January 5, 2000

Mr. Robert Hamilton
U.S. Bureau of Reclamation
1150 North Curtis Rd
Boise, ID 83706

SUBJECT: Comments re: Harza report, Oct 22, 1999, on instream flow needs for fish.

Dear Bob:

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Department of Natural Resources (DNR) is providing the Bureau of Reclamation with (1) master set of comments regarding the draft report on instream flow needs for fish in the Umatilla Basin, prepared by Harza, October 22, 1999, and (2) a report prepared by DNR on flow needs for salmonids and other aquatic organisms in the Umatilla River, December 28, 1999. Please find the above two documents attached.

The report prepared by Harza is well researched and is an excellent summary of the accomplishments achieved through Phases I and II of the Umatilla Basin Project (UBP) to restore salmonids to the Umatilla River. The problems and needs section of the report, however, is not as well developed as the other sections. The problems and needs section should address the inherent inadequacy of both the State's minimum instream flows and the UBP target flows. This problem needs to be explicitly recognized up front to give the context for the flow needs described in the report.

In addition, the report needs more explanation of the problems related to poor habitat and water-quality conditions of the Umatilla River. These problems directly effect any efforts by Federal, State and Tribal agencies to restore self-sustaining salmonid populations. In response to Reclamation request of CTUIR to comment on Harza's report, DNR has prepared a flow needs report which not only expands on the concepts presented in Harza's report but also addresses the quantity and quality of stream flow necessary for salmonid survival during all phases of their life history.

I hope you find these comments helpful. If you have any questions please call Aaron Skirvin at (541) 278-5297. Thank you for the opportunity to comment on this important document.

Sincerely,

Michael J. Farrow
Director, DNR

CC: Ron Costello, Harza
Kate Puckett, USBR
CTUIR DNR Personnel

Attachments

FLOW NEEDS FOR SALMONIDS AND OTHER AQUATIC ORGANISMS IN THE UMATILLA RIVER

By

Department of Natural Resources
Confederated Tribes of Umatilla Indian Reservation

December 28, 1999

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FLOW NEEDS FOR SALMONIDS AND OTHER AQUATIC ORGANISMS IN THE UMATILLA RIVER

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I. INTRODUCTION

This report addresses the quantity and quality of stream flow necessary for salmonid survival during all phases of their life history. In the context of planning a Phase III of the Umatilla Basin Project, the Department of Natural Resources of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) has been requested by the U.S. Bureau of Reclamation to quantify the flows needed to maintain and enhance salmonids and lamprey in the Umatilla River Basin. Salmonids in the Umatilla River Basin include salmon, resident rainbow trout, anadromous rainbow trout (steelhead), bull trout, and mountain whitefish. This report focuses on estimating flow requirements for fish in the mainstem Umatilla River. Flow needs in the tributary streams, which are critical habitat for salmonids, are beyond the scope of this report.

From a fisheries management perspective, the best use of the water would be to manage all of it for the production of fish. However, CTUIR has a policy of trying to find solutions which accommodate the existing water needs of the non-Indian community while fulfilling Tribal reserved water rights and Tribal treaty rights. Hence, managing a limited resource for the best interest of a diverse group of individuals likely will require difficult choices. The difficulty of quantifying fish-flows also lies in the variability of the hydrological system and stream habitats of the Umatilla Basin.

With the current available data, CTUIR cannot provide the specific flows that make a perfect compromise between the needs of fish and the other water users. However, we can provide general guidelines and an understanding of fish-flow management needs in the Umatilla River. Providing the flows, water quality, and habitat suitable for salmonids should address the water requirements of lamprey and other aquatic organisms because salmonids are sensitive indicator species.

Figure 1 shows the location of the Umatilla River, its major tributaries, large diversion dams, McKay Reservoir, and other features discussed in text. In the context of a Phase III of the Umatilla Basin Project, this report focuses on fish needs in three separate reaches of the mainstem of the Umatilla River. These reaches are the lower river (Echo to the Columbia River), the reach between the mouth of McKay Creek and Echo, and the reach from the mouth of McKay Creek to the mouth of Meacham Creek. Although the CTUIR prefers to consider the river basin (watershed) as a whole for fish-restoration purposes, dividing the mainstem into these reaches is helpful because of the location of federal water-development facilities for both consumptive use and instream use, Phases I and II of the Umatilla Basin Project, potential for Phase III water exchange, and fish species life history stages and their temporal and geographic distribution in the Umatilla River.

