and Feasibility Investigations

The success of the Yakima River Basin Water Conservation Program relies on evaluating the current water system and its operation, identifying measures that could improve efficiencies in water delivery and water use, developing a water conservation plan, and investigating in more technical detail the engineering, financial, and environmental feasibility of implementing potential measures. "Interim Guidelines" for use by participants in preparing water conservation plans

[1] The term "operable" in this recommendation means installed, accurate measurements taken, and records maintained.

and conducting feasibility investigations were developed and adopted by the Conservation Advisory Group, as work continued on the Draft Basin Conservation Plan.

The water conservation plan guidelines have been "tailored" for use in the Yakima River basin and to meet the requirements of Title XII. They are compatible with guidelines (1) currently being used by Washington Department of Ecology under its Referendum 38 activities relating to financial assistance for irrigation water supply systems, and (2) currently used for Reclamation water conservation plans.

Guidelines for the conduct of feasibility investigations are similar in many aspects to those of Reclamation's Small Reclamation Projects Loan Program and Distribution System Loan Program.

Recommendation 2: The guidelines developed by the Conservation Advisory Group for preparing water conservation plans and conducting feasibility investigations should be used in the Yakima River Basin Conservation Program. This is with the understanding that, as the Yakima River Basin Water Conservation Program evolves, revisions can be made by Reclamation, in consultation with the Washington Department of Ecology, after seeking advice from the Conservation Advisory Group.

Wetlands

Yakima River Basin Wetlands and Floodplain Habitat Plan—Wetlands, especially those in riparian and floodplain areas, are important to fish, wildlife, flood management, and water quality. A goal of the Yakima River Basin Water Enhancement Project is to protect, create, and enhance wetlands and their associated riparian and floodplain habitat.

To assure that these functions and values are maintained, a coordinated effort is required by Reclamation, participants, and Yakima River basin fish and wildlife resource managers. A first step in this coordinated effort should be the development of a Yakima River Basin Wetlands and Floodplain Habitat Plan to help guide wetlands activities in the Yakima River basin. It should include an inventory, rating, and assess functions of existing wetlands; a comparison of historical and current conditions at a landscape scale; and a ranking of priority areas for protection, creation, and enhancement in each of the four subareas of the Yakima River basin identified in the Basin Conservation Plan.

Recommendation 3: Reclamation and the Washington Department of Ecology, in collaboration with the basin fish and wildlife resource managers, should develop a Yakima River Basin Wetlands and Floodplain Habitat Plan with funds authorized by Title XII. Because it will guide the implementation of many measures designed to fulfill the goals of Title XII,

development of the Yakima River Basin Wetlands and Floodplain Habitat Plan should be initially funded in fiscal year 1998.

Yakima River Basin Wetlands Enhancement Project—Using the Yakima River Basin Wetlands and Floodplain Habitat Plan as a guide, a Yakima River Basin Wetlands Enhancement Project undertaken in each of the four subareas of the basin would assist in protecting, creating, and enhancing high value wetlands and fish and wildlife resources. The Yakima River Basin Wetlands Enhancement Project would provide a cost effective and ecologically advantageous opportunity to mitigate incidental losses of wetlands resulting from implementation of water conservation measures by "pooling" and directing mitigation efforts toward priority areas.

Recommendation 4: Reclamation, the Washington Department of Ecology, and the basin fish and wildlife managers should develop a Yakima River Basin Wetlands Enhancement Project using funds from the Yakima River Basin Water Conservation Program (from the $67.5 million authorization). The first year of funding should be fiscal year 1999. Funding for the Yakima River Basin Wetlands Enhancement Project should be supplemented with monies for wetlands mitigation obtained from entities participating in the Yakima River Basin Water Conservation Program. Other sources of funding should also be pursued.

In preparing the Yakima River Basin Wetlands and Floodplain Habitat Plan, and in pursuing land acquisition activities associated with the development of the Yakima River Basin Wetlands Enhancement Project, full consideration will be given to comprehensive plans prepared by counties and cities pursuant to the Growth Management Act of the State of Washington, Chapter 36.70A RCW.

Water Quality

The greatest results from the implementation of water conservation measures under the Yakima River Basin Water Conservation Program will be realized if (1) the existing delivery systems are upgraded to allow near on-demand delivery to the farm headgates, and (2) onfarm systems are improved so they can be effectively managed to regulate the frequency and duration of water applications. Integration of these improvements will permit the reduction of water diversions from the river, improving instream flows and the reliability of the irrigation supply, and resulting in significant water quality improvements as well.

Currently, most Yakima River basin water delivery systems are not capable of providing on-demand service. While onfarm improvements will allow the farmer to control timing of water use, fluctuations in onfarm demands generally result in operational spills from the entity's water delivery system. To reduce operational spills, the water delivery systems must be upgraded so

they can absorb these flow fluctuations by temporarily holding water for release, or by other means, as appropriate. While improvements in water quality will result from water delivery system modifications, the greatest water quality improvements will result from improved management of water on the farm.

Conservation Districts throughout the Yakima River basin are equipped to work with individual farmers, irrigation entities, and other groups to promote onfarm water conservation measures. While USDA funding has been available to Conservation Districts in the past through various programs, funding for these programs has been limited. This is why the Conservation Advisory Group, to promote onfarm improvements while also complying with Title XII's directive for program funds to result in diversion reductions, has recommended that onfarm water conservation measures can be included for funding as a part of an entity's water conservation plan if a diversion reduction will result from implementation of those onfarm measures. The Conservation Advisory Group encourages the integration of entity water conservation plans with other water conservation activities to realize the greatest reduction in diversions and improvements in the quality of water in the Yakima River and its tributaries.

Recommendation 5: In preparing water conservation plans, participating irrigation entities should work to identify opportunities to incorporate onfarm water conservation measures with associated water quality benefits and integrate the Conservation Program with other onfarm programs.

Water and Land Acquisition

In Title XII, Congress directed the Secretary of the Interior, acting through Reclamation, to facilitate water and water right transfers, water banking, dry-year options, the sale and leasing of water, and other innovative allocation tools to address a host of problems encountered by Yakima River basin anadromous fish in various life cycle stages and at various times throughout the year. Congress authorized Reclamation to use Yakima River Basin Water Conservation Program funds to purchase or lease land, water or water rights from any entity or individual willing to limit or forego water use on a temporary or permanent basis.

The primary emphases for acquiring water and water rights in the mainstem Yakima River and Naches River are to increase instream target flows at Sunnyside Diversion Dam and Prosser Diversion Dam and to supplement instream flows at other critical reaches, and tributary reaches, identified in the Basin Conservation Plan.

An appropriation of $10 million was authorized for the expeditious acquisition of water for the fishery in the "interim" period between enactment of Title XII and the time that a significant increase in instream target flows become a reality and for "flushing" and out-migration flows.

Acquisition of riparian lands with associated water rights in key habitat areas of the basin can accomplish the multiple objectives of providing water for instream flows, re-establishment of critical riparian habitat, wetlands enhancement, and water quality improvement.

Recommendation 6: Reclamation should aggressively seek to acquire water in the "interim" period, fully pursuing the Congressional directive to acquire water for the needs identified in the Basin Conservation Plan and for "flushing" and out-migration flows.

Recommendation 7: Purchase of water, water rights, and lands on a permanent basis should be a priority over leasing. Permanent acquisitions have fewer transaction costs than leases and allow Reclamation to plan for the future operation of the Yakima Project. Long-term water leases and "dry-year" water options may be a cost effective and biologically effective solution to a particular problem, however, where there is no foreseeable opportunity for permanent acquisition.

For the acquisition of wetlands or potential wetland habitat, easements in perpetuity may afford the same sort of long-term planning opportunities as outright purchase and be cost effective. Reclamation should pursue easements in areas that cannot be acquired by fee purchase but are key for re-establishing wetland and riparian habitats for anadromous fish production.

Recommendation 8: When acquiring water rights, the consumptive amount of the right should be accounted for and fully protected from all junior appropriators to the mouth of the Yakima River. In addition, system losses associated with the acquired water right should be protected from appropriation from the point of diversion to the point where such flows would re-enter the river.

Recommendation 9: Reclamation should implement an aggressive water and land acquisition program, pursuing acquisition activities in areas indicated in the Basin Conservation Plan for instream flow improvements and in areas indicated in the Yakima River Basin Wetlands and Floodplain Habitat Plan as important for riparian and floodplain wetland habitat. Such lands with associated water rights should be given priority for acquisition. Reclamation should develop an outreach strategy consisting of such activities as distributing printed materials explaining the water and land acquisition program, providing public service announcements and public information, holding educational meetings, establishing a "hot-line" to respond to questions, and other activities to reach as many people in the Yakima River basin as possible with information.

Tiered or Multiple Block Water Rate Structures

Multiple block water pricing, known as tiered water rates, is a key tool to water conservation. It encourages efficient water use by charging more per unit as water use increases. Many municipalities and some irrigation entities use a multiple block rate structure and report that it is an effective water conservation measure.

Recommendation 10: New and amended water supply contracts entered into by Reclamation in the Yakima River basin should contain a requirement that the contractor establish a conservation-based tiered water pricing structure.[1]

Pumping Energy

There are opportunities to replace some gravity water delivery systems with pumped systems resulting in the relocation of the diversion point downstream. Such actions could provide significant instream flow improvements in critical river reaches. Pumping also provides an opportunity to capture operational spills and drain flows for re-use and assist in reducing diversions. However, the annual cost of pumping energy must be fully borne by the entity which could preclude implementation.

Recommendation 11: Reclamation, the Washington Department of Ecology, and the Bonneville Power Administration should explore opportunities for obtaining pumping energy at less-than-retail-rates for entities willing to include pumping as a part of their water conservation plan under the Yakima River Basin Water Conservation Program. Such rates would be applicable only in those cases where significant instream flow and water quality improvements could be achieved for enhancement of anadromous fish in critical reaches of the Yakima River system. Reclamation and the Washington Department of Ecology should report to the Conservation Advisory Group on the results of these discussions for further consideration.

Post-Implementation Monitoring

One purpose of Title XII is to protect, mitigate, and enhance the fish and wildlife resources of the Yakima River basin through water management, instream flow, and water quality improvements, and the enhancement of wetlands and other habitat improvements. Congress authorized the funding of a variety of water conservation measures and water management improvements in the Yakima River basin in order to achieve these results. While there is

[1] The "Diversion Reduction Agreement" entered into by the entity and Reclamation prior to securing Yakima River Basin Water Conservation Program funds for implementation of water conservation measures is not considered to be a new or amended water supply contract.

provision in Title XII for post-implementation monitoring and evaluation of water conservation measures to determine their effectiveness, there is no particular directive for Reclamation to monitor and evaluate the overall effectiveness of Title XII in improving the fish and wildlife resources of the Yakima River basin.

It is important for Reclamation to document flow changes in the river and to monitor and evaluate whether reduced diversions and acquired water are actually improving conditions for fish and wildlife. It is equally as important to monitor and evaluate whether these flow changes are resulting in the enhancement of anadromous fish populations.

Recommendation 12: The Interim Comprehensive Operating Plan should contain specific monitoring and evaluation provisions, and responsibilities to determine the effectiveness of the Yakima River Basin Water Conservation Program and the use of water from reduced diversions and acquired water to improve the river flow regime and habitat conditions to benefit fish and wildlife. Monitoring and evaluation should include flow (physical), biological, and chemical parameters. The monitoring and evaluation program should be designed to support adaptive management.

Restriction on Expansion of Irrigated Lands

Section 1203(a)(2) of Title XII directs that "conserved water resulting in whole or in part from the expenditure of Federal funds shall not be used to expand irrigation in the Yakima Basin, except as provided in Section 1204(a)(3) on the Yakama Indian Reservation." This is consistent with a purpose of Title XII to improve the reliability of water supply for irrigation and to make water available to entities with proratable water entitlements in water-short years to sustain the existing irrigated lands.

Because of the need to address declining anadromous fish runs, the Secretary of the Interior's Indian trust responsibilities, and possible listings under the Endangered Species Act, Congress stressed that the expenditure of funds under Title XII should not increase irrigated agriculture in the Yakima River basin over current conditions. To implement this directive, baseline conditions must be established.

Recommendation 13: Reclamation and the Washington Department of Ecology should include a provision in the "Implementation Three-Party Grant Agreement" that (1) conserved water achieved under the Yakima River Basin Water Conservation Program will not be used to expand irrigated acreage, and (2) Reclamation and the Washington Department of Ecology

should establish baseline conditions and a process for periodic review to implement this Congressional directive.[1]

Funding

The success of the Yakima River Basin Water Conservation Program depends on adequate annual Federal and State appropriations. Most of the construction work must be accomplished between irrigation seasons, from mid-October through mid-March, and commitments must be made in advance for necessary construction contracts and acquisition of materials.

Recommendation 14: Upon commitment of funds for implementation, annual Federal and State budget requests and appropriations should be sufficient to accomplish the scheduled work. To accomplish objectives, the Yakima River Basin Water Conservation Program should be given a high priority in the budget requests of Reclamation and the Washington Department of Ecology.

[1] The "Implementation Three-Party Agreement" is the agreement among the entity, Reclamation, and the Washington Department of Ecology for funding the implementation of selected water conservation measures.

1.0 INTRODUCTION

1.1 AUTHORITY FOR CONSERVATION PROGRAM AND CONSERVATION PLAN

Title XII of the Act of October 31, 1994, Public Law 103-434 (Title XII), authorized the Secretary of the Interior (Secretary), acting through the Bureau of Reclamation (Reclamation), in consultation with the State of Washington (State), the Yakama Nation, Yakima River basin irrigators, and other interested parties, to establish and administer the Yakima River Basin Water Conservation Program (Conservation Program).[1] The purposes of the Conservation Program are to evaluate and implement measures to improve the availability of water supplies for irrigation and the protection and enhancement of fish and wildlife resources, including wetlands, while improving the quality of water in the Yakima River basin. Title XII is considered to be Phase II of the Yakima River Basin Water Enhancement Project (Enhancement Project).

On July 13, 1995, the Secretary approved a charter and, on October 30, 1995, appointed a six-member Yakima River Basin Water Conservation Advisory Group (CAG) to provide technical advice and counsel to the Secretary and the State on the structure, implementation, and oversight of the Conservation Program. In addition, the Secretary appointed a representative from Reclamation as the designated Federal official and selected a facilitator. The CAG includes one representative from each of the following: Washington State Department of Fish and Wildlife, Washington State University Agriculture Extension Service, Yakama Nation, proratable irrigators, non-proratable irrigators, and environmental interests.[2]

The CAG is tasked to structure a process to prepare and submit a Basin Conservation Plan (Conservation Plan) to the Secretary within 2-1/2 years following enactment of Title XII. On August 12, 1997, a Draft Conservation Plan was released for public review and comment. The public review period extended through October 31, 1997. Comments received have been reviewed and discussed by CAG and the Draft Conservation Plan has been revised to include many of the comments and suggestions. The Conservation Plan was then submitted to the Secretary for publication.

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[1] Appendix I includes a copy of Title XII of Public Law 103-434.

[2] The charter appears in Appendix I-B and information on the CAG members is summarized in Appendix I-C.

1.2 NEED FOR THE ENHANCEMENT PROJECT

Congress directed the implementation of the two phases of the Enhancement Project because the water resources of the Yakima River basin are not always sufficient to meet all demands. There is a Federal interest in protecting and enhancing water supplies because the Yakima Project, one of the largest Federal Reclamation projects, and the Yakama Indian Reservation are located in the basin. Reclamation's Yakima Project regulates and supplies water to about 460,000 acres of irrigated lands in the basin.

An adequate water supply is critical to meeting the needs of the Yakima Project and in meeting Indian Trust Asset considerations of the Yakama Nation. The Secretary exercises responsibility for Reclamation and Bureau of Indian Affairs programs.

Anadromous fish populations in the Yakima River basin have declined to precarious levels. Three indigenous stocks of Yakima anadromous fish—summer chinook, sockeye, and coho salmon—are now considered extinct. Spring chinook are being reviewed for possible listing under the Endangered Species Act of 1973. Steelhead have been reviewed and are considered a "Candidate Species" for listing. A decision on whether to proceed with listing of steelhead is expected in 1998. Bull trout have been proposed for listing and are expected to be listed in 1998.

Weather conditions in 1992, 1993, and 1994, led to deficiencies in the irrigation water supply which required prorating (reducing) water deliveries to irrigation entities with junior (proratable) water entitlements. In 1994, only 1.6 million acre-feet were available for irrigation compared to an annual average diversion of 2.1 million acre-feet. Poor instream flows during these three years also adversely impacted anadromous fish runs. For example, in 1994, only 22,000 acre-feet flowed over Sunnyside Diversion Dam into the lower Yakima River compared to an average of 50,000 acre-feet for the 25-year period of 1970 through 1994.

Congress authorized a feasibility study of the Enhancement Project in 1979, to address water resource needs of the basin. Phase I of the Enhancement Project initiated in 1984, consists of implementation of new fish ladders and fish screens pursuant to the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program. This undertaking is a cooperative effort of the Bonneville Power Administration, Reclamation, Yakama Nation, Federal and State fisheries agencies, and local irrigation entities. The purpose of Phase I is to eliminate anadromous fish mortality at diversion dams and canals by providing safe, efficient passage for adult and juvenile migrants. New fish ladders and fish screens at large diversion dams and canals were completed in 1989. Work continues to provide new fish passage at numerous smaller diversion facilities, which is expected to be completed in 2001.

Phase II of the Enhancement Project was authorized by Congress in 1994. It includes the Conservation Program intended to improve water supplies for anadromous fish and irrigated agriculture.

1.3 PURPOSE OF CONSERVATION PLAN

Title XII defines the Conservation Plan as "a plan for implementing water conservation measures found in the various water conservation plans developed under the Conservation Program." These water conservation plans have been or will be prepared by water entities desiring to participate in the Conservation Program. This Conservation Plan implements that part of Phase II which addresses the planning and implementation of water conservation and efficiency measures by water suppliers and users in the Yakima River basin. It is designed to guide the efforts of Reclamation and other government agencies, as well as non-governmental organizations with the responsibilities for, or interest in, responsible water management and the recovery of the anadromous fish of the Yakima River basin.

The CAG views the Conservation Plan as the document that outlines objectives, problems and needs, and potential water conservation solutions and provides guidelines, processes, and procedures to make the Conservation Program functional. The Conservation Plan will be used in developing the Interim Comprehensive Basin Operating Plan (Operating Plan) for the Yakima Project required in Section 1210 of Title XII. The Operating Plan is to provide a general framework within which the Yakima Project is operated, including measures implemented under the Enhancement Project. The Operating Plan is to be completed by Reclamation within 1-1/2 years of completion of the Conservation Plan

1.4 OBJECTIVES OF CONSERVATION PLAN

The objectives of the Conservation Plan are to:

- Meet the purposes of Title XII through the implementation of the Conservation Program: (1) to protect, mitigate, and enhance fish and wildlife through improved water management; improved instream flows; improved water quality; protection, creation, and enhancement of wetlands; and by other appropriate means of habitat improvement, and (2) to improve the reliability of the water supply for irrigation.

- Realize sufficient results from the Conservation Program so that not less than 40,000 acre-feet annually by the end of the fourth year and 110,000 acre-feet annually by the end of the eighth year of water savings are achieved to protect and enhance fish and wildlife resources, and not less than 55,000 acre-feet per year of water savings is achieved by the end of the eighth year for availability to irrigation.

- Assist in meeting State, Tribal, and local water resource policies and goals for the protection and enhancement of the economic, cultural, and environmental resources of the Yakima River basin.

- Provide a general framework for the processes and procedures to plan, implement, and evaluate a range of water conservation measures within the Yakima River basin.

CAG views the Conservation Plan as a plan to not only enhance the conservation of water, but also to enhance the conservation of the Yakima River ecosystem.

1.5 FOCUS OF CONSERVATION PLAN

A major focus of the Conservation Plan is implementation of structural and non-structural water conservation measures by entities and individuals who receive their water supply as a part of the Total Water Supply Available (TWSA). Those entities divert water primarily from the mainstem Yakima River and its major tributaries, the Naches and Tieton Rivers. Enhancement of water supplies in other tributaries is included in Section 1207 of Title XII and the Conservation Plan is also applicable to those tributaries.

TWSA represents the combined quantity of unregulated flow, return flow, and stored water available for the period of April through September upstream from the Parker gauge at Sunnyside Diversion Dam on the Yakima River. The forecast of TWSA is used to determine whether irrigation diversions will need to be prorated. In accordance with the respective rights and priorities established in the 1945 Consent Decree and Reclamation delivery contracts, any water supply deficiencies are first assessed against proratable entitlements and lastly against non-proratable entitlements. Instream flow requirements are met from TWSA prior to determining if proration is necessary.

Title XII provides for instream flow improvement throughout the Yakima River basin and establishes numerical instream target flows at two primary points: Sunnyside Diversion Dam and Prosser Diversion Dam. These flow goals are to be achieved through (1) reduction in water diversions by the implementation of structural and non-structural water conservation measures, and (2) acquisition of water from any entity or individual willing to limit or forego water use on a temporary or permanent basis.

The reliability of the irrigation water supply for proratable entities will be improved with system improvements and reductions in water diversions.

Section 1205 of Title XII specifies that the Yakima Project must be operated to meet instream target flows at Sunnyside and Prosser Diversion Dams based on TWSA forecasts. These instream target flows range from 300-600 cubic feet per second (cfs). In addition, for each 27,000 acre-feet of reduced annual water diversion achieved through the Conservation

Program, the instream target flows are to be increased in increments of 50 cfs. Such increases, however, shall not further diminish the amount of water that otherwise would have been delivered by an entity to its water users in years of water proration. In years when the water supply is prorated, the target flows obtained through the implementation of water conservation measures will be increased above 300 cfs only in those cases where the irrigation return flows associated with the reduced diversion enter the Yakima River downstream of Sunnyside Diversion Dam.[1]

The 50 cfs increased instream flow increment associated with each 27,000 acre-foot of conserved water that Congress directed in Title XII is predicated upon the following allocation of the conserved water: two-thirds (18,000 acre-feet) to instream flows and one-third (9,000 acre-feet) to irrigation.[2] The Yakima Project will continue to be operated with the TWSA concept. The one-third retained by the participating entity, if unused, will be treated in the same manner as other unused portions of entitlement within the TWSA.

An additional purpose of allowing each participating entity to retain one-third of its estimated diversion reduction is to reduce the risk to the irrigation entity resulting from varying annual water demands and varying annual water savings accruing from conservation elements. When CAG considered how diversion reduction agreements should treat that subject, it had difficulty arriving at a workable solution. Thus, in addition to acting as an incentive to participation in the program, the one-third retained by the entity also serves as a buffer because of climate and other variables that effect water needs from year to year. The use of this water (entity one-third) is limited in any event by the concept of beneficial use and, according to Federal law and contract, cannot be used to expand irrigated acreage, or for other new uses not currently allowed by the entity's water rights and contract entitlements.

Any water acquired from willing sellers and lessors by use of Conservation Program funds will be used to increase instream flows. This water will be administered as a block separate from TWSA for irrigation and will be dedicated to flushing flow requirements for salmon and steelhead smolts and other instream flow purposes. Acquired water will increase instream target flows even in years of proration because this water will be administered separately from TWSA for irrigation.

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[1] If it is determined that consumptive water use is decreased as a result of implementing water conservation measures, the 300 cfs target flow could be increased in years of proration.

[2] 50 cfs over a 180-day period amounts to 18,000 acre-feet.

2.0 SETTING

2.1 GEOGRAPHY

The Yakima River basin (see frontispiece) is located in south central Washington bounded on the west by the Cascade Range, on the north and east by the Wenatchee Mountains, and on the south by the Horse Heaven Hills. Elevations in the basin range from 8,184 feet above mean sea level in the Cascades to 340 feet at the confluence of the Yakima River with the Columbia River. About 6,150 square miles, 4 million acres, are drained by the Yakima River and its tributaries.

Flow of the Yakima River and its major tributary, the Naches River, is generally southeasterly. The upper Yakima River and the Naches join at the city of Yakima to form the two arms of a "Y" and the lower Yakima River forms the bottom leg of the "Y." Major tributaries of the upper Yakima River include the Kachess, Cle Elum, and Teanaway Rivers. Major tributaries of the Naches River are the Bumping and Tieton Rivers. Toppenish and Satus Creeks on the Yakama Indian Reservation are the major tributaries of the lower Yakima River.

2.2 POLITICAL DIVISIONS AND LAND OWNERSHIP

About one-half of the basin is within and occupies most of Yakima County. The upper part of the basin lies in Kittitas County and occupies most of that county. The southeastern part of the basin occupies about one-half of Benton County and the southern part of the basin extends slightly into Klickitat County.

The entire basin lies within areas either ceded to the United States by the Yakama Nation or areas reserved for the use of the Yakama Nation. The Yakama Indian Reservation occupies about 40 percent of Yakima County and about 15 percent of the basin[1].

Nearly 40 percent of the Yakima River basin is forested, another 40 percent is rangeland, 15 percent is cropland, and the remaining acreage includes other land uses and water bodies. The single largest landowner is the Federal Government with 1.5 million acres or 38 percent of the land area. Much of the forested land is Federal land within the Wenatchee National Forest. Other large Federal land holdings include the Yakima Training Center, the Hanford Nuclear Reservation, and Bureau of Land Management lands. Various state agencies also own lands. Other public ownerships (State, county, and local governments) total over 400,000 acres. Indian-owned lands total about 800,000 acres, and nearly 1.7 million acres are in private ownership.

[1] A part of the Yakama Indian Reservation lies within the Klickitat River basin.

About one-half of the population lives within incorporated cities. The larger cities (over 5,000 population) include Yakima, West Richland, Richland (part), Kennewick (part), Ellensburg, Sunnyside, Toppenish, Grandview, and Selah.

2.3 ECONOMY

Timber harvest, cattle grazing, and recreation are the major uses of 2,200 square miles mainly in the forested northern and western areas of the basin. About one-fourth of this area is designated as wilderness. Cattle grazing is the main use of 2,900 square miles of rangeland. Irrigated agriculture, the main economy of the basin, occupies about 1,000 square miles.

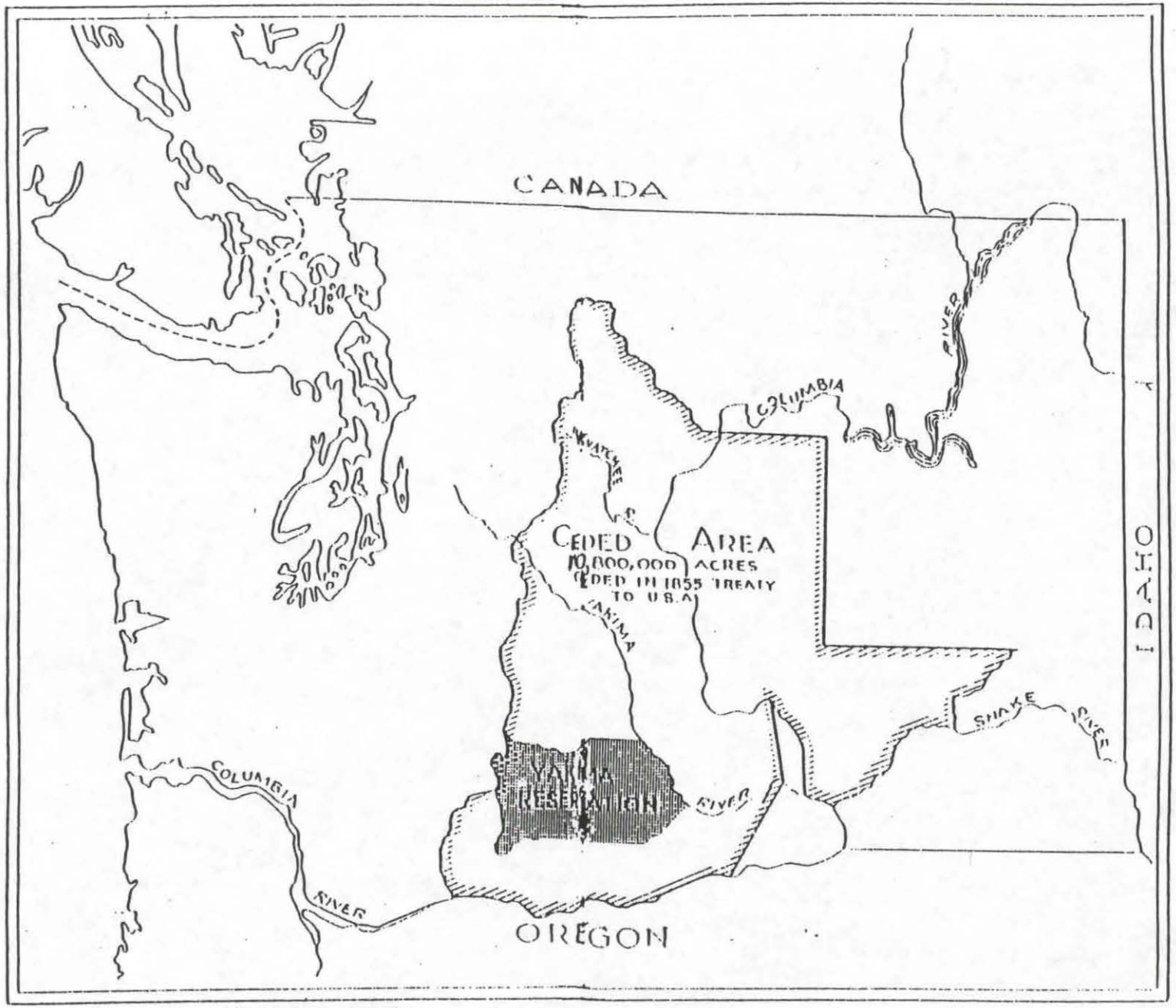
The economy of the basin is tied most directly to agricultural production with associated manufacturing contributing substantially to the economic base. Services, trade, transportation, and forestry are also important contributors to the economy. While cereal crops, irrigated pasture, and hay production predominate in Kittitas County, most farms in Yakima and Benton Counties produce fruits, vegetables, grapes, and other specialty crops[1] such as hops and mint. Yakima County ranks near the top in the nation in production of many fruits, vegetables, and specialty crops. Another significant agricultural commodity is cattle, and this industry is dominated by beef production and dairies.

2.4 INSTITUTIONAL BACKGROUND

2.4.1 Treaty of 1855

By treaty of June 9, 1855, between the United States and the 14 Confederated Tribes of the Yakama Nation, about 12 million acres were ceded to the United States and the tribes agreed to move to a reduced land base. The Treaty of 1855, between the United States and the 14 Confederated Tribes of the Yakama Nation reserved the exclusive right of taking fish in all the streams where running through or bordering the reservation, as well as at all usual and accustomed places, in common with the citizens of the Territory, and of erecting temporary buildings for curing them; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land. The ceded area is shown on Figure 2-1.

[1] Specialty crops are those that require intensive labor; large outlay of capital for development, operation, and maintenance; have high market value; and often have high risk of return on capital.



MAP 8. Yakima territory before treaty and modern reservation.
Reference: The Yakima People
Daugherty, Richard D. 1973

Figure 2.1 — Yakama Nation Ceded Area

2.4.2 Yakima Project

The Reclamation Act of 1902, provided the authority for Federal development of irrigation in the Yakima River basin. The stage was set for Federal help with the private development of over 120,000 acres of irrigated land and an over appropriated water supply. Water users petitioned the Federal Government to develop storage facilities. A March 4, 1905, act of the State Legislature granted the United States the power of eminent domain to acquire lands, water, and properties for reservoirs and other irrigation works. On December 12, 1905, the Secretary set forth conditions which would have to be satisfied prior to any irrigation development by Reclamation. The major requirement was that water rights questions be settled by "limiting agreements." This was accomplished, and the Secretary authorized funds to begin construction of the Tieton and Sunnyside Divisions of the Yakima Project.

Over a period of years, five major irrigation divisions were constructed as part of the Yakima Project—Kittitas, Tieton, Roza, Sunnyside, and Kennewick Divisions. In addition, the Wapato Irrigation Project, constructed and operated by the Bureau of Indian Affairs to irrigate lands of the Yakama Indian Reservation, is treated as a sixth irrigation division and often referred to as the Wapato Division. The six storage reservoirs, constructed between 1909, and 1933, constitute the Storage Division which supplies water to the irrigation divisions. Table 2-1 summarizes information on the six irrigation divisions and the storage division.

