APPENDIX A

Notice of Preparation and Public Comments

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK

NOTICE OF DRAFT EIR PREPARATION

FOR PROPOSED CHANGES IN MAMMOTH CREEK BYPASS FLOW REQUIREMENTS WATERSHED OPERATION CONSTRAINTS, POINT OF MEASUREMENT, AND PLACE OF USE

SCH #97032082

LEAD AGENCY: Mammoth Community Water District
Post Office Box 597, Mammoth Lakes, California 93546

PLEASE RESPOND BY: 25 JANUARY 2008

1.0 SUMMARY OVERVIEW

During November of 2000, a Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) was issued by Mammoth Community Water District (MCWD or the District) as Lead Agency under the California Environmental Quality Act (CEQA), and by the United States Forest Service (USFS or Forest Service) as Lead Agency under the National Environmental Policy Act (NEPA). The 2000 Draft EIR/EIS evaluated a proposal to modify the District's bypass flow requirements, change the point at which stream flows would be measured, and add six customers to the authorized place of use of Mammoth Creek water supplies.

USFS subsequently withdrew from the project, and MCWD in 2005 issued a new Notice of EIR Preparation (NOP) as the sole Lead Agency under CEQA. The 2005 project proposal was identical to the 2000 proposal in terms of proposed modifications to the bypass flow requirements and proposed change in the point at which stream flows would be measured. With respect to the Place of Use, the 2005 NOP proposed to add eleven customers to the authorized place of use (instead of six as in 2000). The 2005 project proposal also incorporated a new proposal to change some of the watershed operation constraints.

During 2005, the Mammoth Creek Collaborative was created from which a technical committee was later convened to address specific concerns over Hot Creek and Mammoth Creek and to identify studies that could be conducted to investigate those concerns. As a result of technical committee input, MCWD undertook additional studies pertaining to Creek flows and fish populations. The District has decided to prepare a new Draft EIR drawing from the 2000 Draft EIR/EIS and incorporating the new information which has been generated since the 2005 NOP. The new Draft EIR also will address modifications to the prior project proposal. The current Notice of Preparation (NOP) is intended to advise the public of these modifications. The new Draft EIR will be circulated as a complete, stand-alone Draft EIR for new public and agency review and comment.

2.0 TOPICS ADDRESSED IN THIS NOTICE OF PREPARATION

This Notice contains eight sections addressing the project proposal and history, the current notice, commenting procedures, the proposed scope of EIR review, and other relevant information. Table 1 below provides an index of topics and page numbers.

Table 1
NOTICE OF PREPARATION INDEX

3.0 STATEMENT OF PROJECT PURPOSE

The primary purpose of this proposed project is to revise the bypass flow requirements for Mammoth Creek consistent with a request by the State Water Resources Control Board (SWRCB) that MCWD undertake, under Term 11 of Temporary Permit 20250, a more detailed analysis of bypass flow requirements for Mammoth Creek. The proposed change is to amend the District's Permit 17332 to specify new bypass flow requirements that will serve to maintain the Mammoth Creek fishery in good conditions, as well as the fishery habitat, and avoid impacts to the other environmental values associated with the Creek. The new bypass flow requirements also would apply to diversions under MCWD Licenses 5715 and 12593.

4.0 COMPARISON OF THE 2000, 2005 and 2007 PROJECT PROPOSALS

Table 2 outlines key elements of the project proposal as stated in the 2000 Draft EIR/EIS, the 2005 Notice of Preparation, and as now proposed in this 2007 NOP. As shown, the current project proposal differs in some respects from the project proposal described in the 2000 Draft EIR/EIS and in the 2005 Notice of Preparation.

Table 2
SUMMARY OF PROPOSED PROJECT ELEMENTS
IN THE 2000 DRAFT EIR/EIS, THE 2005 NOP, AND THIS 2007 NOP

<table>
<tr><th>PROPOSED ELEMENT</th><th>2000 DRAFT EIR/EIS</th><th>2005 NOTICE OF PREPARATION (NOP)</th><th>2007 NOTICE OF PREPARATION</th></tr>
<tr><td>Changes in Bypass Flow Requirements</td><td>Permit 17332 contains the following bypass flow requirements: "Subject to and to the extent of natural streamflow entering Lake Mary, the District shall maintain in Mammoth Creek between Old Mammoth Road and Highway 395 a minimum of 4 cfs at all times, and the following flows on a mean monthly basis:
<table>
<tr><th>Month</th><th>Mean Monthly Flow (cfs)</th><th>Month</th><th>Mean Monthly Flow (cfs)</th></tr>
<tr><td>Jan.</td><td>5.0</td><td>July</td><td>25.0</td></tr>
<tr><td>Feb.</td><td>5.0</td><td>Aug.</td><td>10.0</td></tr>
<tr><td>March</td><td>5.0</td><td>Sept.</td><td>6.0</td></tr>
<tr><td>April</td><td>10.0</td><td>Oct.</td><td>6.0</td></tr>
<tr><td>May</td><td>25.0</td><td>Nov.</td><td>6.0</td></tr>
<tr><td>June</td><td>40.0</td><td>Dec.</td><td>6.0</td></tr>
</table>
The 2000 Draft EIR/EIS proposed to modify the bypass flow requirements as follows: "Subject to and to the extent of natural streamflow entering Lake Mary, and to the extent of its control, [MCWD] shall maintain in Mammoth Creek at the District gage in Mammoth Creek near Old Mammoth Road the following flows on a mean daily basis:
<table>
<tr><th>Month</th><th>Mean Daily Flow (cfs)</th><th>Month</th><th>Mean Daily Flow (cfs)</th></tr>
<tr><td>Jan.</td><td>6.4</td><td>July</td><td>9.9</td></tr>
<tr><td>Feb.</td><td>6.0</td><td>Aug.</td><td>7.2</td></tr>
<tr><td>March</td><td>7.8</td><td>Sept.</td><td>5.5</td></tr>
<tr><td>April</td><td>9.8</td><td>Oct.</td><td>5.5</td></tr>
<tr><td>May</td><td>18.7</td><td>Nov.</td><td>5.9</td></tr>
<tr><td>June</td><td>20.8</td><td>Dec.</td><td>5.9</td></tr>
</table>
</td><td>Bypass flow requirements proposed in the 2005 NOP were the same as described in the 2000 Draft EIR/EIS.</td><td>The current proposal is generally the same as described in the 2000 Draft EIR/EIS and in the 2005 NOP, except that the project proposal now incorporates a mean daily bypass flow requirement at Highway 395 of 4 cfs. The bypass flow requirements would apply to MCWD diversions under its Permit 17332 and Licenses 5715 and 12593.</td></tr>
</table>

PROPOSED ELEMENT	2000 DRAFT EIR/EIS	2005 NOTICE OF PREPARATION (NOP)	2007 NOTICE OF PREPARATION
Changes in Point of Measurement	Permit 17332 currently requires *that Mammoth Creek flows be measured at the LADWP gage at Highway 395 for purposes of compliance with the bypass flow requirements.* The 2000 Draft EIR/EIS proposed to amend this requirement to state that the District would measure the flows *"at the District's gage in Mammoth Creek near Old Mammoth Road."*	The point of measurement proposed in the 2005 NOP was the same as described in the 2000 Draft EIR/EIS (i.e., to change the point of measurement to Old Mammoth Road).	**The point of measurement is the same as described in the 2000 Draft EIR/EIS and in the 2005 NOP, except that MCWD now proposes also to take measurements at LADWP's Highway 395 gage for purposes of compliance with a mean daily bypass flow requirement of 4 cfs at that gage,**
Changes in Watershed Operation Constraints	The project proposal described in the 2000 Draft EIR/EIS did not include any proposed changes in watershed operation constraints.	In the 2005 NOP, MCWD proposed to amend Permit 17332 to change 3 categories of watershed constraints: (a) deletion of water bodies in which MCWD has no rights to store water (Lake George, Lake Mamie and Twin Lakes); (b) changes in the timing of the filling of Lake Mary to be consistent with the storage season identified in Permit 17332[1]; and (c) changes to the flow requirements in Bodle Ditch to reflect existing circumstances.	**The current proposal is generally as described in the 2005 NOP, but the Draft EIR will also evaluate provisions to provide flows to Bodle Ditch (and back into Mammoth Creek) to maintain riparian habitat on a seasonal basis. The Draft EIR will describe applicable USFS plans and policies for Lake Mamie and Twin Lakes. Attachment A describes all proposed changes in watershed operation constraints.**
Changes in Place of Use	The 2000 Draft EIR/EIS noted that MCWD supplies treated water for emergency use (when a domestic well becomes inoperable) and safe drinking water purposes to six customers located outside of the authorized place of use for Mammoth Creek water, and proposed to amend Permit 17332 to include these customers. The customers included a portion of Mill City Tract, Tamarack Lodge, Sierra Meadows, Shady Rest Park, Mammoth Creek Park, and Mammoth Mountain Ski Area (MMSA).	As part of the 2005 NOP, MCWD proposed to amend Permit 17332 to include eleven customers, including the following 5 customers that were not identified in the 2000 Draft EIR/EIS: Twin Lakes Campground, Twin Lakes Art Gallery, Mammoth Lakes Pack Station, Sherwin Creek Campground, and YMCA of Metropolitan Los Angeles.	**The current proposal is the same as described in the 2005 NOP except that MMSA is no longer proposed as an authorized place of use (MMSA will continue to receive groundwater supplies on an emergency basis). The places of use under Licenses 5715 and 12593 should be similarly amended. The Draft EIR also will evaluate new provisions to address the claimed water rights of POU customers.**
Project Alternatives	The 2000 Draft EIR/EIS evaluated three alternatives including (1) No Project/No Action (i.e., the original bypass flow requirements specified in Permit 17332); (2) a Modified Proposal that would round off daily flow requirements to the nearest 1.0 cfs; and (3) a Water Year Type Alternative that would establish different bypass flow requirements for dry years, normal years and wet years.	Alternatives outlined in the 2005 NOP were the same as described in the 2000 Draft EIR/EIS.	**The forthcoming Draft EIR is expected to evaluate 3 alternatives including (1) No Project alternative (the original bypass flow requirements as specified in Permit 17332), (2) the Project Proposal as described in the 2000 Draft EIR/EIS (which did not include a mean daily bypass flow requirement at Highway 395 of 4 cfs), and (3) a Water Year Type Alternative that would establish different**

[1] Bypass flow requirements take precedence over the requirement to fill Lake Mary under the terms of Permit 17332.

PROPOSED ELEMENT	2000 DRAFT EIR/EIS	2005 NOTICE OF PREPARATION (NOP)	2007 NOTICE OF PREPARATION
			bypass flow requirements for dry , normal and wet years.

5.0 COMMENTING PROCEDURES

The District invites comments from the public and from state, federal and local agencies about the scope of issues to be analyzed in the forthcoming Draft EIR. The Draft EIR will address issues raised in comments submitted on this NOP as well as substantive comments that have been previously submitted on the 2000 Draft EIR/EIS and/or the 2005 NOP.

➔ ***Comments submitted on this Notice of Preparation need address only those issues that were not raised in earlier comments on the 2000 Draft EIR/EIS or the 2005 NOP.***

Comments may be submitted by mail, by e-mail or by fax to the address shown below. Please include the name, telephone number and address of a contact person so that we can follow up if questions arise.

➔ ***Please submit comments on this Notice by e-mail, mail or fax to:***

MCWD c/o Sandra Bauer
Bauer Planning & Environmental Services, Inc.
220 Commerce, #230 ♦ Irvine, CA 92602-1376
e-mail: sandra@bpesinc.com ♦ Fax: 714.508.2113

Due to the time limits mandated by state law, your response to this Notice must be sent at the earliest possible date. However, because this Notice is being distributed over the holiday season, MCWD has extended the NOP review and comment period (which normally runs for 30 days) by two weeks. In accordance with the extended schedule, please submit your comments on the NOP by Friday, 25 January 2008. The schedule calls for the recirculated Draft EIR to be distributed for public review during the spring of 2008. If you have any questions, please feel free to contact Sandra Bauer at 714.508.2522, or Gary Sisson, General Manager of MCWD at 760.934.2596.

6.0 SCOPING MEETING

The District is planning to hold a Scoping Meeting for this project. The meeting will be held at the District headquarters (located at 2315 Meridian Boulevard in the Town of Mammoth Lakes) on the morning of January 17 (Thursday). Please feel free to contact the District at 760.934.2596 for more information about the scoping meeting. MCWD will also conduct individual scoping meetings, if requested.

7.0 PROPOSED Draft EIR SCOPE AND FOCUS

Outlined below is the proposed scope and focus of all major elements of the forthcoming Draft EIR.

Introduction, Summary and Project Description

Introductory statements will include lead agency responsibilities, discussion of the project purpose and objectives, and the basis for preparation of a Draft EIR. The Draft EIR will provide a complete description of the project proposal including the following information:

- The location of project elements
- A summary of the project history and prior CEQA and NEPA reviews
- Changes since the prior Draft EIR/EIS was released, including deletion of NEPA elements
- A statement of project purpose and objectives
- A table summarizing all comments received on earlier CEQA and NEPA documents, including the 1997 NOP, the 2000 Draft EIR/EIS and the 2005 NOP. This table will also indicate where and how the issues of concern have been addressed in the recirculated Draft EIR
- Elements and characteristics of the proposed project including (a) bypass flow requirements, (b) the point of measurement, (c) modified watershed operation constraints, (d) changes in place of use, and (e) any other elements added as a result of comments on this Notice and updated scoping consultation
- Identification of all project alternatives evaluated in the Draft EIR
- A list of responsible and trustee agencies, and required permits and approvals
- A schedule for implementation of project elements, and a brief overview of costs and funding sources

An executive summary will highlight significant findings of the Draft EIR, identify key recommendations and point to unresolved issues. The executive summary will also provide a table that summarizes any potentially significant environmental impacts, lists any recommended mitigation measures and indicates whether any such significant effects would remain after mitigation.

→ ***The project study area will extend from Lake Mary to the Hot Creek Gorge Flume (USGS Gage #10265150)***

Potential Impacts and Mitigation Measures

The recirculated Draft EIR will focus on potential project environmental impacts and mitigation measures, if needed, for six key issues of concern. Issues of concern are identified below and discussed in paragraphs that follow:

- Hydrology
- Water Quality
- Surface Water Supply
- Fisheries and Aquatic Resources
- Terrestrial and Riparian Resources
- Recreational and Aesthetic Resources
- Socioeconomic Impacts

Hydrology: Hydrology: *A new water balance operations model is being prepared and would be applied to the Mammoth Creek surface water system to simulate flows associated with and without the Proposed Project or Alternatives. The new operations model will be used to evaluate potential changes in hydrologic characteristics, as well as the effects of these changes on surface water-related resources within the study area from Lake Mary to the Hot Creek Gorge Flume. Hydrologic model results will be used in the analysis of potential impacts on surface water hydrology, Lake Mary storage, and surface elevation of Lake Mary.*

Water Quality: *The Draft EIR assessment will utilize modeling results and other pertinent data to evaluate potential effects upon water quality in the project study area, particularly with respect to sediment transport and deposition.*

Water Supply: *The Draft EIR will provide an overview and a detailed discussion of MCWD programs pertaining to water supply, as outlined in the District's Urban Water Management Plan and annual Demand Reduction Reports. The impact assessment will evaluate results of the water balance operations model to identify potential effects upon local water supply, with consideration of applicable regulatory and physical constraints, as appropriate. An additional groundwater pump test has been conducted in the Mammoth Basin and results of this test will be analyzed to determine whether there is a relationship between groundwater production and surface water flows in the project area. Potential project impacts on water flow downstream of the LADWP gage at Highway 395will be evaluated by quantifying the change in mean daily flows below the LADWP gage. The Draft EIR will assess percent change in mean daily flows during the assumed irrigation season.*

→ ***Consistent with the 2000 and 2005 proposals, MCWD is seeking no increase in consumptive rights or water entitlements***

Fisheries and Aquatic Resources: *The Draft EIR will describe the biological characteristics and physical habitat requirements for the fish community of Mammoth Creek, including species-specific life history requirements, distribution ranges, life stage-specific habitat requirements, pertinent aquatic resources, and other parameters of biological relevance. A fish population analysis utilizing monitoring data from 1988 through 2007 will include a stepwise approach to examine the relationships associated with trends in brown trout and rainbow trout populations and flows in Mammoth Creek under varying conditions. The assessment will identify reach-specific relationships. The Draft EIR will also evaluate available benthic macroinvertebrate data to identify potential relationships between fish populations, food availability, and the general biological integrity of Mammoth Creek.*

→ ***The Draft EIR assessment will incorporate results of the DFG stressor studies completed to date.***

Terrestrial and Riparian Resources: *Hydrologic conditions influence the health of riparian vegetation and wetlands. Modifications to Mammoth Creek bypass flow requirements and watershed operation constraints could impact wetland and riparian resources if such changes substantially alter the frequency and duration of inundation or naturally occurring seasonal flow patterns. Wildlife resources dependent on or strongly associated with wetland or riparian habitats may be impacted by changes in species composition and habitat declines. The Draft EIR will consider these issues.*

Recreation and Aesthetics: *The Draft EIR will evaluate potential impacts on recreational resources and opportunities including regional, local, and site-specific features. Aesthetic resources also will be addressed including a characterization of key scenic resources. Hydrologic modeling results and other relevant information will be used to evaluate potential effects on recreation opportunities and aesthetics associated with fluctuations in water levels in the project study area.*

Socioeconomic Impacts: *The Draft EIR will provide a qualitative assessment of potential socioeconomic impacts that could result from project-related limitations on the amount of water that MCWD could divert during certain months of the year. This assessment will focus on ways in which the resulting enforcement actions (including water use restrictions and mandatory conservation practices) would impact residents and businesses within the project service area.*

Alternatives

The forthcoming Draft EIR is expected to evaluate a range alternatives including (1) No Project alternative (i.e, the bypass flow requirements would remain as specified in Permit 17332, there would be no proposed changes to the watershed operation constraints or to the place of use, and Permit 17332 and Licenses 5715/12593 would not be modified); (2) the Project Proposal as described in the 2000 Draft EIR/EIS (which did not include a mean daily bypass flow requirement at Highway 395 of 4 cfs), and (3) a 'Water Year Type' Alternative (which would include three sets of daily mean bypass flow requirements based on the type of water year [i.e., dry, normal, or wet] occurring in Mammoth Lakes).

> ➔ ***The District is also exploring variations on these alternatives as well as additional alternatives, and would welcome scoping input on the range of alternatives to be evaluated in the forthcoming EIR.***

Growth-Inducing Impacts

The Draft EIR will analyze potential influences of the proposed changes in bypass flow requirements, watershed operation constraints, and places of use on growth in the MCWD service area.

Cumulative Impacts

The Draft EIR will identify other relevant projects or activities in the Mammoth Lakes area and evaluate how these projects, in combination with the proposed project, may affect sensitive resources. The Draft EIR will also analyze groundwater hydrology to assess potential interactions between groundwater production and surface water flows.

Topics Proposed to be Omitted from Draft EIR Discussion

The Draft EIR introduction will identify topics that are proposed to be omitted from analysis based on results of prior scoping. These topics include:

- ***Land Use:*** *The proposed project would not increase consumptive water entitlements, nor would it involve earthwork or construction activities or substantive changes in operational procedures, facilities or staffing. Additionally, MCWD has worked with the Town of Mammoth Lakes to ensure that the recently adopted 2007 General Plan incorporates policies addressing conservation and water reclamation. As a result of these considerations, there are no project elements with the potential to impact land uses, and no General Plan, zoning, or land use incompatibility issues would result.*

- ***Cultural Resources:*** *Changes in stream flows have the potential to impact cultural resources due to the exposure of archaeological finds caused by fluctuations in water levels. In Mammoth Creek, neither the proposed project nor the alternatives would result in substantial flow fluctuations that would exceed those occurring naturally; therefore, no impacts to cultural resources are expected.*

- ***Air Quality:*** *The proposed project would not involve any earthwork or construction activities or changes in operational facilities or staffing. As a result, there is no potential for direct adverse impacts on air quality. For similar reasons, the project would not have the potential to affect global warming through greenhouse gas emissions since there are no project elements associated with substantive traffic, fuel combustion, power generation, space/water heating, industrial/commercial operations, or other related activities. Furthermore, since the project would not change consumptive water entitlements, there are no substantive impacts on growth that could indirectly result in significant contaminant emissions or increases in energy demand that would contribute to regional increases in greenhouse gas emissions and associated climate change effects.*

- ***Noise:*** *None of the project elements would require earthwork or construction, or substantive modifications to the District's treatment facilities and operational practices. There are no proposed activities with the potential to increase noise levels or expose people to severe noise levels, and no impacts are expected.*

- ***Transportation/Circulation:*** *None of the proposed project components would create additional traffic and there are no physical changes proposed that would have the potential to otherwise impact circulation in the study area.*

- ***Geology:*** *No construction is proposed that would expose people to potential geologic impacts (e.g., seismic activity, expansive soils) or cause erosion; therefore, no impacts involving these geologic considerations are expected as a result of the proposed project or alternatives.*

- ***Energy and Mineral Resources:*** *The proposed project would not significantly affect energy demands, and there are no impacts on mineral resources in the project area. The energy requirements of the District's diversion at Lake Mary are low, and would not change significantly with implementation of the proposed project.*

- ***Hazards:*** *Chlorine is used in the water treatment process as a disinfectant, with contact facilities located at the Lake Mary Water Treatment Facility. The level of risk associated with this use is not expected to change as a result of the proposed project.*

- ***Public Services and Utilities:*** *None of the proposed project elements would place added demands on police services, sanitation services, or educational facilities. The project would not place added demands on fire services. MCWD already serves all proposed POU customers through existing facilities, and no new construction or operational facilities are required of MCWD or other agencies.*

8.0 PROJECT LOCATION

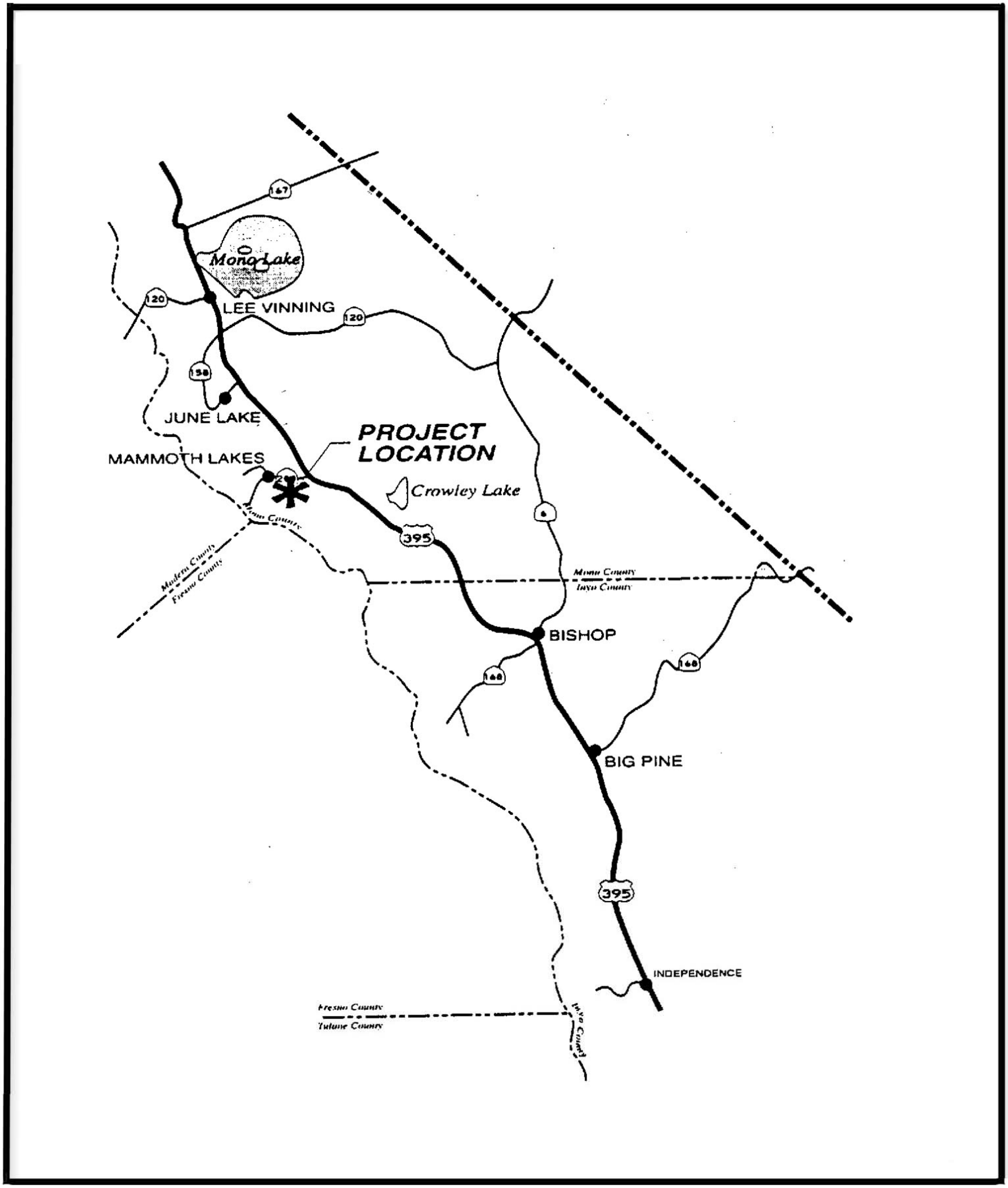
MCWD provides water and sanitation services to a service area located within the boundaries of the Town of Mammoth Lakes, in the southwestern part of Mono County, California. The District and Town are surrounded by National Forest lands administered by USFS. Principal streets include State Highway 395 (a major north-south highway), State Route 203 (SR 203, the major arterial through Mammoth Lakes), Meridian Boulevard (MCWD headquarters are located just southeast of the intersection of Meridian Boulevard at SR 203), Old Mammoth Road (the primary commercial corridor), and Minaret Road (which provides access to the ski area). A regional location map is provided as Exhibit 1. Exhibit 2 shows the MCWD service area in relation to the Town boundaries and other areas considered in this NOP.

9.0 BRIEF CHRONOLOGY OF THE 2000 Draft EIR/EIS, THE 2005 NOP, AND THE 2007 NOP

2000 Draft EIR/EIS: During November of 2000, MCWD and USFS issued a Draft EIR/EIS. The project description noted that the proposal encompassed three elements including: (a) modifications to the bypass flow requirements, (b) a change in the point at which streamflows would be measured, and (c) modifications to the authorized place of use for Mammoth Creek water supplies. The 2000 Draft EIR/EIS identified MCWD as the lead agency under CEQA, and USFS as the lead agency under NEPA, and also identified the SWRCB as a responsible agency. The 2000 Draft EIR/EIS was never finalized due to several factors that included USFS withdrawal from the project as a lead agency for federal action.

2005 Notice of Preparation: In November of 2005, MCWD issued a new NOP. The 2005 NOP advised that USFS had withdrawn from the environmental review process due to a lack of legal authority to implement provisions in the Master Operating Agreement between USFS and MCWD, including the bypass flow requirements. As a result of USFS' withdrawal, there was no longer a need to comply with NEPA. The 2005 NOP also noted other changes in the project description since the 2000 Draft EIR/EIS having to do with certain of the watershed operation constraints that had been incorporated into water right Permit No. 17332. The NOP noted that MCWD had determined to reinitiate the CEQA process as a result of these changes, and invited new comments on the scope and content of the planned Draft EIR. Through the District's participation in the Mammoth Creek Technical Committee and based upon comments received on the 2005 NOP, MCWD undertook additional studies pertaining to fish populations and groundwater/surface water interactions. Because of these studies and the new information developed, MCWD has decided to prepare a new Draft EIR for circulation which will utilize the 2000 Draft EIR/EIS in significant part and incorporate the new information.

2007 Notice of Preparation: This 2007 NOP is intended to advise the public of the new information and the changes that have been incorporated into the project proposal since the 2005 NOP was issued. The new information and project changes will be addressed in a new Draft EIR that will be developed, which will draw from the 2000 Draft EIR/EIS. Section 3 of this Notice describes and compares the 2000, 2005 and 2007 project proposals.