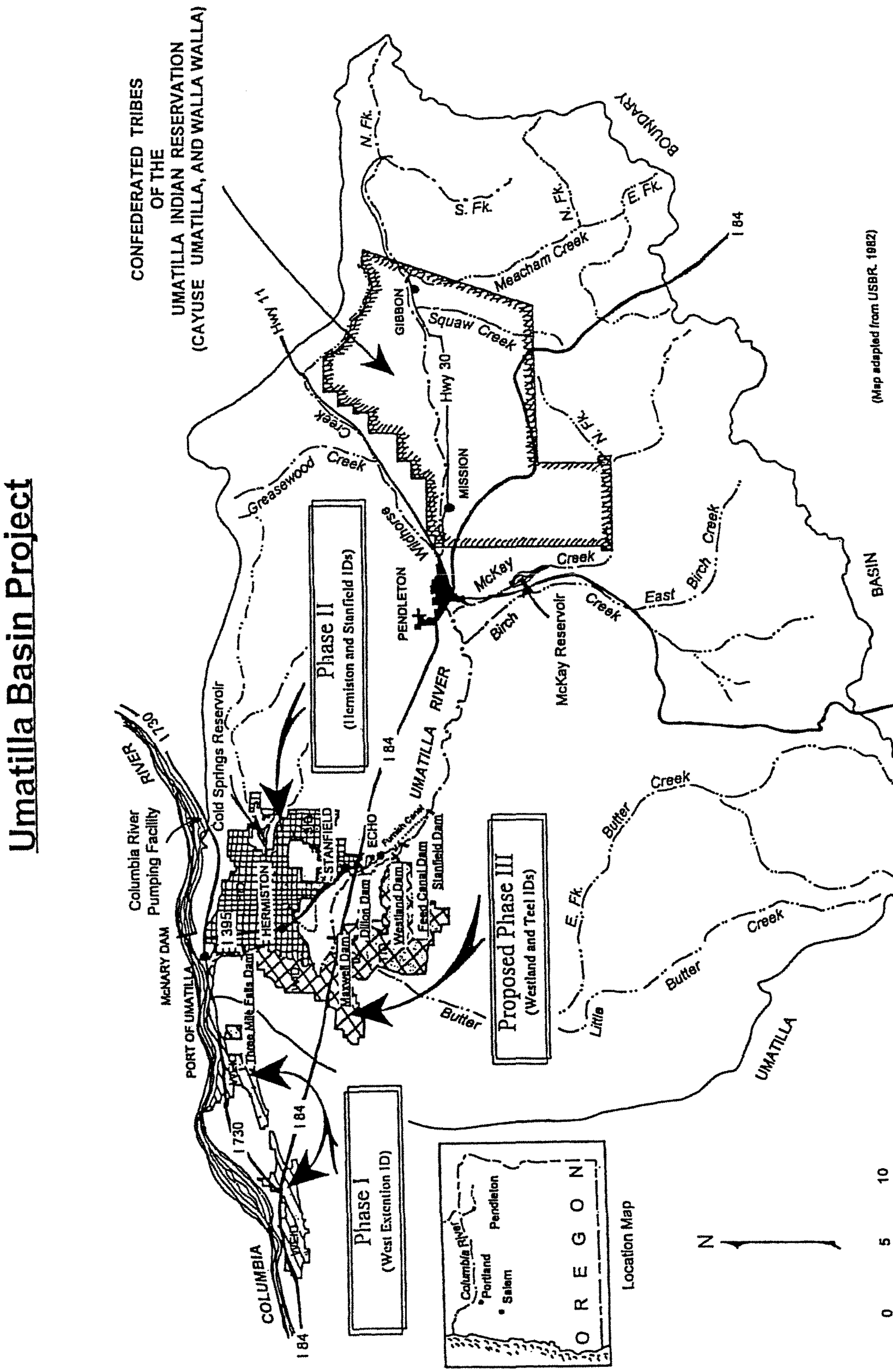

Figure 1. Location map of the Umatilla River, its major tributaries, McKay Reservoir, and several diversion dams below the City of Echo.

II. BACKGROUND

A. Fish Restoration Goals

The goal of Tribal fisheries management is to restore and perpetuate salmonids and lamprey populations in the Umatilla River Basin at levels that provide for natural production and sustainable harvest at substantial rates. The current goal as developed by the Umatilla Tribe and the state of Oregon is to annually produce 47,500 returning adult anadromous salmonids to the Umatilla River Basin: fall chinook – 21,000; spring chinook – 11,000; coho – 6,000; and steelhead – 9,500. Specific lamprey restoration goals have not been set, but a restoration plan is being prepared. To achieve these goals for salmonids, satisfactory habitat conditions, including stream flow, must be restored in the Umatilla River Basin.

B. Phases I and II Target Flows

Phases I and II of the Umatilla Basin Project are now complete and provide improved stream flow from the mouth of McKay Creek to the Columbia River for fishery restoration purposes during part of each year. These phases of the project have provided some live stream flow and stored water in McKay Reservoir for critical migration flows for salmonids each year during June, early July, late September, October, and early November, and in some year as early as May. The target flows described in the Basin Project Planning Report are shown in Table 1. Tribal and state fishery managers have the flexibility to release a portion of the stored water in McKay Reservoir as needed on a day-to-day basis to augment live flows for fish use in the lower river.

Table 1. Current Umatilla Basin Project target flows, McKay Creek to Mouth (USBR 1988).

Period	Target Flow (CFS)
October 1 – November 15	300
November 16 – June 30	250
July 1 – September 15	0
September 16 – September 30	250

C. Lethal Conditions For Salmonids

With respect to salmonid and aquatic-organism survival, water quantity, water quality, and habitat are inter-related. Even with water made available as a result of Phases I and II of the Umatilla Basin Project, flow and/or water quality conditions in some reaches of the Umatilla River during parts of every year are lethal to salmonids. The principal lethal events for salmonids and the associated aquatic community in the Umatilla River are stream dewatering and high stream temperatures, principally during the summer season. Instantaneous water temperatures above 70 degrees (F) should be avoided and prolonged temperatures above 70 degrees (F) can be lethal to salmonids (see Table 2).

Table 2. Upper limit of lethal stream temperatures for spring chinook and coho (DEQ 1995).

Spring Chinook (Degrees F)	Coho (Degrees F)
71.6	77.0

III. GENERAL SALMONID REQUIREMENTS

Salmonids, lamprey and aquatic macro-invertebrates (fish-food organisms, in particular) need perpetual, cool, clean water during all phases of their life history. Salmonids have the highest survival, growth, and reproductive success in complex quality habitat with abundant and diverse fish-food organisms.

