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Memorandum

To:	Said Amali, IRZ Consulting LLC		
From:	Ronan Igloria, PE	Project:	Umatilla Aquifer Recovery Project
CC:	File		
Date:	January 9, 2009	HDR Project No:	00102-86502-002
Re:	Task 1.G – Flow Regimes and Fisheries Resources – Summary of Available Information		

The Oregon Water Resources Department (OWRD) designated four ~~groundwater~~ aquifers within the Umatilla Basin as Critical Groundwater Areas (CGAs) due to their documented overdraft (OWRD 2003). As a result, use of additional groundwater for irrigation in the CGAs has been curtailed causing adverse impact to the economies of Umatilla and Morrow counties. To increase water availability in the CGAs, OWRD has begun a technical assessment of the feasibility of storing water from the Columbia River and other surface sources during high flow periods in shallow sediment and deeper basalt aquifers and recovery of the stored water during the irrigation season. The project has been divided into several tasks. This technical memorandum includes a summary of information regarding the flow regimes and fisheries resources of the Umatilla and Columbia Rivers.

EXECUTIVE SUMMARY

The source of water for the Umatilla aquifer recovery project is to divert water primarily from the Columbia River, and if available from the Umatilla River, during high flow (winter) periods. As part of the feasibility study, this memorandum includes a review of the water availability associated with these water bodies. This memorandum also reviews the potential fish habitat issues and key water quality constraints (temperature) in a qualitative manner.

Based on existing data, water availability for the Columbia River is discussed in terms of target flows derived for the December 2000 Federal Columbia River Power System (FCRPS) biological assessment (BA), while existing water rights, including the adopted instream right, are the basis for water availability for the Umatilla River. OWRD completed a water availability analysis for the Columbia River using the BA target flows at McNary Dam. The analysis indicates that water is available for diversion at McNary Dam in December, January, February, March, and then in September and October under 50% exceedance flows[1]. OWRD uses the 50% exceedance natural flow values to evaluate the availability of water for appropriation for storage projects in Oregon. OWRD has an adopted instream water right on the lower Umatilla River, which is largely consistent with the target flows adopted under the Umatilla Basin Project

[1] *50% exceedance flow is the stream flow rate derived statistically from flow records that represents the monthly-averaged flow value with a 50 percent probability of being exceeded in any given year.*

(UBP) annual operations plan. Based on the Umatilla River instream water right and UBP operation target flows, water is available for diversion from January through April under 50% exceedance flows. Based on these instream flow conditions, the approximate available flows under 50% exceedance flow conditions are summarized in the following table.

Table ES-1. Summary of Months with Water Available at 50% Exceedance Flow Conditions (cubic feet per second)

	Jan	Feb	Mar	Apr	Sep	Oct	Dec
Columbia River (at McNary Dam)	15,000	24,000	24,700	N/A	108,000	111,000	90
Umatilla River (at mouth)	13.8	398	519	431	N/A	N/A	N/A

The greatest target diversion volume of 100,000 acre-feet of water for storage in the "County Line" alluvial aquifer is to be achieved through a proposed total diversion rate of approximately 560 cubic feet per second (cfs) over a 90-day period from the Columbia River. Based on the above flows, the Columbia River has sufficient water available to meet the target storage volume of 100,000 acre-feet.

It should be noted that if a water year drier than the 50% exceedance level occurs, the amount of water available from the Columbia or Umatilla Rivers would correspondingly be less than the values shown in Table ES-1. The quantities shown in Table ES-1 reflect the maximum diversion rate that would be allowed by OWRD for permitting purposes. Other than December, the amount of water available from the Columbia River is significantly greater (at least an order-of-magnitude) than the desired flow of 560 cfs. Nevertheless, it will be prudent to design the project and facilities to store a greater volume of water than the project needs to increase reliability of flow to the users during years of relatively low flows.

The Oregon Department of Fish and Wildlife (ODFW) has developed a guidance document for assessing peak flow needs for Oregon streams other than main stem Columbia River (ODFW 2007). Peak flows which occur during the high flow periods provide channel maintenance and habitat benefits for fisheries. Since the primary source of storage water supply for the project will be from the Columbia River, the peak flow requirements should not affect project feasibility. However, diversion of Umatilla River water for aquifer storage in the Echo Meadows area may be significantly affected if all high flow events were reserved as peak flows during each and all years and if peak flows were established at significantly high levels. The Umatilla River peak flows are significant to this project in that they occur during the same times as when the water for aquifer storage would be diverted, thereby potentially restricting the flows available for aquifer storage. Further discussions need to occur between all the stakeholders and with ODFW and others regarding whether and how peak flows should be addressed for this project.

Aquifer recharge activities have the potential benefit to increase groundwater discharge and Umatilla River base flows resulting in reduced stream temperatures (ODEQ, 2001). Additionally, some of the augmented Umatilla River flow may return to the Columbia River months later thereby increasing its flow during its lower flow periods. This may be an added benefit to Columbia River fisheries resources.

(Note: Some of the water may be diverted as natural flow, depending on the disposition as it is defined under future permitting, and the time of year). Temperature is not considered a constraint in terms of limiting additional diversion of water from the Columbia or Umatilla Rivers during the proposed diversion periods for the project.

