NARROWS PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

1984 COMPROMISE AGREEMENT

AGREEMENT

THIS AGREEMENT, made and entered into the 8th day of June, 1984, by and between the SANPETE COUNTY WATER CONSERVANCY DISTRICT, a Utah Water Conservancy District, herein referred to as "Sanpete" and the CARBON WATER CONSERVANCY DISTRICT, a Utah Water Conservancy District, and the PRICE RIVER WATER USERS ASSOCIATION, a Utah non-profit corporation, collectively herein referred to as "Carbon".

W I T N E S S E T H :

WHEREAS, there has been a long standing controversy concerning the building of storage and diversion works on the Price River System for transmountain diversion of Gooseberry Creek water to the San Pitch River System; and

WHEREAS, the parties hereto desire to compromise and settle the controversy and their respective claims to such water.

NOW, THEREFORE, in consideration of the mutual covenants herein contained, IT IS AGREED:

I

DEFINITIONS

A. "Scofield" means the Scofield Reservoir near Scofield, Utah.

B. "Tripartite Contract" means that contract dated October 11, 1943 among the Carbon Water Conservancy District, the Price River Water Conservation District, and the United States of

America, relating to the reconstruction of Scofield Dam and describing the Gooseberry Plan. The Price River Water Users Association is successor to the Price River Water Conservation District.

C. The expression "prior water rights" as used in this Agreement means the right to the use of the water of the Price River System having priorities earlier than September 6, 1947.

D. "Narrows Site" means the approximate location for a proposed dam to be constructed on Gooseberry Creek, the center of which is located:

North 625 feet and East 1200 feet from the West Quarter corner of Section 19, Township 13 South, Range 6 East, SLB&M.

E. "Narrows Project" means a successor project to the Gooseberry Plan and constitutes a substitute for the allocation of water for the Gooseberry Plan as mentioned in the Tripartite Contract. The Narrows Project is the project proposed by this Agreement and contemplates the building of storage and diversion works at or above the location of the Narrows Site, to store Gooseberry Creek water for transmountain diversion to the San Pitch River System.

F. "Tunnel" means that transmountain diversion tunnel located in Section 24, Township 13 South, Range 5 East, SLB&M which diverts water from the Price River System to the San Pitch River System.

II

WATER RIGHT FILINGS

A. Price River Water Users Association covenants and represents that it is the owner of the following water applications on file in the office of the Utah State Engineer for the diversion, storage, and use of Price River System water:

APPLICATION NO.	CLAIMED DATE OF PRIORITY	NATURE AND AMOUNT OF CLAIMED RIGHT
1035 (91-2)	Aug. 30, 1906	Storage 12,020 acre-feet
8989a (91-78)	Oct. 11, 1937	Storage 17,980 acre-feet
13334 (91-126)	Feb. 13, 1940	Direct Flow 50 second-feet

B. Sanpete covenants and represents that it is the owner of record of the following water applications on file in the office of the Utah State Engineer for the diversion, storage and use of Price River System water, subject to the Assignment Agreement dated July 22, 1975, between Sanpete and the United States of America:

APPLICATION NO.	CLAIMED DATE OF PRIORITY	NATURE AND AMOUNT OF CLAIMED RIGHT
14025 (91-130) Change Application a-9237	Jan. 16, 1941	Storage 30 second feet
14026 (91-131) Change Application a-9236	Jan. 16, 1941	Storage 17,000 acre-feet
14477 (91-132) Change Application a-9238	Sept. 6, 1941	Storage 130 second feet

C. Sanpete covenants and represents that it is the owner of the following application on file in the office of the Utah State Engineer for the diversion, storage, and use of Price River System water:

APPLICATION NO.	CLAIMED DATE OF PRIORITY	NATURE AND AMOUNT OF CLAIMED RIGHT
9593 (91-87)	Oct. 12, 1937	Storage 15,000 acre-feet

III

SUBORDINATION OF WATER RIGHTS

The Price River Water Users Association water rights, evidenced by Application Numbers 1035 (91-2), 8989a (91-78), and 13334 (91-126), shall be subordinated, to the extent hereinafter provided, to the Sanpete water rights evidenced by Application Number 14025 (91-130), Change Application a-9237; Application Number 14026 (91-131), Change Application a-9236; and Application Number 14477 (91-132), Change Application a-9238, to divert and store on a first priority basis in each year all water of Gooseberry Creek and its tributaries arising above the Narrows Site, and to the extent provided in Article IV, paragraph A (3) the waters from Brooks and Cabin Hollow Creeks, and to convey by transmountain diversion up to 5,400 acre-feet of water from storage at the Narrows Site each year for use in the San Pitch River System, subject to the rights of the Cottonwood Gooseberry Irrigation Company for Fairview Lakes.

IV

DISTRIBUTION OF WATER

A. NARROWS PROJECT

1. The active capacity of the reservoir for the Narrows Project shall not exceed 10,000 acre-feet to provide for the transmountain diversion to the San Pitch River System. If requirements are made of Sanpete to release or bypass water for minimum streamflow purposes in Gooseberry Creek below the Narrows Site the active storage capacity of the reservoir for such purposes may be increased as necessary, but shall not exceed 4,500 acre-feet of additional storage capacity. The total active storage capacity shall not exceed 14,500 acre-feet.

2. The 5,400 acre-feet of water to be diverted to the San Pitch River System as provided in Article III shall be measured at the outlet of the tunnel, without deduction for reservoir evaporation, seepage, or storage losses, provided however, that any seepage that would have been intercepted by the tunnel before construction of the Narrows Project shall not be charged against the 5,400 acre-feet. Any additional seepage water resulting from the construction of the Narrows Project shall be charged against the said 5,400 acre-feet.

3. Water from Brooks Canyon and Cabin Hollow Creeks may be diverted, stored and used to provide minimum streamflows in Gooseberry Creek below the Narrows Site.

B. SCOFIELD

1. Application Number 14683 (91-135) in the name of the United States of America, Bureau of Reclamation shall be approved to permit Carbon to use the additional storage capacity of 35,000 acre-feet of water in Scofield Reservoir in addition to the

present storage rights evidenced by Application Numbers 1035 (91-2), and 8989a (91-78).

2. Carbon shall release from storage in Scofield Reservoir water sufficient to satisfy prior water rights, which otherwise would be impaired by the diversion and storage by the Narrows Project. Any and all water stored in the active capacity of Scofield Reservoir shall be subject to such release. The total active capacity of Scofield Reservoir would have to be depleted, and all direct flow water passed through the reservoir to satisfy prior water rights, before any call could be made upon Sanpete to pass through the direct flow waters originating above the Narrows Site. Such releases shall be in such quantity and at such times as may be required to satisfy prior water rights as determined by the Utah State Engineer.

3. Storage releases from Scofield shall be limited to 30,000 acre-feet annually for use by Carbon, exclusive of replacement waters needed to supply prior water rights interfered with by Sanpete's diversion and use of water for the Narrows Project.

V

APPROVALS, WITHDRAWALS, AND REJECTION OF APPLICATIONS

A. The United States of America shall withdraw Application Number 9594 (91-88).

B. The State Engineer shall approve Application Number 14683 (91-135).

C. Within thirty (30) days of approval of this Agreement by the United States of America, the State Engineer may reject the Price River Water Improvement District's Application Number 38852 (91-3557).

D. Sanpete shall within thirty (30) days of approval of this Agreement by the United States of America, withdraw Application Number 9593 (91-87).

E. The parties agree that no protest shall be filed to any of the foregoing approvals, withdrawals, rejections, dismissals or assignments or to any further change applications or permits from any state or federal agencies necessary to carry out the purpose and intent of this Agreement.

VI

DISMISSAL OF PENDING SUIT

Carbon shall file a Motion for Voluntary Dismissal, with prejudice, within thirty (30) days of approval of this Agreement by the United States of America, of the lawsuit entitled Price River Water Users Association, et al, vs United States, et al, Civil No. C-83-0407W, now pending in the United States District Court for the District of Utah, Central Division, upon the grounds that the issues have been settled by this Agreement, and to seek joinder in the motion by other plaintiffs to said case.

VII

MEASURING DEVICES AND OUTLET STRUCTURES

The parties hereto shall install and maintain outlet structures and measuring devices to measure and deliver water in accordance with this Agreement. The expense of such installation and maintenance, as part of the Narrows Project, shall be borne by Sanpete. Such devices shall be approved as to location, type, size and quality by the Utah State Engineer. Each party reserves the right to inspect and test at their own expense, at any reasonable time, any and all facilities for the measurement and delivery of water.

VIII

AGREEMENTS NOT SUPERSEDED OR AMENDED

This Agreement shall not supersede, amend or otherwise modify the rights of the United States of America under the Tripartite Contract, except the Narrows Project shall be substituted for the Gooseberry Plan as mentioned therein; nor shall it amend the repayment contract dated February 28, 1944, between the United States of America and the Carbon Water Conservancy District involving Scofield Reservoir and the Assignment Agreement dated July 22, 1975, between Sanpete and the United States of America.

IX

ADMINISTRATION

All waters stored and diverted pursuant to this Agreement shall be administered by the Utah State Engineer.

X

SUCCESSORS BOUND

This agreement shall be binding upon the parties hereto and upon the successors and assigns of the parties.

XI

INCORPORATION BY REFERENCE

The parties agree that the terms and conditions of this Agreement may be incorporated, by reference, in and made a specific part of the State Engineer's Memorandum Decisions on Sanpete's Application Numbers 14025 (91-130), 14026 (91-131) and

14477 (91-132), as amended, and the Application of the United States of America, Number 14683 (91-135).

XII

APPROVAL OF THE UNITED STATES

This Agreement is subject to the approval of the United States of America.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement the day and year first above written.

SANPETE COUNTY WATER CONSERVANCY DISTRICT

By: ______________________

Its: ______________________

ATTEST:

____
Secretary

CARBON WATER CONSERVANCY DISTRICT

By: ______________________

Its: ______________________

ATTEST:

____
Secretary

PRICE RIVER WATER USERS ASSOCIATION

By: Lyle B Bryner

Its: President

ATTEST:

____

Secretary

The foregoing Agreement is approved this 28 day of June, 1984.

UNITED STATES OF AMERICA

By: _______________

Title

R E S O L U T I O N

BE IT AND IT IS HEREBY RESOLVED by the Board of Directors of the SANPETE WATER CONSERVANCY DISTRICT, at a meeting held on the 7th day of June, 1984, that the President and Secretary of said District be, and they are hereby authorized and empowered to execute on behalf of the District an Agreement with the CARBON WATER CONSERVANCY DISTRICT and the PRICE RIVER WATER USERS ASSOCIATION bearing the above date settling controversies between Carbon County water users and Sanpete County water users on the terms and conditions set out in said agreement presented and considered at this meeting.

C E R T I F I C A T I O N

I, Janice Petersen, Secretary of SANPETE WATER CONSERVANCY DISTRICT, hereby certify that the foregoing is a true and correct copy of a resolution adopted by the directors of the said District at a regular meeting of the SANPETE WATER CONSERVANCY DISTRICT held on the 7th day of June, 1984.

Janice Petersen, Secretary
SANPETE WATER CONSERVANCY DISTRICT

EXHIBIT "B"

JUL 11 1984
WATER RIGHTS

R E S O L U T I O N

BE IT AND IT IS HEREBY RESOLVED by the Board of Directors of the PRICE RIVER WATER USERS ASSOCIATION, at a meeting held on the 8th day of June, 1984, that the President and Secretary of said association be, and they are hereby authorized and empowered to execute on behalf of the Association an Agreement with the SANPETE COUNTY WATER CONSERVANCY DISTRICT bearing the above date settling controversies between Carbon County water users and Sanpete County water users on the terms and conditions set out in said agreement presented and considered at this meeting.

CERTIFICATION

I, ANN B. O'BRIEN, Secretary of PRICE RIVER WATER USERS ASSOCIATION, hereby certify that the foregoing is a true and correct copy of a resolution adopted by the directors of the said District at a special meeting of the PRICE RIVER WATER USERS ASSOCIATION held on the 8th day of June, 1984.

Ann B. O'Brien

ANN B. O'BRIEN, Secretary
PRICE RIVER WATER USERS ASSOCIATION

EXHIBIT "C"

JUL 11 1984

WATER RIGHTS

RESOLUTION

BE IT AND IT IS HEREBY RESOLVED by the Board of Directors of the CARBON WATER CONSERVANCY DISTRICT, at a meeting held on the 8th day of June, 1984, that the President and Secretary of said District be, and they are hereby authorized and empowered to execute on behalf of the District an Agreement with the SANPETE COUNTY WATER CONSERVANCY DISTRICT bearing the above date settling controversies between Carbon County water users and Sanpete County water users on the terms and conditions set out in said agreement presented and considered at this meeting.

CERTIFICATION

I, the undersigned Secretary of the CARBON WATER CONSERVANCY DISTRICT, hereby certify that the foregoing is a true and correct copy of a resolution adopted by the directors of the said District at a special meeting of the CARBON WATER CONSERVANCY DISTRICT held on the 8th day of June, 1984.

Secretary

EXHIBIT "D"

NARROWS PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B

IDENTIFICATION AND EVALUATION OF POTENTIAL DAMSITES

FRANSON-
NOBLE & ASSOCIATES, INC. CONSULTING ENGINEERS

July 25, 1996

To: Files

From: Richard Noble

Subject: Identification and Evaluation of Potential Dam Sites in Sanpete Valley

This document describes a process that was used to identify and evaluate potentially practicable dam sites in north Sanpete Valley. USGS 7.5 minute quadrangle maps were used to identify potentially suitable sites. The goal of this initial search was to find sites that would serve as alternatives to the Narrows Reservoir site and that could create reservoirs with a minimum storage capacity of 5,400 acre-feet, either individually or collectively. Attached is a map showing the location of the 10 sites identified and considered. Following is a tabulation of data related to the sites:

Site	Area (sq. ft.)	Average Depth (ft.)	Max Volume (AF)	Dam Ht (ft.)	Length (ft.)	Max Elevation (ft.)
1	9,728,000	40	8,933	120	2900	6600
2	11,392,000	120	31,383	240	4800	6600
3	40,601,600	20	18,642	50	3000	6280
4	2,560,000	100	5,877	300	1400	7200
5	7,680,000	300	52,893	450	2000	7200
6	1,177,600	40	1,081	90	800	6520
7	5,939,200	40	5,454	120	2800	6400
8	3,840,000	60	5,289	140	1500	6200
9	4,275,200	120	11,777	240	2200	6600
10	2,432,000	120	6,700	240	1200	7200

Site 8 would require pumping from the reservoir to service much of the project area. Those reservoirs with elevations greater than 7000 would need to have a diversion structure and pipeline constructed approximately 2 miles up Cottonwood Canyon to be supplied by gravity flow. This may be infeasible because of the geologic instability of the canyon. Sites 1,2 and 9 would require a diversion approximately 3/4 miles up Cottonwood Canyon.

Initial screening of the above sites resulted in two sites being investigated further. Screening criteria was based on location, dam height and length, and ability of the site to delivery project water with minimal or no pumping. Based on initial screening, sites 1,2,4,6,7,8,9 and 10 were eliminated from further consideration. Preliminary dam height versus capacity curves were developed for sites 3 and 5 to determine the dam height necessary to develop 5,400 acre-feet of storage. Four feet of freeboard is assumed for this more detailed analysis.

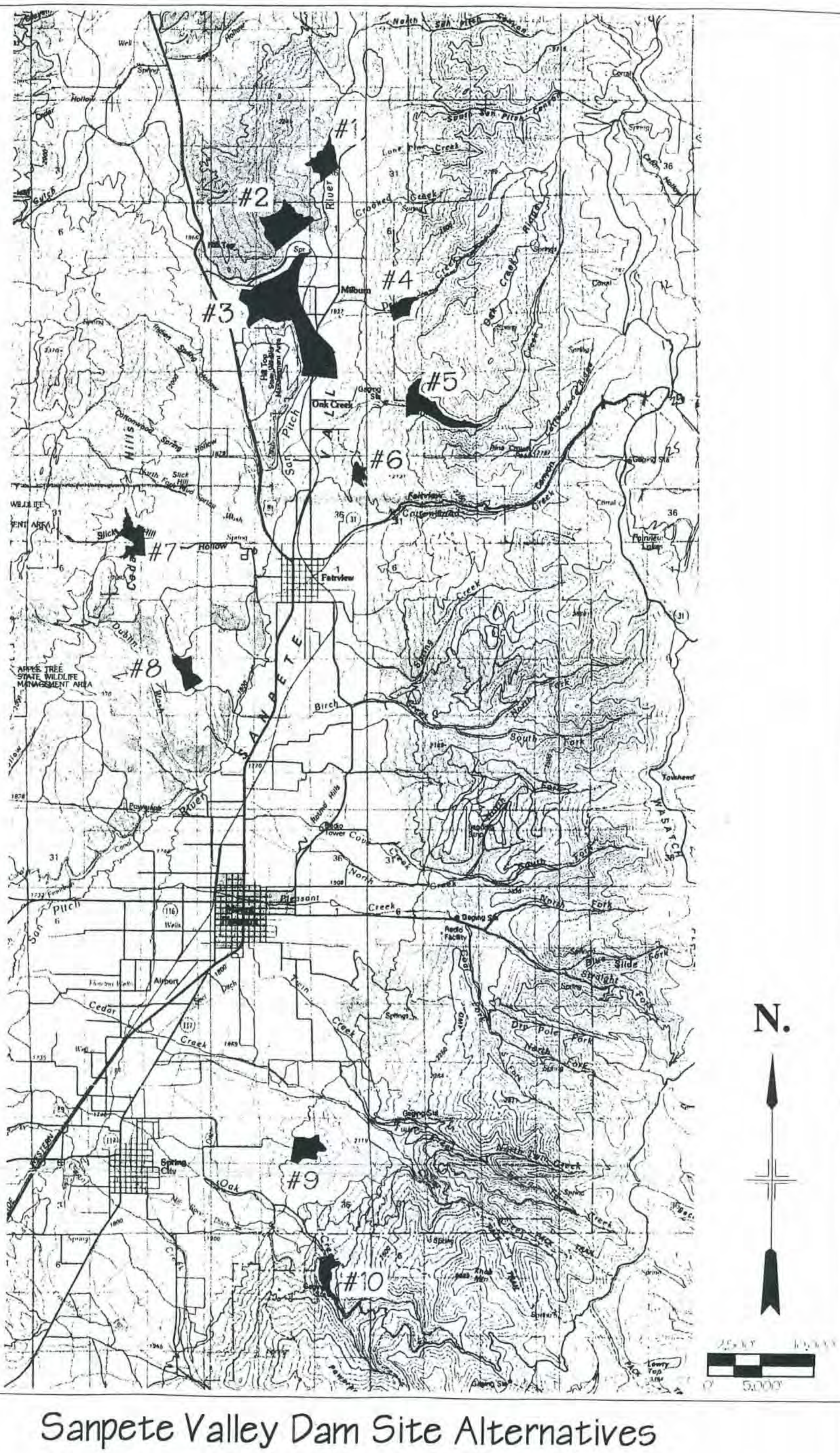
Site 3 would require a dam height of 64 feet and a length of 2,185 feet to develop 5,400 acre-feet. Reconnaissance level cost estimate for constructing a dam at Site 3 is $9.5 million. It would also require annual pumping costs of $95,000 to service project lands and approximately 6,000 feet of additional pipeline to connect the reservoir to the Oak Creek Pipeline at an estimated cost of $1.3 million. The county road would also need to be rerouted around the reservoir. It is estimated that this cost would be comparable to relocation of the highway for Narrows Dam, which is $1 million.

Site 5 would require a dam height of 185 feet and a length of 1,190 feet and would cost approximately $91 million. Site 5 would have the additional cost of one mile of additional pipeline in Cottonwood Canyon and an another mile of pipeline from the Oak Creek Pipeline to the proposed site. The cost for these additional pipelines is estimated to be $2.2 million.

The Oak Creek Pipeline would need to be enlarged from 10 inch PVC to 27 inch concrete pipe to carry the East Bench water with both Site 3 and Site 5. This additional cost is estimated to be $2,5 million. Computations for these estimates are on file.

The total cost of the Site 3 alternative is $14.3 million with annual pumping costs of $95,000 compared to Narrows Dam costs of $7.2 million with no pumping costs. The total cost for Site 5 is $95 million. Clearly, these most reasonable two sites of the ten identified in Sanpete Valley are much more costly than the proposed Narrows Dam.

Richard M Noble



Sanpete Valley Dam Site Alternatives

Narrows Project

July 1995

NARROWS PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C

BIOLOGICAL OPINION FOR THE PROPOSED NARROWS PROJECT – A SMALL RECLAMATION PROJECT ACT (SRPA) LOAN

ORIGINAL

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:

FWS/R6
ES

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

AUG 24 2000

Memorandum

To: Area Manager, Upper Colorado Region
Bureau of Reclamation
Provo, Utah

From: Regional Director, Region 6
U.S. Fish and Wildlife Service
Denver, Colorado.

Subject: Draft Biological Opinion for the Proposed Narrows Project - A Small Reclamation Project Act (SRPA) Loan

In accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), and the Interagency Cooperation Regulations (50 CFR Part 402), this transmits the Fish and Wildlife Service's draft biological opinion on the proposed Narrows Project and its effects on the endangered Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), humpback chub (*Gila cypha*), and bonytail (*Gila elegans*).

This Opinion is the result of reinitiation of an extended consultation including two biological opinions (March 1992, January 1995), one amended biological opinion (October 1995), the original biological assessment (October 1991), and three amended biological assessments (July 1994, March 1997, February 1999), the Draft Environmental Impact Statement (DEIS, March 1998), and the Price River Cumulative Hydrology Study (November 1998). We also considered other materials on file such as technical memoranda, project plans, various reports, and other relevant information. A complete administrative record of this consultation is on file in our Salt Lake City field office.

The reinitiation of consultation and resultant issuance of this Opinion was prompted by the most recent two amended biological assessments. The first of these was received on March 7, 1997, based on new information on the status of Colorado pikeminnow in the lower Price River. The second amended biological assessment dated February 5, 1999, was based on the presence of willow flycatcher (*Empidonax traillii* sp.) preliminarily identified as the endangered subspecies of southwestern willow flycatcher (*E. t. extimus*) (Service memorandum dated October 13, 1998) in the proximity of the proposed Project.

We concur that the project as proposed is not likely to adversely affect the bald eagle for reasons described by the Bureau of Reclamation in the biological assessments and EIS for the proposed Project, and is likely to adversely affect the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail.

Based on more recent information which has become available on the subspecies of willow flycatcher found within the affected project area, at this time we do not believe this willow flycatcher to be the endangered subspecies, the southwestern willow flycatcher. Therefore no discussion is offered specifically in reference to the endangered subspecies, *E. t. extimus* in this Opinion. The basis for this finding follows.

In an October 13, 1998, memorandum, we notified Reclamation that State of Utah surveys had discovered the endangered southwestern willow flycatcher present in the proximity of the Narrows Project, and that an amendment to the biological assessment would be necessary. The memorandum further stated that genetic and vocal sampling was being conducted to verify the willow flycatcher subspecies. To date, we have the following preliminary information of subspecies identification.

- The willow flycatcher subspecies inhabiting the riparian corridor in the Project proximity is located at the extreme northern boundary of *E. t. extimus* but within the range of *E. t. adastus, an unlisted subspecies*. Experts suggest that the central part of the State of Utah is more likely an area of intergradation between *E. t. adastus* and *E. t. extimus* (Behle 1985).

- Genetic analysis to date has shown that the willow flycatcher population does not have the genetic markers of *E. t. extimus* and is more closely related to *E. t. adastus* (Memorandum from Evan Paxton and Dr. Mark Sogge, Biological Resources Division, October 1, 1999). A final report is expected on this analysis.

- Vocalization analysis has determined the population to be *E. t. adastus* (Dr. Jim Sedgwick, USGS, Midcontinent Ecological Science Center, Ft. Collins, pers. comm; Spring 1999). However, these results have yet to be published or peer-reviewed.

Therefore, the following Opinion only addresses the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail. If further analysis determines that the willow flycatcher subspecies population is the *E. t. extimus* subspecies or some significant intercross gradation between *E. t. adastus* and *E. t. extimus,* reinitiation of formal consultation will be required and a new biological opinion which includes the southwestern willow flycatcher will be issued. This opinion does, however, include recommendations to protect the willow flycatcher subspecies population in the Project proximity because of our interest in neo-tropical migratory birds as a trust resource and because of the potential for identifying a biologically significant intercross gradation between *E. t. extimus* and *E. t. adastus* in the Project proximity. Protection of the riparian habitats within the project area could also be important to assist in recovery of *E. t. extimus*.

CONSULTATION HISTORY

We have been involved with Reclamation in an extended consultation on the proposed Project. The following documents the consultation history.

- October 1991 - We receive the first biological assessment on the proposed Narrows Project from Reclamation.

- March 25, 1992 - We issue the initial biological opinion.

- July 7, 1994 - Reclamation requests reinitiation of consultation based on an anticipated increase in average annual depletion and based on newly designated critical habitat for the four endangered Colorado River fish species.

- January 9, 1995 - We issue a second biological opinion on the proposed Project.

- July 18, 1995 - Reclamation provides information to us on capture of one juvenile Colorado pikeminnow in the Price River but indicates that reinitiation of formal consultation may not be necessary.

- October 5, 1995 - We concur that formal consultation is not necessary but amend the January 1995 biological opinion with an additional reasonable and prudent alternative to avoid jeopardy to the Colorado pikeminnow. This reasonable and prudent alternative calls for a 2-year study of fish composition and water quality in the Price River to assess the recovery potential of the Price River.

- We also recommend the Price River be prioritized within the Recovery Implementation Program for Upper Colorado River basin endangered fish species (RIP) Recovery Action Plan (RIPRAP).

- March 7, 1997 - Reclamation issues an amendment to the biological assessment for the proposed Narrows Project which describes new-found information on the status of Colorado pikeminnow and suggests specific items to be included into the RIPRAP. These items include: 1) the RIP depletion charge be applied to the Narrows Project, 2) additional years of study to identify year-round use of the Price River by Colorado pikeminnow, and 3) legal protection of instream flows. This letter also requested reinitiation of consultation.

- October 13, 1998 - We identify southwestern willow flycatcher as an additional endangered species present in the proximity of the proposed Project and advise Reclamation to provide an amendment to the biological assessment addressing southwestern willow flycatcher.

- February 5, 1999 - Reclamation provides an amended biological assessment that includes southwestern willow flycatcher.

BIOLOGICAL OPINION

I. DESCRIPTION OF PROPOSED ACTION

The Sanpete Water Conservancy District has applied to Reclamation for a Small Reclamation Project Act loan to help finance construction of the proposed Narrows Project. Such loans are made available by Reclamation to assist with construction of non-Federal projects. The Sanpete Water Conservancy District has also applied to use lands for the Narrows Project that were withdrawn from the public domain by Reclamation. The proposed Narrows Project would include a 120-foot high dam and 7,900 acre-foot total storage capacity reservoir to be constructed on Gooseberry Creek, a tributary to Fish Creek in the Price River drainage (there are no threatened or endangered species in this drainage). This proposed Project would also include a trans-basin diversion of water through an existing tunnel that would be rehabilitated (3,100 feet in length; 36 inch diameter; 60 cfs capacity) into Cottonwood Creek in the San Pitch/Sevier River drainage. The proposed Narrows Project will result in an average annual depletion of 5,717 acre-feet of water in the Price River. The Narrows Dam and Reservoir site are located approximately 9 miles northeast of the town of Fairview, Utah. Affected downstream water storage projects include the existing Lower Gooseberry Reservoir (small pass-through reservoir) approximately 5 miles downstream and the existing Scofield Dam and Reservoir (approximately 45,000 acre-foot total storage capacity) approximately 20 miles downstream of the proposed Narrows Project site.

The proposed Narrows Project would involve construction of features and facilities to develop a supplemental water supply to be used on presently irrigated lands and by municipal water users in the north part of Sanpete County, Utah. The proposed Project would divert water from Gooseberry Creek in the upper Price River drainage through an existing tunnel to Cottonwood Creek in the San Pitch/Sevier River drainage for delivery to lands and water users in the Sanpete Valley area surrounding Fairview, Utah. Water stored in the Narrows Reservoir would be diverted and delivered trans-basin through the existing Narrows Tunnel to Cottonwood Creek. The Narrows Tunnel would be rehabilitated as part of the proposed Project. Proposed Project water would then be diverted from Cottonwood Creek to a pipeline delivery system constructed as part of the project. This pipeline would then deliver the proposed Project water to existing water distribution systems in northern Sanpete County where it would be used by agricultural and municipal water users. Recreation facilities would be developed at Narrows Reservoir and a 2,500 acre-foot minimum pool for a reservoir fishery would be established. Specific mitigation measures would be implemented to offset wetland, terrestrial wildlife and stream fishery impacts.

Water conservation measures would be implemented as part of the proposed Project (BOR 1998).

Operation of the Narrows Project would affect stream flows in Gooseberry Creek, Fish Creek, Price River, and that portion of the Green River downstream of its confluence with the Price River within the Colorado River Basin, and would also affect stream flow in Cottonwood Creek within the San Pitch/Sevier River Basin. The proposed Project water supply would come from upper Gooseberry Creek and its tributaries. Impacts to lower Gooseberry Creek and Fish Creek would occur primarily during the spring snow melt period as water is stored in the Narrows Reservoir for release later in the summer. Impacts to Scofield Reservoir would be reduced inflows, resulting in lowering of reservoir storage. Impacts downstream of Scofield Dam would include reduced spring peak flows and overall water depletions affecting approximately 130 to 150 miles of the Price River as it flows between Scofield Dam and the Price/Green River confluence and an overall depletion from the Green River. Scofield Dam would spill less frequently and for shorter durations, lowering the volume of peak flows in the Price River below the dam and in the Green River below the mouth of the Price River (138 miles upstream of the Green/Colorado rivers confluence). Depletions to the Price River drainage would average 5,717 acre-feet per year. This amount consists of 5,324 acre-feet of trans-basin diverted water and 393 acre-feet of increased evaporation.

II. BASIS FOR BIOLOGICAL OPINION

The biological opinion addresses an average annual depletion of approximately 5,717 acre-feet from the Upper Colorado River basin. Water depletions in the Upper Basin have been recognized as a major source of impact to endangered fish species. Continued water withdrawal has restricted the ability of the Colorado River system to produce flow conditions required by various life stages of the fishes.

Critical habitat has been designated for the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker within the 100-year flood plain in portions of their historic range (59 FR 13374). Destruction or adverse modification of critical habitat is defined in 50 CFR 402.02 as a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. In considering the biological basis for designating critical habitat, we focused on the primary constituent elements that are essential to the conservation of the species without consideration of land or water ownership or management. We have identified water, physical habitat, and biological environment as the primary constituent elements. This includes a quantity of water of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species. Water depletions reduce the ability of the river system to provide the required water quantity and hydrologic regime necessary for survival and recovery of the fishes. The physical habitat includes areas of the Colorado River system that are inhabited or potentially inhabitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year flood plain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats.

III. STATUS OF THE SPECIES/CRITICAL HABITAT

Information on Colorado pikeminnow, razorback sucker, humpback chub, and bonytail presented in this Opinion are considered the best scientific and commercial biological information available on these species. Sources of information include previous biological opinions concerning these species, technical reports, published scientific manuscripts, unpublished data, and working knowledge of the species. The most comprehensive compilation of information on these species to date was conducted by the Flaming Gorge Technical Team in their efforts to develop Green River and Flaming Gorge flow recommendations to benefit endangered fishes. The team consists of Reclamation and Service personnel and technical experts from Argonne National Laboratory (contracted through Western Area Power Administration) and Colorado State University Larval Fish Laboratory. Although the report from which this information was taken is in draft form and not approved for citation, the biological information is considered the most recently compiled and accurate comprehensive review of the status and biology of the endangered Colorado River fish species and is therefore used in this Opinion.

COLORADO PIKEMINNOW

A. Species description

The Colorado pikeminnow evolved as the dominant predator in the Colorado River system. Historically, adult Colorado pikeminnow attained lengths in excess of one meter and individuals in excess of 20 kg were common (Minckley 1973; Tyus 1991a). Individuals in excess of 0.8 meter in length and 10 kg in weight are now very uncommon and are likely older than 40 years (Tyus 1991a; Osmundson et al. 1997). Habitat of adult Colorado pikeminnow consists of deep, low-velocity eddies, pools, and runs, or seasonally flooded lowlands (Tyus 1990; Tyus 1991a). Adults mature at total lengths exceeding 400 mm and at 5 to 7 years of age (Vanicek and Kramer 1969; Hamman 1981; Tyus 1991a).

Based on early fish collection records, on archaeological finds, and on other observations, the Colorado pikeminnow was once found throughout warm water reaches of the entire Colorado River Basin, including reaches of the upper Colorado River and its major tributaries, the Green River and its major tributaries, and the Gila River system in Arizona (Seethaler 1978). Colorado pikeminnow apparently were never found in colder, headwater areas. Seethaler (1978) indicates that the species was abundant in suitable habitat throughout the entire Colorado River Basin prior to the 1850's. Historically, Colorado pikeminnow have been collected in the upper Colorado River as far upstream as Parachute Creek, Colorado (Kidd 1977).

A marked decline in Colorado pikeminnow populations can be closely correlated with the construction of dams and reservoirs between the 1930's and the 1960's, with introduction of nonnative fishes, with overwhelming water pollution, and with removal of water from the

Colorado River system. Behnke and Benson (1983) summarized the decline of the natural ecosystem. They pointed out that dams, impoundments, and water use practices are probably the major reasons for drastically modified natural river flows and channel characteristics in the Colorado River Basin. Dams on the mainstream essentially have segmented the Colorado River system, blocking Colorado pikeminnow spawning migrations and drastically changing river characteristics, especially flows and temperatures.

In addition, major changes in species composition were caused by introduction of nonnative fishes, many of which have thrived as a result of changes in the natural riverine system (i.e., flow and temperature regimes). The decline of endemic Colorado River fishes seems to be at least partially related to competition or other behavioral interactions with nonnative species, which have perhaps been exacerbated by alterations in the natural fluvial environment. In addition, water pollution, which went virtually unchecked until passing of environmental legislation in the 1960's and 1970's, could in extreme cases cause fish kills. The extent to which pollution affected the status of Colorado River fish is unknown but one example of water pollution noted in a 1953 Utah Fish and Game Bulletin which cited 'heavy losses of fish, particularly Colorado River salmon (*Ptychocheilus lucius*)' suggests impacts may have been spatially and temporally devastating to Colorado pikeminnow populations.

Throughout most of the year, juvenile, subadult, and adult Colorado pikeminnow utilize relatively deep, low-velocity habitats that occur in nearshore areas of main river channels (Tyus 1991a). In spring, however, when discharge is high due to snow-melt runoff, Colorado pikeminnow adults utilize flood plain wetlands, flooded tributary mouths, flooded side canyons, and eddy habitats that are accessible only during high flows (Tyus 1990). Such environments may be particularly beneficial for Colorado pikeminnow because other riverine fishes gather in flood plain habitat to exploit food and temperature resources, and may serve as prey for all life stages. Such low-velocity environments may also serve as resting areas for Colorado pikeminnow.

B. Life history

Adults undergo spawning migrations that may involve long-distance movements. Round-trip distances of over 500 miles (Irving and Modde in press) have been reported and individuals may migrate to natal areas using cues that were imprinted during the larval stage (Tyus 1985; Tyus 1990; Irving and Modde in press). As an integral part of the natural flow regime, peak spring flows aid formation of habitat for all life stages of Colorado pikeminnow and may also provide an important cue to prepare adults for migration. Other factors such as water temperature, photoperiod, and conspecific odors may also be important to cue reproduction (Nesler et al. 1988; Tyus and Karp 1989; Tyus and Karp 1991; Bestgen et al. 1998). Environmental cues used by the fish to complete their life cycle are needed in all areas occupied by adults including tributaries and the mainstem Green River.

Colorado pikeminnow reproduce during late spring and summer after discharge from snow-melt runoff peaks and when water temperatures are increasing and generally greater than 16° C

(Haynes et al. 1984; Tyus 1990; Tyus 1991a; Bestgen et al. 1998). Following spawning, most adults return by late August or September to home ranges occupied the previous spring (Tyus 1990; Irving and Modde in press).

Although direct observation of Colorado pikeminnow spawning is not possible in the Green and Yampa rivers because of high turbidity, radiotelemetry indicates spawning occurs over cobble-bottomed riffles (Tyus 1990). If adhesive eggs are deposited in interstitial spaces of spawning substrate they likely require clean cobble surfaces for secure attachment (Hamman 1981; Tyus and Karp 1989).

Laboratory studies suggested that wild embryos may incubate in the spawning substrate for 4–7 days, with duration inversely related to water temperature (Hamman 1981; Marsh 1985; Bestgen and Williams 1994). Temperatures from 18° to 26° C produced similar and relatively high rates of hatching (54–79 percent) and survival to 7 days posthatch (52–88 percent). Survival was only 13 percent at 30° C, which may be near the upper lethal limit for embryos. Hatching success at 16° C, the lowest temperature at which Colorado pikeminnow were known to spawn in the wild (Bestgen et al. 1998), is unknown. Hatching success averaged about 10 percent higher in fluctuating (5° C diel range) than in constant temperatures (18° to 26° C).

Eggs deposited in spawning gravel hatch within 5–7 days, and larvae swimup 5–7 days later. At swimup, larvae are 6–9 mm (implied total length) and are immediately swept downstream, sometimes long distances, from spawning areas (Hamman 1981; Haynes et al. 1984; Nesler et al. 1988; Bestgen and Williams 1994; Bestgen et al. 1998). Larvae drift to relatively low-gradient river reaches where low-velocity, shallow, channel-margin habitats (e.g., backwaters) are common, and they remain there throughout the summer (Vanicek and Kramer 1969; Tyus and Haines 1991; Muth and Snyder 1995).

The exact mechanism by which Colorado pikeminnow larvae drift downstream and inhabit backwater habitat is not completely understood. Larvae are probably carried near shorelines by prevailing river currents and eventually encounter backwaters with a probability that depends on availability of such habitat. Because swimming in relatively swift main-river currents is energetically costly and mortality risks are high, larvae that quickly encounter a suitable backwater are more likely to survive. Based on tests of swimming performance in a velocity tube, larvae of a size typically captured in drift nets (8–10 mm) were often capable of maintaining position for nearly 30 seconds in water flowing 15 cm/s (K. Bestgen, unpublished data). Thus, active locomotion may play an important role when Colorado pikeminnow larvae move from the main channel into backwaters.