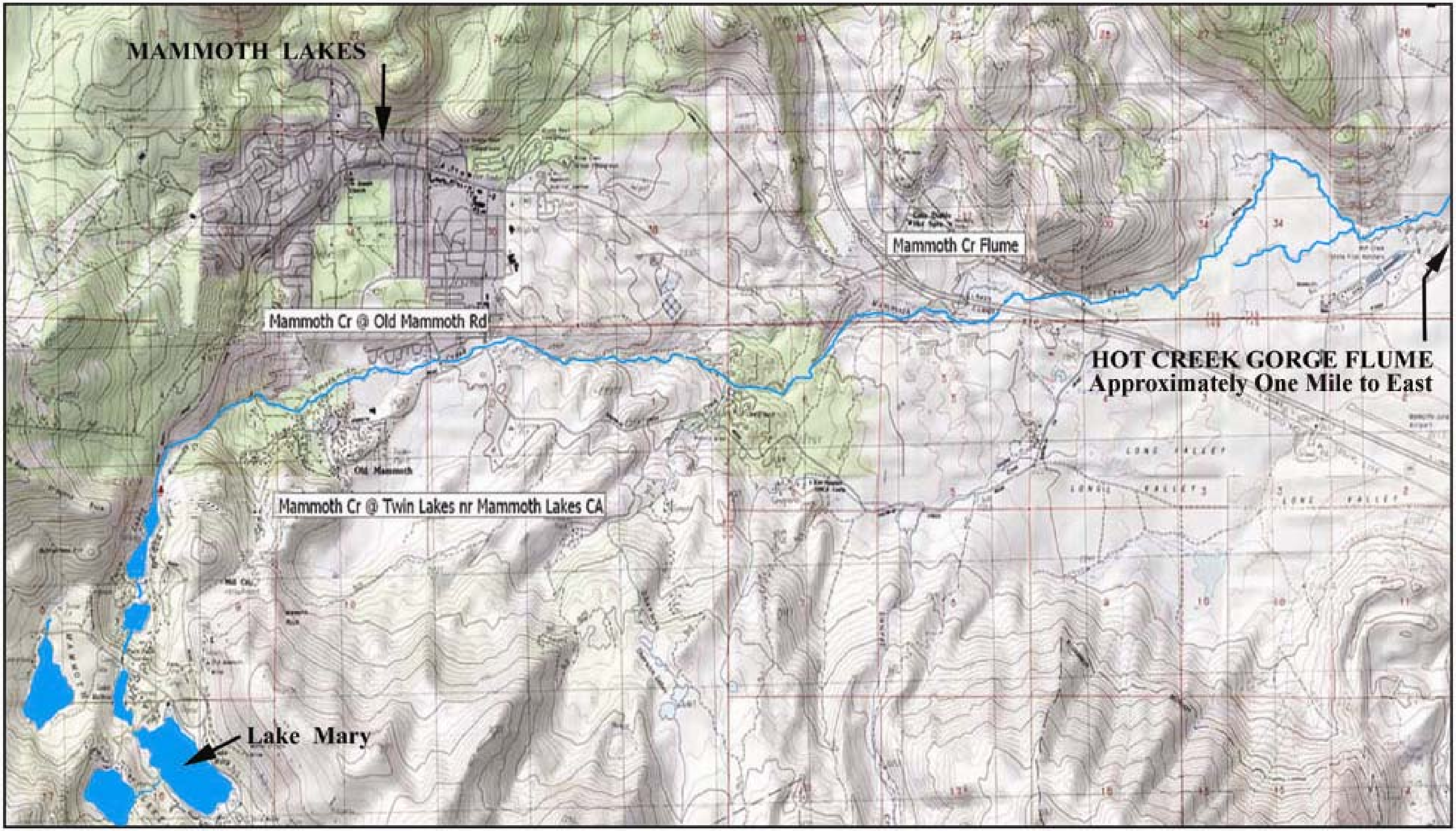
NORTH

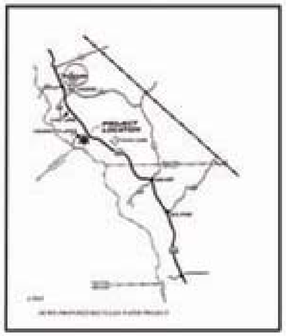
10 5 0 10 20

Scale in Miles

Exhibit 1

Regional Location Map





NORTH

Scale in Miles

Exhibit 2
Regional Location Map

12/2007

MAMMOTH CREEK NOP

10.0 CEQA BASIS FOR RECIRCULATION OF THE 2000 DRAFT EIR/EIS

The basis for recirculation of the 2000 Draft EIR/EIS is in CEQA Guidelines Sections 15088(a) and 15088(c), which state: *"A lead agency is required to recirculate an EIR when significant new information is added to the EIR after public notice is given of the availability of the Draft EIR for public review under §15087 but before certification... New information added to an EIR is not "significant" unless the EIR is changed in a way that deprives the public of a meaningful opportunity to comment upon a substantial adverse environmental effect of the project or a feasible way to mitigate or avoid such an effect (including a feasible project alternative) that the project's proponents have declined to implement."* [§15088(a)]; and *"If the revision is limited to a few chapters or portions of the EIR, the lead agency need only recirculated the chapters or portions that have been modified."* [§15088(d)]

- ***In light of the scope and extent of changes since the Draft EIR/EIS was released in November 2000, MCWD will revise and recirculate the Draft EIR document as a whole. Since the underlying purpose and intent of the Mammoth Creek Project continue to be as previously described, the forthcoming Draft EIR will draw from the 2000 Draft EIR/EIS to the extent possible.***

The CEQA Guidelines also contain provisions governing public notice of recirculation, as stated in Sections 15088.5(d) and §15088.5(f)(3): *"Recirculation of an EIR requires notice pursuant to §15087 and consultation pursuant to §15086."* [CEQA §15088.5(d)]; and *"As part of providing notice of recirculation as required by Public Resources Code §21092.1, the lead agency shall send a notice of recirculation to every agency, person, or organization that commented on the prior EIR. The notice shall indicate, at a minimum, whether new comments may be submitted only on the recirculated portions of the EIR or on the entire EIR in order to be considered by the agency."* [§15088.5(f)(3)]

- ***In keeping with these provisions, new comments on this NOP and on the forthcoming Draft EIR are required only to the extent that they differ from comments submitted previously on the 2000 Draft EIR/EIS and on the 2005 Notice of Preparation. However, MCWD welcomes all comments.***

Scoping consultation will also be updated to provide responsible and trustee agencies with an opportunity to comment on the scope and content of environmental information to be provided in the recirculated Draft EIR. Responsible and trustee agencies include the State Water Resources Control Board (SWRCB), the Lahontan Regional Water Quality Control Board (LRWQCB), the California Department of Fish and Game (CDFG), and the California Department of Health Services (CDHS). MCWD will also conduct updated scoping consultation with the Technical Committee that was convened during 2005. The Technical Committee includes representatives from Hot Creek Ranch, Chance Ranch, the Los Angeles Department of Water and Power (LADWP), the US Forest Service (USFS), University of California Valentine Reserve, the California Department of Conservation (CDC), CalTrout, the California Department of Fish and Game (CDFG), and the US Geologic Survey (USGS).

- ***Scoping consultation will be updated as described in Section 6 of this NOP.***

ATTACHMENT A

MAMMOTH COMMUNITY WATER DISTRICT
PETITION FOR AMENDMENT OF PERMIT 17332 AND PROPOSED CHANGES TO PERMIT 17332 RESPECTING TERM 18 AND THE MANAGEMENT CONSTRAINTS CONTAINED IN DISTRICT RESOLUTION NO. 02-14-78-02, AND TERMS 20, 21, 23 AND 25

ATTACHMENT A

MAMMOTH COMMUNITY WATER DISTRICT
PETITION FOR AMENDMENT OF PERMIT 17332

APPLICATION 25368	PERMIT 17332	ISSUED JUNE 1, 1978
Source	1. Lake Mary 2. Mammoth Creek	
Point of Direct Diversion and Rediversion Storage	S1160 ft and W530 ft from N1/4 Corner of Section 16 T4S R27E MDB&M S67degrees15'W, 2400 ft from N1/4 Corner of Section 16 T4S R27E MDB&M	
Purpose of Use	Municipal	
Storage Amount, Season of Diversion and Diversion Rights	Water appropriated shall not exceed 3 cubic feet per second by direct diversion to be diverted from January 1 to December 31 of each year and 660 acre-feet per annum by storage to be collected as follows: 1) 606 acre-feet per annum from April 1 to June 30 of each year; 2) 54 acre-feet per annum from September 1 to September 30 of each year. The total amount of water to be taken from the source shall not exceed 1,920 acre-feet per water year of October 1 to September 30. The total quantity of water diverted under this permit, together with that diverted under permits issued pursuant to Applications 24295, 12079 (License 5715), and 17770 (Permit 11463), shall not exceed 2,760 acre-feet per year.	
Place of Use	Within the boundaries of the Mammoth Community Water District in: Sections 27,28,33,34,35,36 T3S R27E MDB&M and Sections 2,3,4,10 T4S R27E MDB&M; Petition for Change in Place of Use pending.	
Petition for: Changes	Amend Terms 18, 20, 21 and 23 of Permit 17332. Delete Term 25 of Permit 17332	

MAMMOTH COMMUNITY WATER DISTRICT
PROPOSED CHANGES TO PERMIT 17332 RESPECTING TERM 18
AND THE MANAGEMENT CONSTRAINTS CONTAINED IN
DISTRICT RESOLUTION NO. 02-14-78-02,
AND TERMS 20, 21, 23 AND 25

A. The proposed changes to Term 18 which incorporates the management constraints in District Resolution No. 02-14-78-02 are shown below through highlighting and strikeouts:

1. Lake Mary
   a. Lake to be full ~~by June 1~~ prior to July 1 of each year.
   b. Drawdown not to exceed 3 feet prior to September 15, without prior approval of Forest Service and State Water Resources Control Board.
   c. Drawdown never to exceed 5.7 feet below top of existing gates.
   d. ~~Maximum lake level in accordance with existing cooperative agreement.~~ The water level shall be managed so that the lake will be full to the top of the existing radial arm gates when closed before July 1 of each year; and the water level under normal circumstances shall not exceed 8,912.70 feet above sea level, as referenced to a previous Forest Service benchmark located in the Lake Mary Campground, which was a brass cap set in concrete and designated "Heather", and from which the present brass cap on the right dam abutment was established at elevation 8,912.70 feet above sea level.
2. Stream Portion Between Lake Mary and Lake Mamie
   a. Minimum stream flow of 1.5 cfs required from June 1 – November 1, or natural flows entering Lake Mary, whichever is less.

~~3. Lake Mamie~~
   ~~a. Lake to be full by June 1 of each year.~~
   ~~b. Drawdown not to exceed 1 foot prior to September 15.~~
   ~~c. Drawdown not to exceed 2 feet from September 16 – November 1.~~

~~4. Lake George~~
   ~~a. Lake to be full by June 1 of each year.~~
   ~~Drawdown not to exceed 5 feet during mean or above mean precipitation years.~~
   ~~c. Drawdown not to exceed 4 feet during drought years. (65% of mean) of snowpack water content.~~
   ~~d. Drawdown to occur only between December 1 and March 31.~~
   ~~e. Drawdown not to exceed 3 feet prior to February 1 when snow survey predictions by DWP indicate percent snowpack water content. If survey indicates water content of 65% or less of mean, then no more than 1 foot of additional drawdown shall occur.~~

~~5. Twin Lakes Waterfall~~
   ~~a. minimum flow of 3 cfs from June 1 – August 10.~~
   ~~b. Minimum flow of 2 cfs from August 11 – October 31.~~
   ~~c. Under drought conditions, night-time flows may be reduced, but not eliminated, to maintain day-time flows.~~

~~6. Twin Lakes~~
   ~~a. Lake to be full by May 1, not to exceed current maximum level.~~
   ~~b. No drawdown between May 1 – October 31.~~
   ~~c. Drain lake to minimum level after October 31, as required by USFS to control weeds, following relocation of primary intakes to Lake Mary and reconstruction of Twin Lakes Dam and secondary inlet below Twin Lakes.~~
   ~~d. Upon completion of C above, remove existing intake and pipe line through Twin Lakes.~~

3. ~~7.~~ Mammoth Creek – Twin Lakes To Valentine Botanical Area
   a. Maintain minimum flow of 3 cfs year long~~.~~, subject to natural flows entering Twin Lakes.

~~8. Mammoth Creek – Valentine Botanical Area to East Boundary of Private Land~~
   a. ~~No recommendations.~~

~~9. Mammoth Creek – Old Mammoth Road to Highway 395~~
   ~~a. Mean monthly flow at Highway 395 to be maintained as follows insofar as natural flows and MCWD control permits.~~
   ~~Jan. 5.0 CFS~~
   ~~Feb. 5.0 CFS~~
   ~~March 5.0 CFS~~
   ~~April 10.0 CFS~~
   ~~May 25.0 CFS~~

~~June 40.0 CFS~~
~~Sept. 6.0 CFS~~
~~Oct. 6.0 CFS~~
~~Nov. 6.0 CFS~~
~~Dec. 6.0 CFS~~

~~a. Minimum daily flow of 4.0 CFS, insofar as natural runoff and MCWD control permits.~~

~~Any artificial stream flow augmentation below Old Mammoth Road will not be considered as part of the mean monthly or minimum daily flows recommended above.~~

~~10. Bodle Ditch – Mammoth Creek to Lake Mary Outlet~~

~~a. Maintain 1.5 cfs in ditch from start of spring runoff to July 15.~~

~~b. Maintain 1.0 cfs thereafter only at the request of USFS.~~

4.~~11.~~ Bodle Ditch at Old DWP weir (water supplied via Lake Mary outlet)

a. minimum daily flows as follows:

~~May 1 – June 30 2.5 cfs~~
~~July 1 – July 31 1.5 cfs~~
~~August 1 – August 15 1.0 cfs~~
~~August 16 – September 15 0.5 cfs~~
~~September 16 – November 1 0.3 cfs~~

Flows required to sustain existing vegetation and riparian wildlife habitat associated with Bodle Ditch will be determined through the District's current environmental studies.

~~b. Maximum flow May 1 – August 15, 3 cfs at request of USFS.~~

~~12. Reserve sufficient water in Mammoth Lakes Basin and Mammoth Creek to meet consumptive needs for National Forest purposes.~~

5.~~13.~~ Flow measurement devices shall be ~~installed by proponent~~maintained by Permittee at the inflow to Lake Mary from Mammoth Creek, Coldwater Creek, Coldwater Creek Diversion and George Creek, and at the Lake Mary Outlet, Lake Mamie Outlet, Twin Lakes Outlet, and in the vicinity of Old Mammoth Road, subject to approval of the Forest Service.

~~14. Permanent measurable and controllable diversion works to be installed at the Bodle Ditch diversions from Mammoth Creek.~~

~~15. Management constraints will be re-evaluated by all concerned agencies 5 years after full implementation~~. ~~of Water Management Plan~~.

~~16. Prior to the occupancy of National Forest lands for purposes related to implementation of the Water Management Plan and project proponent (MCWD) shall obtain a Special Use Permit which shall authorize said land occupancy, subject to all conditions deemed necessary by the Forest Service such as the advanced written approval of all development plans, layout plans, location, construction, reconstruction or alteration of improvements, and payment of land use occupancy fees.~~

~~17. Because mean water yields from the Lakes Basin appear to be sufficient to supply MCWD's request for additional water from the Basin only if the water can be stored during the runoff period, and because storage is critical to full implementation of MCWD's Water Management Plan, consistent with their attempt to reduce pumping costs, future proposals by MCWD for additional storage on Lake Mary or at Horseshoe Lake shall be given consideration by the Forest Service.~~

B. The following term is proposed to be added to Permit 17332 consistent with Preliminary Cease and Desist Order No. 9P2:

In the event that the natural flows in Mammoth Creek and its tributaries are insufficient to meet:

(a) the bypass~~instream~~ flow requirements specified in Permit 17332,

(b) the municipal supply needs of the Permittee, and

(c) the minimum lake level requirements and Bodle Ditch flow requirements specified above the Permittee, subject to and to the extent of natural streamflow entering Lake Mary, and to the extent of its control, shall fully comply with the bypass flow requirements~~statutory requirements to provide sufficient instream flows~~ for protection of fish before diverting any such natural flow water to either meet the municipal demands of the District or to comply with the minimum lake levels and Bodle Ditch flow requirements specified above.

C. Term 20 of Permit 17332 is amended as follows:

Permittee will make daily flow measurements at the following locations: Lake Mary Outlet, Lake Mamie Outlet, Twin Lakes Outlet, Mammoth Creek in the vicinity of Old Mammoth Road, Mammoth Creek at Highway 395, ~~Bodle Ditch at Mammoth Creek~~ and Bodle Ditch at the Old Department of Water and Power Weir. The daily ~~and calculated mean monthly~~ flows shall be submitted annually with permit progress reports to the State Water Resources Control Board. ~~and the US Forest Service.~~

D. Term 21 of Permit 17332 is amended as follows:

Permittee shall reevaluate management constraints ~~within five years of the date of permit issuance and~~ prior to the issuance of a license.

E. Term 23 of Permit 17332 is amended as follows:

~~Subject to and to the extent of natural streamflow entering Lake Mary, permittee shall maintain in Mammoth Creek between Old Mammoth Road and Highway 395 a minimum of 4 cfs at all times and the following flows on a mean monthly basis (as recorded by the Los Angeles Department of Water and Power stream gauge near Highway 395):~~The Permittee shall not divert water to storage or divert water directly from Mammoth Creek for municipal purposes whenever the mean daily stream flows are 4 cfs or less at the LADWP gage at highway 395, and whenever the mean daily stream flows, measured at the Old Mammoth Road Gage, are less than the following amounts:

January	~~5.0~~ 6.4 cfs	July	~~25~~9.9 cfs
February	~~5.0~~ 6.0 cfs	August	~~10~~7.2 cfs
March	~~5.0~~7.8 cfs	September	~~6.0~~5.5 cfs
April	~~10.0~~9.8 cfs	October	~~6.0~~5.5 cfs
May	~~25.0~~18.7 cfs	November	~~6.0~~5.9 cfs
June	~~40.0~~20.8 cfs	December	~~6.0~~5.9 cfs

F. Term 25 of Permit 17332 is deleted

MAMMOTH CREEK EIR

SCOPING MEETING

17 January 2008

SCOPING MEETING SUMMARY

Scoping Meeting Attendees:

Name	Affiliation
Doug Jung	Concerned citizen
Brigitte Berman	Concerned citizen
Mark Drew	California Trout
Dan Dawson	UC Santa Barbara - VESR
Bill Thomas	Chance Ranch
Saeed Jorat	LADWP
Glenn Van Orsdal	MCWD
Karl Schnadt	MCWD
Brian Tillemans	LADWP
Steve Parmenter	DFG
Clay Murray	MCWD
Ericka Hegeman	MCWD
Gary Sisson	MCWD
Adrian Pitts	HDR / Surface Water Resources, Inc.
Paul Bratovich	HDR / Surface Water Resources, Inc.
Steve Kronick	MCWD – legal counsel
Sandra Bauer	Bauer Planning and Environmental Services, Inc.

Scoping Meeting Notes and Summary

Sandra Bauer began the meeting with a power point presentation. During that presentation, the following questions were asked:

- Bill Thomas asked about the 1996 Superior Court decision and Steve Kronick read from the text of the decision
- Dan Dawson asked if the 3cfs minimum from Twin Lakes to Valentine would remain in the management constraints. Steve Kronick stated that there is no change proposed to this requirement
- Saeed Jorat asked about the logic of going from the bypass flows in the original permit to the bypass flows proposed in the EIR. Steve Kronick stated that the changes are reflective of studies to maintain the fishery in good condition and the EIR will address these changes in greater detail.
- Saeed Jorat also asked if there will be an analysis in the EIR regarding the effects on water rights. Steve Kronick responded that the focus of the project is developing bypass flows to protect the fishery and that there is a term in the District's water right permit that says it is subject to prior water rights.
- Doug Jung asked about the definition of "mean" as it refers to flows. Paul Bratovich stated that it is average daily flow.
- Brian Tillemans asked if the 395 gage is the LADWP gage. Sandra Bauer stated that yes it is.
- Steve Parmenter confirmed that mean daily is the average of all readings made throughout a 24-hour period.

- Brian Tillemans asked if MCWD would take their own measurements at LADWP gage. Sandra Bauer responded that MCWD is expected utilize the LADWP data.
- Brian Tillemans asked if the terminology related to the "4 cfs at all times" at the LADWP gage is the same as in the original permit. Sandra Bauer responded that that might be a discussion item for the technical committee meeting. The topic was not raised during the technical committee meeting. However, during the team meeting that followed, it was agreed that MCWD could substantially accomplish this goal through placement of a SCADA-linked monitor at the LADWP gage.
- Brian Tillemans asked how long Bodle Ditch has been in operation, and wondered whether it was originally a riparian area (i.e., what is the baseline condition?). He suggested that we may want to look for old photographs that would document the baseline; he also suggested caution in committing flows, noting that USFS has taken the position that it has no water rights with which to support Bodle ditch. During further discussion, several speakers raised the concern that flows diverted to Bodle Ditch would reduce the flows available for other purposes, and noted the importance of weighing the value of this proposal against the water demand. It was noted that the EIR will provide information about the proposed timing, and estimated volume, of flows into and back out of Bodle Ditch.
- Brigitte Berman asked about why the District is proposing to move the date of having Lake Mary full from June 1 to July 1. Gary Sisson stated that this is being proposed to coincide with the storage requirements in the District's water right permit.
- Dan Dawson asked about the emergency use of water for place of use (POU) customers. Following discussion, Sandra clarified that this is not proposed for 'emergency use' but rather as a means to ensure safe drinking water for the proposed POU customers.
- Brian Tillemans asked if the POU customers have their own water rights and requested that all POU demand estimates (including YMCA) be stated in terms of acre-feet per year. He also asked whether the proposed POU provisions would reduce, in some cases, the demand on spring flows; Gary Sisson replied that this could occur. During subsequent group discussion, it was suggested that provisions be added requiring the POU customers to assign their water rights to instream uses; Brian noted that the spring channels can be particularly beneficial for juvenile trout. Mark Drew then asked whether these spring flows would be incorporated into the hydrologic model; Gary Sisson replied that they would not necessarily be included, since not all of the spring channels are monitored.
- Doug Jung commented that in the Town's General Plan multiple dry years, single dry water year terminology is used, and this EIR is using different terminology such as wet, dry, normal water years. Steve Kronick stated that the wet, dry, normal terminology comes from the Beak instream flow studies. MCWD agreed to investigate terminology used by the Town for drought planning, and to reconcile that terminology with language used in the proposed alternative as much as possible.
- Mark Drew asked which section of the EIR the groundwater pump test would be included.
- Steve Parmenter asked if it was possible for MCWD to share the hydrologic model. Adrian Pitts stated that some final QA/QC work is being conducted & then it will be provided to MCWD. G. Sisson stated that he would provide it to anyone interested.
- Saeed Jorat asked if the pump test would be incorporated into the hydrologic model. Adrian Pitts stated that it would not.
- Mark Drew asked about the development of the groundwater model of the Mammoth Basin. Gary Sisson stated that it should be complete in February. Mark then asked whether MCWD had a 'guideline document' that would describe the surface water model. Adrian Pitts replied that the surface water model, referred to as the water balance operations model, would soon be available for MCWD review. He further stated that MCWD was in possession of previous presentations and could make them available as appropriate.
- Dan Dawson asked about the timeframe for a SWRCB hearing. Steve Kronick suggested that it would be better to direct that question to SWRCB staff.
- Dan Dawson asked if his earlier comments in 2000 and 2005 would be incorporated. Sandra Bauer confirmed that these would all be included in the administrative record.
- Doug Jung asked about the definition of a healthy stream. Paul Bratovich stated that the "good condition" definition used by DFG is the definition that is being used in this project.
- Brigitte Berman commented that with the new Snowcreek project going in that the District needs to monitor upstream and downstream of the project.
- Brian Tillemans asked if the "good condition" definition comes from the Mono Basin process. Paul Bratovich confirmed that the "good condition" definition was taken from CDFG testimony at SWRCB hearings for Mono Lake and the Mono Basin.

<u>Comments written on easel board after conclusion of power point presentation</u>

- Dan D. –
  - Range of alternatives:
  - Environmentally superior / creek health alternative

    - Unimpaired Flow Alternative
    - §15126 d3 of CEQA requires environmentally superior alternative.[1]
- Brigitte B. –
    - Will there be the same amount of water at both measurement points?
- Doug J. –
    - Model runs?
    - Maps?
    - Economic impacts (i.e. healthy stream relates to local economics)
    - Where does Bodle Ditch go?
    - Transparency/openness to public
- Mark D. –
    - Environmentally superior alternative
    - In terms of historical diversions, how often is 5cfs diverted and will more diversions in the future result in different conclusions?
    - Baseline – prior to 1988 condition of fishery
    - Surface water / groundwater interaction – need to put everything together
- Dan D. –
    - Draft term A3 describing Twin Lakes to VESR – Is 3cfs adequate?
    - Gauging?
    - "Subject to natural flows" – natural/unimpaired?
- Doug J. –
    - MCWD flow measurement abilities?
- Dan D. –
    - Tables in EIR comparing gauges – 17332 permit terms, proposed project, etc. all should be at OMR gauge. Need one point of comparison
- Mark D. –
    - Correlation between gauges in wet, dry, normal conditions
- Doug J. –
    - Are there inflows to creek or outflows?
- Brian T. –
    - When did Bodle Ditch start flowing?
    - Was riparian resource present before Bodle Ditch was created – baseline?
- Bill T. –
    - How much water is appropriate in Bodle Ditch?
    - POU – Will all users stop using springs?, need to stop using existing sources
- Dan D. –
    - Assign water rights to "instream uses"
- Brian T. –
    - Do all POU users have existing water rights?
    - Springs important to fish rearing
- Mark D. –
    - All inputs (POU) included in hydrologic model?
    - Model specifications available?
- Bill T. –
    - POM – drought years are very important, losing reach between OMR and 395
    - Highway 395 gauge should be continuous POM
    - Bypass flows – reduction in proposed project from 17332 especially in June and July. Beginning and end of irrigation season are most important, particularly the end-season when water supply is typically most limited.
    - In response to Adrian's question, Brian Tillemans confirmed that the irrigation season extends from 1 May to 31 October with significant variation depending upon water year type and timing of runoff.
- Doug J. –
    - General Plan uses multiple dry and single dry water year terminology vs. wet, dry, normal in NOP – need consistency
- Mark D. –
    - Suggested an 'Environmentally Superior Alternative' based on results of their third-party fish population analysis (conducted by 'Stillwater'), which found that increased bypass flows during September of each

[1] NB: The CEQA Statutes and Guidelines contain only one reference to the environmentally superior alternative: "§15126.6(e)(2). The "no project" analysis shall discuss the existing conditions at the time the notice of preparation is published, or if no notice of preparation is published, at the time environmental analysis is commenced, as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services. If the environmentally superior alternative is the "no project" alternative, the EIR shall also identify an environmentally superior alternative among the other alternatives."

year would offer substantive benefits to adult brown trout populations during fall spawning. Though still undergoing internal review, Mark agreed to provide a copy of the draft Stillwater report to MCWD. Mark also noted that conclusions in the Stillwater Report are, overall, similar to conclusions in the fish populations study prepared by SWRI. In response to Mark's comments, Paul Bratovich indicated that technical findings (such as those anticipated in the Stillwater report) could be of value, and he would like to receive a draft of the Stillwater report.

- Doug J. –
  - Brown trout and rainbow trout comparison in environmental / habitat requirements
- Steve P. –
  - Asked whether this EIR could analyze whether Mammoth Creek is a fully appropriated stream. In response, Steve Kronick noted that the concept of 'fully appropriated' derives from SWRCB's determination that some California streams have no unappropriated water during certain seasons of the year or at all, based on their review of SWRCB decisions on water right applications. It is the purview of SWRCB to make such a determination; MCWD has neither the authority nor the resources to make such a determination for Mammoth Creek.
  - Steve P. added that it was not his goal to burden MCWD with this task, but rather to facilitate SWRCB action by providing as much relevant information as possible.
  - Brian Tillemans stated that a number of groups would support such a review by SWRCB, and indicated that results could settle a number of unresolved issues.
- Mark D. –
  - Asked whether the EIR would examine socio-economic issues, as indicated in the NOP but not stated during the scoping meeting. Sandra Bauer responded that CEQA does not require assessment of socioeconomic issues, and the project team was currently reassessing whether to include this in the scope of analysis. Mark noted that sport fishing accounts for a significant share of revenues in the region, but added that CalTrout does not have specific revenue data for the eastern Sierras.

Advocates for Mammoth P.O. Box 2005 Mammoth Lakes, CA 93546

January 25, 2007

Mammoth Community Water District
c/o Sandra Bauer
Bauer Planning & Environmental Services, Inc.
220 Commerce, #230
Irvine, CA 92602-1376

RE: Scoping Comments – NOP for Proposed Changes in Mammoth Creek Bypass Flow Requirements

Dear Ms. Bauer:

The Advocates for Mammoth have completed a review of the document, and are submitting this letter to identify portions of the document that are incomplete and require further data and analysis. Therefore, these additional scoping comments are submitted.

The following specific comments and/or questions are submitted, using your NOP Index format:

1.0 Summary Overview

a. What is the Mammoth Creek Collaborative (MCC), and who are members?
b. Have there been any studies, reports, conclusions, recommendations from the MCC? What about from the Technical Committee?
c. Define DFG "stressor studies" and include in draft EIR.
d. Where are the detailed maps, cross sections, geology, and so forth?

2.0 Topics Addressed

a. Need technical appendix in EIR in a good easily readable format.
b. Hydro models used, assumptions, results, conclusions recommendations clearly described should be in the Tech Appendix.
c. Environmental studies using standard protocols to determine stream and riparian condition and health should be addressed. All aspects of stream health need to be determined not just of the brown trout population. A schedule of full reach periodic stream surveys using accepted protocols such as those used by SWAMP (Surface Water Ambient Monitoring Program) should be adopted. Some upper reaches (B & C) of the fishery survey noted significant stream degradation. It can only get degraded more due to future development along the creek corridor.

3.0 Statement of Project Purpose

a. How are the revised bypass flow requirements (BFRs) to be determined? The EIR needs specific criteria, parameters, and assumptions/what governs?
b. EIR should address all elements that determine the creek's health in general as well as the fishery (again use standard protocols such as that mentioned above in 2c.)
c. Ongoing special and periodic studies are needed to monitor and maintain the health of the Creek. How often should these be scheduled? Actions needed should be specified and implemented.
d. Need to be more specific – what is the net result in acre feet of water to all parties concerned of revising the BFRs in terms of where the water finally is used and by whom after environmental considerations? Need a spreadsheet with details. Also, need a flow sheet to "follow the water".
e. What does this project proposal have to do with MCWD deep well field production, and how is this determined? Need well-engineered well tests to track the impacts.
f. What will be the impact on the geothermal aquifer and production activities in the basin? This has to be analyzed.