Table 2-1.—Yakima Project Divisions

Irrigation Divisions

Division	Location	Major Facilities	Source of Stored Water	Operating Entity
Kittitas	Kittitas Valley near Ellensburg	Easton Diversion Dam, Main Canal, North and South Branch Canals	Keechelus, Kachess	Kittitas Reclamation District
Tieton	Upper Yakima Valley	Tieton Diversion Dam, Tieton Canal	Rimrock	Yakima-Tieton Irrigation District
Roza	Lower Valley north of Sunnyside Division	Roza Diversion Dam, Ridge Canal, pumping plants	Keechelus, Kachess, Cle Elum	Roza Irrigation District
Sunnyside	Lower Yakima Valley, east of river	Sunnyside Diversion Dam, Sunnyside Canal, pumping plants	All reservoirs	Sunnyside Valley Irrigation District and others[1]
Kennewick	Extreme Lower Yakima Valley, Benton County	Prosser Diversion Dam, Chandler Canal, pumping plants, Kennewick Main Canal	Return flows	Kennewick Irrigation District
Wapato[2]	Lower Yakima Valley west of river	Wapato Diversion Dam, Main Canal, drainage works	All reservoirs	Bureau of Indian Affairs

Storage Division

Dam	Reservoir	Construction	Storage (Acre-Feet)
Bumping	Bumping Lake	1909-1910	33,700
Kachess	Kachess Lake	1910-1912	239,000
Keechelus	Keechelus Lake	1913-1917	157,800
Clear Creek	Clear Lake	1914-1918	5,300
Tieton	Rimrock Lake	1917-1925	198,000
Cle Elum	Cle Elum Lake	1931-1933	436,900
Total			1,070,700

[1] Includes Outlook, Granger, Snipes Mountain, Grandview, Benton, Home, Zillah Irrigation Districts; Piety Flat Irrigation Company, Konnewock Water Users, Special Warren Act Lands, and the cities of Sunnyside, Grandview and Prosser.

[2] Ahtanum and Toppenish-Simcoe Units (a small percentage of the total acreage of the Wapato Irrigation Project) are not dependent on Yakima Project storage.

The irrigation entities of the five irrigation divisions entered into contracts with Reclamation for the construction of irrigation diversion, conveyance, and distribution facilities and for storage water in Reclamation reservoirs. The entire water supply for the Roza and Kittitas Divisions is contracted water, whereas other divisions have natural flow rights and the contracted supply is for supplemental water. Individuals and private canals and ditches also entered into water supply contracts with Reclamation.

The treaty water supply for the Wapato Irrigation Project is provided through acts of Congress and agreements with the Bureau of Indian Affairs.

In the total basin, the quantity of water under contract and agreements with Reclamation is about 1.7 million acre-feet.

2.5 LEGAL BACKGROUND

Litigation over water rights in the Yakima River basin is generally related to one of five major actions:

- 1905—Agreements signed by water right claimants agreeing to voluntarily limit their diversions. (Limiting Agreements)
- 1945—Kittitas Reclamation District: Selah and Moxee Irrigation District: and United States v. Sunnyside Valley Irrigation District, et al. (1945 Consent Decree)
- 1977—Confederated Tribes and Bands of the Yakama Nation v. United States, et al. (Tribal Claims)
- 1977—State of Washington v. James J. Acquavella, et al. (Adjudication)
- 1980—Kittitas Reclamation District, et al. v. Sunnyside Valley Irrigation District, et al. (Quackenbush)

2.5.1 Limiting Agreements

As a condition for involvement of Reclamation in the irrigation development of the Yakima River basin, the Secretary in 1905, required limitations on diversions by water claimants. This was accomplished through "Limiting Agreements" with some 50 claimants on the Yakima and Naches Rivers agreeing to limit their diversions to the following: for August and preceding months, the amount actually diverted in August 1905; for September, two-thirds of this amount;

and for October, one-half of the amount. The actual August diversion totaled about 2,000 cfs. Of this amount, nearly 1,900 cfs, 95 percent of the claimed diversion, were covered by limiting agreements or adjusted claims.[1]

2.5.2 1945 Consent Decree

The 1945 Consent Decree was the outgrowth of water supply deficiencies in 1941, 1942, and 1943, and disputes over rights to the available supply. Rather than proceed with extensive litigation, a stipulated settlement was reached by the parties and a judgement was entered by the Federal District Court in January 1945. This judgement set forth the obligations of the United States to deliver water "to the plaintiffs, to the defendants, and to the lands of the Wapato Irrigation Project."

Two classes of water supply—proratable and non-proratable—were identified, water entitlements allotted to each party for the period of April through October, and a process established to apportion the water supply when it was not sufficient to meet all entitlements. Furthermore, TWSA was defined as:

> ". . . that amount of water available in any year from natural flow of the Yakima River, and its tributaries, from storage in the various Government reservoirs on the Yakima watershed and from other sources, to supply the contract obligations of the United States to deliver water and to supply claimed rights to the use of water in the Yakima River, and its tributaries, heretofore recognized by the United States."

The proration of TWSA for irrigation was to be in the same proportion to the quantity of water that each of the parties were entitled to less the non-proratable entitlements which are excluded from proration.[2]

2.5.3 Tribal Claims

In April 1977, the Yakama Nation filed an action in the United States District Court to determine the priority and quantity of the water rights of the Yakama Nation under the Treaty of 1855. The United States, as trustee for the Tribe and owner of the Yakima Project storage facilities, the Secretary, and all nonreservation water users were named as defendants in this

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[1] The adjusted claims included 147 cfs for the Yakama Nation and 650 cfs for the Sunnyside Canal.

[2] This included claims by others for natural flows from the Yakima River and its tributaries which were heretofore recognized by the United States whether or not they signed "Limiting Agreements" or were parties to the 1945 Consent Decree.

action. Subsequently it was determined that the matter of treaty water right claims should be addressed in the Yakima River general adjudication.

2.5.4 Adjudication

The State of Washington, in October 1977, filed an adjudication of the Yakima River system in the Superior Court of Yakima County (Case No. 77-2-0148-5) naming the United States and all persons claiming the right to use the surface water of the Yakima River basin as defendants. In March 1985, the Court ruled that this action could be limited to surface waters of the Yakima River basin and that ground-water users need not be included for a general adjudication.

The Adjudication remains in progress with orders continuing to be issued on water right claims in the Yakima River and its tributaries. It is anticipated that the Adjudication may not be completed for another 5 to 10 years.

2.5.5 Quackenbush

In 1980, spring chinook spawned in the upper portions of the Yakima River between Easton Diversion Dam and the Teanaway River during the period that reservoir releases were being made to meet downstream irrigation demands. When the irrigation season drew to a close and reservoir releases were being curtailed, about 60 redds (fish nests) were identified in the Yakima River reach between the city of Cle Elum and the mouth of the Teanaway River. In October, Judge Justin Quackenbush of the Federal District Court directed Reclamation, acting through the Yakima Project Superintendent, to release water from Yakima Project reservoirs to keep the salmon eggs alive. Their instructions concerned the operation of the Yakima Project reservoirs during the non-irrigation season in consideration of the provisions of the 1945 Consent Decree.

In November 1980, the Court directed the Yakima Project Superintendent to work with fishery biologists and report prior to the 1981 irrigation season:

> ". . . on means by which the needs of the Yakima Project water users can be met through more efficient or less extensive use of Project waters or by modification of Project operations or facilities so as to have less impact on the fisheries resource, including the possibility of management of the various Project reservoirs and releases of water so as to provide for appropriate water flows during the spawning and hatching periods that may be practicable while at the same time providing water for irrigation purposes for users within the Project."

As a result, the "flip-flop" operation was conceived and initiated in 1981, and has since been a part of the Yakima Project operation. The "flip-flop" term derives from the fact that the

Yakima and Naches Rivers form a "Y." In this operation, water from the three reservoirs in the upper Yakima River system (right side of the "Y") is used to meet irrigation demands downstream of the confluence of the Naches and Yakima Rivers through the first week of September, and water is retained in reservoirs of the Naches River arm (left side of the "Y") to the maximum extent possible. After the first week of September, reservoir operations are "flip-flopped" with demands downstream of the confluence of the Naches and Yakima Rivers being met from the Naches River system reservoirs and flows from the upper Yakima River system reservoirs are reduced. This operation reduces flows in the upper Yakima River at the time that fish spawn, forcing the fish to build redds at a lower elevation in the stream channel. As a result, less water is needed to be released during the winter to keep the redds under water and maintain the fish eggs.[1]

The System Operations Advisory Committee (SOAC) was formed by the Yakima Project Superintendent following the Court's directive of November 1980. SOAC consists of fishery biologists representing the Washington Department of Fish and Wildlife, Yakama Nation, irrigation entities, and the United States Fish and Wildlife Service. A Reclamation fishery biologist provides liaison with SOAC and Yakima Project operators. SOAC's function is to provide recommendations on system operations related to fishery aspects.

[1] A "mini" flip-flop operation is also conducted upstream from Easton Diversion Dam by reducing outflow of Keechelus Lake at the headwaters of the Yakima River in early September and drawing on Kachess Lake to meet downstream irrigation needs of the Kittitas Valley and the Roza Irrigation District.

3.0 SYSTEM OPERATIONS

Annual unregulated runoff[1] of the Yakima River basin at the Parker gauge, located just downstream from Sunnyside Diversion Dam, averages 3.4 million acre-feet[2].

3.1 PRE-PROJECT CONDITIONS

The natural ecosystem of the Yakima River basin contained communities of native species evolved and adapted to a river system with flows based on melting snow and subject to large seasonal variations. At least 28 species of resident and anadromous fish were native to the basin.

Natural streamflow was moderated by natural storage mechanisms, particularly ground storage and storage in natural lakes, including the large natural lakes that existed at the current sites of major storage—Cle Elum, Kachess, Keechelus, and Bumping Lakes. These processes captured peak flows and released water as base flow, sustaining riverflows through extended periods of little precipitation. Historically, the channel system in the basin was much more complex with myriad side channels and dense riparian vegetation. Without reservoirs capturing most of the winter and spring runoff, overbank flows were much more frequent. Flood waters infiltrated the floodplain and were naturally released later (natural groundwater storage), sustaining summer flows and moderating water temperatures.

Published information on the natural hydrograph of the Yakima River is found in Parker and Storey (1916) and in historical streamflow records of the U.S. Geological Service (USGS). To estimate natural flow (unregulated flow) at Union Gap, Parker and Storey used a 16-year period of record (water years 1897-1912)[3] and a formula to remove the effect of diversions, return flows, and minor reservoir storage in the basin during that period. They suggested that this was the most accurate estimate of natural flow that was possible to obtain. The general pattern was runoff peaking on average in April through June in the range of 7,000 to 12,000 cfs (Figure 3-1). Flows receded through the summer months with annual lows in September and October. The lowest estimated mean monthly flow during this period was about 800 cfs. Flows were higher in the summer and fluctuated less than with the current development.

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[1] Unregulated runoff is an estimate of natural flow that is based on the measured runoff adjusted to eliminate the effects of major storage and diversion activities.

[2] Sunnyside Diversion Dam is considered to be the operational control point for the Yakima Project. The Parker gauge is located less than 0.1 mile downstream from Sunnyside Diversion Dam.

[3] Water years begin on October 1 and end on September 30 of the following year. A water year record of 1897-1912, in calendar years extends from October 1, 1896, through September 30, 1912.

3.2 POST-PROJECT OPERATIONS

The Yakima River and its major tributary, the Naches River, are currently the main conduits for conveying water to irrigate about 460,000 acres in the Yakima River basin. This and other activities such as timber harvest and urban development have changed the aquatic ecosystem and it is now much different from the pre-development system that predated substantial human manipulation. Development has altered the river ecosystem and negatively impacted fish and wildlife and their respective habitats. The Yakima River Basin Schematic (following the frontispiece) shows the relative positions of selected tributaries, diversions, and drains.

The six reservoirs of the Yakima Project are operated to store and release water to meet downstream diversion demands, primarily for irrigation. About one-half of the basin runoff is regulated by these reservoirs; the residual one-half of the flow is from unregulated tributaries downstream from the reservoirs with no opportunity for storage. Yakima Project operations must take into account varying weather conditions, water demands, "flow time" from the reservoirs to the point of use, inflow from unregulated tributaries, return flows, and other factors.[1]

3.2.1 Operating Seasons

System operations can be divided into four general categories during the year and these correspond closely to the seasons of the year. These categories and their relationship to the irrigation season and water measurement period (water year) are shown in Figure 3-2.

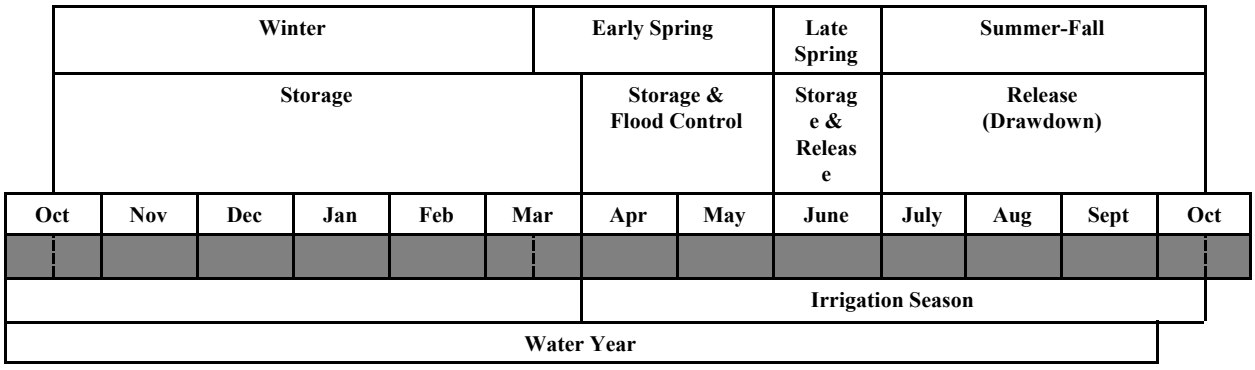
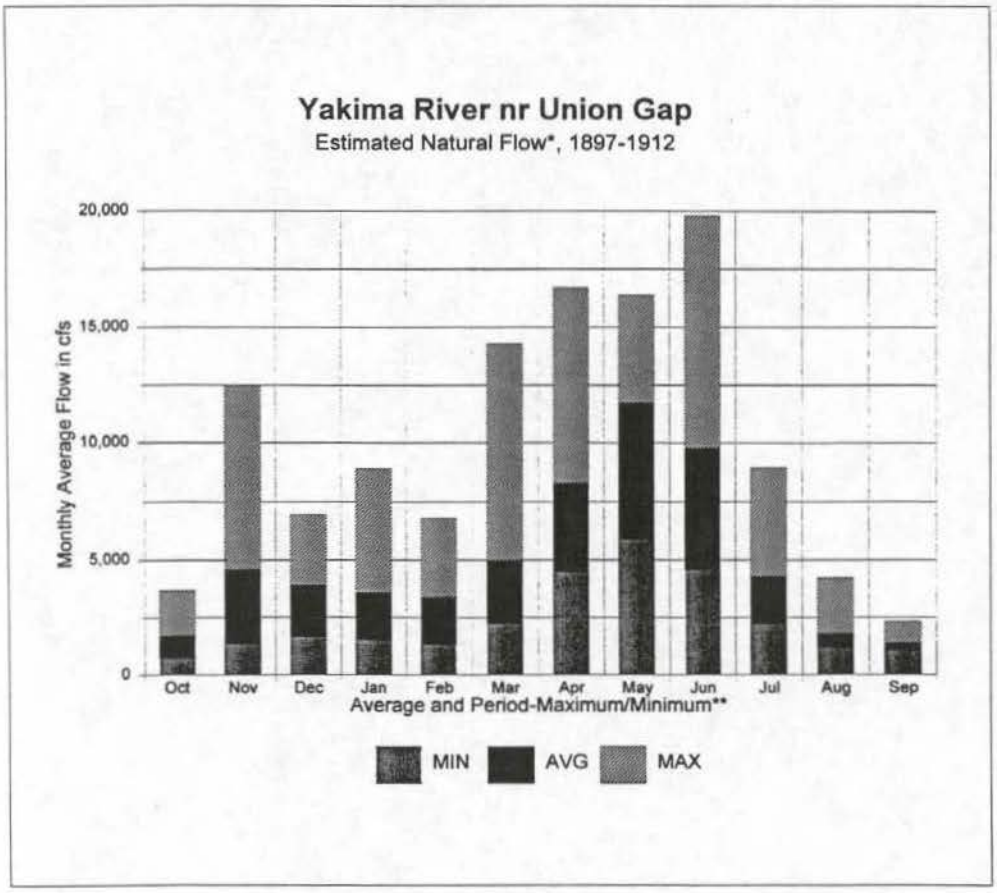


Figure 3-2.—Operating Periods and Seasons

[1] The "flow time" to Sunnyside Diversion Dam is about 48 hours from Keechelus Lake, the uppermost reservoir on the Yakima River, and about 16 hours from Rimrock Lake on the Tieton River.

Winter Operations (Mid-October through Mid-March): Inflow to reservoirs is stored. Some releases are made to provide instream flows for the incubation of spring chinook eggs and fry. Flood control operations are performed in accordance with prescribed flood control rule curves.

Early Spring Operations (Mid-March through May): Inflow to reservoirs is stored. Irrigation diversion demands are met from natural flows accruing downstream from the reservoirs and from unregulated tributaries. Some releases are made for instream flow maintenance for incubation of salmon eggs where unregulated inflow downstream of the dams is inadequate. Flood control operations are implemented as necessary.



* "Estimated Natural Flow" - see discussion in section 3.1
** "Period-Maximum/Minimum" - maximum or minimum of the monthly flows within the period 1897-1912

Figure 3-1. --- Pre-Project Hydrograph of Yakima River

Late Spring (June): Some of the reservoir inflow is stored and some is passed to supplement unregulated flows and return flows for downstream diversion demands. Unregulated flows and return flows are generally adequate to meet irrigation diversions through June. However, storage releases have begun as early as May in dry years and as late as August in wet years. Upon request of SOAC, reservoir releases are coordinated, to the extent possible, to provide flows for downstream migration of salmon and steelhead.

Summer-Fall (July through Mid-October): The majority of the irrigation demands are met from reservoir releases. From July through the end of the irrigation season, normally October 15, stored water is required to meet diversions.[1] As the reservoirs are drawn down to meet irrigation needs, releases are coordinated to maintain system flexibility so that flows can be provided for incubation of spring chinook eggs and fry. The flip-flop operation begins about September 10.

3.2.2 System Flow and Other Measurements

A Hydromet system of some 60 stations has been installed over a period of years to provide real-time data (15 minute intervals) on a number of parameters such as precipitation, reservoir contents, streamflows, and diversions. Polling these stations through a radio-controlled network is possible from the Yakima Project Office.

The Hydromet system provides information on the diversions of the six divisions of the Yakima Project and some non-project diversions such as the Westside Irrigation Company and the Ellensburg Canal Company in the Kittitas Valley and the Naches-Selah Irrigation District in the Naches Valley.

The Adjudication Court directed that all diversions from the Yakima, Naches, and Tieton Rivers of 1 cfs or more shall install measuring and metering devices before March 1, 1995. Diversions must be recorded and the record provided to the Yakima Project office on a weekly basis; this information is then provided to the Washington State Department of Ecology (Ecology). In addition to the Hydromet system, this requirement is met through a system of recorders at other locations that provide information which is manually collected.

3.2.3 Control Point Flows

Sunnyside Diversion Dam (Parker gauge) is the control point for operation of the Yakima Project; diversion demands downstream from Sunnyside Diversion Dam are met by return flows. Operations are keyed to meeting diversion demands upstream of Sunnyside Diversion Dam and maintaining instream target flows over Sunnyside Diversion Dam. In order to meet these goals, the Yakima Project operators ask to be advised verbally 48 hours in advance of

[1] The date when stored water releases begin is called the date of storage control.

any planned diversion or change in diversion. Unplanned changes in diversions are to be reported as soon as possible after the change has been made. Since April 1995, the Yakima Project has been operated to provide flows over Sunnyside and Prosser Diversion Dams from April through October as specified in Title XII. These flows are based on the TWSA forecast and range from 300 to 600 cfs.

Figure 3-3 is a hydrograph of estimated natural flows for pre-project conditions near Union Gap and unregulated flow and measured flow for post-project conditions near Parker.

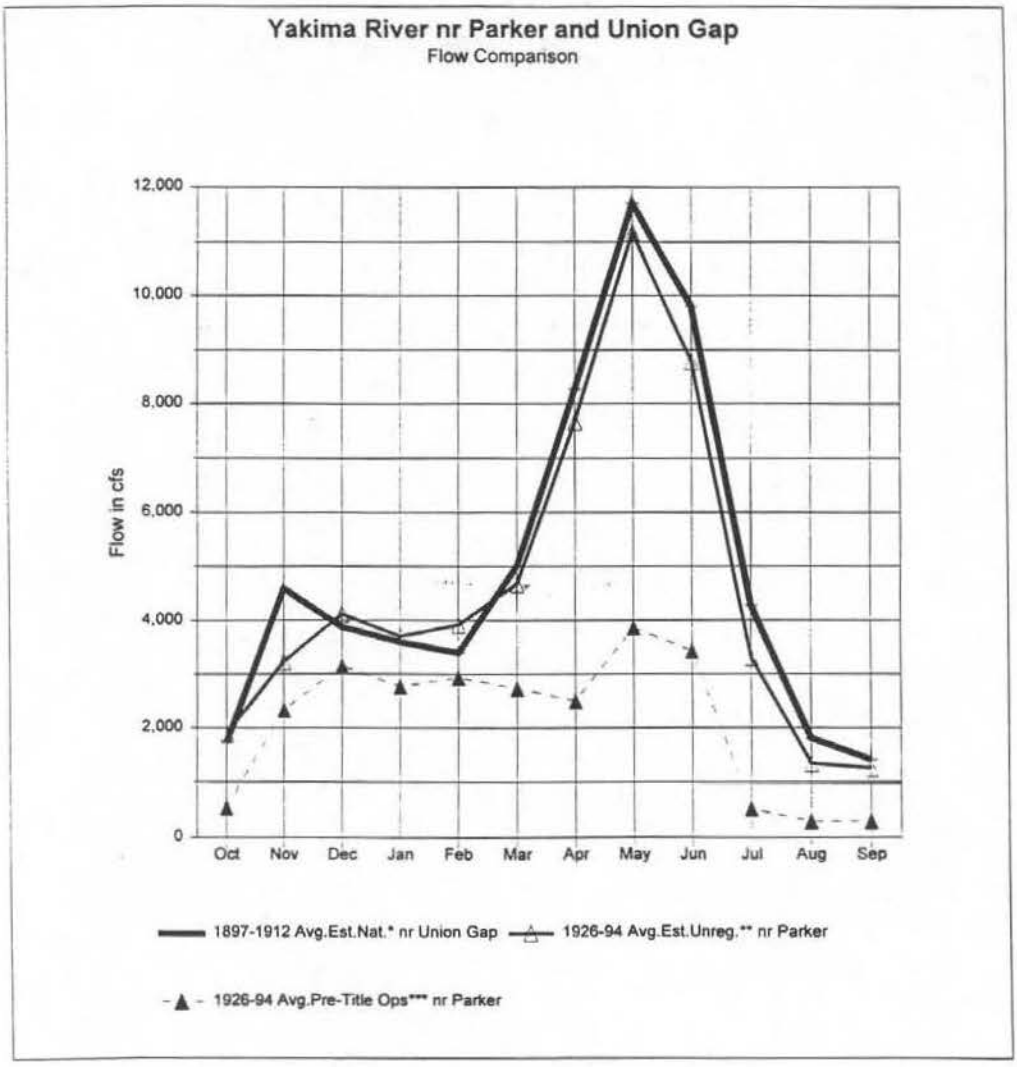
Figure 3-4 shows average measured monthly flows at the Parker gauge for the recent 10 years of 1986 through 1995, and for a year of normal water supply and runoff (1989). Figure 3-5 shows monthly measured flows for a wet year (1991) and a dry year (1994).

3.2.4 Stored Water

Water supplies for entities not having adequate natural flow rights are obtained through contracts with Reclamation which furnishes the water from storage, claimed natural flows, and return flows. Some major entities, such as the Roza Irrigation District and the Kittitas Reclamation District, have no natural flow rights and their entire water supply is contracted. Other entities needing a supplemental supply are furnished contract water under terms of the Warren Act of February 21, 1911, which authorized Reclamation to contract for the sale of water from available supplies.

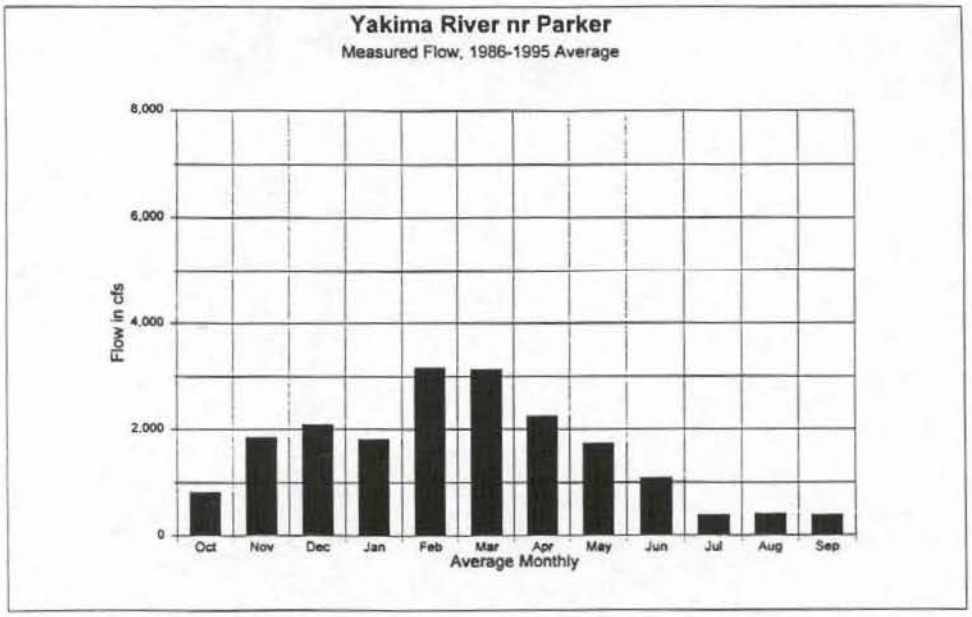
These contracts specify the annual and monthly entitlements (non-proratable and proratable) of each contractor with the construction and operation and maintenance costs of the storage facilities being paid in proportion to the contractor's proratable entitlement.

Stored water is provided as a part of TWSA without assignment to any specific entity. Entities do not have carryover storage rights as all carryover from one year to the next is considered to be a part of the TWSA.



* "Estimated Natural" Flow - see discussion in section 3.1
** "Estimated Unregulated" Flow - measured flow corrected for storage and major diversions only
*** "Pre-Title Operations" - from Yakima River Digital Planning Model, assuming consistent operations of 300 cfs target flow at Parker throughout the period 1926-1994

Figure 3-3. — Yakima River Flows near Parker and Union Gap



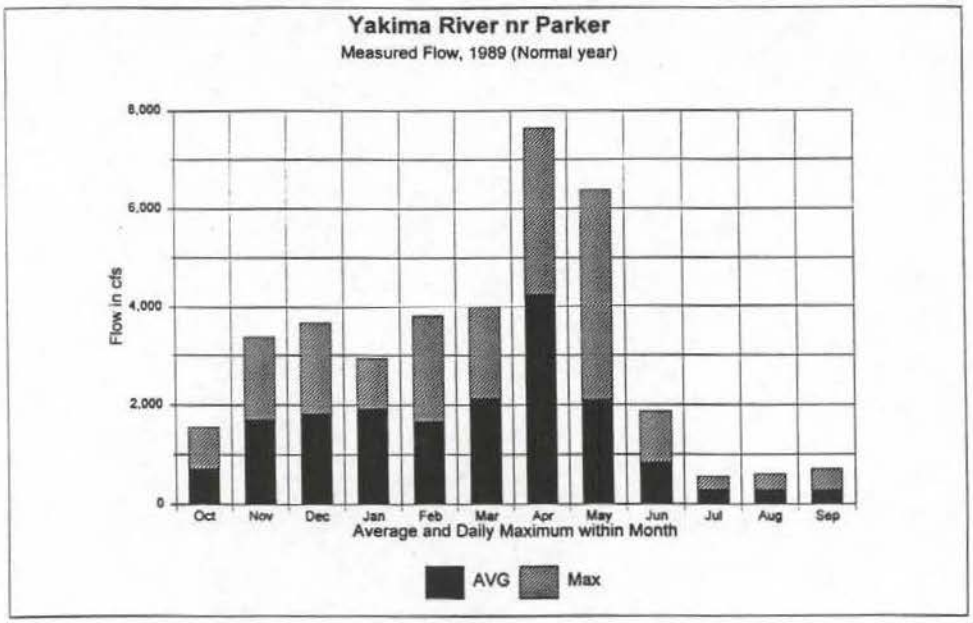
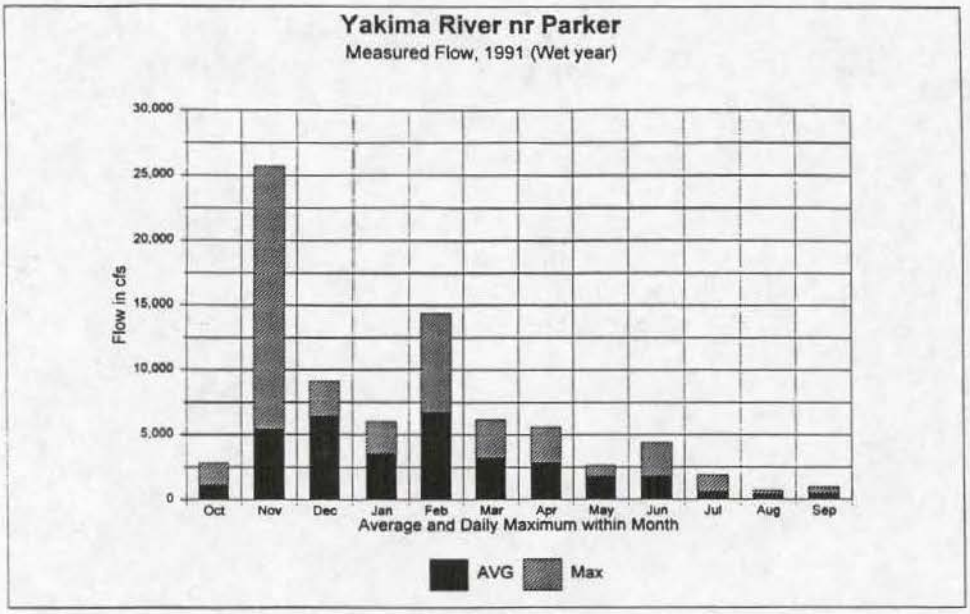


Figure 3-4. — Yakima River Flow near Parker (10-Year Average and Normal Water Year)



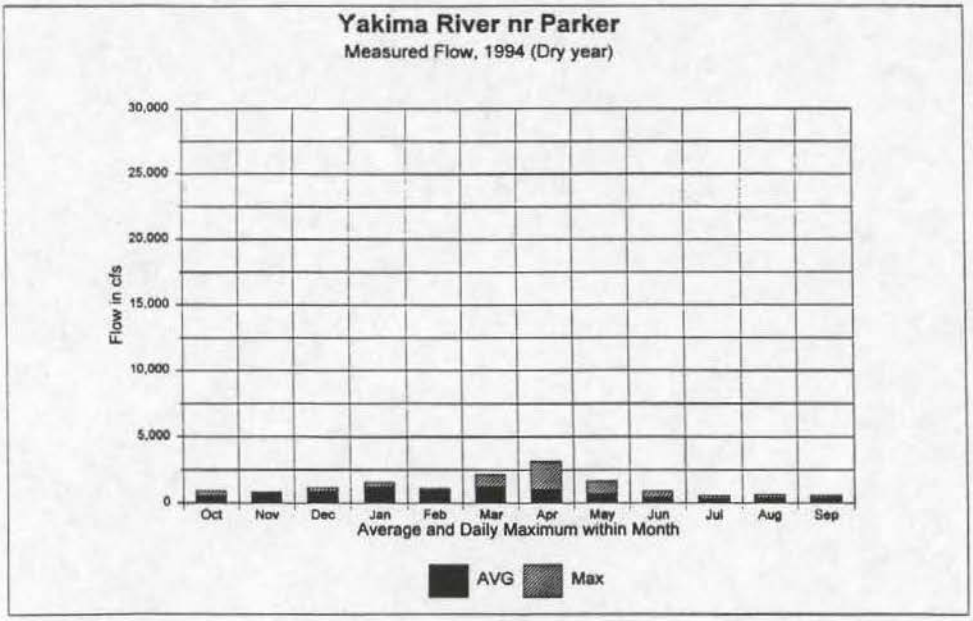


Figure 3-5. — Yakima River Flow near Parker (Wet Year and Dry Year)

4.0 PROBLEMS AND NEEDS

The purpose of this section of the Conservation Plan is to provide information on those water related problems and needs in the Yakima River basin addressed in Title XII to assist (1) entities developing water conservation plans, and (2) Reclamation and Ecology in screening and selecting water conservation measures for funding. Some of the instream flow management problems (needs) such as fluctuations in flow which occur in the river on an hourly, daily, and seasonal basis discussed in this section may be best addressed in the development of the Operating Plan.