Early life stages of Colorado pikeminnow in backwaters feed on a variety of small invertebrates, of which chironomids are particularly important (Muth and Snyder 1995). As in other fishes, the growth rate of Colorado pikeminnow is dependent on food abundance and water temperature (Bestgen 1996). Seasonal food abundance in Green River backwaters is most likely a function of backwater stability, nutrient levels, primary production, and "maturity", which affects the time invertebrates have to colonize and build populations. Benthic assemblages may be an even more important food source for early life stages of fishes in the Green River (Muth and Snyder 1995).

Nighttime temperature fluctuations may cool backwaters to well below 22° C and create sub-optimal growth conditions. In a laboratory study, growth of Colorado pikeminnow larvae was optimal at 31° C and high at all temperature treatments that were 22° C or warmer (Bestgen 1996). At the highest food abundance, growth of Colorado pikeminnow larvae was 36 percent less at 18° C compared to that observed at 22° C (Bestgen 1996). In the wild, Colorado pikeminnow may move to acquire more optimal habitat. For example, Tyus (1991b) found that early life stages of Colorado pikeminnow moved out of backwaters at night, presumably in response to water temperatures that were colder than the main channel, and moved back in as temperatures warmed during the day. Such a strategy would allow Colorado pikeminnow to maximize degree-day accumulation and growth in a diel period.

The abundant nonnative fishes that co-occur with Colorado pikeminnow in backwaters are potential predators on fish larvae. Of particular concern is the most abundant species, red shiner, a known predator on fish larvae in the wild (Ruppert et al. 1993). In laboratory tests, red shiners averaging about 60 mm were able to capture and consume Colorado pikeminnow as large as 22 mm (Bestgen et al. 1997). Larger Colorado pikeminnow were not vulnerable to red shiners because they could not be physically ingested.

Energy reserves, particularly lipids, are thought to influence overwinter survival of age-0 fish (Thompson et al. 1991). Because lipid stores are generally positively correlated with body size and condition of fish, biotic and abiotic conditions in summer and autumn that affect growth may influence overwinter survival. Thompson et al. (1991) found that smaller Colorado pikeminnow with lower amounts of lipid were in poorer condition and survived at lower rates than larger fish over a simulated winter period in the laboratory, and they concluded that overwinter survival of wild fish may be size-dependent.

Comparison of catch-effort data collected in fall and then again in spring from 1979 to 1988 showed negligible overwinter mortality of age-0 Colorado pikeminnow relative to other seasons (Tyus and Haines 1991). However, other studies in other years (Converse et al. 1998b) or those using capture-recapture estimation techniques (Haines et al. 1998) have demonstrated substantial overwinter mortality, especially for small-bodied Colorado pikeminnow. Converse et al. (1998b) suggested that size-dependent overwinter mortality was important in some years, but in others, abundance of Colorado pikeminnow in spring was mostly a function of autumn abundance. Haines et al. (1998) reported overwinter survival of 56 to 62 percent in three estimates but only 6 percent overwinter survival of a cohort in the Green River that had small body size. They suggested that low overwinter survival in that high flow year was partially due to lack of energy reserves.

Juveniles also occupy backwaters and other low-velocity nearshore areas; older and larger subadults tend to use habitat similar to that of adults. Subadults then disperse and recruit to upstream reaches where they establish home ranges (Osmundson et al. 1998).

The ability to feed in turbid waters of the Colorado River system and lack of teeth in jaws are unusual features of piscivorous Colorado pikeminnow. Colorado pikeminnow less than 50 mm eat primarily invertebrates, the diet of those between 50 and 200 mm is a combination of invertebrates and fish, and those greater than 200 mm are mainly piscivorous (Vanicek and Kramer 1969; Muth and Snyder 1995). Large adults also occasionally consume other vertebrates including birds and mammals (Tyus 1991a).

C. Population Dynamics

All life stages of Colorado pikeminnow in the Green River demonstrate wide variations in abundance at seasonal, annual, or longer time scales, but reasons for shifts in abundance are poorly understood. The population structure of the Colorado pikeminnow is thought to resemble a metapopulation in that several somewhat spatially distinct populations are centered around specific spawning locations; however some interchange of individuals between populations occurs (Gilpin 1993). Colorado pikeminnow occupy life-stage specific habitats that are distributed over a broad spatial scale in the Green River system. Adults migrate to canyon-bound spawning areas distant from home ranges, embryos incubate and hatch in spawning gravel, newly emerged larvae drift downstream and into low-velocity nursery habitats, and subadults move back upstream.

In alluvial valley reaches of the Green River where most nursery habitat occurs, age-0 and age-1 Colorado pikeminnow occupy shallow, channel-margin backwaters. Juveniles and adults eventually disperse from nursery-habitat areas and into tributaries or the mainstem Green River up- or downstream of spawning localities. Because factors that affect survival of various Colorado pikeminnow life stages are imposed over a spatially extensive area, a variety of biological and physical factors may interact to influence recruitment success of individual year classes.

A. Status and distribution

The endangered Colorado pikeminnow is endemic to the Colorado River basin and was formerly widespread and abundant in warmwater streams and rivers (Jordan and Evermann 1896). Historic accounts suggest that Colorado pikeminnow were especially abundant in the lower Colorado River basin downstream of Lee's Ferry, Arizona (Minckley 1973; Tyus 1991a; Maddux et al. 1993). Lower basin populations remained abundant until the 1930's (Miller 1961) but declined soon thereafter presumably due to the combined effects of river regulation by dams and introduced fishes (Minckley and Deacon 1968; Minckley 1973). The last Colorado pikeminnow collected in the Gila River system was in 1950; scattered individuals were captured in the lower mainstem Colorado River and reservoirs in the 1960's (Minckley 1973), but by the early 1970's the species was extirpated from the lower Colorado River basin (Tyus 1991a).

In the upper Colorado River basin, historic accounts also report the presence of large populations of Colorado pikeminnow (Tyus 1991a; Quarterone 1993). Populations persist in all three major river and tributary systems of the upper Colorado River basin (i.e., San Juan, Colorado, and Green river systems), but they are severely reduced in all but the latter (Platania et al. 1991; Tyus 1991a; Osmundson and Burnham 1996). There may be less than 100 wild adult Colorado pikeminnow remaining in the San Juan River system based on the few recent captures and relatively high recapture rates (D. Propst, New Mexico Department of Game and Fish, personal communication). Osmundson and Burnham (1996) recently estimated that about 600 to 650 adult Colorado pikeminnow occur in the Colorado River upstream of the Green River confluence. Although no abundance estimates have been calculated, populations in the Green River system are thought to be substantially larger than those in the Colorado River based on relative capture-rate data collected annually in the Interagency Standardized Monitoring Program (ISMP) and capture rates of marked fish (Tyus 1991a; McAda et al. 1994a, 1994b, 1995, 1996, 1997).

Although historic accounts are sketchy, most described Colorado pikeminnow as widespread and abundant in the Green River system (Tyus 1991a; Quarterone 1993). Based on those accounts and habitat tolerances described in more recent studies, it is reasonable to assume that Colorado pikeminnow were found throughout lower reaches of most tributary streams in warm and cool water, and extended far upstream in the mainstem Green River to near Green River, Wyoming (Ellis 1914; Baxter and Simon 1970). In the vicinity of the Flaming Gorge Dam site, an aggregation of ripe male Colorado pikeminnow was discovered in early August 1961 (Vanicek et al. 1970), suggesting that this area once supported a reproducing population.

By the time the first comprehensive surveys were conducted during 1967–1973 (Holden and Stalnaker 1975a, 1975b), the Colorado pikeminnow was considered rare and endangered throughout the upper Colorado River basin, including the Green River system. Holden and Stalnaker (1975a) identified the lower Yampa River in Yampa Canyon and the middle and lower Green River as potential spawning areas based on aggregations of ripe adults and presence of early life stages. These inferences later proved mostly correct as spawning areas have been found in the lower Yampa River and Green River in Gray Canyon (Haynes et al. 1984; Tyus 1990; Tyus and Haines 1991; Bestgen et al. 1998).

The Colorado pikeminnow currently occupies approximately 1,100 river miles in the Colorado River system (25 percent of its original range) and is presently found only in the upper Colorado River basin above Glen Canyon Dam. The Colorado pikeminnow inhabits about 390 miles of the mainstem Green River from its confluence with the Colorado River upstream to the Gates of Ladore (Kevin Bestgen pers.comm.). Colorado pikeminnow have also been observed in the lower 49 miles of the Duchesne River and the lower 88.5 miles of the Price River. The Colorado pikeminnow's range also extends 160 miles up the Yampa River and 104 miles up the White River, the two largest tributaries of the Green River. In the mainstem Colorado River, it is currently found from Lake Powell extending about 201 miles upstream to Palisade, Colorado

(Tyus et al. 1982), and in the lower 60 miles of the Gunnison River, a tributary to the mainstem Colorado River (Burdick 1995).

During most of the year, distribution patterns of adults in the Green River system are stable, and from late summer to the following spring, adults are widely distributed and thought to occupy distinct home ranges (Tyus 1990; Tyus 1991a; Irving and Modde in press). Distribution of adults changes in late spring and early summer when most mature fish migrate to spawning areas in the lower Yampa River in Yampa Canyon and the lower Green River in Gray Canyon (Tyus and McAda 1984; Tyus 1985; Tyus 1990; Tyus 1991a; Irving and Modde in press). Those fish remain in spawning areas for 3–8 weeks before returning to their individual home ranges. Some radio-tagged fish did not migrate to spawning areas each year. These may have been immature or non-spawning individuals, or fish that moved to other areas for spawning (Tyus 1990). Although additional spawning sites may exist (Tyus 1990), recent movement patterns of adults (Irving and Modde in press) and capture rates of larvae at drift-net sites downstream of principal spawning areas (Bestgen et al. 1998) suggest that other sites are rarely used.

Historically, Echo and Island parks in the upper Green River supported nursery habitat for Colorado pikeminnow (Vanicek et al. 1970; Holden and Stalnaker 1975a; Holden and Crist 1981). Early life stages of Colorado pikeminnow in that area remain rare (Holden and Crist 1981; Tyus and Haines 1991; Bestgen and Crist 1998). No larvae or juveniles of Colorado pikeminnow have been collected from the Green River upstream of the Yampa River confluence since initial post-impoundment studies of Flaming Gorge Dam ended in 1966 (Vanicek and Kramer 1969; Vanicek et al. 1970; Holden and Crist 1981; Bestgen and Crist 1998; Bestgen et al. 1998).

Presently, there are two primary reaches of Colorado pikeminnow nursery habitat in the Green River system. One occurs in the middle Green River from near Jensen, Utah, downstream to the Duchesne River confluence. The other is in the lower Green River from near Green River, Utah, downstream to the Colorado River confluence (Tyus and Haines 1991; McAda et al. 1994a; McAda et al. 1994b-1997). The reach of the Green River defined mostly by Desolation and Gray canyons also provides nursery habitat for Colorado pikeminnow (Tyus and Haines 1991; Day et al. 1999).

Juvenile Colorado pikeminnow 80–400 mm have the most restricted distribution of any life stage in the Green River system. Juveniles are most common in the lower portion of the Green River, downstream of Green River, Utah, with fewer in the middle Green River (McAda et al. 1994a). Juveniles are found in the White River and other tributaries (McAda et al. 1994b, 1995, 1996, 1997; Cavalli 1998), but few have ever been caught in the Yampa River upstream of Yampa Canyon. A few age-0 and juvenile Colorado pikeminnow were captured in recent years from the lower Yampa River and the Green River in the Island-Rainbow Park reach (Bestgen and Crist 1998; K. R. Bestgen, unpublished data).

The Colorado pikeminnow was listed as endangered on March 11, 1967. Full protection under the Endangered Species Act of 1973, as amended, occurred on January 4, 1974.

Critical Habitat Description for Colorado pikeminnow

Critical habitat, as defined in section 3(5)(A) of ESA, means: "(i) the specific areas within the geographical area occupied by the species at the time it is listed in accordance with section 4 of the Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by a species at the time it is listed in accordance with section 4 of the Act, upon a determination by the Secretary that such areas are essential for the conservation of the species."

Critical habitat was designated for four endangered Colorado River fishes on March 21, 1994, including the Colorado pikeminnow. Designated critical habitat for the endangered Colorado River fishes includes those portions of the 100-year flood plain that contain constituent elements. The constituent elements are those physical and biological features that the Service considers essential for the conservation of the species and include, but are not limited to, the following items: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally (5) habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distributions of the species.

The primary constituent elements determined necessary for the survival and recovery of four endangered Colorado River fishes include (59 FR 13374), but are not limited to:

(1) Water

A quantity of water of sufficient quality (i.e., temperature, dissolved oxygen, lack of contaminants, nutrients, turbidity, etc.) that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species;

(2) Physical Habitat

Areas of the Colorado River system that are inhabited or potentially habitable by fish for use in spawning, nursing, feeding, and rearing, or corridors between these areas. In addition to river channels, these areas also include bottom lands, side channels, secondary channels, oxbows, backwaters, and other areas in the 100-year flood plain, which when inundated provide spawning, nursery, feeding, and rearing habitats, or access to these habitats;

(3) Biological Environment

Food supply, predation, and competition are important elements of the biological environment and are considered components of this constituent element. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation and competition, although considered normal components of this environment, are out of balance due to introduced nonnative fish species in many areas.

Destruction or adverse modification of critical habitat is defined at 50 CFR 402.02 as a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. In evaluating actions, we consider the action's impact on factors used to determine critical habitat of the Colorado River endangered fishes. These factors include the primary constituent elements of water, physical habitat, and biological environment. The ability of an area to provide these constituent elements into the future and the reaches' capability to contribute to the recovery of the species will also be considered.

Activities which may disturb or remove the primary constituent elements within designated critical habitat include, among others, actions that would reduce the volume and timing of water, destroy or block off spawning and nursery habitat, prevent recruitment, adversely impact food sources, contaminate the river, or increase predation by and competition with nonnative fish. Examples of activities that may destroy or adversely modify critical habitat are listed at 59 FR 13387, and include construction and operation of hydroelectric facilities, irrigation, flood control, bank stabilization, oil and gas drilling, mining, grazing, stocking or introduction of nonnative fishes, municipal water supplies, and resort facilities.

Critical habitat has been designated within the 100-year flood plain of the Colorado pikeminnow's historical range in the following sections of the Upper Basin and the San Juan River (59 FR 13374).

Colorado, Moffat County. The Yampa River and its 100-year flood plain from the State Highway 394 bridge in T. 6 N., R. 91 W., section 1 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah, Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties; and Colorado, Moffat County. The Green River and its 100-year flood plain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (Salt Lake Meridian).

Colorado, Rio Blanco County; and Utah, Uintah County. The White River and its 100-year flood plain from Rio Blanco Lake Dam in T. 1 N., R. 96 W., section 6 (6th Principal Meridian) to the confluence with the Green River in T. 9 S., R. 20 E., section 4 (Salt Lake Meridian).

Colorado, Delta and Mesa Counties. The Gunnison River and its 100-year flood plain from the confluence with the Uncompahgre River in T. 15 S., R. 96 W., section 11 (6th Principal Meridian) to the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).

Colorado, Mesa and Garfield Counties; and Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year flood plain from the Colorado River Bridge at exit 90 north off Interstate 70 in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to North Wash, including the Dirty Devil arm of Lake Powell up to the full pool elevation, in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).

New Mexico, San Juan County; and Utah, San Juan County. The San Juan River and its 100-year flood plain from the state route 371 bridge in T.29N., R.13W., section 17 (New Mexico Meridian) to Neskahai Canyon in the San Juan Arm of Lake Powell in T. 41 S., R. 11 E., section 26 (Salt Lake Meridian) up to the full pool elevation.

RAZORBACK SUCKER

A. Species description

The razorback sucker is a member of the sucker family, *Catostomidae,* and is endemic and unique to the Colorado River system. Females are larger than males of the same age. The moderate sized ventral mouth has a cleft lower lip, with lateral margins continuous and rounded. Razorback sucker coloration ranges from dark brown to olive dorsally and yellow to white ventrally, but color and morphology differ due to a sexual dimorphism that is especially obvious during reproductive seasons.

Adults are distinguished by a pronounced bony dorsal keel ("razor") arising immediately posterior to the occiput and may attain maximum total length of about one meter (commonly 400 -700 mm), weigh 5-6 kg (commonly less than 3 kg), and exceed 40 years of age (Minckley 1983; McCarthy and Minckley 1987). Larvae are generally 7-9 mm at hatching, 9-11 mm at swimup, and consume most of their yolk and begin exogenous feeding by 10-11 mm (Minckley and Gustafson 1982; Marsh and Langhorst 1988; Papoulias and Minckley 1990; Snyder and Muth 1990). Transition to the juvenile period (sensu Snyder 1976) occurs at 27-30 mm (Snyder and Muth 1990), and, generally, fish greater than 350 mm are sexually mature (Minckley 1983; Hamman 1985).

B. Life History and population dynamics

The razorback sucker is adapted to the various habitats and greatly fluctuating, unpredictable hydrologic conditions of the pristine Colorado River system (Minckley 1973, 1983; Holden and Stalnaker 1975a; Behnke and Benson 1983; Carlson and Muth 1989; Lanigan and Tyus 1989; Bestgen 1990; Minckley et al. 1991a) and apparently has a life strategy that includes use of inundated flood plain habitats as growth and conditioning areas (Tyus 1987; Tyus and Karp 1989, 1990, 1991; Modde 1996, 1997; Modde et al. 1995, 1996; Wydoski and Wick 1998). The razorback sucker has a multi-phase life cycle, with larvae and early juveniles representing several life-intervals that are morphologically and ecologically distinct from each other and from later juvenile and adult stages (Snyder and Muth 1990).

Habitats used by adult razorback suckers in rivers of the upper Colorado River basin include deeper runs, eddies, backwaters, and, at higher discharges, flooded off-channel environments in spring (the latter apparently including movements from the colder main channel into warmer habitats, a behavior called "staging", before spawning); runs and pools often in shallow water associated with submerged sandbars in summer; and low-velocity runs, pools, and eddies in winter (Tyus 1987; Osmundson and Kaeding 1989a; Valdez and Masslich 1989; Tyus and Karp 1990; Modde 1997; Modde and Wick 1997; Modde and Irving 1998). Young razorback suckers require nursery environments with quiet, warm, shallow water such as tributary mouths, backwaters, or inundated flood plain habitats in rivers (Smith 1959; Taba et al. 1965; Gutermuth et al. 1994; Modde 1996, 1997; Muth et al. 1998) and coves or shorelines in reservoirs (Minckley et al. 1991a). The diet of all life stages is varied and includes insects, zooplankton, phytoplankton, algae, and detritus (Taba et al. 1965; Vanicek 1967; Hamman 1987; Marsh 1987; Marsh and Langhorst 1988; Muth et al. 1998). Growth to adult size is rapid in warm, food-rich environments (Osmundson and Kaeding 1989b; Minckley et al. 1991a; Mueller 1995).

Minckley (1973) stated that razorback suckers in riverine environments make annual spawning runs to specific river areas. Razorback suckers in the Green River system spawn over bars of cobble, gravel, and sand substrates during spring-runoff flows at widely ranging discharges and water temperatures (McAda and Wydoski 1980; Tyus 1987; Tyus and Karp 1989, 1990; Muth et al. 1998). Reproduction in the lower Colorado River basin generally occurs during January through April (Medel-Ulmer 1983; Minckley 1983; Langhorst and Marsh 1986; Mueller 1989) but may extend from November into May (Bozek et al. 1991). Estimates of the total fecundity of wild females ranged up to 144,000 ova/fish (Minckley 1983). Presumably, long life and high fecundity allow the species to persist through several consecutive seasons of no or low reproduction and recruitment (Bestgen 1990).

Direct observation of spawning behavior and release of gametes in the Green River is prevented by high water turbidity (Tyus 1987; Tyus and Karp 1990). However, Mueller (1989) observed razorback suckers spawning in the clear Colorado River downstream of Hoover Dam, Arizona-Nevada, and reported behavior similar to that reported for populations in lower Colorado River basin reservoirs. In Lake Mohave, spawning groups of one female and several male razorback suckers congregate over coarse cobble in water 0.5-5 m deep. The males press against the female, and spawning convulsions (a few seconds in duration) sweep the substrate clear of fine materials and create depressions 20 cm or more deep. Individual females have been observed spawning hourly and daily on successive days within a week. The number of eggs released by a female with each spawning act is apparently only a small fraction of her total complement (Minckley et al. 1991a). McAda and Wydoski (1980) estimated the total fecundity of 10 razorback suckers (446-534 mm) caught in the Green River during autumn at 27,614 to 76,576 ova/fish, whereas estimates of total fecundity for five razorback suckers (391-570 mm standard length) collected from Lake Mohave during spring ranged from 74,600 to 144,000 ova/fish (Minckley 1983).

Incubation time and hatching success of razorback sucker embryos are temperature dependent. Marsh (1985) evaluated the effects of temperatures ranging from 5° to 30° C on incubation and hatch of captive razorback sucker embryos acclimated at 18° C. Among his treatments, total mortality of embryos occurred at 5°, 10°, and 30° C. Of those treatments with surviving embryos, hatch duration was longest (204 h) and percent hatch was highest (35 percent) at 20° C, hatch duration was shortest (96 h) at 25° C, and percent hatch was lowest (19 percent) at 15° C. Bozek et al. (1990) reported that hatching success of captive razorback sucker embryos acclimated to experimental temperatures ranged from 22 to 57 percent at 10° C, 32 to 65 percent at 15° C, and 34 to 65 percent at 20° C; total mortality occurred at 8° C. They concluded that optimal hatching temperatures were 12°-20° C. Hatching time for 50 percent of the eggs was 420-556 h at 10° C, 256-298 h at 15° C, and 15-168 h at 20° C.

Haines (1995) evaluated the effects of temperature (12°, 16°, and 20° C) on the developmental rate and hatching success of captive embryos of razorback and flannelmouth suckers. Mean number of days between fertilization and peak hatch decreased as temperature increased for both species and ranged from 6.5 to 12.5 days for razorback sucker and 6.0 to 16.5 days for flannelmouth sucker. The period from first to last hatch averaged 2.0 days longer for razorback sucker than for flannelmouth sucker over all temperatures. Percent hatch of flannelmouth embryos was independent of temperature and, at each temperature, was greater (83-91 percent) than for razorback sucker embryos (48-67 percent); hatching success of razorback sucker embryos increased as temperature increased.

Several factors may limit the survival of razorback sucker embryos in the Green River system. These factors include reduced water temperatures caused by operation of Flaming Gorge Dam (Tyus and Karp 1991), sedimentation of cobble and gravel spawning substrates associated with high releases from Flaming Gorge Dam occurring too early in the spring-runoff period (Wick 1997), predation on eggs by nonnative fishes (Hawkins and Nesler 1991; Lentsch et al. 1996c; Tyus and Saunders 1996), and selenium contamination of adults and embryos (Hamilton and Waddell 1994).

Before 1992 (Muth et al. 1998), direct evidence of reproduction by razorback suckers in the Upper Colorado River basin or information on the species' natural early life history in riverine environments were limited to those larvae collected by Tyus (1987) and captures of a few early juveniles from backwaters (e.g., Smith 1959; Taba et al. 1965; Gutermuth et al. 1994). However, diagnostic characters for distinguishing larval razorback suckers from larvae of sympatric suckers were only recently developed (Snyder and Muth 1990) and previous sampling for riverine razorback suckers did not target early life stages. Razorback sucker larvae are generally 7-9 mm at hatching and 9-11 mm at swimup; at 15° C, larvae swimup 13 days after hatching (Minckley and Gustafson 1982; Marsh 1985; Snyder and Muth 1990; R. T. Muth, personal observation). In rivers, larval razorback suckers presumably enter the drift after emerging from spawning substrates (Mueller 1989; Paulin et al. 1989) and are transported downstream into off-channel nursery environments with quiet, warm, shallow water (e.g., tributary mouths, backwaters, and inundated flood plain habitats).

Food-limited growth and survival of razorback sucker larvae has been postulated as contributing to the low or nonexistent recruitment (Minckley 1983; Marsh and Langhorst 1988; Papoulias and Minckley 1990, 1992; Modde 1997). Muth et al. (1998) reported that mean and maximum total length of larval razorback suckers in collections from the middle or lower Green River generally increased as sampling progressed each year, and approximately 20 percent of all larvae captured were larger than 12 mm; the two largest specimens were 20 and 24 mm. They estimated that mean daily growth (posthatching) of larvae less than 35 days old collected from either river section during 1993-1996 was lowest in 1994 (0.31 and 0.27 mm TL/d for the middle and lower Green River, respectively) and greatest in 1996 (0.35 and 0.33 mm TL/d). Over all years, specimens from the middle Green River grew 6-21 percent faster than those from the lower Green River.

Muth et al. (1998) noted that, although food abundance in existing Green River nursery habitats appeared adequate to meet the minimum nutritional requirements for larval survival, growth of razorback sucker larvae was not optimal. Relatively minor differences in growth rates can be biologically significant if size-dependent processes, such as predation by small, gape-limited predators, are important regulators of larval survival. Predation by adult red shiners on larvae of native catostomids in flooded and backwater habitats of the Yampa, Green, or Colorado rivers was documented by Ruppert et al. (1993) and Muth and Wick (1997). Horn (1996) concluded that although nutritional limitations in Lake Mohave may directly contribute to the high mortality of larval razorback suckers, a greater problem is reduced growth, which keeps larvae at a size vulnerable to predation for a longer period of time. He further stated that apparently all razorback sucker larvae in Lake Mohave, starving or not, are consumed by nonnative fish predators.

Predation by nonnative fishes on young razorback suckers is considered a serious threat to populations (Bestgen 1990; Minckley et al. 1991a; Horn 1996; USFWS 1998). Ruppert et al. (1993) and Wydoski and Wick (1998) reported that because razorback suckers in the Green River system spawn on the ascending limb of the hydrograph and their larvae disperse into low-velocity habitats during May and June when invertebrate numbers are low in riverine nursery habitats, razorback sucker larvae would be highly susceptible to predation by nonnative fishes at that time because other food organisms are scarce. Extremely low survival of larval razorback suckers in the Green River during 1992-1996 was suggested by Muth et al. (1998) based on the apparent disappearance of larvae from nursery habitats by early or mid-July each year. Thus it appears that low survival of early life stages is responsible for the low or nonexistent recruitment in wild populations.

Historically, flood plain habitats inundated and connected to the main channel by overbank flooding during spring-runoff discharges would have been available as nursery areas for young razorback suckers in the Green River. Tyus and Karp (1990) associated low recruitment with reductions in flood plain inundation since 1962, and Modde et al. (1996) associated years of high spring discharge and flood plain inundation in the middle Green River (1983, 1984, and 1986) with subsequent suspected recruitment of young adult razorback suckers. Flood plain habitats are typically warmer and substantially more productive than the adjacent river and have abundant vegetative cover (Mabey and Shiozawa 1993; Wolz and Shiozawa 1995; Modde 1997; Wydoski and Wick 1998). Spawning at increasing and highest runoff flows provides drifting razorback sucker larvae maximum access to flooded habitats, and enhanced growth of larvae in those habitats may increase overall survival by shortening the period of vulnerability to predation (Lentsch et al. 1996b).

Little is known about the biology of juvenile razorback suckers, but the few collected from rivers were found in quiet-water habitats. In 1950, about 6,600 larval or early juvenile razorback suckers were seined along warm, shallow margins of the Colorado River at Cottonwood Landing, Nevada (Sigler and Miller 1963). Smith (1959) caught two juveniles (both about 38 mm long) in the Glen Canyon area of the Colorado River before inundation by Lake Powell, one from a backwater and one from a flooded tributary mouth. Taba et al. (1965) collected eight razorback sucker juveniles (90–115 mm long) from backwaters on the Colorado River near Moab, Utah, 1962–1964. The digestive tracts of those fish contained "algae and bottom ooze." Juvenile razorback suckers have been caught in lateral canals off the lower Colorado River (Marsh and Minckley 1989; Maddux et al. 1993), and stocked, hatchery-produced young have been observed along shorelines, in embayments, along sandbars, or in tributary mouths, eventually moving into river channels or larger backwaters (Minckley et al. 1991a).

Outside the breeding season, adult razorback suckers tend to utilize deeper eddies, backwaters, and pool-type habitats (Minckley et al. 1991a), and their movements are generally reduced (Tyus 1987; Tyus and Karp 1990). Summer or autumn habitat use in rivers of the upper Colorado River basin includes submerged mid-channel sandbars, pools, eddies, and runs (Tyus 1987; Osmundson and Kaeding 1989a; Modde and Wick 1997). Tyus (1987) reported that Green River fish during summer occupied uneven mid-channel sandbars in water less than 2 m deep with an mean velocity of 0.5 m/s. Habitat use in the middle Green River during spring and summer 1993 included runs, eddies, or run-eddy interfaces in water 1–3 m deep over sand, cobble, and gravel substrates (Modde and Wick 1997; Modde and Irving 1998). Although turbulent canyon reaches are not considered preferred habitat for razorback suckers (Tyus 1987; Lanigan and Tyus 1989; Minckley et al. 1991a), Modde and Wick (1997) and Modde and Irving (1998) reported that six radio-tagged adults moved into or near the vicinity of Split Mountain Canyon (Reach 2) during summer or autumn in 1993 and 1994, and possibly remained there over winter. Ryden and Pfeifer (1998) reported that large juvenile and adult razorback suckers stocked in the San Juan River, New Mexico-Utah, preferred fast, mid-channel habitats during the summer–autumn base-flow period.

C. Status and distribution

The endangered razorback sucker is an endemic catostomid of the Colorado River basin (Miller 1959; Minckley et al. 1986) and was once widely distributed in warmwater reaches of larger rivers from Mexico to Wyoming (Jordan and Evermann 1896; Minckley 1973; Behnke and Benson 1983; Bestgen 1990; USFWS 1994). Historic records indicate that the lower Colorado River basin supported the largest numbers of razorback sucker; the species was most abundant in the mainstem Colorado River downstream of present-day Lake Mead, the Salton Sea area, and the lower Gila River drainage in Arizona (Kirsch 1888; Gilbert and Scofield 1898; Minckley

1973, 1983; Bestgen 1990; Minckley et al. 1991a). In the upper Colorado River basin, razorback suckers historically occurred in the Colorado, Green, and San Juan river drainages but apparently were common only in calm, flat-water reaches of the mainstem Colorado and Green rivers and lower sections of their major tributaries (Jordan 1891; Evermann and Rutter 1895; Ellis 1914; Simon 1946; Hubbs and Miller 1953; Koster 1960; Sigler and Miller 1963; Baxter and Simon 1970; Vanicek et al. 1970; Holden and Stalnaker 1975a, 1975b; Wiltzius 1978).

Bestgen (1990) reported that this species was once so numerous that it was commonly used as food by early settlers and, further, that commercially marketable quantities were caught in Arizona as recently as 1949. In the Upper Basin, razorback suckers were reported in the Green River to be very abundant near Green River, Utah, in the late 1800's (Jordan 1891). An account in Osmundson and Kaeding (1989) reported that residents living along the Colorado River near Clifton, Colorado, observed several thousand razorback suckers during spring runoff in the 1930's and early 1940's. In the San Juan River drainage, Platania and Young (1989) relayed historical accounts of razorback suckers ascending the Animas River to Durango, Colorado, around the turn of the century.

Declines in the abundance and distribution of razorback suckers were first noted in the early 1940's (Dill 1944; Wiltzius 1978). Today, the species is one of the most imperiled fishes in the Colorado River basin and exists naturally as only a few disjunct, aging populations or scattered individuals (Minckley et al. 1991a). Although there is evidence of reproduction in the two largest extant populations, natural survival of fish beyond the larval period appears low or nonexistent. Wild stocks are primarily composed of older fish and continue to decline in abundance (Lanigan and Tyus 1989; Marsh and Minckley 1989). Lack of recruitment sufficient to sustain populations has been mainly attributed to the cumulative effects of habitat loss and modification (including reductions in river-flood plain connectivity) caused by water and land development, and predation on early life stages by nonnative fishes (Tyus and Karp 1990; Hawkins and Nesler 1991; Modde et al. 1995; Horn 1996; Lentsch et al. 1996c; Tyus and Saunders 1996; Hamilton 1998; USFWS 1998a).

Remaining wild populations of razorback sucker are in serious jeopardy. The largest extant population is found above Davis Dam in Lake Mohave on the lower mainstem Colorado River, Arizona-Nevada, but little or no natural recruitment has occurred since completion of the dam in 1954 (McCarthy and Minckley 1987; Minckley et al. 1991a). Estimated numbers of adult razorback suckers in Lake Mohave declined 68 percent (from 73,500 to 23,000) during 1980–1993 (Marsh 1994), and further steep declines in the population are expected within the next decade (Minckley et al. 1991a; Mueller 1995). Most razorback suckers occupying exclusively riverine habitat are now limited to the upper Colorado River basin and populations are small. Lanigan and Tyus (1989) estimated that from 758 to 1,138 razorback suckers inhabit the upper Green River. More recent studies of this Green River population of razorback suckers indicate that this population consists of a precariously small but dynamic population that appears to be stable or declining slowly and may consist only of about 500 individuals (Modde et al. 1996). In the Colorado River, most razorback suckers occur in the Grand Valley area near Grand

Junction, Colorado; however, they are increasingly rare. Osmundson and Kaeding (1991) report that the number of razorback sucker captures in the Grand Junction area has declined dramatically since 1974. Modde et al. (1996) characterized the middle Green River population as "precariously" small but dynamic, with at least some recruitment.

In the San Juan River subbasin, small concentrations of razorback suckers have been reported at the inflow area in the San Juan arm of Lake Powell, Utah and one specimen was captured in the San Juan River near Bluff, Utah in 1988 (Platania 1990, Platania et al. 1991). In Bestgen (1990) additional captures of small numbers of razorback suckers were reported from the Dirty Devil and Colorado River arms of Lake Powell.

The razorback sucker was listed as endangered, pursuant to the Act, on October 23, 1991.

Critical habitat description for Razorback sucker

Critical habitat has been designated within the 100-year flood plain of the razorback sucker's historical range in the following sections of the Upper and Lower Basin and the San Juan River (59 FR 13374). The critical elements are the same as those listed above under Colorado pikeminnow.

Colorado, Moffat County. The Yampa River and its 100-year flood plain from the mouth of Cross Mountain Canyon in T. 6 N., R. 98 W., section 23 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah, Uintah County; and Colorado, Moffat County. The Green River and its 100-year flood plain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to Sand Wash in T. 11 S., R. 18 E., section 20 (6th Principal Meridian).

Utah, Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties. The Green River and its 100-year flood plain from Sand Wash at river mile 96 at T. 11 S., R. 18 E., section 20 (6th Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (6th Principal Meridian).

Utah, Uintah County. The White River and its 100-year flood plain from the boundary of the Uintah and Ouray Indian Reservation at river mile 18 in T. 9 S., R. 22 E., section 21 (Salt Lake Meridian) to the confluence with the Green River in T. 9 S., R 20 E., section 4 (Salt Lake Meridian).

Utah, Uintah County. The Duchesne River and its 100-year flood plain from river mile 2.5 in T. 4 S., R. 3 E., section 30 (Salt Lake Meridian) to the confluence with the Green River in T. 5 S., R. 3 E., section 5 (Uintah Meridian).

Colorado, Delta and Mesa Counties. The Gunnison River and its 100-year flood plain from the confluence with the Uncompahgre River in T. 15 S., R. 96 W., section 11 (6th Principal Meridian) to Redlands Diversion Dam in T. 1 S., R. 1 W., section 27 (Ute Meridian).

Colorado, Mesa and Garfield Counties. The Colorado River and its 100-year flood plain from Colorado River Bridge at exit 90 north off Interstate 70 in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to Westwater Canyon in T. 20 S., R. 25 E., section 12 (Salt Lake Meridian) including the Gunnison River and its 100-year flood plain from the Redlands Diversion Dam in T. 1 S., R. 1 W., section 27 (Ute Meridian) to the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).

Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year flood plain from Westwater Canyon in T. 20 S., R. 25 E., section 12 (Salt Lake Meridian) to full pool elevation, upstream of North Wash, and including the Dirty Devil arm of Lake Powell in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).

New Mexico, San Juan County; and Utah, San Juan County. The San Juan River and its 100-year flood plain from the state route 371 bridge in T. 29 N., R. 13 W., section 17 (New Mexico Meridian) to Neskahai Canyon in the San Juan Arm of Lake Powell in T. 41 S., R. 11 E., section 26 (Salt Lake Meridian) up to the full pool elevation.

Arizona, Cococini and Mohave Counties; and Nevada, Clark County. The Colorado River and its 100-year flood plain from the confluence with the Paria River in T. 40 N., R. 7 E., section 24 (Gila and Salt River Meridian) to Hoover Dam in T. 30 N., R. 23 W., section 3 (Gila and Salt River Meridian) including Lake Mead to full pool elevation.

HUMPBACK CHUB

A. Species description

The humpback chub is endemic to the Colorado River Basin and is part of a native fish fauna traced to the Miocene epoch in fossil records (Miller 1955, Minckley et al. 1986). Humpback chub remains have been dated to about 4000 B.C., but the fish was not described as a species until the 1940's (Miller 1946), presumably because of its restricted distribution in remote white water canyons (USFWS 1990a). Because of this, its original distribution is not known.

The humpback chub is a relatively large North American minnow reaching a maximum length of 480 mm and a weight of 1,165 g (Valdez and Rycl, 1995). Humpback chub have a laterally-compressed and tapering fusiform body, short narrow caudal peduncle with deeply forked tail fin, and large falcate paired fins. Adults have a narrow flattened head, with small eyes and a long fleshy snout and inferior subterminal mouth. Subadults are olivaceous above with silvery sides fading to a creamy-white belly, while adults are light olivaceous and slate-gray dorsally and laterally, with a white belly tinged with light orange and yellow (Valdez and Rycl, 1995).

Although historic data are limited, the apparent range-wide decline in humpback chubs is likely due to a combination of factors including alteration of river habitats by reservoir inundation, changes in stream discharge and temperature, competition with and predation by introduced fish species, and other factors such as changes in food resources resulting from stream alterations (USFWS 1990a).

B. Life history

The humpback chub evolved in seasonally warm and turbid water and is highly adapted to the unpredictable hydrologic conditions that occurred in the pristine Colorado River system. It is extraordinarily specialized for life in torrential water, with an enlarged stabilizing nuchal hump and large falcate fins (Minckley 1991). Although not strong swimmers (Bulkley et al. 1982), humpback chubs are apparently so well adapted to canyon environments that populations appear to have always occupied a specialized niche in canyon-bound segments of the river system (Carlson and Muth 1989) where individual adults exhibit high fidelity to particular locales (Valdez and Clemmer 1982; Valdez and Ryel 1995).

