Addendum to the Smith River Permit and Change Applications: Supplemental Environmental Assessment

Prepared by

Montana Department of Natural Resources and Conservation

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MONTANA DNRC

WATER Resources Division

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Introduction

This is an addendum to the supplemental environmental assessment (EA) of the potential cumulative impacts of Smith River basin permit and change applications. The addendum contains corrections, clarifications, and responses to comments on the EA. It is best to read the addendum with the supplemental EA at hand. If you do not have a copy of the EA, it is available from DNRC by calling (406) 444-6627, writing DNRC, P.O. Box 210601, 1424 9th Avenue, Helena, Montana 59620-1601, or emailing: ldolan@state.mt.us.

DNRC received many comments on the supplemental EA relating to legal and procedural issues. However, much of the concern expressed as to whether any water use permits or changes should be granted lies outside the scope of this environmental assessment. These concerns will not be discussed in this addendum, but may be brought forward during the administrative permitting/authorization process through timely objections, and addressed on an individual basis. Since many of the comments were similar, DNRC grouped some together rather than responding to each one.

DNRC did include discussions on water rights and MEPA procedures in the supplemental EA. Each application will be addressed on its own merit, and a decision to issue, modify or deny will be based on the statutory criteria. Please refer to Appendix B of the EA for a listing of these criteria.

Applications Not Contributing To Cumulative Impacts

DNRC determined that four of the applications listed in Tables 1.0-1 & 1.0-2 did not contribute enough impacts to warrant including in the cumulative impact assessments of the EA. DNRC will be preparing individual EA checklists for these applications. They are identified below.

Application for Beneficial Water Use Permit 4720800-41J does not contribute sufficiently to the cumulative impacts, as the requested place of use is the same as Application 11779100-41J. Also, information in the application file indicates that only a small fraction of the flow rate and volume requested would be physically available to the applicant.

Application for Beneficial Water Use Permit 11356500-41J does not contribute substantially to the cumulative impacts because it is a small pond that would evaporate little water.

Application to Change a Water Right 1767499-41J does not sufficiently contribute to the cumulative impacts. This change in point of diversion on Eagle Creek would not contribute to the cumulative impacts to the Smith River as the place of irrigation, method of irrigation and flow rate diverted would remain unchanged.

Application to Change a Water Right 5353699-41J does not contribute to the cumulative impacts as the previous industrial use was considered to be entirely consumptive, meaning that none of the water diverted returned to the hydrologic system. There would be no increase in water consumption with the proposed change in use.

Corrections, Clarifications, and Responses to Comments by Resource Area

Land Use: Irrigated Lands and Irrigation Practices

Responses to Comments

Supplemental irrigation
Several of the proposed beneficial water use permit applications requested the use of ground water to serve lands being currently irrigated from surface water sources. This concept is generally referred to as supplemental irrigation. The applications identify annual volumes that the applicant could divert to obtain or exceed full service irrigation. The law allows the combined volumes of existing surface water and new ground water to be used for irrigation. However, none of the proposed applications include a plan to consume less water than requested.

For those existing irrigated lands, surface water sources do not appear to be sufficient to fully supply the lands. The development of the proposed ground water applications to their maximum potential would allow the applicant to transfer the existing surface water rights to another place of use. Also, some of the surface water supplies for these existing irrigated lands came from stored water found in North Fork Smith or Sutherland reservoirs. This water is sold to contract holders by a water users' association. The contract holder has the right to use this water to irrigate new or different lands without the need to receive an authorization from DNRC. Therefore, the stored water may be transferred to new or different lands. When new ground water permit applications are fully developed for lands previously irrigated by contract water or under an existing surface water right, the water users have the potential to transfer the existing water right and expand their water use to it's maximum potential.

Because of the nature of surface water supplies and the ability to fully develop the permitted volume, the beneficial water use permit applications identifying supplemental irrigation were evaluated at their full requested volumes in the supplemental EA. For the sake of comparison, included in this addendum is a second scenario where projects 11778600-41J, 11779100-41J, and 30001310-41J were modeled assuming that the projects would only be pumping half the volume requested and that the pumping would occur during the later part of the summer. In this scenario, the other groundwater projects were assumed to pump the volume requested annually for the reasons that follow.

11366700-41J: This project would irrigate 95 acres. It was not modeled as supplemental because 39 of these acres would be under new irrigation.

11508000-41J: This application is for 344 acre-feet of water per year to irrigate 510.5 acres. The project was already modeled as supplemental in the EA because the volume requested is only 0.675 acre-feet of water, per acre, per season (510.5 acres/344 acre-feet). A full service irrigation requirement for these 510.5 acres would be more than double the amount requested.

30000211-41J: The request is for new irrigation.

Table. AD-1. Potential rates of depletion in cfs, by month, and by reach by proposed wells in the Smith River basin in the 100th year of pumping--scenario 2.

Monthly Potential Cumulative Rates of Depletion (cfs)

	South Fork		North Fork		Main Fork		Total	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2
May	1.09	1.41	0.35	0.49	0.21	0.46	1.65	2.38
June	1.33	1.64	0.34	0.49	0.19	0.56	1.87	2.72
July	1.52	1.84	0.34	0.50	0.18	0.67	2.05	3.03
August	1.66	1.99	0.34	0.51	0.28	0.77	2.29	3.29
September	1.77	2.10	0.35	0.52	0.41	0.86	2.55	3.50
October	1.58	1.92	0.36	0.53	0.49	0.83	2.44	3.30
November	1.38	1.71	0.37	0.53	0.47	0.76	2.22	3.03
December	1.21	1.55	0.37	0.53	0.41	0.67	2.00	2.77
January	1.08	1.42	0.37	0.52	0.36	0.59	1.82	2.55
February	0.99	1.32	0.37	0.52	0.31	0.51	1.67	2.38
March	0.92	1.24	0.36	0.51	0.27	0.45	1.56	2.23
April	0.86	1.18	0.35	0.50	0.23	0.40	1.46	2.11

Increases in irrigated acres associated with the change applications

Comments were received that questioned DNRC's procedures for calculating the potential increases in irrigated lands that could result from the water right change applications. As discussed in the EA, changes in irrigated acres were determined by comparing the acreages sought to be irrigated to those found to be irrigated after examining recent aerial photographs. It was brought up in the comments that this may not be a reasonable approach because irrigated acres can change from year to year based on water supply and other factors. For comparison, DNRC has included 1950 and 1979 irrigated acreage figures relevant to the proposed change projects (Table AD-2 below). The results show that the acres under irrigation in 1950 and 1979 were similar to the acres identified in 1996-1998.

Table AD-2 Expanded comparison of claimed and verified acres for change applications.

Application No.	Claimed Flood Acres Proposed for Conversion	Proposed Sprinkler Acres	Flood Acres Proposed for Conversion Verified as Irrigated in:			Estimated Increase in Irrigated Acres Based on Data From:		
			1996-1998#	1979+	1950*	1996-1998	1979	1950
14609300-41J	405	405	31.9	16.7	44	373.1	388.3	361
14610300-41J	80	288	59.2	59.2	51	228.8	228.8	237
30002272-41J	1,177.7	1,177.7	1,053.7	1,051	1,068.8	124	126.7	108.9
30003392-41J	283	504	148.4	144.7	0	355.6	359.3	504
Cumulative Totals	**1,945.7**	**2,374.7**	**1,293.2**	**1,271.6**	**1,163.8**	**1,081.5**	**1,103.1**	**1,210.9**

#Based on 1996-1998 aerial photos

*Based on 1950 Meagher County Water Resources Survey

+Based on Review of 1979 USDA aerial photos.

Geology and Ground-Water Resources

Clarifications

Commenters contend that a statement referring to drawdown ranging from "0 to about 95 feet" in reference to Figure 3.1-1 on page 37 of the EA represents a discrepancy because maximum drawdown in the figure appears to be 35 feet instead of the reported 95 feet. This does in fact represent a discrepancy. Figure 3.1-1 illustrates drawdown in an unconfined aquifer. Based on a transmissivity of 2,000 ft^2/day and other listed aquifer properties, drawdown is calculated from a standard beginning distance of 1 foot to be 87 feet, rather than 95 feet. Figure 3.1-2 illustrates drawdown in a confined aquifer. Based on a transmissivity of 2,000 ft^2/day and other listed aquifer properties, drawdown is calculated from a standard beginning distance of 1 foot to be 118 feet. To improve readability of the graphs, the drawdown axes were truncated at 50 feet.