For purposes of this section, the Yakima River basin is segregated into four subareas based on the hydrologic characteristics of return flows from the diversion and application of water to the land. These four subareas are the Upper Yakima, Naches, Middle Yakima, and Lower Yakima and are described in Table 4-1 and shown on Figure 4-1. River reaches are identified by river miles (RM)[1].

[1] River miles are a linear measurement made in the center of the stream and beginning at the river mouth (RM 0).

Table 4-1.—Yakima River Basin Subareas for Conservation Plan				
	Subarea			
Item	Upper Yakima	Naches	Middle Yakima[1]	Lower Yakima
Description	Keechelus Dam to Yakima River gauge upstream of Umtanum Creek in the Yakima River Canyon	Naches River drainage	Umtanum Creek gauge to Sunnyside Diversion Dam	Sunnyside Diversion Dam to mouth of Yakima River
River Reach	RM 214.5 to 140.4	All of Naches River	RM 140.4 to 103.8	RM 103.8 to 0.0
Major Surface Inflows	Kachess River Cle Elum River Teanaway River Wilson Creek	Bumping River Tieton River	Wenas Creek Naches River Ahtanum Creek	Granger Drain Marion Drain Toppenish Creek Satus Creek Sulphur Creek
Major Diversions	Kittitas Reclamation District Cascade Irrigation District Ellensburg Water Company Westside Irrigation Company	Naches-Selah Irrigation District Yakima Tieton Irrigation District	Roza Irrigation District Selah-Moxee Irrigation District Wapato Irrigation Project Sunnyside Valley Irrigation District	Kennewick Irrigation District Columbia Irrigation District
Estimated Total Annual Diversions	500,000 acre-feet	200,000 acre-feet	1,400,000 acre-feet[2]	100,000 acre-feet

[1]The Middle Yakima subarea is divided into the Moxee Valley portion, consisting of those entities whose return flows accrue primarily to the Yakima River upstream from Sunnyside Diversion Dam, and the Residual portion whose return flows accrue primarily to the Yakima River downstream from Sunnyside Diversion Dam.

[2]Diversions in the Moxee Valley portion are about 100,000 acre-feet annually; diversions in the Residual portion are about 1,300,000 acre-feet annually

The return flow characteristics of these four subareas are shown in Table 4-2.

Table 4-2.—Return Flow Characteristics of Conservation Plan Subareas

Upper Yakima	Naches	Middle Yakima		Lower Yakima
		Moxee Valley Portion	Residual Portion	
Returns to Yakima River upstream of the Yakima River Canyon	Returns for the most part to Naches River	Returns for the most part to Yakima River upstream of Sunnyside Diversion Dam	Returns for the most part to Yakima River downstream of Sunnyside Diversion Dam	Returns to Yakima River downstream of Sunnyside Diversion Dam
Return flows lag diversions accruing to the river system during and after the irrigation season	Return flows lag diversions accruing to the river system during and after the irrigation season	Return flows lag diversions accruing to the river system during and after the irrigation season	Return flows lag diversions accruing to the river system during and after the irrigation season	Return flows lag diversions accruing to the river system during and after the irrigation season
Makes up a significant part of the return flow component of TWSA	Not as significant a part of the return flow component of TWSA as the Upper Yakima	Not as significant a part of the return flow component of TWSA as the Upper Yakima	Not included in TWSA. However, part of flow at Prosser Diversion Dam and supply for Kennewick Irrigation District	Not included in TWSA. However, part of total flow at Prosser Diversion Dam and supply for Kennewick Irrigation District
Extensive use of return flows as they move from higher to lower lying entities				Return flows are source of water supply

The return flow portion of the TWSA forecast in a normal water supply year is about 375,000 acre-feet

4.1 BACKGROUND

Primary purposes of Title XII include (1) improve instream flows for fish and wildlife, (2) improve the reliability of irrigation water supply, (3) improve water quality, and (4) protect, create, and enhance wetlands. Water problems and needs for these purposes were obtained from reports and documents prepared by various Federal, Tribal, State, and local agencies and organizations which have been involved in Yakima River basin water resource activities. These needs are not an inclusive list.

Background material used to assess problems and needs and the primary source documents are presented first. The instream flow discussion is structured toward providing information on documented concerns of fishery biologists related to regulated system operations which impact

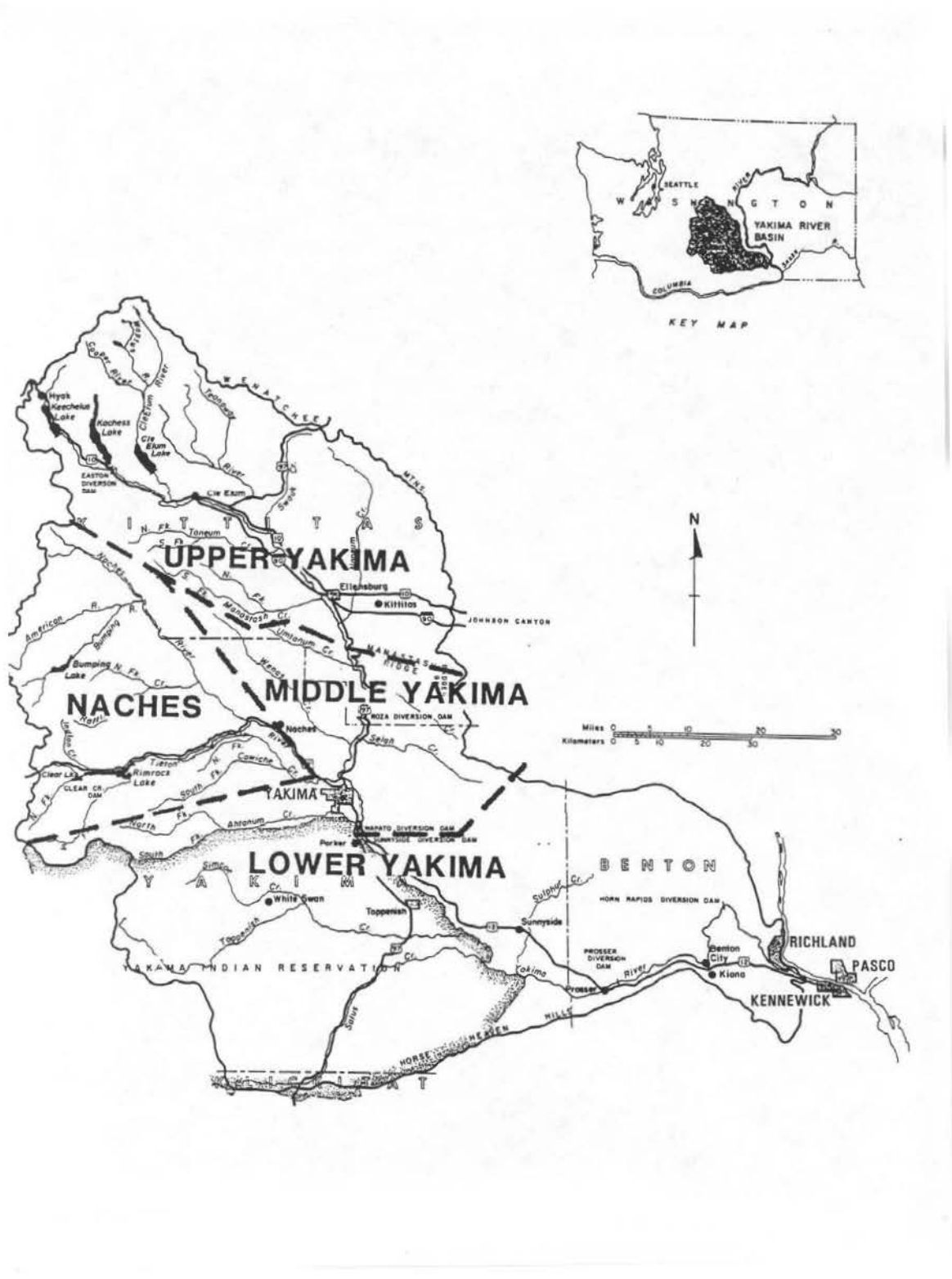


Figure 4-1.-Yakima River Basin Subareas (General Locations)

anadromous fish production. The irrigation supply and water quality discussions are more basin specific. Following the general discussion, the instream flows, irrigation water supply, and water quality problems and needs are discussed for each subarea of the Yakima River basin. A general discussion of basinwide wetlands problems and needs concludes the section.

4.1.1 Instream Flows for Fish and Wildlife

Primary source documents for instream flows include the following:

- Yakima Indian Nation, Washington Department of Fisheries, and Washington Department of Wildlife. *Columbia Basin System Planning, Yakima River Subbasin Salmon and Steelhead Production Plan.* September 1990. Published by the Northwest Power Planning Council. (Yakama Nation, et al., 1990)

- Bureau of Reclamation. 1990. *Yakima/Klickitat Production Project Preliminary Design Report, Appendix B*. April 1990.

- Environmental Protection Agency. 1998. *Proposed 303(d) Listing of Waters Not Meeting State Water Quality Standards*. (EPA)

- Independent Scientific Group. 1996. *Return to the River, Restoration of Salmonid Fishes in the Columbia River Ecosystem, Draft Report*. Northwest Power Planning Council (NPPC) (draft has not yet been adopted by NPPC). (ISG)

- Hunter, Mark. 1992. *Hydropower Flow Fluctuations and Salmonids: A Review of the Biological Effects, Mechanical Causes and Options for Mitigation*. Washington Department of Fisheries Technical Report No. 119.

There is a long history of attempting to quantify needs and identifying operations to improve streamflow conditions in the Yakima River basin. A general consensus of Yakima River basin fishery biologists is that timing and magnitude of flow depletions downstream from most diversions of the Yakima and Naches Rivers and their tributaries impact the watershed habitat of anadromous salmonids[1].

By establishing instream target flows downstream of Sunnyside and Prosser Diversion Dams, Title XII recognizes the need to sustain a base flow level throughout the river system. The 103-mile reach from the mouth of the Columbia River to Sunnyside Diversion Dam serves as the

[1] See Appendix II for information on anadromous salmonids species use of the Yakima River by life stages and seasons.

migration corridor for all anadromous salmonids and provides spawning and rearing habitat for some species.

The Independent Scientific Group (ISG), in its 1996 draft report to the Northwest Power Planning Council concerning the Columbia River basin anadromous fishery, indicated that depleted salmon populations cannot rebuild if any habitat critical to a life stage is seriously compromised. Consequently, the most promising means to help salmon populations rebuild is to reduce or remove conditions which limit the restoration of high quality salmon habitat at each life stage (ISG, 1996).

The ISG proposed the "normative" ecosystem concept where specific functional norms or standards essential for diverse productive populations are maintained. Sustained salmon productivity requires a network of complex and interconnected habitats, which are created, altered, and maintained by natural physical processes in the environment. These diverse and high quality habitats, which have been degraded by human activities, are crucial for salmonid spawning, rearing, and migration and maintenance of food webs and predator avoidance. The ISG proposes aligning water management policies and water resource facility operations to more closely approximate the key features of a normative river such as flow stability and seasonal high flows and to recognize key migration attributes of juvenile salmon (ISG, 1996).

4.1.1.1 Seasonal Low Flows

Seasonal low flows have been identified as problems for migrating anadromous fish and rearing of resident and anadromous fish. Abnormal low flows can adversely affect rearing juvenile fish, newly emergent fry, and out-migrating smolts. Low flows in winter may substantially reduce the availability of wintering habitat. The type of micro habitat typically used by spring chinook—interstices among boulders and rubble, undercut banks, and submerged brush and root wads—is usually associated with the bank of the stream. Water levels lower than normal could dewater many of these areas (Yakama Nation, et al., 1990).

Fry emerge from the stream gravels from mid-February through early July and seek side channels for early rearing. If critically low flows occur during this period, there is a greater possibility of stranding fry and increasing vulnerability to predation in shallow or dewatered side channels (Yakama Nation, et al., 1990).

Low flows during spring chinook out-migration have the potential for increasing in-basin travel time and vulnerability to predation (Yakama Nation, et al., 1990).

4.1.1.2 Hourly and Daily Flow Fluctuations

Flow fluctuations are unnaturally rapid flow changes that may occur over periods of minutes, hours, and even days. Such fluctuations can be immediately lethal or have indirect and delayed

biological effects on both fish and the food chain (Hunter, 1992). Flow fluctuations can be measured by either changes in flow rate (a volume of water passing a specific river transect in a specific time period, typically expressed in cubic feet per second) or by changes in river stage (water surface elevation typically expressed by gauge height). For purposes of system operations such as regulating reservoir releases and irrigation diversion demands, flow rate in cubic feet per second are used. However, biological impacts of flow fluctuations are best measured by river stage or change in wetted width of the stream.

Sudden increases in flows cause fish to leave feeding territories and migrate to new areas. Such forced relocation increases competition and stress, reduces growth, and increases the likelihood of mortality either through predation or displacement to unsuitable habitat (Yakama Nation, et al., 1990). Sudden decreases in flows can strand fish if they are not able to relocate to nearby pools or runs. Flow fluctuations in an experimental stream channel caused juvenile chinook to emigrate downstream (Hunter, 1992).

While some level of fluctuation in river stage is normal, the abruptness and pattern of change can be significantly different in regulated and unregulated rivers. Natural variations in flow caused by events such as storms or warm, sunny days that accelerate snowmelt can rapidly increase river stage in less than a day. After the event, the river stage declines to a relatively stable level for a longer period of time, usually days or weeks. Rapid decreases in river stage rarely occur in unregulated rivers except immediately after floods (Hunter, 1992).

Incidence of stranding is much greater for a stream channel with many side channels, potholes, and low gradient bars than for a stream confined to a single channel with steep banks. Long side channels with intermittent flows are notorious for trapping juvenile fish. Thus, flow fluctuations are particularly hazardous for fish in complex channels which provide the best habitat for rearing of fry.

Juvenile salmonids are more vulnerable to stranding than adults. Although larger juveniles are more inclined to inhabit pools or other instream habitat where they are less subject to stranding, many juveniles inhabit rocky or bushy shoreline areas and side channels and remain vulnerable to stranding until they emigrate to saltwater (Hunter, 1992).

Salmonid fry that have recently emerged are poor swimmers and settle along the shallow margins of the streams where they seek refuge from water currents and larger fish. Small fry are highly vulnerable to stranding and are present in the stream only during late winter, spring, and early summer. Time of day appears to influence stranding in some species. Chinook fry are less dependent on substrate for cover at night and are thus less vulnerable to stranding at night (Hunter, 1992).

Restoration of normative ecosystem conditions requires stabilized daily flow to prevent short-term dewatering of the near shore zone and to allow food-web persistence in the shallow

habitats that provide important juvenile rearing. Short-term fluctuations, often associated with hydropower peaking on rivers, effectively kill all organisms in shallow water habitats. These habitats are essential features of the normative riverine landscape (ISG, 1996). On regulated rivers, down ramping rates (the rate of decrease in river stage that accompanies reductions in discharges) should be established to minimize stranding. Ramping rates of less than 1 inch per hour were needed to protect steelhead fry on the Sultan River, Washington (Hunter, 1992).

4.1.1.3 Sustained High Flows

The bankfull flow is the flow which maintains the channel and moves the greatest amount of bedload over time. Allowing periodic bankfull flow is essential to the health of a river. However, abnormally frequent or sustained high flows near the bankfull stage adversely affect channel substrate and instream habitat by reducing deposition of spawning gravels and large woody debris. Sustained high flows downsteam from reservoirs depletes gravel and finer sediments in the tailwaters, causing armoring of the river channel with large cobble and boulder substratum. Large woody debris is retained in reservoirs (ISG, 1996). This reduces habitat for successful fish production.

4.1.2 Irrigation Water Supply

Primary source documents for irrigation water supply are:

- Bureau of Reclamation. 1994. *Entitlement Summary as Established July 8, 1992, and Reflecting Subsequent Modification by the Adjudication Court*. April 29, 1994.

- Bureau or Reclamation. *Information From Bureau of Reclamation Annual Operations*. Upper Columbia Area Office. Yakima, Washington.

The 1945 Consent Decree specifies the monthly and annual water quantities that can be diverted. Total annual water entitlements upstream of the Parker gauge for the period of April through September are shown in Table 4-3. Monthly and annual water entitlements for each entity are summarized in Appendix III-A.

Table 4-3.—Water Entitlements Upstream of Parker Gauge (April through September)
(Acre-Feet)

Water Users	Non-proratable	Proratable	Total
All users	1,108,595	1,235,848	2,344,443
Five major divisions	624,323	1,195,859	1,820,182

The entitlements of the Kittitas, Tieton, Roza, Wapato, and Sunnyside Divisions, the five major users upstream of the Parker gauge, represent 78 percent of the total entitlements. All of the entitlements of the Kittitas Division and the Roza Division are proratable.

Beginning each March and continuing through the irrigation season, depending on the prevailing water supply conditions, Reclamation prepares forecasts of the TWSA upstream of the Parker gauge. These forecasts are the basis for determining the adequacy of the TWSA to meet irrigation water entitlements and to assist in deciding the amount of proration, if any, that may be necessary. The components of the TWSA forecast are summarized in Appendix III-B.

When the TWSA is not adequate to meet water entitlements, prorating is necessary. Historically, the proration period has not started until the date of storage control, and then the amount of proration is determined monthly by Reclamation in consultation with the water entities. Non-proratable entitlements can divert their full entitlements which are deducted from the TWSA; the remainder is available for proratable entitlements.

Under present operating procedures, a "water bucket" is determined for each entity. This "water bucket" represents the total amount of water available to the entity for the proration period.[1] The water supply in the entity's "water bucket" changes monthly as the result of changes in TWSA forecasts and the amount of water already diverted by the entity.

In any month, each entity can divert the amount of water in its "water bucket" up to its entitlement for that month. This procedure allows the entity to determine how it wants to use its "water bucket" supply. It may reduce its monthly diversions so there may be more water throughout the proration period or may use a greater amount, taking the risk of having to reduce diversions later in the proration period. In the case of an entity with only proratable entitlements, larger diversions early in the proration period could result in significant curtailment of diversions later in the season.

In the period 1970-1996, prorating was imposed in 8 of 27 years. Proratable water users received 58 percent of their proratable entitlement in 1992, 67 percent in 1993, and 37 percent in 1994.

[1] The period of proration extends from the date it is determined that proration must first occur through September.

4.1.3 Water Quality

Primary source documents on water quality include the following:

- Yakima Valley Conference of Governments. 1995. *Final Report of the Yakima Valley Conference of Governments, Yakima River Basin Water Quality Plan, Volumes I and II*. June 23, 1995. (YVCOG, 1995)

- Washington Department of Ecology. July 1997. *A Suspended Sediment and DDT Total Maximum Daily Load Evaluation Report for the Yakima River*. (Ecology, 1997)

- Environmental Protection Agency. *1998. Proposed 303(d) Listing of Waters Not Meeting State Water Quality Standards*. (EPA, 1998)

- U.S. Geological Survey. 1996. *Surface Water Assessment of the Yakima River Basin in Washington*. (USGS, 1996)

Water quality refers to the physical characteristics of a stream or body of water and the suitability of that water to support biological functions of fish and wildlife and a range of human activities. The quality of a stream or body of water is measured by comparing the physical and chemical characteristics against a set of standards which are recommended to support various uses.

The State of Washington has assigned a water quality class designation to all streams and bodies of water in the State based on present and potential uses and considering their natural potential and limitations. The water quality standards (Chapter 173-201A WAC) are ". . . consistent with public health, public enjoyment, and the propagation and protection of fish, shellfish, and wildlife." It is important to recognize that the stream classification is based on "use" and "potential use" as well as actual water quality factors. Classes of surface waters and characteristic uses are shown in Appendix IV-A.

In the Yakima River basin, the Yakima River from the headwaters to the confluence with the Cle Elum River and waters within national forests and wilderness areas are designated as Class AA waters. All other waters in the basin are designated Class A with the exception of Sulphur Creek in the Lower Yakima Subarea which is Class B.

Section 303(d) of the Federal Clean Water Act requires states and tribes to identify water bodies where technology based controls have been insufficient to meet, or are not sufficient to meet, applicable water quality standards or support beneficial uses (see Appendix IV-B). The Total Maximum Daily Load (TMDL) is a mechanism for establishing water quality-based controls on all point and nonpoint sources of pollutants that flow into these water bodies. The

TMDL evaluation uses monitoring data and water quality models to estimate the pollutant load that a water body can receive and continue to meet water quality standards. This loading capacity is then apportioned among all point sources through waste load allocations and among nonpoint and background sources through load allocations. The waste load allocations and load allocations are achieved through discharge permits and by implementing control and education activities in watershed or subbasin management plans.

Ecology is responsible for protecting the quality of water resources and implementing Clean Water Act programs within the State. Pursuant to this responsibility, Ecology in 1994, and 1995, conducted a TMDL evaluation in the Middle and Lower Yakima Subareas to control suspended sediment, turbidity, and DDT contaminants.[1] Ecology views these as key contaminants, the control of which, will make far-reaching water quality and fish habitat improvements in the Yakima River basin. Information from this report is summarized in Appendix IV-C.

Water quality improvement can be achieved primarily by improving onfarm irrigation systems and operating those systems with proper irrigation water management techniques. However, many of the entity systems must be upgraded to fully realize the benefits from onfarm system and management improvements (see Section 5.0).

The vast majority of aquatic organisms are poikilothermic -- their body temperatures and hence metabolic demands are determined by temperature. Consequently, virtually all biological and ecological processes are affected by ambient water temperature (Spence, Lomnicky, Hughes, and Novitzki, 1996). Changes in the water temperature regime can affect the survival and production of anadromous salmonids, even when temperatures are below levels considered to be lethal (Forest Ecosystem Management Assessment Team, 1993).

Increased water temperatures can often be traced to removal of shade-producing riparian vegetation along fish-bearing streams and along smaller tributary streams that supply cold water to fish-bearing streams (Forest Ecosystem Management Assessment Team, 1993). Sediment loads also contribute to increased water temperatures.

Water temperature is a concern in the Yakima River basin. While temperature exceedances above the parameters were noted in the Yakima Valley Conference of Governments (YVCOG) Report primarily in the Middle Yakima Subarea, the lower reaches of the Naches Subarea, and in the Lower Yakima Subarea. However, since publication of the YVCOG Report, Ecology has issued two 303(d) lists showing that temperature is also a parameter of concern in the Upper Yakima Subarea and in the upper tributaries of the Naches Subarea. Various reaches of the mainstem Yakima River and the American and Little Naches Rivers are

[1] The Yakama Nation has similar responsibilities on the reservation. Monitoring activities on the reservation were conducted in cooperation with the Yakama Nation.

listed on the 1998 proposed 303(d) list for temperatures that exceed state water quality standards (see Appendix IV-B).

Ecology is currently developing a TMDL strategy to address listings for temperature. The process may include detailed review of the current temperature water quality standards as they apply to eastern Washington climate and ultimately listings in the Yakima River basin. Following detailed review and assessment, Ecology will develop and implement a strategy to address the causes of the temperature exceedances where appropriate. Ecology suggested that Reclamation and others collaboratively work to determine and implement solutions to temperature problems consistent with other activities in the Conservation Plan.

4.2 UPPER YAKIMA SUBAREA

Throughout this section, various features, streams, and drains are located using the Yakima River Mile Index. River miles are linear distances measured in the center of a stream starting at the mouth. Table 4-4 summarizes the location of various features identified in this discussion of the Upper Yakima Subarea. River mile locations are included in parentheses in the text where considered necessary.

Table 4-4.—River Mile Locations for the Upper Yakima Subarea

Feature	Yakima River Mile
Keechelus Dam	214.5
Cabin Creek	205.0
Kachess River	203.5
Easton Diversion Dam	202.5
Big Creek	195.8
Cle Elum River	185.6
Teanaway River	176.1
Wasteway #1146	173.9
Swauk Creek	169.9
Taneum Creek	166.1
Manastash Creek	154.5
Wilson Creek	147.0
Gauge	140.4

The Upper Yakima Subarea extends 74.1 river miles from Keechelus Dam near the headwaters of the Yakima River to the Yakima River gauge in the Yakima River Canyon just upstream of the mouth of Umtanum Creek (RM 139.8). In this subarea, the river is shallow,

has a high gradient (an average streambed slope of 14 feet per mile), and has a streambed composed mostly of cobble and large gravel with some boulders, sand, and silt (USGS, 1996).

This subarea is entirely within Kittitas County which has a population of about 27,000; the city of Ellensburg, situated in the lower end of the reach, is the county seat with a population of about 12,500. Primary agricultural crops are irrigated pasture, hay, and grains. Timothy hay is the high revenue production crop with grains produced as a rotation crop.

About three-fourths of the Yakima Project storage capacity is situated in this subarea: Keechelus Dam and Keechelus Lake (157,800 acre-feet) on the upper Yakima River; Kachess Dam and Kachess Lake (239,000 acre-feet) on the Kachess River; and Cle Elum Dam and Lake Cle Elum (436,900 acre-feet) on the Cle Elum River. Other major tributaries such as Cabin Creek, the Teanaway River, Swauk Creek, Taneum Creek, and Wilson Creek are unregulated and add significant flows, particularly during spring runoff when inflow to the reservoirs is being stored.

Beginning in early April, unregulated flows in the Yakima River and in some of the tributaries are diverted for irrigation purposes. Return flows resulting from diversions to higher-lying lands, such as in the Kittitas Reclamation District, are used down slope by other irrigation entities to supplement their Yakima River diversions. A significant portion of these return flows enter the river as surface and subsurface accruals upstream of the Yakima River Canyon. Return flows from early season irrigation diversions of unregulated flows and from diversion of stored water releases later in the irrigation season make up a major part of the return flow component of the TWSA.[1]

4.2.1 Instream Flows for Fish and Wildlife

Some of the best spring chinook spawning and steelhead spawning and rearing habitat in the Yakima River basin is in the Upper Yakima Subarea from the confluence of the Teanaway River upstream to Keechelus Dam due to good water quality, the riparian corridor, and numerous unrestrained channels in this reach of the river. There are many excellent gravel bars and resting pools and cover is abundant in this area. The riparian corridor is generally good but locally very poor where clusters of homes have been built, river banks riprapped and vegetation removed. In the lower portion of this subarea, from Taneum Creek downstream to Ellensburg, bank sloughing is common and the riparian vegetation is only fair. There are also a considerable amount of dikes and levees which constrain the width of the river channel.

Principal spawning areas are in the Yakima River from the backwaters of Easton Lake to Keechelus Dam, in the Yakima River downstream of Easton Dam, and in the Cle Elum River

[1] The return flow portion of the TWSA forecast in a normal water year (2.8 million acre-feet) is about 375,000 acre-feet, or about 13 percent.

from the dam to the confluence with the Yakima River. This is the primary spring chinook spawning area in the Upper Yakima subarea.

Yakima Project operations are currently structured to meet irrigation demands and protect incubating salmon eggs in the late summer, fall, and winter, which are buried by female salmon in gravel nests called "redds." In the Upper Yakima Subarea, river flows are generally highest during mid-July through early September, when stored water is being released from the three reservoirs to meet downstream irrigation demands. In early September, releases from these reservoirs are reduced to coincide with the spring chinook spawning season; the "flip-flop" operation. By reducing flows while fish are spawning, less water needs to be released from the reservoirs during the winter to cover the redds with flowing water.

With flip-flop in early September, releases from Lake Cle Elum are generally reduced to about 200 cfs to control the elevation of spawning in the Cle Elum River. When water supply and operations permit, releases from Keechelus Reservoir are targeted to less than 100 cfs to control spawning in the river channel between Keechelus and Easton Diversion Dam. By agreement, this allows opening Easton Diversion Dam fish ladder so that salmon can spawn in this reach; however, the old Easton fish ladder was virtually impassable by adult salmon and steelhead. A new ladder was installed in 1989, but remained closed in 1992, 1993, and 1994, due to low water supplies. In 1996, the ladder was closed because of construction activities at Kachess Reservoir. When the Easton fish ladder is open, the irrigation water supply for Yakima River diverters upstream of the mouth of the Naches River (RM 116.3) during the flip-flop operation is, to the extent possible, met from Kachess Reservoir.

Also during spawning, the Yakima River downstream of Easton Diversion Dam is managed to maintain a flow of about 200 cfs by using the Main Canal of the Kittitas Reclamation District to reroute water around this 20-mile section of the river. This water, at times up to 400 cfs, reenters the Yakima River through the District's 1146 Wasteway.

Following the end of the irrigation season in mid-October, reservoir discharge is adjusted to the minimum discharge needed to cover the redds with flowing water. At this time of the year flows are generally at the lowest annual levels, being comprised of minimum reservoir releases, naturally low inflows from unregulated tributaries, and surface and subsurface return flows.

Mean monthly flows for the period 1986 through 1995, in the Yakima River below Keechelus Dam, immediately downstream of Easton Diversion Dam, at the confluence of the Cle Elum River, and just upstream of Umtanum Creek are shown in Figure 4-2.

Several problems resulting from river management and flows adversely affect fish and wildlife in the Upper Yakima Subarea. The most important are discussed below.

4.2.1.1 Flows in Yakima River From Keechelus Dam to Cle Elum River

Problem—Seasonal Low Flows—Winter flow management is currently based on providing minimum flows for covering redds while storing water for summer irrigation needs. Good overwintering habitat would be available if additional reservoir releases could be made to maintain side channel and river margin habitat.

Problem—Hourly and Daily Flow Fluctuations—Abnormal, rapid hourly and daily flow fluctuations have been noted. Relatively small fluctuations in discharge can result in large changes in the width of the river, shallow water habitats, and flow in side channels. Spring chinook fry prefer and actively seek side channels for early rearing. Impacts from rapid flow fluctuations, particularly abrupt decreases in flow, are a concern in this reach because it has complex instream habitat and channel shape including side channels, braids, and gravel bars. The Easton reach is at least 50 percent side channels (Yakama Nation, et al., 1990).

This reach includes the most heavily used spring chinook spawning area in the entire Yakima River basin. Newly emergent fry are attracted to side channels and braids and habitat created by brush and large woody debris along the river margins. When streamflows decrease to where these habitat features become unusable, it is probable that large numbers of spring chinook fry are trapped in isolated side channels where they are killed directly or indirectly due to predation (Yakama Nation, et al., 1990). Fry displaced to the main river channel are too small to hold their position against high velocity flows and are at risk of being stranded in the side channels by low flows or being moved downstream by high velocities in the main river channel to less suitable habitat. Flow fluctuations and critically low flows in this reach are especially of concern when they occur from late March through July during these early life stages .

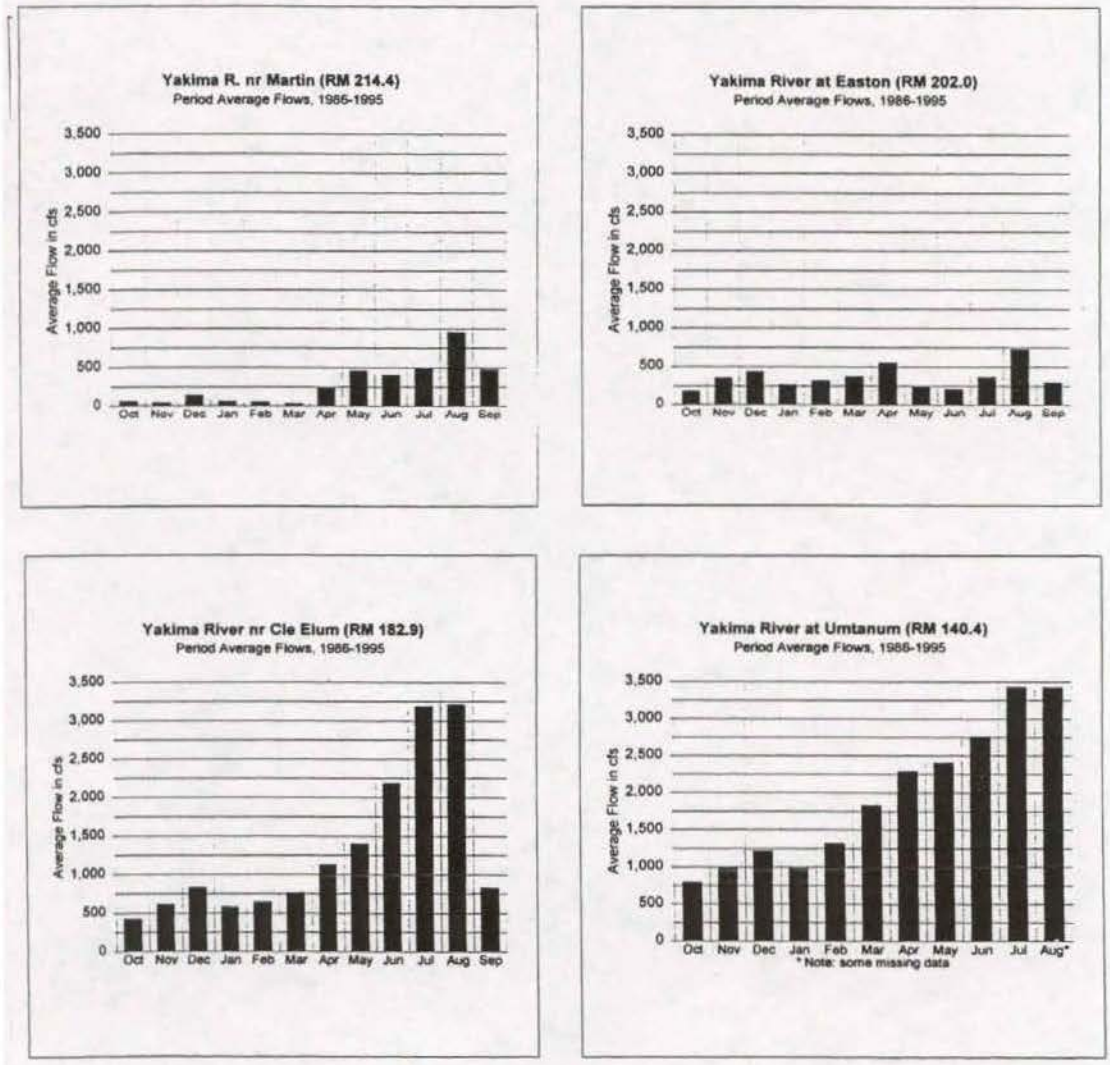


Figure 4-2.---Yakima River Average Monthly Flow (Upper Yakima Subarea)

4.2.1.2 Flows in Yakima River From Cle Elum River to Roza Diversion Dam

Problem—Sustained High Flows—Stream velocities are high to meet irrigation demands between the date of storage control and the date of initiation of flip-flop operation in early September. During this period as much water as possible is retained in the reservoirs in the Naches Subarea for the flip-flop operation. As a result, most of the summer irrigation needs of the Yakima River diverters downstream of the Naches River must be provided from the reservoirs in the Upper Yakima Subarea. This water flows through this reach producing high flows.