Little is known about the specific spawning requirements of the humpback chub. The fish is known to spawn soon after the highest spring flows when water temperatures approach 20° C (Kaeding et al. 1990, Karp and Tyus 1990a, USFWS 1990b). The collection of ripe and spent fish indicated that spawning occurred in Black Rocks during June 2-15, 1980, at water temperatures of 10° to 15° C; in 1981, spawning occurred on May 15-25 at water temperatures of approximately 15° C (Valdez et al. 1982b). Humpback chub spawned in Black Rocks on the Colorado River in 1983 when maximum daily water temperatures were between 12° and 17° C (Archer et al. 1986).

The humpback chub is an obligate warmwater fish that requires relatively warm temperatures for spawning, egg incubation, and survival of larvae. Optimum growth temperatures range from 16° to 22° C (Hamman 1982; Lechleitner 1992). Little else is known about reproduction except that spawning occurs on the descending limb of annual spring hydrographs, most likely over gravel substrates (Valdez and Clemmer 1982; Valdez et al. 1982; Kaeding and Zimmerman 1983; Tyus and Karp 1989; Valdez and Ryel 1995).

Unlike larvae of Colorado pikeminnow and razorback sucker, emerging larval humpback chubs do not appear to drift extensively and remain in the general vicinity of spawning areas. Extensive sampling for larvae and young-of-year immediately downstream of Black Rocks and Westwater Canyon yielded very low numbers of young humpback chubs (Valdez et al. 1982; Chart and Lentsch 1999a). Robinson et al. (1998) documented drift of larval humpback chubs from the Little Colorado River and into the mainstem Colorado River in Grand Canyon; they noted lower abundance at more downstream stations, which suggested that humpback chub larvae may drift shorter distances than speckled dace, bluehead sucker, and flannelmouth sucker. Young-of-year fish in the Little Colorado River were noted to distribute themselves downstream in the main Colorado River within several months of hatching, however it is not known if this emigration is passive or active (Valdez and Ryel 1995).

Backwaters, eddies, and runs have been reported as common capture locations for young-of-year humpback chub (Valdez and Clemmer 1982). These data indicate that in Black Rocks and Westwater Canyon, young utilize shallow areas. Habitat suitability index curves developed by Valdez et al. (1990) indicate young-of-year prefer average depths of 2.1 feet with a maximum of 5.1 feet. Average velocities were reported at 0.2 feet per second. Subadult humpback chub (under 200 mm) occupied shoreline habitats within two meters of the shore and were specifically more abundant in talus and vegetated shorelines which provided more cover compared to sand or cobble bars in the Grand Canyon (Converse et al. 1998a). Humpback chubs mature in 2-3 years at approximately 200 mm and may live 20-30 years (Valdez et al. 1992; Hendrickson 1993).

Adults are thought to be negatively phototactic and are more active in turbid water or at night (Valdez et al. 1992; Valdez and Ryel 1995, 1997). Valdez et al. (1982b) and Wick et al. (1981) found adult humpback chub in Black Rocks and Westwater Canyons in water averaging 50 feet in depth with a maximum depth of 92 feet. In these localities, humpback chub were associated with large boulders and steep cliffs. In Grand Canyon, adult humpback chub were specifically associated with geomorphic reaches of the river characterized by large eddy hydraulic habitat. Humpback chub appear to have a high fidelity for particular eddies in some reaches of the river (Valdez and Ryel 1995).

Generally, humpback chub show fidelity for canyon reaches and move very little (Miller et al. 1982c, Archer et al. 1985; Burdick and Kaeding 1985, Kaeding et al. 1990). Movements of adult humpback chub in Black Rocks on the Colorado River were essentially restricted to a 1-mile reach. These results were based on the recapture of Carlin-tagged fish and radiotelemetry studies conducted from 1979 to 1981 (Valdez et al. 1982) and 1983 to 1985 (Archer et al. 1986; Kaeding et al. 1990).

Diet of humpback chubs in the upper Colorado River basin has not been described. In Grand Canyon, humpback chubs primarily consumed aquatic invertebrates (e.g., midges, blackflies, and amphipods), green algae, terrestrial invertebrates, and occasionally fish and reptiles (Kaeding and Zimmerman 1983; Kubly 1990; Valdez and Ryel 1997). Tyus and Minckley (1988) reported that migrating Mormon crickets (*Anabrus simplex*) were an important food source for humpback chubs in the Green and Yampa rivers.

Two species of non-indigenous parasites infect humpback chubs; the external parasitic copepod (*Lernaea cyprinacea*) has been reported from all populations (Valdez et al. 1982) and the internal Asian tapeworm (*Bothriocephalus acheilognathi*) is found in humpback chubs of Grand Canyon (Brouder and Hoffnagle 1997; Clarkson et al. 1997). Infection by the Asian tapeworm may cause stress or death to the host and widespread infestation during periods of stress. This parasite can complete its life cycle only where water temperatures are greater than 20° C but is apparently able to survive in a fish host at colder temperatures.

C. Status and distribution

The humpback chub is endemic to the Colorado River basin, with ancestral fossil evidence of a *Gila* complex dating back to the Miocene epoch (Miller 1955). *Gila cypha* is believed to be a more recent, specialized derivative that evolved in response to conditions in large, erosive Colorado River habitats during the mid-Pliocene and early Pleistocene epochs, 3–5 million years ago (Minckley et al. 1986). Skeletal remains of humpback chubs were found in 4,000-year-old flood deposits in Stanton's Cave in Marble Canyon, Arizona, as well as at an archeological site in Catclaw Cave, now inundated by Lake Mead (Miller 1955).

Records documenting distribution and abundance of the species in modern time are incomplete, and factors associated with its decline are scarce or poorly understood (Tyus 1998). The lack of early information on humpback chub is due to several factors. Humpback chubs occur primarily in remote canyon areas and apparently were rare in most early collections because of inaccessibility and difficulty in sampling these areas (Tyus 1998). In addition, there has been some uncertainty over nomenclature and taxonomy of species in the genus *Gila*. For example, during the 1950's, two forms of bonytail (a common name for morphotypes of the Colorado River *Gila* complex) were taxonomically recognized as subspecies, roundtail chub *Gila robusta robusta* and bonytail chub *Gila robusta elegans*.

A third form, the humpback chub *Gila cypha*, was described by Miller (1946) and was not universally recognized as a valid taxon (Holden and Stalnaker 1970; Holden 1991). Although many researchers recognized the presence of morphological variants, a common nomenclature has not been accepted. As a result, many early fish surveys of the Colorado River system assigned the vernacular "bonytail" to all three closely-related *Gila* species (*G. cypha*, *G. elegans*, and *G. robusta*), thereby confounding confirmation of humpback chub localities prior to approximately 1970 (Banks 1964; Vanicek and Kramer 1969; Holden and Stalnaker 1970; Valdez and Clemmer 1982; Douglas et al. 1989; Rosenfeld and Wilkinson 1989; Minckley 1991; Dowling and DeMarais 1993; Quartarone 1993).

Despite sparse historic records and taxonomic confusion, strong evidence exists that the historic range of the humpback chub included most canyon-bound reaches of the Colorado River system. Known historic distribution of humpback chubs includes portions of the mainstem Colorado River and four of its tributaries: the Green, Yampa, White, and Little Colorado rivers (USFWS 1990a). However, the species may have been extirpated from some river reaches, in both the lower and upper Colorado River basins, as a result of water development and other human-related alterations prior to complete documentation of its range.

Description of the present distribution of humpback chubs in the Colorado River basin is based on collection records from widely separated locations since approximately 1980. The Humpback Chub Recovery Plan (USFWS 1990a) described the present distribution of the species as:

1. Little Colorado River, Arizona, from its mouth to 13 km upstream;
2. Colorado River in Marble and Grand canyons, Arizona;
3. Colorado River in Cataract Canyon, Utah;

4. Colorado River in Black Rocks, Colorado, and Westwater Canyon, Utah;
5. Green River in Desolation and Gray canyons, Utah;
6. Green River in Whirlpool and Split Mountain canyons, Dinosaur National Monument, Colorado and Utah; and
7. Yampa River in Yampa Canyon, Dinosaur National Monument, Colorado.

The largest and most stable humpback chub population is presently thought to reside in the Little Colorado River and Colorado River near their confluence in Marble and Grand canyons, Arizona (1 and 2 from list above). Valdez and Ryel (1995) estimated that 3,750 adult humpback chubs larger than 200 mm occurred in the mainstem river during 1990–1993, and Douglas and Marsh (1996) reported 4,346 humpback chubs larger than 150 mm in the Little Colorado River in 1992. In addition, several other aggregations of humpback chub are found in the Grand Canyon, always in association with reaches characterized by large eddy complexes. In one aggregation at approximately river mile 30 in Grand Canyon, larval humpback chub were identified in association with springs expressed from local limestone geology; however it is not believed that any recruitment occurs as a result of this spawning activity. Rather the aggregation appears to be a relict group from the pre-dam era, that are prompted to spawn by relatively warmer spring water compared to the cold hypolimnetic river water (Valdez and Ryel 1995).

Of the five locations in the upper Colorado River basin (3–7 from list above), self-sustaining populations occur in Cataract Canyon (Valdez 1990; Valdez and Williams 1993), Black Rocks (Kaeding et al. 1990), Westwater Canyon (Chart and Lentsch 1999a), Desolation and Gray canyons (Chart and Lentsch 1999b), and Yampa Canyon (Karp and Tyus 1990b). A few humpback chubs also have been reported from the Green River in Dinosaur National Monument, primarily in Whirlpool Canyon (Holden and Stalnaker 1975a; Karp and Tyus 1990b) and Split Mountain Canyon (Vanicek 1967; Holden and Stalnaker 1975). Estimates of humpback chub population size in the Green and Colorado rivers have been difficult to obtain because of low numbers of fish and low recapture rates. Chart and Lentsch (1999a) sampled for humpback chubs at three locations in Westwater Canyon and derived abundance estimates ranging from 572 to 5,880 individuals larger than 175 mm; however, confidence intervals about the estimates were typically greater than the estimate means due to low recapture rates. Catch rates of humpback chubs in Black Rocks indicate a relatively large concentration (Maddux et al. 1993), but no abundance estimates have been attempted.

The humpback chub was included in the first List of Endangered Species issued by the Office of Endangered Species on March 11, 1967 (32 FR 4001). The humpback chub was classified as endangered because of declines in distribution and abundance throughout its range. It was afforded full protection under ESA of 1973, as amended.

Critical Habitat for humpback chub

Critical habitat has been designated within the humpback chub's historical range in the following sections of the Upper Basin (59 FR 13374):

Colorado, Moffat County. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah, Uintah County; and Colorado, Moffat County. The Green River from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the southern boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).

Utah, Uintah and Grand Counties. The Green River (Desolation and Gray Canyons) from Sumners Amphitheater in T. 12 S., R. 18 E., section 5 (Salt Lake Meridian) to Swasey's Rapid in T. 20 S., R. 16 E., section 3 (Salt Lake Meridian).

Utah, Grand County; and Colorado, Mesa County. The Colorado River from Black Rocks in T. 10 S., R. 104 W., section 25 (6th Principal Meridian) to Fish Ford in T. 21 S., R. 24 E., section 35 (Salt Lake Meridian).

Utah, Garfield and San Juan Counties. The Colorado River from Brown Betty Rapid in T. 30 S., R. 18 E., section 34 (Salt Lake Meridian) to Imperial Canyon in T. 31 S., R. 17 E., section 28 (Salt Lake Meridian).

Bonytail

A. Species description, life history and distribution

Bonytail have an elongated fusiform body, small flattened head with small eyes, subterminal mouth, long slender caudal peduncle, and large deeply forked tail fin. Subadults are olivaceous above with silvery sides fading to creamy-white belly, while adults are greenish to gray dorsally and laterally, with a white belly and irregular black lateral spots (Valdez and Ryel 1995).

Formerly reported as widespread and abundant in mainstem rivers (Jordan and Evermann 1896), bonytail populations have been greatly reduced. The fish is presently represented in the wild by a low number of old adult fish in Lake Mohave and perhaps other lower Colorado River basin reservoirs (USFWS 1990a). The last known riverine area where bonytail were common was the Green River in Dinosaur National Monument, where Vanicek (1967) and Holden and Stalnaker (1970) collected 91 specimens during 1962-1966.

From 1977 to 1983, no bonytail were collected from the Colorado or Gunnison rivers in Colorado or Utah (Wick et al.1981; Valdez et al. 1982). However, in 1984, a single bonytail was collected from Black Rocks on the Colorado River (Kaeding et al. 1986). Several suspected bonytail were captured in Cataract Canyon in 1985-1987 (Valdez 1990). Researchers continue to capture suspected bonytail individuals or potential hybrid combinations of bonytail, roundtail chub and humpback chub; however it is difficult to determine the extent of hybridization in the field or if certain individuals represent the bonytail species because of the complexity of *Gila* morphometric

The bonytail is considered a species that is adapted to mainstem rivers, where it has been observed in pools and eddies (Vanicek 1967, Minckley 1973). Spawning of bonytail has never been observed in a river, but ripe fish were collected in Dinosaur National Monument during late June and early July suggesting that spawning occurred at water temperatures of about 17° C (Vanicek and Kramer 1969).

Early stocking efforts which placed hatchery-raised adult bonytail into the Green River at Split Mountain and near the Jensen, Utah area proved unsuccessful. Currently, the State of Utah has an experimental stocking program in place through which thousands of subadult bonytail have been stocked into the Colorado River in the Moab area in the past 5 years. This experimental stocking also includes investigations into muscle fitness of stocked fish (Lentsch et al. 1996a).

The bonytail is the rarest native fish in the Colorado River. Fewer than 10 individuals have been caught in the upper Colorado River basin in the last decade and small numbers of adults persist in Lake Mohave, Nevada-Arizona (Kaeding et al. 1986). Bonytail was listed as an endangered species in 1980.

Critical Habitat for Bonytail

Critical habitat has been designated within the bonytail's historical range in the following sections of the Upper Basin (59 FR 13374):

Colorado, Moffat County. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah, Uintah County; and Colorado, Moffat County. The Green River from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).

Utah, Uintah and Grand Counties. The Green River (Desolation and Gray Canyons) from Sumner's Amphitheater (river mile 85) in T. 12 S., R. 18 E., section 5 (Salt Lake Meridian) to Swasey's Rapid (river mile 12) in T. 20 S., R. 16 E., section 3 (Salt Lake Meridian).

Utah, Grand County; and Colorado, Mesa County. The Colorado River from Black Rocks in T. 10 S., R. 104 W., section 25 (6th Principal Meridian) to Fish Ford in T. 21 S., R. 24 E., section 35 (Salt Lake Meridian).

Utah, Garfield and San Juan Counties. The Colorado River from Brown Betty Rapid in T. 30 S., R. 18 E., section 34 (Salt Lake Meridian) to Imperial Canyon in T. 31 S., R. 17 E., section 28 (Salt Lake Meridian).

E. Analysis of the species/critical habitat likely to be affected
It is anticipated that the Colorado pikeminnow that occupy 88.5 miles of the Price River will be directly affected, as will their habitat, by flow depletions and instream habitat modifications. In addition, flow depletions in the Price River will deplete flows in the Green and Colorado rivers and affect critical habitat for the four endangered fish species from the confluence of the Price and Green rivers downstream to Lake Powell. Depletions on Green and Colorado rivers within the affected area are herein considered in accumulation with other small tributary depletions as a net change to the sediment and flow regimes and lost potential for creation and maintenance of habitat characteristics crucial to various life-stages of these fish. For example, lower peak flows prevent interconnection of the 100-year flood plain and flood plain inundation and also decreases capacity for creation of backwaters in downstream reaches. Lower peak flows may also affect Colorado pikeminnow spawning habitat in Gray Canyon and other species spawning habitat as yet unidentified.

IV. ENVIRONMENTAL BASELINE

A. Status of the species within the action area
Colorado pikeminnow are found in the Price River from Farnham Diversion near Wellington at river mile 88.5 down to the confluence of the Price and Green rivers. Wellington is located approximately 50 to 70 miles downstream of the proposed Narrows Dam.

The collection of 21 Colorado pikeminnow in the Price River and seven additional individuals positively identified but not captured during a 2-year seasonal study indicates that some suitable habitat for juvenile and adult Colorado pikeminnow is available during April through September although the quality or quantity is unknown. No data has been collected during late fall or winter, so it is not known whether the Price River is used by Colorado pikeminnow during those seasons.

Although spawning of the Colorado pikeminnow has not been documented in the Price River, the potential for Colorado pikeminnow spawning in the Price River is unknown. The Price River warms earlier than the Green River which may attract Colorado pikeminnow from the Green River that are searching for suitable spawning and/or feeding areas in the spring. A ripe male Colorado pikeminnow was captured at river mile 10.5, which suggests that the fish may attempt to spawn in the Price River, however one ripe male may also be anomalous. The availability and quality of spawning habitat is unknown other than observation of some riffle habitat in the canyon reaches. Minimal quality and quantity of nursery habitat (defined as low-velocity shoreline pockets or backwaters) has been noted within the Price River. The nursery habitat present within the Price River is suspected to be completely dewatered during low water periods. It is not clear if the year-round flow and sediment regimes are adequate to maintain spawning or nursery habitat.

Despite anecdotal accounts of abundant Colorado pikeminnow in the early part of the century (Hardy 1964 in reference to early 1900s), most biologists including biologists from the State of Utah Division of Wildlife Resources (UDWR) did not believe Colorado pikeminnow occupied the Price River at any appreciable level before recent findings from surveys in 1996 and 1997. In fact, McAda et al. (1977) reported that no endangered species were identified at any of three locations within the Price River; however this survey represented minimal effort during 1 year, which happened to be a severe drought year.

It is possible that Colorado pikeminnow have been present in the Price River at varying or low densities but only recently detected, or Colorado pikeminnow may have only recently recolonized the Price River. In either case, juvenile and adult Colorado pikeminnow appear to use as much of the Price River that is available (88.5 miles from the confluence of the Price and Green rivers to the Farnham Diversion, an upstream barrier to fish movement) at least from April through September. In contrast, if Colorado pikeminnow were in fact, locally extirpated, recent note of more than twenty juveniles and adults in the Price River may indicate that Colorado pikeminnow are recolonizing the Price River after years of absence. Recolonization of tributaries may exemplify an increasing trend for Colorado pikeminnow in the Green River system.

The Price River may play an important role to the overall Green River system both biologically and physically. The proportion of native species is much higher in the Price River than in the Green River, and the number of nonnative predators and competitors, such as channel catfish and green sunfish, in the Price River is relatively low. The dominant native fish community in the Price River may be one reason why Colorado pikeminnow are found there. Water temperatures within the Price River warm earlier than the Green River, which may attract the endangered fish from the Green River searching for suitable spawning and/or feeding areas (Cavalli 1999). The Price River may also provide better growing conditions, food supply, and nutrients needed by the endangered fishes; however, further studies are needed to determine the importance of these relationships to the overall recovery of the species in the upper Colorado River basin.

Outside of the Price River basin, Colorado pikeminnow, humpback chub, razorback sucker and to some extent, bonytail, are present and utilize the Green River from the confluence of the Price and Green rivers downstream to Lake Powell; this area will be affected by depleted flows in the Price River. Various life-stages of these species occur within this area including: 1) spawning adult Colorado pikeminnow, humpback chub and most likely razorback sucker; 2) young-of-year Colorado pikeminnow, humpback chub and razorback sucker; 3) juvenile Colorado pikeminnow, humpback chub and razorback sucker; and 4) migrating and feeding adults of all four species. In addition, the critical habitat that is affected by the proposed Project is within several areas of focus for recovery efforts for these species. Any factor detrimentally affecting these species is expected to hinder recovery efforts to some unknown extent.

B. Factors affecting species environment within the action area

The Colorado pikeminnow, razorback sucker, humpback chub, and bonytail are adversely affected by the following project activities or consequences:

1. Depletions to instream flows and resultant degradation of instream habitat as well as direct influences on various life-stages and the food-base of Colorado pikeminnow within 88.5 miles of occupied habitat in the Price River.

2. Depletions to the Green River and Colorado River basin including direct impacts on all four endangered fish species and their critical habitat, cumulative depletion impacts on the sediment and flow regimes, and adverse modification of habitat downstream from the confluence of the Price and Green rivers to Lake Powell.

V. EFFECTS OF THE ACTION

A. Factors to be considered

Water depletions in the upper Colorado River basin have been long recognized as a major source of impact to the endangered fish species native to this basin. Continued water withdrawal has restricted the ability of the Colorado River system to produce flow conditions required to create and maintain habitat for various life stages of these species. Impoundments and diversions, like the proposed Narrows Project, have substantially reduced peak discharges in the Colorado River basin while increasing base flows in some reaches. These depletions along with a number of other factors have resulted in such drastic reductions in the populations of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker that the Service has listed these species as endangered and has implemented programs to prevent extinction and recover the species. Both direct and indirect effects of depletions that will occur as a result of the proposed Narrows Project as well as cumulative effects within the Price River drainage were considered in the formulation of this Opinion.

The fact that the project depletes flows during peak runoff period is of concern to us because this hydrologic characteristic is geomorphically and ecologically significant to the endangered fish species. Spring runoff is the most extreme parameter of the hydrologic cycle, and it precedes and influences the very critical spawning period of the endangered fishes. Observations clearly demonstrate that migration and spawning activities of these fishes are synchronized with and undoubtedly influenced by the runoff period (Archer et al. 1986; Archer and Tyus 1984). The Service further believes that peak spring flows are crucial for creating and maintaining in-channel habitats, such as spawning habitat and backwaters, and for providing access to off-channel habitats, such as inundated floodplains.

Also, we are generally concerned about the base-flow condition. Minimum instream flows have not been identified or secured for the Price River. It is not clear what minimum flows and what time of year such flows would be required to protect and maintain habitat for endangered fish species. Further depletions from the system could affect the base-flow condition which would impact instream habitat quality and quantity.

B. Analysis for effects of the action

The Price River is a tributary to the Green River that drains approximately 1,892 square miles of southeastern Utah. Past and ongoing impacts to the Price River include water development projects for irrigation, industrial, and culinary purposes. Two existing Federal projects impact the Price River Basin. The Price-San Rafael River Salinity Control Project results in an annual depletion of 25,310 acre-feet, and diversions associated with Scofield Reservoir were reported to have an annual depletion of approximately 55,345 acre-feet (based on 63 percent consumptive use) for an average water year (19,161 acre-feet for a dry year and 55,703 acre-feet for a wet year) (Bureau of Reclamation 1998). Appendix A (Tables 1.1 to 1.4) summarizes the cumulative hydrology study.

The historical volume of water available in the Price River was estimated to be approximately 157,249 acre-feet (Bureau of Reclamation 1998). Depletions resulting from the two existing Federal projects have been estimated to be approximately 82,412 AF, resulting in a flow volume that is approximately 47.6 percent of historical flows. Much of the Price River has been channelized for highway and railroad construction. As a result of instream flow and physical channel modifications, instream habitat has shifted from a pool, riffle, run complex to extensive reaches of homogeneous habitat (riffles with large substrates or runs with fine substrates depending on gradient), although some reaches of the lower Price River retain elements of the natural physical habitat.

Subtracting the annual depletion of the Price-San Rafael River Salinity Control Project and Scofield Reservoir Project (82,412 AF) from historic flows (157,249 AF), results in the existing condition or average monthly flows without the Narrows Project of 74,837 AF (Table 1.4). Subtracting the depletion for the Narrows Project (5,717 AF) results in 69,120 AF of water remaining in the Price River. The overall depletion of all Federal projects including the proposed Narrows project will be 88,129 AF. This is a depletion of 56% of historic flows.

C. Species' response to the proposed action

It is expected that the proposed action would detrimentally impact Colorado pikeminnow and result in a decline in the number of individuals using the Price River or possibly inhibiting use altogether. Also, the unknown importance of the Price River as winter or spawning habitat prevents protection of these important life-history elements, if, in fact, they are present. Furthermore, adverse modification of critical habitat for all four endangered fish species from the confluence of the Price and Green rivers downstream to Lake Powell is expected to result in detriment and overall harm to the populations, thereby offsetting recovery efforts elsewhere in the basin.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

We are not aware of any known cumulative effects at this time.

VII. CONCLUSION

The Narrows Project, in association with existing Federal projects, will further reduce peak discharge within the Price River. Annual depletions of the Narrows Project is 5,717 AF. Total depletion within the Price River Basin is 88,129 AF. It is our biological opinion that the effects of the Narrows Project, as proposed, are likely to jeopardize the continued existence of the Colorado pikeminnow, humpback chub, razorback sucker, and bonytail through water depletions from the Green and Colorado rivers and is likely to destroy or adversely modify designated critical habitat in the Green and Colorado rivers from the confluence of the Price and Green rivers downstream to Lake Powell. In addition, the proposed Narrows Project is likely to jeopardize Colorado pikeminnow currently occupying the Price River and detrimentally impact instream habitat conditions of the Price River.

VIII. REASONABLE AND PRUDENT ALTERNATIVES

Regulations (50 CFR 402.02) implementing section 7 of ESA define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technologically feasible; and (4) would, we believe, avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

On January 21-22, 1988, the Secretary of the Interior; Governors of Wyoming, Colorado, and Utah; and the Administrator of the Western Area Power Administration were cosigners of a Cooperative Agreement to implement the RIP (USFWS, 1987). An objective of the RIP was to recover the listed species while providing for new water development in the Upper Colorado River Basin.

In order to further define and clarify processes outlined in sections 4.1.5, 4.1.6, and 5.3.4 of the RIP, a section 7 agreement and a RIPRAP was developed (USFWS 1993). The agreement establishes a framework for conducting all future section 7 consultations on depletion impacts related to new projects and all impacts associated with historic projects in the Upper Basin. Procedures outlined in the agreement will be used to determine if sufficient progress is being accomplished in the recovery of endangered fishes to enable the RIP to serve as a reasonable and prudent alternative to avoid jeopardy. The RIPRAP was finalized on October 15, 1993, and has been reviewed and updated annually.

In accordance with the agreement, the Service assesses the impacts of projects that require section 7 consultation and determines if progress toward recovery has been sufficient for the RIP to serve as a reasonable and prudent alternative. If sufficient progress is being achieved, biological opinions are written to identify activities and accomplishments of the RIP that support it as a reasonable and prudent alternative. If sufficient progress towards the recovery of the endangered fishes has not been achieved by the RIP, actions from the RIPRAP are identified which must be completed to avoid jeopardy to the fishes. For historic projects, these actions serve as the reasonable and prudent alternative as long as they are completed according to the schedule identified in the RIPRAP. For new projects, these actions serve as the reasonable and prudent alternative as long as they are completed before the impact of the project occurs.

In determining if sufficient progress has been achieved, the Service considers: (a) actions which result in a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction; (b) status of fish populations; (c) adequacy of flows; and (d) magnitude of the project impact. In addition, we consider support activities (funding, research, information, and education, etc.) of the RIP if they help achieve a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction. We evaluate progress separately for the Colorado River and the Green River sub-basins; however, we gives due consideration to progress throughout the Upper Basin in evaluating progress towards recovery.

In the amended Biological Assessment from Reclamation to the Service (March 7, 1997), Reclamation suggested the following actions be developed into RIPRAP items to offset the proposed Narrows Project impacts to the Price River and endangered fish species:

1) 'Project sponsors . . . pay the depletion charge for the entire depletion caused by the Narrows Project.'

2) 'The Recovery Program would agree to provide funding for the continuance of the [Price River endangered fish] study for . . . additional . . . year(s) . . . this study could include . . . data . . . to provide a better understanding of the year-round utilization of the Price River by Colorado squawfish (sic); . . . identifying flow needs and potential sources of water . . . for in stream flows needed by endangered fish [in the Price River].'

3) 'The Recovery Program would secure water rights on the Price River that could be used to maintain instream flows during critical times of the year for squawfish (sic) in the Price River.'

The Service agrees that these activities will assist in providing the necessary protection and conservation of listed fishes in the Price River. These items have been incorporated into the following reasonable and prudent alternative and have been identified in the FY2001 RIPRAP finalized March 8, 2000.

The purpose of the following reasonable and prudent alternative is to avoid the likelihood of jeopardy to listed species and destruction or adverse modification of their critical habitats while also allowing the proposed Narrows Project to be constructed and operated for its purposes including water development.

The Service has determined, based on the analysis of the hydrological and biological information that currently exists, that if Reclamation and the Sanpete Water Conservancy District, in cooperation with RIP participants and responsible Federal agencies, agree to carry out all the following elements then these actions will avoid the likelihood of jeopardizing the continued existence of endangered fishes and avoid the likelihood of destruction or adverse modification of critical habitats for the proposed Project.

The following items, numbers 1, 2 and 3 combined, will serve as the reasonable and prudent alternative for the proposed Narrows Project:

1) The following excerpts are pertinent to the consultation because they summarize portions of the RIP that address depletion impacts, section 7 consultation, and project proponent responsibilities:

> "All future section 7 consultations completed after approval and implementation of this program (establishment of the Implementation Committee, provision of congressional funding, and initiation of the elements) will result in a one-time contribution to be paid to the Service by water project proponents in the amount of $10.00 per acre-foot based on the average annual depletion of the project . . . . This figure will be adjusted annually for inflation [the current figure is $14.36 per acre-foot] . . . . Concurrently with the completion of the Federal action which initiated the consultation, e.g., . . . issuance of a 404 permit, 10 percent of the total contribution will be provided. The balance . . . will be . . . due at the time the construction commences . . . ." (Specific figures are listed below)

It is important to note that these provisions of the RIP were based on appropriate legal protection of the instream flow needs of the endangered Colorado River fishes. The RIP further states:

> ". . . it is necessary to protect and manage sufficient habitat to support self-sustaining populations of these species. One way to accomplish this is to provide long term protection of the habitat by acquiring or appropriating water rights to

> ensure instream flows . . . . Since this program sets in place a mechanism and a commitment to assure that the instream flows are protected under State law, the Service will consider these elements under section 7 consultation as offsetting project depletion impacts."

The Sanpete Water Conservancy District has applied to Reclamation for a Small Reclamation Project Act loan to help finance construction of the proposed Narrows Project. Such loans are made available by Reclamation to assist with construction of non-federal projects. The Sanpete Water Conservancy District has also applied to use lands for the Narrows Project that were withdrawn from the public domain by Reclamation. Reclamation has a regulatory responsibility to comply with the National Environmental Policy Act and requirements of the Small Reclamation Project Act. A repayment contract and a Management Agreement between Reclamation and the Sanpete Water Conservancy District will include any stipulations to meet environmental commitments of the project including those contained in this biological opinion.

Thus, we have determined that project depletion impacts, which the Service has consistently maintained are likely to jeopardize the listed fishes, can be offset by (a) the water project proponent's one-time contribution to the RIP in the amount of $14.13 per acre-foot of the project's average annual depletion, (b) appropriate legal protection of instream flows pursuant to State law, and (c) accomplishment of activities necessary to recover the endangered fishes as specified under the RIP RAP. We believe it is essential that protection of instream flows proceed expeditiously, before significant additional water depletions occur.

With respect to (a) above (i.e., depletion charge), the Sanpete Water Conservancy District will make a one-time payment which has been calculated by multiplying the project's average annual depletion of 5,717 acre-feet by the depletion charge in effect at the time payment is made. For Fiscal Year 2000 (October 1, 1999, to September 30, 2000), the depletion charge is $14.36 per acre-foot for the average annual depletion which equals a total payment of $82,096.12 for this project. We will notify the Sanpete Water Conservancy District of any change in the depletion charge by September 1 of each year. Ten percent of the total contribution, $8,210, or total payment, will be provided to our designated agent, the National Fish and Wildlife Foundation (Foundation), at the time of issuance of any funding or authorization from Reclamation. The balance will be due at the time the construction commences. The payment will be included by Reclamation as a stipulation in any agreement or authorization provided by Reclamation to the District. All payments should be made to the Foundation at the following address:

National Fish and Wildlife Foundation
1120 Connecticut Avenue, N.W.
Suite 900
Washington, D.C. 20036

In a letter dated November 11, 1999, the Sanpete Water Conservancy District agreed to this payment (Appendix B). They also noted that on July 13, 1995, the Sanpete Water Conservancy District sent a check for $7,063 to the National Fish and Wildlife Foundation to cover what was then 10 percent of the depletion charge. As soon as Reclamation approves the loan for the proposed Project, the Sanpete Water Conservancy District will send an additional $1147.00 to bring the contribution up to 10 percent of the current depletion charge (Appendix B).

Payment is to be accompanied by a cover letter that identifies the project and biological opinion that requires the payment, the amount of payment enclosed, check number, and any special conditions identified in the biological opinion relative to disbursement or use of the funds (there are none in this instance). The cover letter also shall identify the name and address of the payor, the name and address of the Federal agency responsible for authorizing the project, and the address of our office issuing the biological opinion. This information will be used by the Foundation to notify the payor, the lead Federal agency, and us that payment has been received. The Foundation is to send notices of receipt to these entities within 5 working days of its receipt of payment.

2) An objective of the RIP is to quantify and provide a process for the legal protection of instream flows pursuant to State law, and accomplish activities necessary to recover the endangered fishes as specified under the RIPRAP. To date, flow requirements have not been determined although a RIPRAP item has been developed specifically for the Price. Currently the RIP is evaluating tributary importance and overall contribution to the Green River and Colorado River system and the recovery of its endangered fish species. As part of the RPA to offset impacts from the proposed narrows project, the RIP will fund a study to determine the following:

- Seasonal endangered fish use in the Price River, particularly winter.
- Recommendation of year-round, instream flows requirements for Colorado pikeminnow.

The following background information provides a rationale for this element of the RPA. Historically, the Price River was inhabited by large numbers of native fish including Colorado pikeminnow, flannelmouth suckers, bluehead suckers, speckled dace, roundtail chubs, and possibly razorback suckers (Cavalli, 1999). However, due to impacts resulting from development (i.e., dams, water diversions, highways, railroads, etc.), habitat for the endangered Colorado River fishes now appears to be limited. The channel has been altered and instream habitat is structurally less complex; in addition, flows are substantially lower than historical flows with some periods of complete dewatering in parts of the system. The extent of these instream habitat and flow alterations are not well understood, nor is the effect on fish populations.

Fish surveys from the late 1970's indicated that no endangered fish occupied the Price River. Overall, most biologists familiar with the system believed that endangered fish had been completely extirpated from this river. In 1995, Trout Unlimited sponsored a single, 5-day sampling trip which resulted in the capture of one juvenile Colorado pikeminnow 2.2 miles above the confluence of the Green River. With pending water development projects, it became important to determine the extent of endangered fish use of the Price River. The single capture in 1995 was enough to prompt an additional 2 year study directed at determining endangered fish use of the Price River and examining potential habitat conditions in the lower 50 miles.

The 2-year study, conducted from April through October in 1996 and 1997, unexpectedly showed that the Price River is utilized by juvenile and adult Colorado pikeminnow. Over 20 Colorado pikeminnow were captured ranging in size from under 200 mm to nearly 600 mm. One large adult was captured (and several others were reported to be caught by anglers) at the most upstream possible point for fish movement, at the base of a diversion structure 88.5 miles above the confluence of the Price and Green rivers. These findings suggest the Price River may be hydrologically and biologically important to the Green River and the overall recovery and persistence of Colorado pikeminnow populations in the Upper Colorado River Basin.

The Price River system appears to be important not only in providing an additional 88.5 miles of occupied habitat to Colorado pikeminnow but also in its abundance and high percentage of natives in the fish community. The plentiful forage available in flannelmouth and bluehead suckers may attract the predaceous Colorado pikeminnow. It is unclear whether Colorado pikeminnow have been present in the Price River since the late 1970's but simply elusive to capture. Alternatively, recolonization of the Price River in the recent decade may represent a response to a recovering and increasing metapopulation in the main Green River system.

In the most dire case, the Price River may only provide seasonal, sub-optimal habitat for foraging adults. However, it may not be entirely serendipitous that the presence of Colorado pikeminnow in the Price River represent a recent range expansion in light of the extensive recovery efforts and environmental protection occurring throughout the last three decades. If newly located tributary occupation of Colorado pikeminnow is a response to recovery efforts, it is crucial to document and understand the role of tributaries to overall system recovery and persistence. In either case, 88.5 miles of river occupation by this endangered species should be better understood before it is dismissed and possibly lost during this time of great recovery strides.

In particular, it is important to know if Colorado pikeminnow use the Price River year-round and potentially spawn, thereby comprising a possibly new, contributing population. Instream flow requirements should be identified that will protect this enclave through upcoming water development. Although the 2-year Price River study provided a wealth of new and important information, it was not sufficient to determine year-round or accurate seasonal instream flow requirements. Some cursory data are available from the 2-year study; however, this information contains crucial gaps and does not sufficiently describe the potential for spawning activity and habitat use or year-round use of the river by Colorado pikeminnow (Cavalli 1999).

3) The discharge gage station located at Woodside in the lower Price River will be recommissioned so that flows in the lower river can be evaluated and instream flows can be identified and monitored.

Based on newly acquired and past information, we and Reclamation should determine the flows needed to maintain or improve the biological requirements of the Colorado pikeminnow in the Price River by the year 2003. This field effort should be closely monitored by the Utah Field Office to ensure that study objectives and data collected allow development of flow recommendations and understand year-round use. Funding for these actions should be the responsibility of the RIP and not Reclamation or the Sanpete Water Conservancy District.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, shunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of sections 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

We do not anticipate the proposed action will incidentally take any endangered Colorado River fishes by construction of the proposed Project and water depletion from the Price, Green or Colorado rivers. As such, no incidental take is authorized.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

A. Conservation Recommendations for Willow Flycatcher subspecies.

As previously stated the Service has not included the endangered subspecies southwestern willow flycatcher (*Empidonax traillii extimus*) in this Opinion. However, further analysis may determine that the willow flycatcher population affected by the proposed Narrows Project is *E. t. extimus* or some significant intercross gradation between *E. t. extimus* and *E. t. adastus* (a non-endangered subspecies of willow flycatcher) in which case Reclamation may need to reinitiate formal consultation. Because proposed Project impacts on riparian vegetation cannot be anticipated, and considering the unknown information regarding the status of the flycatcher population in the project area, the following conservation actions are recommended to provide a basis for determining impacts of the project and developing mitigation strategies for riparian vegetation and willow flycatcher subspecies.

1) Develop and implement, in coordination with us and the UDWR: a) a monitoring plan for willow flycatcher subspecies in the proposed Project area, surrounding drainages and mitigation sites; and b) a habitat analysis plan of current and potential willow habitat for the project area, surrounding drainages and mitigation sites.

    A) Develop and implement, in coordination with us and UDWR, a monitoring plan that estimates willow flycatcher subspecies populations and habitat availability.