4.0 Comparison of 2000 draft EIR/EIS, the 2005 NOP and the 2007 NOP

a. Why 4.0 cfs? Where did this come from, how was it determined?
b. What is the difference whether creek flow is measured at Old Mammoth Rd or at 395? In-reach net recharge and discharge has to be considered when measuring creek flow. Again, ongoing proper creek studies are needed.
c. How does the Bodle Ditch flow affect the MCWD deep well production/water supply?
d. How does Horseshoe Lake affect deep well production/water supply ?
e. What's is the POU problem? Defined the claimed water rights.
f. The EIR must include a clear definition of multiple dry years, how the determination was made, and historical references to actual dry periods. Include analysis of the potential effects of climate change on increased flows. Apply this information to:

   Alternatives:#1. none,

   #2. original BFR as in permit 17332, 2000 draft EIR,

   #3. water year type BFR for dry, normal and wet years. Year types appear to NOT be the same as the Town EIR/General Plan. The Town General Plan defines their water years as: average/normal, single dry and multiple dry years (1, 2, and 3 dry years). This definition is not used in the NOP, and must correlate.

g. What is the MCWD water supply and demand situation? When will the water supply be unable to keep up with water demand of developers under the various climatic conditions with and without stringent water rationing?

h. When will the MCWD have to start denying water connections to new construction under the proposed alternatives? Who gets what and why?

i. Alternative 3 (water year type alternative) appears to be the logical alternative of the three in the NOP

j. What will the impact be on water levels of Lake George, Lake Mamie, Lake Mary, Twin Lakes under the alterative #3 constraints?

k. In E, term 23, Permit 17332 NOP constraints, the flow rates for Mammoth Creek for each month have been drastically changed. What is the explanation for these changes?

l. Explain the “Preliminary Cease and Desist order No. 9P2”, what does it mean or accomplish?

We look forward to continued involvement with the process to determine our community’s future.

Sincerely,

John Walter
Chairperson, Advocates for Mammoth

Bob Schotz
Woods Lodge, Lake George
P.O. box 108
Mammoth Lakes, CA, 93546
January 28, 2008

RE: 2007 NOTICE OF DRAFT EIR PREPARATION (NOP)

In my review of this document, I wish to comment on tems in ATTACHMENT A (Petition for Amendment of Permit 17332) the proposed changes to TERM 18 and the management constraints in District Resolution # 02-14-78-02. My concern is that EVERYONE of the proposed changes will be addressed in the EIR that will be prepared.

1. LAKE MARY must be full by late June or early July. This is especially critical during drought years. Summer use begins in June, not July, and the lake must be full for the month of June visitors
3. LAKE MAMIE also must be full for the summer season in June, not July first. Removing constraints on the draw downs of Lake Mamie in the fall will create visual and environmental damage which must be addressed in the EIR.
4. LAKE GEORGE should never be a subject of discussion in MCWD water management plans. MCWD has no water rights on Lake George. The natural flow from lake George is all that MCWD can count on for down stream use. It will not be used a a draw down reservoir.
5. TWIN FALLS:

   A vibrant falls is the invitation to the Lakes for countless summer visitors. To remove constraints, the consequences to follow without controlled management could be disastrous in many areas; environmentally, visually and financially for the community. This must be addressed in the EIR.
6. TWIN LAKES;

   Like the above lakes, Lake George, Lake Mamie and Lake Mary, Twin Lakes could also be adversely impacted by removal of the existing constraints.

   a. There is absolutely no reason why this lake should not be full by May first, the beginning of fishing season.

b.TWIN LAKES, like Lake Mamie is especially fragile. It is shallow. The weed growth problem can be mitigated only by a full lake May 1st to October 31st, with allowance of weed control after October 31st.

9 to 12. All the deleted constraints will have environmental effects on MAMMOTH . CREEK. What will these effects be? We expect the EIR to address these flow change issues.

17. This is an especially critical deletion. It appears that MCWD could take more stream water without providing storage, i.e., Horseshoe Lake. Item 17-b appears to eliminate stream flow requirements.

17-d. Management constraints should be reviewed with public comment and approval.

17-e. This amendment seems to replace those constraints deleted in #9. What will the effect of the change of measurement locations; the gauge at Hwy #395 and at Old Mammoth Road, be on the health and well being of the entire length of this section of the creek?

I am aware of what rights and uses MCWD has on Mammoth Creek and Lake Mary. Over the years I have participated in numerous studies, meetings and decision making processes concerning water issues regarding the Lakes and Mammoth Creek. In the 1970s, 1980s and the controversy in 1990s, MCWD and the USFS proposed to install mechanisms on Crystal Lake, Lake George, T.J. Lake and Arrowhead Lake to create draw down reservoirs. It was also proposed raising the level of Lake Mary over 5 feet with a total draw down of some 10 feet. This was all proposed with a cursory negative declaration. Defending a questionable position in the courts, they wisely chose deep wells as a water source. It was also recommended to use Horseshoe lake as storage for some 1200Ac Ft. of water. What happened to that proposal?

From all these past involvements in the Town's and MCWD's eternal quest for water, I view changes to operational constraints with a jaundiced eye. Constraints are the only mechanization that can begin to preserve the environmental integrity of the Lakes and Mammoth Creek; the visual continuity of these lakes and streams, and the ongoing health of Mammoth Creek and it's tributaries.

Without addressing the effects of the removal of these restraints in this pending EIR, the EIR will be an incomplete one.

Bob Schotz

Bob Schotz

CALIFORNIA TROUT

January 25th, 2008

Mammoth Community Water District
c/o Sandra Bauer
Bauer Planning & Environmental Services, Inc.
220 Commerce, #230
Irvine, CA 92602-1376

Re: Comments on the Notice of Preparation for the Draft Environmental Impact Report for Changes in Mammoth Creek Bypass Flow Requirements, Point of Measurement, Watershed Operations Constraints, and Place of Use.

California Trout (CalTrout) appreciates the opportunity to comment on Mammoth Community Water District's (District) "Notice of Preparation for the Draft Environmental Impact Report (EIR) for Changes in Mammoth Creek Bypass Flow Requirements, Point of Measurement, Watershed Operations Constraints, and Place of Use (NOP)" (Dec. 10th, 2007). It is our intention to support the development and completion of the most relevant and information rich EIR as possible.

We incorporate by reference the comments we filed on April 21, 1997 and January 31, 2001 regarding the draft EIRs issued in 1997 and 2000, respectively. *See* comments from Jim Edmondson, CalTrout, to Mr. Moynier and Mr. Heller (April 21, 1997) and comments from Jim Edmondson to Mr. Bailey and Mr. Moynier (January 31, 2001). We also incorporate by reference comments submitted on December 5, 2005 by Rob Lusardi. We would be happy to provide additional copies of these comments upon request. These comments, along with those previously filed by the State Water Resources Control Board, (SWRCB), the California Department of Fish and Game (DFG), and other interested stakeholders, are applicable to the next iteration of the draft EIR. In order to avoid receiving the same comments on the draft EIR that will be issued in 2008, the District should analyze and use these previous comments to draft the 2008 version. We respectfully request that all prior comments, and those being submitted herein, be taken into due consideration to ensure the EIR provides adequate basis for the respective permitting decisions of the District, the SWRCB, and DFG.

Our specific comments follow. For ease of reference we track the organization and section titles of the NOP.

1.0 Summary Overview

No additional comments at this time.

2.0 Topics Addressed in the Notice of Preparation

No additional comments at this time.

3.0 Statement of Project Purpose

We agree with the District's statement of project purpose. However, we further request that the District explain the need for the project, i.e., the reasoning and justification for requesting the change to bypass flow requirements.

4.0 Comparison of the 2000, 2005, and 2007 Project Proposals

The table provided in the NOP is clear and presented well.

5.0 Commenting Procedures

Caltrout would like to reiterate that the MCWD needs to provide in the next EIR specific, written comments to those previously submitted.

6.0 Scoping Meetings

No additional comments at this time.

7.0 Proposed Draft EIR Scope and Purpose

Our comments below are organized according to the five proposed elements of the EIR-Changes in Bypass Flow Requirements, Change in Point of Measurement, Change in Watershed Operations Constraints, Change in Place of Use and Project Alternatives respectively. Additional comments outside the purview of the five elements are found under an "Other" category.

<u>Changes in Bypass Flow Requirements</u>

No specific comments at this time. However, CalTrout is working in coordination with other stakeholders to develop an environmentally superior alternative for evaluation by the District in the draft EIR, which potentially would result in further recommendations for bypass flow requirements. Caltrout reserves the option to comment further on this specific topic once the environmentally superior alternative has been developed.

Changes in Point of Measurement

We request that the EIR quantitatively evaluate the difference between the requirement of a mean daily flow of 4 cfs and a minimum of 4 cfs instantaneous flow at the 395 gage and evaluate what affect an instantaneous flow requirement would have on the District's Operations.

We request clarification on the comparison of mean monthly flows at LADWP's gauge at 395 and mean daily flows at Old Mammoth Road (OMR). We further request that the EIR evaluates and quantifies the relationship between two stations on a year-type and seasonal basis (i.e. the gains and losses between the two stations appear to systematically vary depending on the time of year and the overall wetness of the year). The draft EIR should also address how do the proposed mean daily at OMR of 4cfs flow requirements differ from a mean monthly flow 6cfs under USFS action?

Changes in Watershed Operation Constraints

We appreciate that the District allowed us to review and provide comments on the water balance operations model in 2006. The model is an essential tool for the EIR analysis and we would like to see the updated model released as soon as possible for final review by interested parties and use by the EIR consultants. Our understanding is that the model is being updated with data through March 2007 (runoff year 2006-07). Given that the snowmelt runoff in the 2007 runoff starting last April was one of the lowest, or perhaps the lowest since 1977, we recommend that, if it is feasible, data through at least September 2007 be included in the model and through March 2008 when the data becomes available (obtaining the data through March 2008 should not hold up the release of the model; the data through September should be available already.

We request that the draft EIR evaluate and discuss how storage and diversion operations affect the magnitude and duration of peak flows in Dry, Normal, and Wet year types.

We request that the draft EIR evaluate how District storage operations are potentially influencing flows to lower Mammoth Basin, particularly, lower Mammoth and Hot Creeks.

We request that the draft EIR discuss decision criteria for, and history of, diverting surface water off of Mammoth Creek by the District and other entities.

Beyond the minimum base flows described in Permit 17332, we request that the draft EIR discuss the constraints (such as demand, system operations, and physical constraints at the intake) limiting the taking of the District's full allocation of water rights. How much more water could the District take and still be in compliance with the minimum flow requirements? How often would the stream be at minimum flows if the District maximized their diversions? How different would the stream hydrograph be if the District maximized their diversions in Dry, Normal, and Wet years compared to current conditions and compared to the preferred alternative?

We request that the draft EIR discuss criteria that are used to determine when and under what circumstances Lake Mary is filled to meet storage requirements.

We request that the draft EIR discuss the storage capabilities of Twin Lakes and Lake Mamie: (1) what storage capability is there for these two lakes and who has authority to store water for the District's use or for in-stream purposes; (2) what constraints exist for storage and management of water in these lakes for the District's use; and (3) have the full storage capabilities of these Lakes been used in the past?

Changes in Place of Use

No additional comments at this time.

Project Alternatives

Caltrout would like to reiterate the need to develop an "environmentally superior alternative" that centers on improving the condition of Mammoth and Hot Creek fisheries, while simultaneously providing for the District's water needs. Caltrout has requested a Technical Advisory Committee meeting be convened with the goal of determining what may constitute such an alternative and will be working with Technical Committee members to develop such an alternative. We understand that the District is amenable to this request and that such a meeting will be convened within the next month.

Other

We request that the draft EIR evaluate the need for periodic reviews of the fisheries, riparian and terrestrial habitats providing for adaptive management in light of changing circumstances such as climate change.

We request that the draft EIR evaluate and discuss the current state of knowledge of groundwater and surface water interactions in the Mammoth Basin and plans for further studies to advance existing knowledge.

We request that the draft EIR discuss how the findings of the Fish Populations of Mammoth Creek Report may vary if and when the District diverts greater amounts of surface water up to their full allocated rights –subject to the in-stream flow requirements- in Dry, Normal, and Wet year conditions.

We request that the draft EIR, to the extent data exists (anecdotal or otherwise), discuss the condition of Mammoth Creek fisheries relative to the conditions of the fisheries prior to 1983 as noted in the Fish Populations of Mammoth Creek Report. How do "today's" fisheries compare to those in the 1950s, 1960, and 1970s?

We request that the draft EIR include a discussion of the minimum flows needed for riparian maintenance of Bodle ditch and are flows needed during non-growing months?

We request that the cumulative impacts analysis include evaluation of other activities besides district operations that potentially affect the fishery and stream conditions of Mammoth Creek, including land use, development impacts from construction activities, riparian removal, irrigation operations, hatchery operations, effluent, and climate change.

We request that the draft EIR include a discussion of compliance with all pending compliance requirements, including but not limited, to the need to include a "Demand Reduction Report" as called for by the revised Preliminary Cease and Desist Order 9P issued by the State Water Resources Control Board.

8.0 Project Location

No additional comments at this time.

9.0 Brief Chronology of the 2000 Draft EIR/EIS, The 2005 NOP, and the 2007 NOP

Caltrout would like to remind the District that we filed a Petition to Establish Appropriate Limitations on Diversions by Mammoth Community Water District, Declare Mammoth Creek Fully Appropriated, and Provide Other Relief to Protect Public Trust Resources in Mammoth Creek, Hot Creek, and Upper Owens River dated December 9th, 2004. As noted, the Petition requests that the State Water Resources Control Board act without further delay to condition the District's permits for water withdrawal on in-stream flows adequate to protect the fisheries in Mammoth and Hot Creeks. The Petition is currently still pending before the State Water Resources Control Board.

10.0 CEQA Basis for Recirculation

No additional comments at this time.

CONCLUSION

CalTrout is committed to cooperating and assisting the District in order to assure that EIR provides adequate basis for the SWRCB's proceeding to amend MCWD's water rights, and is completed without further delay. As stated in our letter dated September 5th, 2007, we expect the District to complete the EIR by the date established by the schedule it published on August 16th, 2007 and subsequently the updated and agreed upon schedule circulated on November 29th, 2007. We look forward to working with the District and the Technical Advisory Committee and thank you for the opportunity to comment on the Mammoth Creek Notice of Preparation.

Sincerely,

Mark Drew
Eastern Sierra Program Manager
California Trout

STATE OF CALIFORNIA--THE RESOURCES AGENCY Arnold Schwarzenegger, Governor

DEPARTMENT OF FISH AND GAME
Inland Deserts Region
Bishop Field Office
407 W. Line Street
Bishop, CA 93514
http://www.dfg.ca.gov

January 25, 2008

MCWD c/o Sandra Bauer
Bauer Planning & Environmental Services, Inc.
220 Commerce, #230
Irvine, CA 92602-1376

Subject: Notice of Preparation for proposed changes in Mammoth Creek bypass flow requirements watershed operation constraints, point of measurement, and place of use; SCH #97032082.

Dear Ms Bauer,

The Department of Fish and Game (Department) has reviewed the Notice of Preparation (NOP) for the above mentioned project. Mammoth Community Water District (MCWD) is proposing to modify its bypass flow requirements in Mammoth Creek consistent with a request by the State Water Resources Control Board (SWRCB) that MCWD undertake a more detailed analysis of the bypass flow requirements for Mammoth Creek. The proposed change would amend the District's Permit 17332 to specify new bypass flow requirements. The project also includes proposed changes in the District's Watershed Operation Constraints, the Point of Measurement, and the Place of Use. The NOP requests responses by January 25, 2008. The Department timely files these responses and comments.

The Department is providing comments on the NOP as the State agency with the statutory and common law responsibilities with regard to fish and wildlife resources and habitats. California's fish and wildlife resources, including their habitats, are held in trust for the people of the State by the Department (Fish & Game Code §711.7). The Department has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitats necessary for biologically sustainable populations of those species (Fish & Game Code §1802). The Department's fish and wildlife management functions are implemented through its administration and enforcement of the Fish and Game Code (Fish & Game Code §702). The Department is a trustee agency for fish and wildlife under the California Environmental Quality Act (see CEQA Guidelines, 14 Cal. Code Regs. §15386(a)) and a Responsible Agency regarding any discretionary actions (CEQA Guidelines §15381) required by the Department. The Department is providing these comments in furtherance of these statutory responsibilities, as well as its common law role as trustee for the public's fish and wildlife.

The Department believes our previous related correspondence provides an inclusive, but incomplete listing of concerns applicable to the project described in the current NOP. These letters are an NOP/NOI comment letter dated April 29, 1997; and EIR/EIS comment letter dated January 31, 2001. Copies of the letters are attached for your convenience. In addition to issues previously identified by the Department, we would like to identify the following additional concerns.

In general, the Department concurs with the issues of concern identified in the NOP and appreciates the discussion provided. The geographic scope of the project study area for surface water related impacts should extend from Lake Mary downstream to the Hot Creek Gorge Flume. We request that the "new water balance operations model" and any Mammoth Basin groundwater models relied on for the EIR analysis be provided to us in a common and/or non-proprietary software platform, to facilitate independent analysis and review of model results. If modeling or other evidence suggests a potential influence of groundwater pumping on surface flows in Mammoth Creek, the EIR should address this potential and identify feasible mitigation.

Section 7.0 of the NOP is entitled "Proposed Draft EIR Scope and Focus". This section includes a subsection entitled "Alternatives". The California Environmental Quality Act Public Resources Code section 21000 et seq. (CEQA) requires an environmental impact report (EIR) to describe a range of reasonable alternatives. DFG believes that the No Project alternative described in the NOP is not reasonable and does not comply with CEQA requirements. The No Project alternative described in the NOP is the bypass flow requirements as specified in Permit 17332. However, Permit 17332 has been modified by the State Water Resources Control Board (SWRCB) Order 97-01. SWRCB Order 97-01 modified the numerical flow requirements in Permit 17332 and those modifications remain in effect "[u]ntil such time as the State Board amends Permit 17332 to revise the long-term fishery flow requirements for Mammoth Creek,…" (Order 97-01 at page 6). Order 97-01 further revised Permit 17332 to explicitly condition SWRCB issuance of a license, based on Permit 17332, with "full compliance with Section 5937 of the Fish and Game Code". (Order 97-01 at page 7). Thus, a No Project Alternative that ignores the mandates of SWRCB Order 97-01 is both unreasonable and not a feasible alternative under CEQA. DFG acknowledges that the CEQA Guidelines do not require that the No Project Alternative be the existing or baseline conditions (CEQA Guidelines 15126.6(e)). CEQA Guidelines do, however, require that the alternatives be "feasible". (CEQA Guidelines section 15126.6(f)). DFG contends that ignoring the mandates of SWRCB Order 97-01 is not a feasible approach to describing a reasonable range of alternatives in the draft EIR. The draft EIR should use the terms of Permit 17332, as modified by Order 97-01 as the No Project Alternative.

A project alternative which develops potential flow operating rules to optimize aquatic and riparian resources should be included to provide a more informative range of alternatives.

Section E of Attachment A proposes specific language amendments to Term 23 of Permit 17332. DFG proposes the following changes to the MCWD proposal for this language. This suggestion is based on what we believe may have been a typographical error in the NOP. Currently, the proposed language for Term 23 of Permit 17332 reads: "The Permittee shall not divert water to storage or divert water directly from Mammoth Creek for municipal purposes whenever the mean daily stream flows are 4 cfs or less at the LADWP gage at highway 395, **and** whenever the mean daily stream flows, measured at the Old Mammoth Road Gage, are less than the following amounts:…" (Emphasis added.) DFG believes that the word "and" in this sentence is not appropriate and that word should be changed to "**or"**. By changing the word to "or", MCWD would stop diverting water to storage or directly from Mammoth Creek for municipal purposes whenever **either** the mean daily stream flow was 4 cfs at the LADWP gage at highway 395 **or** whenever the mean daily stream flows measured at the Old Mammoth Road Gage reached specified amounts. If MCWD leaves the word "and" in that sentence, then MCWD would only need to stop diverting to storage or directly from Mammoth Creek for municipal purposes if **both** of those events occurred simultaneously. DFG does not support the concept that MCWD would not be required to curtail diversions unless both events occur simultaneously.

Finally, the preparation of this EIR represents a significant compilation of information and analysis pertaining to surface water supply in Mammoth Creek. Such a document could potentially serve as the basis for a finding by the State Water Resources Control Board that Mammoth Creek has been fully appropriated pursuant to Water code sections1205-1207. We suggest the document be prepared with this potential utility in mind, in the interest of both the existing water rights holders and the natural resources which depend on Mammoth Creek.

Thank you for the opportunity to comment on this NOP for a Draft EIR for changes in Mammoth Creek bypass flow requirements, watershed operation constraints, point of measurement, and place of use. Questions regarding this letter and further coordination on these issues should be directed to Mr. Steve Parmenter, Senior Biologist, at (760) 872-1123.

Sincerely,

Original Signed

Denyse Racine
Habitat Conservation Supervisor

Attachments:

1. Letter to John Moynier, Mammoth Community Water District, dated April 29, 1997
2. Letter to Jeff Bailey, Inyo National Forest and John Moynier, Mammoth Community Water District, dated January 31, 2001.

cc: C. Taucher, Los Alamitos
N. Murray, Sacramento
B. Kinney and S. Parmenter, Bishop

Mr. Gary Sisson, General Manager
Mammoth Community Water District
P.O. Box 547
Mammoth Lakes, CA 93546

Victoria Whitney, Deputy Director
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812

Mr. Paul Pau
Los Angeles Department of Water and Power
P.O. Box 51111
Los Angeles, California 90051-0100

Mr. Mark Drew, Eastern Sierra Manager
California Trout
P.O box 3442
Mammoth Lakes, CA 93546

Mr. Dan Dawson, Director
Valentine Eastern Sierra Reserve
Route 1, Box 198
1016 Mt. Morrison Road
Mammoth Lakes, CA 93546

Genny Smith Books 23100 Via Esplendor, V-44 Cupertino, CA 95014 650-964-4071

January 14, 2008

Comments

2007 Notice of Draft EIR Preparation (NOP)

Among the MCWD proposals listed in this document are 3 pages of changes to Permit 17332 and management constraints (pp 13 – 15, Attachment A). However, the NOP does not indicate that the impacts of these changes will be addressed in the coming EIR.

They should be! Every single one.

I am quite familiar with the constraints. Years ago I worked with both the USFS and MCWD to establish these constraints. They are all of major importance – to sustain a healthy fishery, to maintain scenic beauty, and to enhance recreation of many kinds. They are especially important to keep fishermen, campers and tourists coming in the "shoulder seasons," those months before the Fourth of July and after Labor Day. The town's commercial interests have long worked hard to encourage tourists and second-home owners to come in these less crowded, quite beautiful months. Eliminating and changing the constraints will impact the fishery, the scenic beauty and opportunities for recreation – such as photography, camping, fishing, and boating – especially during the shoulder seasons.

Some of the changes listed on these pages refer to stream flows from Twin Lakes to Hwy 395, to the Bodle Ditch, and the placement of measuring devices. All of these changes have significant impacts and must be addressed in the EIR.

Many of the proposed changes will impact the Lakes Basin. I will confine the balance of my remarks to these potential impacts. Among the proposals affecting the Lakes Basin are the following:

management of lake levels of lakes Mary, Mamie, and Twin
the timing of drawdowns
stream flows between the lakes
the timing and amount of flows down Twin Lakes Waterfall

Summer:
P.O. Box 1060 Mammoth Lakes, CA 93546 760-934-6185

I am aware that MCWD has storage rights to Lake Mary and that its permit allows it to manage the lake level, how much and when it can draw down the lake. Lake Mary's drawdowns are critical to and affect everything downstream – the levels of Mamie and Twin and also the flows over Twin Lakes waterfall. If, as indicated in the NOP, Lake Mary does not need to be full until July 1 (a change) then how will this change affect scenic beauty and recreation opportunities of Mamie, Twin, as well as Mary, especially during June? And, as it manages the level of Lake Mary, if MCWD does not need to consider the levels of Mamie and Twin downstream during September and October, how will that affect fishing and boating? Have you ever noticed what a drawn-down reservoir looks like? Does anyone want to look at or photograph a lake with a bare bathtub ring all around its muddy shores?

If there are no constraints on management of the flow over Twin Lakes waterfall, what is the effect on one of the most photographed sites of Mammoth? Drawdowns and timing of Lake Mary's level can reduce the waterfall to a trickle by early August, the busiest summer month for tourists. What does that do to the scenery that they come to see?

All of these questions and the impacts of these changes must be addressed in the EIR. All of these changes will have significant impacts on recreation enjoyments of many kinds, on the fishery, on scenic beauty, and on tourism. Without addressing these impacts, the EIR will be woefully incomplete.

Genny Smith

Publisher, editor

Mr. Gary Sisson Jan.20, 2008
Mammoth Community Water District
PO Box 597
Mammoth Lakes, CA 93546

Dear Mr. Sisson:

My name is Kevin Peterson and I am the manager of Hot Creek Ranch. I would like to include these comments in the process of completing a current EIR for Mammoth Creek pertaining to instream flow diversions. We ask that comments from the 1997, 2000 and 2005 drafts be thoroughly reviewed and analyzed for the current version. The current EIR content has the local fishing and recreation community concerned. While trying to not be redundant, we feel that some of the key points that need to be addressed are:

1. In completing a new EIR, the District must consider impacts to the lower watershed of Mammoth Creek (below Highway 395), Hot Creek, and the upper Owens River.

2. Permanent fishery protection flows need to be established on Mammoth and Hot Creek through a hearing process that includes the public and the SWRCB.

3. The District needs to examine potential impacts to downstream aquatic resources and potential infringement on senior water rights holders from the District's proposed in stream flow schedule, direct diversions and storage diversions at Lake Mary. Please provide adequate analysis to necessary channel maintenance and flushing flow requirements needed to mobilize and purge excessive sediments from the watershed.

4. Please analyze the need for reducing minimum instream flows on Mammoth Creek considering the project proposal first occurred in the early 1990's when surface water accounted for the majority of the District's water supply and you were experiencing drought conditions which put your water supply in jeopardy. You now have extensive groundwater production capabilities and the District's water supply is no longer in jeopardy.

5. Better assess the surface flow/aquifer relationship in the Mammoth Basin to understand if groundwater pumping may be influencing spring discharge on reaches along Mammoth Creek.

6. Please consider an environmentally superior alternative, which incorporates stringent water conservation during dry years and compare those supply gains to gains from the proposed bypass flow requirements.

7. We would like to request that a "Minimum" instantaneous flow regime be adopted as opposed to a "Mean" flow regime.

Thank you very much for your attention to this matter and please do not hesitate to contact me at (760) 937-0519

Kevin Peterson

Department of Water and Power the City of Los Angeles

ANTONIO R. VILLARAIGOSA
Mayor

Commission
H. DAVID NAHAI, *President*
EDITH RAMIREZ, *Vice-President*
MARY D. NICHOLS
NICK PATSAOURAS
FORESCEE HOGAN-ROWLES
BARBARA E. MOSCHOS, *Secretary*

RONALD F. DEATON, *General Manager*

January 17, 2008

Ms. Sandra Bauer
Bauer Planning & Environmental Services Inc.
220 Commerce, No. 230
Irvine, CA 92602-1376

Dear Ms. Bauer:

Subject: Notice of Draft Environmental Impact Report Preparation (NOP) for Proposed Changes in Mammoth Creek Bypass Requirements Watershed Operation Constraints, Point of Measurement, and Place of Use, SCH No. 97032082

Thank you for providing the opportunity to the Los Angeles Department of Water and Power (LADWP) to review and provide comments on the Notice of Preparation for the above project. As we understand, the proposed project includes three components: changing bypass requirements along Mammoth Creek, change of point of flow measurement, and changes of place of use of diverted flows.

The Eastern Sierra has historically been the main water supply source for the City of Los Angeles (City). The Mammoth Creek flow is approximately 25 percent of Los Angeles' export from the Eastern Sierra. LADWP has the responsibility of protecting this vital water supply source for the City. This includes ensuring that all diversions from Mammoth Creek are consistent with existing permits from the State Water Resources Control Board. Similarly, in any changes to existing permit conditions, we need to ensure that water rights of the City are protected.

The Mammoth Community Water District's (MCWD) permit, No. 17322, includes minimum bypass flow requirements in mean monthly flow rates as measured at LADWP's gauge located at the Old Highway 395 (see Table 2 of NOP). The subject project proposes changing the bypass flow requirements both in terms of mean daily flow rates for each month and also change in the measuring location from LADWP's gauge at Old Highway 395 to MCWD's gauge near Old Mammoth Road. This EIR should analyze and evaluate the impacts of proposed changes to bypass flow requirements and change in the measuring location on senior water rights holders downstream of LADWP's gauge at Old Highway 395 during dry, normal, and wet runoff conditions.

In recent years, the MCWD's water supply has increased reliance on groundwater resources. While the interaction between the groundwater aquifer system and the surface water facilities is not well understood at this time, there are numerous groundwater-fed springs in the area that flow into Mammoth Creek which end up eventually in the Owens River. As part of the EIR preparation, the surface and groundwater interaction should be studied through field measurements and by development of a representative groundwater flow model of the area. Groundwater models should be utilized as tools for evaluating possible impacts of groundwater withdrawal on flows in Mammoth Creek. The EIR should propose a monitoring program of surface and groundwater systems. Specific triggers should be established and utilized to limit groundwater pumping if the flow in Mammoth Creek is affected.

The City has both riparian and appropriative water rights in the Eastern Sierra. In Long Valley, the City's Chance Ranch property along Mammoth Creek has riparian water rights for irrigation during the growing season. Additionally, the City's appropriative rights for diversion from Owens River for municipal, irrigation, recreational, and stockwater includes flow in the Owens River and also its tributaries, including Mammoth Creek. The EIR should analyze the effect of the changes in MCWD's permit conditions on the City's riparian and appropriative water rights.

Please feel free to contact me at (760) 873-0225 if you have any questions or need clarifications.