Throughout this reach, the river is generally confined so that there are limited opportunities for fish to escape these high velocities. The river flows through two relatively narrow canyons in this reach and is confined by dikes in much of the remaining alluvial areas. Prolonged reservoir releases during the summer may reduce the amount of habitat available for spring chinook juveniles.

4.2.1.3 Flows in Cle Elum River From Cle Elum Dam to the Mouth

Problem—Seasonal Low Flows—There is good side channel habitat for rearing of juvenile salmonids in this reach at certain flow levels, but the present levels of fall and winter releases from Lake Cle Elum are inadequate to provide rearing flows in these side channels.

Problem—Sustained High Flows—From initiation of storage control to time of flip-flop operation in early September, velocities in this reach are high due to reservoir releases to meet downstream irrigation demands. Fry and juveniles which cannot find sheltered rearing areas (or are displaced from such areas) are at risk of being moved downstream by these high flows to less suitable rearing habitat. This is of particular concern from late March through July, during early life stages.

Problem—Hourly and Daily Flow Fluctuations—Abnormal rapid hourly and daily fluctuations in flow have occurred in this reach. Relatively small fluctuations in flows can result in large changes in the width of the river, shallow water habitats, and flow in side channels where the channel is complex. Shoreline shallow water habitats and flow in side channels are adversely affected. Fry prefer and actively seek brush and woody debris along the margins of the channel side channels for early rearing. Impacts of flow fluctuations, particularly abrupt decreases in flow, are of particular concern in this reach because portions are characterized by complex instream habitat and channel shape including side channels and gravel bars.

Although juvenile fish are better swimmers and less subject to stranding than fry, juvenile fish rearing along the river margin and in side channels are still at risk of isolation or stranding by flow fluctuations throughout the year. Flow fluctuations which result in alternate watering and

rapid dewatering of side channels and micro habitat features place juvenile salmonids at high risk of mortality (Hunter, 1992).

Ramping of flows during major operational changes such as the flip-flop needs to be extended over an adequate period to alleviate, to the extent possible, rapid flow fluctuations.

4.2.1.4 Flows in Other Tributary Streams

Historically, the tributary streams of the Upper Yakima Subarea were major producers of anadromous fish. Flows in many of these streams are now depleted by irrigation diversions in one or more sections precluding use by anadromous fish in most years. The Columbia Basin System Planning members identified the following streams as priority streams for flow restoration: Big Creek, Taneum Creek, Manastash Creek, Swauk Creek, and the Teanaway River (Yakama Nation, et al., 1989b)

The Columbia Basin System Planning members identified the Teanaway River as potentially more productive for spring chinook than any Yakima River tributary except the Naches River. However, poor instream flows during summer and fall in the lower Teanaway River significantly impact natural reproduction of spring chinook, steelhead, and coho. Local channelized reaches and locally poor riparian condition further limit fish production (Yakama Nation, et al., 1990)

Other priority tributaries in the Upper Yakima Subarea with potential for increasing anadromous fish production but with currently inadequate instream flows significantly diminishing production include: Big Creek, Taneum Creek, Manastash Creek and Wilson Creek and its tributaries. Big, Taneum, and Manastash Creeks are identified as having deficient instream flows (EPA, 1998).[1]

Flows in Big Creek, upstream of the upper diversion located about 2 miles from the mouth, are adequate for fish production, but flows in the lower 2 miles are minimal and often nonexistent. Historically, Big Creek produced steelhead and probably coho and spring chinook. It appears to have potential for producing steelhead, coho, and spring chinook if the low flow condition can be rectified.

Taneum Creek is considered to have substantial potential for producing steelhead and coho and, to a lesser degree, spring chinook. The riparian corridor beginning about 2.5 miles from the mouth and on upstream is generally in good condition. The North and South Forks flow through heavily timbered land and the riparian conditions are excellent. A constraint to production is very low summer and fall flows in the lower 3.3 miles of Taneum Creek downstream of the major diversions.

[1] The "1998 proposed 303(d) List appears in Appendix IV-B.

Manastash Creek contains potentially productive spawning and rearing habitat. However, due to irrigation diversions, low instream flow conditions and totally dry reaches are prevalent in the summer and fall in the lower 5 miles.

All streams in the Wilson Creek drainage (Cherry, Badger, Park, Coleman, and Taneum Creeks) are heavily diverted on the valley floor. They have been channelized into an intricate irrigation and drainage system that consists of straight-line ditches with high velocity and little or no riparian zone. Riparian zones on the valley floor are extensively impacted by grazing and other agricultural practices.

Lower Wilson Creek and all tributaries are very important for juvenile anadromous fish. These streams are strategically located at the lower end of the Kittitas Valley, providing the largest rearing system before the Yakima River enters the 25-mile long Yakima River Canyon where off-channel rearing opportunities are limited. The potential for anadromous fish utilization is constrained by poor water quality in summer, loss of habitat due to channelization, elimination of a normal, complex riparian zone, and barriers created by irrigation facilities.

Major problems in the Wilson Creek drainage are access to and from the headwater areas and poor water quality. It is estimated that there are over 200 unscreened diversions in this drainage. There is a need to address fish passage problems in the Wilson Creek drainage in a systematic manner.

Other streams with lesser potential for anadromous fish production but which have value for juvenile rearing include Little Creek and Tucker Creek. The remaining streams of the Kittitas Valley have not been prioritized.

The Kachess River downstream from the Kachess Dam has habitat suitable for spawning. Flow regulation for flip-flop does not currently address requirements of fish in the Kachess River.

Problem—Seasonal Low Flows—Some tributary streams are depleted by irrigation diversions in one or more reaches precluding use by anadromous fish in most years.

4.2.2 Irrigation Water Supply

In the Upper Yakima Subarea, the earliest irrigation was of lands contiguous to the Yakima River and its tributaries. As irrigated lands further from the river were developed, return flows from those higher-lying lands mingled with natural flows in the creeks and became a part of the water supply for the down slope irrigation entities. The mid-summer and early fall flows in many of the lower sections of these creeks are predominately irrigation return flows.

The sequence of irrigation of lower-lying to higher-lying lands of the four largest irrigation entities in this reach is: Ellensburg Water Company (1885), Westside Irrigation Company (1889), Cascade Irrigation District (1903), and the Kittitas Reclamation District which operates the Kittitas Division (1930). The diversion, conveyance, and distribution facilities of the Kittitas Division were constructed by Reclamation. Table 4-5 shows the irrigable lands of these four entities, the diversion points, and the diversion capacities at the headworks.

Table 4-5.—Lands, Diversion Points, and Headworks Capacities of the Upper Yakima Subarea

Entity	Irrigable Lands (Acres)	Yakima River Diversion Point (River Mile)	Headworks Capacity (Cfs)
Kittitas Reclamation District	59,000	202.5	1,320
Westside Irrigation Company	5,200	166.1	130
Ellensburg Water Company	10,800	161.3	170
Cascade Irrigation District	12,500	160.3	150

Because its diversion is upstream of the Cle Elum River, the stored water supply for the Kittitas Reclamation District can be provided only from Keechelus and Kachess Reservoirs; the stored water supply for the other Yakima River diverters in the Upper Yakima Reach can be provided from any of the three reservoirs.

The major tributary diversions are in the Taneum Creek and Teanaway River drainages. The Taneum Canal Company diverts water from Taneum Creek (90-cfs-headworks capacity) to about 3,700 acres lying up-slope of the Westside Irrigation Company. The Kittitas Reclamation District delivers water to the Taneum Canal Company to supplement its Taneum Creek supplies as the creek flows decrease in the summer. In the Teanaway River, individuals divert from the Teanaway River to irrigate about 1,600 acres. This irrigation supply is entirely dependent upon the runoff of the Teanaway River.

The annual water entitlements of the four largest irrigation entities are shown in Table 4-6.

Table 4-6.—Annual Water Entitlements (April-October) of the Upper Yakima Subarea

Entity	Entitlement (Acre-Feet)		
	Non-proratable	Proratable	Total
Kittitas Reclamation District	0	336,000	336,000
Westside Irrigation Company	31,128	8,200	39,328
Ellensburg Water Company	47,758	0	47,758
Cascade Irrigation District	49,525	0	49,525
Total	128,411	344,200	472,611

The entitlement of the Kittitas Reclamation District is entirely proratable. Its water supply was about 58 percent of the entitlement in 1992, 67 percent in 1993, and only 37 percent in 1994. In 1994, the Kittitas Reclamation District had used its prorated supply by the end of August and did not divert any water in September and October. The entitlements of the other entities in the Upper Yakima Reach are all, or almost all, non-proratable which, to date, have resulted in a full supply in all years.

Problem—Reliability of Irrigation Supply—The irrigation water supply for the Kittitas Reclamation District is entirely proratable and is reduced in deficient water supply years.

4.2.3 Water Quality

The Yakima River from its headwaters to the Cle Elum River is designated Class AA waters by Ecology. From the Cle Elum River to Wilson Creek, the Yakima River is designated Class A. The Yakima River in the Upper Yakima Subarea does not support these classifications.

The Yakima River upstream of the Cle Elum River is generally of a high quality, minimally affected by man. The 1998 proposed 303(d) list does however, note dissolved oxygen and temperature exceedances in the reach to Easton Diversion Dam and temperature exceedances upstream of Easton Diversion Dam to Keecheles Dam. Progressing downstream from the confluence of the Cle Elum River, there is some visible increase in turbidity and suspended sediments. While streamflows currently are sufficient to dilute the nutrients and sediment loads to low concentrations, efforts to reduce pollutant sources as well as monitoring need to continue to maintain the current high quality of this reach.

The quality of water in Wilson Creek is degraded by fecal coliform, turbidity, and pesticides and overall does not support the Class A designation (EPA, 1998).

The 1998 proposed 303(d) list does show some temperature problems in some of the other tributaries which experience low flows during the summer and early fall (EPA, 1998).

Problem—Poor Water Quality—Lower Wilson Creek and its tributaries are very important for rearing of juvenile anadromous fish. However, water quality is severely degraded by sediment from agricultural return flows. Lower Wilson Creek also degrades the water quality of the Yakima River within the mixing zone at the confluence (Yakama Nation, et al., 1989a).

4.3 NACHES SUBAREA

The Naches Subarea consists of the Naches River, the major tributary of the Yakima River. The Naches River drains about 1,100 square miles and discharges from the west into the Yakima River (RM 116.3) where the Yakima River exits from Selah Gap to the northeast of

the city of Yakima. River mile locations of major physical features discussed in this section are summarized in Table 4-7.

Table 4-7.—River Mile Locations for the Naches Subarea

Feature	River	River Mile
Little Naches River-Bumping River Confluence (Origin of Naches River)	Naches	44.6
Cliffdell	Naches	40.5
Wenatchee National Forest boundary	Naches	37.5
Rattlesnake Creek	Naches	27.8
Naches-Selah Irrigation District diversion	Naches	18.4
Tieton River	Naches	17.5
Wapatox Diversion Dam	Naches	17.1
Naches River near Naches gauge	Naches	16.8
PP&L Powerplant Discharge	Naches	9.7
Naches-Cowiche Diversion Dam	Naches	3.6
Cowiche Creek	Naches	2.7
Naches River near Yakima gauge	Naches	0.1
Naches River mouth	Yakima	116.3

A high-gradient stream with an average streambed slope of 36 feet per mile, the Naches River is shallow with a streambed composed mostly of cobble and large gravel with some boulders, sand, and silt. Elevation of the Naches River ranges from 2,560 feet at the origin (confluence of the Little Naches and Bumping Rivers) to 1,070 feet at the mouth. Headwaters of the Little Naches River is located at an elevation of 6,000 feet (USGS, 1996). Major tributaries include Rattlesnake Creek and the Tieton River. The American River is a tributary of the Bumping River and joins that stream just downstream of Bumping Lake Dam.

About one-fourth of the Yakima Project storage capacity is located in the Naches Subarea: Bumping Dam and Bumping Lake (33,700 acre-feet) on the Bumping River, Tieton Dam and Rimrock Lake (198,000 acre-feet) on the Tieton River, and Clear Creek Dam and Clear Lake (5,300 acre-feet) on Clear Creek, a tributary to the Tieton River.

The Naches Subarea is located entirely in Yakima County; the primary incorporated area is the city of Naches which has a population of less than 1,000 (for this discussion the city of Yakima is considered to be in the Middle Yakima Subarea). Primary agricultural crops are irrigated pasture and apple orchards.

Irrigated areas are generally located along both sides of the lower 18 miles of the Naches River. Irrigated lands of the Yakima-Tieton Irrigation District, which obtains its water supply from the Tieton River, are located on the high bluff on the south side of the Naches River.

Irrigation in the Naches Subarea generally begins in early April with diversion of unregulated flows from the Naches and Tieton Rivers. The return flows from Naches River diversions generally enter the Naches River. However, the major portion of lands irrigated by the Naches-Selah Irrigation District are within the Middle Yakima Subarea. The return flows from these irrigated lands reenter the Yakima River upstream of the confluence of the Naches River. Some surface return flows from the Yakima-Tieton Irrigation District enter Cowiche Creek and flow into the Naches River, while other return flows enter Wide Hollow Creek which joins the Yakima River downstream of the Naches River confluence.

4.3.1 Instream Flows for Fish and Wildlife

The upper 27 miles of the Naches River is one of the best spawning reaches in the Yakima River basin. This reach contains abundant spawning gravel beds interspersed with deep, clear resting pools. This upper reach is used for spawning and rearing by spring chinook and steelhead and could also be used for spawning and rearing coho (Yakama Nation, et al., 1989a). Flows in the upper reach of the Naches River are seldom too low to cause a problem.

River flow below Bumping Dam is generally at a maximum during runoff from the upstream watershed in early spring. Flow below Tieton Dam generally reaches a maximum during flip-flop operation (early September to mid-October). At that time, the majority of the stored water for diversion by the Wapato Division and the Sunnyside Division is released from Rimrock Lake. Bumping Lake is also operated to meet irrigation demands at that time but releases are limited because of the small storage capacity.

The reach of the Naches River from the Tieton River to the mouth of the Naches River has excellent potential for chinook spawning and rearing and fair to good potential for coho and steelhead spawning and rearing. This reach is moderately braided with many good gravel bars and a good riparian corridor. There is however, a lack of riparian cover downstream of the Naches-Cowiche Diversion Dam (Yakama Nation, et al., 1989a).

At the end of the irrigation season in mid-October, reservoir discharges are adjusted to the minimum needed for streamflow maintenance in the Tieton River and to cover the redds in the Bumping River with flowing water. At this time of the year, flows in the Naches River and these two tributaries are generally at their lowest annual levels, being comprised mostly of minimum reservoir releases, naturally occurring low inflow from unregulated tributaries, and surface and subsurface return flows.

Instream flows in this lower reach are generally good except for the 7.4-mile section between Wapatox Diversion Dam and the Pacific Power and Light Company (PP&L) powerplant discharge. Under the "limiting agreements," PP&L has a right to divert 300 cfs of natural flow of the Naches River and up to a maximum of 450 cfs if the rights of other senior diverters and users are satisfied. Reclamation is not obligated to provide water from storage for PP&L diversion. When flows are available and senior rights are not adversely impacted, Reclamation may allow diversions of greater than 450 cfs. This is most likely to occur when releases are made from storage to meet irrigation demands downstream from the powerplant discharge.

Flows in this 7.4-mile section can be too low for adult passage and significant juvenile rearing from July until the flip-flop operation is implemented in early September. This period of low flows coincides with much of the spring chinook spawning period in the Naches drainage. After the irrigation season instream flows can remain low through January.

The Naches River from Wapatox Diversion Dam to Cowiche Creek is the principle steelhead producing area in the Naches Subarea.

Mean monthly flows for the period 1986 through 1995, for the Naches River at Cliffdell, the Tieton River just downstream of the Yakima-Tieton Irrigation District diversion, the Naches River near Naches, and the Naches River near Yakima are shown in Figure 4-3.

There are a number of problems resulting from river management and flows which adversely affect fish and wildlife in the Naches Subarea. The most important are discussed below.

4.3.1.1 Flows in Naches River From Wapatox Diversion Dam to PP&L Powerplant Discharge

Problem—Seasonal Low Flows—Streamflows in this 7.4-mile reach are critically low for optimal rearing and adult passage from July until flip-flop operation begins in September. During this period Naches Subarea reservoirs retain water to the maximum extent. PP&L voluntarily reduces diversions to maintain instream flows at approximately 125-150 cfs below its point of diversion. Up to 100 cfs can be diverted by four other major diversions (Foster-Naches Ditch, Clark, South Naches Channel, and Kelly-Lowery) below Wapatox Diversion Dam.

Combined PP&L diversions and downstream diversions result in typical summer flows at the Naches Bridge of 50 to 100 cfs; at times lower flows have been observed. Low flows also occur after mid-October because of diversions for hydroelectric generation.

Large woody debris, other instream cover associated with channel margins, and side channels are important components of rearing habitat for spring chinook and other salmonids. These

habitat features are dewatered at these typical flows. Rearing fish may become stranded or isolated and subject to predation.

While there is concern that summer low flows could have significant serious adverse impacts on the food chain and primary productivity of this reach, that effect has not been quantified in this reach. Aquatic invertebrates, which are the primary food of juvenile salmonids, can be impacted through dewatering of channels and increases in temperature above tolerances. If this occurs, productivity of this reach will be reduced even after flows return because of the time required to recolonize the habitat.

Problem—Hourly and Daily Flow Fluctuations—Abnormal rapid hourly and daily fluctuations in flow have been noted in this reach. Relatively small fluctuations in discharge can result in large changes in the width of the river where the channel is complex. Shoreline shallow water habitats and flow in side channels are adversely affected. Fry prefer and actively seek brush and woody debris along the margins of the channel and side channels for early rearing. Impacts from flow fluctuations, particularly abrupt decreases in flow, are particularly a concern in this reach because portions are characterized by complex instream habitat and channel shape, including side channels and gravel bars.

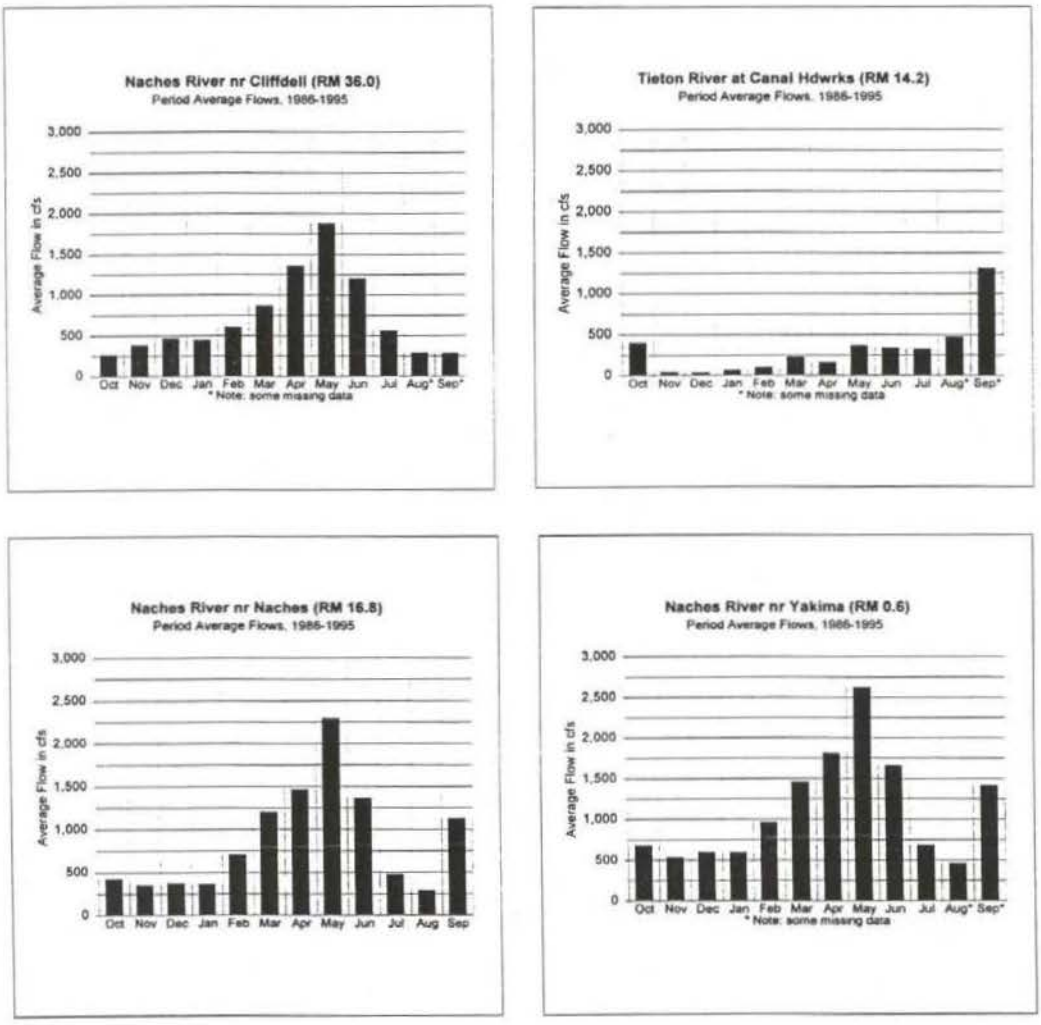


Figure 4-3.---Naches River Average Monthly Flow (Naches Subarea)

Although juvenile fish are better swimmers and less subject to stranding than fry, juvenile fish rearing along the river margin and in side channels are still at risk of isolation or stranding by flow fluctuations throughout the year. Fluctuations which result in alternate watering and rapid dewatering of side channels and micro habitat features place juvenile salmonids at high risk of mortality.

Any rapid increase in flow when flip-flop is implemented can also be a problem for rearing fish in this reach. Because summer low flows dewater typical juvenile rearing habitat in side channels and the river margins, those surviving fish which managed to rear in this reach have relocated within the main channel. Any rapid increase in velocity in the main channel at flip-flop could cause these fish to again relocate to other sites. At flip-flop, flows can go from less than 100 cfs to as high as 2,500 cfs. If unoccupied rearing habitat is not available downstream, these fish will be vulnerable to predation and increased mortality.

Steelhead smolts, which tend to rear in mid-channel, are at a particular disadvantage when flows abruptly change.

4.3.1.2 Flows in Headwaters and Tributary Streams

The Little Naches River is an unregulated stream with some production potential for spring chinook, coho, and steelhead. Prior to 1988, the Little Naches River was a minor spring chinook producer, with moderate amounts of spawning in the lower 4.4 miles downstream of Salmon Falls. With the construction of a fishway at Salmon Falls in 1988, and an extensive instream restoration project, about 18 miles of habitat suitable for spring chinook, steelhead, and coho became available. Spawning gravel in this upper reach is abundant, the riparian zone is excellent, and flows are generally adequate. One limiting factor may, however, be rearing habitat during late summer when instream flows diminish. At the present time this newly opened habitat is not fully colonized.

The American River, an unregulated tributary, is an important spawning area for spring chinook and a potential spawning area for coho and steelhead. The spring chinook in the American River are a unique genetic stock of five year-old fish, distinct from spring chinook in the remainder of the Naches River and the Upper Yakima River. While spawning habitat in the lower reach of the American River is constrained by the steep grade, large boulders, and fallen trees, the middle and upper reaches have abundant spawning gravel and protected resting pools.

A substantial number of spring chinook spawn in the Bumping River, and there is potential for steelhead spawning.

The Tieton River was historically a major producer of spring chinook, steelhead, and probably coho prior to construction of Tieton Dam; however, the dam, precludes access to upstream spawning areas. The combination of Tieton Dam capturing large organic debris and bedload and sustained high flows during flip-flop has caused substantial armoring and simplification of the channel downstream from Tieton Dam. As a result, the spawning and rearing habitat have been degraded, and the present productivity of this reach is questionable.

Cowiche Creek appears to have productive spawning and rearing habitat for steelhead and coho. Streamflows of the mainstem and the South Fork appear adequate to support rearing. Riparian vegetation is dense, and there are enough gravel bars for spawning. Lower Cowiche Creek and a number of intersecting canals are used in most years as off-channel winter refuges for pre-smolt spring chinook and steelhead. The major problems in the Cowiche Creek drainage are migration barriers, low flows in the North Fork, and some riparian degradation on the North and South Forks. It appears that Cowiche Creek could be a major producer of steelhead and coho and a minor producer of spring chinook, if adult passage were improved.

4.3.2 Irrigation Water Supply

Much of the irrigation development in the Naches Subarea occurred before the turn of the century. Diversion and conveyance works were constructed primarily by private water companies to use Naches River water on the valley lands. Most of the diversions are relatively small in relation to flow (less than 75 cfs) and annual quantity (less than 28,000 acre-feet). The largest diversions directly from the Naches River are the Naches-Selah Irrigation District diversion for irrigation and PP&L diversion for hydroelectric generation.

The largest diversion in the Naches Subarea is from the Tieton River at Tieton Diversion Dam (about 7 miles downstream from Tieton Dam) by the Tieton Division. The diversion, conveyance, and distribution facilities of this division, originally constructed by Reclamation as a part of the Yakima Project, are operated and maintained by the Yakima-Tieton Irrigation District.[1] There are also several small diversions from the Tieton River.

Table 4-8 summarizes the irrigable lands, the diversion points, and the diversion capacities at the headworks for some entities in the Naches Subarea.

[1] The Yakima-Tieton Irrigation District completed an extensive upgrade of its facilities in the 1980's, converting its distribution facilities to a closed-pipe pressure system.

Table 4-8.—Lands, Diversion Points, and Headworks Capacities of the Naches Subarea			
Entity	**Irrigable Lands (Acres)**	**Diversion Location On Naches River (River Mile)**	**Headworks Capacity (cfs)**
Naches-Selah Irrigation District	10,600	18.4	145
Wapatox Ditch Company	2,600	17.1	[1]525
Pacific Power & Light Company	Hydroelectric	17.1	[1]525
South Naches Irrigation District	1,700	14.0 & 14.9	130
Naches-Cowiche Irrigation District	1,800	3.61	40
Naches-Union Irrigation District	1,600	2.5	60
Yakima-Tieton Irrigation District	27,900	Tieton River 14.4	350

[1]The Wapatox Ditch Company uses 50 cfs, the remainder is used by PP&L

The annual water entitlements of some irrigation entities are shown in Table 4-9.

Table 4-9.—Annual Water Entitlements (April-October) of the Naches Subarea			
Entity	**Entitlement (Acre-Feet)**		
	Non-proratable	**Proratable**	**Total**
Naches-Selah Irrigation District	49,658	4,486	54,144
Wapatox Ditch Company	20,230	0	20,230
South Naches Irrigation District	17,597	0	17,597
Naches-Cowiche Irrigation District	15,096	0	15,096
Naches-Union Irrigation District	22,319	0	22,319
Yakima-Tieton Irrigation District	75,865	34,835	110,700
Total	200,765	39,321	240,086

The majority of the irrigation entities in the Naches Subarea have non-proratable entitlements which, to date, have resulted in a full water supply in all years. While the Yakima-Tieton Irrigation District does have proratable entitlements, the extensive system upgrade which it completed in the 1980's, has improved the reliability of its irrigation water supply.

4.3.3 Water Quality

The American River, Bumping River, and the Naches River and all its tributaries from the Wenatchee National Forest boundary to the headwaters are designated Class AA. The remainder of the Naches River and those tributaries not within the Wenatchee National Forest are Class A (YVCOG, 1995).

The Little Naches River, American River, Bumping River, and Rattlesnake Creek are all listed for temperature exceedances. The Naches River from the confluence of the Bumping and Little Naches Rivers to the Tieton River, the Tieton River, and Cowiche Creek show temperature and other exceedances such as fecal coliform (EPA, 1998).

The Naches River from the Tieton River to the mouth does not fully support its Class A designation. Exceedances include pH, temperature, fecal coliform, and silver (EPA, 1998).

The Naches River and its tributaries do not appear to have water quality problems which would constrain anadromous fish production.

The Naches River accounts for less than one-third of the increase in phosphorus and nitrogen loads that occur in the Yakima River between Umtanum and Union Gap. In fact, Naches River flows dilute nutrient concentrations of the Yakima River.

4.4 MIDDLE YAKIMA SUBAREA

The Middle Yakima Subarea covers 36.6 river miles from the gauging station on the Yakima River just upstream of the mouth of Umtanum Creek to Sunnyside Diversion Dam. In this subarea, the Yakima River has a high gradient with an average stream bed slope of 11 feet per mile. The river is shallow and the stream bed is composed mostly of cobble and large gravels with some boulders, sand, and silt (USGS, 1996). River mile locations of major physical features discussed in this section are summarized in Table 4-10.

Table 4-10.—River Mile Locations for the Middle Yakima Subarea

Feature	Yakima River Mile
Gauge at Umtanum	140.4
Umtanum Creek	139.8
Roza Diversion Dam (Roza Canal)	127.9
Pomona	123.5
Wenas Creek	122.4
Naches River	116.0
Wasteway 2 (Outfall of Roza Powerplant)	113.3
Wide Hollow Creek	107.4
Moxee Drain	107.3
Ahtanum Creek	106.9
Wapato Diversion Dam (New Reservation Canal)	106.7
Sunnyside Diversion Dam (Sunnyside Canal)	103.8
Parker gauge (Lower Yakima Subarea)	103.7

This subarea is located in Kittitas and Yakima Counties. The cities of Ellensburg and Yakima, with populations of about 14,000 and 60,000 respectively, are the county seats.

The major tributary to the Yakima River in the Middle Yakima Subarea is the Naches River. Other tributaries are Umtanum Creek, Wenas Creek, Wide Hollow Creek, and Ahtanum Creek, all entering the Yakima River from the west.

Diversion points for the Roza Irrigation District and part of the Selah-Moxee Irrigation District are upstream of the confluence of the Naches River. These irrigation districts can be supplied water by gravity only from the Upper Yakima Subarea.

The Middle Yakima Subarea is divided into the Moxee Valley portion, where return flows from irrigating lands from Yakima River diversions enter the river upstream of Sunnyside Diversion Dam, and the residual Middle Yakima portion, where diversions are from the Yakima River but the major portion of return flows enter the river downstream of Sunnyside Diversion Dam.

The majority of irrigated lands in the Middle Yakima Subarea are on the east side of the Yakima River. Several irrigation entities such as the Selah-Moxee Irrigation District and the Union Gap Irrigation District divert from the Yakima River to irrigate lands in the Moxee Valley portion.[1] A portion of the diversions of the Roza Irrigation District are provided to higher-lying lands in the Moxee Valley portion which is served by gravity and pumped deliveries from the Roza Main Canal. Return flows from these irrigated lands enter the Yakima River upstream of Sunnyside Diversion Dam. Major crops in the Moxee Valley portion are apples and hops.