        A qualified biologist with appropriate training and permits should conduct willow flycatcher surveys following the most recent protocol within the project area, surrounding drainages, and mitigation sites for breeding flycatchers, territories, nest locations, and habitat availability.

        Establish a database for the Narrows Project area and surrounding area and update the database annually.

        Determine pre-project willow flycatcher population levels that will help to detect any post-project changes in populations and willow habitat.

        Maintain records for each nest site or territory habitat patch, the location, size, structure, vegetative species composition, hydrology, and vulnerability to erosion.

        Record the use of newly established willow habitats developed as a result of the proposed Project for nesting and report this information to us and UDWR.

    B) Develop and implement, in coordination with us and UDWR, a habitat analysis plan of riparian habitats that includes specific monitoring of suitable nesting habitat. In general, the habitat analysis plan should be designed to detect changes in suitable nesting habitat quantity and quality. The level of detail of suitable nesting habitat monitoring should be commensurate with the population of willow flycatchers determined by initial surveys.

The habitat analysis plan should include an initial inventory of pre-project suitable nesting habitat patches and post-construction monitoring of suitable nesting habitat patches, both pre-project and newly established.

Information that should be collected includes location, size, structure, vegetative species composition, and hydrology of pre-project and established habitat patches. Changes in these characteristics should also be monitored.

Hydrology analysis should determine the importance of spring run-off, inundation frequency, inundation intervals, groundwater influences, beaver activity, and standing water to the willow regeneration process and willow habitat.

2) Develop and implement, in coordination with us and the UDWR, a contingency plan for full replacement of willow habitat suitable for nesting if monitoring reveals that habitat is being impacted or full replacement of this habitat is not occurring at mitigation sites.

   A) Develop and implement, in coordination with us and the UDWR, a technically and economically feasible contingency plan to replace willow habitat and reduce delays in establishing lost habitat later if it becomes necessary to do so.

3) Project mitigation measures for lost sport fish included 300 AF of water that could be used for stream flow maintenance. Develop and implement, in coordination with us and the UDWR, a hydrology plan that includes the 300 AF of sport fish mitigation water to be used in conjunction with natural spring flows to support riparian habitat suitable for willow flycatcher subspecies.

   A) Develop and implement, in coordination with us and the UDWR, a hydrology plan that includes the 300 AF of sport fish mitigation water to be used in conjunction with natural spring flows to support potential riparian or willow habitat. The plan should include measures to store and use this water approximately every four or five years or in conjunction with wet year flows to increase the spring peak flows to inundate more riparian habitat to help regeneration of willows.

4) Coordinate on a regular basis with us on willow flycatcher subspecies plans, monitoring, and study results.

   A) Annual reports for Terms and Conditions 1 - 3 listed above should be submitted to the Service detailing monitoring and study results. Impacts of the project and future measures that would be needed to avoid or reduce impacts to the willow flycatcher should be determined and monitored.

5) A qualified biologist with southwestern willow flycatcher survey certification should conduct nest monitoring to determine nest success and presence of cowbird parasitism.

6) If Reclamation documents cowbird parasitism higher than 50 percent on willow flycatchers, it will initiate a cowbird trapping program within the immediate nesting area. Cowbird trapping will be conducted until the larger issues of cowbird presence (i.e., local foraging sites and concentration areas) are identified and addressed.

7) Reclamation should evaluate livestock concentration sites within and adjacent to the project area that may act as likely foraging sources of cowbirds. Once these sources have been identified, Reclamation should work to eliminate or manage these sites administratively to limit their benefits to cowbirds.

REINITIATION NOTICE

This concludes formal consultation of the action outlined in the Draft Environmental Impact Statement, biological assessment, three amended biological assessments, Price River Cumulative Hydrology Study, and the accompanying request for formal consultation. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action specifically if new information indicates that the subspecies of willow flycatcher present near the proposed Project site is the endangered southwestern willow flycatcher subspecies. In instances where the amount or extent of incidental take is exceeded, any operations causing such take use cease pending reinitiation.

We appreciate the assistance and cooperation of your staff throughout this consultation process and your interest in conserving threatened and endangered species. If you have any questions regarding this biological opinion or would like to discuss it in more detail, please call Reed Harris, Field Supervisor, Utah Ecological Services Field Office, at 801-524-5001.

Sincerely,

Ralph O. Morgenweck

Regional Director

LITERATURE CITED

Archer, D.L., and H.M. Tyus. 1984. Colorado squawfish spawning study, Yampa River. U.S. Fish and Wildlife Service, Salt Lake City, Utah. 32 pp.

Archer, D.L., H.M. Tyus, and L.R. Kaeding. 1986. Colorado River fishes monitoring project, final report. U.S. Fish and Wildlife Service, Colorado River Fishery Project, Lakewood. 64 pp.

Banks, J. L. 1964. Fish species distribution in Dinosaur National Monument during 1961 and 1962. Master's Thesis. Colorado State University, Fort Collins.

Baxter, G. T., and J. R. Simon. 1970. Wyoming fishes. Bulletin 4, Wyoming Game and Fish Department, Cheyenne.

Behle, W.H. 1985. Utah birds: geographic distribution and systematics. Utah Museum of Natural History Occasional Paper, 5:1-147.

Behnke, R.J., and D.E. Benson. 1983. Endangered and threatened fishes of the Upper Colorado River Basin. Ext. Serv. Bull. 503A, Colorado State University, Fort Collins. 38 pp.

Bestgen, K. R. 1996. Growth, survival, and starvation resistance of Colorado squawfish larvae. Environmental Biology of Fishes 46:197–209.

Bestgen, K.R. 1990. Status Review of the Razorback Sucker, Xyrauchen texanus. Larval Fish Laboratory #44. Colorado State University, Ft. Collins.

Bestgen, K. R., D. W. Beyers, G. B. Haines, and J. A. Rice. 1997. Recruitment models for Colorado squawfish: tools for evaluating relative importance of natural and managed processes. Final Report of Colorado State University Larval Fish Laboratory to U.S. National Park Service Cooperative Parks Study Unit and U.S. Geological Survey Midcontinent Ecological Science Center, Fort Collins, Colorado.

Bestgen, K. R., and L. W. Crist. 1998. Restoration potential of the fish community of the Green River upstream of the Yampa River. Draft Report of Colorado State University Larval Fish Laboratory to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Bestgen, K. R., R. T. Muth, and M. A. Trammell. 1998. Downstream transport of Colorado squawfish larvae in the Green River drainage: temporal and spatial variation in abundance and relationships with juvenile recruitment. Final Report of Colorado State University Larval Fish Laboratory to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Bestgen, K. R., and M. A. Williams. 1994. Effects of fluctuating and constant temperatures on early development and survival of Colorado squawfish. Transactions of the American Fisheries Society 123:574 579.

Bozek, M. A., L. J. Paulson, and G. R. Wilde. 1990. Effects of ambient Lake Mohave temperatures on development, oxygen consumption, and hatching success of the razorback sucker. Environmental Biology of Fishes 27:255 263.

Bozek, M. A., L. J. Paulson, G. R. Wilde, and J. E. Deacon. 1991. Spawning season of the razorback sucker, *Xyrauchen texanus* in Lake Mohave, Arizona and Nevada. Journal of Freshwater Ecology 6:61–73.

Brouder, M. J., and T. L. Hoffnagle. 1997. Distribution and prevalence of the Asian tapeworm, *Bothriocephalus acheilognathi*, in the Colorado River and tributaries, Grand Canyon, Arizona, including two new host records. Journal of Helminthological Society of Washington 64:219–226.

Bulkley, R. V., C. R. Berry, R. Pimental, and T. Black. 1982. Tolerance and preferences of Colorado River endangered fishes to selected habitat parameters. Pages 185–241 *in* Colorado River Fishery Project, Final Report, Part 3. U.S. Fish and Wildlife Service and Bureau of Reclamation, Salt Lake City, Utah. 185-241.

Burdick, B. D. 1995. Ichthyofaunal studies of the Gunnison River, Colorado, 1992–1994. Final Report of U. S. Fish and Wildlife Service, Grand Junction, Colorado, to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Burdick, B.D. 1997. Minimum flow recommendations for passage of Colorado squawfish and razorback sucker in the Lower Gunnison River: Redlands Diversion Dam to the Colorado confluence. Final Report prepared for the Recovery Implementation Program for Endangered Fishes in the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Colorado River Fishery Project. Grand Junction, Colorado. 39pp + appendices.

Bureau of Reclamation. 1998. Price river cumulative hydrology study. Unpublished Report. Provo, Utah.

Carlson, C.A. and R.T. Muth. 1989. Colorado River: lifeline of the American southwest. Canadian Special Publication of Fisheries and Aquatic Sciences. 106:202-239.

Cavalli, PA. 1999. Fish community investigations in the lower Price River, 1996-1997. Final Report prepared for the Recovery Implementation Program for Endangered Fishes in the Upper Colorado River Basin. Project No. 78.

Chart, T. E., and L. D. Lentsch. 1999a. Flow effects on humpback chub *Gila cypha* populations in Westwater Canyon. Draft Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Chart, T. E., and L. D. Lentsch. 1999b. Reproduction and recruitment of *Gila* Spp. and Colorado pikeminnow (*Ptychocheilus lucius*) in the middle Green River 1992–1996. Report C *in* Flaming Gorge Studies: Reproduction and Recruitment of *Gila* spp. and Colorado Pikeminnow (*Ptychocheilus lucius*) in the Middle Green River. Draft Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Clarkson, R. W., A. T. Robinson, and T. L. Hoffnagle. 1997. Asian tapeworm (*Bothriocephalus acheilognathi*) in native fishes from the Little Colorado River, Grand Canyon, Arizona. Great Basin Naturalist 57:66–69.

Converse, Y. K, C. P. Hawkins, and R. A. Valdez. 1998a. Habitat relationships of subadult humpback chub in the Colorado River through Grand Canyon: spatial variability and implications of flow regulation. Regulated Rivers 14:267–284.

Converse, Y. K., L. D. Lentsch, and R. A. Valdez. 1998b. Evaluation of size dependent overwinter growth and mortality of age-0 Colorado squawfish. Draft Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Day, K. S., K. D. Christopherson, and C. Crosby. 1999. Backwater use by young-of-the-year chub (*Gila* sp.) and Colorado pikeminnow (*Ptychocheilus lucius*) in Desolation and Gray canyons of the Green River, Utah. Report B *in* Flaming Gorge Studies: Reproduction and Recruitment of *Gila* spp. and Colorado Pikeminnow (*Ptychocheilus lucius*) in the Middle Green River. Draft Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Dill, W. A. 1944. The fishery of the lower Colorado River. California Fish and Game 30:109–211.

Douglas, M . E., and P. C. Marsh. 1996. Population estimates/population movements of *Gila cypha*, an endangered cyprinid fish in the Grand Canyon region of Arizona. Copeia 1996:15–28.

Douglas, M. E., W. L. Minckley, and H. M. Tyus. 1989. Qualitative characters, identification of Colorado River chubs (Cyprinidae: Genus *Gila*) and the "Art of Seeing Well". Copeia 1989:653–662.

Dowling, T. E., and B. D. DeMarais. 1993. Evolutionary significance of introgressive hybridization in cyprinid fishes. Nature 1993:444-446.

Ellis, N.M. 1914. Fishes of Colorado. University of Colorado Studies. Vol. 11(1).

Evermann, B. W., and C. Rutter. 1895. The fishes of the Colorado Basin. U.S. Fish Commission Bulletin 14(1894):473–486.

Gilbert, C. H., and N. B. Scofield. 1898. Notes on a collection of fishes from the Colorado Basin in Arizona. Proceedings of the U.S. National Museum 20:181–192.

Gilpin, M. 1993. A population viability analysis of the Colorado squawfish from the upper Colorado River Basin. Report of University of San Diego, Department of Biology, to U.S. Fish and Wildlife Service, Denver.

Gutermuth, F.B., L.D. Lentsch and K.R. Bestgen. 1994. Collection of age-0 razorback suckers (Xyrauchen texanus) in the lower Green River, Utah. Southwestern Naturalist 39:389-391.

Haines, G. B. 1995. Effects of temperature on hatching success and growth of razorback sucker and flannelmouth sucker. Final Report of U.S. Fish and Wildlife Service, Vernal, Utah, to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Haines, G. B., D. W. Beyers, and T. Modde. 1998. Estimation of winter survival, movement, and dispersal of young Colorado squawfish in the Green River, Utah. Final Report of U.S. Fish and Wildlife Service, Vernal, Utah, to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Hamilton, S. J., and B. Waddell. 1994. Selenium in eggs and milt of razorback sucker (*Xyrauchen texanus*) in the middle Green River, Utah. Archives of Environmental Contamination and Toxicology 27:195–201.

Hamman, R. L. 1981. Spawning and culture of Colorado squawfish in raceways. Progressive Fish-Culturist 43:173–177.

Hamman, R. L. 1982. Spawning and culture of humpback chub. Progressive Fish-Culturist 44:213–216.

Hamman, R. L. 1985. Induced spawning of hatchery-reared razorback sucker. Progressive Fish-Culturist 47:187–189.

Hamman, R. L. 1987. Survival of razorback sucker cultured in earthen ponds. Progressive Fish-Culturist 49:187–189.

Hawkins, J. A., and T. P. Nesler. 1991. Nonnative fishes of the upper Colorado River basin: an issue paper. Final Report of Colorado State University Larval Fish Laboratory and Colorado Division of Wildlife to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Hardy, H. 1964. A cabin on the Price River. True West. November-December 1964. Pp 26-27, 40,44,46.

Haynes, C. M., T. A. Lytle, E. J. Wick, and R. T. Muth. 1984. Larval Colorado squawfish (*Ptychocheilus lucius*) in the upper Colorado River basin, Colorado, 1979–1981. Southwestern Naturalist 29:21–33.

Haynes, C.M., R.T. Muth, and T.P. Nesler. 1985. Identification of habitat requirements and limiting factors for Colorado squawfish and humpback chub. Final Report, Federal Aid in Fish and Wildlife Restoration, Project SE-3-4. Colorado Division of Wildlife, Denver. 62 pp.

Hendrickson, D. A. 1993. Progress report on a study of the utility of data obtainable from otoliths to management of humpback chub (*Gila cypha*) in the Grand Canyon. Arizona Game and Fish Department, Phoenix.

Holden, P. B. 1991. Ghosts of the Green River: Impacts of Green River poisoning on management of native fishes. Pages 43–54 *in* W. L. Minckley and J. E. Deacon, editors. Battle against extinction: native fish management in the American Southwest. University of Arizona Press, Tucson.

Holden, P. B., and L. W. Crist. 1981. Documentation of changes in the macroinvertebrate and fish populations in the Green River due to inlet modification of Flaming Gorge Dam. Final Report PR-16-5 of BIO/WEST, Inc., Logan, Utah.

Holden, P. B., and C. B. Stalnaker. 1975a. Distribution and abundance of fishes in the middle and upper Colorado River basins, 1967–1973. Transactions of the American Fisheries Society 104:217–231.

Holden, P. B., and C. B. Stalnaker. 1975b. Distribution of fishes in the Dolores and Yampa River systems of the upper Colorado River basin. The Southwestern Naturalist 19:403–412.

Horn, M. J. 1996. Nutritional limitation of recruitment in the razorback sucker (*Xyrauchen texanus*). Doctoral Dissertation. Arizona State University, Tempe.

Hubbs, C. L., and R. R. Miller. 1953. Hybridization in nature between the fish genera *Catostomus* and *Xyrauchen*. Papers of the Michigan Academy of Sciences, Arts, and Letters 38:207–233.

Irving, D., and T. Modde. In press. Home-range fidelity and use of historical habitat by adult Colorado squawfish *(Ptychocheilus lucius)* in the White River, Colorado and Utah. Great Basin Naturalist.

Jordan, D.S. 1891. Report of exploration in Colorado and Utah during the summer of 1889, with an account of the fishes found in each or the rivers examined. U.S. Fish Commission Bulletin 9(1889):1-40.

Jordan, D. S., and B. W. Evermann. 1896. The fishes of North and Middle America. Bulletin of the U.S. National Museum 47(1):1–1240.

Joseph, T.W., J.A. Sinning, R.J. Behnke, and P.B. Holden. 1977. An evaluation of the status, life history, and habitat requirements of endangered and threatened fishes of the upper Colorado River system. U.S. Fish and Wildlife Service, Office of Biological Services, Fort Collins, Colorado. 183 pp.

Kaeding, L.R., B.D. Burdick, P.A. Schrader, and W.R. Noonan. 1986. Recent capture of a bonytail (Gila elegans) and observations on this nearly extinct cyprinid from the Colorado River. Coopeia 1986(4):1021-1023.

Kaeding, L. R., B. D. Burdock, P. A. Schrader, and C. W. McAda. 1990. Temporal and spatial relations between the spawning of humpback chub and roundtail chub in the upper Colorado River. Transactions of the American Fisheries Society 119:135-144.

Kaeding L. R., and M. A. Zimmerman. 1983. Life history and ecology of the humpback chub in the Little Colorado and Colorado rivers of the Grand Canyon. Transactions of the American Fisheries Society 112:577–594.

Karp, C. A., and H. M. Tyus. 1990a. Behavioral interactions between young Colorado squawfish and six fish species. Copeia 1990:25–34.

Karp, C. A., and H. M. Tyus. 1990b. Humpback chub (*Gila cypha*) in the Yampa and Green Rivers, Dinosaur National Monument, with observations on roundtail chub (*G. robusta*) and other sympatric fishes. Great Basin Naturalist 50:257-264.

Kidd, G. 1977. An investigation of endangered and threatened fish species in upper Colorado River as related to Bureau of Reclamation Projects. Final Report, Bureau of Reclamation, Salt Lake City, Utah. 36 pp.

Kirsch, P. H. 1888. Notes on a collection of fishes obtained in the Gila River at Fort Thomas, Arizona, Lieut. W. L. Carpenter, U.S. Army. Proceedings of the U.S. National Museum 11:555–558.

Koster, W. J. 1960. *Ptychocheilus lucius* (Cyprinidae) in the San Juan River, New Mexico. Southwestern Naturalist 5:174–175.

Kubly, D. M. 1990. The endangered humpback chub *Gila cypha* in Arizona: a review of past and suggestions for future research. Arizona Game and Fish Department, Phoenix.

Langhorst, D. R., and P. C. Marsh. 1986. Early life history of razorback sucker in Lake Mohave. Final Report of Arizona State University to U.S. Bureau of Reclamation, Tempe, Arizona.

Lanigan, S.H., and H.M. Tyus. 1989. Population size and status of the razorback sucker in the Green River basin, Utah and Colorado. North American Journal of Fisheries Management 9:68-73.

Lechleitner, R. A. 1992. Literature review of the thermal requirements and tolerances of organisms below Glen Canyon Dam. Draft Report submitted to Glen Canyon Environmental Studies, Bureau of Reclamation, Flagstaff, Arizona.

Lentsch, L. D., Y. K. Converse, P.D. Thompson, T. A. Crowl and C. A. Toline. 1996a. Bonytail Reintroduction Plan for the Upper Colorado River Basin. Utah Division of Wildlife Resources Publication number 96-8. Salt Lake City, UT. pp.46.

Lentsch, L. D., T. A. Crowl, P. Nelson, and T. Modde. 1996b. Levee removal strategic plan. Utah State Division of Wildlife Resources Publication 96-6, Salt Lake City.

Lentsch, L. D., R. T. Muth, P. D. Thompson, B. G. Hoskins, and T. A. Crowl. 1996c. Options for selective control of nonnative fishes in the upper Colorado River basin. Utah State Division of Wildlife Resources Publication 96-14, Salt Lake City.

Mabey, L. W., and D. K. Shiozawa. 1993. Planktonic and benthic microcrustaceans from flood plain and river habitats of the Ouray Refuge on the Green River, Utah. Department of Zoology, Brigham Young University, Provo, Utah.

Maddux, H. R., L. A. Fitzpatrick, and W. R. Noonan. 1993. Colorado River endangered fishes critical habitat biological support document. U.S. Fish and Wildlife Service Utah/Colorado Field Office, Salt Lake City, Utah.

Marsh, P. C. 1985. Effect of incubation temperature on survival of embryos of native Colorado River fishes. Southwestern Naturalist 30:129–140.

Marsh, P. C. 1987. Food of adult razorback sucker in Lake Mohave, Arizona-Nevada. Transactions of the American Fisheries Society 116:117–119.

Marsh, P. C. 1994. Abundance, movements, and status of adult razorback sucker, *Xyrauchen texanus* in Lake Mohave, Arizona and Nevada. Proceedings of the Desert Fishes Council 25:35.

Marsh, P. C., and D. R. Langhorst. 1988. Feeding and fate of wild larval razorback sucker. Environmental Biology of Fishes 21:59–67.

Marsh, P.C., and W.L. Minckley. 1989. Observations on recruitment and ecology of razorback sucker: lower Colorado River, Arizona-California. Great Basin Naturalist 49(1):71-78.

McAda, C.W., C. Philips, C. R. Berry and R. S. Wydoski. 1977. A survey of threatened and endangered fish in southeastern Utah streams. A study funded by Utah Division of Wildlife Resources, Salt Lake City, Contract 77-8236. 245pp.

McAda, C.W. 1987. Status of the razorback sucker Xyrauchen texanus in the Colorado River upstream from Lake Powell. Proceedings of the Desert Fishes Council 17(1985):185.

McCarthy, C.W., and W.L. Minckley. 1987. Age estimation for razorback sucker (Pisces: Catostomidae) from Lake Mohave, Arizona and Nevada. Journal Arizona-Nevada Academy of Science 21:87-97.

McAda, C.W. and L.R. Kaeding. 1991. Movements of adults Colorado squawfish during the spawning season in the Upper Colorado River. Transactions of the American Fisheries Society 120:1339-1345.

McAda, C. W., J. W. Bates, J. S. Cranney, T. E. Chart, W. R. Elmblad, and T. P. Nessler. 1994a. Interagency Standardized Monitoring Program: summary of results, 1986–1992. Final Report, Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado

McAda, C. W., J. W. Bates, J. S. Cranney, T. E. Chart, M. A. Trammell, and W. R. Elmblad. 1994b. Interagency Standardized Monitoring Program: summary of results, 1993. Annual Report, Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

McAda, C. W., T. E. Chart, M. A. Trammell, K. S. Day, P. A. Cavalli, and W. R. Elmblad. 1996. Interagency Standardized Monitoring Program: summary of results, 1995. Annual Report, Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

McAda, C. W., W. R. Elmblad, T. E. Chart, K. S. Day, and M. A. Trammell. 1995. Interagency Standardized Monitoring Program: summary of results, 1994. Annual Report, Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

McAda, C. W., W. R. Elmblad, K. S. Day, M. A. Trammell, and T. E. Chart. 1997. Interagency Standardized Monitoring Program: summary of results, 1996. Final Report, Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

McAda, C.W., and R.S. Wydoski. 1980. The razorback sucker, Xyrauchen texanus, in the upper Colorado River basin, 1974-76. U.S. Fish and Wildlife Service Technical Paper 99. 50 pp.

Medel-Ulmer, L. 1983. Movement and reproduction of the razorback sucker (*Xyrauchen texanus*) inhabiting Senator Wash Reservoir, Imperial County, California. Proceedings of the Desert Fishes Council 12:106.

Milhous, R.T. 1982. Effect of sediment transport and flow regulation on the ecology of gravel-bed rivers. In Hey, R.D., J.C. Bathwist, and C.R. Thorne, eds. Gravel-bed rivers. John Wiley and Sons, New York.

Miller, R. R. 1946. *Gila cypha*, a remarkable new species of cyprinid fish from the Colorado River in Grand Canyon, Arizona. Journal of the Washington Academy of Science 36:409–415.

Miller, R. R. 1955. Fish remains from archaeological sites in the lower Colorado River basin, Arizona. Papers of the Michigan Academy of Science, Arts and Letters 40:125–126.

Miller, R.R. 1961. Man and the changing fish fauna of the American southwest. Papers of the Michigan Academy of Science, Arts, and Letters. 46:365-404.

Miller, W.H., D.L. Archer, J. Valentine, H.M. Tyus, R.A. Valdez, and L.R. Kaeding. 1982. Colorado River Fishery Project Final Report Summary. U.S. Fish and Wildlife Service, Salt Lake City, Utah. 42 pp.

Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix.

Minckley, W.L. 1983. Status of the razorback sucker, Xyrauchen texanus (Abbott), in the lower Colorado River basin. Southwestern Naturalist 28(2):165-187.

Minckley, W. L. 1991. Native Fishes of the Grand Canyon: an obituary? *In* Colorado River Ecology and Dam Management. Proceedings of Symposium, May 24–25, 1990, Sante Fe, New Mexico. National Academy Press, Washington, DC.

Minckley, W. L., and J. E. Deacon. 1968. Southwestern fishes and the enigma of "endangered species". Science 159:1424–1433.

Minckley, W. L., D. A. Hendrickson, and C. E. Bond. 1986. Geography of western North America freshwater fishes: description and relationships to intracontinental tectonism. Pages

519–613 *in* C. H. Hocutt and E. O. Wiley, editors. The zoogeography of North American freshwater fishes. Wiley-Interscience, New York.

Minckley, W.L., P.C. Marsh, J.E. Brooks, J.E. Johnson, and B.L. Jensen. 1991. Management toward recovery of the razorback sucker. Pages 305-357, *In*: W.L. Minckley and J.E. Deacon (editors). Battle against extinction: native fish management in the American southwest. University of Arizona Press. Tucson, AZ. 517 pp.

Modde, T. 1996. Juvenile razorback sucker (*Xyrauchen texanus*) in a managed wetland adjacent to the Green River. Great Basin Naturalist 56:375–376.

Modde, T. 1997. Fish use of Old Charley Wash: an assessment of flood plain wetland importance to razorback sucker management and recovery. Final Report of U.S. Fish and Wildlife Service, Vernal, Utah, to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Modde, T., K.P. Burnham, and E.J. Wick. 1996. Population status of the razorback sucker in the middle Green River (U.S.A.). Conservation Biology 10(1):110-119.

Modde, T., and D. B. Irving. 1998. Use of multiple spawning sites and seasonal movements by razorback suckers in the middle Green River, Utah. North American Journal of Fisheries Management 18:318–326.

Modde, T., A. T. Scholz, J. H. Williamson, G. B. Haines, B. D. Burdick, and F. K. Pfeifer. 1995. An augmentation plan for razorback sucker in the upper Colorado River basin. American Fisheries Society Symposium 15:102–111.

Modde, T., and E. J. Wick. 1997. Investigations of razorback sucker distribution, movements and habitats used during spring in the Green River, Utah. Final Report of U.S. Fish and Wildlife Service, Vernal, Utah, to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Mueller, G. 1989. Observations of spawning razorback sucker (*Xyrauchen texanus*) utilizing riverine habitat in the lower Colorado River, Arizona-Nevada. Southwestern Naturalist 34: 147–149.

Mueller, G. 1995. A program for maintaining the razorback sucker in Lake Mohave. American Fisheries Society Symposium 15:127–135.

Muth, R.T., G.B. Haines, S.M. Meismer, E.J. Wick, T.E. Chart, D.E. Snyder and J.M. Bundy. 1998. Introduction and early life history of razorback sucker in the Green River, Utah and Colorado, 1992-1996. Colorado State University Larval Fish Laboratory Draft Report to

Recovery Implementation Program for the Endangered Fish Species in the Upper Colorado River Basin.

Muth, R. T., and D. E. Snyder. 1995. Diets of young Colorado squawfish and other small fish in backwaters of the Green River, Colorado and Utah. Great Basin Naturalist 55:95-104.

Muth, R. T., and E. J. Wick. 1997. Field studies on larval razorback sucker in Canyonlands National Park and Glen Canyon National Recreation Area, 1993–1995. Final Report of Colorado State University Larval Fish Laboratory to U.S. National Park Service Rocky Mountain Region, Denver, Colorado.

Nesler, T. P., R. T. Muth, and A. F. Wasowicz. 1988. Evidence for baseline flow spikes as spawning cues for Colorado squawfish in the Yampa River, Colorado. American Fisheries Society Symposium 5:68–79.

O'Brien, J.S. 1984. Hydraulic and sediment transport investigations, Yampa River, Dinosaur National Monument. Fort Collins, Colorado. National Park Service, Water Resources Field Support Laboratory (WRFSL Report 83 (8)).

Osmundson, D. B., and K. P. Burnham. 1996. Status and trends of Colorado squawfish in the upper Colorado River. 1996. Final Report of U. S. Fish and Wildlife Service, Grand Junction, Colorado, to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Osmundson, D. B., and L. R. Kaeding. 1989a. Studies of Colorado squawfish and razorback sucker use of the "15-mile reach" of the upper Colorado River as part of conservation measures for the Green Mountain and Ruedi Reservoir water sales. Final Report of U.S. Fish and Wildlife Service Colorado River Fishery Project, Grand Junction, Colorado.

Osmundson, D. B., and L. R. Kaeding. 1989b. Colorado squawfish and razorback sucker grow-out pond studies as part of conservation measures for the Green Mountain and Ruedi Reservoir water sales. Final Report of U.S. Fish and Wildlife Service Colorado River Fishery Project, Grand Junction, Colorado.

Osmundson, D.B., and L.R. Kaeding. 1991. Flow recommendations for maintenance and enhancement of rare fish habitat in the 15-mile reach during October-June. Final Report. U.S. Fish and Wildlife Service, Grand Junction, Colorado.

Osmundson, D. B., R. J. Ryel, and T. E. Mourning. 1997. Growth and survival of Colorado squawfish in the upper Colorado River. Transaction of the American Fisheries Society 126:687–698.

Osmundson, D. B., R. J. Ryel, M. E. Tucker, B. D. Burdick, W. R. Elmblad, and T. E. Chart. 1998. Dispersal patterns of subadult and adult Colorado squawfish in the upper Colorado River. Transactions of the American Fisheries Society 127:943–956.

Papoulias, D., and W. L. Minckley. 1990. Food limited survival of larval razorback sucker, *Xyrauchen texanus,* in the laboratory. Environmental Biology of Fishes 29:73–78.

Papoulias, D., and W. L. Minckley. 1992. Effects of food availability on survival and growth of larval razorback suckers in ponds. Transactions of the American Fisheries Society 121:340–355.

Platania, S.P. 1990. Biological summary of the 1987 to 1989 New Mexico-Utah ichthyofaunal study of the San Juan River. Unpublished report to the New Mexico Department of Game and Fish, Santa Fe, and the U.S. Bureau of Reclamation, Salt Lake City, Utah, Cooperative Agreement 7-FC-40-05060.

Platania, S. P., K. R. Bestgen, M. A. Moretti, D. L. Propst, and J. E. Brooks. 1991. Status of Colorado squawfish and razorback sucker in the San Juan River, Colorado, New Mexico, and Utah. Southwestern Naturalist 36:147–150.

Platania, S.P., and D.A. Young. 1989. A Survey of the Icthyofauna of the San Juan and Animas Rivers from Achuleta and Cedar Hill (respectively) to their Confluence at Farmington, New Mexico. Department of Biology, University of New Mexico, Albuquerque.

Paulin, K. M., C. M. Williams, and H. M. Tyus. 1989. Responses of young razorback sucker and Colorado squawfish to water flow and light intensity. Final Report of U.S. Fish and Wildlife Service Colorado River Fishery Project, Vernal, Utah.

Quarterone, F. 1993. Historical accounts of upper Colorado River basin endangered fishes. Colorado Division of Wildlife, Denver.

Robinson, A. T., R. W. Clarkson, and R. E. Forrest. 1998. Dispersal of larval fishes in a regulated river tributary. Transactions of the American Fisheries Society 127:772–786.

Rosenfeld, M. J., and J. A. Wilkinson. 1989. Biochemical genetics of the Colorado River *Gila* complex (Pisces: Cyprinidae). Southwestern Naturalist 34: 232–244.

Ruppert, J. B., R. T. Muth, and T. P. Nesler. 1993. Predation on fish larvae by adult red shiner, Yampa and Green rivers, Colorado. Southwestern Naturalist 38:397–399.

Ryden, D. W., and F. K. Pfeifer. 1998. San Juan River seven year study integration flow recommendation report: razorback sucker information. Draft Report of U.S. Fish and Wildlife Service, Grand Junction, Colorado.

Seethaler, K. 1978. Life History and Ecology of the Colorado Squawfish (Ptychocheilus lucius) in the upper Colorado River basin. Thesis, Utah State University, Logan.

Sigler, W. F., and R. R. Miller. 1963. Fishes of Utah. Utah Department of Fish and Game, Salt Lake City.

Simon, J. R. 1946. Wyoming fishes. Wyoming Game and Fish Department Bulletin 4:1–129.

Smith, G. R. 1959. Annotated checklist of fishes of Glen Canyon. Pages 195–199 *in* A. M. Woodberry, editor. Ecological studies of the flora and fauna in Glen Canyon. University of Utah Anthropological Papers.

Snyder, D. E. 1976. Terminologies for intervals of larval fish development. Pages 41–60 *in* J. Boreman, editor. Great Lakes fish egg and larvae identification, proceedings of a workshop. U.S. Fish and Wildlife Service FWS/OBS

Snyder, D. E., and R. T. Muth. 1990. Descriptions and identification of razorback, flannelmouth, white, Utah, bluehead, and mountain sucker larvae and early juveniles. Colorado Division of Wildlife, Technical Publication 38, Fort Collins.

Stanford, J.A. 1994. Instream flows to assist the recovery of endangered fishes of the Upper Colorado River Basin. Biological Report 24. National Biological Survey, Wash., D.C. 47 pp.

Taba, S. S., J. R. Murphy, and H. H. Frost. 1965. Notes on the fishes of the Colorado River near Moab, Utah. Proceedings of the Utah Academy of Science, Arts, and Letters 42(II):280–283.

Thompson, J. M., E. P. Bergersen, C. A. Carlson, and L. R. Kaeding. 1991. Role of size, condition, and lipid content in the overwinter survival of age-0 Colorado squawfish. Transaction of the American Fisheries Society 120:346–353.

Tyus, H. M. 1985. Homing behavior noted for Colorado squawfish. Copeia 1985:213–215.

Tyus, H.M. 1987. Distribution, reproduction, and habitat use of the razorback sucker in the Green River, Utah, 1979-1986. Transactions of the American Fisheries Society 116:111-116.

Tyus, H.M. 1990. Potamodromy and reproduction of Colorado squawfish (*Ptychocheilus lucius*). Trans. Amer. Fish. Soc. 119:1035-1047.

Tyus, H. M. 1991a. Ecology and management of Colorado squawfish. Pages 379–402 *in* W. L. Minckley and J. E. Deacon, editors. Battle against extinction: native fish management in the American Southwest, University of Arizona Press, Tucson.

Tyus, H. M. 1991b. Movements and habitat use of young Colorado squawfish in the Green River, Utah. Journal of Freshwater Ecology 6:43–51.

Tyus, H. M. 1998. Early records of the endangered fish *Gila cypha,* Miller, from the Yampa River of Colorado with notes on its decline. Copeia 1998:190–193.

Tyus, H. M., B. D. Burdick, R. A. Valdez, C. M. Haynes, T. A. Lytle, and C. R. Berry. 1982. Fishes of the upper Colorado River basin: Distribution, abundance and status. Pages 12–70 *in* W. H. Miller, H. M. Tyus, and C. A. Carlson, editors. Fishes of the upper Colorado River system: present and future. Western Division, American Fisheries Society, Bethesda, Maryland.

Tyus, H.M. and G.B. Haines. 1991. Distribution, habitat use, and growth of age-0 Colorado squawfish in the Green River Basin, Colorado and Utah. Trans. Amer. Fish. Soc. 120:79-89.

Tyus, H.M., and C.A. Karp. 1989. Habitat Use and Streamflow Needs of Rare and Endangered Fishes, Yampa River, Colorado. U.S. Fish and Wildlife Service, Biology Report 89(14). 27 pp.

Tyus, H. M., and C. A. Karp. 1990. Spawning and movements of razorback sucker, *Xyrauchen texanus*, in the Green River basin of Colorado and Utah. Southwestern Naturalist 35:427–433.

Tyus, H. M., and C. A. Karp. 1991. Habitat use and streamflow needs of rare and endangered fishes, Green River, Utah. U.S. Fish and Wildlife Service, Vernal, Utah.

Tyus, H. M., and C. W. McAda. 1984. Migration, movements, and habitat preferences of Colorado squawfish, *Ptychocheilus lucius*, in the Green, White, and Yampa, rivers, Colorado and Utah. Southwestern Naturalist 29:289–299.

Tyus, H. M., and W. L. Minckley. 1988. Migrating Mormon crickets, *Anabrus simplex* (Orthoptera: Tettigoniidae), as food for stream fishes. Great Basin Naturalist 48:25–30.

Tyus, H. M., and J. F. Saunders. 1996. Nonnative fishes in the upper Colorado River basin and a strategic plan for their control. Final Report of University of Colorado Center for Limnology to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

U.S. Fish and Wildlife Service. 1987. Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Denver, Colorado. 82 pp.

U.S. Fish and Wildlife Service. 1990a. Humpback chub recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.

U.S. Fish and Wildlife Service. 1990b. Bonytail chub recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.

U.S. Fish and Wildlife Service. 1993. Section 7 Consultation, Sufficient Progress, and Historic Projects Agreement and Recovery Action Plan, Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Denver, Colorado. 50 pp.

U.S. Fish and Wildlife Service. 1994. Determination of critical habitat for four endangered Colorado River fishes. Federal Register 59(54):13374–13400.

U.S. Fish and Wildlife Service. 1998. Razorback sucker *Xyrauchen texanus* recovery plan. Denver, Colorado.

Utah Fish and Game Bulletin, 1953. 'There's Gold in That Thar River', June, pg 2.

Valdez, R. A. 1990. The endangered fish of Cataract Canyon. Final Report to Bureau of Reclamation, Salt Lake City, Utah. Contract No. 6-CS-40-03980, 134-3. 94 pp. + Appendices.

Valdez, R. A., and G. C. Clemmer. 1982. Life history and prospects for recovery of the humpback and bonytail chub. Pages 109–119 *in* W. H. Miller, H.M. Tyus, and C.A. Carlson, editors. Fishes of the upper Colorado River system: present and future. Western Division, American Fisheries Society, Bethesda, Maryland.

Valdez, R. A., P. B. Holden, and T. B. Hardy. 1990. Habitat suitability index curves for humpback chub of the Upper Colorado River Basin. Rivers 1:31–42.

Valdez, R.A., P.G. Mangan, R.P. Smith, and B.C. Nilson. 1982. Upper Colorado River investigation (Rifle, Colorado to Lake Powell, Utah). U.S. Fish and Wildlife Service and Bureau of Reclamation, Final Report, Part 2, Colorado River Fishery Project, Salt Lake City, Utah.