Sincerely,

Gene L Coufal

Gene L. Coufal
Manager
Aqueduct Section

STATE OF CALIFORNIA Arnold Schwarzenegger, Governor

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-6251
Fax (916) 657-5390
www.nahc.ca.gov
ds_nahc@pacbell.net

December 26, 2007

Mr. Gary Sisson
Mammoth Community Water District
2315 Meridian Boulevard
Mammoth Lakes, CA 93546

Re: SCH# 2007032082; CEQA Notice of Preparation (NOP) draft Environmental Impact Report (DEIR) for the Mammoth Creek Bypass Flow Requirements Project; Mono County, California

Dear Mr. Sisson:

Thank you for the opportunity to comment on the above-referenced document. The Native American Heritage Commission is the state agency designated for the protection of California's Native American cultural resources. The California Environmental Quality Act (CEQA) requires that any project that causes a substantial adverse change in the significance of an historical resource, that includes archeological resources, is a 'significant effect' requiring the preparation of an Environmental Impact Report (EIR per the California Code of Regulations § 15064.5(b)(c) (CEQA Guidelines). In order to comply with this provision, the lead agency is required to assess whether the project will have an adverse impact on these resources within the 'area of potential effect (APE),' and if so, to mitigate that effect. To adequately assess the project-related impacts on historical resources, the Commission recommends the following action:

√ Contact the appropriate California Historic Resources Information Center (CHRIS). Contact information for the 'Information Center' nearest you is available from the State Office of Historic Preservation in Sacramento (916/653-7278). The record search will determine:

- If a part or the entire (APE) has been previously surveyed for cultural resources.
- If any known cultural resources have already been recorded in or adjacent to the APE.
- If the probability is low, moderate, or high that cultural resources are located in the APE.
- If a survey is required to determine whether previously unrecorded cultural resources are present.

√ If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.

- The final report containing site forms, site significance, and mitigation measurers should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum, and not be made available for pubic disclosure.
- The final written report should be submitted within 3 months after work has been completed to the appropriate regional archaeological Information Center.

√ Contact the Native American Heritage Commission (NAHC) for:

* A Sacred Lands File (SLF) search of the project area and information on tribal contacts in the project vicinity who may have information on cultural resources in or near the APE. Please provide us site identification as follows: USGS 7.5-minute quadrangle citation with name, township, range and section. This will assist us with the SLF.

- Also, we recommend that you contact the Native American contacts on the attached list to get their input on the effect of potential project (e.g. APE) impact. In many cases a culturally-affiliated Native American tribe or person will be the only source of information about the existence of a cultural resource.

√ Lack of surface evidence of archeological resources does not preclude their subsurface existence.

- Lead agencies should include in their mitigation plan provisions for the identification and evaluation of accidentally discovered archeological resources, per California Environmental Quality Act (CEQA) §15064.5 (f)of the California Code of Regulations (CEQA Guidelines). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American, with knowledge in cultural resources, should monitor all ground-disturbing activities.
- Lead agencies should include in their mitigation plan provisions for the disposition of recovered artifacts, in consultation with culturally affiliated Native Americans.

√ Lead agencies should include provisions for discovery of Native American human remains or unmarked cemeteries in their mitigations plans.

- CEQA Guidelines §15064.5(d) requires the lead agency to work with the Native Americans identified by this Commission if the Initial Study identifies the presence or likely presence of Native American human remains within the APE. CEQA Guidelines provide for agreements with Native American groups, identified by the NAHE, to ensure the appropriate and dignified treatmentof Native American human remains and any associated grave goods.
- Health and Safety Code §7050.5, Public Resources Code §5097.98 and CEQA Guidelines §15064.5(d) mandate procedures to be followed in the event of an accidental discovery of any human remains in a location other than a dedicated cemetery.

√ Lead agencies should consider avoidance, as defined in CEQA Guidelines §15370 when significant cultural resources are discovered during the course of project planning or execution.

Please feel free to contact me at (916) 653-6251 if you have any questions.

Sincerely,

Dave Singleton
Program Analyst

Attachment: Native American Contact List

Cc: State Clearinghouse

Native American Contacts
Mono County
December 26, 2007

Benton Paiute Reservation
Mike Keller, Chairperson
Star Route 4, Box 56-A — Paiute
Benton, CA 93512
numic@qnet.com
(760) 933-2321
(760)933-2412

Big Pine Band of Owens Valley THPO
Bill Helmer, Tribal Historic Preservation Officer
P.O. Box 700 — Paiute
Big Pine, CA 93513
amargosa@aol.com
(760) 938-2003
(760) 938-2942 fax

Big Pine Band of Owens Valley
David Moose, Chairperson
P. O. Box 700 — Owens Valley Paiute
Big Pine, CA 93513
bigpinetribaladmin@earthlink.
(760) 938-2003
(760) 938-2942-FAX

Bishop Paiute Tribe THPO
Theresa Stone-Yanez, Tribal Historic Preservation
50 Tu Su Lane — Paiute-Shoshone
Bishop, CA 93514
(760) 873-3584, Ext 250
(760) 397-8146 - cell
(760) 873-4143 - FAX

Bridgeport Paiute Indian Colony
Charlotte Baker, Chairperson
P.O. Box 37 — Paiute
Bridgeport, CA 93517
bicgovadm@yahoo.com
(760) 932-7083
(760) 932-7846 Fax

KutzadikaA Indian Community Cultural Presv. Assn.
Raymond Andrews, Chairman
P.O. Box 591 — Paiute
Bishop, CA 93515
(760) 873-8145

Mono Lake Indian Community
Charlotte Lange, Chairperson
P.O. Box 117 — Mono Northern Paiute
Big Pine, CA 93513
(760) 938-1190

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native American with regard to cultural resources for the proposed SCH#2007032082; CEQA Notice of Preparation (NOP) for the Proposed Changes to the Mammoth Creek Bypass Flow Requirements Project; Mono County, California.

State Water Resources Control Board

Division of Water Rights
1001 I Street, 14th Floor ♦ Sacramento, California 95814 ♦ 916.341.5300
P.O. Box 2000 ♦ Sacramento, California 95812-2000
Fax: 916.341.5400 ♦ www.waterrights.ca.gov

Linda S. Adams
Secretary for Environmental Protection

Arnold Schwarzenegger
Governor

January 25, 2008

VIA EMAIL

Mammoth Community Water District
c/o Sandra Bauer
Bauer Planning & Environmental Services, Inc.
220 Commerce, #230
Irvine, CA 92602-1376

sandra@bpesinc.com

Dear Ms. Bauer:

COMMENTS ON NOTICE OF PREPARATION FOR A DRAFT ENVIRONMENTAL IMPACT REPORT FOR PROPOSED CHANGES IN MAMMOTH CREEK BYPASS FLOW REQUIREMENTS, WATERSHED OPERATION CONSTRAINTS, POINT OF MEASUREMENT, AND PLACE OF USE, SCH #97032082

This letter responds to Mammoth Community Water District's (MCWD) 2007 Notice of Preparation (NOP) for a draft Environmental Impact Report (EIR) on petitions to the State Water Resources Control Board (State Water Board), Division of Water Rights (Division) to change MCWD's water right permit/license conditions pursuant to Permit 17332 (Application 25368) and Licenses 5715 (Application 12079) and 12593 (Application 17770). The petitions involve changes in: Mammoth Creek bypass flow requirements, the point of measurement for those flows, watershed operation constraints pursuant to Resolution 02-14-79-02 in Permit 17332, and MCWD's place of use. Pursuant to the California Environmental Quality Act (CEQA), the State Water Board is a responsible agency for this project and will consider the EIR when determining whether or not to approve MCWD's petitions to change its water rights. The Division incorporates by reference its comments on MCWD's 2005 NOP for the project mentioned above.

The Division provides the following comments on the 2007 NOP:

1. According to Section 4.0 of the NOP, MCWD proposes to evaluate three alternatives including, (1) no project, (2) a mean daily bypass flow requirement of 4 cubic feet per second (cfs) at LADWP's Highway 395 gage, and (3) a Water Year Type Alternative that would establish different bypass flow requirements for dry, normal, and wet years. If, the EIR determines alternatives 2 or 3 are the preferred alternatives, MCWD is required to petition the State Water Board to amend Permit 17332, and License numbers 5715 and 12593.

2. Table 2, Section 4, of the NOP states the "project proposal now incorporates a mean daily flow requirement at Highway 395 of 4 cfs." However, there is currently no reporting of mean daily flow at this gage and this gage is subject to freezing in the winter. The draft EIR should

explain how MCWD will collect the readings to comply with the proposed mean daily flow requirement.

3. In Section 7.0 beginning on page 4 of the NOP:

   a. Fisheries and Aquatic Resources: Sites that were sampled during 1988 through 2007 may not be representative of native fish preferred habitats because emphasis of the proposed fish study is and has been on brown and rainbow trout. For Fisheries and Aquatic Resources, the draft EIR should include a study to evaluate impacts on native fish, including Owens sucker (Catostomus fumeiventris) and the Owens tui chub (Gila bicolor snyderi). Although the Owens tui chub in lower Mammoth Creek may be genetically impure, it still may be ecologically important in the watershed. The sites that were sampled during 1988 through 2007 may not be representative of these native fish preferred habitats. Thus, evaluation of project impacts on native species may require additional sampling and analysis of native fish and their respective habitats (including food resources).

   b. For Terrestrial and Riparian Resources, the draft EIR should include a study of the impacts to amphibian species in general, and specifically to the Yosemite toad (Bufo canorus), by modifications to Mammoth Creek bypass flow requirements and watershed operation constraints. The draft EIR should also consider potential impacts to existing wetland, riparian, and meadow habitats, and related effects on fish and wildlife.

4. The Alternatives section of the NOP (page 6) states that three alternatives will be evaluated in the draft EIR. The draft EIR should consider an alternative of bypasses resembling historical natural flows through the year, though at reduced rates than would naturally occur. More specifically, the draft EIR should consider magnitude, frequency, duration, timing, and rate of change in streamflows within and among years (see Poff, 1997 for further explanation, attached). The draft EIR should include projected long-term effects on stream habitat and geomorphic conditions important for fish and wildlife. It should also address the potential effects of changes in river stage on aquatic, riparian, and terrestrial resources. In evaluating changes in stream stage, accounting for watershed topography adjacent to the stream channel likely will be necessary.

5. Under the Cumulative Impacts section on page 6 of the NOP, it states “the draft EIR will identify other relevant projects in the Mammoth Lakes area”. Relevant projects the draft EIR should analyze include all of MCWD’s diversions from the watershed as well as other projects that may impact water quality and temperature relative to the proposed project.

Regardless of its responsibilities under CEQA, the State Water Board will also consider the full range of impacts associated with approving the change petitions in order to fulfill its responsibilities under the public trust doctrine and the Water Code. For example, the State Water Board has an independent obligation to consider the effect of the proposed project on public trust resources and to protect those resources where feasible, and to prevent the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water. (National Audubon Society v. Superior Court (1983) 33 Cal.3d 419 [189 Cal.Rptr. 346]; Cal. Const., art. X, § 2; Wat. Code, § 275.) The State Water Board also must consider whether a change will injure a legal user of water. (Wat. Code, § 1702.) Pursuant to its authority under the Water Code, the Division may request additional information outside of the CEQA process in order to meet the State Water Board's public trust and other obligations.

Accordingly, while MCWD may determine that CEQA does not require an analysis of all of the issues discussed above (including impacts to other legal users of water and public trust resources), it would further the State Water Board's consideration of the change petitions if the draft EIR discussed these issues. Given the similarity of the scope of analyses, it would be expeditious to address these issues in one document.

Thank you for the opportunity to comment on MCWD's NOP. If you have any questions concerning these comments, please contact Jane Farwell, Environmental Scientist, at (916) 341-5349.

Sincerely,

Charles L. Lindsay

Charles Lindsay, Chief
Hearings Unit

Attachment: Poff, et al., 1997

The Natural Flow Regime

A paradigm for river conservation and restoration

N. LeRoy Poff, J. David Allan, Mark B. Bain, James R. Karr, Karen L. Prestegaard, Brian D. Richter, Richard E. Sparks, and Julie C. Stromberg

Humans have long been fascinated by the dynamism of free-flowing waters. Yet we have expended great effort to tame rivers for transportation, water supply, flood control, agriculture, and power generation. It is now recognized that harnessing of streams and rivers comes at great cost: Many rivers no longer support socially valued native species or sustain healthy ecosystems that provide important goods and services (Naiman et al. 1995, NRC 1992).

N. LeRoy Poff is an assistant professor in the Department of Biology, Colorado State University, Fort Collins, CO 80523-1878 and formerly senior scientist at Trout Unlimited, Arlington, VA 22209. J. David Allan is a professor at the School of Natural Resources & Environment, University of Michigan, Ann Arbor, MI 48109-1115. Mark B. Bain is a research scientist and associate professor at the New York Cooperative Fish & Wildlife Research Unit of the Department of Natural Resources, Cornell University, Ithaca, NY 14853-3001. James R. Karr is a professor in the departments of Fisheries and Zoology, Box 357980, University of Washington, Seattle, WA 98195-7980. Karen L. Prestegaard is an associate professor in the Department of Geology, University of Maryland, College Park, MD 20742. Brian D. Richter is national hydrologist in the Biohydrology Program, The Nature Conservancy, Hayden, CO 81639. Richard E. Sparks is director of the River Research Laboratories at the Illinois Natural History Survey, Havana, IL 62644. Julie C. Stromberg is an associate professor in the Department of Plant Biology, Arizona State University, Tempe, AZ 85281.

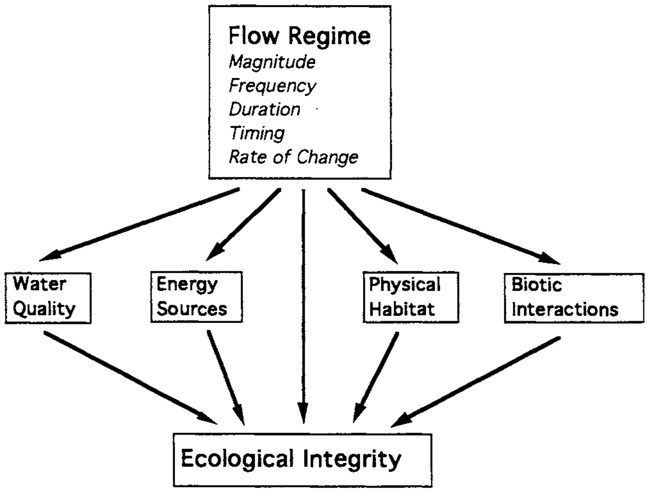
The ecological integrity of river ecosystems depends on their natural dynamic character

The extensive ecological degradation and loss of biological diversity resulting from river exploitation is eliciting widespread concern for conservation and restoration of healthy river ecosystems among scientists and the lay public alike (Allan and Flecker 1993, Hughes and Noss 1992, Karr et al. 1985, TNC 1996, Williams et al. 1996). Extirpation of species, closures of fisheries, groundwater depletion, declines in water quality and availability, and more frequent and intense flooding are increasingly recognized as consequences of current river management and development policies (Abramovitz 1996, Collier et al. 1996, Naiman et al. 1995). The broad social support in the United States for the Endangered Species Act, the recognition of the intrinsic value of noncommercial native species, and the proliferation of watershed councils and riverwatch teams are evidence of society's interest in maintaining the ecological integrity and self-sustaining productivity of free-flowing river systems.

Society's ability to maintain and restore the integrity of river ecosystems requires that conservation and management actions be firmly grounded in scientific understanding. However, current management approaches often fail to recognize the fundamental scientific principle that the integrity of flowing water systems depends largely on their natural dynamic character; as a result, these methods frequently prevent successful river conservation or restoration. Streamflow quantity and timing are critical components of water supply, water quality, and the ecological integrity of river systems. Indeed, streamflow, which is strongly correlated with many critical physicochemical characteristics of rivers, such as water temperature, channel geomorphology, and habitat diversity, can be considered a "master variable" that limits the distribution and abundance of riverine species (Power et al. 1995, Resh et al. 1988) and regulates the ecological integrity of flowing water systems (Figure 1). Until recently, however, the importance of natural streamflow variability in maintaining healthy aquatic ecosystems has been virtually ignored in a management context.

Historically, the "protection" of river ecosystems has been limited in scope, emphasizing water quality and only one aspect of water quantity: minimum flow. Water resources management has also suffered from the often incongruent perspectives and fragmented responsibility of agencies (for example, the US Army Corps of Engineers and Bureau of Reclamation are responsible for water supply and flood control, the US Environmental Protection Agency and state environmental agencies for water quality, and the US Fish &

Figure 1. Flow regime is of central importance in sustaining the ecological integrity of flowing water systems. The five components of the flow regime—magnitude, frequency, duration, timing, and rate of change—influence integrity both directly and indirectly, through their effects on other primary regulators of integrity. Modification of flow thus has cascading effects on the ecological integrity of rivers. After Karr 1991.



Wildlife Service for water-dependent species of sporting, commercial, or conservation value), making it difficult, if not impossible, to manage the entire river ecosystem (Karr 1991). However, environmental dynamism is now recognized as central to sustaining and conserving native species diversity and ecological integrity in rivers and other ecosystems (Holling and Meffe 1996, Hughes 1994, Pickett et al. 1992, Stanford et al. 1996), and coordinated actions are therefore necessary to protect and restore a river's natural flow variability.

In this article, we synthesize existing scientific knowledge to argue that the natural flow regime plays a critical role in sustaining native biodiversity and ecosystem integrity in rivers. Decades of observation of the effects of human alteration of natural flow regimes have resulted in a well-grounded scientific perspective on why altering hydrologic variability in rivers is ecologically harmful (e.g., Arthington et al. 1991, Castleberry et al. 1996, Hill et al. 1991, Johnson et al. 1976, Richter et al. 1997, Sparks 1995, Stanford et al. 1996, Toth 1995, Tyus 1990). Current pressing demands on water use and the continuing alteration of watersheds require scientists to help develop management protocols that can accommodate economic uses while protecting ecosystem functions. For humans to continue to rely on river ecosystems for sustainable food production, power production, waste assimilation, and flood control, a new, holistic, ecological perspective on water management is needed to guide society's interactions with rivers.

The natural flow regime

The natural flow of a river varies on time scales of hours, days, seasons, years, and longer. Many years of observation from a streamflow gauge are generally needed to describe the characteristic pattern of a river's flow quantity, timing, and variability—that is, its natural flow regime. Components of a natural flow regime can be characterized using various time series (e.g., Fourier and wavelet) and probability analyses of, for example, extremely high or low flows, or of the entire range of flows expressed as average daily discharge (Dunne and Leopold 1978). In watersheds lacking long-term streamflow data, analyses can be extended statistically from gauged streams in the same geographic area. The frequency of large-magnitude floods can be estimated by paleohydrologic studies of debris left by floods and by studies of historical damage to living trees (Hupp and Osterkamp 1985, Knox 1972). These historical techniques can be used to extend existing hydrologic records or to provide estimates of flood flows for ungauged sites.

River flow regimes show regional patterns that are determined largely by river size and by geographic variation in climate, geology, topography, and vegetative cover. For example, some streams in regions with little seasonality in precipitation exhibit relatively stable hydrographs due to high groundwater inputs (Figure 2a), whereas other streams can fluctuate greatly at virtually any time of year (Figure 2b). In regions with seasonal precipitation, some streams are dominated by snowmelt, resulting in pronounced, predictable runoff patterns (Figure 2c), and others lack snow accumulation and exhibit more variable runoff patterns during the rainy season, with peaks occurring after each substantial storm event (Figure 2d).

Five critical components of the flow regime regulate ecological processes in river ecosystems: the magnitude, frequency, duration, timing, and rate of change of hydrologic conditions (Poff and Ward 1989, Richter et al. 1996, Walker et al. 1995). These components can be used to characterize the entire range of flows and specific hydrologic phenomena, such as floods or low flows, that are critical to the integrity of river ecosystems. Furthermore, by defining flow regimes in these terms, the ecological consequences of particular human activities that modify one or more components of the flow regime can be considered explicitly.

- The *magnitude* of discharge[1] at any given time interval is simply the amount of water moving past a fixed location per unit time. Magnitude can refer either to absolute or to relative discharge (e.g., the amount of water that inundates a floodplain). Maximum and minimum magnitudes of flow vary with climate and watershed size both within and among river systems.
- The *frequency* of occurrence refers to how often a flow above a given magnitude recurs over some specified time interval. Frequency of occurrence is inversely related to flow magnitude. For example, a 100-year flood is equaled or exceeded on average once every 100 years (i.e., a chance of 0.01 of occurring in any given year). The average (median)

[1]Discharge (also known as streamflow, flow, or flow rate) is always expressed in dimensions of volume per time. However, a great variety of units are used to describe flow, depending on custom and purpose of characterization: Flows can be expressed in near-instantaneous terms (e.g., ft^3/s and m^3/s) or over long time intervals (e.g., acre-ft/yr).

flow is determined from a data series of discharges defined over a specific time interval, and it has a frequency of occurrence of 0.5 (a 50% probability).

- The *duration* is the period of time associated with a specific flow condition. Duration can be defined relative to a particular flow event (e.g., a floodplain may be inundated for a specific number of days by a ten-year flood), or it can be a defined as a composite expressed over a specified time period (e.g., the number of days in a year when flow exceeds some value).
- The *timing*, or *predictability*, of flows of defined magnitude refers to the regularity with which they occur. This regularity can be defined formally or informally and with reference to different time scales (Poff 1996). For example, annual peak flows may occur with low seasonal predictability (Figure 2b) or with high seasonal predictability (Figure 2c).
- The *rate of change*, or *flashiness*, refers to how quickly flow changes from one magnitude to another. At the extremes, "flashy" streams have rapid rates of change (Figure 2b), whereas "stable" streams have slow rates of change (Figure 2a).

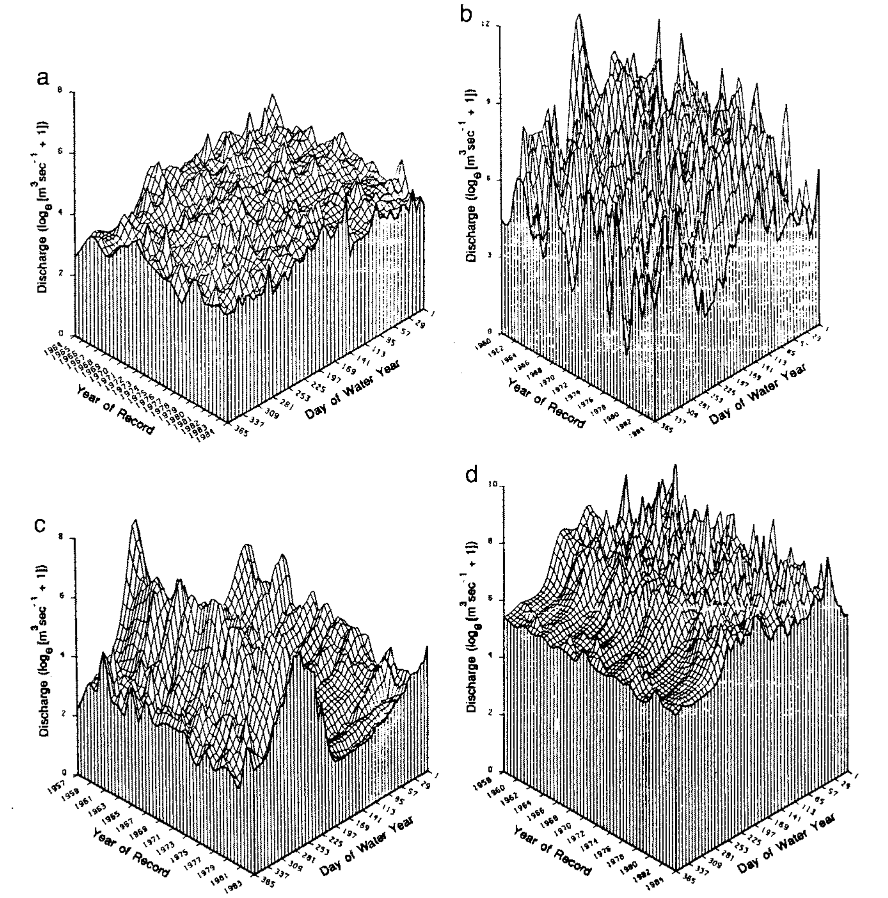


Figure 2. Flow histories based on long-term, daily mean discharge records. These histories show within- and among-year variation for (**a**) Augusta Creek, MI, (**b**) Satilla River, GA, (**c**) upper Colorado River, CO, and (**d**) South Fork of the McKenzie River, OR. Each water year begins on October 1 and ends on September 30. Adapted from Poff and Ward 1990.

Hydrologic processes and the flow regime. All river flow derives ultimately from precipitation, but in any given time and place a river's flow is derived from some combination of surface water, soil water, and groundwater. Climate, geology, topography, soils, and vegetation help to determine both the supply of water and the pathways by which precipitation reaches the channel. The water movement pathways depicted in Figure 3a illustrate why rivers in different settings have different flow regimes and why flow is variable in virtually all rivers. Collectively, overland and shallow subsurface flow pathways create hydrograph peaks, which are the river's response to storm events. By contrast, deeper groundwater pathways are responsible for baseflow, the form of delivery during periods of little rainfall.

Variability in intensity, timing, and duration of precipitation (as rain or as snow) and in the effects of terrain, soil texture, and plant evapotranspiration on the hydrologic cycle combine to create local and regional flow patterns. For example, high flows due to rainstorms may occur over periods of hours (for permeable soils) or even minutes (for impermeable soils), whereas snow will melt over a period of days or weeks, which slowly builds the peak snowmelt flood. As one proceeds downstream within a watershed, river flow reflects the sum of flow generation and routing processes operating in multiple small tributary watersheds. The travel time of flow down the river system, combined with nonsynchronous tributary inputs and larger downstream channel and floodplain storage capacities, act to attenuate and to dampen flow peaks. Consequently, annual hydrographs in large streams typically show peaks created by widespread storms or snowmelt events and broad seasonal influences that affect many tributaries together (Dunne and Leopold 1978).

The natural flow regime organizes and defines river ecosystems. In rivers, the physical structure of the environment and, thus, of the habitat, is defined largely by physical processes, especially the movement of water and sediment within the channel and between the channel and floodplain. To understand the biodiversity, production, and sustainability of river ecosystems, it is necessary to appreciate the central organizing role played by a dynamically varying physical environment.

The physical habitat of a river includes sediment size and heterogeneity, channel and floodplain morphology, and other geomorphic features. These features form as the available sediment, woody debris, and other transportable materials are moved and deposited by flow. Thus, habitat conditions associated with channels and floodplains vary among

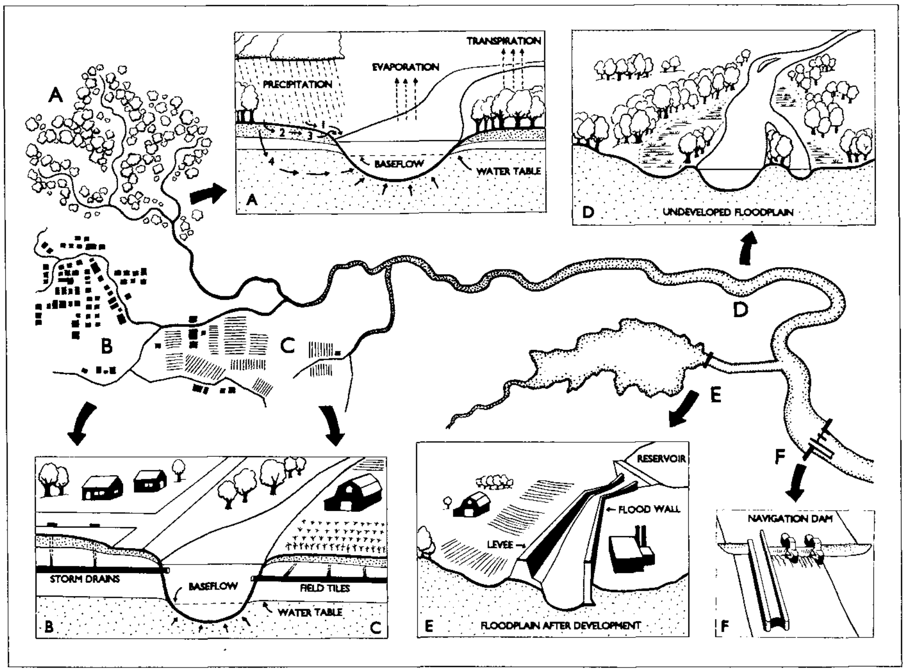


Figure 3. Stream valley cross-sections at various locations in a watershed illustrate basic principles about natural pathways of water moving downhill and human influences on hydrology. Runoff, which occurs when precipitation exceeds losses due to evaporation and plant transpiration, can be divided into four components (**a**): overland flow (1) occurs when precipitation exceeds the infiltration capacity of the soil; shallow subsurface stormflow (2) represents water that infiltrates the soil but is routed relatively quickly to the stream channel; saturated overland flow (3) occurs where the water table is close to the surface, such as adjacent to the stream channel, upstream of first-order tributaries, and in soils saturated by prior precipitation; and groundwater flow (4) represents relatively deep and slow pathways of water movement and provides water to the stream channel even during periods of little or no precipitation. Collectively, overland and shallow subsurface flow pathways create the peaks in the hydrograph that are a river's response to storm events, whereas deeper groundwater pathways are responsible for baseflow. Urbanized (**b**) and agricultural (**c**) land uses increase surface flow by increasing the extent of impermeable surfaces, reducing vegetation cover, and installing drainage systems. Relative to the unaltered state, channels often are scoured to greater depth by unnaturally high flood crests and water tables are lowered, causing baseflow to drop. Side-channels, wetlands, and episodically flooded lowlands comprise the diverse floodplain habitats of unmodified river ecosystems (**d**). Levees or flood walls (**e**) constructed along the banks retain flood waters in the main channel and lead to a loss of floodplain habitat diversity and function. Dams impede the downstream movement of water and can greatly modify a river's flow regime, depending on whether they are operated for storage (**e**) or as "run-of-river," such as for navigation (**f**).

rivers in accordance with both flow characteristics and the type and the availability of transportable materials.