Flow management for fishery values is based on providing continuous flows (at suitable temperatures and quality) to allow for the development of complex and diverse aquatic communities. The quantity of flow should vary seasonally and even within season, but should be sufficient in quality and quantity at all times to maintain the life stages of anadromous fish and the associated aquatic community. An aquatic community includes all of the biological components of a section of stream or lake such as insects, fish, algae, plants, microbes, diatoms, etc. The aquatic community in a backwater pool is different than in a riffle or in a pool. When an aquatic system has many different communities, it is described as being complex and diverse. Where there are many different species and types of organisms in a community, it is described as having a high species richness. The most productive systems are those with high diversity and high species richness.

In terms of instream-flow management, there are three major factors necessary to achieve a high diversity of species-rich aquatic communities:

1. Sufficient flows (rearing flows) to provide both adequate space and suitable stream temperatures throughout the year for: adult holding, spawning, egg incubation, fry emergence, rearing, and adequate food supply;

2. Seasonal periods of higher flows (migration flows) to assist the outmigration of juvenile salmonids and lamprey to the ocean and sufficient flows for adult migration upstream over falls and rapids as they return to spawn; and

3. Channel-maintenance flows to (a) maintain channel features such as width to depth ratio, sinuosity, pool to riffle ratio, riparian habitat; (b) flush sediment; and (c) inundate riparian vegetation and recharge groundwater.

For the reach of Umatilla River above the McKay Creek confluence (RM 50.5), Table 3 lists (1) the types of flows needed for fishery restoration, (2) the monthly fish use of this reach by species and life stage, and (3) the water-quality limiting parameters in the reach[1]. Tables 4 and 5 list the same components as in Table 3 but for the river reaches from McKay Creek to Echo and from Echo to the mouth, respectively. As shown in Tables 3, 4, and 5 fish are present throughout the Umatilla River all year and that water-quality limiting conditions exist all year.

A. Rearing Flows

Flow management for fish should include contingencies for drought and avoid even short-term losses of flow. The effect of a lethal event in a stream is analogous to the effect of a major fire in terrestrial habitat. With stream organisms, the damage of one lethal event can be long-term, although the evidence is not easily seen from a terrestrial perspective. It is a mistake to believe that once water is back in the channel that all is well with the aquatic community. Stream organisms and communities cannot withstand even brief lethal events.

Some species, such as algae and the larvae of biting flies etc., will survive and recolonize quickly, but the most productive invertebrate populations in the stream community take longer to rebound. Important fish-food organisms such as caddis flies, stoneflies and mayflies are sensitive to high temperatures, sediment and dewatering. Some of the most important fish-food organisms also have multiyear life cycles so it takes two to three generations to recolonize the habitat at two and three years per generation.

This is also true for anadromous salmonids because their life cycle includes multiple years in fresh and saltwater. The success of adult steelhead returns from the ocean is directly tied to the survival, growth and well-being of fish throughout their freshwater life history. Without abundant adults returning to spawn, the production of juveniles is reduced. For example, a lethal event in 1990 could affect juvenile production in 1990, 1991, 1992 and the number of returning adults in 1994 through 1998 and the production of their progeny into the next decade. Thus, a single lethal event could affect the number of adult returns for more than a decade.

If lethal events such as high water temperatures or channel dewatering occur even once each decade in important production areas, the steelhead population and aquatic fish-food organisms could be in a constant state of rebuilding and never achieve optimum productivity. Repeated disturbance also reduces stream organism diversity and keeps more of the primary production in forms that are less usable by salmonids (e.g. algae instead of caddis flies).

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[1] As required by the 1972 Federal Clean Water Act (CWA) in Section 303(d), the State of Oregon has identied the stream reach, beneficial use of the stream reach, water-quality limiting parameter that impairs beneficial use of that stream reach, basis for listing the parameter, and the time of year when a violation of the water quality standard is a concern. CTUIR also has recently developed their own water-quality standards and limiting conditions for waterbodies on the Reservation.

Table 3. Types of flows, species and water-quality limiting parameters for the Umatilla River above McKay Creek Confluence. Local conditions vary depending on species and water-quality limiting parameters.

FLOW	ORDER	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1. REARING Spawning Egg/Alevin Incubation Emergence Rearing Adult Holding	CHS CHF CO STS TR TB MW LMP	CHS** CHF** CO** STS** TR** - MW LMP	CHS CHF CO STS TR - MW LMP	CHS CHF CO STS TR - MW LMP	CHS CHF CO STS TR - MW LMP	CHS CHF CO STS TR - MW LMP	CHS CHF CO STS TR - MW LMP	CHS CHF CO STS TR - MW LMP	CHS CHF CO STS TR - MW LMP	*/** CHF** CO** STS* TR - MW LMP	*/** - * * * - * LMP	*/** - * * * - * LMP	*/** - * * * - * LMP
2. MIGRATION Juvenile Adult	CHS CHF CO STS TR TB MW LMP	- CHF** CO** STS** - TB** MW** LMP	CHS CHF CO STS - TB MW LMP	CHS CHF CO STS - TB MW LMP	- - - STS - TB MW LMP	- - - STS - TB MW LMP	CHS - CO STS - TB MW LMP	CHS CHF CO STS - TB MW LMP	CHS CHF CO STS - TB MW LMP	** CHF CO STS - TB MW LMP	** CHF - - - - - LMP	** - - - - - - LMP	** - - - - - - LMP
3. CHANNEL MAINTENANCE				X	X	X	X	X	X				
4. FLOW QUALITY CWA 303(d) Limited		AW/A pH Sed Habitat	Sed Habitat	Sed Habitat	Sed Habitat	Sed Habitat	Sed Habitat	Sed Turb Habitat	AW/A Ph Sed Turb Habitat	AW/A pH Temp Sed Turb Habitat	AW/A pH Temp Sed Turb Habitat	AW/A pH Temp Sed Habitat	AW/A PH Temp Sed Habitat

***Salmonids can survive with decrease in water temperatures. Summer steelhead spawning mostly limited to lateral tributaries.**

**Present, but increase in survival with decreases in water temperatures.

LMP - Lamprey are capable of survival, but if present, only in very low numbers.