Valdez, R.A., and W.J. Masslich. 1989. Winter habitat study of endangered fish-Green River. Wintertime movement and habitat of adult Colorado squawfish and razorback suckers. Report No. 136.2. BIO/WEST Inc., Logan, Utah. 178 pp.

Valdez, R. A., W. J. Masslich, W. Leibfried, A. Wasowicz, B. Cowdell, R. VanHaverbeke, M. Yard, T. M. Trinca, and L. I. Brown. 1992. Characterization of the life history and ecology of the humpback chub in the Grand Canyon. Annual Report TR 250-05 of BIO/WEST, Inc. (Contract No. 0-CS-40-09110) to U.S. Bureau of Reclamation, Salt Lake City, Utah.

Valdez, R. A., and R. Ryel. 1995. Life history and ecology of the humpback chub (*Gila cypha*) in the Colorado River, Grand Canyon, Arizona. Final Report. BIO/WEST, Inc., Logan, Utah.

Valdez, R. A., and R. Ryel. 1997. Life history and ecology of the humpback chub in the Colorado River in Grand Canyon, Arizona. Pages 3–31 *in* van Riper, C., III, and E.T. Deshler, editors. Proceedings of the Third Biennial Conference of Research on the Colorado Plateau. Transactions and Proceedings Series NPS/NRNAU/NRTP-97/12, National Park Service, Denver, Colorado.

Valdez, R. A., and R. D. Williams. 1993. Ichthyofauna of the Colorado and Green rivers in Canyonlands National Park, Utah. Pages 2–22 *in* P.G. Rowlands, C. van Riper III, and M.K. Sogge, editors. Proceedings of the First Biennial Conference on Research in Colorado Plateau National Parks. Transactions and Proceedings Series NPS/NRNAU/NRTP-93/10, National Park Service, Denver, Colorado.

Vanicek, C. D. 1967. Ecological studies of native Green River fishes below Flaming Gorge Dam, 1964–1966. Doctoral Dissertation. Utah State University, Logan.

Vanicek, C.D., and R.H. Kramer. 1969. Life history of the Colorado squawfish Ptychocheilus lucius and the Colorado chub Gila robusta in the Green River in Dinosaur National Monument, 1964-1966. Transactions of the American Fisheries Society 98(2):193.

Vanicek, C. D., R. H. Kramer, and D. R. Franklin. 1970. Distribution of Green River fishes in Utah and Colorado following closure of Flaming Gorge Dam. Southwestern Naturalist 14:297–315.

Wick, E. J. 1997. Physical processes and habitat critical to the endangered razorback sucker on the Green River, Utah. Doctoral Dissertation. Colorado State University, Fort Collins.

Wick, E.J. and J.A. Hawkins. 1989. Observations on the use of the Little Snake River in Colorado, by endangered Colorado squawfish and humpback chub, 1988. Larval Fish Lab., Colorado State University, Fort Collins, CO. 10 pp.

Wick, E. J., T. A. Lytle, and C. M. Haynes. 1981. Colorado squawfish and humpback chub population and habitat monitoring, 1979–1980. Endangered Wildlife Investigations, SE-3-3, Colorado Division of Wildlife, Denver, Colorado.

Wiltzius, W. J. 1978. Some factors historically affecting the distribution and abundance of fishes in the Gunnison River. Final Report of Colorado Division of Wildlife to U.S. Bureau of Reclamation.

Wolz, E. R., and D. K. Shiozawa. 1995. Soft sediment benthic macroinvertebrate communities of the Green River at the Ouray National Wildlife Refuge, Uintah County, Utah. Great Basin Naturalist 55:213–224.

Wydoski, R. S., and E. D. Wick. 1998. Ecological value of flood plain habitats to razorback suckers in the upper Colorado River basin. Final Report of U.S. Fish and Wildlife Service and U.S. National Park Service to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Table 1.1
Theoretical Virgin Flows
Price River at Woodside

Month	Average Year 1968 (cfs)	Average Year 1968 (ac-ft)	Wet Year 1984 (cfs)	Wet Year 1984 (ac-ft)	Dry Year 1977 (cfs)	Dry Year 1977 (ac-ft)
October	14.4	886	368.0	22,622	28.7	1,765
November	6.8	404	77.5	4,761	20.0	1,227
December	15.0	924	65.4	4,017	23.5	1,443
January	2.0	126	38.2	2,350	9.3	571
February	13.2	735	33.7	2,069	7.4	452
March	40.9	2,514	3.9	238	16.1	987
April	301.5	17,934	570.5	35,070	80.6	4,952
May	514.6	31,632	1,842.6	113,267	85.9	5,282
June	655.0	38,969	1,211.6	74,482	68.0	4,183
July	481.1	29,573	458.3	28,175	184.6	11,346
August	291.1	17,896	463.5	28,492	93.9	5,774
September	263.2	15,657	372.9	22,921	72.5	4,455
Annual Total (ac-ft)		157,249		338,467		42,437

Table 1.2
Environmental Baseline Flows
Price River at Woodside

Month	Average Year 1968 (cfs)	Average Year 1968 (ac-ft)	Wet Year 1984 (cfs)	Wet Year 1984 (ac-ft)	Dry Year 1977 (cfs)	Dry Year 1977 (ac-ft)
October	0.0	0	0.0	0	0.0	0
November	0.0	0	0.0	0	0.0	0
December	0.0	0	0.0	0	0.0	0
January	0.0	0	0.0	0	0.0	0
February	0.0	0	0.0	0	0.0	0
March	0.0	0	0.0	0	0.0	0
April	160.0	9,517	155.8	9,579	56.3	3,295
May	154.8	9,517	155.8	9,579	53.6	3,295
June	266.3	15,844	258.7	15,906	156.5	9,622
July	257.7	15,844	258.7	15,906	156.5	9,622
August	257.7	15,844	258.7	15,906	156.5	9,622
September	266.3	15,844	258.7	15,906	156.5	9,622
Annual Total (ac-ft)		82,412		82,782		45,080

Table 1.3*

Average Monthly Flows with Narrows Project
Price River at Woodside

Month	Average Year 1968 (cfs)	Average Year 1968 (ac-ft)	Wet Year 1984 (cfs)	Wet Year 1984 (ac-ft)	Dry Year 1977 (cfs)	Dry Year 1977 (ac-ft)
October	6.7	410	360.3	22,147	21.0	1,289
November	-1.2	-72	69.7	4,286	12.2	751
December	7.3	448	57.6	3,542	15.7	967
January	-5.7	-350	30.5	1,875	1.5	95
February	4.7	259	25.9	1,594	-0.4	-2.4
March	33.2	2,038	-3.9	-237	8.3	511
April	133.5	7,942	406.9	25,016	19.2	1,181
May	352.0	21,639	1,679.0	103,213	24.6	1,511
June	380.7	22,649	945.1	58,100	-96.2	-5,915
July	215.6	13,253	191.8	11,793	20.3	1,248
August	25.6	1,576	197.0	12,110	-70.3	-4,324
September	-11.1	-663	106.4	6,539	-91.8	-5,643
Annual Total (ac-ft)		69,128		249,976		-8,352

Table 1.4
Average Monthly Flows without Narrows Project
Price River at Woodside

Month	Average Year 1968 (cfs)	Average Year 1968 (ac-ft)	Wet Year 1984 (cfs)	Wet Year 1984 (ac-ft)	Dry Year 1977 (cfs)	Dry Year 1977 (ac-ft)
October	14.4	886	368.0	22,622	28.7	1,765
November	6.8	404	77.5	4,761	20.0	1,227
December	15.0	924	65.4	4,017	23.5	1,443
January	2.0	126	38.2	2,350	9.3	571
February	13.2	735	33.7	2,069	7.4	452
March	40.9	2,514	3.9	238	16.1	987
April	141.5	8,417	414.7	25,492	27.0	1,657
May	359.7	22,115	1,686.7	103,689	32.3	1,987
June	388.7	23,124	952.9	58,576	-88.5	-5,440
July	223.3	13,729	199.6	12,269	28.0	1,723
August	33.4	2,052	204.7	12,586	-62.6	-3,849
September	-3.1	-187	114.1	7,015	-84.1	-5,168
Annual Total (ac-ft)		74,837		255,685		2,643

*It is important to note that the depletion for the Narrows Project used in table 1.3 of the Bureau of Reclamation Price River Hydrology Report is 5,709 AF. This depletion was corrected in November 1999 to be 5,717 AF, therefore numbers in the table does not accurately reflect this new depletion estimate. (K. Schwarz, Bureau of Reclamation; personal communication)

SANPETE WATER CONSERVANCY DISTRICT

November 11, 1999

Mr. Reed Harris
Field Supervisor, U.S. Fish
and Wildlife Service
Lincoln Plaza
145 East 1300 South, Suite 404
Salt Lake City, Utah 84115

Subject: Draft Amended Biological Opinion – Narrows Project

Dear Mr. Harris:

The Sanpete Water Conservancy District (District) has reviewed the draft, Amended Biological Opinion on the Narrows Project, as transmitted to the Bureau of Reclamation in October 1999.

The District hereby agrees to pay the $14.13 per acre-foot depletion charge (current fiscal year value) which will be used in accomplishment of the Recovery Implementation Program Recovery Action Plan for the endangered fishes of the Colorado River System. Based on the estimated 5,717 acre-foot depletion, the total depletion charge would be $80,781,21.

On July 13, 1995, the District sent a check for $7,063 to the National Fish and Wildlife Foundation to cover what was then 10 percent of the depletion charge. As soon as Reclamation approves the loan for the project, the District will send an additional $1,015.12 to bring the contribution up to 10 percent of the current depletion charge.

Sincerely,

David L. Peterson
President

cc: Mr. Bruce Barrett
Bureau of Reclamation
Attn: PRO-405
302 East 1860 South
Provo, UT 84606

Mr. Richard Noble
Franson-Noble & Associates, Inc.
776 East Utah Valley Drive
American Fork, UT 84003

NARROWS PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

APPENDIX D

FISH AND WILDLIFE
COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
UTAH FIELD OFFICE
LINCOLN PLAZA
145 EAST 1300 SOUTH, SUITE 404
SALT LAKE CITY, UTAH 84115

In Reply Refer To
(CO/KS/NE/UT)

August 21, 1997

MEMORANDUM

TO: Manager, Resource Management Division, Bureau of Reclamation, Upper Colorado Region, Provo Area Office, 302 East 1860 South, Provo, Utah 84606-7317

FROM: Field Supervisor, Ecological Services, Fish and Wildlife Service, Utah Field Office, 145 East 1300 South, Ste. 404, Salt Lake City, Utah 84115

SUBJECT: Formal Section 7 Consultation for the Proposed Narrows Project and Request for Updated Fish and Wildlife Coordination Act Report

On March 10, 1997, the Fish and Wildlife Service reinitiated and entered into formal Section 7 consultation on the proposed Narrows Project, a small reclamation project act loan. The 135-day consultation period expired on July 24, 1997. Due to personnel shortages and the complexities involved with this consultation, we are requesting a 60-day extension of the consultation period in accordance with 50 CFR Part 402.14(e).

The Service is currently in consultation with the Bureau of Reclamation on two projects involving water depletions in the Price River drainage. New information has revealed the presence of the endangered Colorado squawfish in the Price River. The significance of the Price River to the conservation and recovery of the Colorado squawfish has not been addressed as yet. However, it is the Services intention to evaluate the significance of the Price River and to develop a RIPRAP item for Recovery of Colorado squawfish in the Price River. This will be done as expeditiously as possible, however, a new RIPRAP item must be coordinated with the Management Committee of the Colorado River Fishes Recovery Program and will delay the Service's completion of formal Section 7 consultation on the Narrows Project.

In addition, the Service was requested to complete an updated Coordination Act Report by the 1st of June, 1997. At this time we are attempting to update this Report, however, we do not anticipate that an updated Coordination Act Report will be finalized until the issues involved with Section 7 consultation have been resolved.

United States Department of the Interior

BUREAU OF RECLAMATION
Upper Colorado Region
Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

IN REPLY REFER TO:

PRO-751
ENV-6.00

MAY 0 9 1997

Mr. Reed Harris
Ecological Services
U.S. Fish and Wildlife Service
145 East 1300 South, Suite 404
Salt Lake City UT 84115

Subject: Request for Completion of Updated Fish and Wildlife Coordination Act Report for the Narrows Project

Dear Mr. Harris:

The Bureau of Reclamation completed an Environmental Impact Statement for the proposed Narrows Project in January 1995. A Record of Decision (ROD) was signed by Reclamations' Upper Colorado Regional Director. However, the ROD was later rescinded and a notice of intent to prepare a new draft EIS was published in the Federal Register in February 1996.

A Coordination Act Report (dated October 1994) was prepared by your office, with assistance from Utah Division of Wildlife Resources, for the original EIS. The report evaluates the impacts of the proposed Narrows Project on fish and wildlife resources, and recommends appropriate mitigation in accord with the Fish and Wildlife Coordination Act and the U.S. Fish and Wildlife Service's mitigation policy.

Because it has been almost three years since the Coordination Act Report was prepared, Reclamation believes it is necessary for the Service to review and update, if needed, the 1994 report for inclusion with the revised EIS being prepared. We request that the Coordination Act Report review and update, if needed, be completed by June 1, 1997, so that it can be included with the Draft EIS. Kerry Schwartz of my staff discussed this issue with Janet Mizzi of your staff on April 30, 1997.

If you have any further questions regarding this matter, please contact Kerry Schwartz at (801) 379-1167.

Sincerely,

LEE G. BAXTER

ACTING FOR
Larry Fluharty
Manager, Resource Management Division

cc: Mr. Richard Noble
6 South 100 West
American Fork UT 84003

Mr. John Anderson
Pruitt, Gushee, and Bachtell
Suite 1850, Beneficial Life Tower
36 South State Street
Salt Lake City UT 84111

Mr. David Peterson
President, Sanpete Water Conservancy District
1484 South 70 West
Mount Pleasant UT 84647

Mr. Leland Matheson
Manti-LaSal National Forest
599 West Price River Drive
Price UT 84501

Mr. Bill Bates
Habitat Manager, Utah Division of Wildlife Resources
Southeastern Regional Office
455 West Railroad Avenue
Price UT 84501

bc: Manager, Resources Management Division, Salt Lake City UT, Attention: UC-320
Field Solicitor, Salt Lake City UT, Attention: Scott Loveless

bcc: PRO-750, PRO-751, and PRO-752

GOOSEBERRY NARROWS DAM PROJECT
SANPETE COUNTY, UTAH

A FISH AND WILDLIFE COORDINATION ACT REPORT

PREPARED BY

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
UTAH FIELD OFFICE
SALT LAKE CITY, UTAH

WITH ASSISTANCE FROM

UTAH DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES
SALT LAKE CITY, UTAH
SPRINGVILLE, UTAH
PRICE, UTAH

OCTOBER, 1994

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FIGURES

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INTRODUCTION

This Coordination Act Report has been developed in concert with the Environmental Impact Statement being prepared by the Bureau of Reclamation (Reclamation) for the proposed Narrows Dam Project (Narrows). The report evaluates the impacts of the proposed Narrows Project on fish and wildlife resources, and recommends appropriate mitigation in concert with The Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) and the U.S. Fish and Wildlife Service Mitigation Policy (Federal Register, Vol. 46, No. 15, January 23, 1981 (as modified February 4, 1981)). Endangered Species Act (16 U.S.C. 1531 as amended) requirements have been addressed in a separate Biological Opinion from the U.S. Fish and Wildlife Service (Service) to Reclamation, dated March 25, 1992. National Environmental Policy Act (NEPA) documentation is being prepared by the Sanpete Water Conservancy District (District) for Reclamation.

The Narrows project is proposed by the District. It would develop a supplemental irrigation water supply for presently irrigated lands and provide municipal water to project communities in northern Sanpete County, Utah. The project would include a transbasin diversion of $6.7x10^6$ cubic meters (m^3) (5,400 acre-feet {af}) per year from the Price River (Colorado River drainage) to the San Pitch River drainage (Great Basin). The District plans to apply to Reclamation for a Small Reclamation Project Act Loan. The District also needs a 404 permit for the project from the U.S. Army Corps of Engineers (Corps).

In January of 1991 two teams of specialists from various State and Federal agencies were formed to review plans for the Narrows and assist in the identification of impacts and the development of mitigation plans. A fisheries team was formed to look at aquatic impacts and fisheries issues. This team consisted of a consultant for the District and members from the Service, Reclamation, Corps, U.S. Forest Service (USFS), and Utah Division of Wildlife Resources (UDWR). A wetlands/wildlife team was formed to evaluate impacts to wetlands and wildlife habitat. The team consisted of a consultant for the District and members from the Service, Reclamation, Corps, USFS, and UDWR. Agency representatives on both teams were not necessarily the same.

Information in this report is based on preliminary documents prepared for the District in coordination with the two teams. These include draft reports on Aquatic Ecology (Woodward - Clyde Consultants, December 1991), Vegetation and Wildlife Impacts (Mt. Nebo Scientific, February 1992), the Preliminary Draft Environmental Impact Statement (Reclamation, August 1993), and other information in Service files.

DESCRIPTION OF THE STUDY AREA

The basin which would be inundated by the proposed reservoir lies in a high elevation, shallow valley in the Wasatch Plateau. The basin, isolated by several ridges, is 2,646 meters (m) (8,680 feet {ft}) above sea level. Vegetation consists of plant communities common to high elevation mountain meadow areas, including Vasey sagebrush, Silver sagebrush, and various wetland community types. The majority of the reservoir basin is privately owned, although the actual dam site is in the Manti-LaSal National Forest.

Historically the area has been used for livestock grazing. Cattle and sheep were introduced into the area in the late 1800's and subsequently overgrazed the area so that rangeland restoration became necessary. The USFS established a controlled grazing plan for the Manti National Forest in 1908. Sheep still graze in the area.

The Sanpete Valley, which will receive water from the proposed project, lies at an elevation of 1,676-1,890 m (5,500-6,200 ft). It is bordered on the east by the Wasatch Plateau and on the west by the San Pitch Mountains. U.S. Highway 89 extends through the project area, connecting Fairview, Mt. Pleasant, Ephraim, and Manti (the county seat) with Salt Lake City, approximately 209 kilometers (km) (130 miles {mi}) to the north (Figure 1). The estimated population of Sanpete County in 1990 was 16,259. Government, agriculture, services, manufacturing and retail trade are the leading economic sectors. Approximately 44 percent of the land in Sanpete County is in agricultural use, with 36 percent of the total agricultural land developed for crops.

DESCRIPTION OF THE PROJECT

The Narrows project is designed to bring supplemental irrigation water to the Sanpete Valley and to provide supplemental municipal water for irrigation of lawns and gardens. The District also cites the need for honoring long-standing water rights contracts and agreements, for improving water conveyance facilities, and improving recreation and fishery opportunities. The project area consists of the Sanpete Valley and the headwaters area of the Price River (Figure 2). Sanpete Valley contains approximately 68,800 hectares (ha) (170,000 acres {ac}) of land, of which 24,280 ha (60,000 ac) are currently irrigated. About 6,230 ha (15,400 ac) of currently irrigated land would be eligible to receive project water. Currently these lands experience moderate to severe late season irrigation water shortages, averaging 2.3×10^7 m^3 (19,000 af) per year. The project would provide 6.7×10^6 m^3 (5,400 af) of water per year, of which 6.07×10^6 m^3 (4,920 af) would go to irrigation and 5.9×10^5 m^3 (480 af) to municipal supplies.

The proposed action includes construction of a dam on Gooseberry Creek, a tributary of the Price River, approximately 14.5 km (9 mi) east of Fairview, Utah. The proposed dam would be a zoned earthfill embankment, 37 m (120 ft) high, with a crest length of 168 m (550 ft) and a crest width of 9 m (30 ft). The dam would have 3:1 horizontal to vertical slopes upstream and downstream. The dam would impound a reservoir with a capacity of 2.1×10^7 m^3 (17,000 af), with 1.8×10^7 m^3 (14,500 af) of active storage and 3.1×10^6 m^3 (2,500 af) of dead storage. The maximum reservoir surface area is approximately 244 ha (604 ac). At an average water surface during the recreation season (June through September) the reservoir would cover 184 ha (454 ac). The water surface will fluctuate an average of about 3.7 m (12 ft) vertically each year, with a maximum fluctuation of 5.5 m (18 ft) per year.

An alternative, smaller reservoir, would consist of a dam at the same location that would be 30.5 m (100 ft) high, with a crest length of 129.5 m (425 ft) and a crest width of 9 m (30 ft). The impounded smaller reservoir would have a capacity of $9.7x10^6$ m^3 (7,900 af), with $6.7x10^6$ m^3 (5,400 af) of active storage and $3.1x10^6$ m^3 (2,500 af) of dead storage. The maximum reservoir surface area would be 146 ha (362 ac), with an average of 96.3 ha (238 ac) during the recreation season. The water surface would fluctuate an average of 4.9 m (16 ft) vertically per year, with a maximum fluctuation of 6.7 m (22 ft) per year.

An existing tunnel, which currently conveys water from Fairview Lakes into Cottonwood Creek, would be rehabilitated to carry releases from Narrows Reservoir into Cottonwood Creek. The water would be carried in a pipeline for the upper 1.3 km (0.8 mi) of Cottonwood Creek to prevent degradation of the stream channel. At the mouth of Fairview Canyon some of the flow would be diverted into two pipelines, which would convey project water north to Oak Creek and south to Spring City (Figure 2). Project water would also be diverted into Cottonwood-Gooseberry Irrigation Company's existing pressurized irrigation system for use in the Fairview area. The remainder of the project water would flow into the San Pitch River where it could be diverted into existing canals and ditches. A stream-level emergency outlet would also be constructed through the dam to provide downstream releases into Gooseberry Creek for fisheries and emergency evacuation of the reservoir.

The Narrows Reservoir would inundate about 1.3 km (0.8 mi) of the Skyline Coal Mine Road, which provides access between Fairview and Scofield. Under the project, 4.2 km (2.6 mi) of new road would be constructed across the Narrows Dam. Asphalt surfacing would also occur on 0.5 km (0.3 mi) of existing gravel road to Lower Gooseberry Reservoir.

The District studied several other alternatives to meet project needs, but found them to be nonviable. These included using an alternative dam site, providing year-round releases from the new reservoir, additional groundwater development within Sanpete County, using Central Utah Project water, and direct diversion without a reservoir. The District was hampered by the fact that a 1984 water rights settlement agreement dictates the dam location and storage capacity and because the State Engineer has closed the Sanpete Valley to further ground water development due to downstream water rights interests. Other alternatives were eliminated because of economics, including construction of a storage reservoir in the Sanpete Valley and developing a conveyance system to deliver Central Utah Project water to the area.

On-farm conservation measures, including improved irrigation methods such as canal lining, sprinklers, and gated pipe will be required for participants to be eligible for project water. For the most part, due to existing irrigation water shortages, these measures have already been implemented. Without these conservation measures, the supplemental irrigation demand would be $2.8x10^7$ m^3 (23,000 af) per year, versus the $1.5x10^7$ m^3 (12,300 af) per year that the project is based on.

EVALUATION METHODOLOGY

Terrestrial Resources

Evaluation of terrestrial resources included baseline vegetation mapping and identification of plant and animal species occurring in the potentially affected area. A "Habitat Evaluation Procedures" (HEP) analysis was then used to assess pre-project conditions and impacts to wildlife and their habitats from project development.

Vegetation mapping was achieved by using aerial photography and contour maps on the ground. Plant species lists were compiled from previous reports and verified by District employees on the ground. Wildlife species lists were generated by UDWR, then verified by the District through field observation and animal live-trapping studies.

Use of HEP analysis was chosen by the Wetlands and Wildlife Team biologists as the best tool to quantify project impacts to wetlands, wildlife and their habitats. This is a process developed by the Service and is based on the assumption that habitat quality and quantity can be numerically described on a nonmonetary basis (USFWS, 1980). This species-habitat approach to impact assessment uses selected species as indicators to evaluate habitat for a representative group of species. It is assumed that impacts to indicator species represent impacts to the broader groups as functioning ecosystem units. The HEP process evaluates habitat quality for the selected species and allows for the development of Habitat Suitability Indices (HSI). These indices range from 0.0 to 1.0, with the values being related linearly to the habitat carrying capacity for the species. An HSI value of 1.0 represents optimum habitat for the species, while 0.0 represents unsuitable habitat. Comparison of pre- and post-project HSI values allows for a quantitative determination of impacts to the evaluation species and the groups they represent.

The Wetlands and Wildlife Team determined the species to be evaluated based on the habitat types and wildlife species lists prepared by the District. An attempt was made to identify species which were important or common to the impacted areas. These species were then put into feeding and reproductive guilds, and representative species for which HSI models were available were chosen from these guilds for evaluation. The guilds used are shown in Tables 1 and 2, with chosen indicator species bolded. Indicator species chosen were the montane vole (Microtus montanus)(to represent the closely related Richardson's vole, Microtus richardsoni), yellow warbler (Dendroica petechia), beaver (Castor canadensis), mule deer (Odocoileus hemionus), and Brewer's sparrow (Spizella breweri). It should be noted that, while the mule deer was considered an important species, application of the mule deer model in this situation was not totally appropriate since it is primarily based on winter habitat variables, whereas the reservoir basin is primarily used as summer habitat. Therefore the Brewer's sparrow model was used to evaluate habitat used by mule deer.

District personnel collected data, including quantitative and qualitative habitat variables, and analyzed the HSI models to determine HSI indices. All field parameters were obtained by multiple samplings. Means and standard deviations were calculated for each parameter and an attempt was made to obtain statistically adequate samples for each parameter. Average

Annual Habitat Units were determined for each species by multiplying the determined HSI by the acreage of the cover type(s) used in the evaluation area. The models used and raw data collected are available from the Service.

Aquatic Resources

Analysis of impacts to aquatic resources included evaluating the effects of reservoir inundation, flow alterations on streams, and the effects of the project on reservoir fisheries.

Effects of reservoir inundation were evaluated by assessing the number of stream kilometers (miles) and trout biomass (kilograms {pounds}) and numbers that would be lost to direct inundation by the Narrows project. Standing crop estimates prepared by UDWR provided biomass estimates.

Flow alteration effects will include flow reductions in Middle and Lower Gooseberry and Fish Creeks and a flow increase in Cottonwood Creek. The Instream Flow Incremental Methodology (IFIM) (Bovee, 1982) was chosen by the Fisheries Team to determine the effects flow alterations would have on weighted usable area (WUA) of aquatic habitats. WUA is a measure of usable microhabitat present in a stream reach. It is determined for each life stage of each species evaluated in an analysis and is defined as the microhabitat area per unit length of stream, most often expressed as ft^2 WUA/1,000 ft stream. This procedure uses computer models which combine stream hydraulic characteristics and habitat utilization characteristics for various life stages of a species (Physical Habitat Simulation System (PHABSIM)) (Milhous et al., 1984) to predict changes in WUA with changes in flow. The UDWR used the Habitat Quality Index method to compare project impacts and project-induced mitigation improvements and to provide recommendations for mitigation for stream impacts. The number of Habitat Units present in stream segments which would be impacted by the Narrows project and those which could be used as potential mitigation sites were estimated and compared (Appendix B).

Data on stream channel characteristics was collected in the field by District representatives and Fisheries Team members and the analysis was performed by the District. Five to nine transects were taken across the stream channel at several locations in five different stream reaches (stations) which could be affected. Field measurements were compared with model predictions for calibration. Good calibration was achieved for all stations. The models used and raw data collected are available from the Service.

Reservoir fishery effects were determined by evaluating the number of angler days per year that could be affected by the Narrows project on reservoirs in the Gooseberry and Fish Creek watersheds, including the proposed reservoir.

FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

Terrestrial Resources

Vegetation in the reservoir basin area consists mainly of Vasey sagebrush (Artemisia tridentata v. vaseyana) and silver sagebrush (Artemisia cana) communities. The Vasey sagebrush is the driest plant community in the basin, existing on well-drained soils on upland slopes. Other dominant species include low rabbitbrush (Chrysothamnus viscidiflorus), snowberry (Symphoricarpos oreophilis), Pacific aster (Aster chilensis), slender wheatgrass (Elymus trachycaulus), and Letterman needlegrass (Stipa lettermanii). It encompasses approximately 134 ha (331 ac) of the basin.

The silver sagebrush community type lies downslope of the Vasey sagebrush community and comprises approximately 63.1 ha (156 ac) of the basin. The topography is generally flatter and the soils less well drained than with the Vasey sagebrush type. More mesic species, including shrubby cinquefoil (Potentilla fruticosa), Penstemon spp., orchardgrass (Dactylis glomerata), and Kentucky bluegrass (Poa pratensis) are found in this community.

The majority of the rest of the basin (40.5 ha {100 ac}) is in wetland vegetation types. These include wet meadows, riparian sedge wetlands, and willow thickets. Wet meadows are formed in topographic depressions adjacent to some of the streamside vegetation and seeps. Plant species include rushes (Juncus spp.) and sedges (Carex spp.) and grass species. Riparian sedge wetlands are similar in species and composition, including various rush, sedge, and grass species. They usually form 0.9-1.8 m-wide (3-6 ft-wide) bands of vegetation adjacent to streams. Willow thickets are less common, along stream channels in the basin and along Gooseberry and Cottonwood Creeks. Species include Drummond's (Salix drummondiana), Booth (Salix boothii) and Wolf (Salix wolfii) willows.

Approximately 6.9 ha (17 ac) in the reservoir basin have been previously disturbed by the water diversion tunnel to Cottonwood Creek, and the State road that crosses the north end of the basin.

Plant communities in the Sanpete Valley area which could be temporarily disturbed by pipeline construction include Valley sagebrush, Scrub oak, Grassland and Mountain Brush types.

Approximately 88 bird and 33 mammal species were found to utilize habitats that could be disturbed by the proposed project and adjacent areas. The reservoir basin provides summer habitat for mule deer and elk (Cervus canadensis). Elk use the aspen forests surrounding the reservoir basin for calving. The aspen forest also provides nesting habitat for a variety of passerine and raptorial birds. The linear riparian corridors are important wildlife habitats, providing nesting habitat for a variety of nongame birds, hiding cover for larger animals, and movement corridors for many species. UDWR estimates that up to 70 percent of species in Utah utilize riparian habitats, with some species being dependent on them.

The species picked for HEP analysis were chosen because they were known to use the different vegetation communities in the reservoir basin which will be affected if the project is constructed. Richardson's (meadow) vole uses wet meadow and sedge habitats, which comprise many of the wetlands in the basin. Beaver also use this type of habitat, damming natural streams and creating additional wetlands. The yellow warbler utilizes the deciduous shrub/scrub wetland habitat. Mule deer range throughout the reservoir basin in summer using a variety of habitat types. The Brewer's sparrow which nests and forages in the sagebrush habitats was chosen as a HEP representative species for the habitat types found in the basin, including summer range for mule deer, that are not wetlands habitat. Table 3 gives acreages of the various vegetation and habitat types in the basin to be disturbed and details the habitat units (HUs) of each of the indicator species which were found to occur in the reservoir basin.

Because the land use of the reservoir basin consists primarily of some sheep grazing activities and light recreation, little change is expected to occur in the existing habitat and wildlife resources in the future without the project.

Aquatic Resources

Stream Fisheries

Stream segments in the area of the project which could be impacted include Gooseberry Creek along with its upper tributaries, Fish Creek and Cottonwood Creek (Figure 3). All three of these provide important recreational fisheries use and contain naturally reproducing game fish populations. Gooseberry and Fish Creeks have characteristics which are unique in the State. Fishery values must be maintained.

Gooseberry Creek and its tributaries are categorized by UDWR as a Class 3B-Unique stream. Class 3 streams are important from the standpoint of supporting fishing pressure, and fisheries should be considered a primary use. The B indicates that the stream provides important spawning and nursery habitat. Unique identifies streams that provide unique physical, chemical and biological values to the fishery. Gooseberry Creek has been divided into three segments (Upper, Middle, and Lower), which are 1.6, 4.8 and 11.4 km (1.0, 3.0, and 7.1 mi) in length, respectively. Three unnamed tributaries combine to form the Upper Gooseberry segment.

Upper Gooseberry Creek supports a naturally reproducing cutthroat trout (Oncorhynchus clarki) population, comprised of adult, juvenile, and young-of-the-year (YOY) fish. Numerous riffle areas provide cutthroat trout spawning habitat. UDWR estimates indicate that the standing crop of cutthroat trout in this segment averages about 42.5 kilograms (kg) per ha (38 pounds {lbs} per ac). This stream segment provides important rearing habitat for cutthroat, with over 720 fish per km (450 fish per mi) (mostly YOY) counted by UDWR. This segment provides only marginal overwinter habitat for cutthroat trout due to low winter flows and limited pool habitat.

The *Middle Gooseberry Creek* segment receives inflow from numerous springs and seeps, as well as several tributary streams. Average flows are consequently higher than in the Upper segment. This segment also supports a reproducing population of cutthroat trout.

The *Lower Gooseberry Creek* segment is downstream from the existing Lower Gooseberry Reservoir. Flow in this segment is double the flow of the Upper and Middle segments. Both cutthroat and rainbow (Oncorhynchus mykiss) trout use this segment. Rainbow trout apparently use this section for spawning a few weeks each year, while cutthroats are year-round residents. Spawning habitat for both species is not abundant in this segment, although YOY have been found to be plentiful, so this does not appear to be a limiting factor. More habitat is available for adult and juvenile trout from April through August than during the rest of the year. UDWR has found that the cutthroat standing crop averages 45- 57.5 kg per ha (40-50 lbs per ac). No estimate of standing crop for rainbows has been made, but both adults and juveniles have been collected in this stream segment.

The three *Gooseberry headwater tributaries* contain 12 stream km (7.5 stream mi). During late summer and early fall major portions of these streams have low flow or are dry. The flowing reaches have high value as cutthroat trout spawning and rearing of YOY habitat. Standing crop in these tributaries averages approximately 97.5 kg per ha (86 lbs per ac), with most being YOY or yearling fish.

Fish Creek is rated by UDWR as Class 2-Unique. Class 2 waters are of great importance to the state fishery, indicating productive streams with high aesthetic value. This segment of Fish Creek extends from the confluence with Gooseberry Creek to Scofield Reservoir. In addition to a self-reproducing cutthroat trout population, this segment also provides spawning and rearing habitat for rainbow trout that migrate upstream from Scofield Reservoir. Thus this stream segment provides habitat for adult, juvenile, spawning, and fry life stages of both species. The UDWR surveys have shown a wide range of standing crop values, with an average of almost 57.5 kg of trout per ha (50 lbs per ac).

The 16 km (10 mi) segment of *Lower Fish Creek* (sometimes considered the upper segment of the Price River) between Scofield Dam and its confluence with the White River forming the Price River, is heavily used as a fishery. It is stocked mainly with brown trout (Salmo trutta), but also contains rainbow and cutthroat trout. UDWR is working to make this stretch a blue ribbon brown trout fishery. At present, the standing crop of all trout species in this segment averages 278 kg per ha (244 lbs per ac).

Cottonwood Creek is rated Class 3B by UDWR, indicating that this segment supports natural reproduction. This segment extends from the Narrows tunnel outlet to the mouth of the canyon. Presently the upper part of the segment doesn't support a self-sustaining trout population due to low or intermittent flows during much of the year. A rainbow trout fishery is maintained by stocking catchable-sized fish during the period in which there is adequate water. Flows in the lower portion of this segment are higher year-round and support a standing crop of approximately 237 kg per ha (210 lbs per ac) of rainbow and brown trout.

Nongame fish in the upper sections of Gooseberry Creek include redside shiner (Richardsonius balteatus) and mountain sucker (Catostomus platyrhynchus). Lower Gooseberry Creek below Gooseberry Reservoir and portions of Fish Creek were poisoned in 1991 to kill nongame fish which were causing problems with the fishery in Scofield Reservoir.

Reservoir Fisheries

Reservoirs in the project vicinity are shown on Figure 3. *Lower Gooseberry Reservoir* has a surface area of approximately 109 ha (270 ac) and is managed as a catchable rainbow trout fishery. It also supports a resident cutthroat trout population. It is estimated that 25,000 trout were harvested in 1982, with 31 percent being cutthroat and the remainder rainbows. A large portion of the reservoir is shallow, which has led to problems with low dissolved oxygen (DO) concentrations and resultant fish kills. Recent steps have been taken by the USFS to improve water quality by releasing water from the bottom of the reservoir.

Fairview Lakes are owned and operated by the Cottonwood-Gooseberry Irrigation Company, with water being delivered via the Narrows Tunnel to Cottonwood Creek. The lakes are managed as a catchable rainbow trout fishery, with approximately 12,000 fish stocked every year, and 8,700 harvested. Stocked trout do not generally survive the winter due to the low level of the lakes during this period.

Scofield Reservoir has a storage capacity of 8.1×10^7 m^3 (65,800 af) and an annual surface area averaging 923 ha (2,282 ac). Approximately 9.9×10^6 m^3 (8,000 af) of the reservoir is available as a conservation pool as the reservoir cannot be further drawn down. It provides water for irrigation, culinary and industrial uses to the Price River Valley. The reservoir supports naturally reproducing cutthroat trout and natural and stocked rainbow trout. UDWR stocks approximately 600,000 3-inch rainbows into the reservoir each year. Approximately 250,000 rainbow and cutthroats were caught in 1986. The reservoir has experienced periodic fish kills resulting from low DO levels. The occurrence of fish kills is increasing due to declining water quality.

No changes in stream segment or reservoir management are predicted in the future without the project.

FISH AND WILDLIFE RESOURCES WITH THE PROJECT

Terrestrial Resources

Approximately 244 ha (604 ac) of wildlife habitat, including 40.5 wetland ha (100 ac), in the reservoir basin will be inundated by dam construction under the proposed project. Under the smaller alternative, 147 ha (363 ac) would be inundated. Also inundated will be 6.9 km (4.3 mi) (6.1 km {3.8 mi} under the smaller reservoir alternative) of linear stream channel riparian corridors. This habitat will be lost over a 2-5 year period after dam closure while the reservoir fills. All HUs for indicator species in the reservoir basin will eventually be lost. In addition to habitat inundated by the reservoir, an additional 13 ha (32 ac) would be lost to highway relocation and recreational construction, including campground, boat ramp, picnic site, and restroom facilities.

Riparian vegetation in affected downstream segments will be impacted by the change in water regime. It could be killed by the lowering of the water table and narrowing of stream channels, or flooded by large increases in flow. Hydraulic analyses were performed on Gooseberry and Cottonwood Creeks by the District (Barnes, September 12 and 27, 1991). The maximum reduction in depth of flow for Gooseberry Creek was projected to be 0.15-0.27 m (0.5-0.9 ft), which would occur in May, during normal spring runoff. Since Gooseberry Creek is a gaining stream, the depth of the ground water table adjacent to the stream is directly linked with the water surface of the stream. In Cottonwood Creek 0.6 ha (1.5 ac) of riparian habitat, mostly willows, throughout the affected stream segments will be lost to channel widening due to higher flows. The linear riparian corridors lost to reservoir development may be replaced by wetland vegetation surrounding the reservoir which will not provide the same critical wildlife values. Due to fluctuating reservoir levels it will be hard to reestablish trees around the reservoir.