Within a river, different habitat features are created and maintained by a wide range of flows. For example, many channel and floodplain features, such as river bars and riffle–pool sequences, are formed and maintained by dominant, or bankfull, discharges. These discharges are flows that can move significant quantities of bed or bank sediment and that occur frequently enough (e.g., every several years) to continually modify the channel (Wolman and Miller 1960). In many streams and rivers with a small range of flood flows, bankfull flow can build and maintain the active floodplain through stream migration (Leopold et al. 1964). However, the concept of a dominant discharge may not be applicable in all flow regimes (Wolman and Gerson 1978). Furthermore, in some flow regimes, the flows that build the channel may differ from those that build the floodplain. For example, in rivers with a wide range of flood flows, floodplains may exhibit major bar deposits, such as berms of boulders along the channel, or other features that are left by infrequent high-magnitude floods (e.g., Miller 1990).

Over periods of years to decades, a single river can consistently provide ephemeral, seasonal, and persistent types of habitat that range from free-flowing, to standing, to no water. This predictable diversity of in-channel and floodplain habitat types has promoted the evolution of species that exploit the habitat mosaic created and maintained by hydrologic variability. For many riverine species, completion of the life cycle requires an array of different habitat types, whose availability over time is regulated by the flow regime (e.g., Greenberg et al. 1996, Reeves et al. 1996, Sparks 1995). Indeed, adaptation to this environmental dynamism allows aquatic and floodplain species to persist in the face of seemingly harsh conditions, such as floods and droughts, that regularly destroy and re-create habitat elements.

From an evolutionary perspective, the pattern of spatial and temporal habitat dynamics influences the relative success of a species in a particular environmental setting. This habitat template (Southwood 1977), which is dictated largely by flow regime, creates both subtle and profound differences in the natural histories of species in different segments of their ranges. It also influences species distribution and abundance, as well as ecosystem function (Poff and Allan 1995, Schlosser 1990, Sparks 1992, Stanford et al. 1996). Human alteration of flow regime changes the established pattern of natural hydrologic variation and disturbance, thereby altering habitat dynamics and creating new conditions to which the native biota may be poorly adapted.

Human alteration of flow regimes

Human modification of natural hydrologic processes disrupts the dynamic equilibrium between the movement of water and the movement of sediment that exists in free-flowing rivers (Dunne and Leopold 1978). This disruption alters both gross- and fine-scale geomorphic features that constitute habitat for aquatic and riparian species (Table 1). After

Table 1. Physical responses to altered flow regimes.

Source(s) of alteration	Hydrologic change(s)	Geomorphic response(s)	Reference(s)
Dam	Capture sediment moving downstream	Downstream channel erosion and tributary headcutting	Chien 1985, Petts 1984, 1985, Williams and Wolman 1984
		Bed armoring (coarsening)	Chien 1985
Dam, diversion	Reduce magnitude and frequency of high flows	Deposition of fines in gravel	Sear 1995, Stevens et al. 1995
		Channel stabilization and narrowing	Johnson 1994, Williams and Wolman 1984
		Reduced formation of point bars, secondary channels, oxbows, and changes in channel planform	Chien 1985, Copp 1989, Fenner et al. 1985
Urbanization, tiling, drainage	Increase magnitude and frequency of high flows	Bank erosion and channel widening	Hammer 1972
		Downward incision and floodplain disconnection	Prestegaard 1988
	Reduced infiltration into soil	Reduced baseflows	Leopold 1968
Levees and channelization	Reduce overbank flows	Channel restriction causing downcutting	Daniels 1960, Prestegaard et al. 1994
		Floodplain deposition and erosion prevented	Sparks 1992
		Reduced channel migration and formation of secondary channels	Shankman and Drake 1990
Groundwater pumping	Lowered water table levels	Streambank erosion and channel downcutting after loss of vegetation stability	Kondolf and Curry 1986

such a disruption, it may take centuries for a new dynamic equilibrium to be attained by channel and floodplain adjustments to the new flow regime (Petts 1985); in some cases, a new equilibrium is never attained, and the channel remains in a state of continuous recovery from the most recent flood event (Wolman and Gerson 1978). These channel and floodplain adjustments are sometimes overlooked because they can be confounded with long-term responses of the channel to changing climates (e.g., Knox 1972). Recognition of human-caused physical changes and associated biological consequences may require many years, and physical restoration of the river ecosystem may call for dramatic action (see box on the Grand Canyon flood, page 774).

Dams, which are the most obvious direct modifiers of river flow, capture both low and high flows for flood control, electrical power generation, irrigation and municipal water needs, maintenance of recreational reservoir levels, and navigation. More than 85% of the inland waterways within the continental United States are now artificially controlled (NRC 1992), including nearly 1 million km of rivers that are affected by dams (Echeverria et al. 1989). Dams capture all but the finest sediments moving down a river, with many severe downstream consequences. For example, sediment-depleted water released from dams can erode finer sediments from the receiving channel. The coarsening of the streambed can, in turn, reduce habitat availability for the many aquatic species living in or using interstitial spaces. In addition, channels may erode, or downcut, triggering rejuvenation of tributaries, which themselves begin eroding and migrating headward (Chien 1985, Petts 1984). Fine sediments that are contributed by tributaries downstream of a dam may be deposited between the coarse particles of the streambed (e.g., Sear 1995). In the absence of high flushing flows, species with life stages that are sensitive to sedimentation, such as the eggs and larvae of many invertebrates and fish, can suffer high mortality rates.

For many rivers, it is land-use activities, including timber harvest, livestock grazing, agriculture, and urbanization, rather than dams, that are the primary causes of altered flow regimes. For example, logging and the associated building of roads have contributed greatly to degradation of salmon streams in the Pacific Northwest, mainly through effects on runoff and sediment delivery (NRC 1996). Converting forest or prairie lands to agricultural lands generally decreases soil infiltration and results in increased overland flow, channel incision, floodplain isolation, and headward erosion of stream channels (Prestegaard 1988). Many agricultural areas were drained by the construction of ditches or tile-and-drain systems, with the result that many channels have become entrenched (Brookes 1988).

These land-use practices, combined with extensive draining of wetlands or overgrazing, reduce retention of water in watersheds and,

A controlled flood in the Grand Canyon

Since the Glen Canyon dam first began to store water in 1963, creating Lake Powell, some 430 km (270 miles) of the Colorado River, including Grand Canyon National Park, have been virtually bereft of seasonal floods. Before 1963, melting snow in the upper basin produced an average peak discharge exceeding 2400 m^3/s; after the dam was constructed, releases were generally maintained at less than 500 m^3/s. The building of the dam also trapped more than 95% of the sediment moving down the Colorado River in Lake Powell (Collier et al. 1996).

This dramatic change in flow regime produced drastic alterations in the dynamic nature of the historically sediment-laden Colorado River. The annual cycle of scour and fill had maintained large sandbars along the river banks, prevented encroachment of vegetation onto these bars, and limited bouldery debris deposits from constricting the river at the mouths of tributaries (Collier et al. 1997). When flows were reduced, the limited amount of sand accumulated in the channel rather than in bars farther up the river banks, and shallow low-velocity habitat in eddies used by juvenile fishes declined. Flow regulation allowed for increased cover of wetland and riparian vegetation, which expanded into sites that were regularly scoured by floods in the constrained fluvial canyon of the Colorado River; however, much of the woody vegetation that established after the dam's construction is composed of an exotic tree, salt cedar (*Tamarix* sp.; Stevens et al. 1995). Restoration of flood flows clearly would help to steer the aquatic and riparian ecosystem toward its former state and decrease the area of wetland and riparian vegetation, but precisely how the system would respond to an artificial flood could not be predicted.

In an example of adaptive management (i.e., a planned experiment to guide further actions), a controlled, seven-day flood of 1274 m^3/s was released through the Glen Canyon dam in late March 1996. This flow, roughly 35% of the pre-dam average for a spring flood (and far less than some large historical floods), was the maximum flow that could pass through the power plant turbines plus four steel drainpipes, and it cost approximately $2 million in lost hydropower revenues (Collier et al. 1997). The immediate result was significant beach building: Over 53% of the beaches increased in size, and just 10% decreased in size. Full documentation of the effects will continue to be monitored by measuring channel cross-sections and studying riparian vegetation and fish populations.

instead, route it quickly downstream, increasing the size and frequency of floods and reducing baseflow levels during dry periods (Figure 3b; Leopold 1968). Over time, these practices degrade in-channel habitat for aquatic species. They may also isolate the floodplain from overbank flows, thereby degrading habitat for riparian species. Similarly, urbanization and suburbanization associated with human population expansion across the landscape create impermeable surfaces that direct water away from subsurface pathways to overland flow (and often into storm drains). Consequently, floods increase in frequency and intensity (Beven 1986), banks erode, and channels widen (Hammer 1972), and baseflow declines during dry periods (Figure 3c).

Whereas dams and diversions affect rivers of virtually all sizes, and land-use impacts are particularly evident in headwaters, lowland rivers are greatly influenced by efforts to sever channel–floodplain linkages. Flood control projects have shortened, narrowed, straightened, and leveed many river systems and cut the main channels off from their floodplains (NRC 1992). For example, channelization of the Kissimmee River above Lake Okeechobee, Florida, by the US Army Corps of Engineers transformed a historical 166 km meandering river with a 1.5 to 3 km wide floodplain into a 90 km long canal flowing through a series of five impoundments, resulting in great loss of river channel habitat and adjacent floodplain wetlands (Toth 1995). Because levees are designed to prevent increases in the width of flow, rivers respond by cutting deeper channels, reaching higher velocities, or both.

Channelization and wetland drainage can actually increase the magnitude of extreme floods, because reduction in upstream storage capacity results in accelerated water delivery downstream. Much of the damage caused by the extensive flooding along the Mississippi River in 1993 resulted from levee failure as the river reestablished historic connections to the floodplain. Thus, although elaborate storage dam and levee systems can "reclaim" the floodplain for agriculture and human settlement in most years, the occasional but inevitable large floods will impose increasingly high disaster costs to society (Faber 1996). The severing of floodplains from rivers also stops the processes of sediment erosion and deposition that regulate the topographic diversity of floodplains. This diversity is essential for maintaining species diversity on floodplains, where relatively small differences in land elevation result in large differences in annual inundation and soil moisture regimes, which regulate plant distribution and abundance (Sparks 1992).

Ecological functions of the natural flow regime

Naturally variable flows create and maintain the dynamics of in-channel and floodplain conditions and habitats that are essential to aquatic and riparian species, as shown schematically in Figure 4. For purposes of illustration, we treat the components of a flow regime individually, although in reality they interact in complex ways to regulate geomorphic and ecological processes. In describing the ecological functions associated with the components of a flow regime, we pay particular attention to high- and low-flow events, because they often serve as ecological "bottlenecks" that present critical stresses and opportunities for a wide array of riverine species (Poff and Ward 1989).

The magnitude and frequency of high and low flows regulate numerous ecological processes. Frequent, moderately high flows effectively transport sediment through the channel (Leopold et al. 1964). This sediment movement, combined with the force of moving water, exports organic resources, such as detritus and attached algae, rejuvenating the biological community and allowing many species with fast life cycles and good colonizing ability to reestablish (Fisher 1983). Consequently, the composition and relative abundance of species that are present in a stream or river often reflect the frequency and intensity of high flows (Meffe and Minckley 1987, Schlosser 1985).

High flows provide further ecological benefits by maintaining ecosystem productivity and diversity. For example, high flows remove and transport fine sediments that would otherwise fill the interstitial spaces in productive gravel habitats (Beschta and Jackson 1979). Floods import woody debris into the channel (Keller and Swanson 1979), where it creates new, high-quality habitat (Figure 4; Moore and Gregory 1988, Wallace and Benke 1984). By connecting the channel to the floodplain, high overbank flows also maintain broader productivity and diversity. Floodplain wetlands provide important nursery grounds for fish and export organic matter and organisms back into the main channel (Junk et al. 1989, Sparks 1995, Welcomme 1992). The scouring of floodplain soils rejuvenates habitat for plant species that germinate only on barren, wetted surfaces that are free of competition (Scott et al. 1996) or that require access to shallow water tables (Stromberg et al. 1997). Flood-resistant, disturbance-adapted riparian communities are maintained by flooding along river corridors, even in river sections that have steep banks and lack floodplains (Hupp and Osterkamp 1985).

Flows of low magnitude also provide ecological benefits. Periods of low flow may present recruitment opportunities for riparian plant species in regions where floodplains are frequently inundated (Wharton et al. 1981). Streams that dry temporarily, generally in arid regions, have aquatic (Williams and Hynes 1977) and riparian (Nilsen et al. 1984) species with special behavioral or physiological adaptations that suit them to these harsh conditions.

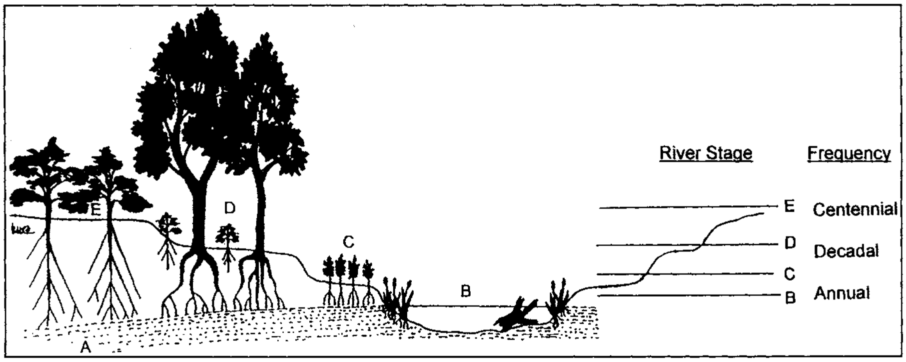


Figure 4. Geomorphic and ecological functions provided by different levels of flow. Water tables that sustain riparian vegetation and that delineate in-channel baseflow habitat are maintained by groundwater inflow and flood recharge (A). Floods of varying size and timing are needed to maintain a diversity of riparian plant species and aquatic habitat. Small floods occur frequently and transport fine sediments, maintaining high benthic productivity and creating spawning habitat for fishes (B). Intermediate-size floods inundate low-lying floodplains and deposit entrained sediment, allowing for the establishment of pioneer species (C). These floods also import accumulated organic material into the channel and help to maintain the characteristic form of the active stream channel. Larger floods that recur on the order of decades inundate the aggraded floodplain terraces, where later successional species establish (D). Rare, large floods can uproot mature riparian trees and deposit them in the channel, creating high-quality habitat for many aquatic species (E).

The duration of a specific flow condition often determines its ecological significance. For example, differences in tolerance to prolonged flooding in riparian plants (Chapman et al. 1982) and to prolonged low flow in aquatic invertebrates (Williams and Hynes 1977) and fishes (Closs and Lake 1996) allow these species to persist in locations from which they might otherwise be displaced by dominant, but less tolerant, species.

The timing, or predictability, of flow events is critical ecologically because the life cycles of many aquatic and riparian species are timed to either avoid or exploit flows of variable magnitudes. For example, the natural timing of high or low streamflows provides environmental cues for initiating life cycle transitions in fish, such as spawning (Montgomery et al. 1983, Nesler et al. 1988), egg hatching (Næsje et al. 1995), rearing (Seegrist and Gard 1978), movement onto the floodplain for feeding or reproduction (Junk et al. 1989, Sparks 1995, Welcomme 1992), or migration upstream or downstream (Trépanier et al. 1996). Natural seasonal variation in flow conditions can prevent the successful establishment of nonnative species with flow-dependent spawning and egg incubation requirements, such as striped bass (*Morone saxatilis*; Turner and Chadwick 1972) and brown trout (*Salmo trutta*; Moyle and Light 1996, Strange et al. 1992).

Seasonal access to floodplain wetlands is essential for the survival of certain river fishes, and such access can directly link high wetland productivity with fish production in the stream channel (Copp 1989, Welcomme 1979). Studies of the effects on stream fishes of both extensive and limited floodplain inundation (Finger and Stewart 1987, Ross and Baker 1983) indicate that some fishes are adapted to exploiting floodplain habitats, and these species decline in abundance when floodplain use is restricted. Models indicate that catch rates and biomass of fish are influenced by both maximum and minimum wetland area (Power et al. 1995, Welcomme and Hagborg 1977), and empirical work shows that the area of floodplain water bodies during nonflood periods influences the species richness of those wetland habitats (Halyk and Balon 1983). The timing of floodplain inundation is important for some fish because migratory and reproductive behaviors must coincide with access to and avail-

Table 2. Ecological responses to alterations in components of natural flow regime.[a]

Flow component	Specific alteration	Ecological response	Reference(s)
Magnitude and frequency	Increased variation	Wash-out and/or stranding	Cushman 1985, Petts 1984
		Loss of sensitive species	Gehrke et al. 1995, Kingsolving and Bain 1993, Travnichek et al. 1995
		Increased algal scour and wash-out of organic matter	Petts 1984
		Life cycle disruption	Scheidegger and Bain 1995
		Altered energy flow	Valentin et al. 1995
	Flow stabilization	Invasion or establishment of exotic species, leading to:	
		Local extinction	Kupferberg 1996, Meffe 1984
		Threat to native commercial species	Stanford et al. 1996
		Altered communities	Busch and Smith 1995, Moyle 1986, Ward and Stanford 1979
		Reduced water and nutrients to floodplain plant species, causing:	
		Seedling desiccation	Duncan 1993
		Ineffective seed dispersal	Nilsson 1982
		Loss of scoured habitat patches and secondary channels needed for plant establishment	Fenner et al. 1985, Rood et al. 1995, Scott et al. 1997, Shankman and Drake 1990
		Encroachment of vegetation into channels	Johnson 1994, Nilsson 1982
Timing	Loss of seasonal flow peaks	Disrupt cues for fish:	
		Spawning	Fausch and Bestgen 1997, Montgomery et al. 1993, Nesler et al. 1988
		Egg hatching	Næsje et al. 1995
		Migration	Williams 1996
		Loss of fish access to wetlands or backwaters	Junk et al. 1989, Sparks 1995
		Modification of aquatic food web structure	Power 1992, Wootton et al. 1996
		Reduction or elimination of riparian plant recruitment	Fenner et al. 1985
		Invasion of exotic riparian species	Horton 1977
		Reduced plant growth rates	Reily and Johnson 1982
Duration	Prolonged low flows	Concentration of aquatic organisms	Cushman 1985, Petts 1984
		Reduction or elimination of plant cover	Taylor 1982
		Diminished plant species diversity	Taylor 1982
		Desertification of riparian species composition	Busch and Smith 1995, Stromberg et al. 1996
		Physiological stress leading to reduced plant growth rate, morphological change, or mortality	Kondolf and Curry 1986, Perkins et al. 1984, Reily and Johnson 1982, Rood et al. 1995, Stromberg et al. 1992
	Prolonged baseflow "spikes"	Downstream loss of floating eggs	Robertson 1997
	Altered inundation duration	Altered plant cover types	Auble et al. 1994
	Prolonged inundation	Change in vegetation functional type	Bren 1992, Connor et al. 1981
		Tree mortality	Harms et al. 1980
		Loss of riffle habitat for aquatic species	Bogan 1993
Rate of change	Rapid changes in river stage	Wash-out and stranding of aquatic species	Cushman 1985, Petts 1984
	Accelerated flood recession	Failure of seedling establishment	Rood et al. 1995

[a]Only representative studies are listed here. Additional references are located on the Web at http://lamar.colostate.edu/~poff/natflow.html.

ability of floodplain habitats (Welcomme 1979). The match of reproductive period and wetland access also explains some of the yearly variation in stream fish community composition (Finger and Stewart 1987).

Many riparian plants also have life cycles that are adapted to the seasonal timing components of natural flow regimes through their "emergence phenologies"—the seasonal sequence of flowering, seed dispersal, germination, and seedling growth. The interaction of emergence phenologies with temporally varying environmental stress from flooding or drought helps to maintain high species diversity in, for example, southern floodplain forests (Streng et al. 1989). Productivity of riparian forests is also influenced by flow timing and can increase when short-duration flooding occurs in the growing season (Mitsch and Rust 1984, Molles et al. 1995).

The rate of change, or flashiness, in flow conditions can influence species persistence and coexistence. In many streams and rivers, particularly in arid areas, flow can change dramatically over a period of hours due to heavy storms. Non-native fishes generally lack the behavioral adaptations to avoid being displaced downstream by sudden floods (Minckley and Deacon 1991). In a dramatic example of how floods can benefit native species, Meffe (1984) documented that a native fish, the Gila topminnow (*Poeciliopsis occidentalis*), was locally extirpated by the introduced predatory mosquitofish (*Gambusia affinis*) in locations where natural flash floods were regulated by upstream dams, but the native species persisted in naturally flashy streams.

Rapid flow increases in streams of the central and southwestern United States often serve as spawning cues for native minnow species, whose rapidly developing eggs are either broadcast into the water column or attached to submerged structures as floodwaters recede (Fausch and Bestgen 1997, Robertson in press). More gradual, seasonal rates of change in flow conditions also regulate the persistence of many aquatic and riparian species. Cottonwoods (*Populus* spp.), for example, are disturbance species that establish after winter–spring flood flows, during a narrow "window of opportunity" when competition-free alluvial substrates and wet soils are available for germination. A certain rate of floodwater recession is critical to seedling germination because seedling roots must remain connected to a receding water table as they grow downward (Rood and Mahoney 1990).

Ecological responses to altered flow regimes

Modification of the natural flow regime dramatically affects both aquatic and riparian species in streams and rivers worldwide. Ecological responses to altered flow regimes in a specific stream or river depend on how the components of flow have changed relative to the natural flow regime for that particular stream or river (Poff and Ward 1990) and how specific geomorphic and ecological processes will respond to this relative change. As a result of variation in flow regime within and among rivers (Figure 2), the same human activity in different locations may cause different degrees of change relative to unaltered conditions and, therefore, have different ecological consequences.

Flow alteration commonly changes the magnitude and frequency of high and low flows, often reducing variability but sometimes enhancing the range. For example, the extreme daily variations below peaking power hydroelectric dams have no natural analogue in freshwater systems and represent, in an evolutionary sense, an extremely harsh environment of frequent, unpredictable flow disturbance. Many aquatic populations living in these environments suffer high mortality from physiological stress, from wash-out during high flows, and from stranding during rapid dewatering (Cushman 1985, Petts 1984). Especially in shallow shoreline habitats, frequent atmospheric exposure for even brief periods can result in massive mortality of bottom-dwelling organisms and subsequent severe reductions in biological productivity (Weisberg et al. 1990). Moreover, the rearing and refuge functions of shallow shoreline or backwater areas, where many small fish species and the young of large species are found (Greenberg et al. 1996, Moore and Gregory 1988), are severely impaired by frequent flow fluctuations (Bain et al. 1988, Stanford 1994). In these artificially fluctuating environments, specialized stream or river species are typically replaced by generalist species that tolerate frequent and large variations in flow. Furthermore, life cycles of many species are often disrupted and energy flow through the ecosystem is greatly modified (Table 2). Short-term flow modifications clearly lead to a reduction in both the natural diversity and abundance of many native fish and invertebrates.

At the opposite hydrologic extreme, flow stabilization below certain types of dams, such as water supply reservoirs, results in artificially constant environments that lack natural extremes. Although production of a few species may increase greatly, it is usually at the expense of other native species and of systemwide species diversity (Ward and Stanford 1979). Many lake fish species have successfully invaded (or been intentionally established in) flow-stabilized river environments (Moyle 1986, Moyle and Light 1996). Often top predators, these introduced fish can devastate native river fish and threaten commercially valuable stocks (Stanford et al. 1996). In the southwestern United States, virtually the entire native river fish fauna is listed as threatened under the Endangered Species Act, largely as a consequence of water withdrawal, flow stabilization, and exotic species proliferation. The last remaining strongholds of native river fishes are all in dynamic, free-flowing rivers, where exotic fishes are periodically reduced by natural flash floods (Minckley and Deacon 1991, Minckley and Meffe 1987).

Flow stabilization also reduces the magnitude and frequency of overbank flows, affecting riparian plant species and communities. In rivers with constrained canyon reaches or multiple shallow channels, loss of high flows results in increased cover of plant species that would otherwise be removed by flood scour (Ligon et al. 1995, Williams and Wolman 1984). Moreover, due to other related effects of flow regulation, including increased water salinity, non-native vegetation often dominates, such as the salt cedar (*Tamarix* sp.) in the semiarid western United States (Busch and Smith 1995). In alluvial valleys, the loss of overbank flows can greatly modify riparian communities by causing plant desiccation, reduced growth, competitive exclusion, ineffective seed dispersal, or failure of seedling establishment (Table 2).

The elimination of flooding may also affect animal species that depend on terrestrial habitats. For example, in the flow-stabilized Platte River of the United States Great Plains, the channel has narrowed dramatically (up to 85%) over a period of decades (Johnson 1994). This narrowing has been facilitated by vegetative colonization of sandbars that formerly provided nesting habitat for the threatened piping plover (*Charadius melodius*) and endangered least tern (*Sterna antillarum*; Sidle et al. 1992). Sandhill cranes (*Grus canadensis*), which made the Platte River famous, have abandoned river segments that have narrowed the most (Krapu et al. 1984).

Changes in the duration of flow conditions also have significant biological consequences. Riparian plant species respond dramatically to channel dewatering, which occurs frequently in arid regions due to surface water diversion and groundwater pumping. These biological and ecological responses range from altered leaf morphology to total loss of riparian vegetation cover (Table 2). Changes in duration of inundation, independent of changes in annual volume of flow, can alter the abundance of plant cover types (Auble et al. 1994). For example, increased duration of inundation has contributed to the conversion of grassland to forest along a regulated Australian river (Bren 1992). For aquatic species, prolonged flows of particular levels can also be damaging. In the regulated Pecos River of New Mexico, artificially prolonged high summer flows for irrigation displace the floating eggs of the threatened Pecos bluntnose shiner (*Notropis sinius pecosensis*) into unfavorable habitat, where none survive (Robertson in press).

Modification of natural flow timing, or predictability, can affect aquatic organisms both directly and indirectly. For example, some native fishes in Norway use seasonal flow peaks as a cue for egg hatching, and river regulation that eliminates these peaks can directly reduce local population sizes of these species (Næsje et al. 1995). Furthermore, entire food webs, not just single species, may be modified by altered flow timing. In regulated rivers of northern California, the seasonal shifting of scouring flows from winter to summer indirectly reduces the growth rate of juvenile steelhead trout (*Oncorhyncus mykiss*) by increasing the relative abundance of predator-resistant invertebrates that divert energy away from the food chain leading to trout (Wootton et al. 1996). In unregulated rivers, high winter flows reduce these predator-resistant insects and favor species that are more palatable to fish.

Riparian plant species are also strongly affected by altered flow timing (Table 2). A shift in timing of peak flows from spring to summer, as often occurs when reservoirs are managed to supply irrigation water, has prevented reestablishment of the Fremont cottonwood (*Populus fremontii*), the dominant plant species in Arizona, because flow peaks now occur after, rather than before, its germination period (Fenner et al. 1985). Non-native plant species with less specific germination requirements may benefit from changes in flood timing. For example, salt cedar's (*Tamarix* sp.) long seed dispersal period allows it to establish after floods occurring any time during the growing season, contributing to its abundance on floodplains of the western United States (Horton 1977).

Altering the rate of change in flow can negatively affect both aquatic and riparian species. As mentioned above, loss of natural flashiness threatens most of the native fish fauna of the American Southwest (Minckley and Deacon 1991), and artificially increased rates of change caused by peaking power hydroelectric dams on historically less flashy rivers creates numerous ecological problems (Table 2; Petts 1984). A modified rate of change can devastate riparian species, such as cottonwoods, whose successful seedling growth depends on the rate of groundwater recession following floodplain inundation. In the St. Mary River in Alberta, Canada, for example, rapid drawdowns of river stage during spring have prevented the recruitment of young trees (Rood and Mahoney 1990). Such effects can be reversed, however. Restoration of the spring flood and its natural, slow recession in the Truckee River in California has allowed the successful establishment of a new generation of cotton-

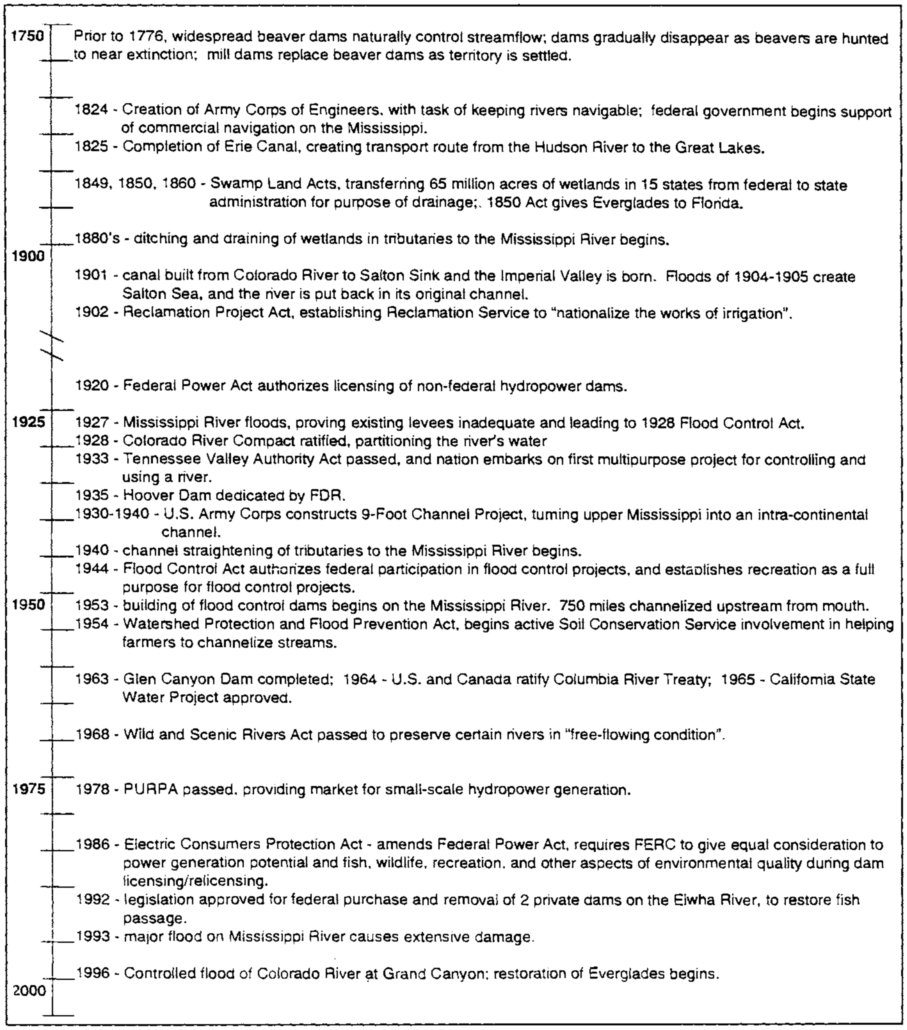


Figure 5. A brief history of flow alteration in the United States.