Diversions are also made from Ahtanum Creek to irrigate lands lying on both sides of the creek. The return flows from this irrigation enter Ahtanum Creek. A portion of the irrigated lands are in the Yakama Indian Reservation. Major crops are irrigated pasture and hay.

4.4.1 Instream Flows for Fish and Wildlife

About one-half of the Yakima River in the Middle Yakima Subarea flows within the Yakima River Canyon. The magnitude of flows in this reach during the irrigation season, upstream of Pomona are influenced by the flip-flop operations resulting in high flows prior to September, when irrigation stored water demands downstream of the Naches River are met from the three upper Yakima River reservoirs. After September when the irrigation demands are provided from the reservoirs in the Naches River drainage, flows in this reach are significantly lower. This flip-flop operation impacts the extent of habitat availability. In the reach from Selah Gap to Sunnyside Diversion Dam, the river is more braided and contains a good series of riffles and pools. Riparian vegetation is generally good except for an 8-mile section (RM 114.0-122.0)

[1] The Union Gap Irrigation District also provides water to lands in the Lower Yakima Subarea up slope of the initial reach of the Sunnyside Main Canal.

which has been adversely affected by construction of the interstate highway and dikes and by livestock grazing.

The primary importance of this reach for anadromous fish is overwintering habitat for spring chinook and steelhead; however, spawning and rearing of spring chinook and steelhead are also significant. This reach also has potential for summer chinook and some coho spawning and rearing.

Water is diverted to the Roza Main Canal at Roza Diversion Dam to irrigate the Roza Division and to generate hydroelectric power at the Roza Powerplant. At present, diversions for hydroelectric generation at Roza Powerplant are subordinated (reduced) whenever a target instream flow of 400 cfs past Roza Diversion Dam would not otherwise be met. Subordination occurs primarily about the beginning of September when the flip-flop operation is implemented through late fall and early winter. Whenever streamflows exceed the target by 200 cfs (a minimum flow of 200 cfs is required to operate the powerplant), the flow in excess of the target can be diverted for hydroelectric generation. Roza Powerplant operates through the winter except when extreme low temperatures cause icing problems.

Downstream of the Naches River, high flow velocities during June and July may adversely impact rearing steelhead. Low flows in late fall and winter adversely affect the amount of habitat available for spring chinook and steelhead.

Mean monthly flows for the period 1986 through 1995, in the Yakima River at the gauge just upstream of the mouth of Umtanum Creek, just downstream from Roza Diversion Dam, at the Terrace Heights Bridge, and at the Parker gauge immediately downstream of Sunnyside Diversion Dam are shown in Figure 4-4.

There are a number of problems resulting from river management and flows which adversely affect fish and wildlife in the Middle Yakima Subarea. Some of the most important are discussed below.

4.4.1.1 Flows in Yakima River From Naches River Confluence to Union Gap

Problem—Riparian Zones and Sustained High Flows—This reach is crucial for juvenile steelhead and spring chinook as it is the farthest reach downstream where summer water temperatures remain low enough for rearing of salmonids. Unfortunately, the velocity in this reach is high during the irrigation season and the opportunity for fish to escape the main channel of the river is limited as the Yakima River flows between dikes in this urbanized reach. Side channels, backwater areas, and complex riparian areas are greatly reduced from historic conditions.

An increasing body of evidence indicates that salmonid population densities increase in proportion to the hydraulic complexity created by a matrix of large organic debris (Yakama Nation, et al., 1990). Lack of riparian zone width, large woody debris, and side channel complexity is particularly a problem for chinook and coho which rear in closer association with woody debris than steelhead.

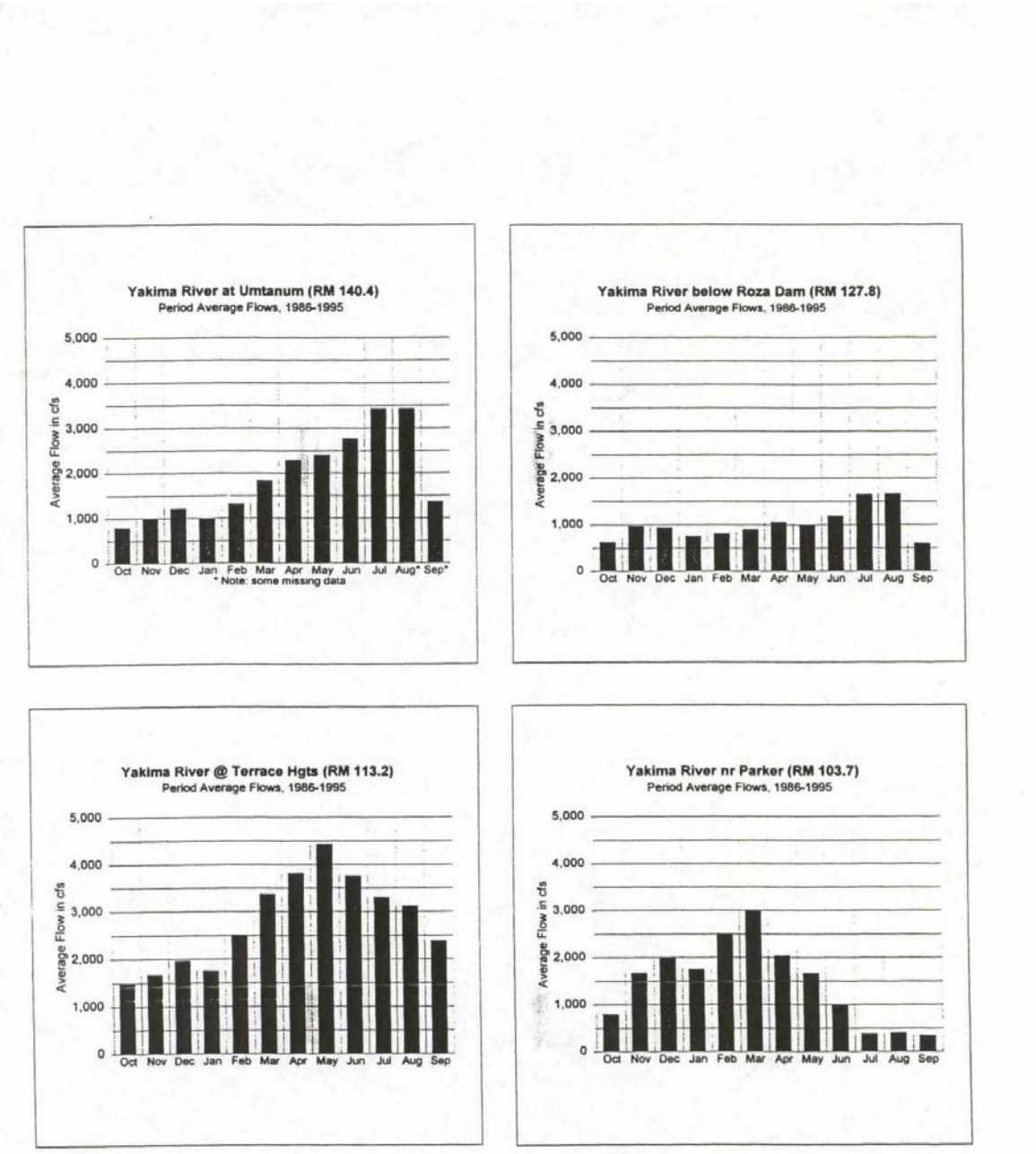


Figure 4-4.---Yakima River Average Monthly Flow (Middle Yakima Subarea)

Sustained high velocity flows in this reach are a problem especially for steelhead parr which tend to rear in mid-channel. Cover is needed for all salmonid life stages from emergent fry to overwintering juveniles.

4.4.1.2 Flows in Tributary Streams

Umtanum Creek drops over an impassable falls, located about 8 miles from the mouth, flows through rugged and arid terrain, and enters the Yakima River from the west. The deciduous and bushy riparian habitat has recovered significantly from prior grazing impacts. Rearing habitat for coho and steelhead appear excellent, and spawning gravel is present in most areas. The primary factor limiting anadromous fish production in this stream is low summer flows.

Wenas Creek flows from the west to join the Yakima River as it discharges from the canyon. At present, Wenas Creek has very little potential for anadromous fish production due to low flows in the lower 9 miles caused by irrigation withdrawals. There is also extensive riparian damage; however, there may be opportunities for stream restoration.

Wide Hollow Creek flows through the city of Yakima and surrounding orchard lands before entering the Yakima River from the west. Summer streamflows appear good but the riparian corridor is patchy, seriously degraded, channelized, and over grazed in some areas; the corridor is relatively intact in other areas. It appears that this stream could provide good coho and steelhead rearing habitat in many reaches, but spawning gravel may be deficient. Water quality and degraded riparian and floodplain conditions are identified problems.

Ahtanum Creek enters the Yakima River from the west. Ahtanum Creek originates near Tampico at the confluence of the North and South Forks which have lengths of 23 miles and 15 miles respectively. Ahtanum Creek flows for 23.1 miles to enter the Yakima River about 1 mile south of Union Gap.

Summer flows in the North and South Forks are unregulated and adequate to support anadromous fish. However, flows downstream (Ahtanum Creek) are heavily diverted during the irrigation season. Until July 10, the Ahtanum Irrigation District is allowed to divert 75 percent of the natural flow (up to 46.96 cfs) to irrigate lands north of Ahtanum Creek. During this period, the Wapato Irrigation Project receives the remaining 25 percent of natural flow, plus any flows in excess of 62.59 cfs that can be beneficially used.

After July 10, the Wapato Irrigation Project is entitled to divert water to meet all of its needs with any extra flows then being available to Ahtanum Irrigation District. Due to the declining runoff of the watershed there is little extra flow and essentially all of Ahtanum Creek flow is diverted at RM 19.7 to the Wapato Irrigation Project to irrigate Yakama Indian Reservation lands to the south (YVCOG, 1995). At this time, the Ahtanum Irrigation District must rely upon wells for its water supply. Because of the short water supply, most of the irrigated lands

in the Ahtanum Irrigation District are planted in pasture, hay, and grain. In mid-October, water is again available for the Ahtanum Irrigation District and the lands on the north side of the creek for irrigation before winter.

Ahtanum Creek has potential for producing steelhead, spring chinook, and coho salmon if instream flow and passage problems were addressed.

4.4.2 Irrigation Water Supply

Early development of irrigation facilities in the Middle Yakima Subarea was prior to 1900. Initial diversion and conveyance facilities of the current Sunnyside Division date to 1878 when the Konewock Ditch was constructed. The Union Gap Irrigation District, the Selah and Moxee Irrigation District, and the Moxee-Hubbard Irrigating Company succeed early private irrigation development efforts in the late 1880's and early 1890's. The Selah and Moxee Irrigation District and the Moxee-Hubbard Irrigating Company consolidated in early 1995, to form the Selah-Moxee Irrigation District.

The first major canal on the Yakama Indian Reservation, the Old Reservation Canal, was constructed in 1897. Its headworks was in a slough on the right bank of the Yakima River where the Sunnyside Diversion Dam was constructed. The New Reservation Canal was constructed in 1917, with a headworks capacity of 1,000 cfs. Subsequently the canal was enlarged to 2,200 cfs to irrigate over 100,000 acres.

In 1905, Reclamation purchased the Sunnyside Canal from its owner, the Washington Irrigation Company. The canal capacity at that time was about 650 cfs and provided water to about 40,000 acres. In the fall of 1906, Reclamation started construction on the Sunnyside Diversion Dam and the enlargement of the Sunnyside Main Canal. At present, the headworks capacity is 1,300 cfs, and the canal provides water to over 103,000 acres.

Water was first delivered to lands of the Roza Division in 1941. Roza Diversion Dam, conveyance and distribution facilities, and Roza Powerplant were constructed by Reclamation.

The largest diversions in the Middle Yakima Subarea are by the Roza Division, Wapato Irrigation Project, and the Sunnyside Division. The operation and maintenance of diversion, conveyance, and distribution facilities of the Roza Division and Wapato Irrigation Project are by the Roza Irrigation District and the Bureau of Indian Affairs, respectively. Reclamation operates and maintains Roza Powerplant. The diversion dam and the main canal of the Sunnyside Division is operated by the Sunnyside Valley Irrigation District acting on behalf of a Board of Control comprised of seven irrigation districts. Facilities required to distribute water from the main canal to lands within each irrigation district are operated and maintained by the respective districts.

Roza Main Canal conveys water 11 miles for hydroelectric generation at the Roza Powerplant. Bifurcation works at mile 11 diverts flows for hydroelectric generation. The powerplant, consisting of one 11,250-kilowatt unit, provides energy to 18 canal side pumps that lift water from the main canal to irrigate up-slope lands within the Roza Irrigation District. Residual energy is marketed by the BPA as part of the Federal Columbia River Power System. Discharge from the powerplant enters the Yakima River via Wasteway 2.

As previously discussed, Ahtanum Creek is diverted to irrigate Yakama Indian Reservation lands and other lands in the Ahtanum Creek drainage.

Table 4-11 summarizes irrigable lands, the diversion points, and the diversion headworks capacity of major entities in the Middle Yakima Subarea.

Table 4-11.—Lands, Diversion Points, and Headworks Capacities of the Middle Yakima Subarea

Entity	Irrigable Lands (Acres)	Yakima River Diversion Location (River Mile)	Headworks Capacity (Cfs)
Roza Irrigation District	72,600	127.9	[1]2,200
Selah-Moxee Irrigation District	5,400	123.9 & 115.9	90
Union Gap Irrigation District	2,800	114.7	[2]80
Wapato Irrigation Project	120,000	106.7	2,200
Sunnyside Division	103,500	103.8	1,300

[1] The design capacity of the Roza Main Canal at the bifurcation works is 1,300 cfs.
[2] Includes Fowler Ditch

Moxee Valley Portion—Return flows from lands in the Roza Division which are within the Moxee Valley portion of the Middle Yakima Subarea are used by lower-lying lands before entering the Yakima River above Sunnyside Diversion Dam. Irrigation return flows from water delivered by entities such as the Selah-Moxee Irrigation District enter the river above Sunnyside Diversion Dam. Some of the lands served by the Union Gap Irrigation District are below Sunnyside Diversion Dam.

Residual Portion—The majority of the water diverted by the Roza Division is delivered to lands lying upslope of the Sunnyside Division service area downstream of Sunnyside Diversion Dam in the Lower Yakima Subarea. Some return flows from the irrigation of these lands enter the Sunnyside Main Canal and are re-used within the Sunnyside Division; other return flows enter the river directly. The irrigated lands of the Sunnyside Division are all downstream from Sunnyside Diversion Dam in the Lower Yakima Subarea.

A small portion of the water diverted at Wapato Diversion Dam (Wapato Division) is used to irrigate Yakama Indian Reservation lands where irrigation return flows enter the Yakima River upstream of Sunnyside Diversion Dam. However, a very significant part of the diversions are used on lands downstream of Sunnyside Diversion Dam where return flows from these diversions enter the Yakima River in the Lower Yakima Subarea.

Table 4-12 shows annual water entitlements of the three largest diverters in the Middle Yakima Subarea as well as entitlements of some other entities.

Table 4-12.—Annual Water Entitlements (April-October) for the Middle Yakima Subarea

Entity	Entitlement (Acre-Feet)		
	Non-proratable	Proratable	Total
Roza Irrigation District	0	375,000	375,000
Wapato Irrigation Project	305,613	350,000	655,613
Sunnyside Division	315,836	142,684	458,520
Selah-Moxee Irrigation District	27,493	4,281	31,774
Union Gap Irrigation District	20,697	4,642	25,339
Total	669,639	876,607	1,546,246

The entitlement of the Roza Irrigation District is entirely proratable and was reduced in recent water deficient years. Its water supply was about 58 percent of the entitlement in 1992, 67 percent in 1993, and only 37 percent in 1994. The Sunnyside Division and the Wapato Irrigation Project suffered fewer severe overall reductions because some parts of their entitlements are non-proratable; however, their proratable entitlements were reduced to the same percentages as the Roza Irrigation District in 1992, 1993, and 1994.

Problem—Reliability of Irrigation Supply—The irrigation supply for the Roza Irrigation District is entirely proratable and is reduced in deficient water supply years. Although the Wapato Irrigation Project, the Sunnyside Division, and others have some non-proratable entitlements, they also have significant proratable entitlements which are reduced in deficient water supply years.

4.4.3 Water Quality

The Yakima River and all of its tributaries in the Middle Yakima Subarea are designated Class A. The Yakima River reach from the Naches River to Sunnyside Diversion Dam does not fully support the Class A designation due to the presents of ammonia, chlorine, pesticides, fecal coliform, and mercury (EPA, 1998).

Nutrient concentrations in the Yakima River increase significantly in the Middle Yakima Subarea. Dilution from the Naches River flow and the Roza Powerplant return flow reduce the concentration of nutrients. Although representing only 14 percent of the Yakima River basin drainage area, the drainage area between Umtanum and Union Gap contributes a phosphorus load equal to 38 percent of the phosphorous load at the Kiona gauge (RM 29.9) at Benton City. However, the diversions at Wapato Diversion Dam and Sunnyside Diversion Dam reduce the potential impact of this phosphorus contribution.

Wide Hollow Creek and Moxee Drain do not meet the Class A standards. Parameters exceeding the standards were DDT, temperature, dissolved oxygen, and fecal coliform; pH standards were also exceeded for Moxee Drain. The Moxee Drain has been identified as one of the priority areas requiring more immediate attention to reduce sediment loading in the Yakima River (Ecology, 1997).

Problem—Water Quality of the Yakima River From Naches River to Sunnyside Diversion Dam and Drains—The water quality of the Yakima River reach from the Naches River to Sunnyside Diversion Dam and the quality of flows in Wide Hollow Creek and the Moxee Drain do not meet Class A standards.

4.5 LOWER YAKIMA SUBAREA

The Lower Yakima Subarea extends for 103.8 river miles from Sunnyside Diversion Dam to the confluence of the Yakima and Columbia Rivers. The streambed has an average slope of 7 feet per mile and has a substrate, in the higher gradient portions of this reach, similar to that of the Upper and Middle Yakima Subareas. River mile location of features discussed in this section are summarized in Table 4-13.

Table 4-13.—River Mile Locations for the Lower Yakima Subarea	
Feature	**Yakima River Mile**
Sunnyside Diversion Dam	103.8
Parker Gauge	103.7
Granger Drain	82.8
Marion Drain	82.6
Toppenish Creek	80.4
Satus Creek	69.6
Sulphur Creek	61.0
Yakima-Benton County Line	53.1
Prosser Diversion Dam	47.0
Spring/Snipes Creeks	41.8
Discharge of Chandler Power Canal	35.8
Kiona Gauge	29.9
Horn Rapids Dam	16.0

Most of the Lower Yakima Subarea is in Yakima County; however, the lowermost portion, beginning about midway between the cities of Mabton and Prosser is within Benton County. The major population areas are the city of Kennewick with a population of 45,000, the city of Prosser with 4,500, and West Richland with 4,000. The Yakama Indian Reservation, situated on the west side of the Yakima River and encompassing over 1 million acres, comprises almost half of the land area in the Lower Yakima Subarea. Agricultural production in this subarea include apples, pears, wine grapes, hops, mints, row crops, and livestock for beef and milk.

The largest tributaries to the Yakima River in the Lower Yakima Subarea are Marion Drain, Toppenish Creek, and Satus Creek, all entering from the west from the Yakama Indian Reservation, and Sulphur Creek and Spring/Snipes Creeks which flow in from the east. All of these tributaries and drains have been modified with constructed channels and networks to provide irrigation water to adjoining lands (Ecology, 1997).

The largest diversion is to the Chandler Power Canal at Prosser Diversion Dam. This canal conveys water to the Chandler Power and Pumping Plant. Hydraulic pumps lift some of the water to fill the Kennewick Division Main Canal for irrigation, and some water is used for hydroelectric generation at the Chandler Powerplant. Water used to power hydraulic pumps and the hydroelectric generators is discharged to the Yakima River about 11.2 miles downstream from Prosser Diversion Dam. Title XII authorizes installation of electric pumps to replace the hydraulic pumps that lift water to the Kennewick Main Canal.

Diversions from the Yakima River in the Lower Yakima Subarea are provided from unregulated flows and return flows. Stored water is not released from Yakima Project reservoirs for diversions downstream of Sunnyside Diversion Dam.

4.5.1 Instream Flows for Fish and Wildlife

The importance of this 103.8-mile reach to anadromous fish is emphasized in Title XII by direction that the Yakima Project is to be operated to meet specific interim instream target flows over Sunnyside and Prosser Diversion Dams during the irrigation season. Further, these interim instream target flows are to be increased as diversions are reduced through implementation of water conservation measures and by water purchases and leases.

Riffles, pools, and multiple channels are common in the Yakima River reach from Sunnyside Diversion Dam to Satus Creek, and gravels comprise a larger portion of the substrate than downstream to the mouth. Although instream cover is scarce, the riparian corridor has a reasonably dense stand of trees and can be classed as fair to good (Yakama Nation et al., 1990). Low gradient riffle and run habitats dominate this reach. Flow fluctuations, low streamflows, and poor water quality reduce the quality of anadromous fish habitat in this reach.

The Yakima River from Prosser Diversion Dam to the mouth is the passage corridor for all salmonid species moving to and from all upstream areas. Streamflows and water quality in this reach have the potential to influence anadromous fish production in the entire Yakima River basin.

In addition to passage, anadromous salmonid fish use of the river downstream from Prosser Diversion Dam includes fall chinook spawning, incubation, and rearing and overwintering of spring chinook and steelhead. While fall chinook do spawn between Sunnyside and Prosser Diversion Dams, the majority of spawning occurs between Prosser Diversion Dam and the Horn Rapids Dam. The lowest 2-6 miles of the Yakima River are inundated by the McNary Pool, a reservoir on the Columbia River which fluctuates with McNary Dam operations.

At times, water quality, particularly high water temperatures, makes much of the lower Yakima River unsuitable for salmonids, acting as a barrier to both upstream and downstream migration. During July and August, water temperature can exceed 75 degrees Fahrenheit (°F) which constitutes at least a partial thermal block to late summer spawning runs of adult anadromous fish and movement of rearing and migrating juveniles (Yakama Nation, et al., 1990).

Lichatowich et al., 1995, theorized that under pre-development conditions, higher flows, a complex floodplain and inflow of cool water from the hyporheic zone would have mitigated the natural warming of the lower river in summer. Further, regional patterns of hyporheic flow appear to be critical to rivers of the high desert of the Columbia plateau such as the Yakima River where late spring, summer, and early fall instream temperatures are often too high for

salmonids. Relative to surface temperatures, ground water from the hyporheic zone is cool in the summer and warm in the winter. The up welling zones provide cool refuge for salmonids and may lower the temperature of the entire stream. In addition, up welling may raise the temperature of some areas or reaches in the winter, which allows higher growth rates during the winter.

Other aspects of water quality may also influence the production of salmon in the lower Yakima River. There is a presumed problem of too much fine sediments in the gravels which otherwise would be suitable for fall chinook spawning. Although a survey of particle size distribution of substrate materials in the lower river has never been conducted or quantified, qualitative observations by Tribal and State biologists suggest that fine sediment is a problem, especially between Union Gap and Kiona.

Mean monthly flows of the Yakima River for the period 1986-1995, at the Parker, Prosser, and Kiona gauges are shown in Figure 4-5.

There are a number of problems resulting from river management and flows which adversely affect fish and wildlife in the Lower Yakima Subarea. Some of the most important are discussed below.

4.5.1.1 Flows in Yakima River From Sunnyside Diversion Dam to Chandler Powerplant Discharge

Problem—Base Flow Over Sunnyside Diversion Dam—Adequate instream flow is needed downstream from Sunnyside and Prosser Diversion Dams during the irrigation season to meet anadromous fish needs. This is particularly critical during the storage control period when the Yakima River system is being regulated to meet irrigation diversions.

Problem—Additional Flow Needed During Out-migration—Additional flows to supplement base flows are desirable in this reach during April to June as high flows appear to enhance spring chinook smolt survival by reducing travel time and diminishing predator mortality (Yakama Nation, et al., 1990).

Problem—Hourly and Daily Flow Fluctuations—Relatively small fluctuations in discharge can result in large changes in the width of the river where the channel is complex. Abnormally rapid flow decreases in particular are a concern in this reach because portions are characterized by complex channel shape, including side channels and gravel bars, and instream habitat features.

Growth and survival of salmonids will be impaired in a river with rapidly fluctuating flows. Such conditions have been demonstrated to reduce the abundance and diversity of benthic insects preferred by salmonids (ISG, 1996). The energy costs of smoltification and out-

migration are high. Fish that arrive at the ocean in a good energy condition, i.e., have relatively high proportions of body fats, stand a better chance of surviving to adulthood.

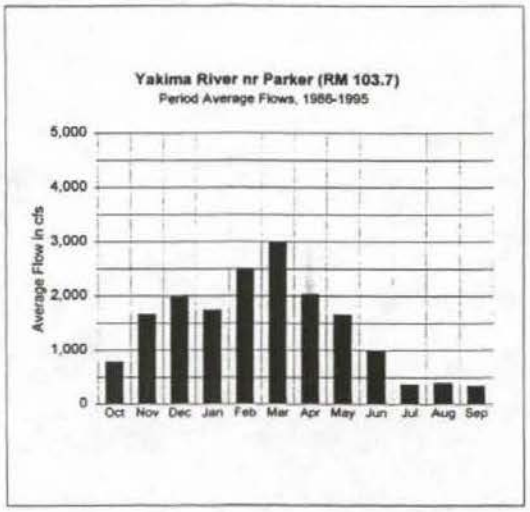
Low flows prolong the transit time for out-migrating spring chinook and steelhead smolts, decreasing energy reserves of the smolts. Fluctuating base flows reduce the productivity of shallow, low velocity habitats resulting in a varial zone along each side of the river where aquatic biota cannot live (ISG, 1996). These effects of flow fluctuations have not been specifically documented in the Yakima River basin, but are documented in other river basins.

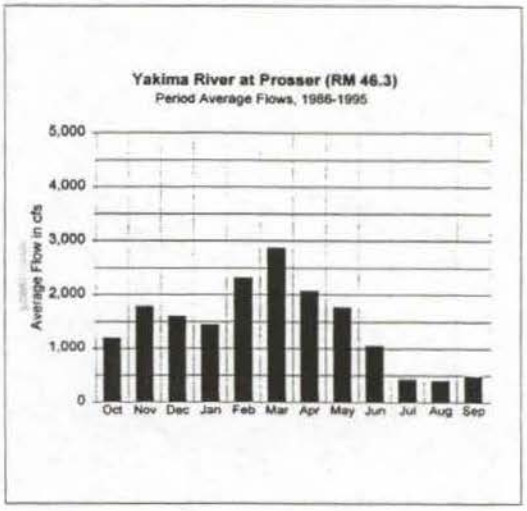
It is important for fall chinook to grow rapidly and move downstream to the Columbia River to avoid the summer temperature increases in the lower Yakima River. Adverse impacts of fluctuating flows on the food chain decreases the likelihood that fall chinook can obtain the food resources for rapid growth.

Problem—Seasonally High Water Temperatures—Water temperatures are often too high for salmonids during late spring, summer, and early fall. Late spring water temperatures in excess of 70°F have been recorded and summer temperatures at Prosser and Kiona frequently exceed 75°F and occasionally reach 80°F in July and August. These high temperatures preclude summer rearing of salmonids in the lower river. The precise downstream boundary for rearing habitat in the summer probably varies from year to year, sometimes being upriver as far as Sunnyside Diversion Dam and sometimes as far down river as Marion Drain (Yakama Nation, et al., 1990).

4.5.1.2 Flows in Yakima River From Chandler Powerplant Discharge to Columbia River

Problem—Additional Flow Needed During Out-migration—Additional flows to supplement base flows are desirable in this reach during April to June as high flows appear to enhance fall and spring chinook smolt survival by reducing travel time and diminishing predator mortality (Yakama Nation, et al., 1990).





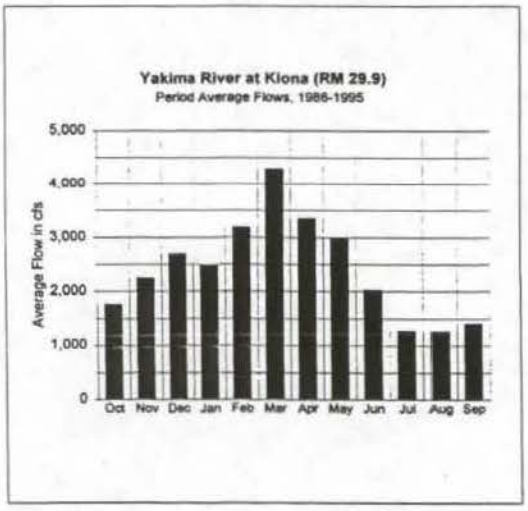


Figure 4-5.---Yakima River Average Monthly Flow (Lower Yakima Subarea)

4.5.1.3 Flows in Tributary Streams

Toppenish Creek is approximately 75 miles long, discharging into the Yakima River at river mile 80.4 near Granger. The 625-square-mile watershed comprises more than 10 percent of the Yakima River basin and lies wholly within the Yakama Indian Reservation. Simcoe Creek, a tributary with a drainage area of 141 square miles, discharges to Toppenish Creek near its midpoint. Toppenish and Simcoe Creeks flow through the lands of the Wapato Irrigation Project and both are heavily diverted by private irrigators and the Wapato Irrigation Project. Downstream reaches of both Creeks receive heavy flows of warm, turbid Project tail-water.

The Toppenish Creek watershed supports a small summer steelhead run which has generally declined over the last decade. This population appears to be genetically distinct from other populations in the Yakima River basin. Steelhead spawn and the juveniles rear primarily upstream from irrigation diversions in Toppenish Creek and the North Fork.

Channel and riparian conditions are fair to good in Toppenish and Simcoe Creeks upstream from the agricultural zone. Rain-on-snow flooding through narrow floodplains, encroached upon by roads, has heavily scoured the channels in portions of the upper watershed. Downstream in the agricultural valley, the channels and riparian corridors have suffered from diking, channelization, downcutting, and removal of vegetation and bank trampling by livestock. Fine sediment from irrigated fields settles in the lower reach during the summer.

Using a combination of redd counts and radiotagging data, the adult steelhead runs of 100 fish appears typical for the years 1989 through 1992. Since 1992, adult escapements to Toppenish Creek are likely to have followed the downward trend of adult counts at Prosser Diversion Dam and redd counts in the Satus Creek watershed.

Marion Drain parallels lower Toppenish Creek for 21 miles. This drain was excavated to facilitate drainage of irrigation tail-water from the Wapato Irrigation Project through the Toppenish Creek floodplain to the Yakima River. Marion Drain is straight, deeply incised, and lacks riparian vegetation. Flows near the mouth of the drain can exceed 500 cfs during the irrigation season, then taper off to less than 200 cfs during the winter. The two largest contributors of surface flow to Marion Drain are Wanity Slough and Harrah Drain.

Near the downstream end, most of the flow of Marion Drain is commingled with Toppenish Creek and diverted to the Satus area of the Wapato Irrigation Project. Marion Drain has captured Toppenish Creek floodflows upstream of this diversion point on several occasions, resulting in significant channel erosion.

Marion Drain is quite turbid during the irrigation season, but discharges relatively clear water in the late fall and winter when groundwater is the principal source of flow. At the end of the irrigation season, fall chinook ascend the drain to spawn. This population appears to be

genetically distinct from the population that spawn in the Yakima River. A 1992 trapping study indicated a fall chinook run of over 400 adults, but fewer than 60 were females. Relatively warm winter temperature and protection from higher winter flows and turbidity result in early fry emergence and exit to the river. This probably results in a relatively high early survival rate for Marion Drain fall chinook. A few steelhead redds have also been found in Marion Drain.

Wanity Slough is a 20-mile-long flood channel of the Yakima River which conveys irrigation water from drains west of the slough to canals on the east. During the irrigation season, the discharge of Wanity Slough is about 100 cfs near its confluence with Marion Drain. In the late fall, this flow declines by half or more. The headgate, located on the Yakima River just upstream from Sunnyside Dam, is opened each year after the irrigation season to maintain flow in the upper portion of Wanity Slough. In February 1996, Wanity Slough captured floodwaters of the Yakima River and caused significant damage in the Wapato area.

There are anecdotal reports of salmon carcasses in Wanity Slough in the early 1900's, but no recent data on anadromous fish populations. Diversions from Wanity Slough, unlike diversions from Marion Drain, are not screened to prevent fish movement into irrigation laterals.

Also lying wholly within the Yakama Indian Reservation, the Satus Creek drainage area of 612 square miles, constitutes nearly 10 percent of the Yakima River basin. Satus Creek begins at an elevation of 5,500 feet on the north slopes of the Simcoe Mountains, near the southern boundary of the Yakama Indian Reservation and flows northeast toward the lower Yakima Valley. The three largest tributaries of Satus Creek are Dry Creek, Logy Creek, and Mule Dry Creek with watershed of 158 square miles, 109 square miles, and 100 square miles respectively. About 75 percent of the watershed is shrub-steppe rangeland; the balance is forest.