1.0 OBJECTIVES

This review is intended to provide a summary of existing information regarding water availability and instream needs for the Columbia and Umatilla Rivers. Instream needs focus on fisheries resources and other existing water quality requirements. This memorandum documents information from the following tasks:

- Review and summarize available information on water availability for diversion from the Columbia and Umatilla Rivers.
- Review existing instream requirements and needs; including input from federal and state agencies.
- Review and summarize available information on target flows for the Columbia and Umatilla Rivers based on fish-management and other water quality needs.
- Review potential impact from project on Columbia and Umatilla river flows and water quality.

Existing information on water availability and instream flow needs will be used to identify constraints on the amount of water that can be diverted from the Columbia and Umatilla Rivers for this project. While the Umatilla Basin is fully appropriated during the summer (irrigation) months, the project intends to divert high (winter) flows in the source waters to supply the storage volume for infiltration/injection to the aquifers. Water availability for the Columbia and Umatilla Rivers are compared to the desired rates to meet the project objectives. In particular, the maximum target diversion volume of 100,000 acre-feet of water for storage in the "County Line" alluvial aquifer is equal to approximately 560 cubic feet per second (cfs) over 90 days of diversion from the Columbia River.

In the sections to follow, the water availability findings are discussed first, followed by the target flow objectives derived from instream beneficial uses (fisheries habitat and water quality).

2.0 WATER AVAILABILITY

In general, water available for new diversions is the flow remaining in the stream after instream and out-of-stream flow requirements are met. For the purposes of this review, water availability is considered in terms of Oregon's Water Availability Program associated with determining availability of surface water for new appropriations (issuing new water rights permits). Oregon follows the "prior appropriation doctrine" where water goes first to those with the oldest water rights whenever water is limited. The permit simply gives the owner the right to access the quantity of water issued under the

permit. It defines the maximum diversion that can be taken from the source water. The amount of water available under the terms of the water right along with the amount that can be beneficially used are the limiting factors as to what can physically be diverted in the field.

Under Oregon rules, water availability is defined in terms of the following equation:

$$WA = Q_{nsf} - ST - CU - IS \qquad \text{(Eqn. 1)}$$

Where WA= water available

Q_{nsf} = Natural (live) streamflow at a specified point on the stream (50% or 80% exceedance level)

ST = storage in or from the stream and its tributaries upstream from the specified point

CU = consumptive uses from the stream and its tributaries upstream from the specified point (calculated based on existing out-of-stream water rights)

IS = instream flow demands for a stream reach that includes the specified point

OWRD maintains a database of the amount of water available for appropriation for most waters in the state. This "Water Availability Reporting System" (WARS) database is used to evaluate applications for new uses of water using Equation (1) shown above. Each of the components of the water availability calculation is determined using methodology documented in the report, "Determining Surface Water Availability in Oregon" (OWRD 2002). The standard methodology (referred to in this report as the "OWRD method") was adopted into rule by the Water Resources Commission in July 1992 (OAR 690-400-010[11][a][A]). Instream demands in the OWRD method are made up of existing instream water rights and scenic waterway flows, which diminish water availability upstream only of the point.

The natural (or live) streamflow used in the equation is meant to represent "unmanaged" streamflow conditions and is not affected by consumptive use or reservoir storage. Furthermore, the natural streamflow is represented by a statistic ("exceedance flow") because stream-flow is naturally variable. An exceedance streamflow is the stream-flow exceeded a given percent of time (in this case an average for a given month). The percent exceedance flow quantifies how often a rate of flow is present in a stream, and hence how often a rate of flow would be available. For this project in the equation above, OWRD and ODFW agreed to use the 50% exceedance flow values as the basis for determining water availability for appropriation (water rights permit) purposes for this project, as it is used for water storage projects in general (personal communication, Barry Norris, OWRD, December 19, 2008). Therefore, the project can expect use of water 50% of the time at the flow rate determined to be available[2].

2.1 Umatilla River

[2] *Oregon rules use 80% exceedance flow for out-of-stream appropriation based on the model that at full appropriation of the surface water source, the most junior (water right) user can expect use of water 80 percent of the time. For instream appropriations from live flow, the 50% exceedance level is used. The 50% exceedance natural flow values are used to evaluate storage projects.*

Water availability for the Umatilla River is summarized in **Table 1** based on the WARS database. Based on the data, water is only available for diversion from January through April under 50% exceedance flow conditions. The 80% exceedance data is presented for comparison purposes. There is no water available for appropriation under the 80% exceedance flow level. It should be noted that water availability at the mouth of the Umatilla River does not mean that amount is available at a diversion point somewhere upstream of the mouth. Water availability would be assessed at the next higher WAB.

Table 1. Umatilla River – Water Availability at 50% and 80% Exceedance Flows (cubic feet per second) at Mouth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water Available @ 50%	**13.8**	**398**	**519**	**431**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Water Available @ 80%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Natural Stream flow @ 50%	648	1120	1380	1540	1020	323	106	65.7	74	87.8	173	521
Natural Stream flow @ 80%	292	548	697	984	569	187	82.7	48.1	56.6	67.9	101	215
Consumptive Uses	384	472	611	859	1130	794	421	314	238	138	187	357
Instream Requirements	250	250	250	250	250	250	120	85	250	300	300	250

Notes: N/A = Water is not available
Water Availability is calculated per Equation 1 in this memorandum using data from OWRD WRATS database and methodology.
Instream Requirements are as listed in Table 7 below.