One commenter stated," there is no evidence to demonstrate that potential stream depletion rates could vary from 31 to 52 percent (or is it 43 to 63 percent?) of the pumping rates." To clarify, the combined pumping rate of all the proposed wells calculated by spreading the requested volumes over a 152-day irrigation season is 6.69 cfs. The maximum monthly rate of stream depletion obtained from the MODFLOW simulations was 3.48 cfs in September, which is 52 percent of 6.69 cfs. The minimum monthly rate of stream depletion obtained from the MODFLOW simulations was 2.08 cfs in April, which is 31 percent of 6.69 cfs. The effects of different input values for aquifer and streambed hydraulic conductivity on the results of MODFLOW simulations were evaluated in Appendix C. This limited sensitivity analysis yielded alternative estimates for the maximum monthly rate of stream depletion that ranged from 2.87 cfs to 4.19 cfs; a range from 43 to 63 percent of 6.69 cfs.

Another comment states "it appears completely unrealistic that 65 percent of the potential streamflow depletion in the South Fork could result from pumping of the Wilhelm well …" As stated in the EA, "65 percent of streamflow depletion resulting from pumping proposed under application #11366700-41J is expected to come from the South Fork Smith River with the remainder coming from the North Fork Smith River". This statement only refers to the apportionment of streamflow depletion resulting from pumping under the single application not the entire streamflow depletion of the South Fork. Therefore, response ratios for each application necessarily will add to 1.00.

Another comment needing clarification stated, "The erroneous assumption of a direct, immediate hydraulic connection in a closed system most likely greatly overestimates possible ground/surface water interaction." A well is interpreted to be directly or immediately connected to surface water by DNRC if it is expected to induce infiltration from surface water. We believe ground water in the upper Smith River basin is tributary to surface water and that pumping will eventually reduce the amount of ground-water discharge to surface water. However, DNRC does not make any assumptions in the EA regarding direct or immediate connection of the proposed wells to surface water in the upper Smith River basin. Determinations of direct or immediate connection to surface water will be made by the DNRC at individual administrative hearings, and will be based on evaluations of pumping tests and other information presented by the applicants and objectors.

Responses to Comments

Some commenters raised concerns with the Geology and Ground-Water Resources section of the EA for its subjectiveness and lack of data to support a number of statements. DNRC acknowledged in its disclaimer on page 73 of the EA that technical data were limited.

DNRC began the Smith River Return Flow Study in 2000 to assess and quantify surface- and ground-water resources in the upper Smith River basin. Although the study was terminated after two years, it did provide useful data for hydrologic characterization. Ground-water level measurements, drilling logs, and hydrogeologic principles were used to interpret the conceptual hydrogeologic model presented in the EA.

Verification of drilling logs used in the conceptual model
Commenters stated, "that drilling logs from the Montana Bureau of Mines and Geology Ground-Water Information System (GWIC) are an acceptable tool for general information but that field verification is required." Drilling logs from GWIC were used as the primary (and only) source of subsurface lithology. GWIC drilling logs were used only for generalized interpretative purposes and the asserted well-site location errors are unimportant. Drilling logs could not be field-verified during the EA's 90-day preparation period. The commenters can obtain drilling logs from GWIC.

Clay-layer continuity in the alluvial aquifer
A number of comments claim that clay is horizontally continuous in the alluvial aquifer of the upper Smith River basin. They assert that a continuous clay layer will effectively diminish or eliminate the potential for the new ground-water appropriations to impact surface-water availability. DNRC's interpretation of discontinuous clay layers is based on a review of drilling logs and published descriptions of Quaternary alluvium and Tertiary deposits in other basins of southwestern Montana. A continuous clay layer in the alluvial deposits of the upper Smith River basin has not been identified from drilling logs nor was it reported by various studies referenced by DNRC. Identification of a significant, alluvial clay layer on all drilling logs for the upper basin would demonstrate the horizontal continuity of the clay.

Quaternary-age alluvial sediments on floodplains and alluvial fans in the upper Smith River basin are expected to be discontinuous in nature. Fluvial processes (i.e., related to stream action), that deposited these sediments, are dynamic and subject to sudden and rapid changes. Constantly changing flow velocity and shifting channel positions cause stratigraphic interfingering and pinchouts, which result in alluvial deposits with characteristic geometric irregularity and textural variability. Individual strata tend to be spatially discontinuous, resulting in a heterogeneous assemblage of coarse- and fine-grained layers. Because of the textural variability and spatial discontinuity of individual layers, they are difficult to trace. Cross sections, fence diagrams, and stratigraphic correlations have not been developed from the drilling logs because of the uncertainties in interpretation. One of the applicant wells is interpreted to be completed in the Quaternary alluvium.

Quaternary alluvium is common in the mainstem Smith River Valley west and southwest of White Sulphur Springs. Alluvial sand and gravel, interpreted to be river and alluvial-fan deposits, gradually thicken in this area of the upper basin. Sand and gravel deposits are identified on drilling logs from Sections 9 and 10 of Township 9 North, Range 6 East, and from Sections 28, 30, 31, and 32 of Township 10 North, Range 6 East. Clay layers are interpreted to be discontinuous, localized confining deposits. The alluvium is believed to thin considerably to the southwest toward the Smith River and is based on the following geologic information. Project monitoring well MW19 was drilled in Section 17 of Township 9 North, Range 6 East. The well is completed in shale at a depth of 16 feet and penetrates no sand or gravel. The Riverside Ranch (personal communication, 2000) also informed DNRC that red clay was encountered at a very shallow depth (i.e. 2-3 feet) while attempting to complete a new domestic well in Section 7 of Township 9 North, Range 6. Last, a project monitoring well, referred to as "old monitoring well 2" that was installed in Section 1 of Township 9 North, Range 5 East near the Smith River, encountered silt and clay in the augered borehole.

Tertiary-age sediments are grouped into two general categories. Older Tertiary units are generally fine-grained (i.e., clay, silt, and shale) and represent low-energy river and lake deposition. Younger Tertiary units are generally coarser-grained (i.e., sand and gravel) and represent higher-energy river and alluvial fan deposition. Some of the Tertiary aquifers in the upper Smith River basin are interpreted as discontinuous, thin seams of loose or cemented gravel or sand interbedded with sequences of clay. Other Tertiary aquifers appear to be thicker gravel and sand sequences underlying thick clay deposits. Applicant wells are completed in both types of Tertiary-age aquifers.

Tertiary-age deposits commonly occur in the South Fork Smith River valley south of White Sulphur Springs beneath the thin and often discontinuous Quaternary alluvium. Clay is the predominant Tertiary sediment that occurs as either thick, massive beds or interbedded with gravel or sand lenses. In Sections 3 and 10 of Township 8 North, Range 6 East, thick, coarse, permeable gravel deposits, interpreted as buried stream channels, are believed to underlie thick, massive clay sequences. These thick clay sequences may be locally-continuous, but their continuity across the valley is questionable, as suggested by drilling logs from Section 2 of Township 8 North, Range 6 East, Section 5 of Township 8 North, Range 6 East, and Sections 25, 26 and 35 of Township 9 North, Range 6 East.

A commenter contends that data collected during the Riverside Ranch aquifer test indicate that clay is extensive in Sections 8 and 9 of Township 9 North, Range 6 East. A review of drilling logs in this area suggests that sand and gravel are the major components of the alluvial aquifer. Furthermore, the commenter believes that the aquifer is confined because a thin layer of clay was observed in the pumping-well borehole. DNRC does not agree with the interpretation, nor does the presence of the clay layer constitute proof of its horizontal continuity. A horizontally-extensive clay stratum in the alluvial material needs to be credibly demonstrated. In the longer-term, the aquifer may respond as a hydraulically-connected, unconfined system. The applicant's well was pumped for only 24 hours, which is a typical testing period for confined aquifers, but not for unconfined aquifers. However, if the well is pumped longer, it is anticipated that unconfined responses will be observed in observation wells.