1. One or more of these life stages by species is present for the period noted. CHS= Spring Chinook; CHF= Fall Chinook; CO= Coho; STS= Summer Steelhead; TR= Rainbow Trout; TB= Bull Trout; MW= Mountain Whitefish; and LMP= Pacific Lamprey.
2. Juvenile and/or adult migration by species occurs for the period noted.
3. Seasonal, periodic high flow needed to move bedload and maintain channel/riparian habitat. These flows usually occur during the period noted by an X.
4. CWA 303(d) = Clean Water Act 303(d); water-quality limited by parameter: AW/A= Aquatic weeds/Algae; Temp= Temperature; Sed= Sedimentation; Turb= Turbidity; Flow= Flow modification; Habitat= Habitat modification; pH=high pH.

Table 4. Types of flows, species and water-quality limiting parameters for the Umatilla River from McKay Creek to Echo. Local conditions vary depending on the species and the water-quality limiting parameters.

FLOW	ORDER	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1. REARING Spawning Egg/Alevin Incubation Emergence Rearing Adult Holding	CHS CHF CO STS TR TB MW LMP	CHS CHF CO STS TR ** ** LMP	CHS CHF CO STS TR ** ** LMP	CHS CHF CO STS TR ** ** LMP	CHS CHF CO STS TR ** ** LMP	CHS CHF CO STS TR ** ** LMP	CHS CHF CO STS TR ** ** LMP	CHS CHF CO STS TR ** ** LMP	CHS CHF CO STS TR - - LMP	CHS CHF CO STS TR - - LMP	* CHF CO STS TR - - LMP	* - CO *STS TR - - LMP	* * CO STS TR - - LMP
2. MIGRATION Juvenile Adult	CHS CHF CO STS TR TB MW LMP	- CHF CO STS - - - LMP	- CHF CO STS - - - LMP	- CHF CO STS - - - LMP	- - - STS - - - LMP	- - - STS - - - LMP	CHS - CO STS - - - LMP	CHS CHF CO STS - - - LMP	CHS CHF CO STS - - - LMP	CHS CHF CO - - - - LMP	- CHF - - - - - LMP	- - - - - - - LMP	- * * * - - - LMP
3. CHANNEL MAINTENANCE				X	X	X	X	X	X				
4. FLOW QUALITY CWA 303(d) Limited		AW/A PH Sed Flow Habitat	Habitat	Habitat	Habitat	Habitat	Habitat	Turb Habitat	AW/A pH;Am Turb Habitat	AW/A pH;Am Temp Turb Flow Habitat	AW/A pH;Am Temp Turb Flow Habitat	AW/A pH;Am Temp Flow Habitat	AW/A pH;Am Temp Flow Habitat

*Salmonid summer rearing and migration in this reach can be limited by high water temperatures.

**Over-wintering bull trout and mountain whitefish

LMP – Lamprey are capable of survival, but if present, only in very low numbers.

1. One or more of these life stages by species is present for the period noted. CHS= Spring Chinook; CHF= Fall Chinook; CO= Coho; STS= Summer Steelhead; TR= Rainbow Trout; TB= Bull Trout; MW= Mountain Whitefish; and LMP= Pacific Lamprey.
2. Juvenile and/or adult migration by species occurs for the period noted.
3. Seasonal, periodic high flow needed to move bedload and maintain channel/riparian habitat. These flows usually occur during the period noted by an X.
4. CWA 303(d)= Clean Water Act 303(d); water-quality limited by parameter: AW/A= Aquatic Weed/Algae; Am= Ammonia; Temp= Temperature; Sed= Sedimentation; Turb= Turbidity; Flow= Flow modification; Habitat= Habitat modification; pH=high pH.

Table 5. Types of flows, species and water-quality limiting parameters for the Umatilla River below Echo. Local conditions vary depending on the species and the water-quality limiting parameters.

FLOW	ORDER	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1. REARING Spawning Egg/Alevin Incubation Emergence Rearing Adult Holding	CHS CHF CO STS TR TB MW LMP	- CHF CO STS TR - MW LMP	- CHF CO STS TR - MW LMP	- CHF CO STS TR - MW LMP	- CHF CO STS TR - MW LMP	- CHF CO STS TR - MW LMP	- CHF CO STS TR - MW LMP	- CHF CO STS TR - MW LMP	- CHF CO STS TR - MW LMP	- CHF CO STS TR - * LMP	- * * * * - - LMP	- * * * * - - LMP	- * * * * - * LMP
2. MIGRATION Juvenile Adult	CHS CHF CO STS TR TB MW LMP	- CHF CO STS - - - LMP	- CHF CO STS - - - LMP	- CHF CO STS - - - LMP	- - - STS - - - LMP	- - - STS - - - LMP	CHS - CO STS - - - LMP	CHS CHF CO STS - - - LMP	CHS CHF CO STS - - - LMP	CHS CHF CO STS - - - LMP	- CHF - * - - - LMP	- - - * - - - LMP	- * * * - - - LMP
3. CHANNEL MAINTENANCE				X	X	X	X	X	X				
4. FLOW QUALITY CWA 303(d) Limited		AW/A PH Sed Flow Habitat	Habitat	Habitat	Habitat	Habitat	Habitat	Turb Habitat	AW/A pH;Am Turb Habitat	AW/A pH;Am Temp Turb Flow Habitat	AW/A pH;Am Temp Turb Flow Habitat	AW/A pH;Am Temp Flow Habitat	AW/A pH;Am Temp Flow Habitat

*Salmonid summer rearing and migration in this reach severally limited by high water temperatures and low flows, found mostly associated with springs or cold water inflow along mainstem.