The Umatilla River yields approximately 80,000 acre-feet (from February – April) under the water availability rates shown in Table 1 for the 50% exceedance flow conditions[3]. In other words, there is a 50% probability that 80,000 acre-feet of water is available at the mouth for diversion from the Umatilla River during the period February-April in any given year. It should be noted that if a drier water year occurs (lower flows than the 50% exceedance level), the amount of water available from the Umatilla River would likely be less. **Table 2** lists similar values for the 60% and 70% exceedance flows using linear [Unsure this is linaear – these exceedances are derived from a nonlinear distribution, right?] interpolation, of the 50% and 80% exceedance data. The values in **Table** 2 illustrate how water availability can change under different hydrologic conditions. This assessment provides a basis to design the project and facilities to a level of reliable flow quantity to take advantage of the years when river flow is available to balance the years when flow is insufficient to allow target storage volumes.

Table 2. Umatilla River – Total Volume at Different Exceedance Flows at the Mouth

Month	50% Exceedance	60% Exceedance	70% Exceedance	80% Exceedance
January	14 cfs	N/A	N/A	N/A

[3] *It should be noted that irrigation diversion by Westland Irrigation District and others begin April 15, and water has not been available in river after that date.*

February	398 cfs	207 cfs	17 cfs	N/A
March	519 cfs	291 cfs	64 cfs	N/A
April	431 cfs	246 cfs	60 cfs	N/A
Total Volume* (acre-feet)	**81,000**	**44,000**	**8,000**	**N/A**

** Sum of the total volume diverted from January – April assuming the diversion rate is the water availability for each month.*

For the purposes of this assessment, water availability on the Umatilla River is based only on live flow. Releases from storage (i.e. McKay Reservoir releases) are not added to water availability. Although out-of-stream and instream appropriations may be allocated from stored water, it is assumed that releases from McKay Reservoir will continue to be operated to fulfill the Umatilla Basin Project objectives and not used for this project.

2.2 Columbia River

Water availability calculations using the OWRD method is only applicable to the Umatilla River. The Columbia River is not included in OWRD's water availability database. OWRD completed a separate water availability analysis of the Columbia River at Bonneville and McNary dams (Cooper 2005 and 2007) based on target flows identified in the NOAA Fisheries FCRPS BA and Biological Opinion (BiOp) of December 2000 ("Target Flows"). The 2000 BiOp was invalidated by the Federal 9th U.S. District Court; however, both the U.S. Army Corps of Engineers and U.S. Bureau of Reclamation submitted their final decision document on the May 2008 FCRPS BiOp in August and September 2008, respectively, which uses the same Target Flows as those in the December 2000 BiOp.

Table 3 includes a summary of the data used by OWRD for the Columbia River at McNary Dam and Bonneville Dam. OWRD used a streamflow period of record from 1975 to 2004 in their analysis. The flow data from the actual period of record was adjusted to the base period (1975-2004) using a method described by Searcy (1959)[4]. The flow values represent stream-flows affected by regulation from numerous upstream dams and depletions due to diversion. The water availability is calculated simply as the difference between the 50% (or 80%) exceedance flow less the Target Flow for each month. This analysis departs from the OWRD method in that the natural Columbia River flows at Bonneville and McNary Dam stations are not determined, and subtractions for expected consumptive demands are not calculated between the two points, e.g. the effects of stream regulation by the dams and depletions from diversions are not explicitly evaluated. The analysis is based on the 30 years of flow records at the two locations, and does not necessarily account for new allocations or changing operations.

Table 3. Columbia River at McNary Dam (USGS 14019200) – 50% and 80% Exceedance Flows (1975-2004) and Target Flows

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
50% Exceedance Flows (cfs)												
Bonneville	175,015	184,030	184,744	206,681	264,345	266,440	172,464	133,581	114,365	118,532	135,269	160,090

[4] *The Searcy method is used in the OWRD water availability methodology report, 'Determining Surface Water Availability in Oregon.'*

McNary	156,000	165,000	167,000	189,000	249,000	259,000	167,000	128,000	108,000	111,000	126,000	146,000
80% Exceedance Flows (cfs)												
Bonneville	137,218	138,229	136,520	152,586	217,312	182,812	121,721	103,120	95,505	98,137	115,799	130,968
McNary	125,000	125,000	124,000	140,000	206,000	179,000	119,000	98,700	88,800	91,100	108,000	120,000
Target Flows Based on FCRPS Biological Opinion (2008) (cfs) (see Section 3.1)												
Bonneville	160,000	160,000	160,000	160,000	None	None	None	None	None	None	160,000	160,000
McNary	None	None	None	260,000	260,000	260,000	200,000	200,000	None	None	None	None

Table 4 includes a summary of the results of the water availability analysis. For the purposes of this analysis, the McNary Dam location is used to represent the project location. Based on the analysis, water is available for diversion from the Columbia River at the project location in December, January, February, March, and then in September and October. Water availability is limited by Bonneville Dam flows in January, February and March, while McNary Dam flows limit the water availability in September and October.