Evidence of connection between ground water and surface water

Several commenters state that it is assumed that the Smith River is gaining and "directly or immediately" connected to ground water, that new wells will cause interception of ground water that will deplete the river, and that ground-water/surface-water interactions constitute a single hydrologic system. The principle that ground-water/surface-water interactions represent a single hydrological system is explained in the professional literature (e.g., Ground Water and Surface Water: A Single Resource, 1998, USGS Circular 1139, 79 p.).

A river is typically the principal control on the hydrogeology of an alluvial aquifer and commonly serves as a regional discharge zone by gaining water from the aquifer on an annual basis. For ground water to flow from the aquifer to the stream, the ground-water level in the aquifer must lie topographically higher than the stage in the stream. Elevational differences result in a vertical hydraulic gradient being established between the aquifer and the stream. The amount of ground water discharging to the stream is a function of the area and thickness of the streambed, its vertical hydraulic conductivity, and the elevational difference between the ground water and stream stage.

Ground-water levels measured in upper-basin wells were contoured and plotted on topographic maps as illustrated in Figures 2.1-5 through 2.1-8 in the EA. Ground-water flow directions, as illustrated on these figures, indicate that ground water flows from high to low elevations. Observed ground-water elevations were higher than stream stage in the Smith River thus establishing the potential for gaining conditions to occur between ground water and surface water. Ground-water movement from the aquifer to the stream occurs where the unconfined aquifer is in hydrologic connection with the streambed. The rate and timing of the discharge to the stream are unquantified.

Recharge from bedrock

Several commenters contend that the EA ignores ground-water flow from surrounding bedrock to the alluvial aquifers. The first paragraph under the Ground-Water and Flow Direction section on page 14 of the EA neither explicitly states nor implies that bedrock does not interact with the alluvial aquifer. The intent of the paragraph is to state that basins bounded by bedrock mountains often form localized, single-valley flow systems in which significant ground-water recharge originates within the basin as snowmelt and rainfall in the uplands (i.e., bedrock mountains and alluvial fans) and moves downward toward discharge areas through bedrock and alluvial materials.

Other concerns

A commenter contends that an explanation of the hydrogeologic significance of the igneous sill was not provided. The explanation is provided on page 14 of the EA.

Several commenters request further explanation regarding EA statements about high ground-water levels. In general, a thinning aquifer and a decrease of hydraulic conductivity of the aquifer materials cause a rise of the water-table elevation. Furthermore, an upward vertical hydraulic gradient, characteristic of discharge areas, causes the water table to lie near or at the land surface in discharge areas. Bedrock discharge may cause a shallow water table where its discharge is greater than the infiltration capacity of the material into which it discharges. Shallow clay layers may also cause a shallow, perched water table.

Commenters contend that Figure 2.1-9 on page 22 of the EA does not represent the complexities of the aquifer system and may lead to false interpretations regarding the potential for groundwater and surface water to interact. The figure is a simplified representation of the aquifer system and is not intended to be misleading. The figure simply depicts for the layperson the concept of streamflow capture and depletion as a result of pumping. The figure is an example of the application of the Law of Mass Conservation as explained in the EA.

One commenter states that the EA ignores the existence of artesian springs in the valley that imply confining conditions. The springs in the upper Smith River basin do not imply confining conditions; they are related to solution conduits in local limestone and/or area thrust faulting.

Recovery of ground-water levels
A common comment disputed the statement that "ground-water levels do not entirely recover between pumping cycles". One commenter disputed this statement because water levels recovered to pre-pumping levels or higher during some of the applicants' pumping tests.

The analysis of drawdowns from pumping presented in the "Impacts of Ground-Water Development" subsection of the EA considers the case where water is taken from aquifer storage in an infinite aquifer. There are several basic concepts; first, removal of ground water from aquifer storage is associated with declining ground water levels. Second, in the case of cyclic pumping where pumping occurs for a fraction of the time, say an irrigation season, ground water is redistributed between pumping cycles and ground-water levels recover nearly to pre-pumping water level. When water is pumped solely from storage there will remain some residual effect of pumping that will increase with ensuing pumping cycles. Water levels can recover within the measurement accuracy of typical pumping tests if relatively small volumes of water are removed from storage. Last, the effects on ground-water levels from pumping individual wells may be difficult to distinguish from pre-pumping trends in water levels.

The decline of water levels from pumping will stop only when the cone of depression impinges on aquifer boundaries where ground-water discharge can be reduced or ground-water recharge can be increased. The following quote from a paper by Theis (1938) emphasizes this point:

"Discharge by wells is an additional discharge superimposed on the previously more or less stable hydraulic system. If such discharge is continued indefinitely, it is evident that eventually the aquifer must either receive more water or else the discharge through natural outlets must decrease. Neither of these effects can be accomplished without changing either the gradient of the water table or piezometric surface or the level of the water table in the areas of recharge or discharge, respectively, or, in other words, depressing water levels the entire distance between the well and one or the other of these areas."

Therefore, the condition where water levels recover between pumping cycles can be reached, but only after the cone of depression impinges on an area of recharge or discharge. Commonly, the system is brought into balance only when drawdown in areas of discharge decreases ground-water outflow (Bredehoeft and others, 1982). In the Smith River basin, discharge occurs through seepage to surface waters, evapotranspiration by plants, and ground-water outflow from the basin.

In summary, the potential for cumulative impacts to existing wells by interference between the proposed new wells is considered in subsection "Impacts of Ground-Water Development". Fundamental concepts of hydrogeology hold that withdrawal of water from aquifer storage will result in declining ground-water levels. Because water is removed from the system, water levels will not recover between pumping cycles regardless of whether the residual drawdown can be distinguished from other effects. Residual effects will stabilize only by capture of water that otherwise would discharge to surface water, be consumed by riparian vegetation, or pass out of the basin as ground-water outflow.

To reiterate statements in the EA, DNRC did not intend to evaluate impacts of individual projects, only cumulative effects of all projects. Information provided by the applicants on the effects of individual wells will be evaluated by DNRC at individual administrative hearings. Pumping test data for individual projects would have been useful for interpreting the properties of the aquifer or aquifers in the Smith River basin. Unfortunately, pumping test data were only available for one project.

Numerical modeling
There were a number of questions regarding the applicability of numerical modeling results used to investigate potential effects of ground-water pumping on stream flows in the Smith River basin. In general, the comments expressed concern that the models do not represent the complex hydrogeologic environment of the Smith River basin in sufficient detail to be used to evaluate individual beneficial use applications. The validity of simplifying assumptions, the adequacy of baseline data, and use of uncalibrated models were questioned.

DNRC agrees with the premises of many of the comments regarding the shortcomings of numerical modeling based on limited data. Existing data on aquifer geometry, aquifer properties, and the basin water balance are generally insufficient to calibrate a detailed numerical model or models. For this reason, the numerical models used for the EA were not designed to be used to evaluate whether individual projects meet the criteria for issuance of a permit; they were designed to represent the general geometry of the basin using estimates of aquifer properties and geometry interpreted from well logs, one pumping test, and published geologic maps. A simple analytical model could have been used instead of the numerical models, however the geometry of the basin could not have been considered in that approach.

Some of the simplifying assumptions of the numerical models used to investigate the impacts of ground-water pumping on stream flows do disregard complexities of the basin hydrogeology. Specifically, inflow from bedrock surrounding the basin is neglected and ground water from the upper basin is assumed to discharge solely to surface water. Ground water in bedrock aquifers could provide a significantly greater reservoir of ground water storage that would influence the timing of effects of new wells on stream flows. However, water inflow from bedrock aquifers is not believed to be new water to the basin because it most likely originates in surrounding highlands and probably otherwise would have discharged to basin fill sediments. In contrast, errors in the potential rate and volume of surface water depletion could be introduced by neglecting the potential for new wells capturing ground water outflow from the basin or discharge to riparian vegetation. Reductions in groundwater outflow from the upper basin would decrease the volume of water depleted from surface water by an equal amount.

In summary, the results of numerical modeling presented in the EA provide a conceptual basis for evaluating the potential or worst case cumulative impacts of new wells on stream flows. Individual hearings for each project will provide applicants for beneficial use permits for new wells and objectors an opportunity to present information on aquifer properties and geometry, and the basin's water balance.