Satus Creek and its tributaries no longer have active diversions; however, the lower most 8 miles of Satus Creek receives tail-water from the Wapato Irrigation Project; the water originated from Yakima River diversions. A greater share of this flow appears to be groundwater, compared to return flows in Toppenish Creek. Upstream from the Wapato Irrigation Project, Satus Creek and its tributaries have been affected mainly by grazing and riparian road building. The first large scale logging operations on the Yakama Indian Reservation took place in the upper Satus Creek watershed during the 1940's, resulting in a road system which has impacts on channel morphology, sediment loading, and riparian vegetation cover to this day. Rain-on-snow flooding, most recently in 1997, has exacerbated these impacts. Cattle have extensively grazed the Satus Creek watershed, especially riparian zones, but have recently been excluded from a significant portion of the watershed. Wild horses continue to roam the shrub-steppe uplands.

Redd counts and radiotagging data indicate that more than a third of adult steelhead returning to the Yakima River basin spawn in Satus, Dry, and Logy creeks. Annual escapement estimates have ranged from 110 to 1,157 fish since 1988, with a generally downward trend.

Sulphur Creek enters the Yakima River from the north and is a combined wasteway for the Roza Irrigation District and the Sunnyside Valley Irrigation District. It is used for drainage by several county drainage districts and the city of Sunnyside storm water system and sewerage treatment plant. Habitat is currently in poor condition due to channelization. The flow causes a false attraction problem. Discharge from the Roza and Sunnyside Valley Irrigation District wasteways creates a plunge pool where fish, attracted to the Yakima River water, repeatedly attempt to jump up to the wasteway until they are poached or become exhausted and die.

Snipes and Spring Creeks join and flow about 1/4 mile to enter the Yakima River from the north. These creeks were altered to serve as irrigation wasteways. After the irrigation season, flows in these creeks diminish significantly. Spawning gravel is scarce in both creeks, but there is some steelhead and coho spawning and rearing. Water quality is a concern because of high temperatures, suspended sediment loads, and pesticide concentrations. Habitat is currently in poor condition due to channelization, elimination of a normal, complex riparian zone, and some barriers created by irrigation facilities.

4.5.2 Irrigation Water Supply

Irrigation of lands, which are now the Kennewick Division, date to 1891, when water rights were acquired to divert water from the Yakima River near Horn Rapids for irrigation in the vicinity of the city of Kennewick. Subsequently, other development occurred in this area and the Kennewick Irrigation District, organized in 1917, to pursue the development of a larger project, proceeded to purchase the right-of-way for a canal. Through a condemnation suit, the Kennewick Irrigation District settled power water rights and acquired rights and property of facilities at what is now Prosser Diversion Dam.

The present facilities of the Kennewick Division were constructed by Reclamation with power first being generated at the Chandler Powerplant in 1956, and water first delivered to the Kennewick Irrigation District in 1957. The intake capacity of the Chandler Power Canal is 1,500 cfs. At peak irrigation demand, delivery to the Kennewick Main Canal is about 340 cfs. An additional 425 cfs (1.25 times the delivery amount) is required to operate the hydraulic pumps. A significant amount of the land now served by the district is in small suburban tracts.

The Chandler Powerplant has two 6,000-kilowatt generators. Electric generation requires a minimum of 200 cfs. Because the Chandler Power Canal lacks adequate control structures to stabilize water levels in the canal, one generator is operated at all times to absorb flow fluctuations and allow stable flow deliveries to the Kennewick Main Canal.

Prosser Diversion Dam, Chandler Power Canal, and Chandler Pumping and Powerplant are operated by Reclamation. The Kennewick Irrigation District operates and maintains the Kennewick Main Canal and distribution facilities.

The water supply for the Kennewick Division is provided through contractual arrangements between the Kennewick Irrigation District and Reclamation. The April through October contract supply is 109,275 acre-feet, delivered at the headworks of the Kennewick Main Canal. The entire amount is proratable in years of deficient water supplies. Conservation activities in Kennewick Irrigation District would reduce the risk of proration.

The Columbia and Richland Canals with headworks at Horn Rapids Dam (RM 16.0) are the most significant diversions downstream of Prosser Diversion Dam. The peak diversion to these two canals is about 280 cfs.

Return flows accruing to the river downstream from Sunnyside Diversion Dam have been generally adequate for irrigation diversions.

4.5.3 Water Quality

The Yakima River in the Lower Yakima Subarea is designated Class A. This classification is not supported due to failure to meet standards for the following: pesticides, dissolved oxygen, pH, fecal coliform, mercury, turbidity, and temperature (EPA, 1998). Temperature impacts on the anadromous fish are discussed in Section 4.5.1.

Eleven major irrigation drains with poor water quality enter the river in the Lower Yakima Subarea. Ecology (1997), reported that of the 330 tons per day of total suspended sediment load recorded in the Middle Yakima Subarea in 1995, more than half (190 tons per day) passed to the Lower Yakima Subarea during the irrigation season. However, this comprises only a third of the total suspended load of about 540 tons per day generated in the Lower Yakima Subarea. Estimates of the total suspended sediment load concentrations over the 1995, irrigation season include: Granger Drain—60 tons per day; drains and tributaries from the Yakama Indian Reservation including Marion Drain, Toppenish Creek, and Satus Creek—75 tons per day; and Sulphur Creek, the largest contributor—110 tons per day.

Problem—Poor Water Quality of Drain Flows—Eleven major irrigation drains with poor water quality enter the river in this subarea. The top five sources of sediment loading to the Yakima River introduce over 200 tons of suspended solids per day and are located between Union Gap and Spring/Snipes Creek. Sulphur Creek, which drains lands in the Roza and Sunnyside Division, is the largest contributor of suspended sediment.

4.6 PROTECT, CREATE, AND ENHANCE WETLANDS (BASINWIDE)

Wetlands, especially those in riparian and floodplain areas, are of special importance to fish, wildlife, flood management, and water quality. According to the National Wetlands Policy Forum:

> These areas are important to both the environmental and economic health of the nation. They provide habitat indispensable to a great varied array of aquatic, avian, and terrestrial wildlife. They nurture the nation's commercial and recreational fisheries. They help reduce flood damages and abate water pollution. They support many valued recreational opportunities, and they provide a number of other important functions as well.

Wetlands, riparian areas, and associated buffer areas comprise less than 5 percent of Washington's land area. Yet, this small land area is used by 80 percent of Washington's 640 terrestrial wildlife species and is important to most inland fish species including salmonids. The importance of wetlands, riparian, and floodplain areas in restoring anadromous fish runs in the Yakima River basin cannot be overstated.

The clearing and overgrazing of riparian vegetation, draining of wetlands adjacent to stream channels, and channel straightening fragmented the habitat of salmon in the mid-Columbia subbasins including the Yakima River basin (Lichatowich et al., 1995). The Yakima River is separated from the floodplain by dikes and levees throughout large portions of the basin. This severely limits movement of river water into the floodplain and recharge of wetlands and associated aquifers. These dikes and levees facilitate further degradation and filling of much wetland and side channel habitat used by rearing fish. Wetland and side channel habitat still persisting within diked floodplains is often in poor condition and inaccessible to anadromous fish.

Floodplain wetlands and side channels in complex alluvial areas provide extremely valuable rearing areas for juvenile salmonids. These complex alluvial areas are limited in location and extent—occurring at intervals along the river system like beads on a string (ISG, 1996). Unfortunately, these areas, along with their associated wetlands and side channels have been extensively altered by dikes, clearing, and channel simplification. Remaining complex alluvial areas in good functional condition for rearing of juvenile salmonids are limited in extent and location and should be specifically protected and restored. Examples of such areas include the Easton reach of the Yakima River and the Yakima River reach immediately upstream of the Yakima Canyon.

A goal of the Conservation Plan is to protect and enhance wetlands. It is expected that the implementation of some conservation measures in the Yakima River basin may result in the loss

of some wetland areas. These losses should be fully offset through integration of wetland mitigation plans within an entity conservation plan, when proposed measures are expected to result in wetland losses.

Because wetlands differ in type and the extent of beneficial functions and values they provide, it is essential in the conservation planning process to identify wetlands with notably high values that warrant special protection and to identify wetland protection, mitigation and enhancement opportunities that warrant special consideration, as described below. Assessment of wetland functions and values should be compatible with hydrogeomorphic methodology (HGM). Ecology is currently developing HGM for use in eastern Washington.

The following wetland types have exceptional values (actual or potential) for fish, wildlife, and water quality. Water conservation plans should strive to specifically protect these wetlands from adverse impacts of conservation measures:

- Category I and II wetlands (Ecology's Eastern Washington Wetland Rating System)[1].

- Floodplain wetlands and wetland complexes in continuity with the Yakima River or tributary streams.

- Wetlands which provide "connectivity." Special consideration should be given to protecting and restoring wetlands that are connected with other special aquatic sites, wetlands that could re-establish that connectivity, or wetlands that help provide a corridor of habitat for wildlife linking Yakima River riparian areas to upland areas. (The latter are typically associated with larger water courses and draws.)

It is biologically preferable for wetland protection and enhancement efforts to take place within the context of a Yakima River Basin Wetlands and Floodplain Habitat Plan (Habitat Plan). This Habitat Plan, together with a comprehensive basin wetlands banking program could then be used to mitigate some of the wetland losses in lieu of piecemeal efforts by individual entities. A Habitat Plan has yet to be developed for the Yakima River basin. While some wetlands/habitat information is available, additional data acquisition and analysis must be completed to provide a sound biological basis for the Habitat Plan.

[1] A description of the wetland categories is included in Appendix V.

5.0 POTENTIAL SOLUTIONS

Reducing diversions from the Yakima River and its tributaries is necessary to achieve the desired results of the Conservation Program. Diversion reductions are accomplished by implementation of water conservation measures to improve the efficiency of entity water conveyance and distribution (delivery) systems and individual onfarm systems and their operation and management.

The greatest results from the implementation of water conservation measures under the Conservation Program will be realized if (1) the existing delivery systems are upgraded to allow near on-demand delivery to the farm headgates and (2) onfarm systems are improved so they can be effectively managed to regulate the frequency and duration of water applications.

Ideally, subject to some maximum rate of delivery, this means the farmer has control over when water is used and for how long. The delivery system is capable of providing water on demand and absorbing flow fluctuations by temporarily holding water for release. Onfarm water savings can then be used within an entity's service area rather than being lost from the system as operational spill. The greatest reduction in diversions are thus achieved through conservation efforts directed at all components of water delivery and application systems. Conservation Program funds for onfarm water conservation measures can be included as a part of an entity's water conservation plan if a diversion reduction will result from such implementation.

Although many entity delivery systems in the Yakima River basin may not currently offer this level of flexibility, there is an opportunity to realize diversion reductions without all components having been upgraded. This Conservation Program facilitates reductions in diversions now. The Conservation Program also provides an opportunity to achieve greater reductions as water conservation improvements to these water delivery and onfarm systems are completed and their operation and management are fully integrated.

This section of the Conservation Plan outlines a range of measures that could be implemented to address some of the Yakima River basin water related problems and needs identified in section 4. These identified measures represent a menu to be considered by entities applying for funds under the Conservation Program and by Reclamation, Ecology, other governmental, tribal, and citizen organizations that seek to implement the goals of the Enhancement Project. However, the measures discussed in this section do not represent an all inclusive list of potentials.

Section 5 of the Conservation Plan is organized as follows:

Sections 5.1 - 5.2	Non-structural and structural water conservation measures applicable basinwide.
Section 5.3	Measures applicable to basinwide wetland problems.

Section 5.4	Measures for consideration in the Operating Plan.
Section 5.5	Water and Land Acquisition Program.
Sections 5.6 - 5.9	Water conservation measures applicable to specific subareas. An index of problems and potential solutions is included.

5.1 NON-STRUCTURAL SOLUTIONS

Non-structural water conservation measures are operational, management, and administrative changes that can be implemented by an entity to improve water delivery and water use efficiencies. They may not require extensive capital investment but implementation may make a significant contribution to water conservation and efficiency. Non-structural measures that require intensive water measurement may require extensive capital investment for measurement devices. A brief description of some non-structural options follows.

5.1.1 Water Measuring and Accounting System

Measuring and accounting of water use is necessary for developing a sound water management program. The most effective water measuring and accounting system is one capable of tracking the amount of water delivered to each water user and, in the case of agricultural users, to each farm field. The ideal system would provide data to farmers and irrigation entities on a real-time basis through the use of automated recording and data transmission devices so that delivery and use can be adjusted. This type of system informs both the water user and the water delivery entity of the quantity, timing, and location of water use.

CAG believes that the goal for the Yakima River basin should be the measuring and accounting of water deliveries to each farm delivery point and/or to each individual ownership wherever practicable.

Sharing of water use information among farmers is reported to promote water conservation (Laird and Dyer, 1992). Some areas where this has been effective are:

- Broadview Irrigation District in the Central Valley, California (Wichelns, 1991)
- State of Kansas (Kansas Water Office and Division of Water Resources, 1995)

5.1.2 Tiered or Multiple Block Water Rate Structures

The structure of water rates can be an effective means of encouraging efficient water use. Water rates can promote an economic awareness for farmers of their water use and its impact on the net income from their agricultural operations. Traditionally, agricultural water rates have reflected only a “fixed” charge or a “water rate” charge.

The fixed charge rate based on acreage is the simplest. The fixed charge per acre is usually assessed at the beginning of the year and all landowners are required to pay the charge whether or not they use water that year. The drawback of this rate schedule is the lack of an incentive to efficiently manage water because the cost to the farmer is the same regardless of the amount of water used. From the farmer's perspective, with a fixed charge per acre, the average price per acre-foot of water decreases as the total delivered amount increases.

Under a single block water rate schedule, farmers pay a specified amount per acre-foot of water delivered, and the total bill for the farmer increases directly with the amount of water delivered. While this rate structure does promote efficient use of water, it does not generate a stable revenue stream for the water delivery entity; total revenues are directly related to total water deliveries. If deliveries fluctuate from one year to the next, revenues may occasionally fall short of that necessary to cover annual costs of the entity.

To promote water efficiency while maintaining sufficient revenues for the water delivery entity, a combination rate schedule or tiered water rate can be used. With such a rate structure, a portion of the entity's revenues is associated with a fixed charge and remains stable from year to year while a portion is generated from water rates that may provide a variable amount of revenue each year. A specific water allotment (delivery) is provided at a fixed charge (base) with deliveries greater than the base water allotment provided at increasing rates (tiers) per acre-foot. The rates of the tiers above the base can be set to encourage reductions in water use and to realize water conservation goals. Tiered water pricing can be designed to recognize the consumptive use requirements of different crops and the efficiency of delivery and onfarm systems and obtain revenues to finance water conservation projects (Environmental Defense Fund, 1994). A tiered water rate structure is dependent on an effective water measuring and accounting program.

Some irrigation entities where tiered water pricing is in place are:

- Roza Irrigation District, Yakima River basin, Washington, uses a base charge and one tier. The base per acre charge provides a water allotment of 3 acre-feet per acre. The tiered charge is an acre-foot rate applied to deliveries in excess of the base allotment.

- Lake Chelan Reclamation District, Washington, has a base charge and two tiers. The base per acre charge provides a water allotment of 3 acre-feet per acre. The first tier rate is for additional deliveries up to ½ acre-foot per acre and the second tier rate is for deliveries in excess of 3½ acre-feet per acre.

- East Columbia Basin Irrigation District, Washington, has a base charge per acre and three tiers. The base charge varies by the four land classes and provides different water allotments. The first tier provides an additional ½ acre-foot per acre at the same cost

as the base charge. Each additional tier, also providing ½ acre-foot per acre, is even more costly.

- The 10,000 acre Broadview Irrigation District in the San Joaquin Valley, California, designed a crop specific tiered water pricing program in 1989, to reduce water use and selenium-laden drain water discharge to the San Joaquin River (Wichelns, 1991).

- Central California Irrigation District, which provides water service to 144,000 acres on the west side of the San Joaquin Valley, California, has implemented a tiered water rate structure. Even though the District has senior water rights, in 1989, it put tiered water pricing in place to educate users about the value of water and to encourage efficient use. The District is using some of the revenues generated through this program to create loans for farmers to finance water efficiency projects and to implement District-wide distribution efficiency measures.

The Environmental Defense Fund, 1994, discusses a variety of water rate structures that could be applied to achieve water conservation and other goals and the elements and issues to consider in designing and implementing incentive pricing in irrigation districts in the State of Washington. Hydrosphere Resource Consultants, 1997, recently prepared a handbook on incentive water pricing that provides information on designing and suggestions for implementing tiered water rates. This handbook recommends that tiered water pricing be phased in over a minimum 4-year period to avoid revenue problems for the entity. With tiered water rates, total revenues become more dependent on actual water deliveries (increased revenue variability) and are less dependent on irrigated acres (fixed revenue) in the service area.

5.1.3 Water Transfers

Economic theory indicates that voluntary water transfers, collectively known as water markets, provide financial incentives for reallocating water to the highest economic use. To oversimplify, buyers will enter into transactions that provide a less expensive water supply, and sellers will transfer water if the transfer provides more financial benefits than its current use. As water becomes more valuable and prices rise, markets provide users with incentives to conserve, which can reduce environmental degradation and free-up water to be sold for other uses (Government Accounting Office, 1994). Although water transfers are not without complications, they hold promise for the voluntary redistribution of water in a relatively efficient manner to help satisfy natural resource needs and farm supplies in water short years (McDowell et al., 1994).

Transfers of water between willing buyers and sellers can make the water supply more "flexible" and contribute to satisfying both agricultural and anadromous fish needs. Congress has directed Reclamation to facilitate water and water rights transfers. One means to facilitate this may be through a central, public forum or a water brokerage, so that anyone interested in

water transfers will know where to go for information on pricing and how to conduct transactions.

Some water transfers within irrigation districts have already occurred in the Yakima River basin. In water deficient years such as 1994, non-proratable water was temporarily acquired to supplement proratable water supplies. In 1996, and 1997, Reclamation leased irrigation water from farmers in the Teanaway River basin to enhance instream flows in the Teanaway River. These transfers have been limited and cannot be said to constitute a water market in the Yakima River basin.

There appears to be sufficient authority for water transfers already in place at both the State and Federal level (Dufford, 1997). For instance, under State law, the priority date of conserved water is protected in certain transfers. In 1989, Washington State established "trust water rights" for the Yakima River basin (Revised Code of Washington (RCW) 90.38). This statute states that "Ecology may acquire water rights, including but not limited to storage rights, by purchase, gift, or other appropriate means other than condemnation, from any person or entity or combination of persons or entities." Trust water rights retain the same priority date as the water from which they originated and may be held by Ecology for instream flows and/or irrigation use.

In addition, Washington State law provides that a water right (as opposed to conserved water) may be transferred between willing parties without the loss of priority if the transfer will not injure existing rights (RCW 90.03.380). Under Title XII, the Secretary of the Interior may purchase or lease land, water, or water rights from any entity or individual willing to limit or forego water use on a temporary or permanent basis.[1] One of the responsibilities of CAG is to provide recommendations consistent with statutes of the State of Washington on rules, regulations, and administration of a process to facilitate the voluntary sale or lease of water. This task will be pursued by CAG in the near future.

In 1988, the Department of the Interior developed principles for use in voluntary water transactions involving facilities which it owns and/or operates (Department of the Interior, 1988). These are to be used by Reclamation, and others, in evaluating specific water transfer proposals.

5.1.4 Onfarm Irrigation Scheduling

When to irrigate and how much water to apply are two basic questions each irrigator must answer during the irrigation season. The answers change throughout the irrigation season and

[1] See Section 5.5 of the Conservation Plan for a more thorough discussion of the Secretary's authority to acquire water and lands under the Conservation Program.

depend on crop type, climatic conditions, soil types, application efficiencies, and previous water applications (Hydrosphere Resource Consultants, 1996).

Improving onfarm irrigation scheduling to better match actual crop needs, thereby reducing over-application of water, is an effective water management measure. This can have positive effects on water quality by reducing the amount of irrigation return flows—deep percolation and surface runoff—which result from over-irrigation. Where the irrigation delivery infrastructure is able to operate on a near demand basis and react to and capture the onfarm savings, this practice can reduce the amount of water diverted from the river.

Crop production can also be improved through more precise applications of water to more nearly meet crop irrigation requirements. Programs administered by State, Federal, local, and private agencies and companies provide opportunities through soil moisture sensing, in conjunction with precipitation and consumptive use data, to determine when and the amount of water to apply to maximize crop production.

5.1.5 Entity Operating Procedures

Changes to an entity's operating procedures may provide opportunities for more efficient water use. One example is to develop a more flexible water ordering and delivery schedule. Flexibility in timing and amounts of water delivery usually reduces waste and under-deliveries. Such flexibility, however, requires a significant investment in structural improvements to old open canal delivery systems before water savings can be realized.

Integrating system operations of several entities can improve water use efficiencies and at the same time improve overall system yield.

5.1.6 Educational Programs

An important component of any water management program is providing information to water users about efficient water use and water management services available through the entity or other organizations. Examples of educational programs include irrigation system improvement programs, onfarm irrigation scheduling programs, agricultural evapotranspiration programs, and technical and financial assistance programs. Many Federal and State Agencies provide this information through their technical and/or financial assistance programs. Some of the agencies providing this information are Natural Resources Conservation Service (NRCS), Washington State University (WSU) Cooperative Extension Service, and local Conservation District offices.

Examples of education/information/demonstration/technical assistance programs currently available to irrigators are listed below. These programs could be enhanced and extended through programs available from the NRCS Environmental Quality Incentives Program (EQIP),

the Washington Centennial Clean Water Program, Washington State Department of Ecology (Ecology), and other cost-sharing and granting programs:

- Best management practices for soil and water conservation. *Irrigation Management Practices to Protect Ground Water and Surface Water Quality, State of Washington*, WSU Extension Publications EM 4885, provides detailed information. (WSU, 1995)

- Irrigation method efficiencies. The *State of Washington Irrigation Guide*, a joint publication of the NRCS and WSU Cooperative Extension available in each NRCS and WSU Cooperative Extension office, provides considerable detail. (USDA)

- Day-to-day crop water use estimates. The Washington State University Public Agriculture Weather System (PAWS) and Reclamation's AgriMet System provide daily estimates of crop water use at a large number of agricultural locations. The PAWS network (as of March 1997) had seventeen weather station locations in the irrigated lands of the Yakima River basin between Ellensburg and Kennewick. These provide daily crop water user estimates. The AgriMet network has one additional station in the Yakima Valley.

- Conservation oversight and funding. The three conservation districts in the basin have staff to assist farmers, irrigation districts and watershed groups with their onfarm conservation activities. The districts develop conservation demonstration projects, provide planning assistance, cost-share onfarm conservation measures, and provide oversight to all conservation activities occurring within their district.

- Educational outreach and technical assistance. Ecology has placed two non-regulatory agricultural water quality specialists in the field to provide compliance education and technical assistance to farmers and irrigators in the Yakima River basin. The Ecology staff will help irrigators understand Washington's water quality laws and, if appropriate, refer them to other agencies that provide funding and planning assistance for irrigation management improvements.

5.2 STRUCTURAL BASINWIDE SOLUTIONS

Measures that require modifications of existing water diversion, conveyance, and distribution facilities, or the construction of new and complementary facilities, are structural water conservation measures. Structural measures at the water delivery system level can require a significant capital investment and may require construction over an extended period to not disrupt water service. Improvements to onfarm irrigation systems and/or conversion of systems to more modern techniques are also considered structural measures. Some structural water conservation solutions are discussed below.

5.2.1 Lining and Piping Conveyance and Distribution Facilities

Conveyance (canals) and distribution (lateral) facilities may lose significant amounts of water to seepage and evaporation. Lining and piping are effective methods to reduce water losses.

Seepage losses from unlined canals may range from 10 percent to more than 50 percent of water flow. Lining commonly reduces losses to less than 10 percent, depending on site characteristics and the type of lining. Piping will reduce seepage and evaporation losses. An additional benefit of piping is the potential for pressurized water service which can facilitate onfarm water scheduling flexibility, more efficient onfarm irrigation systems, and energy savings.

5.2.2 Construction of Reregulating Reservoirs

Reregulating reservoirs can assist irrigation entities in matching water deliveries to fluctuations in irrigation demands. They provide "buffering" capacity in the irrigation delivery system to allow temporary storage and release of water to meet fluctuations in irrigation water demand. These reservoirs can temporarily store water that would otherwise be lost as operational spills and to improve the timely and efficient delivery of water. Reregulating reservoirs need not be large but sized to hold the fluctuation volume of 1-2 days of delivery system operation and should be strategically located in the entity service area.

5.2.3 System Automation

System automation includes such items as automated gated check structures which, through remote sensing, can manage the surface water elevation of the system to make deliveries in specific reaches in lieu of maintaining the system at full capacity and spilling excess water, and automating deliveries at farm turnouts.

5.2.4 Onfarm System Improvements

Improvements to onfarm irrigation systems in conjunction with water management techniques can improve the efficiency of water use and reduce erosion and suspended sediment loads in the Yakima River and its tributaries. The voluntary EQIP, administered by NRCS, provides technical and financial assistance to farmers to improve and manage their onfarm irrigation systems.

Examples of onfarm system structural improvements are:

- Improvements to surface (rill) irrigation systems by carefully matching the irrigation stream size to the field slope and the length of run. Surface irrigation requires ponding at the ends of fields or tail-water runoff to effectively irrigate the bottom ends of the field. Tail-water runoff and re-use systems use onfarm ponds to capture runoff, allow

sediment to settle, and re-use captured water on the same or other farm fields. Such systems can greatly improve surface irrigation efficiency to compete with other methods of water application. Other surface irrigation improvements include surge flow irrigation and use of polyacrylamide to control erosion.

- Conversion to sprinkler and drip irrigation methods where there is more precise control over the rate and total amount of water application can improve onfarm water application efficiency. It has been reported that extensive reductions in water use and improved water quality can result from implementation of such measures in the Yakima River basin. Converting to inherently more efficient onfarm irrigation methods does not guarantee system water conservation. Less water may be used or needed onfarm; however, water savings will not be fully realized until the irrigation delivery system has the infrastructure in place to realize these savings.

- Construction of onfarm ponds and reservoirs for diversion of water in times of low demands and release during periods of higher demand may improve system efficiency. Such onfarm ponds operate under the same concept as delivery system reregulating reservoirs. They allow individual farmers to temporarily store water and use that water on a near demand basis.

5.2.5 Water Re-use Systems

The purpose of water re-use systems is to capture system spills, seepage, and drainage waters for immediate or later use. In the case of operational spills, a storage facility is usually required to hold water until irrigation demands increase. In contrast, drain water may be captured and re-used on a more immediate basis. Although onfarm storage may not be required for drain water re-use, temporary storage to allow sediment to settle may be desirable. Re-use of water potentially reduces the required diversion into the system. The use of water re-use systems can also result in significant improvements to the quality of return flows from the irrigated lands.

5.3 PROTECTION, CREATION, AND ENHANCEMENT OF WETLANDS AND RIPARIAN AND FLOODPLAIN HABITAT

A purpose of the Conservation Program authorized by Title XII is to "protect, create, and enhance wetlands." To accomplish this purpose, the following guiding principles are applicable to the Conservation Plan:

- Existing wetlands shall be protected from adverse impacts associated with implementation of water conservation measures to the greatest extent possible.

- Any potential loss of wetlands caused by implementation of water conservation measures shall be fully mitigated to ensure no net loss of wetlands functions and values.

- Wetlands shall be created, re-established, and enhanced in a manner which significantly addresses the problems and needs identified in Section 4.6.

The following program could be used to address these guiding principles. Figure 5-1 shows how this program could be integrated in the process for the protection, creation, and enhancement of wetlands and floodplain habitat.

5.3.1 Habitat Plan

A Habitat Plan could be developed for the Yakima River basin. This Habitat Plan would include an inventory, rating, and functional assessment of existing wetlands; a comparison of historical and current conditions at a landscape scale; and a ranking of priority areas by subareas for protection, re-establishment, creation and enhancement. The assessment of wetland functions and values should be compatible with the hydrogeomorphic methodology (HGM) and the appropriate HGM should be used when possible.

The Habitat Plan would help guide Reclamation's water and land acquisition activities (see Section 5.5); entity water conservation planning and wetland mitigation efforts; and the protection, creation, and enhancement activities of other public and private organizations with an interest in wetlands, fish, wildlife, and special aquatic areas. The landscape map will contribute to an understanding of the extent and location of current and pre-project aquatic habitats and where links between aquatic sites have been severed and potential for re-establishment of special sites.

Because a Habitat Plan will provide a guide for implementing many of the potential solutions discussed in Section 5.0, CAG recommends the development of a Habitat Plan be given a high priority (see Section 9.0). The Habitat Plan would be developed collaboratively by Reclamation, basin fish and wildlife resource managers, and other interested public and private organizations with funds authorized by Title XII.

5.3.2 Protect High Value Wetlands

Potential impacts to wetlands which could result from implementation of water conservation measures will be identified in the water conservation plans and in the feasibility investigations.

High value wetlands need to be identified. These include wetlands rated as Category I and II on Ecology's wetland rating system, floodplain wetlands (particularly those in complex alluvial areas of the Yakima River and tributary streams), and wetlands which provide connections between areas of wildlife habitat or special aquatic sites. These high value wetlands should be protected from degradation or loss from implementation of water conservation measures under the Conservation Program.

Adverse impacts to other wetlands need to be identified and avoided to the extent possible. When avoidance is not possible, mitigation should be implemented to ensure no net loss of wetland functions and values. Mitigation can take place within the entity's service area or as a part of a Yakima River Basin Wetlands Enhancement Project (Wetlands Enhancement Project) discussed in Section 5.3.3.

5.3.3 Wetlands Enhancement Project

Using Section 4.6 (Problems and Needs) and the Habitat Plan as guides, a Wetlands Enhancement Project could be initiated in each of the subareas. The Wetlands Enhancement Project would be directed at protecting, re-establishing, creating, and enhancing wetlands to benefit fish and wildlife resources and to contribute to the health and recovery of the Yakima River basin ecosystem

The Wetlands Enhancement Project would provide a cost effective and ecologically advantageous opportunity to protect high value wetlands as well as the opportunity to mitigate for incidental losses of wetlands resulting from implementing water conservation measures because mitigation efforts can be "pooled" and directed toward the priorities identified in the Habitat Plan. It is also consistent with the purposes of Title XII to protect, create, and enhance wetlands and fish and wildlife habitat resources in the Yakima River basin.

The Growth Management Act of the State of Washington, Chapter 36.70A RCW, provides for the development of comprehensive plans by counties and cities in the State of Washington. Its objective is to provide for cooperation and coordination in land use planning among citizens, communities, local governments, and the private sector. In preparing the Habitat Plan and in pursuing land acquisition activities associated with the development of the Wetlands Enhancement Project, comprehensive plans prepared pursuant to the Growth Management Act by counties and cities in the Yakima River basin should be fully considered.

Where opportunities exist, Reclamation should work with other programs to maximize wetlands opportunities and benefits. Creating fish and wildlife corridors by linking existing wetland habitat with wetland protection, creation, and enhancement activities can be aided by the "Wetland Reserve Program" and the "Wildlife Habitat Incentives Program" of the NRCS. These programs provide financial incentives for landowners to protect and enhance wetlands by retiring marginal agricultural land and by providing financial and technical assistance to improve wetland habitat on private lands.