Table 4. Columbia River at McNary Dam – Water Availability at 50% and 80% Exceedance Flows (1975-2004)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Water Availability at 50% Exceedance Flows (cfs)												
50 % Exceedance	**15,015**	**24,030**	**24,744**	N/A	N/A	N/A	N/A	N/A	**108,000**	**111,000**	N/A	**90**
Water Availability at 80% Exceedance Flows (cfs)												
80% Exceedance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**88,800**	**91,100**	N/A	N/A

The Columbia River yields over 16,800,000 acre-feet (during the months having water availability) under the water availability rates shown in **Table 4** for the 50% exceedance flow conditions. Again, if a drier water year occurs (lower flows than the 50% exceedance level), the amount of water available from the Umatilla River would correspondingly be less also. **Table 5** includes a list of similar values for the 60% and 70% exceedance flows using linear interpolation, of the 50% and 80% exceedance data. The values in **Table 5** illustrate how water availability can change under different hydrologic conditions. Under all exceedaence scenarios, there is significant amount of flow available in the Columbia River to supply the project based on the target flow comparisons in the BA.

Finally, it should be noted that OAR 690-033 (Division 33) rules prevent the withdrawal of water from the Columbia River above Bonneville Dam during the month of September with some exceptions. One of the exceptions is for multipurpose storage projects or other projects with measurable public benefits, such as being considered in this project.

Table 5. Columbia River – Total Volume at Different Exceedance Flows				
Month	**50% Exceedance**	**60% Exceedance**	**70% Exceedance**	**80% Exceedance**
January	15,015 cfs	N/A	N/A	N/A
February	24,030 cfs	4,353 cfs	N/A	N/A
March	24,744 cfs	4,496 cfs	N/A	N/A
September	108,000 cfs	101,600 cfs	95,200 cfs	88,800 cfs
October	111,000 cfs	104,367 cfs	97,33 cfs	91,100 cfs
December	90 cfs	N/A	N/A	N/A
Total Volume* (acre-feet)	**16,832,500**	**12,782,400**	**11,480,300**	**10,704,800**

** Sum of the total volume diverted from January – April assuming the diversion rate is the water availability for each month.*

3.0 FLOW OBJECTIVES

The information on flow objectives summarized in this section is the basis for the target flows and instream requirements used previously in Section 2 to derive water availability.

3.1 Columbia River Flow Objectives

The flow objectives for the Columbia River are based on the Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp), which was most recently released by National Oceanic and Atmospheric ~~eronautics~~ Administration (NOAA) Fisheries Service on May 1, 2008. The flow objectives used in the BiOp were developed under the FCRPS Biological Assessment (August 2007). The original 2000 BiOp was invalidated by the Federal 9th U.S. District Court, which resulted in the BiOp undergoing a series of remands and revisions but the flow objectives remained intact through the process. Additional details of the history and status of the BiOp are discussed in **Attachment A.**

NOAA Fisheries and the FCRPS Action Agencies have attempted to manage Columbia and Snake River water resources to maintain seasonal flows to meet the wide range of objectives (i.e. flow vs. survival relationships) for different species. The flow objectives shown in **Table 6** are used to guide preseason reservoir planning and in-season flow management with the understanding that their achievement depends on the water resources available in a given year.

Table 6. Seasonal Flow Objectives and Planning Dates for the Mainstem Columbia River

	Spring		Summer	
Location	**Dates**	**Objective (cfs)**	**Dates**	**Objective (cfs)**
Columbia River at McNary Dam	April 10 to June 30	220,000 to 260,000[(1)]	July 1 to August 31	200,000
Columbia River at Bonneville Dam	November 1 to emergence	125,000 to 160,000[(2)]	N/A	N/A

Notes: Table was adopted from FCRPS Biological Assessment (August 2007), Table B.2.1-2.

(1) Objective varies according to water volume forecasts.

(2) Objective varies based on actual and forecasted water conditions

3.2 Umatilla River Flow Objectives

Umatilla River target flows are based on instream water rights adopted by OWRD. The instream water right under Certificate 59837 has a priority date of November 3, 1983, and specifies minimum flows from McKay Creek to the mouth at Columbia River. The minimum flows were originally set in the Umatilla Basin Program and then converted to instream water rights as a result of passage of the Instream Water Right act in 1987. **Table 7** includes a list of the specific minimum flow requirements by month.

Table 7. Umatilla River Instream Water Right (from McKay Creek to Mouth) Certificate 59837; Priority Date of November 3, 1983	
Period	**Target Flow (cfs)**
October 1 – November 15	300
November 16 – November 30	250
December 1 – June 30	250
July 1 – July 31	120
August 1 – September 15	85
September 16 – September 30	250

The Umatilla Basin Project (UBP) is operated by the U.S. Bureau of Reclamation (BOR). Under the UBP, BOR developed a Umatilla Basin Annual Operation Plan with defined target flows for McKay Creek to the mouth of the Umatilla River. The target flows were developed under Phases I and II of the UBP to improve stream flows for fishery restoration purposes during each part of the year. Phases I and II included construction of facilities and operations to improve stream flows for anadromous fish primarily through water exchange.