Surface-Water Resources

Clarifications

Data and methods used to estimate Smith River flows above and below Sheep Creek
In Section 2.2 of the supplemental EA, DNRC estimated Smith River flows above and below the mouth of Sheep Creek for the 24-year period from 1978 through 2001. Table AD-3 below describes how flows were estimated for each station for this time period. When available, recorded streamflow data were used. The USGS operated a stream gaging station on the Smith River near Fort Logan, above the mouth of Sheep Creek, from 1977 through 1996. The gage was relocated below the mouth of Sheep Creek--just

below the mouth of Eagle Creek--in 1996 and has been operated at that site ever since. DNRC operated a stream gaging station on the Smith River above Sheep Creek from May through October in 2000 and 2001. A stream gage has been operated on upper Sheep Creek from 1941 through late 1972 by the USGS and by the NRCS from late 1972 to present.

Table AD-3. Methods used to estimate Smith River monthly average flows.

Smith River above Sheep Creek	Data or Method Used
January, 1977 through September, 1996	USGS daily flow data from gaging records
May through October of 2000 and 2001	DNRC daily flow data from gaging records
May through October of 1996-1999	USGS flow data below Sheep Creek were adjusted using the 2000-2001 flow ratios of DNRC measured flows above Sheep Creek to the USGS measured flows below Sheep Creek
October through April of 1996-2001	Drainage area-adjusted Sheep Creek gaged flows were subtracted from the USGS (Smith River below Sheep Creek) flow data.
Smith River below Sheep Creek	**Data or Method Used**
October, 1996 through December, 2001	USGS daily flow data from gaging records
January, 1977 through September 1996	Drainage area adjusted Sheep Creek gaged flows were added to USGS flow data for the Smith River above Sheep Creek.

The final monthly flow estimates that DNRC used are attached as Appendix E. An EXCEL spreadsheet contains all the data and calculation procedures used, and this spreadsheet is available upon request from DNRC.

These flow data were used as input to the Smith River basin surface water model,
and were used to produce Tables 2.2-1 and 2.2-2, and Figure 2.2-1 in the supplemental EA.

For the benefit of the lay reader flow estimates in Table 2.2-1 and 2.2-2 were presented for very wet, wet, middle, dry, and very dry years. The corresponding percentile flows for these types of years are as follows: very wet = 10^{th} percentile; wet = 20^{th} percentile; middle, median = 50^{th} percentile; dry = 80^{th} percentile; very dry = 90^{th} percentile. Percentile flows are flows that are equaled or exceeded a certain percentage of the time. For instance, a 90^{th} percentile flow is equaled or exceeded 90 percent of the time.

Smith River basin surface-water model

The Smith River basin surface water model was described in Appendix D of the supplemental EA. Input data to the model include the estimated streamflows described above, and the irrigation characteristics summarized in Tables D-1, D-2, and D-3 of Appendix D of the supplemental EA. The model is digital and in the form of an EXCEL spreadsheet. This spreadsheet is available on request from DNRC.

In Table D-1, the irrigation system water-use characteristics that were used in the model for flood and sprinkler irrigation systems are discussed. This includes the percent of the diverted water that is: (1) used by the crop, (2) returns to the stream as surface water return flow, (3) returns to the stream as groundwater return flow, and (4) is lost from the system. The "irrigation efficiency" is the percent of diverted water that is used by the crop (the numbers in the first column of table D-1).

Water that is lost from an irrigation system (column 4 in Table D-1) includes both conveyance losses and field losses. Conveyance losses would include canal seepage that is used by non-target plants, seepage that is lost to deep percolation, and evaporation from the water surface of the canal. Field losses would include water lost to evaporation during application by a sprinkler, water that can pond and evaporate during flood irrigation, or water lost to deep percolation. Losses can be quite high. For instance, the estimated total (canal and field) lost water for partial service flood irrigation (10% of the water diverted) is one-half of the amount that is estimated to be used by the crop. For sprinkler irrigation, a substantial percentage of the applied water may evaporate before it reaches the ground, especially on hot, windy days (Bauder, 2000).

Ground water return flow factors used in the modeling were presented in Table D-2. The return flows were lagged over a 12-month period in the model. DNRC's analysis indicates that, in some cases, return flows would extend beyond the 12-month period and this was accounted for in the modeling. For example, return flow factors for month 13 were added to month 1; those for month 14 were added to month 2, and so on.

The annual crop water-use values used in the surface water model were summarized in Table D-2 of the EA. Crop water use varies depending on the type of system used and the type of year. Those used in the model ranged, on an annual basis, from 8.86 to 16.01 inches per year. For the modeling, DNRC estimated that 70 percent of the flood-irrigated land was "full service", meaning that it was irrigated throughout the irrigation season. For these lands, whether the crop was harvested after the first cutting or left standing as forage was not differentiated.

A commenter thought that a crop irrigation requirement of 24 inches was used in the modeling, but this was not the case. In the EA, 24 inches was described as the approximate amount of water that would be consumed by an alfalfa crop under optimal conditions, without down-time allowed for haying. It was only used to compare the percentages of land area in the basin that receives greater than 24 inches of average precipitation a year, to that which received less than 24 inches of precipitation a year (see the last paragraph of page 23 of the supplemental EA).

The use of monthly average flows

In the supplemental EA, DNRC generally presented streamflow estimates as monthly average flows. One group commented that flows that might impact a fishery are not the function of means and averages, but extreme events. They submitted estimates of the lowest daily late-summer flow levels for the 1978-2002 period for the Smith River at the location of the USGS gaging station below the mouth of Sheep Creek.

DNRC has included these yearly daily low flows in Table AD-4 because we conclude they are generally good estimates and that showing the daily minimums is important in defining existing conditions.

Table AD-4. Estimated minimum flows for the Smith River during August and September for the Smith River below the mouth of Sheep Creek in cfs.

Year	Lowest Flow	Year	Lowest Flow	Year	Lowest Flow	Year	Lowest Flow	Year	Lowest Flow
1978	143	1983	123	1988	26	1993	293	1998	125
1979	116	1984	81	1989	68	1994	79	1999	78
1980	118	1985	66	1990	83	1995	95	2000	31
1981	108	1986	139	1991	59	1996	92	2001	34
1982	147	1987	88	1992	45	1997	200	2002	65

One commenter stated further that there is a clear downward trend, and implies that it is due to continued water appropriation and sprinkler conversion. DNRC agrees that there is a downward trend, and that sprinkler conversions could be contributing to lower late-season flows. However, the higher flows during the early part of the period were probably due more to higher precipitation in those years.

Flow reductions during dry years

In Tables 3.2-1 and 3.2-2 of the supplemental EA, DNRC estimated potential changes to flows in the Smith River and tributaries due to the cumulative effects of the proposed projects. In the supplemental EA, it was further stated that the estimated flow reductions in these tables might not occur in full during the late summer of dry years because the flow in some of the streams and sources during these drier years would not be sufficient to support all of the additional full-service irrigation proposed. Also, a flow reduction upstream may not result in a direct depletion further downstream because, when water is short, another irrigator may have already diverted the water if it were available.

One commenter took the Smith River flow change values from Table 3.2-1 and divided them by flow estimates from Table 2.2-1 to come up with percentage flow reductions during average and dry years. This approach may be valid to estimate flow reductions during wetter and average years, but not for dry years as the percentage would be under-estimated for the reasons stated in the paragraph above.

Further clarification on how impacts to surface-water flows were determined to be moderate adverse

DNRC characterized the cumulative impacts to surface-water flows from the proposed projects in the basin as moderate adverse. In doing so the severity of the impact was considered. Flows during the late summer would be reduced from 10-to-25 percent which was characterized as a moderate reduction. The duration of the impact was determined to be greatest during the late summer and minor during the remainder of the year. The geographic extent of the moderate impacts would be limited to the Smith River and the North Fork, South Fork, Birch Creek, and Sheep Creek tributaries. Moderate impacts would probably occur during average and drier years; during wetter years, impacts could be minor. There is a probability that these impacts will occur, if all of the applications were granted. Flow reductions would cause adverse effects to other resource areas such as economics and fisheries. Please refer to these sections for a more comprehensive understanding of potential impacts from flow reductions.