LMP – Lamprey may be present, but in very low numbers.

1. One or more of these life stages by species is present for the period noted. CHS= Spring Chinook; CHF= Fall Chinook; CO= Coho; STS= Summer Steelhead; TR= Rainbow Trout; TB= Bull Trout; MW= Mountain Whitefish; and LMP= Pacific Lamprey.
2. Juvenile and/or adult migration by species occurs for the period noted.
3. Seasonal, periodic high flow needed to move bedload and maintain channel/riparian habitat. These flows usually occur during the period noted by an X.
4. CWA 303(d)= Clean Water Act 303(d); water-quality limited by parameter: AW/A= Aquatic Weed/Algae; Am= Ammonia; Temp= Temperature; Sed= Sedimentation; Turb= Turbidity; Flow= Flow modification; Habitat= Habitat modification; pH=high pH.

Currently, lethal temperatures and/or dewatering occur annually in some reaches of the Umatilla River. The Oregon Department of Environmental Quality (DEQ), in cooperation with CTUIR and the Umatilla Basin Watershed Council, is presently developing a flow/temperature model based on existing habitat conditions to assess the flow and channel conditions needed to meet the temperature standards for salmonids in the Umatilla River. The CTUIR and DEQ temperature standard for salmonids is based on the seven-day moving average of the daily maximum stream temperature for waters that support salmonids in the Umatilla Basin at different life stages. For rearing, the temperature standard is 64° F (June 1 through September 30); for salmon spawning, egg incubation, and fry emergence from the egg and from the gravels (October 1 through May 31), the temperature standard is 55° F; and for waters that support bull trout, the temperature standard is 50° F (CTUIR 1999; DEQ 1995). Managing water temperature based on averages is risky for salmonid populations because, while the average temperature over a time period may meet the standard, that same time period may include short intervals when water temperatures are lethal to salmonids. It is vitally important to manage the instream water supply to avoid lethal events. Table 6 below lists the optimum water temperatures for spring chinook and coho salmon during freshwater life stages (DEQ 1995).

Table 6. Optimum water temperatures for rearing spring chinook and coho salmon.

Life Stage	Spring Chinook (Degree F)	Coho (Degree F)
Egg incubation	42.1 to 55.0	39.9 to 55.9
Juvenile rearing	50.0 to 58.6	53.2 to 58.3
Adult migration	37.9 to 55.9	45.0 to 60.1
Spawning	42.1 to 55.0	39.9 to 48.9

CTUIR, in cooperation with DEQ, are currently developing spatial-distribution maps of thermal/habitat and fish use using data collected from (1) habitat surveys conducted by the Tribes and Oregon Department of Fish and Wildlife and (2) aerial imagery of surface temperatures along the river and riparian corridor using data collected from Forward-Looking Infrared (FLIR) techniques. This information along with a flow/temperature model will be very useful in defining instream flow needs for salmonid rearing.

Much of the success in restoring anadromous salmonids to existing levels in the Umatilla River is the availability of "fish water" in McKay Reservoir, which resulted from implementation of Phase II of the Umatilla Basin Project. It is important to manage the "fish water" in McKay Reservoir such that the cool waters of the reservoir (the hypolimnion[2]) are not completely used before stream temperatures cool in the fall. Therefore, it will be necessary to monitor the volume of the hypolimnion. If warm water is released from McKay Reservoir, lethal conditions could result even with higher flow releases.

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[2] The term "hypolimnion" refers to the bottom layer of cold water in a lake or reservoir.

The management of this "fish water" during drought years is critical. During the summer, the released water heats up as it flows downstream. The lower the flows, the faster water heats up and the shorter the reach with suitable temperatures for salmonids. Providing higher flows and adequate temperatures for only part of the summer damages the entire aquatic community in the end. In a drought year (or other period of water shortage), it is much better to maintain a shorter section all year than maintain all of the reach for only part of the year.

1. Umatilla River from McKay Creek (RM 50.5) to Echo (RM 28)

Summer augmentation flows with suitable stream temperature are critical to the survival of juvenile chinook, coho, steelhead, or trout utilizing the Umatilla River from the mouth of McKay Creek to the irrigation diversions near Echo. Generally, flows released from McKay Reservoir for irrigation use during the summer provide adequate flows and temperatures for the rearing of salmon, steelhead and trout in this reach. However, there are periods before the onset of irrigation releases from McKay Reservoir when river flows are less than those that occur during the irrigation season. In addition, reducing irrigation releases for even short periods during the summer could pose a threat of creating lethal conditions in this reach of river. Phase III should include plans to augment these flows to avoid even a temporary de-watering of this reach of the river.

Rearing flows must be continued and maintained in late summer/early fall after irrigation releases are reduced. Otherwise, the river heats up and lethal conditions can occur within one or two days. Water planning and management activities need to address maintenance of suitable flow conditions in this reach of river from June through October.

The amount of water to be released could be determined by flow/temperature modeling and real-time monitoring. During the course of the summer, we would probably need to vary the flow releases from the reservoir in order to maintain satisfactory temperature conditions for rearing salmonids. As a hypothetical example, in mid July in any given year, flow needs (which are satisfied by reservoir releases) may be 200 cfs to maintain suitable temperature and habitat conditions. However, by the middle of August the flow needs may be 270 cfs to maintain similar temperature and habitat conditions through the reaches below the mouth of McKay Creek. Over the next few decades, riparian and flood plain rehabilitation projects, which result in increased stream flow (live flow) and reduced stream temperature, could reduce flow releases from McKay Reservoir gradually through time. By utilizing modeling tools and implementing stream-corridor restoration projects, "fish water" stored in McKay Reservoir could be conserved and utilized most efficiently by fishery managers.