Phase I of the project includes pumping of water from the Columbia River into the West Extension Irrigation District system, to offset diversion of Umatilla River water. The capacity of Phase I is 140 cubic feet per second. This improves flows below the diversion point at Three Mile Dam. Phase II pumping and conveyance exchanges Umatilla River for Columbia River water for Stanfield and Hermiston Irrigation Districts. The capacity of Phase II is 240 cubic feet per second. The Stanfield Irrigation District historically diverted live flow[5] and McKay Reservoir releases, which are now retained in-stream as needed to meet stream target flows for fish passage (USBR, 1998). Phase II can offset diversion from the Umatilla River that would have occurred at and downstream from the Stanfield Dam at river mile 32. **Table 8** includes a list of the Umatilla Basin Project target flows based on the UBP annual operations plan. The target flow values under the UBP are the same as those defined by the instream water rights with the exception that the UBP target flows do not have a minimum flow requirement from July 1 – August 15, but require a higher minimum flow from August 15 – September 15 (see **Table 7**).

[5] *"Live flow" is the term used for the portion of flow that results from runoff and natural drainage into the stream. It does not include stored water releases from the reservoir*

Table 8. Umatilla Basin Project Target Flows from McKay Creek to Mouth		
Period	**Target Flow (cfs)**	**Notes**
October 1 – October 30	300	Instream flows are predominantly from stored water releases for fisheries enhancement. Typically not enough live flow for SID exchange. Return flows provide live flow at Three Mile Diversion Dam for WEID exchange.
November 1 – November 15	300	HID exchange may begin on Nov. 2 or as soon as Feed Canal is operable.
November 16 – June 30	250	Diversions generally begin mid-March. HID diversions are curtailed if necessary; WEID and SID exchanges can begin depending on where water is needed. Stored water releases from McKay Reservoir for fish enhancement typically begins this period.
July 1 – August 15	75	In June 2006 an interim target flow of 75 cfs was adopted so live flow water can be exchanged during July 1 – August 15. Return flows generally result in live flows at Three Mile Diversion for WEID exchange. Stored water is used for flow augmentations and Columbia River water is provided to SID under Phase II (SID used to rely on stored water releases from McKay Reservoir).
August 15 – September 30	250	Typically not enough live flow for SID exchange (historically relied on stored water from McKay Reservoir).

Notes:
HID – Hermiston Irrigation District
SID – Stanfield Irrigation District
WEID – West Extension Irrigation District

4.0 OVERVIEW OF INSTREAM NEEDS

This section provides a qualitative overview of the considerations used to develop the target flows listed in Section 3. The winter water diversions to supply the project from the Columbia River will reduce Columbia River stream flow downstream from the project during the diversion periods. The objective of this project is to divert flows only to the extent that flow objectives for environmental benefits are maintained in the source waters. A portion of the stored water developed under this project is intended for Umatilla River flow augmentation to benefit fisheries.

4.1 Water Quantity Impacts on Fisheries Habitat Quality

Stream flows in both the Columbia River and Umatilla River have changed as a result of flow regulation and water withdrawals. For example, large-scale U.S. and Canadian reservoir storage and flow regulation that began in the 1970s reduced the 2-year flood peak discharge, as measured at The Dalles, Oregon, from 580,000 cfs to 360,000 cfs (USCOE, 2007).

Salmonids in the Umatilla River Basin include salmon, resident rainbow trout, anadroamous rainbow trout (steelhead), bull trout and mountain white fish. The Umatilla Basin Project manages flow to

maintain and enhance salmonids and lamprey in the Umatilla River Basin. The flow needs report by CTUIR Department of Natural Resources (CTUIR, 1999) includes a succinct summary of salmonid presence in the Umatilla River Basin. **Attachment B** includes a table from the flow needs report illustrating the fish presence and timing for the Umatilla River below Echo (CTUIR, 1999).

Table 9 includes a summary of the three major factors for management of stream flows for fisheries needs: (i) rearing flows; (ii) migration flows; and (iii) channel-maintenance flows. These three flow needs are issues for both the Columbia River and Umatilla River. Typically, minimum instream flow requirements attempt to meet the rearing and migration flows needed by fish-species and life-stages present throughout the year in the water body of interest.

Channel-maintenance flows are different from rearing and migration flows in that they involve short-duration, high peaks in flow. Channel-maintenance flows need to occur every one- to two-years (typically the bank-full discharge) (CTUIR, 1999). They are not typically defined for a specified period when adopting flow requirements, but under natural hydrologic events will typically occur from December through May.