Responses to Comments

Potential impacts to stock water on the lower Smith River and access to the river bed
It was brought to DNRC's attention that potential impacts to stock watering on the lower Smith River were not discussed in the supplemental EA. During the late summer of 2000 and 2001, when the lower Smith River went dry, it was not possible to water cattle from much of the lower river. As discussed in the supplemental EA, cumulative flow reductions from the proposed projects would increase the frequency and times of zero flow. This would result in an adverse impact to those who water cattle from the lower river.

One commenter noted that some people were driving vehicles in the riverbed for recreation during the recent drought. This type of activity would probably increase with further flow reductions.

Salvage water
The supplemental EA did not directly address the issue of "salvage" water. Montana statute states, ".... holders of appropriation rights who salvage water may retain the right to the salvaged water for beneficial use." (85-2-419 MCA). If a water right holder proposes to salvage water, they must demonstrate that water is actually being salvaged. This can be difficult. "Salvage" means to make water available for beneficial use from an existing valid appropriation through application of water-saving methods. (85-2-102 (16) MCA). Therefore, an appropriator must both prove water-saving methods were used and made water available for beneficial use, and must also prove pursuant to the change statute that the change would not adversely affect other water rights. (85-2-402 MCA).

Estimated flows for Smith River tributaries
One commenter pointed out that flow estimates are available for the Smith River tributaries that could be affected by these water applications. The flows were estimated by the USGS (1989) for a 1937-1986 base period and are contained in Appendix F. These flows were estimated by the USGS based on basin characteristics, channel widths, weighted averages, and concurrent discharge measurements. These flows can be compared to the predicted changes in tributary flows due to the cumulative effects of the proposed projects (Table 3.2-2 in the supplemental EA).

Cumulative impacts to stream flows
A commenter stated that DNRC's cumulative impact analysis should encompass the impacts of all past water development and all potential future development. DNRC's approach was to write an EA that focused primarily on the proposed projects under consideration and to set reasonable limits on the scope of past and other future impacts to examine. Determining how all prior irrigation development has affected streamflows would be extremely difficult because streamflow data prior to irrigation development are not available.

The earliest streamflow records for the basin were for the Smith River near Truly for a short period of time from 1905 through 1907. But by then, there had already been extensive irrigation development in the basin. For instance, appropriations were comprehensive enough on the North Fork of the Smith River, Willow Creek and Trinity Springs that a court decree adjudicating these rights was issued in 1890. The Water Resources Survey (State Engineers Office, 1950) contains a decree that was issued on the South Fork of the Smith River during 1890, and many other decrees that were issued on Smith River tributaries--including Birch Creek, Camas Creek, Newlan Creek, and Eagle Creek--between 1890 and 1920.

Scattered streamflow data are available for basin streams during the 1920-1940 period, and there is better data for more recent years. But all of these flow records will reflect streamflows that have been heavily influenced by irrigation.

To assess the impacts of past changes in irrigation practices, DNRC focused on known conversions from flood to sprinkler irrigation that have been occurring since the 1970s. This coincides with the time when continuous long-term gaging data became available for the upper Smith River (the Fort Logan gage began operation during 1978). The availability of irrigation and streamflow data for this time period allows for a reasonable evaluation of the potential impacts of system changes. Data from the Montana Agricultural Statistics do not show a consistent trend in total irrigated-acreage increases or decreases during the 1978 to 2001 time period, so basin irrigated acreages for the period were modeled at a consistent 36,000 acres.

In regards to future impacts, DNRC examined the cumulative impacts of all related applications it has pending, as required by MEPA. In addition, DNRC examined how continuation of the trend of conversion from flood to sprinkler irrigation might impact streamflows and associated resources.

Water Quality

Corrections

The last sentence on page 45 of the EA has been corrected to read as follows, "The beneficial impacts are considered minor because they would be offset to some degree by potential ~~increases~~ decreases in dissolved oxygen and increases in water temperature due to lower streamflows.

Streams on the 303d list
On the bottom of page 27 of the supplemental EA, streams in the upper Smith River basin that are on the DEQ 303d list were discussed, but the identification of streams on the list was incomplete. The following table summarizes upper basin streams that are on the DEQ 303d list.

Table AD-10. Upper Smith River basin streams on the DEQ 303d list.

Stream	Impaired Reach	Probable Causes
Smith River	Confluence of North and South Forks to Hound Creek	dewatering, flow alteration, nutrients, pathogens, phosphorus
North Fork Smith River	Lake Sutherlin to mouth	algal growth, nitrogen, nutrients, pathogens, phosphorous
Sheep Creek	Headwaters to mouth	mercury, metals, pathogens
Benton Gulch	Headwaters to mouth	pathogens
Newlan Creek	Newlan Reservoir to mouth	pathogens
Camas Creek	Junctions of Big and Little Camas creeks to mouth	pathogens

Source: Montana DEQ Environet Watershed Information Web site: nris.state.mt.us/wis/

Responses to Comments

Impacts of stagnant water on the breeding of mosquitoes and the West Nile Virus
One commenter was concerned that an increase in stagnant water due to flow reductions may increase human and animal health risks associated with the West Nile Virus. The West Nile Virus is a concern, but DNRC did not think it could conduct a satisfactory impact analysis on how the proposed projects might contribute to the West Nile Virus threat.

Concerns about the oxygen fixing impacts of algal blooms
One commenter believes that algal blooms in the Smith River have increased over the past decade. DNRC is aware of the algal blooms but does not have any data that could verify or dispute the observation that they have increased. It is possible that algal blooms may have increased in recent years because streamflows in the Smith River have been low and because higher flows have been less frequent during recent years. Normally, higher flows are needed to move the gravels and cobbles on the streambed and this could subsequently dislodge algae. If algae growth is increasing in the Smith River, then the cumulative flow reductions that are predicted to occur as a result of the proposed projects would add to this problem.

Conclusion of impacts to water quality
In Section 3.3 of the supplemental EA potential positive and negative cumulative impacts of the proposed projects were discussed and balanced. By reducing return flows through conversion to sprinkler systems, the projects are likely to decrease the amount of nutrients, sediments, and total dissolved solids that return to the stream. Conversely, flow reductions associated with the projects could increase water temperatures, which in turn would lead to reduced dissolved oxygen concentrations.

One commenter suggests that reducing relatively good quality inflows from Sheep Creek, as a result of one of the proposed projects, would be detrimental to water quality in the Smith River. DNRC acknowledges the validity of this comment because Sheep Creek flows generally have lower TDS concentrations and higher dissolved oxygen concentrations than the Smith River.

After weighing all of these factors, DNRC still considers the overall cumulative impacts to water quality would be minor. Because these impacts would be detrimental in some cases and beneficial in others, DNRC has amended Table 4.1 to reflect this.

Amendment to Table 4-1 of the Supplemental EA.

Resource	**Impact**
Water quality	~~Minor beneficial~~ Minor adverse to Minor beneficial

Fisheries

DNRC prepared the fisheries sections of the EA. The data used by DNRC was collected the Montana Department of Fish, Wildlife and Parks (DFWP), the state agency responsible for managing Montana's fisheries resources. DFWP reviewed the assessment to ensure the data were interpreted correctly. DNRC deleted the sentence pertaining to water reservations because reservations do have force for those instances in which applications can be accepted by DNRC.

Corrections

Paragraph 5 on page 29 should read as follows:

During the 1980s, DFWP applied for and received several water reservations on the Smith River and some of its tributaries. The purpose of the water reservations was to set aside a minimum river flow to protect fish habitat. ~~Although these reservations have no force and effect as provided in the Board's Final Order because of the current Upper Missouri River Basin closure, they are an indication of flows needed for fishery habitat~~. Using the wetted perimeter inflection-point method (Leathe and Nelson 1989), DFWP has shown that the rate of habitat loss increased substantially as flows ~~decreased from~~ dropped below 150 cfs ~~to 80 cfs~~. Several water rights ("Murphy Rights") are held by DFWP with a priority date of 1970. Water reservation requests and Murphy water rights assigned to the Smith River for instream flows are listed in Table 2.4-2.