Wildlife in the area will be directly impacted by loss of habitat to the reservoir and associated activities such as roadbuilding, or indirectly impacted through increased human activities, including recreational uses such as fishing, boating and off-road vehicle use, constructing cabins and increasing traffic throughout the area. A small area of aspen (Populus tremuloides) forest will be disturbed when the road is rerouted over the new dam. Bisection of the aspen grove by the rerouted road and increased traffic through the area may cause elk to desert their calving areas. Although less than 0.4 ha (one ac) of actual disturbance to the aspen habitat is proposed, the road will divide and fragment the existing unbroken block of forest, which could create passage problems for big game and will give interior forest-nesting birds smaller areas of suitable nesting habitat. Nesting raptors may be subject to harassment in addition to loss of prey base from the flooded meadows. Loss of hiding cover may cause many medium- and large-sized animals to discontinue traveling through the basin.

Construction of a water distribution system in the Sanpete Valley will temporarily disturb plant communities including Valley sagebrush/grass, scrub oak, grassland and mountain brush. These disturbances will be temporary as the pipelines will be buried underground and the linear nature of the disturbance will cause relatively small areas to be disturbed per unit area. A total of 12.1 ha (30 ac) along the 27.4 km (17 mi) pipeline alignment would be disturbed. These disturbed areas will be reseeded following completion of construction and wildlife impacts should be minimal.

UDWR has identified a potential impact of the project on an existing crop depredation program in northern Sanpete County. They have determined that increasing alfalfa production through use of project water will encourage mule deer to remain at low elevations during summer to feed on agricultural fields, exacerbating an existing problem. Crop depredations could increase, requiring UDWR to spend additional time removing problem deer and to pay additional damages for crop depredations. UDWR will also have to pay for fencing for any new haystacks developed due to greater alfalfa production. It estimates that additional depredation expenses could increase by as much as $2,000 over the existing program costs of approximately $20,000. No mitigation for this project impact has been identified by UDWR at this time.

Aquatic Resources

Stream Fisheries

Operation of the dam will affect flows in Gooseberry, Fish and Cottonwood Creeks. The Upper Gooseberry Creek segment (1.6 km {one mi}) and 6.9 km (4.3 mi) of the tributary streams will be inundated. Under the smaller reservoir alternative 6.1 km (3.8 mi) of the Gooseberry Creek tributaries would be inundated. All other aquatic impacts should be the same under both alternatives.

Flows in the Middle Gooseberry Creek segment will be reduced by an average of 91 percent. The State Engineer has stipulated that a minimum of 0.03 cubic meters per second (cms) (one cubic foot per second {cfs}) be released from the Narrows Dam so that the segment will not be totally dewatered. If the flow at the Gooseberry Campground (approximately one mile below the dam site) is not 0.04 cms (1.5 cfs), then 0.035 cms (1.25 cfs) must be released from the dam. Flows in Lower Gooseberry Creek are expected to be reduced by as much as 62 percent, with an average flow reduction of 51 percent. Fish Creek flows will be reduced by an average of 18 percent, and up to 24 percent. Flows in the upper part of Cottonwood Creek would be increased by up to 1000 percent through the diversion of project water. Flows in the lower section would increase by up to 550 percent.

Table 4 shows the pre- and post-project flows for Gooseberry Creek, Fish Creek, the Price River, and Cottonwood Creek. Tables 5-9 show changes in WUA for cutthroat and rainbow trout in Gooseberry and Fish Creeks with the implementation of the project. Changes range from a monthly decrease of less than one percent to 100 percent.

In general, the decrease in flow in the *Middle Gooseberry segment* will have the greatest impacts during the spring and summer when flow is normally the highest. This is the time when cutthroat spawning occurs. Flow will be reduced to 0.03 cms (one cfs) from average flows of 1.27 and 1.76 cms (45 and 62 cfs) in May and June, respectively. Spawning and fry habitat will be seriously reduced (by 94 and 45 percent, respectively). Fry will also be prevented from being carried downstream by the dam. Adult (-72 percent) and juvenile (-81.6 percent) habitat will also be reduced during this period. Without flushing flows the width of the stream will reduce and more fine materials will accumulate in the substrate, which could eliminate any remaining spawning habitat. Fifty to 75 percent of trout biomass could be lost from this segment.

Lower Gooseberry Creek will also suffer the largest flow reduction from April to August. However, due to tributary inflow, reductions will not be as severe. Flows will be reduced from approximately 2.29 to 1.05 cms (81 to 37 cfs) in May and from 2.78 to 1.05 cms (98 to 37 cfs) in June. The low flow period, from October through March, is considered to be the most restrictive for providing trout habitat. Flows would be reduced from 8-32 percent at this time. During this period adult and juvenile cutthroat trout habitat would be reduced by 10.5 and 29.5 percent respectively. Reductions of adult and juvenile habitat of less than 10 percent will occur during other times of the year. Rainbow trout adult and juvenile habitat is projected to be reduced by 6.5 and 5.4 percent, respectively, during the low flow period. Implementation of the proposed project is expected to slightly increase rainbow spawning and fry habitat.

During the low flow period average flow will be reduced between 5 and 8 percent in *Fish Creek*. Habitat is expected to be reduced by up to 7.3 and 3.3 percent,respectively, for adult and juvenile cutthroat trout. For rainbow trout habitat may be reduced by up to 2.7 and 1.3 percent, for adults and juveniles, respectively. Spawning habitat could decrease by 16 percent for rainbows and increase by approximately the same amount for cutthroats. Fry habitat would change by less than 3 percent for both species.

Flows in *Lower Fish Creek* will not be directly affected by construction of the Narrows, but will be indirectly affected by changes in operation of Scofield Reservoir. Because the Narrows will capture runoff during spring high flows that would otherwise have gone to Scofield Reservoir, Scofield will spill less frequently and for shorter durations, lowering the volume of peak flows in Lower Fish Creek, and consequently in the Price and Green Rivers downstream. Controlled releases from Scofield Reservoir would remain unaltered during most years. However, under prolonged drought conditions, irrigation releases would be reduced due to lack of water in the reservoir. In simulations using data for the years 1960-1992, reductions would have occurred in 5 of the 33 years if the Narrows Project had been in place.

Flows in *Cottonwood Creek* will increase dramatically during water delivery, from July to October (Table 4). Because flows will not be increased during the low flow period the upper portion will still support a catch and release fishery. However, fishing will be more difficult due to higher flows. The self-sustaining fishery in the lower portion of the creek could be affected by impacts to riparian vegetation or streambank sloughing due to high flows. An engineering stability report (Barnes, September 12, 1991) was prepared for the District, which showed that the increased flows will degrade the channel by up to 0.1 m (0.36 ft) in certain segments. The District has committed to place a pipe in the upper 1.3 km (0.8 mi) of the stream to convey irrigation releases during the summer season. Thus, project impacts in this segment will be avoided. Change in flows could affect the lower 7.9 km (4.9 mi) of Cottonwood Creek. An IFIM analysis has not been done on Cottonwood Creek, so exact reductions in habitat for fish life stages, due to the project are unknown.

Reservoir Fisheries

Flow of Gooseberry Creek into *Lower Gooseberry Reservoir* will be substantially reduced, particularly during spring and summer months. Flow reduction during this period may reduce the exchange rate in the reservoir, affecting water quality and leading to more severe fish kill problems. The project could also affect the cutthroat trout population in the reservoir by decreasing recruitment from upstream.

Fairview Lakes will not be directly affected by the project, but changes in management and fishing pressure may occur due to coordination of operation with the Narrows. Effects on the fishery could be beneficial due to reduced fishing pressure and greater availability of water due to operational changes.

A study prepared for the District (Cloward, Madden & Associates, November 1991) has shown that probability of eutrophication of *Scofield Reservoir* is slightly lower with the project conditions (from 79.3 to 78.0 percent). This is due to reduced sediment entering Scofield. However, sediments currently existing in the reservoir will continue to act as a nutrient sink, and reduction of incoming sediments due to the project will not improve the situation. After project construction, sediments would be intercepted in the Narrows Reservoir or build up in the contributing stream channels as discussed above.

Another concern is that decreased inflow may degrade water quality and increase the number of periodic fish kills. A comparison of Scofield Reservoir flushing rates under future without-project and project conditions showed an increase in projected fish kills from four in 30 years to five in 30 years. This is based on the assumption that fish kills occur 80 percent of the time when the annual flushing rate is less than 0.85 (Stephens, 1985). Decreased inflow will also result in a lower average surface area for the reservoir which will reduce the standing crop of fish in the reservoir. This loss of fish biomass would result in the loss of approximately 4,500 angler days per year.

The loss of spawning habitat for rainbow trout in Fish Creek could affect the fishery in Scofield Reservoir by reducing the number of rainbows entering the Scofield population from natural reproduction. It is not known what proportion of the rainbow trout existing in Scofield Reservoir come from natural production.

The *Narrows Reservoir* will be operated so that it will be at its highest level following spring runoff and water would be released so that most of the 6.7×10^6 m^3 (5,400 af) would be delivered by the end of September. It is expected that UDWR will manage the reservoir for a cutthroat trout fishery, though sterile rainbows may also be stocked. Natural cutthroat reproduction is expected under the proposed project alternative in the remaining segments of the three tributary streams, but this may need to be supplemented by stocking of fingerling cutthroats and rainbows. UDWR has expressed concern that, due to existing demand, there may not be enough hatchery stock available to meet demand in the new reservoir. The reservoir may support approximately 13,700 angler days of fishing annually (7,200 days under the smaller reservoir alternative), if managed similarly to other reservoirs in the area.

Endangered Species

The Service determined that the endangered bald eagle (Haliaeetus leucocephalus) and the endangered Colorado squawfish (Ptychocheilus lucius), razorback sucker (Xyrauchen texanus), humpback chub (Gila cypha) and bonytail chub (Gila elegans) could occur in the area of the project. Reclamation prepared a Biological Assessment (BA) with a determination that the project "may affect" the four endangered Colorado River fish through the 6.7×10^6 m^3 (5,400 af) depletion. The Service prepared a Biological Opinion (March 25, 1992) based on the BA which concluded that the Narrows project would not jeopardize the continued existence of the fish species with the implementation of a designated Conservation Measure. The Conservation Measure requires the payment of a depletion charge into the Recovery Implementation Program (RIP) established by the Service to recover the endangered Colorado River fish. If sufficient progress is not made in the RIP through the ongoing reoperation of Flaming Gorge Dam, additional steps may need to be taken by the District to offset the Narrows depletion. Since the Biological Opinion was prepared the District has changed its estimate of average annual water depletion to 6.85×10^6 m^3 (5,557 af). The Service is preparing a revised Biological Opinion at this time. Additional mitigation measures may be required under the RIP in the amended Biological Opinion. These measures are not included in this document, but would need to be added to the District's final mitigation plan.

A category 2 candidate species, the spotted frog (Rana pretiosa) could also occur in the project vicinity. The District conducted a survey for this species in historic habit in the Sanpete Valley. Two frogs were found near Oak Creek at the northern terminus of the proposed water delivery pipeline. It is not expected that the project will have an adverse effect on this species (Hovingh, 1992).

Since the Biological Assessment was prepared the roundtail chub (Gila robusta), a fish which occurs in the lower Price River, has been added to the list of species which are candidates for threatened or endangered species listing. It is not known how this species could be impacted by lowered flows in the Price River.

DISCUSSION/PROPOSED MITIGATION

The main impacts of the Narrows project will occur on fish and wildlife resources in the reservoir basin and adjacent downstream segments of Gooseberry Creek and Cottonwood Creek. Proposed fish and wildlife mitigation measures as detailed in the Draft Environmental Impact Statement are described below. These measures were developed through coordination of the two technical teams and adopted by the District. They are referenced in the following text as the District's proposed mitigation, but it should be understood that these measures were developed with input from all interested agencies. Where there are differences between the project proposal and the small reservoir alternative, information pertaining to the small reservoir alternative is shown in parentheses. The District's intention is to totally mitigate all impacts, where possible. To the extent possible, the District attempted to find mitigation measures which could be implemented "in place" and "in kind".

Flooding of the reservoir basin will destroy all HUs of indicator species present, as shown in Table 3. Wetland areas to be destroyed, including 6.9 km (4.3 mi) of the Gooseberry Creek tributaries (6.1 km {3.8 mi}) and the 1.6 km (one mi) Upper Gooseberry Creek segment, provide habitat units for the Richardson's vole, yellow warbler, mule deer and beaver. The District has proposed two alternatives to mitigate for wetlands losses. One alternative would involve enlarging existing wetlands and creating new wetlands adjacent to the Narrows Reservoir. Under this proposal approximately 44.5 ha (110 ac) of new wetlands will replace the hectares (acres) lost, including riparian habitat lost to flooding along Cottonwood Creek. Habitat units lost for all wetland habitat types will be replaced onsite adjacent to the reservoir according to the District's plan. However, the Corps has not accepted this plan as mitigation for wetland losses at this time. The District has proposed another alternative for full or partial mitigation that consists of purchase and restoration of wetlands adjacent to Mud Creek, a tributary to Scofield Reservoir. Approximately 89 ha (220 ac) of private lands containing degraded wetlands would be purchased. Most of the degradation has been caused by cattle which would be removed to facilitate enhancement of the wetlands. Figure 4 shows the location of the alternative wetland mitigation sites.

Conversion of upland habitat adjacent to the reservoir for wetland replacement would remove additional HUs for mule deer and Brewer's sparrow. This is reflected in the acreage of impacted HUs shown in Table 3 and will need to be mitigated if this alternative is chosen for wetlands mitigation. If the Mud Creek alternative wetland mitigation is chosen, these additional HUs would not be required.

The District has proposed mitigation measures to replace lost upland shrub HUs for mule deer and Brewer's sparrow. Proposed measures include acquiring 60.7 ha (150 ac) of conservation easements with land use restrictions adjacent to the reservoir basin, which would avoid future adverse impacts, but would not mitigate for project impacts. Offsite mitigation through participating in other projects in the Manti-LaSal National Forest such as reclaiming areas infested with tarweed (Media glomerata) to native shrub/grass habitats is also proposed. It is not known if these rehabilitated areas would meet the specific habitat needs of mule deer and Brewer's sparrow lost due to the project. Specific projects have not been committed to as yet. The District has also committed to acquire 259 ha (640 ac) of private land adjacent to Lower Fish Creek (Price River) below Scofield Reservoir. The sections also contain some upland sagebrush habitats whose protection could compensate somewhat for upland habitats including elk calving and mule deer fawning areas lost to the project. Wildlife values would be enhanced by fencing.

Other project impacts include impacts to stream fisheries, stream channels and riparian habitat corridors in downstream segments of Gooseberry and Cottonwood Creeks.

The 4.8 km (3 mi) Middle Gooseberry segment will be largely dewatered. The channel will become narrower and shallower. Sediments will also accumulate due to low flow conditions. The District proposes to mitigate riparian habitat losses onsite by placing constrictions in the channel to prevent the water surface from dropping and modifying stream banks so that overbank flooding will still be possible. Riparian plantings will be used in areas where vegetation has been damaged or destroyed. Buildup of fine sediments in the stream channel will be minimized by providing flushing flow releases from the Narrows Dam when necessary. The District has proposed to acquire a 16.2 ha (40 ac) parcel of private land that this segment of the creek runs through.

Impacts to stream fisheries in the inundated segments in Upper Gooseberry will be total, and they will be severe in the Middle Gooseberry segment. Other impacted stream segments will not be as directly affected. To mitigate onsite for lost fisheries the District will restore year-round flows in two of the Gooseberry Creek tributaries through releases from Fairview Lakes. This will result in the creation of approximately 3.7 km (2.3 mi) of spawning and rearing habitat for cutthroat trout, which will partially mitigate for the 8.5 km (5.3 mi) lost in the Upper Gooseberry segments. Under the smaller reservoir alternative, this mitigation measure will not be available and the District will need to provide an additional stream segments for cutthroat spawning habitat elsewhere.

The District has proposed to release water from the Narrows Dam for flushing sediments and for fish habitat during critical periods to avoid some fishery losses in the Middle Gooseberry segment. An average of 3.7×10^5 m^3 (300 af) would be available for release each year. UDWR has also suggested that the water might be used as an instream flow supplement during the winter period to help prevent fish kills in Lower Gooseberry Reservoir. The District and UDWR would determine the timing and amount of water to be released.

Through these measures, spawning and rearing habitat for cutthroat trout will be able to be maintained in the Middle Gooseberry segment. However, habitat for adult and juvenile trout will be lost throughout 6.4 km (4 mi) of stream in the Upper and Middle segments. The District has proposed to acquire stream segments in a 1:1 ratio with the mileage of impacted streams. The District proposed to acquire approximately 20.2 ha (50 ac) of private land containing live fishery streams. A corridor, approximately 61 m (200 ft) wide, would be acquired along a total of 6.4 km (4 mi) of stream. The project might include parcels from several different streams. In the DEIS, the District identified five stream segments that may be available for purchase. The acquired stream corridors would be fenced with a pole top fence to exclude grazing. These stream segments would provide habitat for all life stages of cutthroat trout.

The purchase of the State section in the Lower Fish Creek area could also contribute to mitigation of fishery impacts associated with the project, particularly to stream segments suitable for adult and juvenile occupancy. This section of Fish Creek currently provides habitat for adult and juvenile cutthroat, rainbow and brown trout.

The District has proposed to prevent stream degradation from increased flows in Upper Cottonwood Creek by construction of a 1.3 km (0.8 mi) pipeline to convey reservoir releases. A winter release of 0.056 cms (2 cfs) would also be made from the Narrows Reservoir to Cottonwood Creek during the winter months (October through March) to increase fish habitat during that period and to provide mitigation for stream channel widening that would occur due to high summer flows. No mitigation was proposed for loss of fishery habitat in Lower Cottonwood Creek.

Lower stream flows and their impacts on fisheries in Gooseberry and Fish Creeks may affect reproduction and recruitment into the Lower Gooseberry and Scofield Reservoir populations. This could impact recreational use of the two reservoirs. The District calculates that 4,500 angler days per year will be lost at Scofield Reservoir but does not calculate potential losses at Lower Gooseberry Reservoir. Creation of a new fishery on the Narrows Reservoir would provide approximately 13,700 angler days of use, according to the District, offsetting losses at other reservoirs. The smaller reservoir alternative would provide approximately 7,200 days of angler user.

The District has committed to a monitoring program to evaluate the progress of wildlife and wetlands mitigation plans, both qualitatively and quantitatively to ensure that lost HUs and wetland acreages are replaced. Statistical comparisons will be made and additional mitigation measures would be required if full mitigation standards are not achieved. A similar monitoring program for aquatic mitigation measures was not included in the Draft EIS.

The Service and UDWR believe that the types of mitigation proposed in the DEIS are appropriate. However, the two agencies were concerned about inadequacies in the amount of mitigation proposed, as not all impacts were proposed to be totally mitigated. The Corps will determine whether the amount of mitigation proposed for wetland resource losses is appropriate. Mitigation for upland wildlife species will be total replacement of lost HUs. The main concern of the Service and UDWR was the adequacy of proposed aquatic mitigation measures, particularly for losses of stream segments that support fisheries. In a letter dated September 21, 1994 (see Appendix B), the UDWR has recommended measures, including some already committed to by the District, to be taken to totally mitigate for these losses in both the Price River Basin and the Sanpitch River Basin. The Service concurs with the recommendations of UDWR. The District voted on September 7, 1994 to incorporate those additional measures not contained in the DEIS into their mitigation plan in the Final EIS. Therefore the cost estimate (Appendix A) and the Aquatic Impacts and Mitigation Measures (Table 10) include these additional measures, as described below.

Affected streams in the **Price River Basin** (Gooseberry Creek, and Fish Creek) will suffer losses to fishery values; in some segments the losses will be complete. The UDWR recommended the following measures to offset project impacts. Acquisition and fencing of 4.0 miles of Mud Creek would complement the proposed wetland mitigation project in this area. These projects together would mitigate for both wetlands and stream impacts, as well as potentially benefitting water quality in Scofield Reservoir by reducing nutrients entering the reservoir from the Mud Creek drainage. UDWR recommended that two miles of Lower Fish Creek be acquired, fenced and enhanced. This would be done in conjunction with the acquisition of a section of State School trust lands which is proposed as mitigation for upland impacts. It is also recommended that 2.5 miles of Winterquarters Creek, and one mile of Pondtown Creek within the USFS boundary, be acquired, fenced, and/or enhanced for improvement of stream and riparian habitat conditions.

Recommendations for the **Sanpitch River Basin** include piping the irrigation flows in the upper 0.8 miles of Cottonwood Creek and providing a minimum 2 cfs instream flow for this stretch during the winter season. For enhancement of the segment of Cottonwood Creek from the canyon mouth to the confluence with the Sanpitch River, UDWR recommended a 2 cfs minimum instream flow during the irrigation season. This will provide year-round flows for fish habitat and enhance the riparian corridor. Currently, this stream segment is dewatered during the irrigation season. UDWR also recommended enhancement of 4 miles of Starvation Creek, from the confluence of Bennion Creek to the confluence with Soldier Creek in Spanish Fork Canyon to improve water quality and riparian habitat. Enhancement may include bank stabilization, revegetation, or other measures.

RECOMMENDATIONS

Properties acquired for mitigation, whether for upland wildlife, wetlands, or aquatic wildlife, could be managed under the following strategies: acquisition for protection, acquisition for enhancement, conservation easements for protection, conservation easements for enhancement, enhancement of USFS property and enhancement of UDWR property. Mitigation for this project will probably includes a combination of several or all of these strategies.

The following recommendations also need to be addressed in the Final EIS to complete the mitigation plan:

1. The above recommendations apply to the preferred (large reservoir) alternative. If the small reservoir alternative is chosen, additional mitigation will be required for the loss of cutthroat trout spawning habitat which could not be replaced by restoration of headwater streams from Fairview Lakes. At the time this alternative is chosen, additional mitigation measures will be developed in coordination with the Service and UDWR.

2. Acquisition of private lands should preferably be made by fee title. In areas adjacent to the reservoir basin easements would be appropriate. In the Final EIS the District should identify the appropriate management entities for specific properties being considered for acquisition. Conditions of easements should also be specified in the Final EIS.

3. As part of the mitigation plan the District must develop a comprehensive monitoring and maintenance program to ensure that aquatic and wildlife habitat replacement values are being met. This program will address monitoring procedures, responsible parties, and steps to be taken if mitigation efforts do not prove successful. It should also include an Operation and Maintenance account with adequate funding to ensure that mitigation requirements are met. This plan should be included as part of the Final EIS.

4. Reclamation will ensure that language in the Small Reclamation Project Loan repayment contract stipulates that mitigation will be concurrent with project construction.

5. Any additional measures for wetland mitigation required by the Corps should be included in the Final mitigation plan.

6. Any additional measures for impacts to listed fish species required by the Amended Biological Opinion should be included in the Final mitigation plan.

7. The Final EIS should list detailed mitigation commitments for all project impacts. Specifics such as management entities for the various stream segments, and specific enhancement measures to be taken in each area should be listed. If there are any areas where a specific final mitigation strategy has yet to be determined a timetable for development should be included, along with a list of agencies to be consulted for concurrence.

Appendix A includes a preliminary cost analysis of the mitigation plan including costs for mitigation as proposed by the District in the DEIS as well as costs for additional mitigation measures approved by the District as discussed above. Costs are estimated since property acquisition costs may vary.

LITERATURE CITED

Barnes, F.R. September 12, 1991. Cottonwood Creek Channel Degradation. Memorandum prepared for Cottonwood Canyon Slope Stability Team Members - Narrows Project. 2 pp. + tables.

Barnes, F.R. September 27, 1991. Comparison of Gooseberry Creek Preproject and Project Flow Depths - Narrows Project Environmental Analysis. Memorandum to Narrows Project Files. 2 pp. + tables.

Bovee, K.D. 1982. A guide to stream habitat analysis using the Instream Flow Incremental Methodology. Instream Flow Inf. Paper No. 12, FWS/OBS - 82/26. U.S. Fish and Wildlife Service, Office of Biological Services. Ft. Collins, CO. 248 pp.

Cloward, Madden & Associates. November 1991. Schofield (sic) Eutrophication Study. 28 pp.

Franson - Noble & Associates. February 1992. Preliminary Narrows Project Proposed Fish and Wildlife Mitigation Measures. 3 pp. + figure.

Hovingh, P. November 1991. Spotted Frog Survey of San Pitch River System. Summary of Findings. 14 pp. + tables.

Milhous, R.T., D.L. Wegner, and T. Waddle. 1984. User's guide to the Physical Habitat Simulation System. Instream Flow Inf. Paper No. 11, FWS/OBS - 81/43. U.S. Fish and Wildlife Service, Office of Biological Services. Ft. Collins, CO. 465 pp.

Mt. Nebo Scientific. February 1992. Vegetation and Wildlife Impacts from the Narrows Project. Draft Report. 28 pp. + tables.

Stephens, D.W. 1985. Why Scofield Reservoir is eutrophic - Effects of nonpoint source pollutants on a water supply reservoir in Utah. Pages 142-146 in Perspectives on nonpoint source pollution. U.S. Environmental Protection Agency report 440/5-85-001.

U.S. Fish and Wildlife Service. 1980. Habitat Evaluation Procedures (HEP). Ecological Services Manual, Part 102.

Woodward - Clyde Consultants. December 1991. Aquatic Ecology Section. 22 pp. + tables.

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APPENDIX A

MITIGATION COST ESTIMATE (PREFERRED ALTERNATIVE)

Mitigation Item	Quantity	Unit	Unit Price	Cost
Wetland Mitigation Area (adjacent to reservoir)	110	acre	500	55,000
Plantings for Wetland Mitigation Area	lump sum	lump sum	10,000	10,000
or				
Wetland Mitigation Area *(Mud Creek)	220	acre	500	110,000
Fencing on Mud Creek	2	mile	13,000	26,000
Wildlife Conservation Easement Adjacent to Reservoir	150	acre	400	60,000
Acquire State Section on Price River below Scofield Reservoir	640	acre	350	224,000
Fencing for State Section	4	mile	13,000	52,000
Acquire Middle Gooseberry land	40	acre	350	14,000
Fencing on Middle Gooseberry	0.25	mile	13,000	3,250
Middle Gooseberry Channel rehab	3	mile	10,000	30,000
Upper Gooseberry Tributaries Planting & Channel Improvements	lump sum	lump sum	10,000	10,000
Reseeding on Forest Service lands	900	acre	30	27,000
Monitoring Aquatic and Wildlife Mitigation	lump sum	lump sum	50,000	50,000
Endangered Fish Depletion Fee (1995 Cost)	5,557	acre-feet	12.71	70,629.47

APPENDIX A (CONT'D)

Acquire Stream Segments (2 mi *Mud Creek, 1 mi Lower Fish Creek, 1 mi Upper Fish Creek, 2.5 mi Winterquarters Creek, 2 mi Pond-town Creek, 4 mi Starvation Creek)	303	acre	500	151,500
Fence Fishery Segments	25	mile	13,000	325,000
Enhance Stream Segments	13.5	mile	15,000	202,500

TOTAL (Wetlands Alternative Adjacent to Reservoir) 1,284,879.47

TOTAL (Mud Creek Wetland Alternative) 1,355,879.47

*2 miles of Mud Creek will be purchased for mitigation of aquatic impacts. If the Mud Creek wetlands mitigation alternative is chosen, an additional 2 miles of stream will be purchased and fenced.

APPENDIX B

UTAH NATURAL
RESOURCES
Wildlife Resources
1596 West North Temple • Salt Lake City, UT 84116-3195 • 801-533-9333

memorandum

SEP 28 1994

September 21, 1994

Mr. Reed Harris
U.S. Fish and Wildlife Service
Lincoln Plaza
145 East 1300 South, Suite 404
Salt Lake City, Utah 84115

Subject: Final Comments, Fish and Wildlife Coordination Act Report, Narrows Project

Dear Reed:

We have reviewed the subject draft Fish and Wildlife Coordination Act Report dated June 1994 for the proposed Narrows Project in Utah. Contained herein are the Division of Wildlife Resources' (Division) final comments regarding the document. We have provided additional information and mitigation recommendations which have been derived since the draft report was issued.

Through previous consultation among our agencies, the Division had recommended that mitigation for stream impacts occur on a 3:1 or 2:1 linear basis whenever the project sponsor proposed improvement of existing stream segments as a mitigation method, by either fencing to protect riparian and stream bank areas, or through other unidentified methods. Since that time, Division staff have refined the recommendation to account for project impacts and project-induced mitigation improvements using the Habitat Quality Index method. For this analysis, Division staff used existing file data, published reports, and professional judgement to estimate the number of Habitat Units present in stream segments which would or could be affected by the Narrows project, either as impacted streams or as potential mitigation sites. Both pre- and post-project Habitat Units were estimated using those methods.

Table 1 presents the Division's recommended mitigation for impacts to stream fishery resources of the Proposed Large Dam Alternative of the Narrows Project which had previously been recommended in concept at 3:1 or 2:1 linear ratios. All other proposed mitigation recommendations in the draft report would remain unchanged, unless specifically modified herein. Also shown is the analysis of Habitat Units for each stream segment under existing and Post-Project conditions. Specific recommendations regarding the types of improvements which should be implemented follow.

Price River Basin

The recommendation to acquire and fence 4.0 miles of Mud Creek is intended to complement the proposed wetland mitigation project also along Mud Creek. Together these two projects would not only mitigate wetland and stream impacts, but could potentially benefit water quality in Scofield Reservoir by trapping and reducing nutrients entering Scofield Reservoir from the Mud Creek drainage. The recommendation regarding Lower Fish Creek is to acquire, fence and enhance two miles. Much of this would be accomplished in concert with the proposed mitigation for upland impacts of acquiring a section of State School Trust lands. Acquiring and fencing 2.5 miles of Winterquarters Creek would allow for improvement of stream and riparian conditions. One mile of Pondtown Creek within the U.S. Forest Service boundary is also recommended for acquisition and fencing or enhancement.

Sanpitch River Basin

Piping most of the irrigation flows from the tunnel outlet downstream 0.8 miles to discharge into Cottonwood Creek will avoid an impact from high project releases, and will allow for enhancement of summer flows in the upper 0.8 mile reach of Cottonwood Creek. Providing a 2 cfs minimum instream flow in the winter season to this same reach of stream will provide for establishment of year-round flows and a naturally reproducing complement of fish species. The enhancement measure proposed for the lower Cottonwood Creek, from the canyon mouth to the confluence of the San Pitch River, is to provide a 2 cfs minimum instream flow during the irrigation season. This will provide year-round flows in the stream, which will provide some fish habitat, will create a fishery for local residents, and enhance the riparian corridor. Presently this reach of stream is de-watered during the irrigation season.

Enhancement along the 4 miles of Starvation Creek, from the confluence of Bennion Creek down to the confluence with Soldier Creek (Utah County, Spanish Fork Canyon) will improve water quality and riparian habitat of the stream. Enhancement can include, but is not limited to, bank stabilization, especially where the road confines the stream channel and causes bank erosion, and revegetation in appropriate locations.

Mitigation recommendations for the Small Dam Alternative would be similar to the recommendations provided for the Large Dam Alternative, with the exception that additional mitigation for loss of cutthroat trout spawning habitat would need to be provided in lieu of the restoration of headwater streams from Fairview Lakes. The Division proposes that a final mitigation plan for that impact would be developed in consultation with the project sponsor at that time, if the Smaller Dam Alternative is selected.

The only other comment we have on the report is that the 2 cfs minimum streamflow release from the Narrows Tunnel to the headwaters of Cottonwood Creek during the "winter" should actually be a commitment to maintain the 2 cfs minimum flow in the stream from the end of one irrigation season to the beginning of the next. This should be noted in the report, rather than beginning and ending on a fixed date regardless of when irrigation deliveries equal to or greater than the 2cfs minimum begin and end.

We appreciate the efforts of your staff in working closely with Division staff during the past several years on this project. Please contact Mark Holden or Catherine Quinn at 538-4700 if you have any questions regarding these comments.

Sincerely,

Robert G. Valentine
Director

RGV/MH/kj

cc: Richard Noble, Franson-Noble Associates
Manti-LaSal National Forest Supervisor

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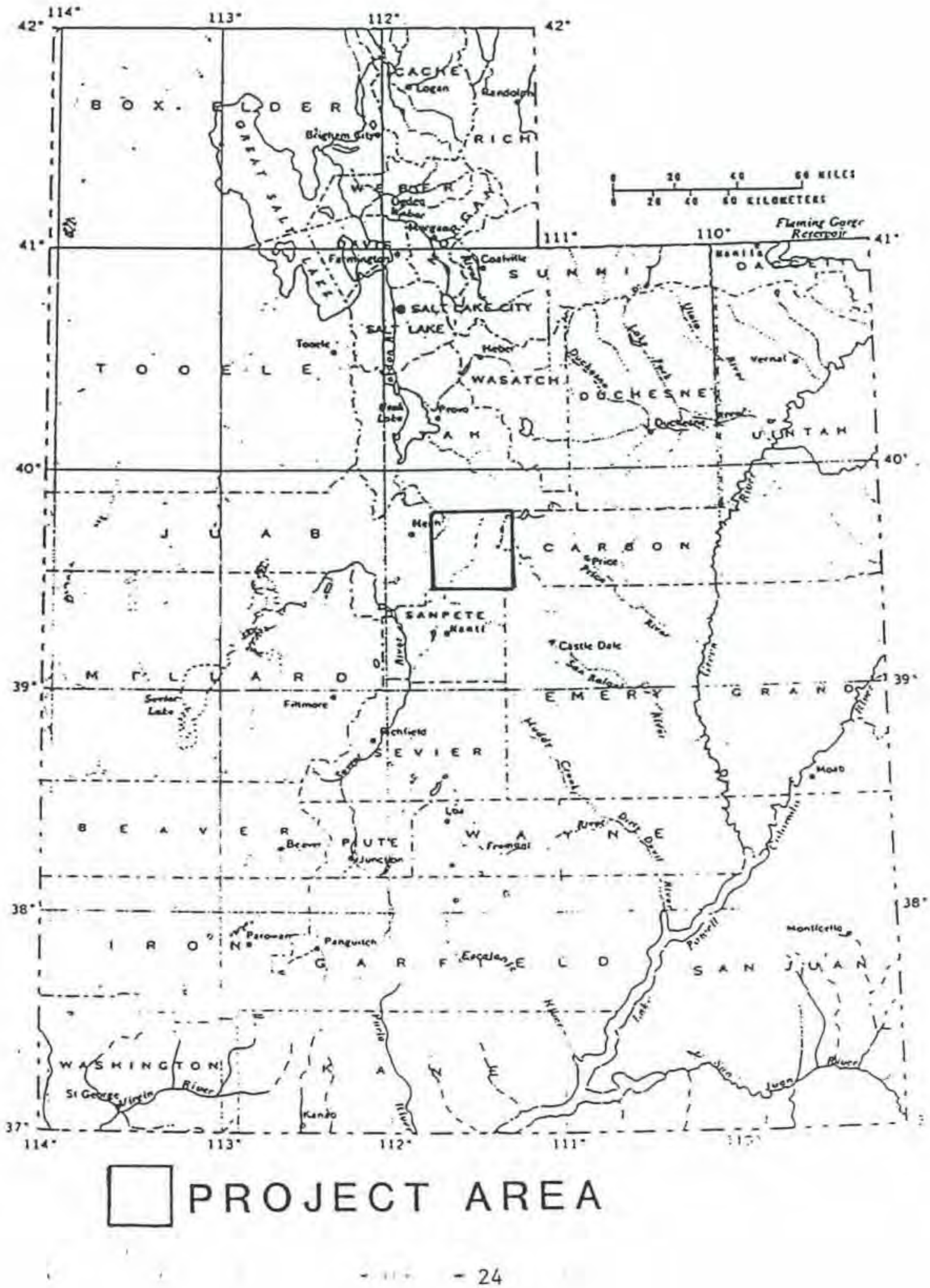
TABLE 1
ESTIMATION OF HABITAT QUALITY INDEX UNITS ON AFFECTED AND POTENTIAL MITIGATION REACHES, PREFERRED ALTERNATIVE

Stream	Miles Affected	Existing HUs/mi	HUs Post Project	Change in HUs/mi	HUs to Replace	Replacement HUs Gained
Price River Basin						
Middle Gooseberry C.	4	139	0	-139	556	-----
Lower Gooseberry Cr.	2	203	132	-71	142	-----
Total HUs Lost					**698**	
Mud Creek	4	79	160	81	----	324
Lower Fish Creek	2	312	350	38	----	76
Upper Fish Creek	1	432	517	85	----	85
Winterquarters Creek	2.5	35	77	42	----	105
Pondtown Creek	2	50	103	53	----	106
Total HUs Replaced						**696**
Sanpitch River Basin						
Cottonwood Creek	4.9	79	13	-66	322	----
Total HUs Lost					**322**	
Upper Cottonwood Cr.	0.8	4	202	198	----	158
Lower Cottonwood Cr.	1.2	0	40	40	----	48
Starvation Creek	4	82	111	29	----	116
Total HUs Replaced						**322**