2. Umatilla River from Echo (RM 28) to the Columbia River (RM 0)

Currently, the target flows for Phases I and II of the Umatilla Project (and actual flows) during the summer period are 0 cfs in the river reach from Echo to the mouth. There simply is an insufficient quantity of McKay Reservoir "fish water" available under the Phase II exchange to provide instream flow during the summer months. Unfortunately, this management limitation has "built-in" a lethal situation for salmonids and the associated aquatic community downstream from Echo.

Phase III planning should promote extending flows year round in the Umatilla River from Echo (about RM 28) to the mouth at Umatilla. The benefit would be chinook, coho, steelhead, trout, and lamprey production capability in an additional 28 river miles below Echo. The flow needed during the period of June through October (probably in the range of 250 cfs) could be estimated by flow/temperature modeling with existing and with rehabilitated riparian areas.

The number of additional salmon and steelhead that would be reared is difficult to predict precisely. Electrofishing surveys during the summer at low flows (45-50 cfs) produced estimates of about 9,000-10,000 juvenile salmon and steelhead per mile in the Umatilla River above the mouth of Meacham Creek (RM 80-89; Contor et al. 1998). The Umatilla River flow below Echo would necessarily be much greater (perhaps about 250 cfs) than above RM 80 and would likely produce substantially more fish per mile <u>if temperatures were suitable</u>. At 40,000 fish per mile, which is a reasonable estimate of production at this time, the 28-mile reach could rear about a million fish per year. Actual production of this reach would not be known until sampling could be performed after enough adults spawned in the reach to fully seed the area. Some juveniles produced in upstream habitat also would move down and rear in this reach as well.

<u>3. Umatilla River from Meacham Creek (RM 79) to McKay Creek (RM 50.5)</u>

The flow condition in the river above the mouth of McKay Creek (RM 79 to 50.5) is very different than the reach below the mouth of McKay Creek to Echo (RM 50.5 to 28). This reach does not have the benefit of the release of cold, stored water during the summer. Current live flows in the Umatilla River (RM 50.5-79) are too low and warm for significant salmonid production during parts of June and September and all of July and August. The fish habitat related problems of this reach are complex but can be simplified into several main factors. These factors include flow, temperature, channel morphology, sediment and riparian condition. The complex part of these factors is how they all interact. Temperatures are too warm, but increasing flows of cool water could allow for the production of hundreds of thousands of juvenile salmonids in this reach.

To produce fish at reasonable densities in this reach of the Umatilla River, more flow than occurs currently is needed during June through September. However, flow is not the only consideration. For example, small streams with much less flow can produce many fish because channel configuration, groundwater exchange, abundant pools, heavy shade, and undercut banks provide the cool water temperatures and habitat needed for salmonids.

Because riparian habitat and streambanks are degraded in this reach and other reaches of the mainstem Umatilla River and some tributaries, the peak flows observed during the winter and/or spring have eroded banks and riparian areas. As a response to this re-adjustment, the stream channel has become wider and shallower, which in turn has created conditions where stream temperatures have become warmer than would otherwise occur. Riparian restoration projects, which produce stream shading and increase water storage in the flood plain, are needed in this reach of the Umatilla River to produce cool water and optimize salmonid production.

B. Migration Flows

Migration flows include attraction flows, passage flows, and flushing flows. Migration flows are necessary for adults to find the mouth of the Umatilla River (attraction flows) and to migrate up the channel and rocky reaches (passage flows). Migration flows also are needed to assist juvenile salmon smolts moving out of the Umatilla River system and into the Columbia River (smolt-flushing flows). In general, it is believed that the higher the flow (except extreme flood flows) the better the attraction, migration and survival. Migration flows include moderately higher flows that persist throughout a migration season. The Umatilla Basin Project Target Flows for Phases I and II are focused primarily on providing attraction and passage flows. With the completion of Phases I and II, flows currently are augmented for spring chinook adult passage through late June and juvenile fall chinook outmigration through mid July. Water also is released from McKay Reservoir in late summer and fall to assist the upstream migration of fall chinook, coho and steelhead adults.

C. Channel-Maintenance Flows

Flow management to meet fish needs also includes some high flows. Channel-maintenance flows are different from migration flows in that they involve short-duration, high peaks in flow. These high flows serve an important function in both creating and maintaining the stream habitat diversity required by salmonids. Important habitat features include pools with overhanging banks (cover, resting, rearing, feeding), riffles with gravel bars (spawning, feeding), side channels with calmer waters and canopy cover (rearing, resting, feeding), low flow channels (migrating), and debris jams (cover, feeding). Cover is critical for winter survival of fish as well as for summer rearing. Channel-maintenance flows contribute to maintenance of salmonid habitat in the following ways:

1. Formation and maintenance of pools and backwater areas through the scouring and erosive action of high flows. The creation of interconnected side channels and pools provides a range of habitat niches important to fish at various stages in their life cycles.

2. Scouring and erosion is also important in recruiting spawning gravels and cleansing spawning gravels of fine sediments.

3. Recruitment of large woody debris, nutrient exchange and detritus input add to stream structure and riverine food chain.

4. Groundwater recharge affects base flow of streams and water temperature. During high flows groundwater is recharged from surface water, then during low flow periods, groundwater discharges to streams as base flow. This exchange allows a river to flow year round without continual precipitation.