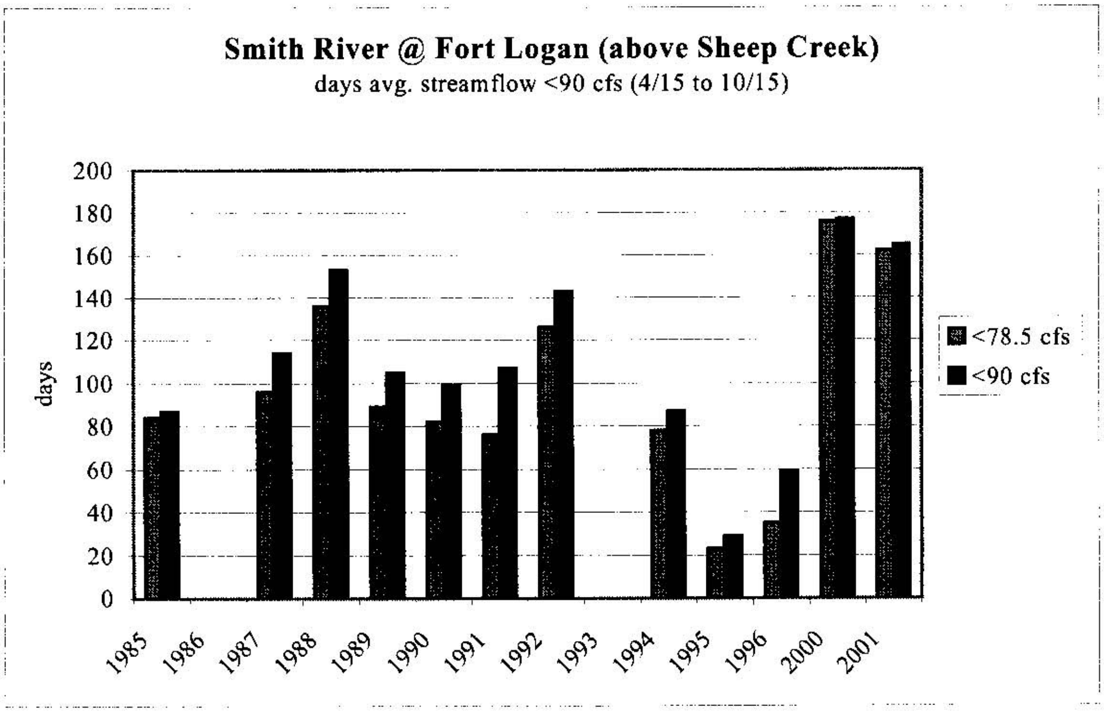
Several corrections were made to Table 2.4-2. The correct endpoint for the Murphy Right from river mile 24.4 to river mile 64.3 is Hound Creek to the Cascade-Meagher County Line and not Mud Creek. It should be noted that the Wetted Perimeter Inflection Point Method or WET-P methodology was used to generate many of the Murphy Rights listed in the table (not just the reservations). Table 2.4-2 is reprinted below with the appropriate corrections.

Reach	**Begin**	**End**	**Flow (cfs)**	**Type**
Smith River				
Mouth (river mile 0.0) to Hound Cr (rm 25.4)	1/1	12/31	80	Water Reservation*
Hound Cr (rm 24.4) to Cascade-Meagher County Line (rm 64.3)	5/1	5/15	372	Murphy Right*
	5/16	6/15	400	Murphy Right
	6/16	6/30	398	Murphy Right*
	7/1	4/30	150	Murphy Right*
Hound Cr (rm 24.4) to Sheep Cr (rm 83.4)	*1/1*	12/31	150	Water Reservation*
Cascade_Meagher Co Line (rm 64.3) to Sheep Cr (83.4)	5/1	6/30	150	Murphy Right
	7/1	8/31	140	Murphy Right*
	9/1	3/31	125	Murphy Right
	4/1	4/30	140	Murphy Right*
Sheep Cr (rm 83.4) to Smith R, N FK (rm 123.4)	1/1	12/31	78.5	Water Reservation*
Sheep Cr (rm 83.5 to Rabbit Cr (rm 103.5)	5/1	6/30	150	Murphy Right
	7/1	4/30	90	Murphy Right*
NF Smith River	1/1	12/31	9	Water Reservation*
SF Smith River	1/1	12/31	7	Water Reservation*
Big Birch Creek	1/1	12/31	11	Water Reservation*
Eagle Creek	1/1	12/31	2.5	Water Reservation*

**Water Reservations and some of the Murphy Rights were determined using the WET-P. When WET-P method results did not exceed the originally filed amount represented by the Murphy Right, the original filings were modified down to the WET-P calculated amount. When WET-P results exceeded the original Murphy filing amount, the originally filed amount was used.*

The WET-P quantification for the water reservation on the Smith River above Sheep Creek should have been reported as 90 cfs. The value used in Figure 3.4-1, 78.5 cfs, is the amount granted in the reservation but it does not reflect the actual flow amount quantified in the DFWP's application for reservation that the agency felt was necessary to support the coldwater fisheries. Figure 3.4-1 also has been altered to reflect the days when instream flows dropped below 90 cfs. The original assessment is correct, that is, in 12 out of 14 years of record, there were numerous days when the minimum instream flow requirement was not met.

Figure 3.4-1: Revised. Number of days fisheries instream flow needs are not met (based on DFWP water reservation and Murphy Right documentation).



Clarifications

DFWP data discussed in section 2.4 suggest lower rainbow trout populations occur in years when late summer flows are below 100 cfs. Long-term fish population data made available by DFWP indicates rainbow trout survival is strongly influenced by low August/September flows. For example, survival rates for young rainbow trout were noticeably lower in years when August/September flows averaged less than 150 cfs.

Table 2.4-1 documents dewatering and the fish kills that occurred in the Smith River basin. The term dewatering in this table refers to zero flow or a dry channel.

During some years, the surface water connection between some Smith River tributaries and the Smith River mainstem is lost due to low flow conditions. In low flow conditions, adult trout have difficulty migrating into tributaries to spawn and young fish have difficulty migrating back to the river.

Much of the lower Smith River reach below Eden Bridge has poor to marginal instream habitat for trout. DFWP feels that some of the reach, the first 5-7 miles below Eden Bridge, could be supportive of fish if sufficient flows are available.

Whirling disease was first detected in Smith River fish in 1999. Whirling disease in the upper Smith River (above Camp Baker) is considered severe and getting worse (Vincent, pers comm. 2003). Following emergence from eggs, rainbow trout are very susceptible to infection. The potential for infection is greatest at water temperatures of 45-60°F, which is optimum for triactinomyxon (TAM) spores production. Research conducted on the Madison River showed a linear correlation between increased infection intensity and lower streamflows, because decreased concentrate TAM spores. A specific discharge-infection intensity relationship has yet to be established for the Smith River. It is difficult to ascertain when the greatest impacts of flow depletions on whirling disease would occur in the upper Smith River. During the spring months when water temperatures are optimum for TAM production, projected flow depletions are relatively small. However, during the July and August when flow depletions are higher, mean daily water temperatures are greater than optimum TAM production. The severity of these potential impacts is difficult to gage based on available data. However, the combined stress of lower flows and the existence of whirling disease is not conducive to fish survival.

It should be noted that the conversion from flood irrigation to sprinkler irrigation from its present use of about 34% of total irrigation to 66% will further lower stream flows which in turn will probably increase the impacts.

Responses to Comments

Use of a dry Smith River photo

One commenter questioned the use of a photo of the Smith River dry at Eden Bridge in the EA. This photo was included in the existing environment section of the EA to demonstrate extreme conditions that do occur in the Smith River. These conditions are part of the existing environment. Sections of the mainstem Smith River as well as the North and South Forks, were documented as dry between 1999-2001. Fish kills did occur, as documented in Table 2.4-1 of the EA, in the lower and upper Smith River basin.

Debilitating adverse impact to the fishery

A commenter requested an assessment of what it would take to create an acute or debilitating adverse impact to the fishery resource in the Smith River. Based on available data, there is no clear definition on what an acute or debilitating adverse event would be or the threshold at which the fishery would be placed in acute peril. Further, it is beyond the scope of the EA to attempt to quantify the probability of such an event. DNRC can only identify the threshold determined by the wetted perimeter methodology for maintaining viable fish habitat as defined in the DFWP's water reservation. When flows are below this threshold, the impacts would probably be chronic, not acute. A discussion of the downward trend of the lowest daily flows is presented earlier in this addendum.