Table 9. Summary of Flow Types for Fisheries Needs

Flow Type	Fisheries Need	Timing
Rearing Flow	Provide adequate volume (space) and stream temperatures throughout the year for adult holding, spawning, egg incubation, fry emergence, rearing, and food supply.	Variable throughout the year
Migration Flow	Higher flows support out-migration of juvenile salmonids to the ocean and provides flows for adult migration upstream over falls and rapids for spawning	Seasonal
Channel-maintenance Flow	Maintain channel features such as width:depth ratio, sinuosity, pool:riffle ratio~~n~~; flushing sediment; inundate riparian vegetation and recharge groundwater	One- to two-year recurrence interval at bank-full discharge

Table 10 includes a comparison of the 50% exceedance flow for the potential diversion periods for the Umatilla River against the migration and channel-maintenance flow benchmarks outlined in the flow needs memorandum prepared by CTUIR (CTUIR, 1999). The migration flow needs can further reduce the amount of water available for diversion to supply the project, e.g. comparing 600 cfs for migration to the 250 cfs minimum flow defined in the instream water right for March and April. The channel-maintenance flow is significantly higher than the 50% exceedance flow, but these are based on bankfull [be consistent – sometimes hyphenated, sometimes not; preferred form is non-hyphenated.] discharge events. ODFW has developed a guidance document titled *"Calculating Channel Maintenance/Elevated Instream Flows When Evaluating Water Right Applications for Out-of-Stream and Storage Water Rights"* for assessing peak flow needs (ODFW, 2007). Further scientific and policy discussions need to occur regarding how peak flows will be considered in projects similar to this one.

Table 10. Comparison of Migration and Channel Maintenance Flow Benchmarks for Umatilla River (Below McKay Creek Confluence)				
Month	**50% Exceedance Flow (monthly) (cfs)**	**Migration Flow (cfs)**	**Channel Maintenance (cfs)**	**Minimum Instream Flow Right (cfs)**
January	648	370	3,700-5,500	250
February	1,120	510	3,700-5,500	250
March	1,380	600	3,700-5,500	250
April	1,540	600	3,700-5,500	250

In the Columbia River, flow affects juvenile migrant travel time and the distribution of fish among the various routes of dam passage. In general, the lower the flow through the series of reservoirs, the longer the travel time of out-migrating juveniles that migrate in-river. The longer juveniles remain in project reservoirs, the greater their exposure to predation, elevated temperatures, disease, and other sources of mortality and injury. The longer juveniles remain in the project reservoirs, the greater the potential that they will stop migrating. Because of this, dam operating protocols designed to improve fish passage survival are often defined in terms of streamflow criteria. The target flows discussed in the previous sections are based in part on managing migrant travel time.

Combined with the influence of reservoirs behind the dams within the migratory corridor, reductions in spring and early summer flows slow juvenile fish emigration, increases their exposure to injury and mortality factors within the reservoirs (e.g. predation, temperature stress, disease, and others), and changes ocean-entry timing. The amount of water proposed for diversion (<600 cfs) during the winter months is significantly smaller than the available water based on the target flow analysis. It is unlikely that the proposed diversions will interfere with these fisheries migration times when flows are on the order of >100,000 cfs during these periods when diversion is proposed.

4.2 Water Quality Impacts on Fisheries – Temperature TMDL on Umatilla River

Water quantity and quality are inter-related when it comes to salmonid impacts. A Total Maximum Daily Load (TMDL) has been established for the Umatilla River for several parameters including temperature, sediment, nitrate, ammonia, bacteria, aquatic weeds, algae and pH (ODEQ, 2001). The most widespread concerns in the Umatilla River Basin are temperature and excess soil erosion which leads to sedimentation and impaired salmonid spawning areas (ODEQ, 2001). For the purposes of this study, temperature is considered the key water quality parameter associated with the potential impacts and benefits of this project.

Additional groundwater inflow from the project would have a cooling effect on summertime stream temperatures. Subsurface water is insulated from surface heating processes and most often groundwater temperatures fluctuate little and are cool. Groundwater inflow not only cools summertime stream temperatures, but also augments summertime flows. Subsurface flow of imported Columbia River and its contribution to increasing groundwater discharge to Umatilla River will also act to dilute the concentrations of other water quality parameters (e.g. nitrate, ammonia, bacteria). [unless it contains some of these in higher concentrations – nitrate??]

The temperature TMDL for the Umatilla Basin is primarily concerned with the summer low flow periods. The temperature standard for Umatilla River is listed in **Attachment C**. As documented in the Umatilla Basin TMDL, elevated summertime stream temperatures are attributed to non-point sources in the Umatilla River Basin resulting from riparian vegetation disturbance (reduced stream-surface shade), summertime decrease in flow (reduced assimilative capacities) and channel widening (increased stream surface area exposed to solar radiation). To analyze the temperature affects of different management activities on these non-point sources, the Umatilla River Basin TMDL defined "*other appropriate measures*" (or surrogates measures) as provided under EPA regulations. In the TMDL temperature analysis, the surrogates used included: system potential vegetation (i.e. potential effective shade levels from riparian vegetation); near stream disturbance zone (e.g. channel disturbance); and width to depth ratios of the channel.

Stream temperature is generally inversely related to flow volume. As flows decrease, stream temperature tends to increase. Particularly relevant to this project is that low summertime flows decrease the thermal assimilative capacity of the Umatilla River, which allows solar radiation loading to cause larger temperature increases in stream segments where flows are reduced. During parts of the summer, flow augmentation released from McKay Reservoir is largely withdrawn from the Umatilla River for irrigation before it reaches the Columbia River. Analysis results presented in the Umatilla Basin TMDL demonstrate that when flows are depleted in the lower river reaches (including the portion adjacent to the proposed project area), temperatures in excess of 80^{o}F are the lowest achievable.