NOTE: Numbers refer to text in Section 5.3

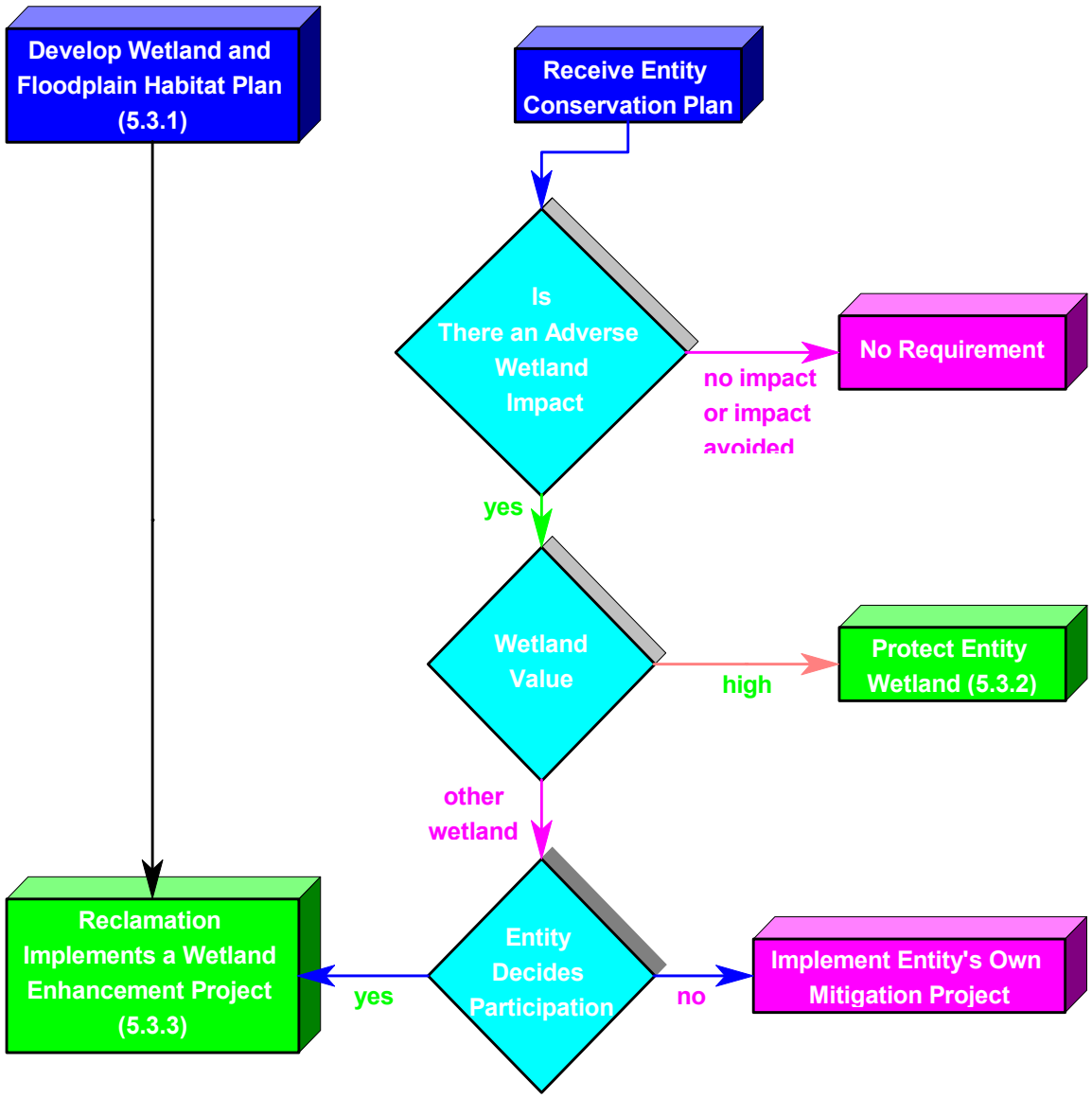


Figure 5-1 --- Process for Protection, Creation and Enhancement of Wetlands, Riparian and Floodplain Habitat

State and Federal laws require a clear accounting of wetland losses and mitigation. Reclamation must maintain an accounting of such losses and re-establishment and enhancement to ensure that the Conservation Plan's goal of no net loss of wetlands functions and values is achieved. A "pooled" mitigation effort should be consistent with the 1995 Federal guidance for the establishment, use, and operation of "wetlands mitigation banks."

A Wetlands Enhancement Project could be financed by Federal funds authorized by Title XII and entity cost-sharing as a part of their participation in the Conservation Program. Another source of funding may be collaborating agencies and entities that have an interest in protecting, creating, and enhancing wetland resources in the Yakima River basin.

5.4 YAKIMA PROJECT OPERATIONS

This section discusses some potential solutions to the problems and needs (identified in Section 4.0.) which could be addressed as a part of Yakima Project operations. This is not an all inclusive list of potential operational solutions.

5.4.1 Operating Plan

A cornerstone of potential operational solutions is the Operating Plan authorized by Section 1210 of Title XII. Pursuant to this section, the Secretary is directed, acting through Reclamation, and in consultation with the State, Yakama Nation, basin irrigation districts, Bonneville Power Administration, and other entities to develop an Operating Plan. The purpose of this Operating Plan is to provide a general framework within which the Yakima Project, including measures implemented under the Enhancement Project, is operated. The Operating Plan is to include, but not be limited to, the following:

- System operating capability and constraints
- Information on water supply calculations and water needs
- System operations and streamflow objectives
- Activities of the System Operations Advisory Committee

A draft of the Operating Plan is to be available within 18 months after completion of the Conservation Plan. Following the close of a 90-day public review period, the Operating Plan is to be published by the Secretary within 90 days. The Operating Plan is to be updated as needed.

Development of the Operating Plan provides an opportunity for Reclamation to assess current Yakima Project operating protocols. It also provides a forum to further examine alternatives

which could assist in improving operations. Examples include assessment of the flip-flop operation, initiated in 1981, and examination of ramping rates associated with changes in reservoir discharges.

5.4.2 Improve Operational Capability to Adjust Reservoir Releases

In general, adjustment of reservoir releases are now made manually only on weekdays between 8 a.m. and 5 p.m. System automation would allow adjustments of reservoir releases at any time and permit release changes to be made more slowly and smoothly over a longer period of time to help avoid rapid flow increases or decreases. As an example, a change could be made in 10 equal increments, each an hour apart.

5.4.3 Improve Multipurpose Operation of the Yakima Project

The need for biologically based ramping rate curves for the five major Yakima Project reservoirs and key river stations is one of the items discussed by CAG. These ramping curves, providing parameters for changes in reservoir releases, could be used in combination with flood rule curves, instream target flows, irrigation needs, and other contractual obligations to help guide operational decisions among often competing needs. The operating curves must allow for flexibility of use and several curves may be necessary to provide information on unacceptable, acceptable, and optimal ramping rates. Ramping curves will likely vary depending on the time of year and the flow in the river.

The System Operations Advisory Committee is currently evaluating what is necessary to have biologically based instream target flows for various reaches of the river system. Target flows with reasonable variations for operational flexibility could assist the Yakima Project Superintendent to better incorporate fish and wildlife resource needs into system operations.

Additional operational modeling tools could enhance system operations. The existing monthly planning model provides information on various operational scenarios, such as potential impacts on TWSA from increased winter streamflows. The accuracy of this model is, however, limited by the use of monthly data which smooths out natural daily and weekly fluctuations. A daily planning model as proposed under the "Watershed and River System Management Program," would allow for more accurate evaluation of system management options.

The current state-of-the-art forecasting of precipitation and runoff combined with reservoir carryover does not provide a high level of confidence in the forecast of the water supply for managing Yakima Project operations at the beginning of the water year. Improved runoff forecasting and predictive models would assist in considering system management options.

5.5 WATER AND LAND ACQUISITION PROGRAM

5.5.1 Authority and Funding

In Title XII, Congress directed the Secretary of the Interior, through Reclamation, to facilitate water and water right transfers, water banking, dry-year options, the sale and leasing of water, and other innovative allocation tools to maximize existing Yakima River basin water supplies. Congress also authorized Reclamation to use Conservation Program funds to purchase or lease land, water, or water rights from any entity or individual willing to limit or forego water use on a temporary or permanent basis. Such acquisitions are to be used to restore the anadromous fish resources of the Yakima River basin and to meet the other natural resource goals of Title XII, including improving water quality; protecting, creating, and enhancing wetlands; and otherwise improving fish and wildlife habitat.

Congress authorized the use of funds appropriated for the Conservation Program ($67.5 million) for these purposes and also an additional, specific appropriation ($10 million) for the expeditious acquisition of water for "flushing flows" in the "interim" period between enactment and the time that a significant increase in target flows from saved water becomes a reality. Congress also authorized additional appropriations in amounts yet to be specified for the acquisition of water as one of the means to enhance water supplies for fish and wildlife in tributaries, depending on the Secretary's recommendations.

An important aspect of water and water rights acquired by Reclamation is the requirement that it shall be administered as a block of water separate from TWSA for irrigation. This enables Yakima Project operators to shape water for fish needs after storage control is initiated. Water acquired for instream flows upstream of Sunnyside and Prosser Diversion Dams will increase the target flows in direct proportion to the amount of water acquired.

5.5.2 Priorities for Water and Land Acquisition

The primary emphasis for acquiring land, water, and water rights, in the Yakima River basin is to:

- Increase the instream target flows at Sunnyside Diversion Dam and Prosser Diversion Dam.

- Supplement instream flows at other critical river reaches, including tributary reaches, identified in Section 4 of the Conservation Plan.

- Acquire lands in areas indicated by the wetlands studies recommended in Section 5.3 of the Conservation Plan as important areas for protection and enhancement of riparian and floodplain wetland habitats, as well as in other riparian areas that are key to

anadromous fish restoration. Lands with associated water rights should be given priority for acquisition.

Reclamation should aggressively pursue the appropriation of the $10 million authorized by Congress for the "interim" acquisition of water to fulfill the direction of Congress that "efforts to acquire water should be made immediately . . . to meet the three-year goal . . . to provide water . . . for instream flow purposes."

Congress' directive to acquire water for flushing and migration in the time period between enactment of the law and the time that water conservation measures are implemented is even more critical than it was when Title XII was passed. At least two species of anadromous fish in the Yakima River basin—steelhead and chinook salmon—are now under consideration for listing under the Endangered Species Act.

Reclamation should make the purchase of water, water rights, and lands a priority with permanent acquisition being the preferred method. Permanent acquisition allows Reclamation to plan for the future operation of the Yakima Project. Long-term water leases and dry-year options may be a cost effective and biologically effective solution to a particular problem, especially where there is no foreseeable opportunity for permanent acquisition. With respect to the acquisition of wetland or potential wetland habitats, easements in perpetuity might provide the same sort of long-term planning advantage to Reclamation as outright purchases. Easements may also be more cost effective than outright purchase.

Acquisition of riparian lands, especially with the associated water rights, in key habitat areas of the basin can accomplish the multiple objectives of water for instream flows, protection of critical riparian habitat, wetland enhancement, water quality improvement, and restoration of fish and wildlife habitat. Reclamation should exploit the opportunity to acquire such lands to the fullest extent possible.

When acquiring water rights, the consumptive amount of the right should be accounted for on a one-to-one basis and fully protected from junior appropriators to the mouth of the Yakima River. In addition, to the extent feasible, the conveyance portion of the acquired right should be protected from appropriation from the point of diversion to the point where it re-enters the river as return flow.

Reclamation should consider a "water brokerage"[1] as one possibility in addressing Congress' directive to facilitate water right transfers and water banking, dry-year options, and the sale and lease of water.

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[1] A "water brokerage" operates as a clearing house providing information on who desires to sell or lease water, who desires to buy, prices, rules and regulations associated with acquisitions and assists in consummating transactions.

Reclamation should implement an aggressive Yakima River basin outreach strategy to reach as many people in the basin as is possible with information about the acquisition program. This could consist of distributing printed materials that explain the program, public announcements, public education meetings, a "hot-line" to answer questions, and other strategies.

The next four Sections (5.6 through 5.9) are specific to a single subarea. Each section summarizes the problems and needs for that subarea (identified in Section 4) and the potential solutions discussed in Sections 5.1 - 5.5. As previously indicated, these measures do not represent an all inclusive list of potential measures.

5.6 UPPER YAKIMA SUBAREA

This section generally restates, from Section 4, the major problems identified in the Upper Yakima Subarea and identifies potential solutions for each problem. Table 5-1 cross references the problems and potential solutions for the Upper Yakima Subarea.

Table 5-1.—Index of Upper Yakima Subarea Specific Problems and Potential Solutions

	Problem		Solution	
Location	**Description**	**Section**	**Description**	**Section**
Yakima River from Keechelus Dam to mouth of Cle Elum River	Seasonal low flows	4.2.1.1	Operating Plan Acquire water	5.4 5.5
	Hourly and daily flow fluctuations		Reregulating reservoirs Operating Plan	5.2.2 5.4
Yakima River from Cle Elum River to Roza Diversion Dam	Sustained high flows	4.2.1.2	Non-structural Structural Operating Plan	5.1 5.2 5.4
Cle Elum River from Cle Elum Dam to mouth	Seasonal low flows - winter	4.2.1.3	Cle Elum Dam modification Operating Plan	5.6.1.3 5.4
	Sustained high flows preceding flip-flop		Instream structures Non-structural Structural Operating Plan	5.6.1.3 5.1 5.2 5.4
	Hourly and daily fluctuations		Reregulating reservoirs Operating Plan	5.2.2 5.4
Tributary streams	Seasonal low flows during the irrigation season in one or more reaches	4.2.1.4	Water diversion Non-structural Structural Acquire water	5.6.1.4 5.1 5.2 5.5

Table 5-1.—Index of Upper Yakima Subarea Specific Problems and Potential Solutions				
	Problem		Solution	
Location	Description	Section	Description	Section
Kittitas Reclamation District	Improve reliability of irrigation supply	4.2.2	Non-structural Structural	5.1 5.2
Yakima River, Lower Wilson Creek, and other tributaries	Improve water quality	4.2.3	Non-structural Structural Vegetation	5.1 5.2

5.6.1 Instream Flows for Fish and Wildlife

5.6.1.1 Yakima River From Keechelus Dam to Confluence of Cle Elum River

Problem: *Seasonal Low Flows—More overwintering habitat would be available if additional reservoir releases could be made to maintain more side channel and river margin habitat (4.2.1.1).*

Solution: Operating Plan (5.4); purchase and lease water (5.5).

Problem: *Hourly and Daily Flow Fluctuations—Rapid flow fluctuations, particularly abrupt decreases, are a concern because this reach has a complex instream habitat and channel shape, including side channels, braids, and gravel bars (4.2.1.1).*

Solution: Construct entity reregulating reservoirs as well as reregulating reservoirs along the mainstem rivers (5.2.2) and review operational "ramping" rates (5.4).

5.6.1.2 Yakima River From Cle Elum River to Roza Diversion Dam

Problem: *Sustained High Flows—From storage control to flip-flop operation in early September, velocities are high to meet irrigation demands and to allow the flip-flop operation (4.2.1.2).*

Solution: Implement non-structural (5.1) and structural (5.2) water conservation measures; Operating Plan (5.4).

5.6.1.3 Flows in Cle Elum River From Cle Elum Dam to Mouth

Problem: *Seasonal Low Flows—There is good side channel rearing habitat, but the present level of winter releases from Cle Elum Lake are inadequate to provide rearing flows in these side channels (4.2.1.3).*

Solution: Water available from the additional 14,600 acre-feet of Lake Cle Elum storage capacity resulting from modification of the radial gates at Cle Elum Dam could be released to supplement winter flows.

Installation of temporary or permanent structures in the Cle Elum River may help to direct available flows into the side channels. Because of velocity considerations, structures could probably be installed only where there is sufficient side channel capacity (large channels or multiple channels) to convey summer flows at reasonable velocities for rearing fish. Operating Plan (5.4).

Problem: *Sustained High Flows—Flow velocities are high preceding the flip-flop operation and fry and juveniles are at risk of being moved downstream to less suitable rearing habitat (4.2.1.3).*

Solution: Habitat improvement projects in the Cle Elum River to create velocity breaks through installation of temporary or permanent structures, development of new side channels to increase the channels cross-section, and construction of berms to reduce velocities in specific channels may be possible solutions.

Implement non-structural (5.1) and structural (5.2) water conservation measures; Operating Plan (5.4).

Problem: *Hourly and Daily Fluctuations—Rapid flow fluctuations, particularly decreases, put fry and juveniles at risk to stranding in the side channels. Major operational changes, such as flip-flop need to be extended over an adequate period of time, to the extent possible, to alleviate rapid fluctuations.*

Solution: Construct entity reregulating reservoirs, as well as reregulating reservoirs along mainstem rivers (5.2.2), and review operational "ramping" rates (5.4).

5.6.1.4 Flows in Tributary Streams

Problem: *Some of the tributary streams are depleted by irrigation diversions in one or more reaches precluding their use by anadromous fish in most years (4.2.1.4).*

Solution: Entities diverting from the Yakima River whose conveyance facilities cross tributaries can implement water conservation measures to free up capacity in the conveyance facilities so that water can be conveyed from the Yakima River and discharged into the tributary. The water would then flow down the tributary to the Yakima River for downstream use.

Implement non-structural (5.1) and structural (5.2) water conservation measures; purchase and lease water (5.5).

5.6.2 Irrigation Water Supply

Problem: *The reliability of the irrigation supply for the Kittitas Reclamation District needs to be improved (4.2.2).*

Solution: Implement non-structural (5.1) and structural (5.2) water conservation measures.

5.6.3 Water Quality

Problem: *The quality of water in the Yakima River and some of the tributaries such as Lower Wilson Creek do not meet State standards (4.2.3).*

Solution: Implement non-structural (5.1) and structural (5.2) water conservation measures. Plant vegetative cover along river channel.

5.7 NACHES SUBAREA

This section generally restates, from Section 4, the major problems identified in the Naches Subarea and identifies potential solutions for each problem. Table 5-2 cross references the problems identified in Section 4 and potential solutions identified in this section.

Table 5-2.—Index of Naches Subarea Specific Problems and Potential Solutions				
	Problem		Solution	
Location	Description	Section	Description	Section
Naches River from Wapatox Diversion Dam to the PP&L Powerplant discharge	Seasonal low flows	4.3.1.1	Subordinate flows Diversion relocation Non-structural Structural Operating Plan Acquire water	5.7.1.1 5.7.1.1 5.1 5.2 5.4 5.5
	Hourly and daily flow fluctuations		Non-structural Structural Reregulating reservoirs Operating Plan	5.1 5.2 5.2.2 5.4
Naches River and tributaries	Improve water quality in the Naches River and tributaries	4.3.3	Non-structural Structural Vegetation	5.1 5.2

5.7.1 Instream Flows for Fish and Wildlife

5.7.1.1 Naches River From Wapatox Diversion Dam to PP&L Powerplant Discharge

Problem: *Seasonal Low Flows—Sreamflows in this 7.4-mile reach of the Naches River can, at time, be less than desirable for anadromous fish. Prior to the flip-flop operation diversions at Wapatox Diversion Dam for hydroelectric generation at PP&L's Powerplant, as well as downstream irrigation diversions, can result in low streamflows. Passage in the Naches River is impaired and flows in the side channels are depleted (4.3.1.1).*

Solution: Enter into an agreement with PP&L for the subordination of diversions for hydroelectric generation when instream flows below Wapatox Diversion Dam would be less than desirable for anadromous fish.

Solution: Encourage the Naches-Selah Irrigation District to relocate its point of diversion from upstream of Wapatox Diversion Dam to the vicinity of the discharge from the PP&L Powerplant.

Also implement non-structural (5.1) and structural (5.2) measures; Operating Plan (5.4), and purchase and lease water (5.5).

Problem: *Hourly and Daily Flow Fluctuations—Rapid flow fluctuations, particularly abrupt decreases, are a concern because this reach has a complex instream habitat and channel shape including side channels and gravel bars (4.3.1.1).*

Solution: Implement non-structural (5.1) and structural (5.2) water conservation measures; construct entity reregulating reservoirs and regulating reservoirs along the mainstem (5.2.2); Operating Plan (5.4).

5.7.2 Water Quality

Problem: The quality of water in the Naches River and its tributaries does not meet State standards (4.3.3).

Solution: Implement non-structural (5.1) and structural (5.2) water conservation measures, and plant vegetative cover along river channel.

5.8 MIDDLE YAKIMA SUBAREA

This section generally restates, from Section 4, the major problems identified in the Middle Upper Yakima Subarea and identifies potential solutions for each problem. Table 5-3 cross references the problems identified in Section 4 and potential solutions identified in this section.

Table 5-3.—Index of Middle Yakima Subarea Specific Problems and Potential Solutions

Location	Problem		Solution	
	Description	Section	Description	Section
Yakima River from Naches River confluence to Union Gap	Riparian zones and sustained high flows	4.4.1.1	Non-structural Structural Reregulating reservoirs Wetlands habitat	5.1 5.2 5.2.2 5.3
Roza Irrigation District, Wapato Irrigation Project, and Sunnyside Division	Improve reliability of irrigation supply	4.4.2	Non-structural Structural	5.1 5.2
Yakima River from Naches River confluence to Sunnyside Diversion Dam and drains	Improve water quality in Yakima River and Wide Hollow Creek and Moxee Drain	4.4.3	Non-structural Structural Vegetation	5.1 5.2

5.8.1 Instream Flows for Fish and Wildlife

5.8.1.1 Yakima River From Naches River to Union Gap

Problem: *Riparian Zones and Sustained High Flows—This reach is critical for juvenile steelhead and spring chinook as it is the farthest reach downstream where summer water temperatures remain low enough for rearing of salmonids. The velocity in this reach is high during the irrigation season. The river flows between dikes and healthy side channels, backwater areas and complex riparian areas are greatly reduced from historic conditions (4.4.1.1).*

Solution: Implement non-structural (5.1) and structural (5.2) measures; construct entity reregulating reservoirs and reregulating reservoirs along the mainstem rivers (5.2.2); implement wetlands habitat measures (5.3).

5.8.2 Irrigation Water Supply

Problem: *Reliability of Irrigation Water Supply—The irrigation supply for the Roza Irrigation District is entirely proratable and is reduced in deficient water supply years. Although the Wapato Irrigation Project, the Sunnyside Division, and others, have some non-proratable entitlements, they also have significant proratable entitlements which are reduced in deficient water supply years (4.4.2).*

Solution: Implement non-structural (5.1) and structural (5.2) water conservation measures.

5.8.3 Water Quality

Problem: *Water Quality of the Yakima River from confluence of Naches River to Sunnyside Diversion Dam and Drains—The Yakima River downstream of the Naches River and Wide Hollow Creek and Moxee Drain do not meet Class A water quality standards (4.4.3).*

Solution: Implement non-structural (5.1) and structural (5.2) water conservation measures, and plant vegetative cover along river channel.

5.9 LOWER YAKIMA SUBAREA

This section generally restates, from Section 4, the major problems identified in the Lower Yakima Subarea and identifies potential solutions for each problem. Table 5-4 cross references the problems identified in Section 4 and potential solutions identified in this section.

Table 5-4.—Index of Lower Yakima Subarea Specific Problems and Potential Solutions

Location	Problem		Solution	
	Description	Section	Description	Section
Yakima River from Sunnyside Diversion Dam to Chandler Pumping and Powerplant discharge	Base flow over Sunnyside Diversion Dam	4.5.1.1	Non-structural Structural Acquire water	5.1 5.2 5.5
			Electrification of pumps	5.9.1.1
	Additional flow during April - June out-migration		Non-structural Structural Acquire water	5.1 5.2 5.5
	Hourly and daily flow fluctuations		Non-structural Structural Operating Plan	5.1 5.2 5.4
	Seasonally high water temperatures		Vegetation	5.9.1.1
Yakima River from Chandler Pumping and Powerplant discharge to Columbia River	Additional flow during out-migration	4.5.1.2	Non-structural Structural Acquire water	5.1 5.2 5.5
The Yakima River from Sunnyside Diversion Dam to the Columbia River confluence	Yakima River does not meet Class A water quality standards. Sulphur Creek does not meet the Class B water quality standards. Other tributaries also discharge water of a very poor quality.	4.5.3	Non-structural Structural	5.1 5.2

5.9.1 Instream Flows for Fish and Wildlife

5.9.1.1 Yakima River From Sunnyside Diversion Dam to Chandler Pumping and Powerplant Discharge

Problem: *Base Flow Over Sunnyside Diversion Dam—A minimum flow is needed below Sunnyside Diversion Dam (4.5.1.1).*

Solution: Implement non-structural (5.1) and structural (5.2) water conservation measures; purchase and lease water (5.5).

Problem: *Additional Flow Needed During Out-migration (4.5.1.1)*

Solution: A part of the diversions at Prosser Diversion Dam now required to operate the hydraulic pumps to lift water to the Kennewick Division could be eliminated if the pumps were replaced with electric pumps.

Also, non-structural (5.1) and structural (5.2) water conservation measures; purchase and lease water (5.5).

Problem: *Hourly and Daily Flow Fluctuations—Abnormal rapid flow fluctuations, particularly decreases, are a concern because this reach is characterized by complex channel shape, including side channels and gravel bars, and instream habitat features (4.5.1.1).*

Solution: Implement non-structural (5.1) and structural (5.2) water conservation measures; Operating Plan (5.4).

Problem: *Seasonally High Water Temperatures—During July and August water temperatures may be too high for salmonids (4.5.1.1).*

Solution: Plant vegetative cover along river channel.

5.9.1.2 Yakima River From Chandler Powerplant Discharge to Mouth

Problem: *Additional Flow Needed During Out-migration—Additional flows during April through June appear desirable (4.5.1.2)*

Solution: Non-structural (5.1) and structural (5.2) water conservation measures; purchase and lease water (5.5)

5.9.2 Water Quality

Problem: *Water Quality of the Yakima River from Sunnyside Diversion Dam to the mouth and tributary streams—The Yakima River does not meet Class A water quality standards. Sulphur Creek, which does not meet Class B water quality standards, and other tributaries discharge water of a very poor quality into the Yakima River (4.5.3).*

Solution: Implement non-structural (5.1) and structural (5.2) measures.

6.0 PROCESSES

6.1 ELIGIBILITY

The following entities are eligible to participate in the Conservation Program:

- Irrigation districts
- Canal companies
- Conservation districts
- Individuals within an irrigation district or canal company working through a water conservation district in coordination with the irrigation district or canal company
- Individuals not within an irrigation district or canal company
- Water purveyors such as cities and towns

Participants in the Conservation Program must agree to reduce water diversions by a mutually determined amount. Individuals within an irrigation district or canal company must provide confirmation by the entity Directors.

6.2 PHASES AND FUNDING

The Conservation Program is structured in four phases: (1) development of water conservation plans; (2) feasibility investigation of specific water conservation measures; (3) implementation; and (4) post-implementation monitoring and evaluation. A process flow chart is shown in Figure 6-1.

Section 1203(d) of Title XII defines the manner in which costs incurred in each of the four phases are to be shared. The applicant must meet the definition of "public body" as defined in RCW 43.99E.030 to be eligible to receive State funds. Table 6-1 illustrates the cost-sharing formula for each phase of the Conservation Program. Cost-share opportunities and limitations are discussed in Appendix VIII-A.

Table 6-1.—Funding of Phases of the Conservation Program			
	Non-Federal		
Program Phase	State Grant	Local	Federal Grant
1. Development of water conservation plans	50 percent of cost but not more than $200,000 per recipient	Residual cost	50 percent of cost
2. Investigation of specific water conservation measures	50 percent of total cost of phase 1 and 2 but not greater than $200,000 per recipient	20 percent of cost after deducting State funds for phase 2	Residual cost after deducting non-Federal funds for phase 2
3. Implementation	17.5 percent of cost	17.5 percent of cost	65 percent of cost
4. Post-implementation monitoring and evaluation	17.5 percent of cost	17.5 percent of cost	65 percent of cost

6.3 WATER CONSERVATION PLANS

The first phase of the Conservation Program is development of water conservation plans. Eligible entities apply for funding, develop water conservation plans, and submit their plans for consideration. The water conservation plans are intended to identify potential conservation measures, potential reductions in water diversions with implementation of each measure, cost of implementing each measure, and environmental effects of the measures. Upon completion of the water conservation plan, the entity submits it to Reclamation and Ecology for review and approval.

An application for funds to prepare a water conservation plan and guidelines to be used in developing the plan are contained in Appendix VI.

6.4 FEASIBILITY INVESTIGATIONS OF SELECTED MEASURES

Approved water conservation plans will be reviewed and evaluated by Reclamation and Ecology to identify conservation measures judged to have potential to reduce water diversions, a sound engineering, economic, and environmental basis; and could assist in meeting the basins' water problems and needs. These measures will be eligible to receive Federal and State grant funds for feasibility investigation. The scope and extent of the feasibility investigation will be jointly determined by the program participant, Reclamation, and Ecology. The purpose of the feasibility investigation phase is to carry out more detailed evaluations to assess the engineering,

operational, financial, and environmental feasibility of implementing specific water conservation measures.

The criteria shown in Table 6-2 will be used by Reclamation and Ecology to review the water conservation plans and determine the desirability of investing Federal and State funds to proceed with the feasibility investigation on proposed "First Tier" water conservation measures. The "Minimum Requirements" must be included in the water conservation plan. Although water conservation plans do not need to include all of the "Selection Considerations" to be funded, the more considerations the better chance of being selected.

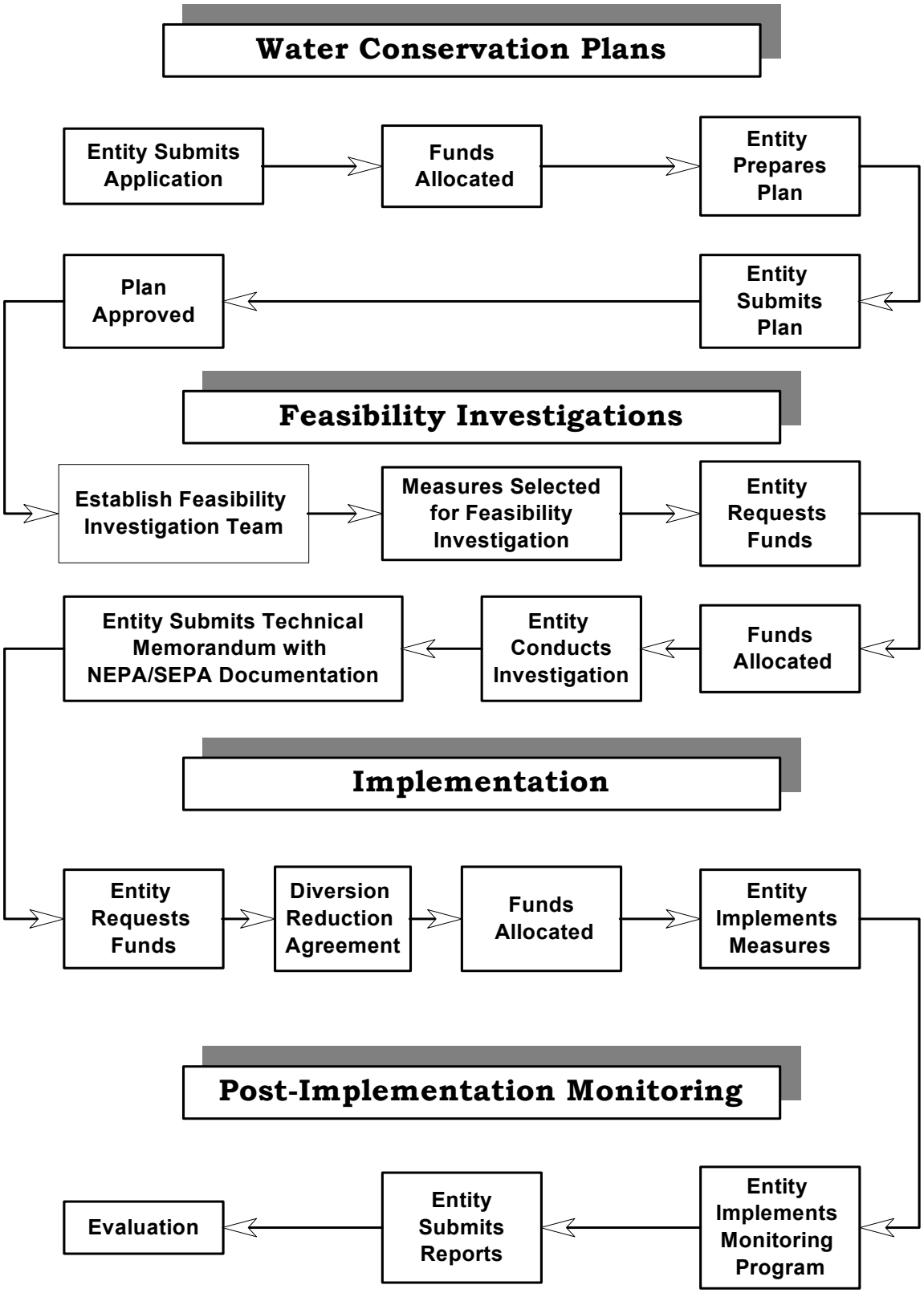


Figure 6.1 — Basin Conservation Program Process Flow Chart

A Feasibility Investigation Team (FIT) will be assembled at the beginning of the feasibility investigation phase. FIT will consist of a "core" technical team of two or three from Reclamation and Ecology staff who may call upon other staff as well as technical expertise from other agencies and organizations for assistance.

The functions of FIT are to:

- help Reclamation and Ecology identify water conservation measures for feasibility investigations.

- assist Conservation Program participants in structuring the scope, level of detail, and data collection needs of the feasibility investigation.

- help Reclamation and Ecology perform the technical review of the feasibility analysis.

6.5 IMPLEMENTATION

The third step is for the entity to submit the feasibility investigation for evaluation and possible implementation funding. The feasibility investigation will refine the design and cost estimates for specific conservation measures, define achievable diversion reductions, and evaluate the environmental effects of the proposed actions. Reclamation and Ecology will rely upon FIT to perform the technical review of all feasibility analyses. Experts from other technical disciplines and the social sciences will be requested to review the proposal and provide their technical assessment of merit.