Persistence of algal blooms

Several comments were made regarding the existence of algal blooms in the upper Smith River. The existence of algal blooms is based on DFWP's assessment. In addition to that assessment, DNRC observed and documented the existence of substantial algal blooms in some reaches of the upper Smith

River during the late summer months of the years, 2000 and 2001. The harmful effects of excessive algae are discussed in the water quality section of this addendum.

Effects of projects on fish populations

A commenter pointed out that Montana's rivers are not stocked with trout and following a high mortality event, it could take several years for the fish population to return and grow to a "catchable" size, even if Smith River flows were to return to normal conditions. It should be noted that documented mortality events thus far have not been drainage-wide, rather observed in specific locations (in the North and South Forks and below the canyon on the mainstem of the Smith River, see Table 2.4-1 in the EA). Therefore, while the above statement is likely true, the geographic extent of the impacts should be considered.

One commenter identified a written assessment of the fish population that was submitted by DFWP as evidence that the finding of moderate adverse impacts to fisheries was flawed and that fish populations have not declined with lower flows. The DFWP data does not support this assertion (Liknes, pers comm. 2003). Population estimate data for trout 8 inches and longer from the Eagle Creek Section, a 2.04 mile reach that starts below the mouth of Eagle Creek, clearly shows major changes in species composition and densities in the 1990's when compared to the historic densities of the 1970's and 1980's. These changes demonstrate that rainbow trout populations have responded adversely to habitat conditions and interspecific competition among species in the Smith River since drought conditions persisted in the late 1980's. Rainbow trout levels increased to previous levels only in one year during the 1990's. The population increases were noted in both rainbow and brown trout in 1999, which followed years where streamflows were adequate to provide recruitment and survival substantial enough to allow population expansion. Rainbow trout densities reached historic low levels in 1996 and have returned to those levels in 2001 and 2002.

Brown trout population densities have increased dramatically from low levels in the 1980's, typically under 200 per mile, to a historical high of 918 per mile in 1999. This peak in brown trout numbers was substantially lower than previous peak levels reached by rainbow trout. After reaching the peak in 1999, brown trout levels have progressively declined. Brown trout have been the dominant trout species present in the Eagle Creek Section since the early 1990's. Brown trout may have expanded and become the dominate species as a result of a greater thermal tolerance than rainbow trout, which is advantageous during periods of extreme and\or prolonged low water. The cumulative effects of depletions of late summer flows may have been a causative agent partially responsible for the change in species composition and domination by brown trout in the Smith River.

Further clarification on how fisheries impacts were considered moderate adverse

As discussed in section 3.4 of the EA, there is a high probability that if the proposed projects are developed, surface flows will be reduced and therefore trout habitat will decrease. Flow reductions will occur in the entire Smith River and the lower reaches of the NF Smith River, SF Smith River, Birch Creek, and Sheep Creek. Although the severity impacts to fish cannot be quantified, it is likely they will occur in average to dry water years. The quantity of the fishery resource affected by the proposed project can not be determined due to the variability associated with such an assessment. However, adverse impacts to the fishery will occur through the loss of instream habitat, elevation of temperatures, depletion of dissolved oxygen, increased stress on sport fish, and reduction of the carrying capacity of the river. The combination of these effects indicates the degree of adverse affect would be more than minor. However, the variability associated with the above parameters and the lack of precise information precludes a finding of significant adverse impact. Therefore, the cumulative effects of streamflow reductions on fishery resources resulting from the implementation of the proposed projects is considered to be moderate adverse.

Economics

Responses to Comments

Impacts to recreation of reduced flows

Several commenters correctly asserted that the elimination of floating and fishing opportunities on the Smith River would have severe negative consequences for those who enjoy such opportunities as well as for the commercial interests that serve recreation. The Smith River is a unique and highly valued recreation destination that attracts large numbers of Montana residents and non-residents. In fact, the supplemental EA reports that, over the last ten years, non-residents have accounted for nearly one-third of summer angling days.

While the supplemental EA acknowledges the potentially adverse impacts to recreation resulting from development of the proposed projects, the hydrology and fishery sections describe impacts that are less severe than those that would result in the elimination of floating and fishing activity on the Smith River. The impacts of the proposed projects are considered unlikely to cause the Smith to lose its status as a "blue ribbon" fishing site. The quality and quantity of recreational opportunities are more likely to be diminished incrementally through potentially lower catch rates, lower flows for floating and fewer floating days. Estimating the implications of this marginally diminished recreation activity for recreators and for the local and regional economies requires data that are not available.

Duration of the floating season

Questions were raised regarding the length of the floating season and how it may be affected by the cumulative impacts of the proposed projects. DFWP also mentioned that, prior to the relocation of the USGS gage in 1996, a single floating guideline of 100 cfs at the Fort Logan gage was used for rafts. Since the gage has been moved downstream and now includes the flows of Sheep and Eagle creeks, the recommended minimum flow for rafting is 250 cfs. The number of days average daily flows at the gaging stations were higher than the recommended minimums are presented in Table AD-10 below. The other columns of the table contain the number of days that flows are calculated to be below the recommended minimum when the estimated cumulative flow reductions from the proposed projects (Table 3.2-1 of the supplemental EA) are subtracted.

Table AD-10. Number of days that daily average streamflows were greater than the recommended floating minimums and the number of days that daily average streamflows were greater than the recommended floating minimums when the potential cumulative flow depletions from Table 3.2-1 of the supplemental EA are subtracted.

Year	Days flow was higher than recommended minimum	Days flow was higher than recommended minimum when potential depletions are subtracted	Year	Days that flow was higher than recommended minimum	Days flow was higher than recommended minimum when potential depletions are subtracted
1978	181	167	1991	59	56
1979	154	131	1992	25	11
1980	122	105	1993	184	184
1981	140	133	1994	82	72
1982	184	163	1995	148	145
1983	158	144	1996	84	76
1984	101	92	1997	119	115
1985	84	73	1998	96	95
1986	174	163	1999	53	51
1987	44	35	2000	34	32
1988	7	3	2001	18	18
1989	53	50	2002	45	45
1990	60	57			

Note: Days between May 1 and October 31 when daily average flows exceeded 100 cfs when gaging station was above Sheep Creek (1978-1996), or 250 cfs for when gaging station was downstream of Sheep Creek (1997-2002).

During wetter years, streamflows can be above the recommended minimums late into the summer and again during the fall. During drier years, the floating season may only last until late June or early July and flows are generally too low during the fall for floating. The recommended minimums are just recommendations and some floaters may choose to try and float the river when flows are lower.

On page 48 of the supplemental EA, potential cumulative impacts of flood to sprinkler irrigation conversions to floating were discussed. The predicted result of substantial acre-for-acre conversion from flood to sprinkler irrigation would be to increase early season (May and June) flows and to decrease later summer and fall flows in the Smith River. This was discussed in more detail on page 40 of the supplemental EA. Higher spring flows, that may result from these types of conversions, would benefit floaters during dry years when the floating season is short and does not extend into July and August. During wetter years, the predicted late season decreases in flows resulting from sprinkler conversion would decrease floating opportunities during July and August and during the fall.

Economic impacts regarding the anticipated change in the duration of the floating season

As discussed above in the response to the issue regarding the duration of the floating season, the reduced flows resulting from the potential development of the projects would lead to fewer days of floating on the Smith River. On average, 7.72 days of floating potentially may be lost annually due to the development of the proposed projects. The direct impacts to floaters would take the form of lost benefits associated with fewer opportunities to recreate on the Smith River. Based on DFWP's estimate of expenditures related to floating for 2002 on page 32 of the supplemental EA, the projects may result in a reduction of $157,642 in recreational spending--or 0.4 percent of total personal income in Meagher County. Because many outfitters and others who provide recreation-related services reside outside of Meagher County, much of this impact would occur outside of the immediate area. Some outfitters may go to less desirable alternative sites and retain some portion of lost Smith River revenues. One impact may be higher prices for guided Smith River trips due to more restricted supply.

Impacts to fishery-dependent businesses
The impact to anglers and businesses that provide services to them is difficult to estimate for marginal diminishment of quality of the Smith River fishing experience. In other words, moderately lower catch rates or a moderate decrease in the probability of catching large fish incrementally diminishes the value of fishing the Smith. Estimating the size of this incremental decline in value and its implications for fishing-related businesses requires data that are not available.