As part of the TMDL development, simulations were run for a range of conditions that apply the surrogates management activities listed under three flow conditions:

- "Current Flows" occur when flow conditions are those that were measured during August 10, 1998 (flow augmentation from McKay Reservoir, with water withdrawals and return flows);

- "Natural Flows" occur when there is no flow augmentation from McKay Reservoir, no water withdrawals and no irrigation return flows;

- "Flow Augmentation" occurs when there is flow augmentation from McKay Reservoir, no water withdrawals and no irrigation return flows.

The analysis found that maximum potential flows achieve the greatest temperature reductions. In all scenarios, the distribution of incipient lethal temperatures is dramatically reduced from the "current flows" condition. That is, when "natural flows" are simulated and flow augmentation is allowed without water withdrawals, stream temperature become significantly more favorable for fisheries. One of the scenarios specifically evaluated in the Temperature TMDL was to release 200 cfs of hypolimnion water from McKay Reservoir during the August period. The analysis revealed that significant temperature reduction in the Umatilla River can be achieved. The output graph illustrating this result is included in **Attachment D.**

Temperature is not considered a constraint in terms of limiting additional diversion of water from the Columbia or Umatilla Rivers during the proposed diversion periods for the project. Aquifer recharge activities have the potential benefit to increase baseflows [Again – be consistent. Sometimes this is spelled as two words.] in the Umatilla River resulting in reduced stream temperatures (ODEQ, 2001). However, reach-specific modeling is necessary to quantify the extent of the benefits. The Umatilla River TMDL states, "to attain the flows in the lower Umatilla River that are supportive of water quality and habitat needs, ODEQ advocates the use of the Umatilla temperature TMDL and further modeling as needed to assist developing flow goals for a Phase III of the Umatilla Basin Project." The TMDL also notes that benefits of the Umatilla Basin groundwater influences on stream temperatures may provide basis for modification of TMDL allocations in potential future iterations of Umatilla Basin TMDLs.

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Attachment A

HISTORY AND STATUS OF FEDERAL COLUMBIA RIVER POWER SYSTEM BIOLOGICAL OPINION

In response to the listing of several fish species under the Endangered Species Act, NOAA Fisheries Service (NMFS) submitted a biological opinion in 2000 on whether the operation of the Federal Columbia River Power System (FCRPS) was jeopardizing the continued existence of listed salmon. A number of organizations challenged the 2000 BiOp in court saying that the BiOp did not do enough to protect and recover endangered salmon. In June 2003, the US District Court in Oregon invalidated the 2000 FCRPS Biological Opinion. NMFS released its revised Biological Opinion in November 2004 which included an Updated Proposed Action on how the action agencies would run the FCRPS. The 2004 BiOp was again challenged and the courts issued an opinion against the 2004 BiOp.

In August 2007, the FCRPS Action Agencies (U.S. Army Corps of Engineers, Bonneville Power Administration, Bureau of Reclamation) completed an assessment of the biological effects of the FCRPS and the mainstem effects of other hydro projects on listed salmon and steelhead. The FCRPS Action Agencies submitted a biological assessment to NOAA Fisheries on August 21, 2007 for evaluation and consultation. NOAA Fisheries released a draft FCRPS Biological Opinion and Supplemental Comprehensive Analysis (SCA) on October 31, 2007. The current May 2008 FCRPS Biological Opinion includes a 10-year operations and configuration plan for the FCRPS facilities, as well as the mainstem [Previously listed as two words – be cnsistent.] effects for various other hydro projects on Columbia River tributaries operated for irrigation purposes. The FCRPS action includes additional habitat, hatchery, predation management, and harvest actions to mitigate for the adverse effects of the hydro projects. On August 1, 2008 the U.S. Army Corps of Engineers finalized their Record of Consultation and Record of Decision on the May 2008 BiOp. Similarly, on September 1, 2008, the U.S. Bureau of Reclamation finalized their Record of Decision on the May 2008 BiOp. The overall flow objectives developed under the biological assessments did not change through the remand and revision process to the BiOp.

Attachment B

TYPES OF FLOWS, SPECIES AND WATER QUALITY LIMITING PARAMETERS FOR UMATILLA RIVER BELOW ECHO

(taken from "Flow Needs for Salmonids and Other Aquatic Organisms in the Umatilla River." CTUIR Department of Natural Resources. December 1999)

Types of Flows, Species, and Water Quality Limiting Parameters for the Umatilla River below Echo													
Flow	Order	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1. Rearing	CHS	-	-	-	-	-	-	-	-	-	-	-	-
Spawning	CHF	CHF	CHF	CHF	CHF	CHF	CHF	CHF	CHF	CHF	*	*	*
Egg/Incubation	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	*	*	*
Emergence	STS	STS	STS	STS	STS	STS	STS	STS	STS	STS	*	*	*
Rearing	TR	TR	TR	TR	TR	TR	TR	TR	TR	TR	*	*	*
Adult holding	TB	-	-	-	-	-	-	-	-	-	-	-	-
	MW	MW	MW	MW	MW	MW	MW	MW	MW	*	-	-	-
	LMP	LMP	LMP	LMP	LMP	LMP	LMP	LMP	LMP	LMP	LMP	LMP	LMP
2. Migration	CHS	-	-	-	-	-	CHS	CHS	CHS	CHS	-	-	-
Juvenile	CHF	CHF	CHF	CHF	-	-	-	CHF	CHF	CHF	CHF	-	*
Adult	CO	CO	CO	CO	-	-	CO	CO	CO	CO	-	-	*
	STS	STS	STS	STS	STS	STS	STS	STS	STS	STS	*	*	*
	TR	-	-	-	-	-	-	-	-	-	-	-	-
	TB	-	-	-	-	-	-	-	-	-	-	-	-
	MW	-	-	-	-	-	-	-	-	-	-	-	-
	LMP	LMP	LMP	LMP	LMP	LMP	LMP	LMP	LMP	LMP	LMP	LMP	LMP
3. Channel Maintenance				X	X	X	X	X	X				
4. Flow Quality 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 severely 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. 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.