Reclamation and Ecology will use the criteria shown in Table 6-3 to assist in determining which measures warrant the expenditure of State and Federal funds for implementation. The "Minimum Requirements" must be met, however, all the "Selection Considerations" are not required. Paramount to the decision to fund implementation of specific measures is a determination of how well the proposal contributes to meeting the overall goals of the Conservation Plan and the objectives of Title XII.

Up to this point, the screening has involved measures only from an individual entity's conservation plan and not among plans. It is CAG's intent to fully recognize the relative benefits of various plans, including their biological benefits, in selecting measures to be implemented. To accomplish this, the conservation measures which come out of the prior screening process will be prioritized on the basis of benefits which are expected to result from implementation. The benefits to be considered should be all-inclusive encompassing economic, social, environmental, and biological benefits. Benefits will include both a qualitative assessment and a quantitative assessment to the extent possible. The CAG is not recommending that Reclamation perform a formal cost-benefit analysis.

Table 6-2.—Criteria to Obtain Funds for Feasibility Investigation	
Criterion	**Description**
Minimum Requirements	
1. Eligible to participate in the Conservation Program	Irrigation districts, conservation districts, water purveyors, other area wide entities, and individuals not included in area wide entities are eligible to participate in the Conservation Program and receive Federal funding. The State portion of the funding is limited to those entities that meet the definition of "public body" contained in RCW 43.99E.030. The public body must be managing and operating water supply and distribution facilities used for agricultural irrigation.
2. Reduced water diversions[1]	A reduction in annual water diversions will occur when conservation measures are implemented.
3. Acceptability	The proposed water conservation measures are acceptable to the entity's Board of Directors. A resolution of the Board of Directors indicating acceptability of the plan should be included with the funding application.
4. No net loss of wetland functions and values	The water conservation plan identifies existing wetlands, assesses the potential impacts from implementing water conservation measures, and, if necessary, describes potential mitigation measures to assure no net loss of wetland functions and values.
5. Compatibility with Conservation Plan	The proposed water conservation measures address the instream flow problems and needs identified in Section 4 of the Conservation Plan.
Selection Considerations	
6. Extent of reduced diversions	The contribution of reduced diversions toward meeting the diversion reduction goals of Title XII. Operation and Maintenance (O&M) measures will not be funded.
7. Cost	The capital cost per acre-foot to reduced diversions is reasonable and competitive with potential alternatives to accomplish the goals of the Conservation Plan.
8. Technical soundness	The measures are technically sound from an engineering, operational, and environmental perspective and can be implemented.
9. Post-implementation monitoring	An effective post-implementation monitoring program can be established and maintained to evaluate the effectiveness of the measures in meeting projected diversion reductions and other benefits attributed to the measures.
10. Improved quality of surface waters	The measure would improve the quality of surface waters in the Yakima River basin.
11. Complements other program activities	The measure integrates with other measures, enhances Yakima Project operations, increases opportunities for reducing water diversions through onfarm measures, or leverages additional funding of measures.
12. Integral component of entity water conservation plan	The measure is an integral component of the entity's water conservation plan and funding by the Conservation Program will facilitate implementation of other measures in the entity's water conservation plan.
13. Innovative project value	The measure tests an innovative approach to accomplish the goals of the Conservation Plan.

Guidelines to assist the participant in preparing the investigation of feasibility of selected measures are contained in Appendix VII.

[1] "Reduced diversion" includes all the water conserved; water to increase fish flows and water to improve irrigation reliability.

Table 6-3.—Criteria to Obtain Implementation Funds	
Criterion	**Description**
Minimum Requirements	
1. Eligible for participation in the Conservation Program	Irrigation districts, conservation districts, water purveyors, other area wide entities, and individuals not included in area wide entities are eligible to participate in the Conservation Program and receive Federal Funding. The State portion of the funding is limited to the entities that meet the definition of "public body" contained in RCW 43.99E.030. The public body must be managing and operating water supply and distribution facilities used for agricultural irrigation.
2. Reduced water diversions[1]	A reduction in annual water diversions as identified in the diversion reduction agreement will occur when conservation measures are implemented.
3. Acceptability	Include a resolution from the Board of Directors indicating the entity has the authority to spend its portion of the implementation costs.
4. Technical soundness	The proposed water conservation measures are technically sound from an engineering, operational, and environmental perspective and can be implemented.
5. Cost	The capital cost per acre-foot of estimated reduced diversions is reasonable and competitive with other potential alternatives to accomplish the goals of the Conservation Plan.
6. Post-implementation monitoring	An effective post implementation monitoring plan is prepared to evaluate the effectiveness of the water conservation measures in meeting the projected diversion reductions and other benefits attributed to the measures.
7. No net loss of wetland functions and values	The feasibility investigation identifies existing wetlands, assesses the impacts of implementing water conservation measures, and, if necessary, describes potential mitigation measures to assure no net loss of wetland functions and values.
8. Compatibility with Conservation Plan	The proposed water conservation measures address the instream flow problems and needs identified in Section 4 of the Conservation Plan.
Selection Considerations	
9. Extent of reduced diversions	The extent that the reduced diversions will contribute to meeting instream flow needs identified in Section 4 of the Conservation Plan in years of (1) non-proration and (2) proration.
10. Improved quality of surface waters	The proposed water conservation measure improves the quality of surface water returning to the Yakima River.
11. Complements other Conservation Program activities	The proposed water conservation measures integrate with other water conservation measures, enhance Yakima Project operations, increase opportunities for reducing water diversions through onfarm water conservation measures, or leverage additional funding of water conservation measures.
12. Integral component of entity water conservation plan	The proposed measures are an integral component of the entity's water conservation plan and funding from the Conservation Program will facilitate implementation of other measures in the entity's water conservation plan.
13. Innovative project value	The proposed conservation measure is testing an innovative approach to accomplish the goals of the Conservation Plan.

The outgrowth of the foregoing benefit prioritization will be approved conservation measures for implementation. If water is available for acquisition, which will result in greater benefits than can be realized through implementation of the approved conservation measures, then water

[1] "Reduced diversion" includes all the water conserved; water to increase fish flows and water to improve irrigation reliability.

acquisition should be funded as a priority; if not, the conservation measures should be funded. The screening process for Conservation Program funding is illustrated in Figure 6-2.

The CAG believes that tiered water rate structures will improve water use efficiency in the Yakima River basin. CAG encourages participants in the Conservation Program to develop and implement tiered water rates as part of their water conservation plans.

As an initial effort, CAG suggests the establishment of tiered water rate structures with the following characteristics:

- The base rate (first tier) established would recover the entity's basic annual budget through an acreage assessment and include a contingency allowance. The water allotment for this tier would be based on the crop irrigation requirement of the predominate crops within the entity's boundaries pursuant to the State of Washington Irrigation Guide (WA 683-1).

- Subsequent tiers, possibly two or three tiers, of water delivery would have significant rate increments over the prior tier.

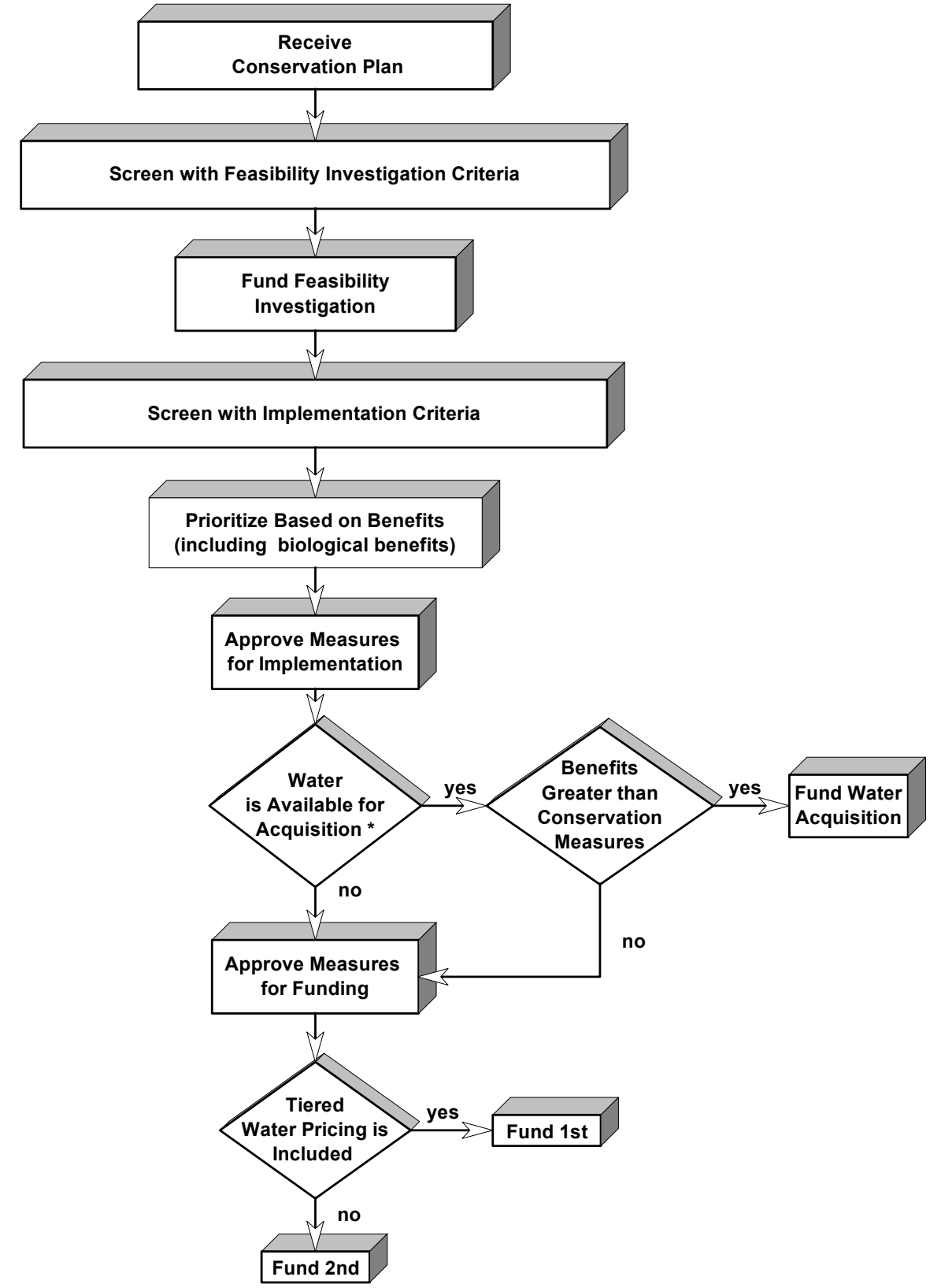
- Commitment to a long-term tiered water rate structure.

Implementation funding for participants promoting tiered water rates will receive priority consideration in cases where implementation funding criteria are equally met and there are competing demands for funds (see "tiered water rates on Figure 6-2).

6.6 MEASURING, MONITORING, EVALUATION, AND REPORTING

6.6.1 Pre-Implementation Measuring Program

A primary condition for participating in the Conservation Program is an agreement that the participant will "equip all surface water delivery systems within their boundaries with volumetric meters or equally effective water measuring methods within 5 years of the date of enactment of this Act." This 5-year period ends on October 31, 1999. It should be noted that the Adjudication Court, on October 13, 1994, directed that measuring devices must be installed by March 1, 1995, at each diversion of 1 cfs and greater from the Yakima, Naches, and Tieton Rivers.



* Priorities for Water Acquisition are Identified in Section 5.5

Figure 6.2 --- Screening Process for Conservation Program Funding

Neither Title XII nor the supporting documentation provide insight on the extent of intended system measuring. However, CAG believes that the measurement requirement includes points of diversion of the surface water supply and at all delivery points (farm turnouts). At present, the larger entities in the Yakima River basin have measuring devices that should meet the requirement; however, some smaller entities that desire to participate in the Conservation Program may not. The intent of this requirement of Title XII is to obtain timely implementation of measuring and monitoring programs, not to exclude participation in the Conservation Program.

Some entities, which do not meet this requirement, may wish to participate in the Conservation Program and install new water measuring devices as a part of their water conservation elements. In these cases, it would be more economical to equip the new system with water measuring devices than meet the requirement by installing equipment on a system that is to be replaced.

CAG recommends the following pre-implementation water measuring policy for participants in the Conservation Program:

- Measuring devices shall be operable at all points of diversion of the surface water supply as a requirement for participation in the Conservation Program.

- Measuring devices shall be operable at all points of delivery of surface water (farm turnouts) prior to October 31, 1999[1]. Entities anticipating modification of distribution and lateral systems as a part of their water conservation plans may request a deferment of this requirement if a request is submitted to Reclamation not later than December 31, 1998. The request shall describe the current status of the entity's water measuring program, how water flow and volume data needed to prepare the water conservation and the feasibility investigation will be developed, and why such a deferment is justified. Reclamation shall make a decision (approve or disapprove) the request within 60 days of receipt.

- Entities who have not installed water measuring devices in their water delivery systems and desire to participate in the Conservation Program may be considered for crediting, as local cost-sharing, those costs which they incur in acquiring and installing such devices by October 31, 1999. Crediting is contingent upon (1) submitting a written request to Reclamation prior to acquisition and installation, but not later than December 31, 1998, (2) Reclamation approval of the proposed acquisition and installation program, and (3) completion of a water conservation plan seeking funds for

[1] The term "operable" in CAG's recommendation means installed, accurate measurements taken, and records maintained.

implementing water conservation measures under the Conservation Program and approval by Reclamation.

6.6.2 Post-Implementation Monitoring Program

Participating entities must prepare a plan for post-implementation monitoring as part of their feasibility investigation. The "Guidelines for Feasibility Investigations" (see Appendix VII) provide guidance for development of a monitoring plan.

Information gathered during the post-implementation monitoring and evaluation phase of the Conservation Program will be reported to and maintained by Reclamation to evaluate the overall success of the Conservation Program. This data will also serve to develop a historical record of water conservation accomplishments in the Yakima River basin and establish a new baseline for future project operations.

7.0 AGREEMENTS

The purpose of this section is to provide a quick overview of the agreements and administrative procedures Reclamation and Ecology will use for the Conservation Program.

7.1 COST-SHARING AGREEMENT

Section 1203(d)(2) directs Reclamation and Ecology to enter into a cost-sharing agreement within 1 year of enactment of Title XII. This agreement, completed and signed May 25, 1995, sets forth the cooperative funding of actions under the Conservation Program and the cost-sharing principles which will apply. A copy of the cost-sharing agreement appears in Appendix VIII-B.

7.2 COORDINATION PLAN

Reclamation and Ecology have developed a Coordination Plan which defines and describes the specific process and procedures which will be used in implementing the Conservation Program. The Coordination Plan describes each agency's role and responsibilities and identifies the time allotted for completing each activity. The consistent goal of the Coordination Plan is to provide for speedy processing of grant funding requests.

Reclamation has the lead coordination role and acts as the primary contact with the entities that participate in the Conservation Program. These activities include accepting funding application, providing written notice of receipt, providing information on funding decisions, negotiation of three-party grant agreements, and maintenance of files. A copy of the Coordination Plan is included in Appendix IX.

7.3 FUNDING AGREEMENTS

7.3.1 Water Conservation Plans

Reclamation and Ecology have prepared an application packet for participants which includes the Guidelines for the Preparation of Water Conservation Plans, the Application for Funds to Prepare a Water Conservation Plan, and explanatory information (see Appendix VI). Entities interested in applying for conservation planning grant funds must complete and submit an application form to Reclamation. Reclamation will send the entity a letter acknowledging receipt of the application and transmit a copy of the application to Ecology. Following review of the application, Reclamation will inform the entity of the joint agency decision on funding request. If the decision is favorable, Reclamation will initiate negotiation of a three-party grant agreement.

Copies of the acknowledgment, transmittal, and funding decision letters and the three-party grant agreement for funding development of water conservation plans are attached to the Coordination Plan in Appendices IX-A, IX-B, IX-C, and IX-D.

7.3.2 Feasibility Investigations

Entities submit their completed water conservation plans to Reclamation for approval of funding a feasibility investigation. Reclamation, Ecology, and a Feasibility Investigation Team will review the plan for adequacy, completeness, and benefits towards the goals of Title XII using the Conservation Plan criteria (Table 6-2). Reclamation and Ecology jointly decide whether to fund a feasibility investigation of some or all of the proposed water conservation measures. If there are deficiencies in the plan, Reclamation informs the entity of the deficiencies and that further work by the entity is required. If the plan is adequate, a decision is made on funding, and, if funding is approved, Reclamation will initiate negotiation on a three-party grant agreement.

Copies of the acknowledgment, transmittal, and funding decision letters and the three-party grant agreement for feasibility investigation funding are attached to the Coordination Plan in Appendices IX-E, IX-F, IX-G, and IX-H.

7.3.3 Implementation

Entities submit a completed feasibility investigation report to Reclamation. Reclamation and Ecology review the plan for adequacy and completeness, and Reclamation informs the entity of any deficiencies and further work required by the entity. Using the Conservation Plan criteria (Table 6-3) for disbursement of funds, Reclamation and Ecology jointly decide whether or not to fund implementation of some or all of the measures. If the decision is favorable, Reclamation initiates negotiation of a three-party funding agreement.

Copies of the acknowledgment, transmittal, and funding decision letters and the three-party grant agreement for implementation funding are attached to the Coordination Plan in Appendices IX-I, IX-J, IX-K, IX-L.

8.0 OVERSIGHT

Primary responsibility for implementation and monitoring of the Conservation Program rests with Reclamation and Ecology. The parameters of Reclamation and Ecology responsibilities relative to cost-sharing, annual work plans, and the three-party agreements with program participants are defined in the cost-sharing agreement of May 25, 1995. The Coordination Plan describes the process and procedures by which these two agencies will coordinate the implementation of the Conservation Program pursuant to the Conservation Plan.

Pursuant to Section 1203(c)(3)(D) of Title XII, CAG shall "provide annual review of the implementation of the applicable water conservation guidelines of the Secretary." This is to assure that the guidelines developed by CAG in the Conservation Plan for use in preparing water conservation plans, conducting feasibility investigations, and selecting water conservation measures for implementation continue to be workable to achieve the desired diversion reductions to meet the purposes of Title XII.

Periodic consultation with CAG is anticipated in the administration of the cost-sharing agreement, including development of work plans, budgets, and schedules for carrying out the four phases of the Conservation Program.[1] Work plans are to be revised annually to provide for changes in Reclamation and Ecology appropriations and other normal fluctuations in the program schedule and to provide a means to define areas of program emphasis.

The CAG is to terminate 5 years after the date of its establishment unless otherwise extended by the Secretary.

[1] Articles 7(A) and 15 of Cost-Sharing Agreement

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 PRE-IMPLEMENTATION WATER MEASURING PROGRAM

Measuring and accounting for water diverted and delivered is an essential component of water system operations. Knowing what is diverted and where it is delivered is the basis for structuring and maintaining a sound water management program. Title XII recognized this need by stipulating that a primary condition for participation in the Conservation Program is an agreement that the participants will "equip all surface water delivery systems within their boundaries with volumetric meters or equally effective measuring methods within 5 years of the date of enactment of this Act." This 5-year period ends October 31, 1999.

The CAG believes this measuring requirement includes points of surface water diversion and points of water delivery (farm turnouts). At present, the larger entities in the Yakima River basin have measuring devices that should meet this requirement; however, some smaller entities that desire to participate in the Conservation Program may not. The intent of this requirement of Title XII is to achieve timely implementation of measuring and accounting systems, not to exclude participation in the Conservation Program.

Some entities, which do not meet this requirement, may wish to install water measuring devices as a part of their water conservation elements. In these cases, it would be more economical to equip the new system with water measuring devices than meet the requirement by installing equipment on a system that is to be replaced.

Recommendation 1: The following pre-implementation water measuring policy is recommended for participation in the Conservation Program:

- Measuring devices shall be operable[1] at all points of diversion of the surface water supply as a requirement for participation.

- Measuring devices shall be operable at all points of surface water delivery (farm turnouts) prior to October 31, 1999. Entities anticipating modification of distribution and lateral systems as a part of their water conservation plans may request a deferment of this requirement if a request is submitted to Reclamation not later than December 31, 1998. The request shall describe the current status of the entity's water measuring program, how water flow and volume data needed to prepare the water conservation plan and conduct the feasibility investigation will be developed, and why such a

[1] The term "operable" in this recommendation means installed, accurate measurements taken, and records maintained.

deferment is justified. Reclamation shall make a decision on the request (approve or disapprove) within 60 days.

- Entities who have not installed water measuring devices in their water delivery systems and desire to participate may be considered for crediting, as local cost-sharing, those costs which they incur in acquiring and installing such devices by October 31, 1999. Crediting is contingent upon (1) submission of a written request to Reclamation prior to acquisition and installation, but not later than December 31, 1998, (2) Reclamation approval of the proposed acquisition and installation program, and (3) completion of a water conservation plan, feasibility investigation, and implementation of water conservation measures.

9.2 GUIDELINES FOR WATER CONSERVATION PLANS AND FEASIBILITY INVESTIGATIONS

The success of the Conservation Program relies on evaluating the current water system and its operation, identifying measures that could improve efficiencies in water delivery and water use, developing a water conservation plan, and investigating in more technical detail the engineering, financial, and environmental feasibility of implementing potential measures. Guidelines for use by participants in preparing water conservation plans and conducting feasibility investigations have been developed and adopted by the CAG.

The water conservation plan guidelines have been "tailored" for use in the Yakima River basin and to meet the requirements of Title XII. They are compatible with guidelines (1) currently being used by Ecology under its Referendum 38 activities relating to financial assistance for irrigation water supply systems and (2) currently used for Reclamation water conservation plans.

Guidelines for the conduct of feasibility investigations are similar in many aspects to those of Reclamation's Small Reclamation Projects Loan Program and Distribution System Loan Program.

Recommendation 2: The guidelines developed by the Conservation Advisory Group for preparing water conservation plans and conducting feasibility investigations should be used in the Yakima River Basin Conservation Program. This is with the understanding that, as the program evolves, revisions can be made by Reclamation, in consultation with the Ecology, after seeking advice from the Conservation Advisory Group.

9.3 WETLANDS

9.3.1 Habitat Plan

Wetlands, especially those in riparian and floodplain areas, are important to fish, wildlife, flood management, and water quality. A goal of the Enhancement Project is to protect, create, and enhance wetlands and their associated riparian and floodplain habitat.

To assure that these functions and values are maintained, a coordinated effort is required by Reclamation, participants, and Yakima River basin fish and wildlife resource managers. A first step in this coordinated effort should be the development of a Habitat Plan to help guide wetlands activities in the Yakima River basin. It should include an inventory, rating, and assess functions of existing wetlands; a comparison of historical and current conditions at a landscape scale; and a ranking of priority areas for protection, creation, and enhancement in each of the four subareas of the Yakima River basin identified in the Conservation Plan.

Recommendation 3: Reclamation and Ecology, in collaboration with the basin fish and wildlife resource managers, should develop a Habitat Plan with funds authorized by Title XII. Because it will guide the implementation of many measures designed to fulfill the goals of Title XII, development of the Habitat Plan should be initially funded in fiscal year 1998.

9.3.2 Wetlands Enhancement Project

Using the Habitat Plan as a guide, a Wetlands Enhancement Project undertaken in each of the four subareas of the basin would assist in protecting, creating, and enhancing high value wetlands and fish and wildlife resources. The Wetlands Enhancement Project would provide a cost effective and ecologically advantageous opportunity to mitigate incidental losses of wetlands resulting from implementation of water conservation measures by "pooling" and directing mitigation efforts toward priority areas.

Recommendation 4: Reclamation, Ecology, and the basin fish and wildlife managers should develop a Wetlands Enhancement Project using funds from the Conservation Program (from the $67.5 million authorization). The first year of funding should be fiscal year 1999. Funding for the Wetlands Enhancement Project should be supplemented with monies for wetlands mitigation obtained from entities participating in the Conservation Program. Other sources of funding should also be pursued.

In preparing the Yakima River Basin Wetlands and Floodplain Habitat Plan and in pursuing land acquisition activities associated with the development of the Yakima River Basin Wetlands Enhancement Project, full consideration will be given to comprehensive plans prepared by counties and cities pursuant to the Growth Management Act of the State of Washington, Chapter 36.70A RCW.

9.4 WATER QUALITY

The greatest results from the implementation of water conservation measures under the Yakima River Basin Water Conservation Program will be realized if (1) the existing delivery systems are upgraded to allow near on-demand delivery to the farm headgates and (2) onfarm systems are improved so they can be effectively managed to regulate the frequency and duration of water applications. Integration of these improvements will permit the reduction of water diversions from the river, improving instream flows and the reliability of the irrigation supply, and resulting in significant water quality improvements as well.

Currently, most Yakima River basin water delivery systems are not capable of providing on-demand service. While onfarm improvements will allow the farmer to control timing of water use, fluctuations in onfarm demands generally result in operational spills from the entity's water delivery system. To reduce operational spills, the water delivery systems must be upgraded so they can absorb these flow fluctuations by temporarily holding water for release, or by other means, as appropriate. While improvements in water quality will result from water delivery system modifications, the greatest water quality improvements will result from improved management of water on the farm.

Conservation Districts throughout the Yakima River basin are equipped to work with individual farmers, irrigation entities, and other groups to promote onfarm water conservation measures. While USDA funding has been available to Conservation Districts in the past through various programs, funding for these programs has been limited. This is why CAG, to promote onfarm improvements while also complying with Title XII's directive for program funds to result in diversion reductions, has recommended that onfarm water conservation measures can be included for funding as a part of an entity's water conservation plan if a diversion reduction will result from implementation of those onfarm measures. CAG encourages the integration of entity water conservation plans with other water conservation activities to realize the greatest reduction in diversions and improvements in the quality of water in the Yakima River and its tributaries.

Recommendation 5: In preparing water conservation plans, participating irrigation entities should work to identify opportunities to incorporate onfarm water conservation measures with associated water quality benefits and integrate the Conservation Program with other onfarm programs.

9.5 WATER AND LAND ACQUISITION

In Title XII, Congress directed the Secretary, acting through Reclamation, to facilitate water and water right transfers, water banking, dry-year options, the sale and leasing of water, and other innovative allocation tools to address a host of problems encountered by Yakima River basin anadromous fish in various life cycle stages and at various times throughout the year.

Congress authorized Reclamation to use Conservation Program funds to purchase or lease land, water or water rights from any entity or individual willing to limit or forego water use on a temporary or permanent basis.

The primary emphasis for acquiring water and water rights in the mainstem Yakima River and Naches River is to increase instream target flows at Sunnyside Diversion Dam and Prosser Diversion Dam and to supplement instream flows at other critical reaches, and tributary reaches, identified in the Conservation Plan.

An appropriation of $10 million was authorized for the expeditious acquisition of water for the fishery in the "interim" period between enactment of Title XII and the time that a significant increase in instream target flows become a reality and for "flushing" and out-migration flows.

Acquisition of riparian lands with associated water rights in key habitat areas of the basin can accomplish the multiple objectives of providing water for instream flows, re-establishment of critical riparian habitat, wetlands enhancement, and water quality improvement.

Recommendation 6: Reclamation should aggressively seek to acquire water in the "interim" period, fully pursuing the Congressional directive to acquire water for the needs identified in the Conservation Plan and for "flushing" and out-migration flows.

Recommendation 7: Purchase of water, water rights, and lands on a permanent basis should be a priority over leasing. Permanent acquisitions have fewer transaction costs than leases and allow Reclamation to plan for the future operation of the Yakima Project. Long-term water leases and "dry-year" water options may be a cost effective and biologically effective solution to a particular problem when there is no foreseeable opportunity for permanent acquisition.

For the acquisition of wetlands or potential wetland habitat, easements in perpetuity may afford the same sort of long-term planning opportunities as outright purchase and be cost effective. Reclamation should pursue easements in areas that cannot be acquired by fee purchase but are key for re-establishing wetland and riparian habitats for anadromous fish production.

Recommendation 8: When acquiring water rights, the consumptive amount of the right should be accounted for and fully protected from all junior appropriators to the mouth of the Yakima River. In addition, system losses associated with the acquired water right should be protected from appropriation from the point of diversion to the point where such flows would re-enter the river.

Recommendation 9: Reclamation should implement an aggressive water and land acquisition program, pursuing acquisition activities in areas indicated in the Conservation Plan for instream flow improvements and in areas indicated in the Habitat Plan as important for riparian and floodplain wetland habitat. Such lands with associated water rights should be given priority for

acquisition. Reclamation should develop an outreach strategy consisting of such activities as distributing printed materials explaining the water and land acquisition program, providing public service announcements and public information, holding educational meetings, establishing a "hot-line" to respond to questions, and other activities to reach as many people in the Yakima River basin as possible with information.

9.6 TIERED OR MULTIPLE BLOCK WATER RATE STRUCTURES

Multiple block water pricing, known as tiered water rates, is a key tool to water conservation. It encourages efficient water use by charging more per unit as water use increases. Many municipalities and some irrigation entities use a multiple block rate structure and report that it is an effective water conservation measure.

Recommendation 10: New and amended water supply contracts entered into by Reclamation in the Yakima River basin should contain a requirement that the contractor establish a conservation-based tiered water pricing structure.[1]

9.7 PUMPING ENERGY

There are opportunities to replace some gravity water delivery systems with pumped systems resulting in the relocation of the diversion point downstream. Such actions could provide significant instream flow improvements in critical river reaches. Pumping also provides an opportunity to capture operational spills and drain flows for re-use and assist in reducing diversions. However, the annual cost of pumping energy must be fully borne by the entity which could preclude implementation.

Recommendation 11: Reclamation, Ecology, and BPA should explore opportunities for obtaining pumping energy at less-than-retail-rates for entities willing to include pumping as a part of their water conservation plan under the Conservation Program. Such rates would be applicable only in those cases where significant instream flow and water quality improvements could be achieved for enhancement of anadromous fish in critical reaches of the Yakima River system. Reclamation and Ecology should report to the CAG on the results of these discussions for further consideration.

[1] The "Diversion Reduction Agreement" entered into by the entity and Reclamation prior to securing Conservation Program funds for implementation of water conservation measures is not considered to be a new or amended water supply contract.

9.8 POST-IMPLEMENTATION MONITORING

One purpose of Title XII is to protect, mitigate, and enhance the fish and wildlife resources of the Yakima River basin through water management, instream flow, and water quality improvements, and the enhancement of wetlands and other habitat improvements. Congress authorized the funding of a variety of water conservation measures and water management improvements in the Yakima River basin in order to achieve these results. While there is provision in Title XII for post-implementation monitoring and evaluation of water conservation measures to determine their effectiveness, there is no particular directive for Reclamation to monitor and evaluate the overall effectiveness of Title XII in improving the fish and wildlife resources of the Yakima River basin.

It is important for Reclamation to document flow changes in the river and to monitor and evaluate whether reduced diversions and acquired water are actually improving conditions for fish and wildlife. It is equally as important to monitor and evaluate whether these flow changes are resulting in the enhancement of anadromous fish populations.

Recommendation 12: The Operating Plan should contain specific monitoring and evaluation provisions to determine the effectiveness of the Conservation Program and the use of water from reduced diversions and acquired water to improve the river flow regime and habitat conditions to benefit fish and wildlife. Monitoring and evaluation should include flow (physical), biological, and chemical parameters. The monitoring and evaluation program should be designed to support adaptive management.

9.9 RESTRICTION ON EXPANSION OF IRRIGATED LANDS

Section 1203(a)(2) of Title XII directs that "conserved water resulting in whole or in part from the expenditure of Federal funds shall not be used to expand irrigation in the Yakima Basin, except as provided in Section 1204(a)(3) on the Yakama Indian Reservation." This is consistent with a purpose of Title XII to improve the reliability of water supply for irrigation and to make water available to entities with proratable water entitlements in water-short years to sustain the existing irrigated lands.

Because of the need to address declining anadromous fish runs, the Secretary's Indian trust responsibilities, and possible listings under the Endangered Species Act, Congress stressed that the expenditure of funds under Title XII should not increase irrigated agriculture in the Yakima River basin over current conditions. To implement this directive, baseline conditions must be established.

Recommendation 13: Reclamation and Ecology should include a provision in the "Implementation Three-Party Grant Agreement" that (1) conserved water achieved under the Conservation Program will not be used to expand irrigated acreage and (2) Reclamation and

Ecology should establish baseline conditions and a process for periodic review to implement this Congressional directive.[1]

9.10 FUNDING

The success of the Conservation Program depends on adequate annual Federal and State appropriations. Most of the construction work must be accomplished between irrigation seasons, from mid-October through mid-March, and commitments must be made in advance for necessary construction contracts and acquisition of materials.

Recommendation 14: Upon commitment of funds for implementation, annual Federal and State budget requests and appropriations should be sufficient to accomplish the scheduled work. To accomplish objectives, the Conservation Program should be given a high priority in the budget requests of Reclamation and Ecology.

[1] The "Implementation Three-Party Agreement" is the agreement among the entity, Reclamation, and the Washington Department of Ecology for funding the implementation of selected water conservation measures.

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