Table 3. Recent projects in which restoration of some component(s) of natural flow regimes has occurred or been proposed for specific ecological benefits.

Location	Flow component(s)	Ecological purpose(s)	Reference
Trinity River, CA	Mimic timing and magnitude of peak flow	Rejuvenate in-channel gravel habitats; restore early riparian succession; provide migration flows for juvenile salmon	Barinaga 1996[a]
Truckee River, CA	Mimic timing, magnitude, and duration of peak flow, and its rate of change during recession	Restore riparian trees, especially cottonwoods	Klotz and Swanson 1997
Owens River, CA	Increase base flows; partially restore overbank flows	Restore riparian vegetation and habitat for native fishes and non-native brown trout	Hill and Platts in press
Rush Creek, CA (and other tributaries to Mono Lake)	Increase minimum flows	Restore riparian vegetation and habitat for waterfowl and non-native fishes	LADWP 1995
Oldman River and tributaries, southern Alberta, Canada	Increase summer flows; reduce rates of postflood stage decline; mimic natural flows in wet years	Restore riparian vegetation (cottonwoods) and cold-water (trout) fisheries	Rood et al. 1995
Green River, UT	Mimic timing and duration of peak flow and duration and timing of nonpeak flows; reduce rapid baseflow fluctuations from hydropower generation	Recovery of endangered fish species; enhance other native fishes	Stanford 1994
San Juan River, UT/NM	Mimic magnitude, timing, and duration of peak flow; restore low winter baseflows	Recovery of endangered fish species	—[b]
Gunnison River, CO	Mimic magnitude, timing, and duration of peak flow; mimic duration and timing of nonpeak flows	Recovery of endangered fish species	—[b]
Rio Grande River, NM	Mimic timing and duration of floodplain inundation	Ecosystem processes (e.g., nitrogen flux, microbial activity, litter decomposition)	Molles et al. 1995
Pecos River, NM	Regulate duration and magnitude of summer irrigation releases to mimic spawning flow "spikes"; maintain minimum flows	Determine spawning and habitat needs for threatened fish species	Robertson 1997
Colorado River, AZ	Mimic magnitude and timing	Restore habitat for endangered fish species and scour riparian zone	Collier et al. 1997
Bill Williams River, AZ (proposed)	Mimic natural flood peak timing and duration	Promote establishment of native trees	USCOE 1996
Pemigewasset River, NH	Reduce frequency (i.e., to no more than natural frequency) of high flows during summer low-flow season; reduce rate of change between low and high flows during hydropower cycles	Enhance native Atlantic salmon recovery	FERC 1995
Roanoke River, VA	Restore more natural patterning of monthly flows in spring; reduce rate of change between low and high flows during hydropower cycles	Increased reproduction of striped bass	Rulifson and Manooch 1993
Kissimmee River, FL	Mimic magnitude, duration, rate of change, and timing of high- and low-flow periods	Restore floodplain inundation to recover wetland functions; reestablish in-channel habitats for fish and other aquatic species	Toth 1995

[a]J. Polos, 1997, personal communication. US Fish & Wildlife Service, Arcata, CA.
[b]F. Pfeifer, 1997, personal communication. US Fish & Wildlife Service, Grand Junction, CO.

wood trees (Klotz and Swanson 1997).

Recent approaches to streamflow management

Methods to estimate environmental flow requirements for rivers focus primarily on one or a few species that live in the wetted river channel. Most of these methods have the narrow intent of establishing minimum allowable flows. The simplest make use of easily analyzed flow data, of assumptions about the regional similarity of rivers, and of professional opinions of the minimal flow needs for certain fish species (e.g., Larson 1981).

A more sophisticated assessment of how changes in river flow affect aquatic habitat is provided by the Instream Flow Incremental Methodology (IFIM; Bovee and Milhous

1978). IFIM combines two models, a biological one that describes the physical habitat preferences of fishes (and occasionally macroinvertebrates) in terms of depth, velocity, and substrate, and a hydraulic one that estimates how the availability of habitat for fish varies with discharge. IFIM has been widely used as an organizational framework for formulating and evaluating alternative water management options related to production of one or a few fish species (Stalnaker et al. 1995).

As a predictive tool for ecological management, the IFIM modeling approach has been criticized both in terms of the statistical validity of its physical habitat characterizations (Williams 1996) and the limited realism of its biological assumptions (Castleberry et al. 1996). Field tests of its predictions have yielded mixed results (Morehardt 1986). Although this approach continues to evolve, both by adding biological realism (Van Winkle et al. 1993) and by expanding the range of habitats modeled (Stalnaker et al. 1995), in practice it is often used only to establish minimum flows for "important" (i.e., game or imperiled) fish species. But current understanding of river ecology clearly indicates that fish and other aquatic organisms require habitat features that cannot be maintained by minimum flows alone (see Stalnaker 1990). A range of flows is necessary to scour and revitalize gravel beds, to import wood and organic matter from the floodplain, and to provide access to productive riparian wetlands (Figure 4). Interannual variation in these flow peaks is also critical for maintaining channel and riparian dynamics. For example, imposition of only a fixed high-flow level each year would simply result in the equilibration of in-channel and floodplain habitats to these constant peak flows.

Moreover, a focus on one or a few species and on minimum flows fails to recognize that what is "good" for the ecosystem may not consistently benefit individual species, and that what is good for individual species may not be of benefit to the ecosystem. Long-term studies of naturally variable systems show that some species do best in wet years, that other species do best in dry years, and that overall biological diversity and ecosystem function benefit from these variations in species success (Tilman et al. 1994). Indeed, experience in river restoration clearly shows the impossibility of simultaneously engineering optimal conditions for all species (Sparks 1992, 1995, Toth 1995). A holistic view that attempts to restore natural variability in ecological processes and species success (and that acknowledges the tremendous uncertainty that is inherent in attempting to mechanistically model all species in the ecosystem) is necessary for ecosystem management and restoration (Franklin 1993).

Managing toward a natural flow regime

The first step toward better incorporating flow regime into the management of river ecosystems is to recognize that extensive human alteration of river flow has resulted in widespread geomorphic and ecological changes in these ecosystems. The history of river use is also a history of flow alteration (Figure 5). The early establishment of the US Army Corps of Engineers is testimony to the importance that the nation gave to developing navigable water routes and to controlling recurrent large floods. However, growing understanding of the ecological impacts of flow alteration has led to a shift toward an appreciation of the merits of free-flowing rivers. For example, the Wild and Scenic Rivers Act of 1968 recognized that the flow of certain rivers should be protected as a national resource, and the recent blossoming of natural flow restoration projects (Table 3) may herald the beginning of efforts to undo some of the damage of past flow alterations. The next century holds promise as an era for renegotiating human relationships with rivers, in which lessons from past experience are used to direct wise and informed action in the future.

A large body of evidence has shown that the natural flow regime of virtually all rivers is inherently variable, and that this variability is critical to ecosystem function and native biodiversity. As we have already discussed, rivers with highly altered and regulated flows lose their ability to support natural processes and native species. Thus, to protect pristine or nearly pristine systems, it is necessary to preserve the natural hydrologic cycle by safeguarding against upstream river development and damaging land uses that modify runoff and sediment supply in the watershed.

Most rivers are highly modified, of course, and so the greatest challenges lie in managing and restoring rivers that are also used to satisfy human needs. Can reestablishing the natural flow regime serve as a useful management and restoration goal? We believe that it can, although to varying degrees, depending on the present extent of human intervention and flow alteration affecting a particular river. Recognizing the natural variability of river flow and explicitly incorporating the five components of the natural flow regime (i.e., magnitude, frequency, duration, timing, and rate of change) into a broader framework for ecosystem management would constitute a major advance over most present management, which focuses on minimum flows and on just a few species. Such recognition would also contribute to the developing science of stream restoration in heavily altered watersheds, where, all too often, physical channel features (e.g., bars and woody debris) are re-created without regard to restoring the flow regime that will help to maintain these re-created features.

Just as rivers have been incrementally modified, they can be incrementally restored, with resulting improvements to many physical and biological processes. A list of recent efforts to restore various components of a natural flow regime (that is, to "naturalize" river flow) demonstrates the scope for success (Table 3). Many of the projects summarized in Table 3 represent only partial steps toward full flow restoration, but they have had demonstrable ecological benefits. For example, high flood flows followed by mimicked natural rates of flow decline in the Oldman River of Alberta, Canada, resulted in a massive cottonwood recruitment that extended for more than 500 km downstream from the Oldman Dam. Dampening of the unnatural flow fluctuations caused by hydroelectric generation on the Roanoke River in

Virginia has increased juvenile abundances of native striped bass. Mimicking short-duration flow spikes that are historically caused by summer thunderstorms in the regulated Pecos River of New Mexico has benefited the reproductive success of the Pecos bluntnose shiner.

We also recognize that there are scientific limits to how precisely the natural flow regime for a particular river can be defined. It is possible to have only an approximate knowledge of the historic condition of a river, both because some human activities may have preceded the installation of flow gauges, and because climate conditions may have changed over the past century or more. Furthermore, in many rivers, year-to-year differences in the timing and quantity of flow result in substantial variability around any average flow condition. Accordingly, managing for the "average" condition can be misguided. For example, in human-altered rivers that are managed for incremental improvements, restoring a flow pattern that is simply proportional to the natural hydrograph in years with little runoff may provide few if any ecological benefits, because many geomorphic and ecological processes show nonlinear responses to flow. Clearly, half of the peak discharge will not move half of the sediment, half of a migration-motivational flow will not motivate half of the fish, and half of an overbank flow will not inundate half of the floodplain. In such rivers, more ecological benefits would accrue from capitalizing on the natural between-year variability in flow. For example, in years with above-average flow, "surplus" water could be used to exceed flow thresholds that drive critical geomorphic and ecological processes.

If full flow restoration is impossible, mimicking certain geomorphic processes may provide some ecological benefits. Well-timed irrigation could stimulate recruitment of valued riparian trees such as cottonwoods (Friedman et al. 1995). Strategically clearing vegetation from river banks could provide new sources of gravel for sediment-starved regulated rivers with reduced peak flows (e.g., Ligon et al. 1995). In all situations, managers will be required to make judgments about specific restoration goals and to work with appropriate components of the natural flow regime to achieve those goals. Recognition of the natural flow variability and careful identification of key processes that are linked to various components of the flow regime are critical to making these judgments.

Setting specific goals to restore a more natural regime in rivers with altered flows (or, equally important, to preserve unaltered flows in pristine rivers) should ideally be a cooperative process involving river scientists, resource managers, and appropriate stakeholders. The details of this process will vary depending on the specific objectives for the river in question, the degree to which its flow regime and other environmental variables (e.g., thermal regime, sediment supply) have been altered, and the social and economic constraints that are in play. Establishing specific criteria for flow restoration will be challenging because our understanding of the interactions of individual flow components with geomorphic and ecological processes is incomplete. However, quantitative, river-specific standards can, in principle, be developed based on the reconstruction of the natural flow regime (e.g., Richter et al. 1997). Restoration actions based on such guidelines should be viewed as experiments to be monitored and evaluated—that is, adaptive management—to provide critical new knowledge for creative management of natural ecosystem variability (Table 3).

To manage rivers from this new perspective, some policy changes are needed. The narrow regulatory focus on minimum flows and single species impedes enlightened river management and restoration, as do the often conflicting mandates of the many agencies and organizations that are involved in the process. Revisions of laws and regulations, and redefinition of societal goals and policies, are essential to enable managers to use the best science to develop appropriate management programs.

Using science to guide ecosystem management requires that basic and applied research address difficult questions in complex, real-world settings, in which experimental controls and statistical replication are often impossible. Too little attention and too few resources have been devoted to clarifying how restoring specific components of the flow regime will benefit the entire ecosystem. Nevertheless, it is clear that, whenever possible, the natural river system should be allowed to repair and maintain itself. This approach is likely to be the most successful and the least expensive way to restore and maintain the ecological integrity of flow-altered rivers (Stanford et al. 1996). Although the most effective mix of human-aided and natural recovery methods will vary with the river, we believe that existing knowledge makes a strong case that restoring natural flows should be a cornerstone of our management approach to river ecosystems.

Acknowledgments

We thank the following people for reading and commenting on earlier versions of this paper: Jack Schmidt, Lou Toth, Mike Scott, David Wegner, Gary Meffe, Mary Power, Kurt Fausch, Jack Stanford, Bob Naiman, Don Duff, John Epifanio, Lori Robertson, Jeff Baumgartner, Tim Randle, David Harpman, Mike Armbruster, and Thomas Payne. Members of the Hydropower Reform Coalition also offered constructive comments. Excellent final reviews were provided by Greg Auble, Carter Johnson, an anonymous reviewer, and the editor of *BioScience*. Robin Abell contributed to the development of the timeline in Figure 5, and graphics assistance was provided by Teresa Peterson (Figure 3), Matthew Chew (Figure 4) and Robin Abell and Jackie Howard (Figure 5). We also thank the national offices of Trout Unlimited and American Rivers for encouraging the expression of the ideas presented here. We especially thank the George Gund Foundation for providing a grant to hold a one-day workshop, and The Nature Conservancy for providing logistical support for several of the authors prior to the workshop.

References cited

Abramovitz JN. 1996. Imperiled waters, impoverished future: the decline of freshwa-

ter ecosystems. Washington (DC): Worldwatch Institute. Worldwatch paper nr 128.
Allan JD, Flecker AS. 1993. Biodiversity conservation in running waters. BioScience 43: 32–43.
Arthington AH, King JM, O'Keefe JH, Bunn SE, Day JA, Pusey BJ, Bluhdorn DR, Thame R. 1991. Development of an holistic approach for assessing environmental flow requirements of riverine ecosystems. Pages 69–76 in Pigram JJ, Hooper BA, eds. Water allocation for the environment: proceedings of an international seminar and workshop. University of New England Armidale (Australia): The Centre for Water Policy Research.
Auble GT, Friedman JM, Scott ML. 1994. Relating riparian vegetation to present and future streamflows. Ecological Applications 4: 544–554.
Bain MB, Finn JT, Booke HE. 1988. Streamflow regulation and fish community structure. Ecology 69: 382–392.
Barinaga M. 1996. A recipe for river recovery? Science 273: 1648–1650.
Beschta RL, Jackson WL. 1979. The intrusion of fine sediments into a stable gravel bed. Journal of the Fisheries Research Board of Canada 36: 207–210.
Beven KJ. 1986. Hillslope runoff processes and flood frequency characteristics. Pages 187–202 in Abrahams AD, ed. Hillslope processes. Boston: Allen and Unwin.
Bogan AE. 1993. Freshwater bivalve extinctions (Mollusca: Unionida): a search for causes. American Zoologist 33: 599–609.
Bovee KD, Milhous R. 1978. Hydraulic simulation in instream flow studies: theory and techniques. Ft. Collins (CO): Office of Biological Services, US Fish & Wildlife Service. Instream Flow Information Paper nr 5, FWS/OBS-78/33.
Bren LJ. 1992. Tree invasion of an intermittent wetland in relation to changes in the flooding frequency of the River Murray, Australia. Australian Journal of Ecology 17: 395–408.
Brookes A. 1988. Channelized rivers, perspectives for environmental management. New York: John Wiley & Sons.
Busch DE, Smith SD. 1995. Mechanisms associated with decline of woody species in riparian ecosystems of the Southwestern US. Ecological Monographs 65: 347–370.
Castleberry DT, et al. 1996. Uncertainty and instream flow standards. Fisheries 21: 20–21.
Chapman RJ, Hinckley TM, Lee LC, Teskey RO. 1982. Impact of water level changes on woody riparian and wetland communities. Vol. 10. Kearneysville (WV): US Fish & Wildlife Service. Publication nr OBS-82/83.
Chien N. 1985. Changes in river regime after the construction of upstream reservoirs. Earth Surface Processes and Landforms 10: 143–159.
Closs GP, Lake PS. 1996. Drought, differential mortality and the coexistence of a native and an introduced fish species in a south east Australian intermittent stream. Environmental Biology of Fishes 47: 17–26.
Collier M, Webb RH, Schmidt JC. 1996. Dams and rivers: primer on the downstream effects of dams. Reston (VA): US Geological Survey. Circular nr 1126.
Collier MP, Webb RH, Andrews ED. 1997. Experimental flooding in the Grand Canyon. Scientific American 276: 82–89.
Connor WH, Gosselink JG, Parrondo RT. 1981. Comparison of the vegetation of three Louisiana swamp sites with different flooding regimes. American Journal of Botany 68: 320–331.
Copp GH. 1989. The habitat diversity and fish reproductive function of floodplain ecosystems. Environmental Biology of Fishes 26: 1–27.
Cushman RM. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North American Journal of Fisheries Management 5: 330–339.
Daniels RB. 1960. Entrenchment of the willow drainage ditch, Harrison County, Iowa. American Journal of Science 258: 161–176.
Duncan RP. 1993. Flood disturbance and the coexistence of species in a lowland podocarp forest, south Westland, New Zealand. Journal of Ecology 81: 403–416.
Dunne T, Leopold LB. 1978. Water in Environmental Planning. San Francisco: W. H. Freeman and Co.
Echeverria JD, Barrow P, Roos-Collins R. 1989. Rivers at risk: the concerned citizen's guide to hydropower. Washington (DC): Island Press.
Faber S. 1996. On borrowed land: public policies for floodplains. Cambridge (MA): Lincoln Institute of Land Policy.
Fausch KD, Bestgen KR. 1997. Ecology of fishes indigenous to the central and southwestern Great Plains. Pages 131–166 in Knopf FL, Samson FB, eds. Ecology and conservation of Great Plains vertebrates. New York: Springer-Verlag.
[FERC] Federal Energy Regulatory Commission. 1995. Relicensing the Ayers Island hydroelectric project in the Pemigewasset/Merrimack River Basin. Washington (DC): Federal Energy Regulatory Commission. Final environmental impact statement, FERC Project nr 2456-009.
Fenner P, Brady WW, Patten DR. 1985. Effects of regulated water flows on regeneration of Fremont cottonwood. Journal of Range Management 38: 135–138.
Finger TR, Stewart EM. 1987. Response of fishes to flooding in lowland hardwood wetlands. Pages 86–92 in Matthews WJ, Heins DC, eds. Community and evolutionary ecology of North American stream fishes. Norman (OK): University of Oklahoma Press.
Fisher SG. 1983. Succession in streams. Pages 7–27 in Barnes JR, Minshall GW, eds. Stream ecology: application and testing of general ecological theory. New York: Plenum Press.
Franklin JF. 1993. Preserving biodiversity: species, ecosystems, or landscapes? Ecological Applications 3: 202–205.
Friedman JM, Scott ML, Lewis WM. 1995. Restoration of riparian forest using irrigation, artificial disturbance, and natural seedfall. Environmental Management 19: 547–557.
Gehrke PC, Brown P, Schiller CB, Moffatt DB, Bruce AM. 1995. River regulation and fish communities in the Murray-Darling river system, Australia. Regulated Rivers: Research & Management 11: 363–375.
Greenberg L, Svendsen P, Harby A. 1996. Availability of microhabitats and their use by brown trout (*Salmo trutta*) and grayling (*Thymallus thymallus*) in the River Vojman, Sweden. Regulated Rivers: Research & Management 12: 287–303.
Halyk LC, Balon EK. 1983. Structure and ecological production of the fish taxocene of a small floodplain system. Canadian Journal of Zoology 61: 2446–2464.
Hammer TR. 1972. Stream channel enlargement due to urbanization. Water Resources Research 8: 1530–1540.
Harms WR, Schreuder HT, Hook DD, Brown CL, Shropshire FW. 1980. The effects of flooding on the swamp forest in Lake Oklawaha, Florida. Ecology 61: 1412–1421.
Hill MT, Platts WS. In press. Restoration of riparian habitat with a multiple flow regime in the Owens River Gorge, California. Journal of Restoration Ecology.
Hill MT, Platts WS, Beschta RL. 1991. Ecological and geomorphological concepts for instream and out-of-channel flow requirements. Rivers 2: 198–210.
Holling CS, Meffe GK. 1996. Command and control and the pathology of natural resource management. Conservation Biology 10: 328–337.
Horton JS. 1977. The development and perpetuation of the permanent tamarisk type in the phreatophyte zone of the Southwest. USDA Forest Service. General Technical Report nr RM-43: 124–127.
Hughes FMR. 1994. Environmental change, disturbance, and regeneration in semi-arid floodplain forests. Pages 321–345 in Millington AC, Pye K, eds. Environmental change in drylands: biogeographical and geomorphological perspectives. New York: John Wiley & Sons.
Hughes RM, Noss RF. 1992. Biological diversity and biological integrity: current concerns for lakes and streams. Fisheries 17: 11–19.
Hupp CR, Osterkamp WR. 1985. Bottomland vegetation distribution along Passage Creek, Virginia, in relation to fluvial landforms. Ecology 66: 670–681.
Johnson WC. 1994. Woodland expansion in the Platte River, Nebraska: patterns and causes. Ecological Monographs 64: 45–84.
Johnson WC, Burgess RL, Keammerer WR. 1976. Forest overstory vegetation and environment on the Missouri River floodplain in North Dakota. Ecological Monographs 46: 59–84.
Junk WJ, Bayley PB, Sparks RE. 1989. The flood pulse concept in river-floodplain systems. Canadian Special Publication of Fisheries and Aquatic Sciences 106: 110–127.
Karr JR. 1991. Biological integrity: a long-neglected aspect of water resource management. Ecological Applications 1: 66–84.
Karr JR, Toth LA, Dudley DR. 1985. Fish communities of midwestern rivers: a history of degradation. BioScience 35: 90–95.
Keller EA, Swanson FJ. 1979. Effects of large organic material on channel form and fluvial processes. Earth Surface Processes and Landforms 4: 351–380.
Kingsolving AD, Bain MB. 1993. Fish assemblage recovery along a riverine disturbance gradient. Ecological Applications 3: 531–544.
Klotz JR, Swanson S. 1997. Managed instream flows for woody vegetation recruitment, a case study. Pages 483–489 in Warwick J,

ed. Symposium proceedings: water resources education, training, and practice: opportunities for the next century. American Water Resources Association, Universities Council on Water Resources, American Water Works Association; 29 Jun–3 Jul; Keystone, CO.
Knox JC. 1972. Valley alluviation in southwestern Wisconsin. Annals of the Association of American Geographers 62: 401–410.
Kondolf GM, Curry RR. 1986. Channel erosion along the Carmel River, Monterey County, California. Earth Surface Processes and Landforms 11: 307–319.
Krapu GL, Facey DE, Fritzell EK, Johnson DH. 1984. Habitat use by migrant sandhill cranes in Nebraska. Journal of Wildlife Management 48: 407–417.
Kupferberg SK. 1996. Hydrologic and geomorphic factors affecting conservation of a river-breeding frog (*Rana boylii*). Ecological Applications 6: 1332–1344.
Larson HN. 1981. New England flow policy. Memorandum, interim regional policy for New England stream flow recommendations. Boston: US Fish & Wildlife Service, Region 5.
Leopold LB. 1968. Hydrology for urban land planning: a guidebook on the hydrologic effects of land use. Reston (VA): US Geological Survey. Circular nr 554.
Leopold LB, Wolman MG, Miller JP. 1964. Fluvial processes in geomorphology. San Francisco: W. H. Freeman & Sons.
Ligon FK, Dietrich WE, Trush WJ. 1995. Downstream ecological effects of dams, a geomorphic perspective. BioScience 45: 183–192.
[LADWP] Los Angeles Department of Water and Power. 1995. Draft Mono Basin stream and channel restoration plan. Los Angeles: Department of Water and Power.
Meffe GK. 1984. Effects of abiotic disturbance on coexistence of predator and prey fish species. Ecology 65: 1525–1534.
Meffe GK, Minckley WL. 1987. Persistence and stability of fish and invertebrate assemblages in a repeatedly disturbed Sonoran Desert stream. American Midland Naturalist 117: 177–191.
Miller AJ. 1990. Flood hydrology and geomorphic effectiveness in the central Appalachians. Earth Surface Processes and Landforms 15: 119–134.
Minckley WL, Deacon JE, ed. 1991. Battle against extinction: native fish management in the American West. Tucson (AZ): University of Arizona Press.
Minckley WL, Meffe GK. 1987. Differential selection by flooding in stream-fish communities of the arid American Southwest. Pages 93–104 in Matthews WJ, Heins DC, eds. Community and evolutionary ecology of North American stream fishes. Norman (OK): University of Oklahoma Press.
Mitsch WJ, Rust WG. 1984. Tree growth responses to flooding in a bottomland forest in northern Illinois. Forest Science 30: 499–510.
Molles MC, Crawford CS, Ellis LM. 1995. Effects of an experimental flood on litter dynamics in the Middle Rio Grande riparian ecosystem. Regulated Rivers: Research & Management 11: 275–281.
Montgomery WL, McCormick SD, Naiman RJ, Whoriskey FG, Black GA. 1983. Spring migratory synchrony of salmonid, catostomid, and cyprinid fishes in Rivière á la Truite, Québec. Canadian Journal of Zoology 61: 2495–2502.
Moore KMS, Gregory SV. 1988. Response of young-of-the-year cutthroat trout to manipulations of habitat structure in a small stream. Transactions of the American Fisheries Society 117: 162–170.
Morehardt JE. 1986. Instream flow methodologies. Palo Alto (CA): Electric Power Research Institute. Report nr EPRIEA-4819.
Moyle PB. 1986. Fish introductions into North America: patterns and ecological impact. Pages 27–43 in Mooney HA, Drake JA, eds. Ecology of biological invasions of North America and Hawaii. New York: Springer-Verlag.
Moyle PB, Light T. 1996. Fish invasions in California: do abiotic factors determine success? Ecology 77: 1666–1669.
Næsje T, Jonsson B, Skurdal J. 1995. Spring flood: a primary cue for hatching of river spawning Coregoninae. Canadian Journal of Fisheries and Aquatic Sciences 52: 2190–2196.
Naiman RJ, Magnuson JJ, McKnight DM, Stanford JA. 1995. The freshwater imperative: a research agenda. Washington (DC): Island Press.
[NRC] National Research Council. 1992. Restoration of aquatic systems: science, technology, and public policy. Washington (DC): National Academy Press.
______. 1996. Upstream: salmon and society in the Pacific Northwest. Washington (DC): National Academy Press.
Nesler TP, Muth RT, Wasowicz AF. 1988. Evidence for baseline flow spikes as spawning cues for Colorado Squawfish in the Yampa River, Colorado. American Fisheries Society Symposium 5: 68–79.
Nilsen ET, Sharifi MR, Rundel PW. 1984. Comparative water relations of phreatophytes in the Sonoran Desert of California. Ecology 65: 767–778.
Nilsson C. 1982. Effects of stream regulation on riparian vegetation. Pages 93–106 in Lillehammer A, Saltveit SJ, eds. Regulated rivers. New York: Columbia University Press.
Perkins DJ, Carlsen BN, Fredstrom M, Miller RH, Rofer CM, Ruggerone GT, Zimmerman CS. 1984. The effects of groundwater pumping on natural spring communities in Owens Valley. Pages 515–527 in Warner RE, Hendrix KM, eds. California riparian systems: ecology, conservation, and productive management. Berkeley (CA): University of California Press.
Petts GE. 1984. Impounded rivers: perspectives for ecological management. New York: John Wiley & Sons.
______. 1985. Time scales for ecological concern in regulated rivers. Pages 257–266 in Craig JF, Kemper JB, eds. Regulated streams: advances in ecology. New York: Plenum Press.
Pickett STA, Parker VT, Fiedler PL. 1992. The new paradigm in ecology: implications for conservation biology above the species level. Pages 66–88 in Fiedler PL, Jain SK, eds. Conservation biology. New York: Chapman & Hall.
Poff NL. 1996. A hydrogeography of unregulated streams in the United States and an examination of scale-dependence in some hydrological descriptors. Freshwater Biology 36: 101–121.
Poff NL, Allan JD. 1995. Functional organization of stream fish assemblages in relation to hydrological variability. Ecology 76: 606–627.
Poff NL, Ward JV. 1989. Implications of streamflow variability and predictability for lotic community structure: a regional analysis of streamflow patterns. Canadian Journal of Fisheries and Aquatic Sciences 46: 1805–1818.
______. 1990. The physical habitat template of lotic systems: recovery in the context of historical pattern of spatio-temporal heterogeneity. Environmental Management 14: 629–646.
Power ME. 1992. Hydrologic and trophic controls of seasonal algal blooms in northern California rivers. Archiv für Hydrobiologie 125: 385–410.
Power ME, Sun A, Parker M, Dietrich WE, Wootton JT. 1995. Hydraulic food-chain models: an approach to the study of food-web dynamics in large rivers. BioScience 45: 159–167.
Prestegaard KL. 1988. Morphological controls on sediment delivery pathways. Pages 533–540 in Walling DE, ed. Sediment budgets. Wallingford (UK): IAHS Press. International Association of Hydrological Sciences Publication nr 174.
Prestegaard KL, Matherne AM, Shane B, Houghton K, O'Connell M, Katyl N. 1994. Spatial variations in the magnitude of the 1993 floods, Raccoon River Basin, Iowa. Geomorphology 10: 169–182.
Reeves GH, Benda LE, Burnett KM, Bisson PA, Sedell JR. 1996. A disturbance-based ecosystem approach to maintaining and restoring freshwater habitats of evolutionarily significant units of anadromous salmonids in the Pacific Northwest. American Fisheries Society Symposium 17: 334–349.
Reily PW, Johnson WC. 1982. The effects of altered hydrologic regime on tree growth along the Missouri River in North Dakota. Canadian Journal of Botany 60: 2410–2423.
Resh VH, Brown AV, Covich AP, Gurtz ME, Li HW, Minshall GW, Reice SR, Sheldon AL, Wallace JB, Wissmar R. 1988. The role of disturbance in stream ecology. Journal of the North American Benthological Society 7: 433–455.
Richter BD, Baumgartner JV, Powell J, Braun DP. 1996. A method for assessing hydrologic alteration within ecosystems. Conservation Biology 10: 1163–1174.
Richter BD, Baumgartner JV, Wigington R, Braun DP. 1997. How much water does a river need? Freshwater Biology 37: 231–249.
Robertson L. In press. Water operations on the Pecos River, New Mexico and the Pecos bluntnose shiner, a federally-listed minnow. US Conference on Irrigation and Drainage Symposium.
Rood SB, Mahoney JM. 1990. Collapse of riparian poplar forests downstream from dams in western prairies: probable causes and prospects for mitigation. Environmental Management 14: 451–464.
Rood SB, Mahoney JM, Reid DE, Zilm L. 1995. Instream flows and the decline of