Channel-maintenance flows, also called bankfull discharge, need to occur every one to two years depending on the climate and watershed. The bankfull discharge is needed to maintain channel form (dimension, pattern, and profile) and function as described above for salmonid habitat. The bankfull discharge is a function of the climate, valley type (geomorphology), drainage area, and the volume and size of sediment transported. Because of these variables, the bankfull discharge is unique to a stream reach.

According to recent preliminary field determinations of bankfull stage and corresponding discharges at various stream reaches in the upper and mid-Umatilla River, bankfull discharges were found to range between a 1.2 to 1.5-year recurrence interval (unpub. data, Harza 1999; K. Ely and J. Webster, CTUIR, 1999; C. Clifton, U.S. Forest Service, 1999; J. Williams, USDA Agricultural Research Station, 1999). Table 6 lists the discharges computed from flood-frequency curves of data collected from gaging stations in the Umatilla River and Meacham Creek. The bankfull discharge for stream reaches in the Umatilla Basin will occur within the ranges listed in Table 7 for a given drainage area. Table 8 lists benchmark migration flows and channel maintenance flows in two reaches of the Umatilla River.

Under stable channel conditions, flows much greater than bankfull discharge will not cause a dramatic change to the channel form or fish habitat. With unstable channel and riparian conditions, however,

Table 7. Computed streamflow for the 1.2-, 1.5-, and 2.0-year recurrence interval.

Stream	Drainage Area (Square Miles)	Discharge by Recurrence Interval (Cubic Feet/Sec)			Reference
		2.0 year	1.5 Year	1.2 Year	
Umatilla River near Gibbon (1933-1998)	131	2,000	1,650	1,300	1
Meacham Creek at Gibbon, tributary (1975-1998)	176	2,575	1,950	1,425	1
Umatilla River at West Boundary (1996-98, +estimated)	430	5,050	4,075	3,000	1
Umatilla River at Pendleton (1883, 1904-5, 1922, 1924-98)	637	5,100	4,100	3,100	1
Umatilla River at Yoakum (1905-91)	1,280	5,510	4,500	3,700	2
Umatilla River at Umatilla (1904-1995)	2,290	5,045	3,740	3,075	3

References:
1. U.S. Army Corps of Engineers, 1999.
2. HARZA, 1999, Westland/Ramos Pilot Habitat Restoration Project Plan for Westland Irrigation District. K. Ely, CTUIR, 1999, Unpublished flood-frequency analysis.
3. K. Ely, CTUIR, 1999, Unpublished flood-frequency analysis.

these high flows can completely move the channel and remove large sections of riparian vegetation. The unstable condition results from, and is perpetuated by, land use practices that increase runoff from the uplands. In addition, land use on the flood plain often reduces the ability of the flood plain to disperse the erosive power of the stream. Straightening the channel (channelization) and confining

Table 8. Estimated benchmark flows (cfs) for fish migration and channel maintenance in mainstem Umatilla River.

BENCHMARK FLOW [1]	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Migration- Above McKay Creek Confluence	200	240	310	310	430	500	500	490	270	200	180	180
Channel Maintenance Above McKay Creek Confluence[2]			3,100-5,100	3,100-5,100	3,100-5,100	3,100-5,100	3,100-5,100	3,100-5,100				
Migration- Below McKay Creek Confluence	250	290	370	370	510	600	600	600	330	250	210	210
Channel Maintenance Below McKay Creek Confluence			3,700-5,500	3,700-5,500	3,700-5,500	3,700-5,500	3,700-5,500	3,700-5,500				

Notes:
1. Because of water-quality limited conditions in the Umatilla River, estimated summer and early fall migration flows exceed average monthly values. Flows needed for rearing and other life stages are not necessarily the same value.
2. Range of periodic, peak flows needed for sediment transport, riparian habitat inundation, and maintenance of channel form and diversity.

flood flows within the channel increases stream power (velocity x mass of the water = stream power) and the erosive damage of a flood. Channelization also reduces the area of exchange between the stream channel and shallow groundwater, thereby inhibiting riparian vegetation establishment and growth.

Streams with stable banks and developed riparian vegetation tend to form narrower and deeper channels. The erosive power of floods is turned away from the banks and diverted to create pools and undercut banks. Dense riparian vegetation slows over-bank flow velocities and reduces both water velocity and stream power. These lower velocity flows spread out over the flood plain and drop silts and organic debris that build and enhance floodplain soils. Flood waters seep into the flood plain during over-the-bank flow events. Later, the water stored in the floodplain drains back into the river along the bank and stream bottom. This bank-storage makes up much of the summer base-flow, which is critical for supporting salmonid populations, and can substantially reduce stream temperatures during the summer. Riparian inundation affects plant germination and growth and provides habitat for macro-invertebrates and other biota that are important food sources for salmonids and lamprey.

D. Considerations for the Management of Fish Water in McKay Reservoir

Water released from McKay Reservoir must be cool enough during the summer months to sustain salmonid production. During drought years, McKay Reservoir does not contain enough cold water in the hypolimnion to provide fish habitat during the summer season. The cold water is entirely used before the end of the hot season. Releasing warm water from McKay Reservoir into the Umatilla River could create lethal conditions below the mouth of McKay Creek and affect fish production in that reach for a number of years. For McKay Reservoir to be used most effectively, it needs a larger hypolimnion that could be carried-over for drought years. Phase III planning should consider enlarging the volume of McKay Reservoir for improving water temperature and for increasing fish flows. In addition, if water could be released from multiple levels in the reservoir, fish managers could optimize the conservation of the cold water in the hypolimnion and optimize river temperatures for fish habitat. Optimizing flow releases from McKay Reservoir would require modeling and real-time monitoring throughout the lower river.