Figure 1 - General Project Location Map



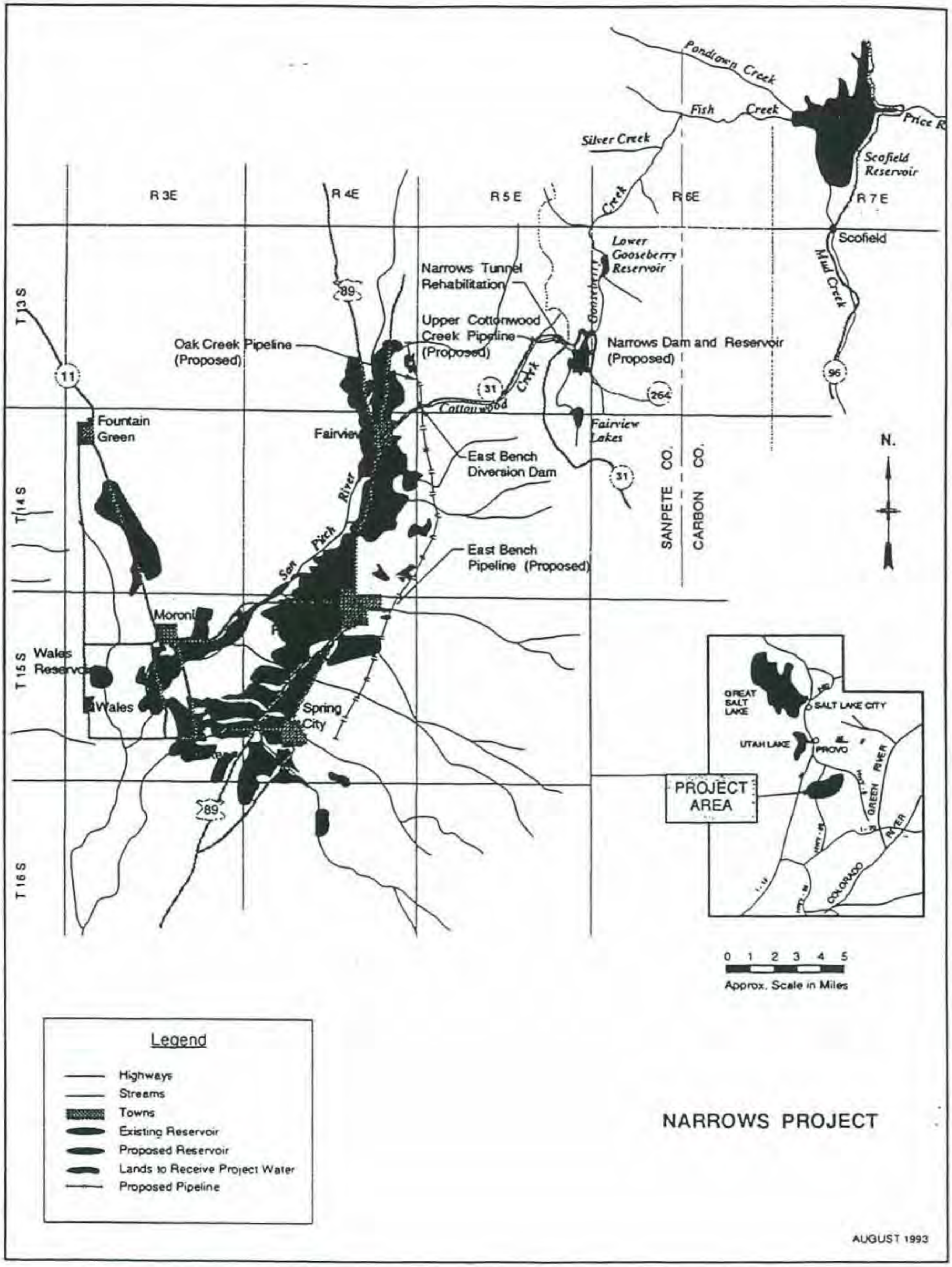


Figure 2. Narrows Project Area and Water Distribution System

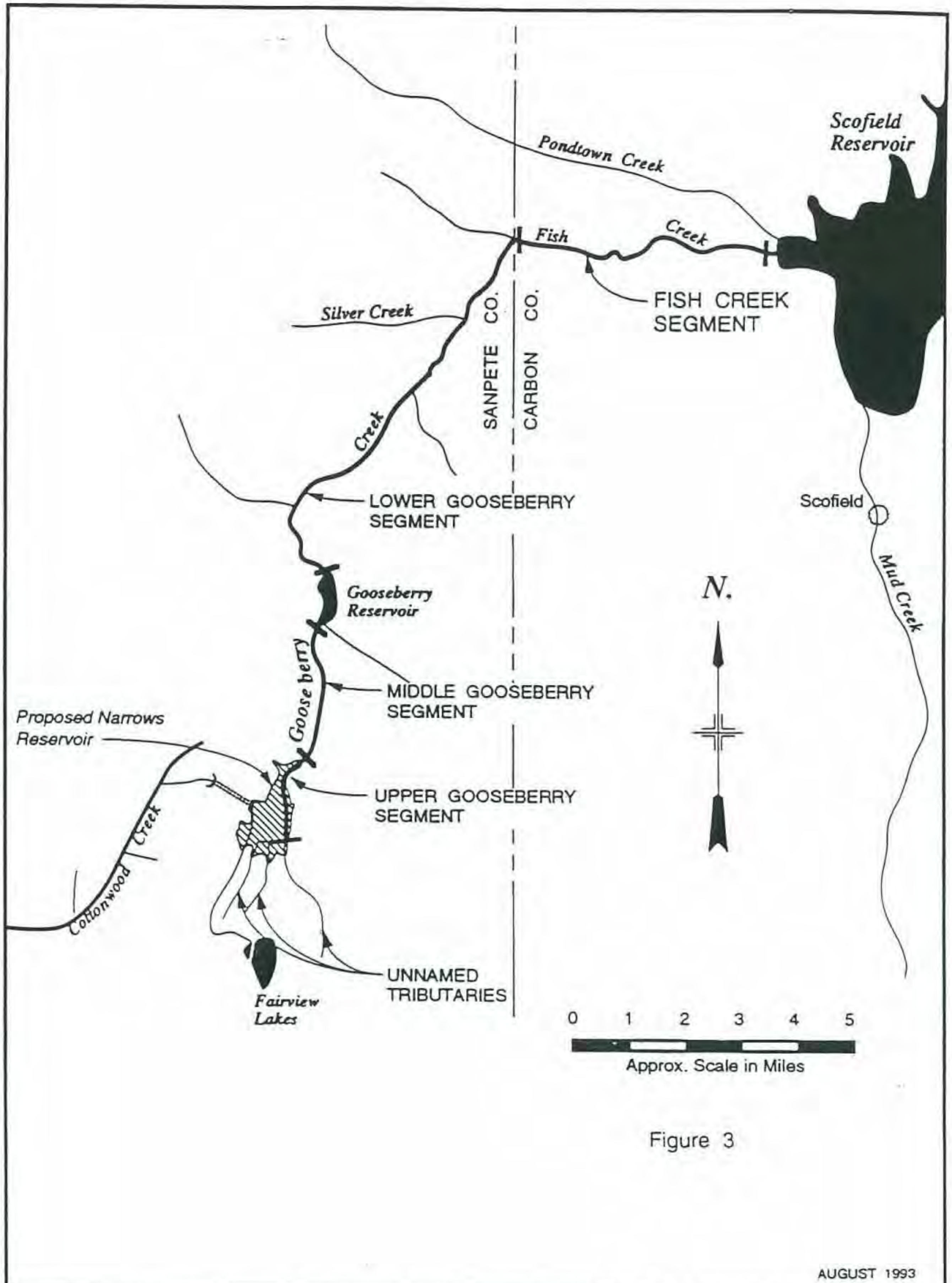


Figure 3. Streams and Reservoirs in the Narrows Project Area

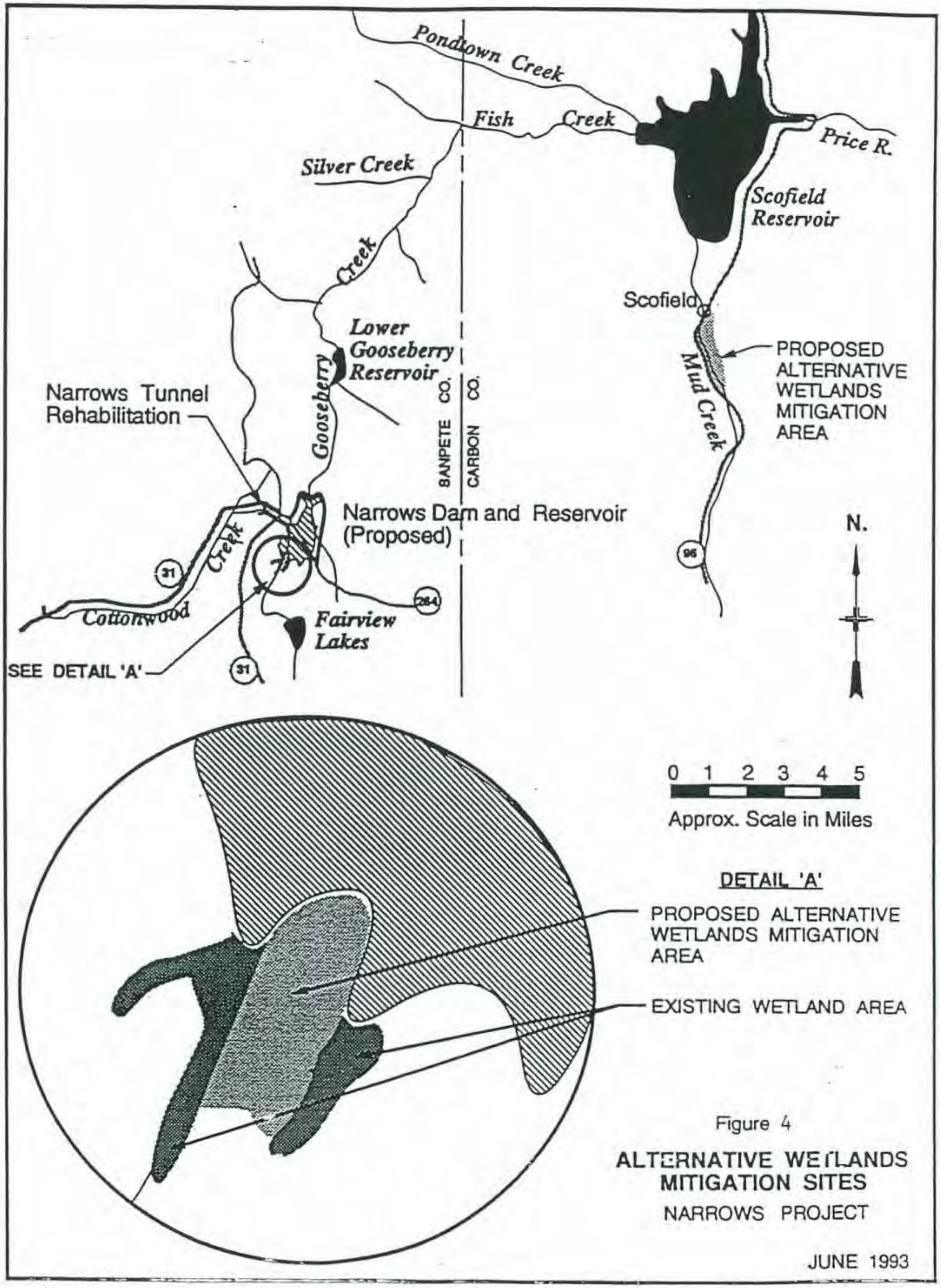


Figure 4

ALTERNATIVE WETLANDS MITIGATION SITES

NARROWS PROJECT

JUNE 1993

TABLE 1: Wildlife Feeding Guilds for the Narrows Basin Study.

FEEDING TYPES

COVER	CARNIVORE	INSECTIVORE	HERBIVORE	OMNIVORE
AERIAL		Common Nighthawk Poor-will Townsend's Solitaire Tree Swallow Small Footed Myotis Western Pipistrelle		
SHRUB LAYER		Willow Flycatcher		Mtn. Bluebird Greentailed Towhee **Brewer's Sparrow** Sage Sparrow
TERRESTRIAL SURFACE	Cooper's Hawk Gt. Horned Owl Northern Harrier	Killdeer Vagrant Shrew Northern Flicker Sagebrush Lizard Short-horned Lizard Western Garter Snake	Broadtail Hummingbird Montane Vole Jumping Mouse Deer Mouse Uinta Ground Squirrel Cottontail Rabbit Least Chipmunk Moose Elk **Mule Deer**	Magpie Raven Rock Wren Coyote
TERRESTRIAL SUBSURFACE	Badger		Pocket Gopher	
RIPARIAN/ WETLAND	Belted Kingfisher	Tiger Salamander Northern Leopard Frog Water Shrew Common Snipe Yellow Warbler	Green-winged Teal Cinnamon Teal Mallard Canada Goose Sandhill Crane American Dipper **Beaver** **Montane Vole**	

Bolded names were evaluation species.

TABLE 2: Wildlife Reproductive Guilds for the Narrows Basin Study

COVER TYPES	REPRODUCTIVE GUILD SPECIES
SHRUB	
Vegetation	Green-tailed Towhee, **Brewer's Sparrow**, Willow Flycatcher, **Yellow Warbler**
Bareground	Cottontail, Deer Mouse, Common Nighthawk, Poor-will, Sagebrush Lizard, Short-horned Lizard
RIPARIAN/WETLAND	
Vegetation	**Montane Vole**, Harvest Mouse, Common Snipe, Vagrant Shrew, Water Shrew, Tiger Salamander, Northern Leopard Frog, Western Garder Snake, Green-winged Teal, Cinnamon Teal, **Mallard**
Organic Litter	Northern Harrier, Poor-will, Jumping Mouse, **Beaver**
Bareground	Killdeer
Bank	Belted Kingfisher, Muskrat, Dipper
SUBSURFACE	
Borrow	Badger, Uinta Ground Squirrel, Least Chipmunk, Pocket Gopher

Bolded names were evaluation species.

TABLE 3: Baseline Habitat Conditions Within the Narrows Reservoir Basin for (A) Affected Areas; and (B) Evaluation Species.

(A) AFFECTED AREAS

Vegetation type (HEP cover type)

Reservoir inundation	Acres
Vasey sagebrush (USHE)	331
Silver sagebrush (USHE)	156
Wetlands (PEM, PSS)	100
Aspen	0.19
Previously disturbed	17
Subtotal	604.19
Potential Disturbance in wetland mitigation area	
Vasey sagebrush	110.00
TOTAL	714.19

(B) EVALUATION SPECIES

(Smaller Reservoir Alternative in Parentheses)

Species	Cover Type(s) Used	Acres	HSI	HUs
Richardson's vole	PEM	63 (18)	1.00	63 (18)
Yellow warbler	PSS	37 (10)	0.70	26 (7)
Beaver	PEM,PSS	100 (28)	0.13	13 (4)
Mule deer	PEM,PSS, USHE	587 (246)	0.23	135 (57)
Brewer's sparrow	USHE	487[a](218)	0.98	624 (214)

HEP = Habitat Evaluation Procedures
PEM = Palustrine emergent wetland cover (herbaceous wetlands)
PSS = Palustrine scrub/shrub cover (shrubby wetlands)
USHE = Shrub cover (Vasey sagebrush; silver sagebrush)
HSI = Habitat Suitability Index
HUs = Habitat Units
a = all USHE habitat type areas, including area disturbed for mitigation

TABLE 4

Average Existing and Projected Flows
(unit–cfs)

Month	Recommended Plan: Average year (1968)	Recommended Plan: Wet year (1984)	Recommended Plan: Dry year (1977)	Smaller Reservoir Plan: Average year (1968)	Smaller Reservoir Plan: Wet year (1984)	Smaller Reservoir Plan: Dry year (1977)	No Action Plan: Average year (1968)	No Action Plan: Wet year (1984)	No Action Plan: Dry year (1977)
Gooseberry Creek at Proposed Narrows Damsite									
October	1.0	1.0	1.0	1.0	1.0	1.0	2.0	4.7	1.6
November	1.0	1.0	1.0	1.0	1.0	1.0	1.5	3.3	1.4
December	1.0	1.0	1.0	1.0	1.0	1.0	1.4	4.2	0.7
January	1.0	1.0	1.0	1.0	1.0	1.0	1.3	2.4	1.0
February	1.0	1.0	1.0	1.0	1.0	1.0	1.3	2.4	1.2
March	1.0	1.0	1.0	1.0	1.0	1.0	1.4	2.4	1.2
April	1.0	1.0	1.0	1.0	1.0	1.0	3.5	5.3	5.5
May	5.9	79.3	5.9	1.0	87.2	1.0	45.3	102.9	15.1
June	10.5	100.0	1.0	37.7	102.0	1.0	61.8	92.8	6.5
July	1.0	1.0	1.0	1.0	1.0	1.0	7.2	12.8	3.0
August	1.0	1.0	1.0	1.0	1.0	1.0	4.9	6.0	1.5
September	1.0	1.0	1.0	1.0	1.0	1.0	3.2	4.3	0.9
Gooseberry Creek Below Lower Gooseberry Reservoir									
October	2.9	5.8	2.4	2.9	5.8	2.4	4.1	10.2	3.0
November	3.1	5.9	2.2	3.1	5.9	2.2	3.8	8.8	2.7
December	3.2	5.4	2.1	3.2	5.4	2.1	3.8	9.0	1.9
January	3.6	6.2	2.1	3.6	6.2	2.1	4.0	7.8	2.1
February	3.7	6.1	2.2	3.7	6.1	2.2	4.1	7.6	2.4
March	3.7	5.2	2.3	3.7	5.2	2.3	4.2	7.0	2.6
April	4.6	6.4	6.5	4.6	6.4	6.5	7.5	11.2	10.9
May	38.2	172.5	0.9	33.3	180.5	0.9	82.1	199.3	12.9
June	34.8	156.9	3.9	62.0	159.0	3.9	92.1	162.0	9.8
July	5.9	9.9	1.5	5.9	9.9	1.5	12.8	24.1	3.8
August	5.6	4.9	1.3	5.6	4.9	1.3	10.0	10.7	2.0
September	3.9	3.6	1.9	3.9	3.6	1.9	6.4	7.4	1.9
Fish Creek Above Scofield Reservoir									
October	9.4	18.9	7.6	9.4	18.9	7.6	10.6	23.3	8.2
November	9.5	17.3	7.9	9.5	17.3	7.9	10.2	20.2	8.4
December	8.4	15.6	7.5	8.4	15.6	7.5	9.1	19.2	7.3
January	9.1	16.3	5.5	9.1	16.3	5.5	9.5	17.9	5.6
February	10.6	19.0	5.3	10.6	19.0	5.3	11.1	20.6	5.5
March	14.1	17.3	5.4	14.1	17.3	5.4	14.6	19.1	5.7
April	17.8	43.7	24.5	17.8	43.7	24.5	20.7	48.5	29.0
May	211.7	614.5	11.4	206.8	622.5	6.5	255.6	641.3	23.5
June	173.5	360.8	8.5	200.7	362.8	8.5	230.8	365.8	14.4
July	29.6	51.4	4.6	29.6	51.4	4.6	36.5	65.7	6.8
August	17.6	21.6	3.5	17.6	21.6	3.5	22.0	27.4	4.1
September	12.2	17.3	3.5	12.2	17.3	3.5	14.7	21.0	3.5

TABLE 4 (continued)

(unit—cfs)

Month	Recommended Plan Average year (1968)	Recommended Plan Wet year (1984)	Recommended Plan Dry year (1977)	Smaller Reservoir Plan Average year (1968)	Smaller Reservoir Plan Wet year (1984)	Smaller Reservoir Plan Dry year (1977)	No Action Plan Average year (1968)	No Action Plan Wet year (1984)	No Action Plan Dry year (1977)
Price River Below Scofield Dam									
October	40.0	176.5	22.8	40.0	176.5	22.8	40.0	204.0	22.8
November	2.8	5.1	10.1	2.8	5.1	10.1	2.8	5.1	10.1
December	3.4	0.0	11.4	3.4	0.0	11.4	3.4	0.0	11.4
January	3.7	0.0	13.0	3.7	0.0	13.0	3.7	0.0	13.0
February	0.3	0.0	7.2	0.3	0.0	7.2	0.3	0.0	7.2
March	0.0	0.0	6.5	0.0	0.0	6.5	0.0	199.0	6.5
April	0.0	274.6	32.0	0.0	274.6	32.0	0.0	309.8	32.0
May	0.0	661.9	41.1	0.0	669.9	41.1	27.7	463.7	41.1
June	4.4	529.2	43.8	4.4	531.2	43.8	4.4	534.2	43.8
July	152.8	149.3	61.9	152.8	149.3	61.9	152.8	155.3	61.9
August	87.2	108.5	39.1	87.2	108.5	39.1	87.2	124.2	39.1
September	163.8	114.1	21.9	163.8	114.1	21.9	163.8	135.6	21.9
Fairview Tunnel at Outlet									
October	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0
November	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0
December	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0
January	2.0	2.0	2.0	2.0	2.0	1.3	0.0	0.0	0.0
February	2.0	2.0	2.0	2.0	2.0	0.2	0.0	0.0	0.0
March	2.0	2.0	2.0	2.0	2.0	0.2	0.0	0.0	0.0
April	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
May	0.6	1.2	0.0	0.6	1.2	0.0	0.6	1.2	0.0
June	4.3	12.3	8.8	4.3	12.3	8.8	4.1	12.1	8.6
July	45.3	45.0	43.3	45.3	45.0	25.3	14.7	12.4	0.3
August	43.5	45.5	33.1	43.5	45.5	0.2	13.4	16.3	0.2
September	17.4	24.9	0.1	17.4	24.9	0.1	1.6	10.3	0.1
Cottonwood Creek at Mouth of Canyon									
October	3.3	5.1	3.1	3.3	5.1	3.1	1.3	3.1	1.1
November	3.6	5.0	3.3	3.6	5.0	3.3	1.6	3.0	1.3
December	3.4	4.8	3.2	3.4	4.8	3.2	1.4	2.8	1.2
January	3.4	4.7	3.0	3.4	4.7	2.3	1.4	2.7	1.0
February	3.6	4.6	3.2	3.6	4.6	1.4	1.6	2.6	1.2
March	4.0	4.7	3.3	4.0	4.7	1.5	2.0	2.7	1.3
April	3.7	8.1	3.2	3.7	8.1	3.2	3.7	8.1	3.2
May	45.0	117.1	4.9	45.0	117.1	4.9	45.0	117.1	4.9
June	46.6	63.4	12.8	46.6	63.4	12.8	46.4	63.2	12.6
July	49.4	53.5	44.6	49.4	53.5	26.6	18.8	20.9	1.6
August	46.0	49.2	34.0	46.0	49.2	1.1	15.9	20.0	1.1
September	19.1	27.9	1.0	19.1	27.9	1.0	3.3	13.3	1.0

Table 5
Weighted Usable Area for
Cutthroat Life Stages in
Upper Gooseberry Creek with Existing Flows

Month	Life Stage	Average Weighted Usable Area (1,000 units)
January	Adult	8.4
	Juvenile	1.9
February	Adult	8.4
	Juvenile	1.9
March	Adult	8.7
	Juvenile	1.9
April	Adult	11.3
	Juvenile	3.3
May	Adult	11.7
	Juvenile	2.7
	Spawning	0.0
June	Adult	10.7
	Juvenile	2.5
	Spawning	0.0
July	Adult	13.2
	Juvenile	3.5
	Spawning	1.5
August	Adult	12.2
	Juvenile	3.7
	Spawning	1.3
	Fry	4.7
September	Adult	11.1
	Juvenile	3.0
	Fry	4.8
October	Adult	10.2
	Juvenile	2.0
November	Adult	8.9
	Juvenile	2.0
December	Adult	8.7
	Juvenile	1.9

Table 6
Monthly Pre- and Post-Project Cutthroat Trout Habitat In Middle and Lower Gooseberry Creek During Average Water Year1/

Month	Life Stage	Middle Gooseberry Creek			Lower Gooseberry Creek		
		Pre-project	Post-project	Change (%)	Pre-project	Post-project	Change (%)
January	Adult	62.9	57.6	8.4	355.4	344.7	-3.0
	Juvenile	18.0	16.7	7.2	61.6	60.9	-1.1
February	Adult	62.9	57.6	-8.4	359.0	348.5	-2.9
	Juvenile	18.0	16.7	-7.2	63.0	61.1	-3.0
March	Adult	64.7	57.6	-11.0	359.0	344.7	-4.0
	Juvenile	18.3	16.7	-8.7	62.6	60.9	-2.7
April	Adult	106.2	57.6	-45.8	404.9	393.1	-2.9
	Juvenile	30.1	16.7	-44.5	73.2	68.7	-6.1
May	Adult	205.8	57.6	-72.0	562.1	548.3	-2.5
	Juvenile	91.0	16.7	-81.6	75.0	56.0	-25.3
	Spawning	1.5	0.1	-93.3	0.0	0.0	-
June	Adult	202.6	57.6	-71.6	553.2	548.1	-0.9
	Juvenile	88.7	16.7	-81.2	79.6	56.1	-29.5
	Spawning	0.4	0.1	-75.0	0.0	0.0	-
July	Adult	144.4	57.6	-60.1	430.6	405.3	-5.9
	Juvenile	42.7	16.7	-60.9	71.3	73.4	+2.9
	Spawning	0.9	0.1	-88.9	0.0	0.0	-
August	Adult	127.4	57.6	-54.8	413.9	398.7	-3.7
	Juvenile	36.6	16.7	-54.4	73.0	70.4	-3.6
	Spawning	2.8	0.1	-96.4	0.0	0.0	-
	Fry	57.3	28.1	-51.0	65.3	73.1	+11.9
September	Adult	100.2	57.6	-42.5	397.3	355.4	-10.5
	Juvenile	28.4	16.7	-41.2	69.8	61.6	-11.7
	Fry	44.5	28.1	-36.9	73.6	67.1	-8.8
October	Adult	75.4	57.6	-23.6	362.2	327.4	-9.6
	Juvenile	20.9	16.7	-20.1	63.2	58.0	-8.2
November	Adult	66.4	57.6	-13.3	341.5	323.9	-5.2
	Juvenile	18.8	16.7	-11.2	60.0	57.5	-4.2
December	Adult	64.7	57.6	-11.0	348.5	330.9	-5.1
	Juvenile	18.3	16.7	-8.7	61.1	58.5	-4.3

1/ The amount of Weighted Usable Area is expressed in 1,000 units. Average water year is defined as 1968 flows.

Table 7
Monthly Pre- and Post-Project Rainbow Trout Habitat
In Lower Gooseberry Creek During Average Water Year1/

Month	Life Stage	Pre-project	Post-project	Change (%)
January	Adult	44.1	43.2	-2.0
	Juvenile	21.0	21.0	0.0
February	Adult	44.5	43.5	-2.2
	Juvenile	21.1	21.0	-0.5
March	Adult	44.5	43.2	-2.9
	Juvenile	21.1	21.0	-0.5
April	Adult	65.6	50.0	-23.8
	Juvenile	29.4	22.3	-24.1
May	Adult	142.1	133.0	-6.4
	Juvenile	49.7	51.9	+4.4
	Spawning	0.0	0.0	-
June	Adult	141.9	132.9	-6.3
	Juvenile	47.8	51.9	+8.6
	Spawning	0.3	0.0	-100.0
July	Adult	87.0	66.3	-23.8
	Juvenile	35.1	29.7	-15.4
	Spawning	0.0	0.0	-
August	Adult	79.4	56.3	-29.1
	Juvenile	35.3	25.2	-28.6
	Spawning	0.1	0.0	-100.0
	Fry	62.6	51.8	-17.3
September	Adult	54.4	44.2	-18.8
	Juvenile	24.3	21.0	-13.6
	Fry	49.7	48.8	-1.8
October	Adult	44.8	41.7	-6.9
	Juvenile	21.1	20.9	-0.9
November	Adult	42.9	41.4	-3.5
	Juvenile	21.0	20.9	-0.5
December	Adult	43.5	42.0	-3.4
	Juvenile	21.0	20.9	-0.5

1/ The amount of Weighted Usable Area is expressed in 1,000 units.
Average water year is defined as 1968 flows.

Table 8
Monthly Pre- and Post-Project Cutthroat Trout Habitat In Fish Creek During Average Water Year1/

Month	Life Stage	Pre-project	Post-project	Change (%)
January	Adult	362.7	363.0	+0.1
	Juvenile	85.3	85.5	+0.2
February	Adult	370.4	365.7	-1.3
	Juvenile	85.8	85.3	-0.6
March	Adult	414.2	406.6	-1.8
	Juvenile	88.3	88.3	0.0
April	Adult	476.9	456.1	-4.4
	Juvenile	87.5	87.8	+0.3
May	Adult	666.4	694.6	+4.2
	Juvenile	226.7	235.4	+3.8
	Spawning	0.8	6.0	+650.0
June	Adult	680.8	714.1	+5.0
	Juvenile	231.2	229.4	-0.7
	Spawning	1.7	21.8	+1,182.4
July	Adult	603.4	575.2	-4.7
	Juvenile	91.3	88.3	-3.3
	Spawning	39.8	27.3	-31.4
August	Adult	489.6	454.1	-7.3
	Juvenile	87.4	87.8	+0.5
	Spawning	17.8	14.2	-20.2
	Fry	88.6	84.2	-5.0
September	Adult	415.2	387.8	-6.6
	Juvenile	88.2	87.6	-0.7
	Fry	82.2	81.3	-1.1
October	Adult	369.2	362.5	-1.8
	Juvenile	86.0	85.2	-0.9
November	Adult	364.5	362.8	-0.5
	Juvenile	82.1	85.3	+3.9
December	Adult	363.1	363.9	+0.2
	Juvenile	85.5	85.9	+0.5

1/ The amount of Weighted Usable Area is expressed in 1,000 units. Average water year is defined as 1968 flows.

Table 9
Monthly Pre- and Post-Project Rainbow Trout Habitat In Fish Creek During Average Water Year1/

Month	Life Stage	Pre-project	Post-project	Change (%)
January	Juvenile	170.7	171.0	+0.2
February	Juvenile	173.1	171.5	-0.9
March	Juvenile	187.2	185.0	-1.1
April	Juvenile	203.1	198.4	-2.3
May	Juvenile	239.5	239.6	<0.1
	Spawning	45.9	44.9	-2.2
June	Juvenile	240.2	238.8	-0.6
	Spawning	48.4	36.9	-23.8
July	Juvenile	224.0	219.5	-2.0
	Spawning	23.6	18.2	-22.9
August	Juvenile	202.6	197.9	-2.3
	Spawning	11.0	8.2	-25.5
	Fry	226.4	223.1	-1.5
September	Juvenile	183.7	179.0	-2.6
	Fry	219.0	214.9	-1.9
October	Juvenile	172.7	170.5	-1.3
November	Juvenile	171.1	170.8	-0.2
December	Juvenile	171.0	171.6	+0.4

1/ The amount of Weighted Usable Area is expressed in 1,000 units. Average water year is defined as 1968 flows.

Table 10

Narrows Project
Aquatic Impacts and Recommended Mitigation Measures

Impacts	Mitigation Commitment
Stream Fisheries	
Gooseberry Creek tributaries - Loss of 4.3 miles (spawning cutthroat).	Restore year-round flows in 2.3 miles of tributaries and stabilize 3.0 miles of middle Gooseberry Creek.
Upper Gooseberry Creek - Loss of 1.0 mile (all life stages cutthroat); Middle Gooseberry Creek - 72% reduction in average annual flow for 3.0 miles (all life stages cutthroat); Lower Gooseberry Creek - 47% flow reduction for 7.1 miles. (Decrease of 5% adult and 4% juvenile low-flow habitat for cutthroat); Fish Creek - Average 17% flow reduction of 6.0 miles. (Decrease of less than 1% adult and juvenile low-flow habitat for cutthroat. Overall increase of 15% spawning and 3% fry habitat for cutthroat. Decrease of 1.3% adult and 0.5% juvenile low-flow habitat for rainbow. Overall decrease of 16% spawning and 2% fry habitat for rainbow.)	Acquire, fence, and improve fishery habitat on the following stream segments: Mud Creek 4.0 miles Winterquarters Creek 2.5 miles Upper Fish Creek 1.0 mile Pondtown Creek 2.0 miles Price River below Scofield Reservoir 2.0 miles
Upper Cottonwood Creek - No summer flow increase, 2 cfs winter flow provided.	Construct Upper Cottonwood Creek Pipeline and provide 2 cfs winter release.
Lower Cottonwood Creek - Average 162% annual flow increase. Average 300% summer flow increase. Loss of 4.9 miles of habitat for all life stages for Rainbow, Cutthroat, and Brown Trout.	Provide 2 cfs minimum flow during irrigation season in lower Cottonwood Creek, Acquire (as necessary), fence, and improve fishery habitat on 4.0 miles of Starvation Creek.
Reservoir Fisheries	
Scofield Reservoir - Increased potential for poor water quality resulting in fish kills, loss of some natural reproduction in rainbows. Reduced surface area resulting in reduced standing crop of fish and loss of 4,500 angler days per year.	Reduce external phosphorus loading by improving riparian areas along Mud Creek, Winterquarters Creek, Upper Fish Creek, and Pondtown Creek. These measures will also improve habitat for all life stages of cutthroat and rainbow trout including spawning. Lost angler days would be replaced by fishery in Narrows Reservoir.
Lower Gooseberry Reservoir - Increased potential for poor water quality resulting in fish kills.	Provide 300 acre-feet of water from Narrows Reservoir to be used for instream flow augmentation in consultation with UDWR.
Fairview Lakes - Lower fishing pressure, less severe drawdown during fishing season.	Beneficial impact. No mitigation required.
Narrows Reservoir - New reservoir fishery.	Would provide approximately 13,700 angler days use.

NARROWS PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

APPENDIX E

CULTURAL RESOURCE COORDINATION

SEP 10 1997

UC-325
ENV-3.00

CERTIFIED - RETURN RECEIPT REQUESTED

Mr. Max J. Evans
Utah State Historic Preservation Officer
300 South Rio Grande
Salt Lake City UT 84101

Subject: Gooseberry Narrows Environmental Commitments - Cultural Resources

Dear Mr. Evans:

In order to comply with Section 106 of the National Historic Preservation Act (NHPA) of 1966, the Provo Area Office of the Bureau of Reclamation wishes to consult with you concerning proposed environmental commitments regarding cultural resources compliance with NHPA on the Gooseberry Narrows Project.

The Gooseberry Narrows Project consists of construction of a dam and a small reservoir on Gooseberry Creek for the purpose of diverting water from the Price River drainage for the use of farmers in Sanpete County. The area of potential effect includes the zone of construction of the dam and reservoir, a 1/4 mile zone around the reservoir that will be used by fishermen and other recreational visitors, the zone of construction and use of recreational facilities associated with the project, improvements to an existing tunnel (which may itself be National Register eligible), the zone of construction of a delivery system (pipeline) for the water, and the zone of construction associated with enhancing wetlands as part of wildlife mitigation associated with the project.

Current Status of Project

The current status of this project is as follows: An environmental impact statement (EIS) is being prepared by the Provo Area Office, working with the Sanpete Water Conservancy District and with a private contractor. Because the project has been controversial, all parties wish to see a record of decision on the EIS prior to commencing with the environmental compliance work required, including cultural resources compliance. Therefore, the cultural resources work necessary to comply with Section 106 takes the form of environmental commitments in the EIS. These commitments must be met prior to any construction on the project.

The current status of cultural resources compliance on the Gooseberry Narrows project is as follows: An inventory of the reservoir pool area was done by the University of Utah in 1976, and three sites (two prehistoric lithic scatters and one historic foundation) were recorded. The sites were not evaluated as to their National Register eligibility, and a testing program was recommended (but never completed). The current pool area is slightly different than the area inventoried in 1976, but there is a great deal of overlap with the 1976 inventory. A1992 letter from your office outlines steps that need to be taken in order to complete NHPA Section 106 requirements. The project has changed somewhat in scope since 1992, and the environmental commitments for cultural resources compliance for the present configuration of the project are outlined below.

Native American consultation regarding the project has been initiated. On August 5, 1997, Betsy Chapoose and Clifford Duncan of the Uintah-Ouray Ute Tribe toured the project area with Signa Larralde and Kerry Schwartz of the Provo Area Office and were briefed on the scope of the proposed project. The Uintah-Ouray Ute Tribe is the only tribe believed to have aboriginal ties to the project area. We are currently awaiting feedback from Ms. Chapoose and Mr. Duncan regarding any areas of traditional cultural importance within the project area. The only concerns expressed on the tour were that the Utes be provided with a list of plants in the project area, with the possible intent of plant collecting for medicinal use in the future.

Environmental Commitments for Cultural Resources Compliance

The following environmental commitments to be included in the EIS provide compliance with Section 106 of the National Historic Preservation Act:

- Evaluate three previously recorded sites in pool area as to National Register eligibility. Limited testing necessary in order to evaluate the sites will be accomplished through placing auger holes in a pattern on each site, or excavating test units.

- Inventory any of the pool area, dam construction zone, and road realignments not inventoried in 1976, including a 1/4 mile zone around pool area that would be impacted by recreational use of the reservoir. Inventory the location of all recreational facilities proposed in the project plan, plus all areas slated for wetlands enhancement.

- Inventory the rights of way for the proposed East Bench and Oak Creek pipelines, consisting of 16.1 linear miles of proposed water pipeline near Fairfield in Sanpete County.

- Inventory and evaluate the existing historic tunnel delivery system on Gooseberry Creek as to its National Register eligibility.

- Conduct a cultural resources overview of U.S. Forest Service information on historic features in and near project area; evaluate any features within the project area as to their National Register eligibility.

- Conduct a paleontological literature search and survey of the project area and its immediate vicinity, with the particular view of assessing the likelihood of recovering Pleistocene fauna during the project (the project area is near the site of the Huntington mammoth discovery).

- Consult with your office regarding the National Register eligibility of any historic or archaeological sites found during work associated with any of the above commitments. If we jointly reach the conclusion that significant sites will be impacted by the project, Reclamation will then consult with your office and with the Advisory Council on Historic Preservation to negotiate a Memorandum of Agreement that outlines mitigation measures to be taken prior to project construction to avoid adverse effects of the project on historic properties.

We would appreciate it if you would review the above environmental commitments and respond as to whether or not your office believes they will provide compliance with Section 106 of the National Historic Preservation Act. We would also appreciate any suggestions you may have as to how best to complete the cultural resources work and the consultation necessary for compliance. We would very much appreciate a response within 30 days of receipt of this letter, or by October 15, 1997.

Should you have any questions about the Gooseberry Narrows Project, please contact Signa Larralde at 524-3684.

Sincerely,

Larry Walkoviak
Manager, Resources Management Division

cc: Area Manager, Provo UT
Attention: PRO-406

David Peterson, President, Sanpete Water Conservancy District,
1484 South 70 West, Box 265, Mount Pleasant UT 84647

WBR:SLarralde:lw:09/03/97:801-524-3684:NARRWSHP.997

ORIGINAL

Department of Community & Economic Development
Division of State History
Utah State Historical Society

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ENV 3.00
9709 0772

September 16, 1997

Larry Walkoviak
Manager, Resources Management Division
Bureau of Reclamation
Upper Colorado Regional Office
125 South State Street, Room 6107
Salt Lake City UT 84138-1102

RE: Gooseberry Narrows Environmental Commitments

In Reply Please Refer to Case No. 94-0609

Dear Mr. Walkoviak:

The Utah State Historic Preservation Office received information on the project referenced above on September 11, 1997. After consideration of the letter and the seven environmental commitments, the Utah Preservation Office concur with the Bureau of Reclamation that they do meet the standards for Section 106 of the National Historic Preservation Act.