riparian cottonwoods along the St. Mary River, Alberta. Canadian Journal of Botany 73: 1250–1260.
Ross ST, Baker JA. 1983. The response of fishes to periodic spring floods in a southeastern stream. American Midland Naturalist 109: 1–14.
Rulifson RA, Manooch CS III, eds. 1993. Roanoke River water flow committee report for 1991–1993. Albemarle-Pamlico estuarine study. Raleigh (NC): US Environmental Protection Agency. Project nr APES 93-18.
Scheidegger KJ, Bain MB. 1995. Larval fish in natural and regulated rivers: assemblage composition and microhabitat use. Copeia 1995: 125–135.
Schlosser IJ. 1985. Flow regime, juvenile abundance, and the assemblage structure of stream fishes. Ecology 66: 1484–1490.
______. 1990. Environmental variation, life history attributes, and community structure in stream fishes: implications for environmental management assessment. Environmental Management 14: 621–628.
Scott ML, Friedman JM, Auble GT. 1996. Fluvial processes and the establishment of bottomland trees. Geomorphology 14: 327–339.
Scott, ML, Auble GT, Friedman JM. 1997. Flood dependency of cottonwood establishment along the Missouri River, Montana, USA. Ecological Applications 7: 677–690.
Sear DA. 1995. Morphological and sedimentological changes in a gravel-bed river following 12 years of flow regulation for hydropower. Regulated Rivers: Research & Management 10: 247–264.
Seegrist DW, Gard R. 1972. Effects of floods on trout in Sagehen Creek, California. Transactions of the American Fisheries Society 101: 478–482.
Shankman D, Drake DL. 1990. Channel migration and regeneration of bald cypress in western Tennessee. Physical Geography 11: 343–352.
Sidle JG, Carlson DE, Kirsch EM, Dinan JJ. 1992. Flooding mortality and habitat renewal for least terns and piping plovers. Colonial Waterbirds 15: 132–136.
Southwood TRE. 1977. Habitat, the templet for ecological strategies? Journal of Animal Ecology 46: 337–365.
Sparks RE. 1992. Risks of altering the hydrologic regime of large rivers. Pages 119–152 in Cairns J, Niederlehner BR, Orvos DR, eds. Predicting ecosystem risk. Vol XX. Advances in modern environmental toxicology. Princeton (NJ): Princeton Scientific Publishing Co.
______. 1995. Need for ecosystem management of large rivers and their floodplains. BioScience 45: 168–182.
Stalnaker CB. 1990. Minimum flow is a myth. Pages 31–33 in Bain MB, ed. Ecology and assessment of warmwater streams: workshop synopsis. Washington (DC): US Fish & Wildlife Service. Biological Report nr 90(5).
Stalnaker C, Lamb BL, Henriksen J, Bovee K, Bartholow J. 1995. The instream flow incremental methodology: a primer for IFIM. Ft. Collins (CO): National Biological Service, US Department of the Interior. Biological Report nr 29.
Stanford JA. 1994. Instream flows to assist the recovery of endangered fishes of the Upper Colorado River Basin. Washington (DC): US Department of the Interior, National Biological Survey. Biological Report nr 24.
Stanford JA, Ward JV, Liss WJ, Frissell CA, Williams RN, Lichatowich JA, Coutant CC. 1996. A general protocol for restoration of regulated rivers. Regulated Rivers: Research & Management 12: 391–414.
Stevens LE, Schmidt JC, Brown BT. 1995. Flow regulation, geomorphology, and Colorado River marsh development in the Grand Canyon, Arizona. Ecological Applications 5: 1025–1039.
Strange EM, Moyle PB, Foin TC. 1992. Interactions between stochastic and deterministic processes in stream fish community assembly. Environmental Biology of Fishes 36: 1–15.
Streng DR, Glitzenstein JS, Harcombe PA. 1989. Woody seedling dynamics in an East Texas floodplain forest. Ecological Monographs 59: 177–204.
Stromberg JC, Tress JA, Wilkins SD, Clark S. 1992. Response of velvet mesquite to groundwater decline. Journal of Arid Environments 23: 45–58.
Stromberg JC, Tiller R, Richter B. 1996. Effects of groundwater decline on riparian vegetation of semiarid regions: the San Pedro River, Arizona, USA. Ecological Applications 6: 113–131.
Stromberg JC, Fry J, Patten DT. 1997. Marsh development after large floods in an alluvial, arid-land river. Wetlands 17: 292–300.
Taylor DW. 1982. Eastern Sierra riparian vegetation: ecological effects of stream diversion. Mono Basin Research Group Contribution nr 6, Report to Inyo National Forest.
[TNC] The Nature Conservancy. 1996. Troubled waters: protecting our aquatic heritage. Arlington (VA): The Nature Conservancy.
Tilman D, Downing JA, Wedin DA. 1994. Does diversity beget stability? Nature 371: 257–264.
Toth LA. 1995. Principles and guidelines for restoration of river/floodplain ecosystems—Kissimmee River, Florida. Pages 49–73 in Cairns J, ed. Rehabilitating damaged ecosystems. 2nd ed. Boca Raton (FL): Lewis Publishers/CRC Press.
Travnichek VH, Bain MB, Maceina MJ. 1995. Recovery of a warmwater fish assemblage after the initiation of a minimum-flow release downstream from a hydroelectric dam. Transactions of the American Fisheries Society 124: 836–844.
Trépanier S, Rodríguez MA, Magnan P. 1996. Spawning migrations in landlocked Atlantic salmon: time series modelling of river discharge and water temperature effects. Journal of Fish Biology 48: 925–936.
Turner JL, Chadwick HK. 1972. Distribution and abundance of young-of-the-year striped bass, *Morone saxatilis*, in relation to river flow in the Sacramento-San Joaquin estuary. Transactions of the American Fisheries Society 101: 442–452.
Tyus HM. 1990. Effects of altered stream flows on fishery resources. Fisheries 15: 18–20.
[USCOE] US Army Corps of Engineers, Los Angeles District. 1996. Reconnaissance report, review of existing project: Alamo Lake, Arizona.
Valentin S, Wasson JG, Philippe M. 1995. Effects of hydropower peaking on epilithon and invertebrate community trophic structure. Regulated Rivers: Research & Management 10: 105–119.
Van Winkle W, Rose KA, Chambers RC. 1993. Individual-based approach to fish population dynamics: an overview. Transactions of the American Fisheries Society 122: 397–403.
Walker KF, Sheldon F, Puckridge JT. 1995. A perspective on dryland river ecosystems. Regulated Rivers: Research & Management 11: 85–104.
Wallace JB, Benke AC. 1984. Quantification of wood habitat in subtropical coastal plains streams. Canadian Journal of Fisheries and Aquatic Sciences 41: 1643–1652.
Ward JV, Stanford JA. 1979. The ecology of regulated streams. New York: Plenum Press.
Weisberg SB, Janicki AJ, Gerritsen J, Wilson HT. 1990. Enhancement of benthic macroinvertebrates by minimum flow from a hydroelectric dam. Regulated Rivers: Research & Management 5: 265–277.
Welcomme RL. 1979. Fisheries ecology of floodplain rivers. New York: Longman.
______. 1992. River conservation—future prospects. Pages 454–462 in Boon PJ, Calow P, Petts GE, eds. River conservation and management. New York: John Wiley & Sons.
Welcomme RL, Hagborg D. 1977. Towards a model of a floodplain fish population and its fishery. Environmental Biology of Fishes 2: 7–24.
Wharton CH, Lambou VW, Newsome J, Winger PV, Gaddy LL, Mancke R. 1981. The fauna of bottomland hardwoods in the southeastern United States. Pages 87–160 in Clark JR, Benforado J, eds. Wetlands of bottomland hardwood forests. New York: Elsevier Scientific Publishing Co.
Williams JG. 1996. Lost in space: minimum confidence intervals for idealized PHABSIM studies. Transactions of the American Fisheries Society 125: 458–465.
Williams DD, Hynes HBN. 1977. The ecology of temporary streams. II. General remarks on temporary streams. Internationale Revue des gesampten Hydrobiologie 62: 53–61.
Williams GP, Wolman MG. 1984. Downstream effects of dams on alluvial rivers. Reston (VA): US Geological Survey. Professional Paper nr 1286.
Williams RN, Calvin LD, Coutant CC, Erho MW, Lichatowich JA, Liss WJ, McConnaha WE, Mundy PR, Stanford JA, Whitney RR. 1996. Return to the river: restoration of salmonid fishes in the Columbia River ecosystem. Portland (OR): Northwest Power Planning Council.
Wolman MG, Gerson R. 1978. Relative scales of time and effectiveness of climate in watershed geomorphology. Earth Surface Processes and Landforms 3: 189–208.
Wolman MG, Miller JP. 1960. Magnitude and frequency of forces in geomorphic processes. Journal of Hydrology 69: 54–74.
Wootton JT, Parker MS, Power ME. 1996. Effects of disturbance on river food webs. Science 273: 1558–1561.

The Natural Flow Regime

N. LeRoy Poff; J. David Allan; Mark B. Bain; James R. Karr; Karen L. Prestegaard; Brian D. Richter; Richard E. Sparks; Julie C. Stromberg

BioScience, Vol. 47, No. 11. (Dec., 1997), pp. 769-784.

Stable URL:

http://links.jstor.org/sici?sici=0006-3568%28199712%2947%3A11%3C769%3ATNFR%3E2.0.CO%3B2-0

References cited

Biodiversity Conservation in Running Waters

J. David Allan; Alexander S. Flecker

BioScience, Vol. 43, No. 1. (Jan., 1993), pp. 32-43.

Stable URL:

http://links.jstor.org/sici?sici=0006-3568%28199301%2943%3A1%3C32%3ABCIRW%3E2.0.CO%3B2-6

Relating Riparian Vegetation to Present and Future Streamflows

Gregor T. Auble; Jonathan M. Friedman; Michael L. Scott

Ecological Applications, Vol. 4, No. 3. (Aug., 1994), pp. 544-554.

Stable URL:

http://links.jstor.org/sici?sici=1051-0761%28199408%294%3A3%3C544%3ARRVTPA%3E2.0.CO%3B2-T

Streamflow Regulation and Fish Community Structure

Mark B. Bain; John T. Finn; Henry E. Booke

Ecology, Vol. 69, No. 2. (Apr., 1988), pp. 382-392.

Stable URL:

http://links.jstor.org/sici?sici=0012-9658%28198804%2969%3A2%3C382%3ASRAFCS%3E2.0.CO%3B2-K

A Recipe for River Recovery?

Marcia Barinaga

Science, New Series, Vol. 273, No. 5282. (Sep. 20, 1996), pp. 1648-1650.

Stable URL:

http://links.jstor.org/sici?sici=0036-8075%2819960920%293%3A273%3A5282%3C1648%3AARFRR%3E2.0.CO%3B2-L

LINKED CITATIONS

Mechanisms Associated With Decline of Woody Species in Riparian Ecosystems of the Southwestern U.S.
David E. Busch; Stanley D. Smith
Ecological Monographs, Vol. 65, No. 3. (Aug., 1995), pp. 347-370.
Stable URL:
http://links.jstor.org/sici?sici=0012-9615%28199508%2965%3A3%3C347%3AMAWDOW%3E2.0.CO%3B2-L

Flood Disturbance and the Coexistence of Species in a Lowland Podocarp Forest, South Westland, New Zealand
Richard P. Duncan
The Journal of Ecology, Vol. 81, No. 3. (Sep., 1993), pp. 403-416.
Stable URL:
http://links.jstor.org/sici?sici=0022-0477%28199309%2981%3A3%3C403%3AFDATCO%3E2.0.CO%3B2-G

Preserving Biodiversity: Species, Ecosystems, or Landscapes?
Jerry F. Franklin
Ecological Applications, Vol. 3, No. 2. (May, 1993), pp. 202-205.
Stable URL:
http://links.jstor.org/sici?sici=1051-0761%28199305%293%3A2%3C202%3APBSEOL%3E2.0.CO%3B2-7

The Effects of Flooding on the Swamp Forest in Lake Ocklawaha, Florida
William R. Harms; Hans T. Schreuder; Donal D. Hook; Claud L. Brown
Ecology, Vol. 61, No. 6. (Dec., 1980), pp. 1412-1421.
Stable URL:
http://links.jstor.org/sici?sici=0012-9658%28198012%2961%3A6%3C1412%3ATEOFOT%3E2.0.CO%3B2-5

Command and Control and the Pathology of Natural Resource Management
C. S. Holling; Gary K. Meffe
Conservation Biology, Vol. 10, No. 2. (Apr., 1996), pp. 328-337.
Stable URL:
http://links.jstor.org/sici?sici=0888-8892%28199604%2910%3A2%3C328%3ACACATP%3E2.0.CO%3B2-5

Bottomland Vegetation Distribution along Passage Creek, Virginia, in Relation to Fluvial Landforms
Cliff R. Hupp; W. R. Osterkamp
Ecology, Vol. 66, No. 3. (Jun., 1985), pp. 670-681.
Stable URL:
http://links.jstor.org/sici?sici=0012-9658%28198506%2966%3A3%3C670%3ABVDAPC%3E2.0.CO%3B2-5

LINKED CITATIONS

Woodland Expansions in the Platte River, Nebraska: Patterns and Causes
W. Carter Johnson
Ecological Monographs, Vol. 64, No. 1. (Feb., 1994), pp. 45-84.
Stable URL:
http://links.jstor.org/sici?sici=0012-9615%28199402%2964%3A1%3C45%3AWEITPR%3E2.0.CO%3B2-I

Forest Overstory Vegetation and Environment on the Missouri River Floodplain in North Dakota
W. Carter Johnson; Robert L. Burgess; Warren R. Keammerer
Ecological Monographs, Vol. 46, No. 1. (Winter, 1976), pp. 59-84.
Stable URL:
http://links.jstor.org/sici?sici=0012-9615%28197624%2946%3A1%3C59%3AFOVAEO%3E2.0.CO%3B2-H

Biological Integrity: A Long-Neglected Aspect of Water Resource Management
James R. Karr
Ecological Applications, Vol. 1, No. 1. (Feb., 1991), pp. 66-84.
Stable URL:
http://links.jstor.org/sici?sici=1051-0761%28199102%291%3A1%3C66%3ABIALAO%3E2.0.CO%3B2-R

Fish Communities of Midwestern Rivers: A History of Degradation
James R. Karr; Louis A. Toth; Daniel R. Dudley
BioScience, Vol. 35, No. 2. (Feb., 1985), pp. 90-95.
Stable URL:
http://links.jstor.org/sici?sici=0006-3568%28198502%2935%3A2%3C90%3AFCOMRA%3E2.0.CO%3B2-E

Valley Alluviation in Southwestern Wisconsin
James C. Knox
Annals of the Association of American Geographers, Vol. 62, No. 3. (Sep., 1972), pp. 401-410.
Stable URL:
http://links.jstor.org/sici?sici=0004-5608%28197209%2962%3A3%3C401%3AVAISW%3E2.0.CO%3B2-K

Hydrologic and Geomorphic Factors Affecting Conservation of a River- Breeding Frog (Rana Boylii)
Sarah J. Kupferberg
Ecological Applications, Vol. 6, No. 4. (Nov., 1996), pp. 1332-1344.
Stable URL:
http://links.jstor.org/sici?sici=1051-0761%28199611%296%3A4%3C1332%3AHAGFAC%3E2.0.CO%3B2-Q

LINKED CITATIONS

Downstream Ecological Effects of Dams
Franklin K. Ligon; William E. Dietrich; William J. Trush
BioScience, Vol. 45, No. 3, Ecology of Large Rivers. (Mar., 1995), pp. 183-192.
Stable URL:
http://links.jstor.org/sici?sici=0006-3568%28199503%2945%3A3%3C183%3ADEEOD%3E2.0.CO%3B2-E

Effects of Abiotic Disturbance on Coexistence of Predator-Prey Fish Species
Gary K. Meffe
Ecology, Vol. 65, No. 5. (Oct., 1984), pp. 1525-1534.
Stable URL:
http://links.jstor.org/sici?sici=0012-9658%28198410%2965%3A5%3C1525%3AEOADOC%3E2.0.CO%3B2-6

Persistence and Stability of Fish and Invertebrate Assemblages in a Repeatedly Disturbed Sonoran Desert Stream
Gary K. Meffe; W. L. Minckley
American Midland Naturalist, Vol. 117, No. 1. (Jan., 1987), pp. 177-191.
Stable URL:
http://links.jstor.org/sici?sici=0003-0031%28198701%29117%3A1%3C177%3APASOFA%3E2.0.CO%3B2-X

Fish Invasions in California: Do Abiotic Factors Determine Success?
Peter B. Moyle; Theo Light
Ecology, Vol. 77, No. 6. (Sep., 1996), pp. 1666-1670.
Stable URL:
http://links.jstor.org/sici?sici=0012-9658%28199609%2977%3A6%3C1666%3AFIICDA%3E2.0.CO%3B2-0

Comparative Water Relations of Phreatophytes in the Sonoran Desert of California
Erik Tallak Nilsen; M. Rasoul Sharifi; Philip W. Rundel
Ecology, Vol. 65, No. 3. (Jun., 1984), pp. 767-778.
Stable URL:
http://links.jstor.org/sici?sici=0012-9658%28198406%2965%3A3%3C767%3ACWROPI%3E2.0.CO%3B2-0

Functional Organization of Stream Fish Assemblages in Relation to Hydrological Variability
N. LeRoy Poff; J. David Allan
Ecology, Vol. 76, No. 2. (Mar., 1995), pp. 606-627.
Stable URL:
http://links.jstor.org/sici?sici=0012-9658%28199503%2976%3A2%3C606%3AFOOSFA%3E2.0.CO%3B2-V

LINKED CITATIONS

Hydraulic Food-Chain Models

Mary E. Power; Adrian Sun; Gary Parker; William E. Dietrich; J. Timothy Wootton

BioScience, Vol. 45, No. 3, Ecology of Large Rivers. (Mar., 1995), pp. 159-167.

Stable URL:

http://links.jstor.org/sici?sici=0006-3568%28199503%2945%3A3%3C159%3AHFM%3E2.0.CO%3B2-P

The Role of Disturbance in Stream Ecology

Vincent H. Resh; Arthur V. Brown; Alan P. Covich; Martin E. Gurtz; Hiram W. Li; G. Wayne Minshall; Seth R. Reice; Andrew L. Sheldon; J. Bruce Wallace; Robert C. Wissmar

Journal of the North American Benthological Society, Vol. 7, No. 4, Community Structure and Function in Temperate and Tropical Streams: Proceedings of a Symposium. (Dec., 1988), pp. 433-455.

Stable URL:

http://links.jstor.org/sici?sici=0887-3593%28198812%297%3A4%3C433%3ATRODIS%3E2.0.CO%3B2-C

A Method for Assessing Hydrologic Alteration within Ecosystems

Brian D. Richter; Jeffrey V. Baumgartner; Jennifer Powell; David P. Braun

Conservation Biology, Vol. 10, No. 4. (Aug., 1996), pp. 1163-1174.

Stable URL:

http://links.jstor.org/sici?sici=0888-8892%28199608%2910%3A4%3C1163%3AAMFAHA%3E2.0.CO%3B2-E

The Response of Fishes to Periodic Spring Floods in a Southeastern Stream

Stephen T. Ross; John A. Baker

American Midland Naturalist, Vol. 109, No. 1. (Jan., 1983), pp. 1-14.

Stable URL:

http://links.jstor.org/sici?sici=0003-0031%28198301%29109%3A1%3C1%3ATROFTP%3E2.0.CO%3B2-K

Larval Fish Distribution and Microhabitat Use in Free-Flowing and Regulated Rivers

Karl J. Scheidegger; Mark B. Bain

Copeia, Vol. 1995, No. 1. (Feb. 15, 1995), pp. 125-135.

Stable URL:

http://links.jstor.org/sici?sici=0045-8511%2819950215%293%3A1995%3A1%3C125%3ALFDAMU%3E2.0.CO%3B2-O

Flow Regime, Juvenile Abundance, and the Assemblage Structure of Stream Fishes

Isaac J. Schlosser

Ecology, Vol. 66, No. 5. (Oct., 1985), pp. 1484-1490.

Stable URL:

http://links.jstor.org/sici?sici=0012-9658%28198510%2966%3A5%3C1484%3AFRJAAT%3E2.0.CO%3B2-D

LINKED CITATIONS

Flood Dependency of Cottonwood Establishment Along the Missouri River, Montana, USA
Michael L. Scott; Gregor T. Auble; Jonathan M. Friedman
Ecological Applications, Vol. 7, No. 2. (May, 1997), pp. 677-690.
Stable URL:
http://links.jstor.org/sici?sici=1051-0761%28199705%297%3A2%3C677%3AFDOCEA%3E2.0.CO%3B2-Q

Flooding: Mortality and Habitat Renewal for Least Terns and Piping Plovers
John G. Sidle; David E. Carlson; Eileen M. Kirsch; John J. Dinan
Colonial Waterbirds, Vol. 15, No. 1. (1992), pp. 132-136.
Stable URL:
http://links.jstor.org/sici?sici=0738-6028%281992%2915%3A1%3C132%3AFMAHRF%3E2.0.CO%3B2-4

Habitat, the Templet for Ecological Strategies?
T. R. E. Southwood
The Journal of Animal Ecology, Vol. 46, No. 2. (Jun., 1977), pp. 336-365.
Stable URL:
http://links.jstor.org/sici?sici=0021-8790%28197706%2946%3A2%3C336%3AHTTFES%3E2.0.CO%3B2-M

Need for Ecosystem Management of Large Rivers and Their Floodplains
Richard E. Sparks
BioScience, Vol. 45, No. 3, Ecology of Large Rivers. (Mar., 1995), pp. 168-182.
Stable URL:
http://links.jstor.org/sici?sici=0006-3568%28199503%2945%3A3%3C168%3ANFEMOL%3E2.0.CO%3B2-Z

Flow Regulation, Geomorphology, and Colorado River Marsh Development in the Grand Canyon, Arizona
Lawrence E. Stevens; John C. Schmidt; Tina J. Ayers; Bryan T. Brown
Ecological Applications, Vol. 5, No. 4. (Nov., 1995), pp. 1025-1039.
Stable URL:
http://links.jstor.org/sici?sici=1051-0761%28199511%295%3A4%3C1025%3AFRGACR%3E2.0.CO%3B2-S

Woody Seedling Dynamics in an East Texas Floodplain Forest
Donna R. Streng; Jeff S. Glitzenstein; P. A. Harcombe
Ecological Monographs, Vol. 59, No. 2. (Jun., 1989), pp. 177-204.
Stable URL:
http://links.jstor.org/sici?sici=0012-9615%28198906%2959%3A2%3C177%3AWSDIAE%3E2.0.CO%3B2-H

LINKED CITATIONS

Effects of Groundwater Decline on Riparian Vegetation of Semiarid Regions: The San Pedro, Arizona

J. C. Stromberg; R. Tiller; B. Richter

Ecological Applications, Vol. 6, No. 1. (Feb., 1996), pp. 113-131.

Stable URL:

http://links.jstor.org/sici?sici=1051-0761%28199602%296%3A1%3C113%3AEOGDOR%3E2.0.CO%3B2-8

Effects of Disturbance on River Food Webs

J. Timothy Wootton; Michael S. Parker; Mary E. Power

Science, New Series, Vol. 273, No. 5281. (Sep. 13, 1996), pp. 1558-1561.

Stable URL:

http://links.jstor.org/sici?sici=0036-8075%2819960913%293%3A273%3A5281%3C1558%3AEODORF%3E2.0.CO%3B2-9

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO | SANTA BARBARA • SANTA CRUZ

VALENTINE EASTERN SIERRA RESERVE (VESR)

HCR 79, BOX 198, 1016 MT. MORRISON ROAD
MAMMOTH LAKES, CA 93546
http://vesr.ucnrs.org

January 25, 2008

MCWD c/o Sanda Bauer
Bauer Planning & Environmental Services, Inc.
220 Commerce, #230
Irvine, CA 92602-1376

RE: Notice of Draft EIR Preparation (NOP) For Proposed Changes in Mammoth Creek Bypass Flow Requirements, Watershed Operation Constraints, Point of Measurement, Place of Use, SCH #97032082

Dear Sandra:

In response to the Notice of Preparation referred to above, please find the following response. As a Trustee Agency under CEQA for lands held in the Natural Reserve System ("NRS"), the University of California is obligated to work to ensure no significant impacts take place to lands held in the public trust. As you know Mammoth Creek flows directly through the Valentine Eastern Sierra Reserve ("the Reserve"), a unit in the NRS. The proposed project has the potential to significantly impact the Reserve. Correspondence between the University and the Mammoth Community Water District over the bypass flows in Mammoth Creek dates back to 1976. My personal involvement dates back to 1979, several years before I acquired my first personal computer. Hence, that correspondence is not as easily accessed, but I will be happy to provide copies if you would like them. It is our sincere hope that the analysis contained in the EIR will resolve these issues for good.

In the course of preparing my comments on this NOP, I have reviewed the following correspondence from me, on behalf of the University, to the Mammoth Community Water District:

Attachment A	November 17, 1994	letter to Dennis Erdman	comments in CEQA early consultation
Attachment B	April 28, 1997	letter to John Moynier	comments on NOP/NOI (2000 EIR/EIS)
Attachment C	January 31, 2001	letter to John Moynier	comments on 2000 Draft EIR/EIS
Attachment D	December 3, 2005	letter to Gary Sisson	comments on 2005 NOP

After re-reading all this material I find that I really have nothing more to say. Even the notion of the "Environmentally Superior Alternative" or "Creek Health Alternative" that I brought up at the January 17, 2008 Scoping Meeting is adequately described in my previous correspondence.

Therefore, I respectfully, submit copies of all this correspondence as my comment on the NOP and scope of the most recent EIR.

The NOP requests the name, address, and telephone number of a contact person. Please use:

Daniel R. Dawson
Valentine Eastern Sierra Reserve
HCR 79, Box 198
Mammoth Lakes, CA 93546
760-935-4334
dawson@icess.ucsb.edu.

Please contact me if you have any questions.

Sincerely,

Daniel R. Dawson Digitally signed by Daniel R. Dawson
DN: cn=Daniel R. Dawson, o=UCSB, ou=VESR, email=dawson@icess.ucsb.edu, c=US
Date: 2008.01.23 14:37:12 -08'00'

Daniel R. Dawson
Director

attachments

ATTACHMENT A

VALENTINE EASTERN SIERRA RESERVE
STAR ROUTE 1, BOX 198
MAMMOTH LAKES, CA 93546
(619) 935-4334, 935-4867 FAX

November 17, 1994

Mr. Dennis Erdman
General Manager
Mammoth County Water District
P.O. Box 597
Mammoth Lakes, CA 93546

Dear Mr. Erdman:

In response to your letter dated October 20, 1994, and pursuant to Section 15063(g) of the California Environmental Quality Act (CEQA) Guidelines, the University of California would like to offer the following comments, as a Trustee Agency, on the environmental review respecting Mammoth County Water District's (MCWD) pending water right petitions and Mammoth Creek instream flow requirements.

We believe that the preparation of an Environmental Impact Report is critical for the proposed projects. There are many unresolved issues that cannot be resolved without benefit of the depth of analysis required in an EIR. Although the District may have substantial data relating to potential impacts from this project, it is through the EIR process that the data is made available for public scrutiny, comment and challenge. We believe that there is substantial evidence that the proposed project may have a significant effect on the environment and that pursuant to Section 15064(a)(1) of the CEQA Guidelines, you are required to prepare an EIR. This conclusion is based upon the potential direct and secondary impacts of the project (15064(d)); the substantial body of opinion that will likely consider such impacts as substantial adverse changes in the environment (15064(c)); the substantial evidence in the record that the project may have a significant effect on the environment (15064(g)); and the likely serious public controversy over the environmental effects of the project that have been associated with similar District projects (15065(h)). At the State Water Resources Control Board hearings conducted in Mammoth Lakes in March, 1992 there was substantial expert testimony that your proposal for a reduction in stream flow minimums for Mammoth Creek would result in significant adverse environmental impact. Based on this testimony, and the afore mentioned CEQA Guidelines, we believe you are required to prepare an EIR.