Because of current seasonal patterns of irrigation releases from the reservoir, changing the remaining irrigation storage over to fish storage may not make much difference in fish habitat above Westland diversion. However, if those cold waters were allowed to flow all the way to the Columbia River, it would greatly increase salmonid production capacity of the Umatilla Basin. Fall chinook salmon and coho salmon are known to spawn in large numbers between Westland diversion and the mouth of McKay Creek. Their range in the basin would be expanded by providing year round flows in the lower river. Spring chinook salmon and steelhead could also spawn and rear successfully below the mouth of McKay Creek if storage flows could be used to provide suitable spawning and rearing conditions all year.

The sediment that flows out of McKay Reservoir impacts water quality and may affect salmonid production in the Umatilla River. Fine sediments are known to adversely impact the survival of eggs in redds. As the reservoir is drawn down during the summer, McKay Creek begins to erode fine sediments deposited near the inlet to the Reservoir. These fine sediments are then transported to the

Umatilla River. Reducing the transport of fine sediment from McKay Reservoir into the Umatilla River may enhance the survival of fall chinook salmon and coho salmon eggs. Phase III planning should consider options which would reduce sediment delivery from McKay Reservoir.

Fishery biologists have recently found rainbow trout, bull trout, juvenile salmon, and juvenile summer steelhead in McKay Creek downstream from McKay Dam. This lower reach of McKay Creek is currently used as a "canal" to seasonally convey water from the reservoir to the Umatilla River. Management of McKay Creek includes the shutting off of all flows below the dam during several months each year to fill the reservoir. This practice causes lethal conditions for salmonids in lower McKay Creek, annually. There is the potential for lower McKay Creek to provide a significant salmonid fishery. Phase III planning should consider options, which would maintain stream flow in lower McKay Creek, year round, for salmonid production.

IV. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In this report, we have provided preliminary estimates of fish flow requirements based on existing data. Salmonid populations depend on a variety of stream flows to maintain complex-quality habitat conditions that optimize population levels. To meet the established fish restoration goals for the Umatilla River, three types of flows are needed: (1) rearing flows; (2) migration flows; and (3) channel-maintenance flows. High peak flows, which at least partially inundate the flood plain, are also needed periodically to create instream habitat features and maintain riparian areas.

Stream conditions and water management must be improved to prevent or minimize the occurrence of lethal events (de-watering and high stream temperatures) in the Umatilla River. Year round flows, with suitable water temperature, will need to be established in the lower Umatilla River. Stream temperature in the Umatilla River is dependent upon flow volume, temperature of stored water released from McKay Reservoir, riparian conditions, and groundwater exchange. Flow releases from McKay Reservoir during the warmer months will need to be monitored and adjusted to conserve cool water and to maintain suitable rearing conditions as reservoir temperatures change and weather conditions affect stream temperature. The DEQ flow/temperature model should begin to better define the rearing flows needed to meet required temperatures.

Improving stream flow (quantity) and water quality during the summer in the reaches from the mouth of Meacham Creek to the mouth of McKay Creek and downstream from Echo will greatly increase production of salmonids in the Umatilla River. Releases of cool water from McKay Reservoir should be used to improve habitat conditions in the lower river and lower McKay Creek. Watershed and riparian restoration projects will be needed to improve stream temperature and habitat needs for salmonids in the upper reaches of the Umatilla River, and indeed throughout the entire Umatilla Basin. As more data are collected and evaluated on fish use and production in the basin, the estimated flow requirements will be further refined.

We suggest that the best management strategy will include monitoring and flexibility to adapt to changing conditions. Adaptive management will require considerable coordination among the various water/fish managers in the Umatilla Basin when conditions deviate outside expected norms.

Expanding on the accomplishments of Phases I and II of the Umatilla Basin Project with a Phase III, e.g. using the remaining stored water in McKay Reservoir for fishery benefits, will address many instream flow needs for fish in the lower river. Phase III planning should also consider enlarging the volume of McKay Reservoir and its hypolimnion, which could provide significant fish benefits in the Umatilla River and in McKay Creek below the dam. Other habitat needs, such as riparian restoration, which cannot be addressed simply by instream-flow augmentation, should be considered as part of a Phase III, too. However, riparian restoration can and should be pursued through separate efforts as well, and need not wait for completion of a Phase III water exchange.

LITERATURE CITED

Confederated Tribes of the Umatilla Indian Reservation, 1984, Umatilla Basin recommended salmon and steelhead habitat (hatchery and passage) improvement measures. Pendleton, OR.

Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources, 1999, Water Quality Standards, Beneficial Uses, and Treatment Criteria. Pendleton, OR.

Contor, C.R., Hoverson, E.H., and Kissner, Paul, 1998, Umatilla Basin natural production monitoring and evaluation project, annual report for Bonneville Power Administration. Portland, OR.

HARZA Engineering Company, 1999, Westland/Ramos Reach of the Umatilla River, Engineering Feasibility Study and Preliminary Channel Design. Pendleton, OR.

Oregon Department of Environmental Quality, 1995, 1992 – 1994 Water Quality Standards Review. Portland, OR.

Oregon Department of Fish and Wildlife, 1986, a comprehensive plan for rehabilitation of anadromous fish stock in the Umatilla River Basin. U.S. Department of Energy, BPA, Portland, OR.

U.S. Army Corps of Engineers, 1999, Flood Evaluation Study for Umatilla River, Squaw Creek, and Meacham Creek. Portland, OR.

U.S. Bureau of Reclamation, 1988, Umatilla Basin Project, Oregon, Planning Report – Final Environmental Statement. Boise, ID.