Fishing impact conclusion
Factors that contribute to the value of a fishing site include scenic beauty, accessibility, and, certainly, the quality of the fishery. Because the impact to the fishery has been estimated to be moderate adverse, the impact to fishing has been characterized as moderate adverse.

Estimating the extent of the adverse impact to agricultural producers
The level of detail required to trace the impacts of the proposed projects to the potentially adversely affected agricultural producers was not available. Estimating such impacts would require the precise locations of such producers, the hydrologic relationships of those producers' lands to the proposed projects, the productive capabilities of those producers' lands, as well as other factors.

Impacts on property values
The value of non-commercial property reflects in part the anticipated benefits associated with non-market related amenities such as proximity to recreational opportunities, privacy, desirable views or other amenities as difficult to define as the prestige of owning a "piece of Montana." In this case, the impact to property values of the proposed projects would likely be transmitted through diminished recreational opportunities. Hedonic pricing is a technique used to estimate implicit prices of property attributes and can be useful in estimating the impact of changes in environmental services. The technique, however, presents several technical challenges and requires extensive data collection covering numerous properties and a broad array of property attributes. Estimating a change in value due to incremental changes in flows and fishing quality would be particularly challenging.

Hydropower impacts
The impacts to hydropower production from implementation of the proposed projects were estimated using turbine factors included in DNRC's Missouri River Model that was developed for the Missouri River reservation process. The turbine factors represent the relationship between stream flow and power output for a hydropower plant. The turbine factors, expressed as kilowatts per cfs, for PPL Montana's five Missouri River plants located downstream of the Smith River follow:

Black Eagle	3.7
Rainbow	6.5
Cochrane	5.7
Ryan	10.0
Morony	6.0

An average monthly flow reduction of 5.583 cfs (from Table 3.2-1) would result in 1,560 fewer megawatt hours (MWh) of annual hydropower production. At a price of $35 per MWh, annual hydropower revenues associated with the five plants are conservatively estimated to be reduced by $54,605.

The estimate of the impact of power production at Fort Peck relied on a power production formula that assumed 200 feet of head, a power reduction factor of 0.63, and flows adjusted for evaporation of 5.022 cfs. Annual hydropower production losses associated with the reduction in flows are estimated to be 469 MWh. The reduction in revenues resulting from such a loss is estimated to be $16,420 based on a price of $35 per MWh. The combined impact for the six facilities would be a reduction in annual hydropower revenues of $71,025.

The amount of power associated with the potential reduction in flows represents 0.0064 percent of electricity generation in Montana and is unlikely to affect electricity prices in the region.

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New Appendix E: Estimated Streamflows for the Smith River Above and Below the Mouth of Sheep Creek.

Table E-1. Estimated Smith River monthly average flows above the mouth of Sheep Creek in cfs.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1978	97	116	399	363	428	465	445	131	137	150	113	127
1979	102	107	237	256	331	429	160	113	101	111	103	91
1980	71	81	129	172	240	379	160	86	95	120	113	113
1981	93	114	123	140	798	623	214	98	88	126	132	125
1982	81	218	162	261	330	833	412	128	134	160	137	133
1983	131	130	142	148	208	280	299	101	110	138	116	87
1984	142	128	159	193	229	319	135	68	82	108	111	74
1985	82	87	136	175	162	85	42	58	92	118	103	98
1986	93	159	203	188	270	409	217	108	166	147	118	113
1987	101	101	109	115	122	78	111	68	68	79	73	46
1988	52	74	99	102	79	47	37	27	61	64	51	58
1989	53	49	187	127	146	134	58	57	72	85	90	84
1990	85	88	102	122	120	225	83	72	68	80	82	76
1991	75	95	95	102	209	257	74	51	68	69	79	84
1992	82	78	82	79	63	94	93	43	50	65	66	52
1993	47	51	193	134	308	245	338	276	299	273	237	220
1994	146	118	186	322	425	153	111	62	60	83	88	81
1995	69	119	100	130	173	290	217	81	111	126	136	111
1996	109	373	256	311	386	422	116	79	80	78	76	77
1997	183	89	188	246	211	619	285	143	135	132	99	94
1998	103	99	121	178	74	189	288	103	89	106	101	81
1999	79	110	131	127	58	121	74	51	62	74	66	60
2000	72	78	88	160	51	60	45	27	38	67	46	40
2001	54	59	97	117	62	50	42	20	30	41	40	38

Table E-2. Estimated Smith River monthly average flows below the mouth of Sheep Creek in cfs.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1978	144	171	454	478	1,076	1,026	663	203	201	230	167	186
1979	151	159	290	364	801	899	269	160	143	167	153	136
1980	108	124	189	247	426	617	231	123	125	185	167	167
1981	138	169	181	211	1,278	1,012	307	136	121	181	179	183
1982	121	261	199	299	641	1,531	548	180	179	231	200	195
1983	191	191	197	206	432	543	431	162	153	202	169	135
1984	207	190	231	291	606	676	220	106	117	157	165	112
1985	123	131	198	374	493	275	92	101	138	216	185	145
1986	138	212	255	333	786	896	318	153	217	217	174	167
1987	150	151	160	180	251	203	153	88	93	178	102	74
1988	80	114	146	152	398	214	83	48	82	105	80	89
1989	82	77	230	190	449	408	118	89	106	137	150	126
1990	127	132	151	277	573	707	181	112	104	144	124	115
1991	114	143	138	149	691	765	149	84	103	127	127	126
1992	123	119	121	134	185	221	148	71	79	110	107	81
1993	73	80	236	193	693	513	523	403	426	402	334	317
1994	213	174	269	522	912	374	175	95	93	136	132	122
1995	105	176	139	176	387	733	344	133	153	194	187	163
1996	161	431	311	419	852	923	215	120	118	127	138	136
1997	249	145	254	328	1,119	1,893	601	276	219	213	181	167
1998	149	143	178	261	391	578	607	199	145	172	185	144
1999	129	144	168	179	307	371	156	99	101	119	120	106
2000	107	112	115	229	328	187	95	44	55	96	84	72
2001	85	88	125	160	257	152	88	46	54	67	74	68

New Appendix F: Estimated Percentile Streamflows for Upper Smith River Tributaries. (Source: USGS, 1989)

Table F-1. Estimated percentile flows for the South Fork of the Smith River near White Sulphur Springs.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q90	6	6	9	15	38	28	10	5	8	8	9	7
Q80	7	8	12	18	49	39	13	7	9	9	10	7
Q50	9	11	16	27	67	82	25	12	11	12	11	10
Q20	12	17	25	42	100	130	42	16	14	17	14	12
AVG	9	12	19	30	73	88	29	11	12	13	12	10

Table F-2. Estimated percentile flows for the North Fork of the Smith River at Highway 89 near White Sulphur Springs.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q90	2	2	1	3	47	31	9	6	4	3	3	2
Q80	3	2	2	5	80	48	13	8	6	4	4	3
Q50	4	3	2	11	330	160	23	12	9	6	7	4
Q20	5	3	2	24	820	340	40	21	13	11	14	6
AVG	4	3	2	16	410	190	24	13	9	8	8	4

Table F-3. Estimated percentile flows for Big Birch Creek at mouth near White Sulphur Springs.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q90	10	12	20	43	39	37	14	5	16	17	21	13
Q80	12	15	31	51	49	65	23	8	18	20	22	14
Q50	17	26	49	81	130	270	63	22	25	32	28	21
Q20	26	57	100	100	250	410	100	40	32	41	31	27
AVG	18	33	60	76	170	260	79	20	25	29	25	20

Table AD-9. Estimated percentile flows for Sheep Creek near mouth.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q90	10	9	10	18	150	130	41	21	17	16	12	10
Q80	12	12	12	25	190	190	62	29	23	19	16	13
Q50	17	16	16	51	290	350	100	41	30	26	22	18
Q20	22	18	18	110	460	530	160	62	42	38	31	24
AVG	17	15	17	69	320	380	110	44	33	31	25	20

Note: Percentile flows are those flows that are equaled or exceeded a certain percent of the time. For instances, the Q50 or 50^{th} percentile flow is equaled or exceeded 50 percent (or one-half) of the time. A Q90 flow would represent that for a very dry year, Q80 would be a dry year, Q50 a middle year, and Q20 a wet year.