We would like to mention several of the unresolved issues that should be analyzed in the EIR. We reserve the right to provide additional comments following the Notice of Preparation. For a more thorough analysis of many of these issues please refer to the written copy of the University's testimony before the State Water Resources Control Board in March, 1992. MCWD was provided with a copy of that testimony and the appended exhibits at that time.

1. Sufficient information is not presently available, or has not been provided to us, to establish instream flow requirements within the Valentine Reserve ("Reserve") which will insure compliance with Fish and Game Code Sections 5946 and 5937. Although a great deal of work has been done by your consultants on the instream flow requirements of fish in Mammoth Creek, all of that work has focused on reaches of stream outside of the Reserve. While portions of Mammoth Creek within the Reserve are too high a gradient to analyze using the method employed by your consultant (IFIM), there are substantial portions of the stream that can be, and should be analyzed. The high gradient portions of the stream should be analyzed by the best method available for a stream of that type.

2. Any analysis of minimum flows must take into consideration the flows required to maintain the riparian corridor through the Reserve. It is has been shown that the width of a riparian corridor is highly correlated with average annual discharge. Changes in minimum flow requirements could adversely affect the well developed riparian vegetation within the Reserve. The riparian corridor supports the highest diversity of plants and animals on the Reserve. In our area, nesting bird density is highest in undisturbed riparian vegetation. This diversity of plants and animals is a significant resource for the Reserve and the region and a decline in average stream flows may result in an adverse impact to this resource.

3. The analysis of minimum flow requirements to date does not account for the spring flows that join the creek near the east boundary of the Reserve. The combined contribution of the springs on the Reserve is approximately 2 cfs and this is borne out by comparison of low flow gauge measurements at Old Mammoth Road with those at the outlet of Twin Lakes, which are 2-4 cfs less. As a result, the creek within the Reserve will have 2 cfs less flow than that measured at Old Mammoth Road. Furthermore, the creek within the Reserve at this point is braided, resulting in a further reduction in flow per channel. Sufficient information is not available to ensure compliance with Sections 5946 and 5937 of the Fish and Game Code.

4. Although the change in measuring point for the stream flow requirements from Old 395 to Old Mammoth Road appears to be justified, the conversion between gauge readings is in dispute. The conversion presented in the Beak study differs substantially from that proposed by Mr. Charles Rich of the State Water Resources Control Board staff. Before the measuring point is relocated, and the minimum flow requirements established, this conversion must be resolved to the satisfaction of all parties.

5. The recent development of wells on private land throughout the community by MCWD should have reduced the burden on surface water supplies. Because of the competing demands for surface water, and the potential for alternate supply, a detailed analysis of supply and demand should be included.

6. The revised Preliminary Cease and Desist Order 9P issued by the State Water Resources Control Board called for a Demand Reduction Report to be prepared by MCWD. An analysis should be prepared of long-term demand reduction which includes reduction or elimination of outside watering, continued implementation of the leak detection program, retrofit of water saving devices, use of reclaimed wastewater, and limitation on new hookups. The later is relevant to Part 1 of MCWD's project description which is to increase their place of use under Permit 17332 and allow many new hookups.

7. MCWD is proposing a single flow regime based on the dry year hydrologic condition. The 1991 study by Beak Consultants developed flow regimes based on dry, normal and wet year hydrologic conditions. This idea has merit because establishing higher instream flow requirements for normal and wet years would allow the ecosystem to recover from the stresses imposed upon it by the dry year flows. However, one effect of the three flow regimes identified in the Beak study would be that diversion of water would not be allowed during certain periods of "wet" years, but would be allowed during periods of less flow in the same months of "dry" or "normal" years. Revised dry, normal and wet year flows should be analyzed and considered.

8. In your project description you conclude that by the transfer of surface water appropriative rights from private property owners to MCWD, there will be "no net increase in surface water diversions." However, depending on the actual "take" by these subject property owners, it is not clear that the District acquisition of the "rights" will result in no net increase in surface water diversions. The potential impact of any net increase in surface water diversion must be analyzed.

Thank you for your effort to consult with us early in this process. We may have additional comments after the Notice of Preparation is distributed. Your consultants have contacted us several times during the past year to gain access to the Reserve and we appreciate their courtesy. As additional analysis is required on the Reserve please have them contact us again. We look forward to reviewing the Notice of Preparation and the ensuing EIR.

Sincerely,

Daniel R. Dawson
Reserve Manager

cc: Ed Anton, SWRCB
Carl Droese, Office of General Counsel
Steve Drown, Office of General Counsel
Dr. Scott Cooper, UCSB NRS

ATTACHMENT B

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO — SANTA BARBARA • SANTA CRUZ

SANTA BARBARA, CALIFORNIA 93106

VALENTINE EASTERN SIERRA RESERVE
STAR ROUTE 1, BOX 198
MAMMOTH LAKES, CA 93546
(619) 935-4334, 935-4867 FAX

April 28, 1997

Mr. John Moynier
Mammoth Community Water District
P.O. Box 597
Mammoth Lakes, CA 93546

RE: NOP/NOI, DRAFT EIR/EIS FOR CHANGES IN MAMMOTH CREEK MINIMUM STREAM FLOW

Dear John:

Thank you for the opportunity to comment on the NOP/NOI. As a Trustee Agency under CEQA for lands held in the Natural Reserve System, the University is obligated to work to insure no significant impacts take place to lands held in the public trust. We have had differences with the Mammoth Community Water District since 1976 over minimum stream flows in Mammoth Creek. It is our sincere hope that the analysis contained in the EIR will resolve these issues for good. Please consider the following comments.

1. Mammoth Creek runs through the center of the University's Valentine Reserve and is one of the dominant features. For portions of the traverse, the creek is braided into 2 or 3 channels. The creek supports a lush and diverse riparian forest with associated understory plants, wetlands, and wildlife. Where the creek is braided the riparian forest much wider. The riparian forest contributes highly to the biodiversity of the Reserve. The proposal to change the minimum flow standards must analyze in detail all potential impacts to the Reserve.

2. The DEIR must consider the need for flushing flows and channel management flows in Mammoth Creek, not just the flows required to maintain the fish.

3. As the Creek traverses the Reserve there is considerable spring flow that accrues to the Creek, on the order of 2 cubic feet per second (cfs). Most of this accrues to the creek as it nears the east boundary of the Reserve. Consequently, the stream flow through the Reserve is actually much less than that measured downstream. The proposal for a change in minimum flows and change in measuring point must identify what the actual flows within the Reserve will be, and what the associated impacts from that level of flow will be. Under the proposed minimum stream flows, flow within the Reserve might be less than 3 cfs in September-December. Where the channel is braided this would result in flows less than 1 cfs per channel. It is our contention that the integrity of the fishery, the rest of the benthic community, and the riparian forest would be lost at this level of flow.

4. The IFIM studies and fish censuses conducted to date have all been downstream of the Reserve. It has been contended that this is because IFIM will not work in the Reserve. The DEIR must use the best methods available to analyze the impacts of the actual flows through the Reserve on fish, amphibians, invertebrates, and riparian community within the Reserve. Based on #3 above, these flow may be considerably less than those determined at the measuring point.

5. The analysis in the DEIR must be done in the context of a detailed water supply and demand plan for the District. Only then can we make informed decisions about which alternative to select. Such a document would take into consideration demand management, use of reclaimed water, water demand for new uses such as snowmaking, use of water from Dry Creek, groundwater use and the potential impacts from its use.

6. Only two alternatives are identified in the NOP: the proposed project and the no project alternatives. A wider range of alternatives exists and should be analyzed to provide the best, most informed decision making. Please include an alternative that considers all of the water uses in the Mammoth Creek watershed, both appropriated and in-stream and attempts to optimize use for all parties. The proposed project alternative only considers the needs of MCWD and fails to consider all the other beneficial uses.

7. The DEIR should provide the analysis that allows one to compare one measuring point to another. Such an analysis was performed by Chuck Rich of the State Water Resources Control Board. With this calculation we could better understand how the proposed minimum flows at the new measuring point compare to the existing minimum flows at the existing measuring point.

8. What will happen to the water that currently or recently supplied the 9 license holders identified in Table 1? The NOP states that "The existing water rights held by these entities are proposed to be transferred to the District". How will the District exercise these rights? The City of Los Angeles is prohibited from transferring their water rights, they are identified as one of the license holders.

Please ensure that each of these items is addressed in the DEIR. We will be happy to cooperate with your consultants and allow them as much access to the Reserve as they require. Please have them arrange their initial visit through me at the number above. Thank you for the opportunity to comment.

Sincerely,

Daniel R. Dawson
Resident Director

c: UC Office of General Counsel
SWRCB
CA DFG
CALTROUT
Genny Smith

ATTACHMENT C

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBARA • SANTA CRUZ

VALENTINE EASTERN SIERRA RESERVE (VESR)

ROUTE 1, BOX 198
1016 MT. MORRISON ROAD
MAMMOTH LAKES, CA 93546
http://nrs.ucop.edu/reserves/valentine.html

January 31, 2001

Mr. John Moynier
Public Affair Manager
Mammoth Community Water District
P.O. Box 597
Mammoth Lakes, CA 93546

Mr. Jeff Bailey
Forest Supervisor
Inyo National Forest
873 N. Main Street
Bishop, CA 93514

Gentlemen:

Thank you for the opportunity to comment on the Draft EIR/EIS "Changes in Mammoth Creek Instream Flow Requirements, Change of Point of Measurement, and Change of Place of Use" ("the Draft"). As a Trustee Agency under CEQA for lands held in the Natural Reserve System, the University is obligated to insure no significant impacts take place to lands held in the public trust. As you know Mammoth Creek flows directly through the Valentine Reserve ("the Reserve"), a unit in the University's Natural Reserve System. The proposed project has the potential to significantly impact the Reserve.

1. Since 1976, when the Mammoth Community Water District (MCWD or "the District") first proposed to change its instantaneous diversion capacity of Mammoth Creek from 2 cfs to 5 cfs the University and the District have been in dispute over appropriate minimum stream flow requirements. During periods of high flow, the District's diversion has little impact on flow. However, during periods of low flow such as those that occur in late fall and winter, the District's instantaneous diversion capacity can severely affect the flow and negatively impact the Reserve. As detailed on page 4-26 of the Draft, springs located on the Reserve contribute to flow in Mammoth Creek. Consequently, stream flow within the Reserve is approximately 2 cfs lower than flow measured at the Old Mammoth Road measuring point. Furthermore, the creek is braided into 3 channels in a section of the Reserve. When the minimum flows currently in use (the Proposed Action) are approached in the months September - February, the flow in each of these channels is close to 1 cfs. This is barely adequate to wet the bottom of the stream and is unacceptably low. Direct impacts are occurring to fishery resources, benthic invertebrates, and the riparian plant community. This is a significant impact and must be identified a such in Section 4.11 of the document, "Impact Conclusion".

2. Unfortunately, the Draft EIR/EIS fails to provide adequate information to allow one to determine the full extent of impact to the Reserve. Despite our explicit request (Appendix A, next to last page, item 3) during the EIR/EIS scoping period, the Draft does not contain a table detailing the flows through the Reserve that would result from the proposed action. We request that such a table be added. Flow from Twin Lakes outlet adequately represents the flow through the Reserve. The flow model in Appendix C should be expanded to include the regression between the Old Mammoth Road (MCWD) gage and the flow at Twin Lakes outlet and an appropriate table developed.

3. The Draft does not contain an analysis of an alternative that we can support. The CEQA Guidelines Section 15126.6 states "An EIR shall describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project...it must consider a range of potentially feasible alternatives that will foster informed decision making and public participation." Each alternative considered is favorable to the District and its water supply needs and none of them represents an environmentally favorable alternative even though an identified goal of the project is to "Maintain the environmental values of Mammoth Creek and its associated habitats". The Draft has been in preparation since 1997. During that period, numerous administrative drafts were prepared for District and Forest Service review. We requested the opportunity to review administrative drafts to forestall this possibility of no suitable alternative. Our requests were denied. A revised Draft with a full and meaningful range of project alternatives must be prepared. It is not adequate to issue an addendum to this EIR, nor to simply respond to comments and issue the Final EIR/EIS. A revised draft must be prepared and recirculated for public comment.

4. The Draft document consistently looks at impacts associated with the change from the conditions established in Permit 17332, the No Action Alternative, to the Proposed Action. However, the impacts associated with the No Action Alternative have never been fully analyzed. There is no certified CEQA or NEPA document that considers the impacts of the instream flow requirements of that permit. This document also fails to consider these impacts. Some analysis of such impacts must be included in a revised Draft. Consideration of these impacts would be easier if in each relevant table and figure, the unimpaired condition were included. The unimpaired condition could be represented by the long-term average monthly flow at a given measuring point. We request that this be added to a revised draft EIR to allow consideration of the extent of diversion.

5. The Draft consistently blends the results of the project's two principal objectives, the change in instream flow requirements and the change of measuring point. Because every table and figure shows the permitted flow requirements at the Old 395 (LADWP) measuring point and the proposed action at the Old Mammoth Road (MCWD) measuring point, it is impossible to tease apart the effects. If we examine Permit 17332's minimum required flow of 5.0 cfs at the LADWP gage for the month of January (No Action alternative) compared to current minimum of 6.4 cfs at the MCWD gage (Proposed Action) we can't tell if this actually represents a change in the flow requirement or just the differences between the measuring points. Hidden in Appendix C is a formula from the regression between the two measuring points. If one applies that formula to the proposed 6.4 cfs at the MCWD gage it results in an equivalent flow of 4.2 cfs at the LADWP gage. Therefore, the proposed action results in a reduction of the Permit minimum flow by 0.8

cfs or 16%. Every relevant table and figure in the Draft must be revised to include a column that shows the proposed action at the old measuring point. Only with this information can we accurately tell what the proposed action is. For example, the first few columns of Table S-1 would look something like

	No Action	**Proposed Action**	**Proposed Action**	**Proposed Action**
Compliance Basis	Mean Monthly Flow	Mean Daily Flow	Mean Daily Flow	Mean Daily Flow
Measurement Location	LADWP gage	LADWP gage	MCWD gage	Twin Lakes Outlet
Year Type	all	all	all	all
Month				approximate (regression needed
January	5.0	4.2	6.4	4.4
February	5.0	3.7	6.0	4.0
March	5.0	5.9	7.8	5.8
April	10.0	8.5	9.8	7.8
May	25.0	18.7	18.7	16.7
June	40.0	21.2	20.8	18.8
July	25.0	8.3	9.9	7.9
August	10.0	5.1	7.2	5.2
September	6.0	3.1	5.5	3.5
October	6.0	3.1	5.5	3.5
November	6.0	3.6	5.9	3.9
December	6.0	3.6	5.9	3.9

Comparison of the first two columns reveals that the proposed action results in dramatic across the board reductions in the instream flow requirements. This fact is obscured in the document.

6. The instream flow requirements established in Permit 17332 as well as the current flow requirements were established when the District and the community were severely impacted by drought. Thus, instream flow requirements were established that maximized the District's ability to supply its customers. With the development of the well field in Town and the prospect of the development of the Dry Creek project, the District is now "drought-proof". Although groundwater is more expensive, the District has the luxury of erring on the side of caution with respect to Mammoth Creek. The District should be required to "give back" some water to Mammoth Creek, by curtailing diversions during the lowest flow periods in order to prevent any potential impacts.

7. The Draft states that with the Proposed Action, and a mean daily minimum stream flow instead of a mean monthly, that an instantaneous minimum is no longer required. We do not follow this logic. If the daily average minimum is established at 6 cfs for a given month, what prevents the District from allowing stream flows of 3 cfs for 12 hours and 9 cfs for 12 hours. We ask that the statement referred to be striken.

8. All of the University's concerns could be met if a reasonable instantaneous minimum streamflow was set for the Twin Lakes Outlet. This would ensure adequate flow through the Reserve. We request such a minimum be established at 5 cfs. When the combined inflows to District's storage

in the Lakes Basin (Lake Mary + Lake Mamie) falls below 5 cfs, the District should be required to pass through all of the combined inputs.

9. Preliminary Cease and Desist Order 9P2 states that meeting instream flow minima shall take precedence over the requirement to fill Lake Mary by June 1. All of the operational requirements in the Lakes Basin are related to aesthetics and cannot compare in importance to maintaining the health of the Creek ecosystem. Therefore, the instream flow minima must take precedence over every other requirement of the Permit or MOA.

10. The hydrographs contained in Appendix C are very important in the interpretation of the Draft. They are, however, almost impossible to read. They should be reprinted, in color if necessary, so the differences in the alternatives can be distinguished.

11. Section 4.3.2, which among other things considers potential project impacts to the Reserve, is inadequate. Furthermore, the section draws spurious conclusions. Table 4-5 indicates that under all the alternatives, riparian zone widths within the Reserve will decrease by 25% from the unimpaired flow. The Draft states, "However, the predicted differences are small and would not result in a substantial change in riparian communities along Mammoth Creek". We believe this is a spurious conclusion. A decrease in riparian zone width of 25% is a significant impact to the Reserve and should be identified as such in Section 4.11 Impact Conclusions.

12. On page 4-26 of the Draft it states that interpretation of the box-and-whisker plots in Appendix E (these are actually in Appendix D) shows "None of the alternatives would substantially reduce the magnitude of high flows, nor result in substantially lower flows." Some more detailed interpretation of the plots is required to draw this conclusion. It is not adequate simply to state that the plots "show" this. Without the inclusion of the unimpaired condition in these plots, it is impossible to draw that conclusion. Furthermore, the plots don't appear to adequately model current conditions. As I write, outflow from Twin Lakes is approximately 3 cfs. The braided streams within the Reserve are virtually dry. Yet the plot in Figure D-7 for January shows no values below the bottom limit (25 percentile) of the box at 5.5 cfs.

13. We do not believe there is adequate justification to add Mammoth Mountain Ski Area (MMSA) to the place of use. Unlike the other changes to the place of use, MMSA is not providing any water rights to the District in exchange. Furthermore, their temporary connection to the District has been contentious. They already have a District supply for potable water use at Canyon Lodge. The original emergency connection was presumably for construction water but recently has probably been used for snowmaking. The District cannot and should not meet MMSA's water needs for snowmaking. They currently have their own water system and an allocation from the Inyo National Forest. If they require more water for snowmaking, or for other needs, they should work through the Forest Service to increase their allocation. The annual 4 acre feet they have received could be groundwater left in the ground or water left in Mammoth Creek for beneficial instream use.

14. It is inconsistent that the SWRCB should allow a diversion of up to 4840 acre feet (above and below US 395) by LADWP without instream flow requirements. The SWRCB should act to establish appropriate requirements.

Conclusion:
The University believes that deficiencies identified above make the DEIR/EIS insufficient as written to satisfy the requirements of CEQA Guidelines Sections 15124 and 15126.6. We strongly recommend the deficiencies in organization and content of the document be corrected through issuance of a new, revised draft, for public review and comment. Issuance of an addendum would make the Draft even more confusing and disorganized. The document, in its present form, is not adequate to allow the University to evaluate the full extent of impacts to the Reserve nor adequate to allow the SWRCB to make a fully informed decision on the action before them. The University strongly objects to adoption of a project before revision and additional opportunity for review. Furthermore, we request that an instantaneous instream flow minimum be established for the Twin Lakes outlet to ensure an adequate streamflow within the Reserve.

Thank you for the opportunity to comment.

Sincerely,

Daniel R. Dawson
Resident Director

c. Dr. Henry Offen, UCSB
Violet Handelman, UC Office of the President
Office of General Counsel

ATTACHMENT D

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBARA • SANTA CRUZ

VALENTINE EASTERN SIERRA RESERVE (VESR)

HCR 79, BOX 198, 1016 MT. MORRISON ROAD
MAMMOTH LAKES, CA 93546
http://vesr.ucnrs.org

December 3, 2005

Mr. Gary Sisson
General Manager
Mammoth Community Water District
P.O. Box 597
Mammoth Lakes, CA 93546

RE: Mammoth Creek EIR NOP

Dear Gary:

Thank you for the opportunity to provide input on the Notice of Preparation (NOP) for the Draft Environmental Impact Report "Changes in Mammoth Creek Instream Flow Requirements, Change of Point of Measurement, and Change of Place of Use" ("the Draft"). As a Trustee Agency under CEQA for lands held in the Natural Reserve System, the University is obligated to insure no significant impacts take place to lands held in the public trust. As you know Mammoth Creek flows directly through the Valentine Reserve ("the Reserve"), a unit in the University's Natural Reserve System. The proposed project has the potential to significantly impact the Reserve.

1. Since 1976, when the Mammoth Community Water District (MCWD or "the District") first proposed to change its instantaneous diversion capacity from 2 cfs to 5 cfs the University and the District have been in dispute over appropriate minimum stream flow requirements. During periods of high flow, the District's diversion has little impact on flow. However, during periods of low flow such as those that occur in late fall and winter, the District's instantaneous diversion capacity can severely affect the flow and negatively impact the Reserve. Springs located on the Reserve contribute to flow in Mammoth Creek. Consequently, stream flow within the Reserve is approximately 2-4 cfs lower than flow measured at the Old Mammoth Road measuring point. This fact is borne out by comparison of low flow gauge measurements at Old Mammoth Road with those at the outlet of Twin Lakes. Furthermore, the creek is braided into 3 channels in a section of the Reserve. When the minimum flows currently in use (the Proposed Action) are approached in the months September - February, the flow in each of these channels is close to 1 cfs. This is barely adequate to wet the bottom of the stream and is unacceptably low. Direct impacts are occurring to fishery resources, benthic invertebrates, and the riparian plant community. This is a significant impact and must be identified as such in the EIR.

2. In order to adequately assess the impacts of the proposed project, a table is needed in the EIR that shows the approximately stream flow in the Reserve. Flow from Twin Lakes outlet adequately represents the flow through the Reserve. We formally request such a table.

3. Any analysis of minimum flows must take into consideration the flows required to maintain the riparian corridor through the Reserve. It is has been shown that the width of a riparian corridor is highly correlated with average annual discharge. Changes in minimum flow requirements could adversely affect the well-developed riparian vegetation within the Reserve. The riparian corridor supports the highest diversity of plants and animals on the Reserve. In our area, nesting bird density is highest in undisturbed riparian vegetation. This diversity of plants and animals is a significant resource for the Reserve and the region and a decline in average stream flows may result in an adverse impact to this resource.

4. The EIR must contain an analysis of an alternative that we can support. The CEQA Guidelines Section 15126.6 states "An EIR shall describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project...it must consider a range of potentially feasible alternatives that will foster informed decision making and public participation." Each alternative considered in past documents has been favorable to the District and its water supply needs and none of them represents an environmentally favorable alternative even though an identified goal of the project is to "Maintain the environmental values of Mammoth Creek and its associated habitats". We request the opportunity to review administrative drafts to forestall this possibility of no suitable alternative. A Draft with a full and meaningful range of project alternatives must be prepared. This should include an unimpaired flow alternative to provide adequate comparison for the other alternatives.

5. Past documents have consistently looked at impacts associated with the change from the conditions established in Permit 17332, the No Action Alternative, to the Proposed Action. However, the impacts associated with the No Action Alternative have never been fully analyzed. There is no certified CEQA or NEPA document that considers the impacts of the instream flow requirements of that permit. Some analysis of such impacts must be included in the new Draft. Consideration of these impacts would be easier if in each relevant table and figure, the unimpaired condition were included. The unimpaired condition could be represented by the long-term average monthly flow at a given measuring point. We request that this be added to the new EIR to allow consideration of the extent of diversion.

6. The Proposed action blends the results of the project's two principal objectives, the change in instream flow requirements and the change of measuring point. In past documents every table and figure shows the permitted flow requirements at the Old 395 (LADWP) measuring point and the proposed action at the Old Mammoth Road (MCWD) measuring point. It is impossible to tease apart the effects. If we examine Permit 17332's minimum required flow of 5.0 cfs at the LADWP gage for the month of January (No Action alternative) compared to current minimum of 6.4 cfs at the MCWD gage (Proposed Action) we can't tell if this actually represents a change in the flow requirement or just the differences between the measuring points. If we use the regression between the two measuring points the proposed 6.4 cfs at the MCWD gage it results in an equivalent flow of 4.2 cfs at the LADWP gage. Therefore, the proposed action results in a reduction of the Permit

minimum flow by 0.8 cfs or 16%. Every relevant table and figure in the Draft must include a column that shows the proposed action at the old measuring point. Only with this information can we accurately tell what the proposed action is. For example, a table might look something like:

	No Action	**Proposed Action**	**Proposed Action**	**Proposed Action**
Compliance Basis	Mean Monthly Flow	Mean Daily Flow	Mean Daily Flow	Mean Daily Flow
Measurement Location	LADWP gage	LADWP gage	MCWD gage	Twin Lakes Outlet
Year Type	all	all	all	all
Month				approximate (regression needed
January	5.0	4.2	6.4	4.4
February	5.0	3.7	6.0	4.0
March	5.0	5.9	7.8	5.8
April	10.0	8.5	9.8	7.8
May	25.0	18.7	18.7	16.7
June	40.0	21.2	20.8	18.8
July	25.0	8.3	9.9	7.9
August	10.0	5.1	7.2	5.2
September	6.0	3.1	5.5	3.5
October	6.0	3.1	5.5	3.5
November	6.0	3.6	5.9	3.9
December	6.0	3.6	5.9	3.9

Comparison of the first two columns reveals that the proposed action results in dramatic across the board reductions in the instream flow requirements. This fact must not be obscured in the document.

7. The instream flow requirements established in Permit 17332 as well as the current flow requirements were established when the District and the community were severely impacted by drought. Thus, instream flow requirements were established that maximized the District's ability to supply its customers. With the development of the well field in Town and the prospect of the development of the Dry Creek project, the District is now "drought-proof". Although groundwater is more expensive, the District has the luxury of erring on the side of caution with respect to Mammoth Creek. The District should be required to "give back" some water to Mammoth Creek, by curtailing diversions during the lowest flow periods in order to prevent any potential impacts. An alternative that considers alternate supplies must be included. Because of the competing demands for surface water, and the potential for alternate supply, a detailed analysis of supply and demand must be included.

8. The Proposed Action seeks a mean daily minimum stream flow instead of a mean monthly, that an instantaneous minimum is no longer required. We do not follow this logic. If the daily average minimum is established at 6 cfs for a given month, what prevents the District from allowing stream flows of 3 cfs for 12 hours and 9 cfs for 12 hours? We ask that the statement referred to be stricken.

9. The revised Preliminary Cease and Desist Order 9P issued by the State Water Resources Control Board called for a Demand Reduction Report to be prepared by MCWD. An analysis should be

prepared of long-term demand reduction which includes reduction or elimination of outside watering, continued implementation of the leak detection program, retrofit of water saving devices, use of reclaimed wastewater, and limitation on new hookups. The later is relevant to Part 1 of MCWD's project description which is to increase their place of use under Permit 17332 and allow many new hookups.

10. All of the University's concerns could be met if a reasonable instantaneous minimum streamflow was set for the Twin Lakes Outlet. This would ensure adequate flow through the Reserve. We request such a minimum be established at 5 cfs. When the combined inflows to District's storage in the Lakes Basin (Lake Mary + Lake Mamie) falls below 5 cfs, the District should be required to pass through all of the combined inputs.

11. Preliminary Cease and Desist Order 9P2 states that meeting instream flow minima shall take precedence over the requirement to fill Lake Mary by June 1. All of the operational requirements in the Lakes Basin are related to aesthetics and cannot compare in importance to maintaining the health of the Creek ecosystem. Therefore, the instream flow minima must take precedence over every other requirement of the Permit or future operating permit for the USFS.

12. We do not believe there is adequate justification to add Mammoth Mountain Ski Area (MMSA) to the place of use. Unlike the other changes to the place of use, MMSA is not providing any water rights to the District in exchange. Furthermore, their temporary connection to the District has been contentious. They already have a District supply for potable water use at Canyon Lodge. The original emergency connection was presumably for construction water but recently has probably been used for snowmaking. The District cannot and should not meet MMSA's water needs for snowmaking. They currently have their own water system and an allocation from the Inyo National Forest. If they require more water for snowmaking, or for other needs, they should work through the Forest Service to increase their allocation. The annual 4 acre feet they have received could be groundwater left in the ground or water left in Mammoth Creek for beneficial instream use.

13. The combined effects of stream diversion and groundwater pumping have the potential to induce significant cumulative impacts on the Mammoth Creek Basin. Furthermore, groundwater pumping may be influencing stream flows directly. Analysis of the effects of groundwater pumping is needed.

Thank you for the opportunity to comment.

Sincerely,

Daniel R. Dawson
Reserve Director

U.S. FISH & WILDLIFE SERVICE

United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003

81440-2008-FA-0030

January 25, 2008

Sandra Bauer
Bauer Planning and Environmental Services, Inc.
220 Commerce, Suite 230
Irvine, CA 92602-1376

Subject: Notice of a Draft Environmental Impact Report Preparation, Changes in Mammoth Creek Bypass Flow Requirements (SCH#97032082)

Dear Ms. Bauer:

Thank you for providing us with a copy of the notice of the Draft Environmental Impact Report (EIR) preparation. We have the following issues and questions regarding proposed changes in bypass flow requirements for Mammoth Creek and believe these should be addressed in the Draft EIR.

Because ground water and surface water are linked, we urge the Mammoth Community Water District to determine baseline conditions of aquatic and riparian habitats within the watershed and groundwater basin, and monitor the effects of any changes in flow requirements on these habitats. Changes in ground water can influence flows out of Hot Creek, which includes a population of the federally endangered Owens tui chub (*Gila bicolor snyderi*). Changes in flows can also affect the occurrence and health of riparian habitat which is important to federally listed bird species and migratory birds.

In addition, we urge the Mammoth Community Water District to evaluate the short-term, long-term, and cumulative impact of these bypass flows on socio-economic growth in the area and how this would impact aquatic and riparian natural resources.

If you have any questions on these comments, please contact Judy Hohman of my staff at 805-644-1766, ext. 304.

Sincerely,

Judy Hohman

Acting Carl T. Benz
Assistant Field Supervisor