Attachment C

UMATILLA BASIN TEMPERATURE STANDARD - OAR 340-041-645(2)(b)(A)

To accomplish the goals identified in OAR 340-041-120(11), unless specifically allowed under a ODEQ-approved surface water temperature management plan as required under OAR 340-041-026(3)(a)(D), no measurable surface water temperature increase resulting from anthropogenic activities is allowed:

(i) In a basin for which salmonid fish rearing is a designated beneficial use, and in which surface water temperatures exceed 64.0°F (17.8°C);

(ii) In the Columbia River or its associated sloughs and channels from the mouth to river mile 309 when surface waters exceed 68.0°F (20.0°C);

(iii) In waters and periods of the year determined by ODEQ to support native salmonid spawning, egg incubation, and fry emergence from the egg and from the gravels in a basin which exceeds 55.0°F (12.8°C);

(iv) In waters determined by ODEQ to support or to be necessary to maintain the viability of native Oregon bull trout, when surface water temperatures exceed 50.0°F (10.0°C);

(v) In waters determined by ODEQ to be ecologically significant cold-water refugia;

(vi) In stream segments containing federally listed Threatened and Endangered species if the increase would impair the biological integrity of the Threatened and Endangered population;

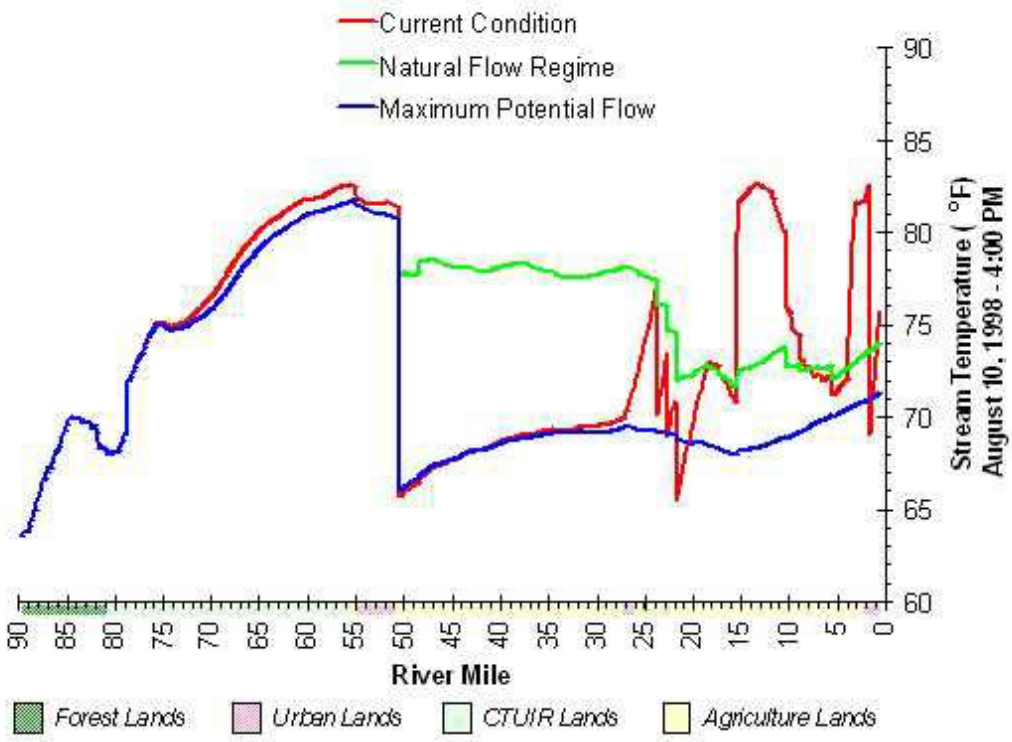
(vii) In Oregon waters when the dissolved oxygen (DO) levels are within 0.5 mg/l or 10 percent saturation of the water column or intergravel DO criterion for a given stream reach or Basin; and

(viii) In natural lakes.

Attachment D

TEMPERATURE MODELING OUTPUT PLOT OF UMATILLA RIVER STREAM TEMPERATURE UNDER DIFFERENT FLOW SCENARIOS

Taken from Umatilla TMDL (DEQ, 2001) Appendix A-4 – Temperature Analysis (Figure A-54)



Natural Flow: No withdrawals return flows or augmentation from McKay

Flow Augmentation: No withdrawals or return flows with augmentation from McKay