This information is being provided on request to assist the Bureau of Reclamation in identifying historic properties, as specified in §36CFR800, for Section 106 consultation procedures. If you have questions, please contact me at (801) 533-3555, or Barbara L. Murphy at (801) 533-3563. My email address is: jdykman@history.state.ut.us

As ever,

James L. Dykmann
Compliance Archaeologist

JLD:94-0609 BOR/NAE

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NARROWS PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

APPENDIX F

2006 EUTROPHICATION STUDY

Appendix F

Eutrophication Study
Flow and Phosphorus Impacts of Proposed Narrows Project on Scofield Reservoir

EUTROPHICATION STUDY

Flow and Phosphorus Impacts of
Proposed Narrows Project on Scofield Reservoir

Prepared For:
US Bureau of Reclamation

Updated
October 2006

Prepared By:

FRANSON NOBLE
ENGINEERING

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FRANSON NOBLE
ENGINEERING
The Water Resource Specialists

November 8, 2006

Mr. Kerry Schwartz
Bureau of Reclamation
302 East 1860 South
Provo, Utah 84606-7317

Re: Narrows Project - Final Updated Scofield Reservoir Eutrophication Study Report

Dear Mr. Schwartz:

Attached is the final version of the updated Scofield Reservoir Eutrophication Study Report for the Narrows Project. The Eutrophication Study has been updated to include data through 2005. Steve Noyes' comments on the current draft as well as his comments on the August 2003 Draft Eutrophication Report have been addressed in this final version of the report.

Please contact me if you require any additional water quality information related to the Narrows Project.

Thank you for your assistance with this project.

Sincerely,

Layne Jensen

Layne D. Jensen, P.E.

Enclosures

cc: Edwin Sunderland
Chairman, Sanpete Water Conservancy District

NOTICE: IF YOU DETACH ENCLOSURES PLEASE INSERT CODE NO. PRO-700

1276 South 820 East, Suite 100, American Fork, Utah 84003
T 801 756-0309 or 888 756-3726 (toll free) F 801 756-0481

EUTROPHICATION STUDY
Flow and Phosphorus Impacts of Proposed Narrows Project on Scofield Reservoir

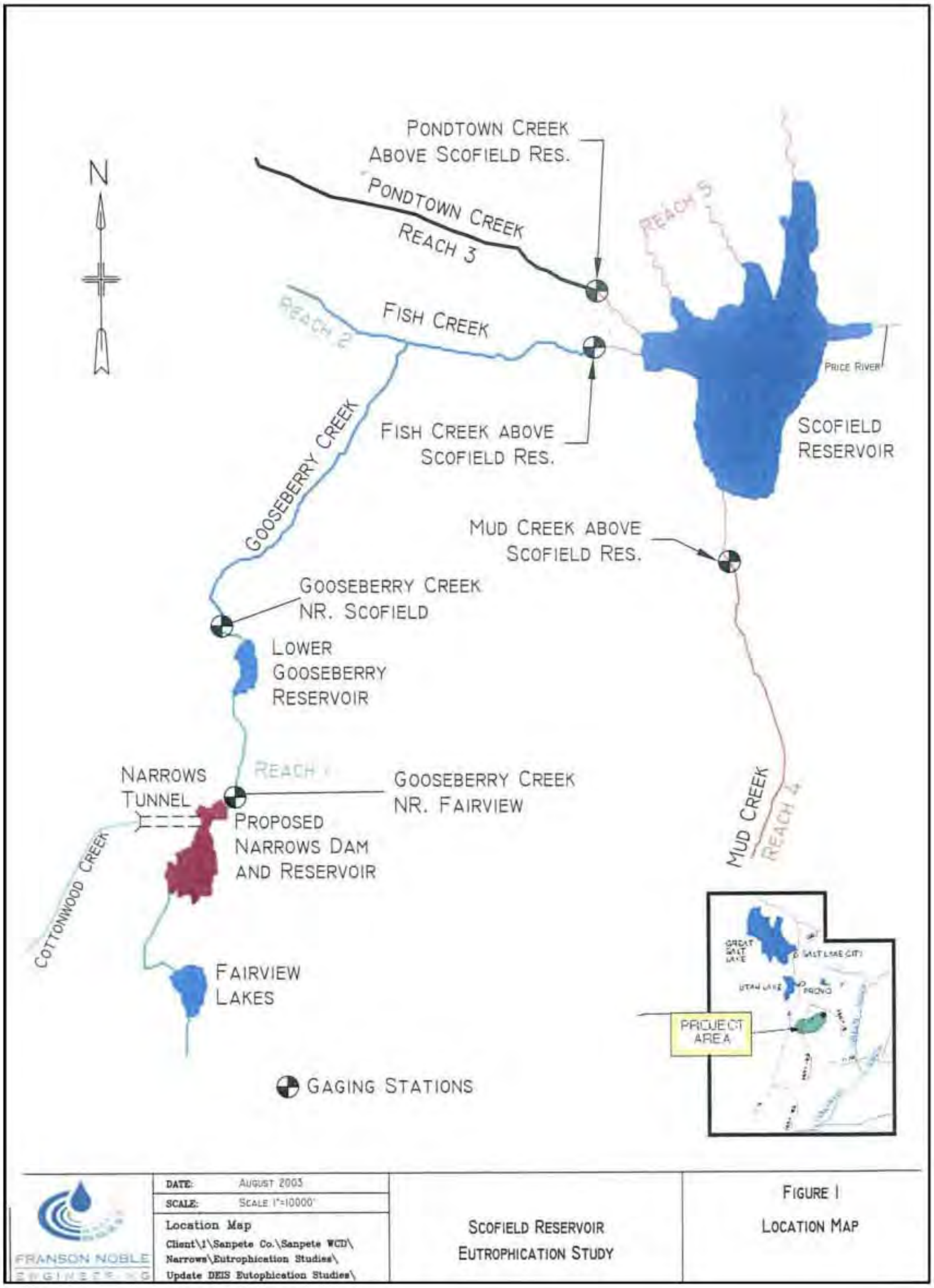
Introduction-

The proposed Narrows Project is comprised of new features and facilities to develop a supplemental water supply to be used on presently irrigated lands and by municipal water users in northern Sanpete County, Utah. The project would divert water from Gooseberry Creek in the upper Price River drainage basin through an existing tunnel to Cottonwood Creek in the San Pitch/Sevier River drainage for delivery to lands and water users in the Sanpete Valley area surrounding Fairview, Utah. The proposed Narrows Dam and Reservoir would be constructed on Gooseberry Creek. Water stored in the reservoir would be diverted and delivered through a rehabilitated (existing) Narrows Tunnel to Cottonwood Creek. Diverted project water would reduce the normal flow in Gooseberry Creek, through Lower Gooseberry Reservoir, downstream to Fish Creek, and Fish Creek flows into Scofield Reservoir. (See location map included as Figure 1).

Several studies have been conducted to determine the various impacts of the Proposed Narrows Project on Scofield Reservoir drainage system and the river below. An initial Eutrophication Study was conducted by Cloward, Madden and Associates in November 1991 using data from 1978 - 1989. A study was conducted in 2001 to update the 1991 Eutrophication Study. This study was specific to the phosphorus changes in Scofield Reservoir from 1978-1992 and was designed to provide a response to the comments received from the 1998 Narrow Project DEIS including the need for additional modeling studies to further define the flow and phosphorus impacts of the Narrows Project on Scofield Reservoir. The 2001 Eutrophication Study was updated in 2003 during an effort to update the DEIS. The 2003 update included data up through 2002 and incorporated changes to respond to previous comments. The 2003 study relied on previous studies for much of the basic data and procedures. The 2003 study was never finalized since efforts to update the DEIS ended soon thereafter.

This update is being prepared to provide current information for the Supplemental Draft EIS (SDEIS) currently being prepared. All of the water supply and water quality models, including those done for phosphorus loading and modeling have been updated through 2005. In response to comments made regarding the 2003 draft eutrophication study some of the procedures have been changed. Namely, the monthly phosphorus distributions for the various creeks and reservoirs were updated based on all of the data currently available rather than using a distribution developed using only data collected prior to 1990 as was the case up to the 2003 update. Also, phosphorus concentrations measured in Lower Gooseberry Reservoir are no longer used to estimate the phosphorus concentration for the inflow to the proposed Narrows Reservoir. Phosphorus concentrations for the inflow to the Narrows Reservoir were estimated based on samples taken from Fairview Lakes and on Gooseberry Creek above Lower Gooseberry Reservoir

Inflow to Scofield Reservoir is composed of measured Fish Creek Flows above Scofield Reservoir (60%), Mud Creek Flows above Scofield Reservoir (18%), Pondtown Creek Flows above Scofield Reservoir (7%), and the unmeasured inflow to Scofield Reservoir (15%). Gooseberry Creek flow contributes about 38% of Fish Creek's flow or approximately 23% of the total inflow to Scofield Reservoir. Impacts of the Narrows Project are confined to only the contribution of Gooseberry Creek to Scofield Reservoir inflow.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PONDTOWN CREEK
ABOVE SCOFIELD RES.
PONDTOWN CREEK
REACH 3
REACH 5
FISH CREEK
REACH 2
PRICE RIVER
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SCOFIELD
RESERVOIR
GOOSEBERRY CREEK
MUD CREEK ABOVE
SCOFIELD RES.
GOOSEBERRY CREEK
NR. SCOFIELD
LOWER
GOOSEBERRY
RESERVOIR
NARROWS
TUNNEL
REACH 1
GOOSEBERRY CREEK
NR. FAIRVIEW
PROPOSED
NARROWS DAM
AND RESERVOIR
COTTONWOOD CREEK
MUD CREEK
REACH 4
FAIRVIEW
LAKES
GAGING STATIONS
GREAT SALT LAKE
SALT LAKE CITY
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FRANSON NOBLE
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SCOFIELD RESERVOIR
EUTROPHICATION STUDY
FIGURE 1
LOCATION MAP

Modeling Procedures-

The period of study has been extended through water years 1978-2005 because of data availability. In most cases, the Utah State Department of Water Quality collects phosphorus data at selected sites twice per year, every other year. The results are posted on STORET (short for STOage RETreival, www.epa.gov/storet). Therefore, phosphorus concentrations had to be estimated for the missing months by applying typical monthly distributions of phosphorus. The monthly distributions were calculated by averaging all of the phosphorus concentration data available for a particular month. When less than three sample results were available for a particular month the value used in previous studies was used. Previous studies used the principles of "The General Time Interval Method" outlined in the publication "Guidelines for Studies of Potential Eutrophication" Bureau of Reclamation, December 1981. Measured phosphorus concentrations were used in calculations whenever available. Shaded concentrations values in the tables represent observed data. Shaded blocks in the column headings indicate stream flow control points. Previously, samples below the detection limit were not used in calculations. For this study the non-detects have been included in the calculations by assuming a value equal to half the detection limit. In the last 10 years many of the samples have been non-detects. If non-detect values were not used the older data would have a greater influence on the monthly distributions used when sample results are not available. To evaluate the sensitivity of the model to the use of non-detect values the eutrophication potential was calculated using the detection limit rather than half the detection limit for non-detect samples. The use of half the detection limit resulted in an increase of the eutrophication potential for Scofield Reservoir of 0.09% over the use of the detection limit for non-detect values.

Operation and Eutrophication Studies without Narrows Project

Studies for conditions without Narrows Project are found in Appendix A and B.

Narrows Reservoir Site Operation without Narrows Project (Table A-1)

River operations at the Narrows Reservoir site were taken from Franson Noble Engineering operations study conducted for the 2006 Narrows Project Supplemental Draft EIS. Phosphorus concentrations at Fairview Lakes No. 2 and Gooseberry Creek above Lower Gooseberry Reservoir are the basis for the concentrations in the column "Natural Flow-Gooseberry Creek near Fairview". These same concentrations were used for the columns "Diversion by Cottonwood-Gooseberry", "Other Inflows at Narrows Reservoir Site", "Net Inflow at Narrows Reservoir Site", "Stream Flow Below Narrows Reservoir Site", and "Reach Gains between Narrows Reservoir Site and Lower Gooseberry Reservoir". Flows for "Reach Gains between Narrows Reservoir and Lower Gooseberry Reservoir" are estimated by subtracting the flows below Narrows Reservoir from the flows at Gooseberry Creek near Scofield.

Lower Gooseberry Reservoir Operation without Narrows Project (Table A-2)

Net inflow to Lower Gooseberry Reservoir, for both acre-feet and grams of phosphorus, is the sum of the columns "Stream Flow below Narrows Reservoir Site" and "Reach Gains between Narrows Reservoir Site and Lower Gooseberry Reservoir" from the Narrows Reservoir Site Operation, Table A-1 (see Reach 1 in Figure 1). Since Lower Gooseberry Reservoir is a stabilized reservoir, storage is assumed constant and the discharge is equal to the inflow. Reservoir discharge is represented by the stream gage, Gooseberry Creek near Scofield, which is only a short distance downstream from the reservoir. However, this does not hold for the phosphorus because some uptake or removal takes place in Lower Gooseberry Reservoir. To estimate the phosphorus concentration and probability of eutrophication in the reservoir, an empirical annual eutrophication model for Lower Gooseberry Reservoir was developed according to the *Guidelines for Studies of Potential Eutrophication, Bureau of Reclamation, December 1981* (See Table B-1). Phosphorus uptake in the Lower Gooseberry Reservoir is calculated as the difference between the phosphorus inflow and the phosphorus outflow.

Scofield Reservoir Operation without Narrows Project (Table A-3)
The column "Stream Flow-Fish Creek Above Scofield Reservoir" is a control point for this study where the flows are measured by the USGS. Phosphorus concentrations are obtained from STORET and estimates calculated for the missing months. The column "Gains for Fish Creek Above Fish Creek Above Scofield Reservoir" (see Reach 2 in Figure 1) are the differences between the columns "Stream Flow-Fish Creek Above Scofield Reservoir" and "Stream Flow-Gooseberry Creek near Scofield". The columns "Stream Flow-Mud Creek Above Scofield Reservoir" (see Reach 4 in Figure1) and "Stream Flow-Pondtown Creek Above Scofield Reservoir" (see Reach 3 in Figure 1) are obtained from averaging all sampling results for a particular month unless 3 or fewer samples were available. In the case of 3 or fewer samples the concentrations used for previous calculations have been used. As always actual sampling results were used where available. The values in the columns "Scofield Reservoir Contents", "Reservoir Evaporation", and "Price River Below Scofield Dam" are obtained from the Franson-Noble operations studies cited above.

The column "Other Inflow (flow only) Above Scofield Reservoir" (see Reach 5 in Figure 1) was calculated from the columns "Total Inflow Above Scofield Reservoir" minus "Stream Flow-Fish Creek Above Scofield Reservoir" minus Stream Flow-Mud Creek Above Scofield Reservoir" minus "Stream Flow-Pondtown Creek Above Scofield Reservoir".

During review of the 2003 draft Eutrophication Study a comment was made regarding how the phosphorus concentrations for the "Other Reservoir Inflows Above Scofield Reservoir" were being estimated. Previously, the phosphorus concentrations were estimated by taking a flow weighted average of the concentrations in Fish Creek, Pondtown Creek and Mud Creek. The phosphorus concentration in Scofield Reservoir calculated using this method to calculate the "Other Inflows" phosphorus concentration does not correlate well with actual measurements of phosphorus concentration in the reservoir. In Table A-3 the concentration column for Scofield Reservoir has been changed from showing the phosphorus concentration calculated in Table B-2 to showing the phosphorus concentrations in Scofield Reservoir based on actual data. As can be seen the estimated and measured have a poor correlation. To address this problem, the phosphorus concentrations for the "Other Reservoir Inflows Above Scofield Reservoir" were estimated using the measured phosphorus concentrations of the reservoir. By using the measured phosphorus concentration in the reservoir and other knowns, such as flow in the three creeks and outflow to the Price River, a value could be estimated to represent the unknowns, such as phosphorus uptake and recycling, phosphorus contributions from other tributaries, and errors in data. However, the empirical formula to estimate the eutrophication potential requires the total inflow of phosphorus into the reservoir. To our knowledge there are no methods available to estimate directly the uptake and recycling of phosphorus in a reservoir. Without being able to remove the phosphorus uptake and recycling from the "Other Inflows" estimating the actual phosphorus inflow to the reservoir from other sources cannot be determined. Although certainly not ideal, estimating the phosphorus concentration from the other inflow to Scofield Reservoir using a flow weighted average of the three measured creeks is the best estimate that can be made. Using the phosphorus concentrations estimated for Scofield Reservoir by the empirical equation presented in the *Guidelines for Studies of Potential Eutrophication, Bureau of Reclamation, December 1981* allows direct comparison of the eutrophication potential for the with and without Narrows Reservoir conditions. Although the estimated phosphorus concentration in Scofield Reservoir is likely too low when compared to measured concentrations using the same methodology to estimate the phosphorus concentrations for both conditions allows comparison of the eutrophication potential to be valid. See Table E-5 in Appendix E for a comparison of total phosphorus values for the three reservoir sample sites and the estimated monthly average phosphorus concentration for Scofield Reservoir.

The column "Total Inflow (flow only) Above Scofield Reservoir" was calculated from the change in reservoir contents, evaporation, and reservoir discharge. Phosphorus mass (grams) in "Total Inflow" column is the sum of the phosphorus mass in the columns "Fish Creek Above Scofield Reservoir", "Mud Creek Above Scofield Reservoir", 'Pondtown Creek Above Scofield Reservoir", and "Other Inflow Above Scofield Reservoir".

Operation and Eutrophication Studies with Narrows Project

Studies for conditions with Narrows Project are found in Appendix C and D.

Narrows Reservoir Operation with Narrows Project (Table C-1)

River operations at Narrows Reservoir were taken from the Franson Noble Engineering, Inc. operation study updated for the Supplemental Draft EIS. Phosphorus concentrations at Fairview Lakes No. 2 and Gooseberry Creek above Lower Gooseberry Reservoir were used in the same manner as used in the "without Narrows" case. To estimate the phosphorus concentration and probability of eutrophication in the reservoir, an empirical eutrophication model for Narrows Reservoir was developed according to the *Guidelines for Studies of Potential Eutrophication, Bureau of Reclamation, December 1981* (See Table D-1). This same in-lake phosphorus concentration is used as the concentration for the columns "Diversion by Cottonwood-Gooseberry", "Project Irrigation Delivery" and "Stream Flow Below Narrows Reservoir". Phosphorus uptake in the Narrows Reservoir is calculated from the change in reservoir phosphorus mass, the phosphorus inflow, phosphorus outflow, and phosphorus diverted for "Diversion by Cottonwood-Gooseberry", and "Project Irrigation Delivery". The "Diversion by Cottonwood-Gooseberry" represents water from Fairview Lakes currently being diverted through the Narrows Tunnel. "Project Irrigation Delivery" represents water to be diverted through the Narrows Tunnel in addition to "Diversion by Cottonwood-Gooseberry".

Lower Gooseberry Reservoir Operation with Narrows Project (Table C-2)

Net inflow to Lower Gooseberry Reservoir, for both flow and phosphorus, is the sum of the columns "Stream Flow below Narrows Reservoir Site" and "Reach Gains between Narrows Reservoir and Lower Gooseberry Reservoir" in Table C-1. The values in the column "Reach Gains between Narrows Reservoir and Lower Gooseberry Reservoir" are held the same as in the "without" Narrows Project. Since Lower Gooseberry Reservoir is a stabilized reservoir, storage is assumed constant and the discharge is equal to the inflow. Because the flow and phosphorus inflow to Lower Gooseberry Reservoir have been changed by the Narrows Project, another annual eutrophication model for Lower Gooseberry Reservoir was developed to estimate the phosphorus concentration and eutrophication probability in the reservoir (See Table D-2). Again, phosphorus uptake in the Lower Gooseberry Reservoir was calculated as the difference between the phosphorus inflow and the phosphorus outflow.

Scofield Reservoir Operation with Narrows Project (Table C-3)

The model for Scofield Reservoir with the Narrows Project is slightly different from that used for the reservoir without the Narrows Project. However, the data changes are confined to the flow and phosphorus concentrations in Fish Creek caused by the projects impact on Gooseberry Creek. This means flow and phosphorus data for the columns "Gains for Fish Creek Above Fish Creek Above Scofield Reservoir", "Mud Creek Above Scofield Reservoir", "Pondtown Creek Above Scofield Reservoir", and "Other Reservoir Inflow Above Scofield Reservoir" (including any errors in data, methods, and assumptions made in the WITHOUT model) remain the same. Because the total flow and phosphorus load into Scofield Reservoir have been changed by the Narrows Project, an empirical annual eutrophication model for Scofield Reservoir was developed to estimate the phosphorus concentration and eutrophication probability in the reservoir (See Table D-3). The column "Total Inflow Above Scofield Reservoir" is now the sum of the columns "Fish Creek Above Scofield Reservoir", "Mud Creek Above Scofield Reservoir", "Pondtown Creek Above Scofield Reservoir", and "Other Reservoir Inflow Above Scofield Reservoir". The values in the columns "reservoir evaporation", "end-of-month contents", and flows for "Price River Below Scofield Reservoir", are taken from the Franson-Noble operation study for the proposed project.

Operation and Eutrophication Studies of Scofield Reservoir to show proposed Mitigation Target with Narrows Project
Studies are found in Appendix F.

According to the phosphorus loading models and eutrophication studies that have been presented in Appendix A through Appendix D, Scofield Reservoir shows a slight increase in annual average phosphorus concentration from 0.0279 to 0.0309 mg/l. This increase is primarily a result of the reduced dilution affects of water coming from Gooseberry Creek under the Narrows Project. The phosphorus concentrations in Table A-3 and C-3 do not match the values reported above from Tables B-2 and D-3. The value in Table A-3 is different because the values in the concentration column represent actual measurements made in Scofield Reservoir. As discussed above the value calculated in Table B-2 needs to be used so that the with and without eutrophication potential can be compared. The Table C-3 and D-3 results vary by 0.0006 mg/l. The difference is because Table C-3 uses the average contents for Scofield Reservoir for the entire year while Table D-3 only uses the average contents for June through September.

To mitigate the potential affects of the project, the Environmental Impact Statement (EIS) proposes several miles of stream bank enhancement and fencing to help reduce cattle grazing in and around the stream. Also, with the enhanced stream banks, they will become more stable and high flows will not cause as much erosion, which directly leads to phosphorus loading. The proposed mitigation is on the following lengths and creeks, which are tributaries to Scofield Reservoir:

Mud Creek – 6.5 miles (2.5 miles in Winter Quarters Ck)
Pond Town Creek – 2.0 miles
Fish Creek – 1.0 mile

The "Scofield Reservoir Operation with Narrows Project" phosphorous routing model and eutrophication study were used as the basis for the mitigation target. The mitigation target was determined by reducing the phosphorous concentration in each of the creeks mentioned above by a percentage. The percentages were loosely based on a proportionate amount of stream bank treatment on each creek. Some consideration of total phosphorous loading from each creek was given in allocating the percent reduction. This was done until the 25 year average in-lake phosphorous concentration in Scofield Reservoir with the Narrows Project was below the phosphorous concentration of the pre-project operation (0.0279 mg/l). It was determined that by reducing the phosphorous loading by an annual average of 530 kilograms per year, this goal could be met. The results of both the phosphorous routing model and the eutrophication study are found in Appendix F.

This mitigation goal will be presented in the Narrows Reservoir Project EIS. Once the project is operating, the effectiveness of the mitigation on phosphorous loading will need to be monitored. Because this area is regularly sampled and monitored for water quality, including phosphorous, the post-project phosphorous samples will be compared with pre-project data to determine if the mitigation goal is being met. Because of the variability of water years, it will be important to compare averages during similar hydrologic periods to determine the effectiveness of the proposed mitigation.

Table 1 Date: 25-Sep-06

Flow and Phosphorus Routing Summary

Location	Water Years 1978 - 2005					
	Without Narrows Project		**With** Narrows Project		Change (With-Without)	
	Flow acre-feet	Phosphorus grams	Flow acre-feet	Phosphorus grams	Flow acre-feet	Phosphorus grams
Natural Flow- Gooseberry Creek Near Fairview	9,230	162,408	9,230	162,408	0	0
Other Inflow at Narrows Reservoir Site	748	13,155	748	13,155	0	0
Reservoir Evaporation at Narrows	0		843		843	
Phosphorus Uptake at Narrows		0		66,180		66,180
Diversion- Cottonwood-Gooseberry	2,070	36,548	2,070	25,098	0	-11,450
Diversion- Narrows Project	0	0	4,932	58,709	4,932	58,709
Stream flow below Narrows Reservoir (site)	7,907	139,015	* 2,182	* 26,376	-5,725	-112,639
Reach Gains Between Narrows and Lower Gooseberry Reservoir	6,397	113,875	6,397	113,875	0	0
Inflow to Gooseberry Reservoir	14,304	252,890	8,578	140,252	-5,726	-112,638
Reservoir Evap at Gooseberry	0		0		0	
Phosphorus Uptake at Gooseberry		21,939		14,068		-7,871
Gooseberry Creek below Lower Gooseberry Reservoir	14,304	230,951	8,578	126,184	-5,726	-104,767
Gooseberry Creek near Scofield	14,304	230,951	8,578	126,184	-5,726	-104,767
Fish Creek GAINS above Fish Creek above Scofield Reservoir	23,165	1,937,841	23,165	1,937,841	0	0
Fish Creek above Scofield Reservoir	37,469	2,168,792	31,743	2,064,025	-5,726	-104,767
Fish Creek above Scofield Reservoir Concentration (mg/l)		0.0469		0.0527		0.0058
Mud Creek above Scofield Reservoir	11,074	1,265,200	11,074	1,265,200	0	0
Pondtown Creek above Scofield Reservoir	4,093	374,420	4,093	374,420	0	0
Other Reservoir Inflow above Scofield Reservoir	9,377	625,708	9,377	625,708	0	0
Total Reservoir Inflow above Scofield Reservoir	62,013	4,434,120	56,287	4,329,353	-5,726	-104,767
Scofield Evaporation	5,472		4,874		-598	
Scofield Phosphorus Uptake		1,397,727		2,370,171		972,444
Ave. Reservoir End-of-Month Contents Scofield Reservoir	42,635	2,393,857	32,056	1,197,455	-10,579	-1,196,402
Reservoir EOM Concentration Scofield Reservoir (mg/l)		# 0.0455 & 0.0279		+ 0.0303 & 0.0309		-0.0030
Probability of Eutrophication Scofield Reservoir	68.3%		73.5%		5.2%	
Price River below Scofield Reservoir	* 55,402	* 3,088,417	* 50,307	* 1,906,182	-5,095	-1,182,235

* Change in reservoir contents over the period 1978-2005 not included

\# Phosphorus concentration based on actual measurements of Scofield Reservoir.

& Phosphorus concentration is based on the model shown on Tables B-2 and D-3

\+ Phosphorus concentration is based on the model shown on Table C-3

Phosphorus concentrations based on actual measurements in Scofield Reservoir can be seen on Table A-3

Results

This study relies heavily on data and methods of earlier studies and, therefore, is limited in scope and study period. It could be improved with additional data, especially with additional monthly phosphorus samples at major control points. When possible, actual sampling results have been used. When sampling results are not available monthly distributions have been developed based on available sample results. The method used in the empirical estimates of in-lake phosphorus depends heavily on statistical correlation. It assumes that the data provided represents homogeneous and continuous lake conditions, which are rarely true.

Reservoir operations under "without" Narrows Project and "with" Narrows Project are summarized in Table 1. The flow and phosphorus impacts of the proposed Narrows Project are further described as follows:

1. Narrows Reservoir
   - The Narrows Reservoir will consume (uptake) about 66 kilograms of Phosphorus annually.
   - The project will divert an average annual amount of about 4,932 acre-feet of water and about 59 kilograms of phosphorus annually. In addition to the water to be diverted by the Narrows Project, the Cottonwood-Gooseberry project, which is currently diverting water through the Narrows Tunnel, will divert an average annual amount of 2,070 acre-feet of water and about 25 kilograms of phosphorus annually.
   - Water deliveries to Cottonwood-Gooseberry project are not affected, but the phosphorus diverted is reduced by about 11.5 kilograms annually (about 31 percent) because diversions are taken from the reservoir, which has a lower concentration. The average annual concentration of Cottonwood-Gooseberry deliveries is reduced by 0.0045 mg/l.

2. Gooseberry Creek near Scofield
   - Flow is reduced by 5,726 acre-feet (about 40 percent).
   - Phosphorus uptake in Lower Gooseberry Reservoir is reduced by about 8 kilograms (about 36 percent).
   - Phosphorus mass is reduced by 105 kilograms (about 45 percent). The resulting phosphorus concentration is reduced by 9 percent.

3. Fish Creek Above Scofield Reservoir
   - Flow is reduced by 5,726 acre-feet or about 15 percent.
   - Phosphorus mass is reduced by 105 kilograms or about 5 percent.
   - Concentration of phosphorus is increased by an annual average of 0.0058 mg/l or about 12 percent.

4. Scofield Reservoir
   - Reservoir inflow is reduced by 5,726 acre-feet or about 9 percent.
   - Phosphorus mass inflow is reduced by 105 kilograms or about 2 percent.
   - In-lake phosphorus concentration is increased by an annual average of 0.003 mg/l or about 10.8 percent.

- Average reservoir content is reduced by about 10,579 acre-feet or about 24.8 percent.
- Discharge is reduced by 5,095 acre-feet or about 9 percent.

The following figures compare conditions in Scofield Reservoir without and with Narrows Project. Figure 2 compares the reservoir monthly content. Figure 3 compares average annual Total Phosphorus inflow. Figure 4 compares average annual in-lake phosphorus concentration. Figure 5 compares the probability of eutrophication.

Conclusion

The proposed Narrows Project will reduce the total phosphorus mass loading into Scofield Reservoir, but the phosphorus concentration is increased as shown above. The probability of eutrophication at Scofield Reservoir is increased slightly every year except 1987 without any mitigation. The average annual increase is about 5.2 percent. The 1998 Narrows Project Draft EIS stated there would be essentially no increase in eutrophication and a small increase in the Trophic State Index. However this study includes an estimate of phosphorus inflow to Scofield Reservoir from sources other than Mud Creek, Pondtown Creek, and Fish Creek. This study also includes data collected through 2005. Average monthly phosphorus concentrations have been updated to reflect the additional data. Mitigation measures are offered as part of the project plan. This study indicates a small increase in the annual average in-lake phosphorus concentration (0.0279 mg/l to 0.0309 mg/l). Also, the annual average probability of eutrophication is increased 5.2 percent, which may require changes in the presentation of that conclusion.

As a result of the increase in potential eutrophication in Scofield Reservoir, a mitigation target has been established. The goal will be to reduce the total phosphorus loading to Scofield Reservoir by an annual average of 530 kilograms through stream bank treatment and fencing along 9.5 miles of tributaries. The effectiveness of the mitigation will be determined by comparing post-project phosphorus concentrations in Fish Creek, Mud Creek, and Pond Town Creek with pre-project measurements.

Appendix E - Supplemental Information

Phosphorus Data Development
This section is provided to document the development of phosphorus data for Gooseberry Creek and Fish Creek. The Utah State Department of Water Quality collects water quality samples about twice per bi-annually on most Utah streams. The laboratory analytical results from these samples are posted on STORET for public use. In order to estimate phosphorus concentration for the Natural Flow above Narrows Reservoir, all available Total Phosphorus data from Fairview Lakes #2, and Gooseberry Creek above Lower Gooseberry Reservoir were evaluated to generate a composite monthly concentration for all points above Lower Gooseberry Reservoir (see Table E-1). Sample results for Lower Gooseberry Reservoir have been included in Table E-1 to allow comparison of the composite monthly concentrations with the reservoir measurements.

Substantially more data for Fish Creek are available. See Table E-2 for a list of Total Phosphorus at Fish Creek above Scofield Reservoir that is used in this study. A typical monthly distribution was estimated for both Gooseberry Creek and Fish Creek based on all sample results posted on STORET. This typical monthly distribution was used when measured data was not available. Previously the typical monthly distribution was estimated using the procedures outlined in the *State of Utah Scofield Reservoir Phase I Clean Lakes Study, December 1983.* This monthly distribution was based on only 4 years of data. The additional 24 years of data collected since this study was published warranted the update of the monthly distribution.

Table E-3 shows a list of Total Phosphorus at Mud Creek above Scofield Reservoir for 1992 – 2005 and Table E-4 is a list of Total Phosphorus at Pond Town Creek for the same period. As with Fish Creek and Gooseberry Creek, a typical monthly distribution is used when measured data is not available. This typical monthly distribution was generated using all of the available data posted on STORET.

Table E-5 was created to determine whether the model in Table B-2 was accurately predicting the average annual phosphorus concentrations in Scofield Reservoir. Table E-5 contains all of the phosphorus concentration data reported for the Scofield Reservoir in the STORET database. The samples were collected from three sites at various depths. As can be seen in the table the phosphorus concentration can vary by an order of magnitude at different sites for a given month. However, there are months that phosphorus data for the three sites agree very well. The sample results from all three sites have been averaged to estimate a phosphorus concentration for the given month. This monthly data was then used in conjunction with the end of month reservoir contents to determine an actual average reservoir phosphorus concentration that could be compared to the predicted values in Table B-2. The results of the comparison are discussed in the Scofield Reservoir Operation <u>without</u> Narrows Project Section

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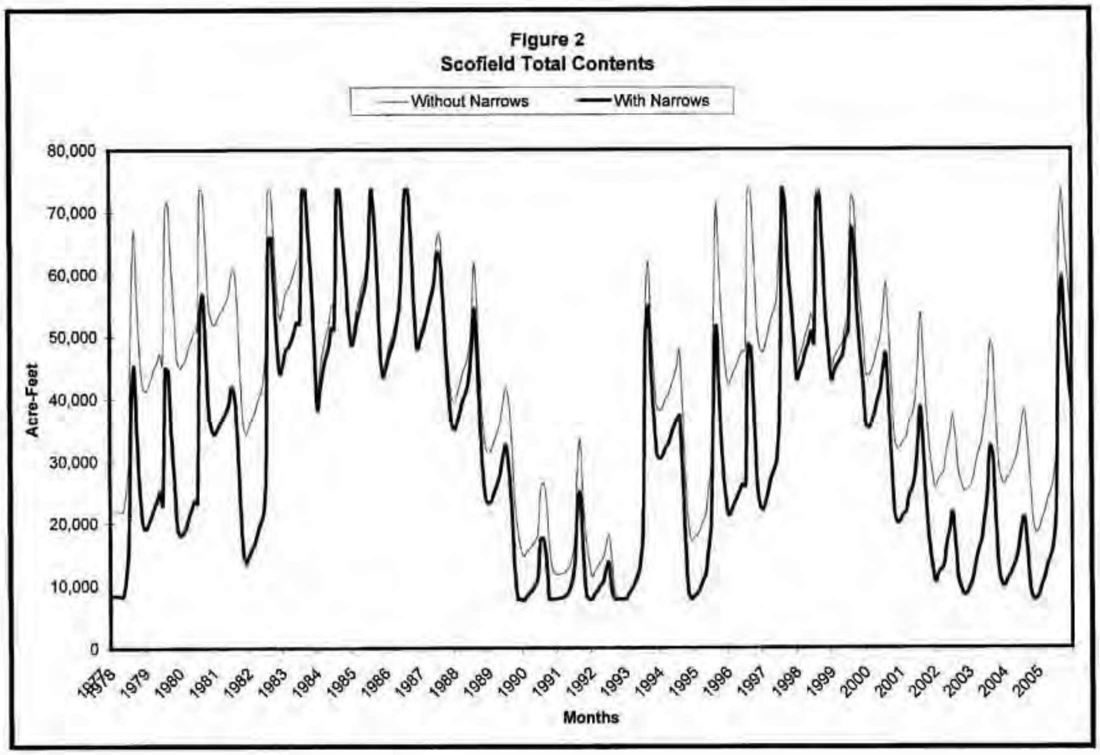
Figure 2
Scofield Total Contents
Without Narrows
With Narrows
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Acre-Feet
Months

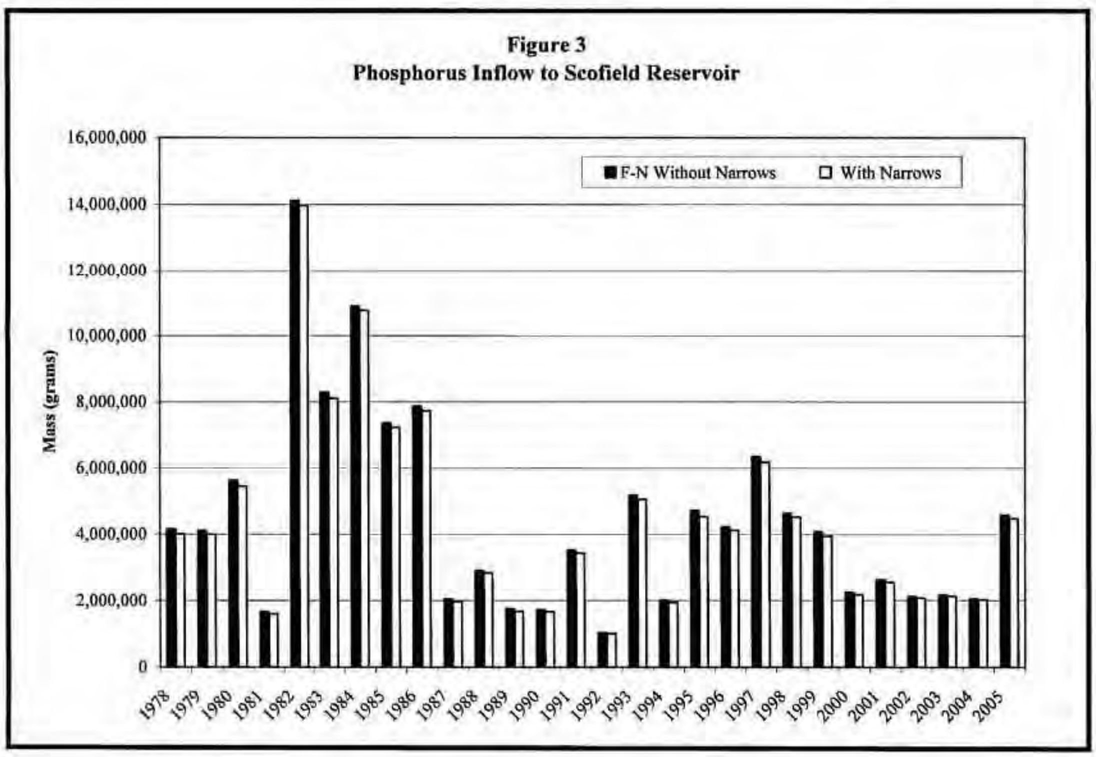
Figure 3
Phosphorus Inflow to Scofield Reservoir
F-N Without Narrows
With Narrows
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
Mass (grams)

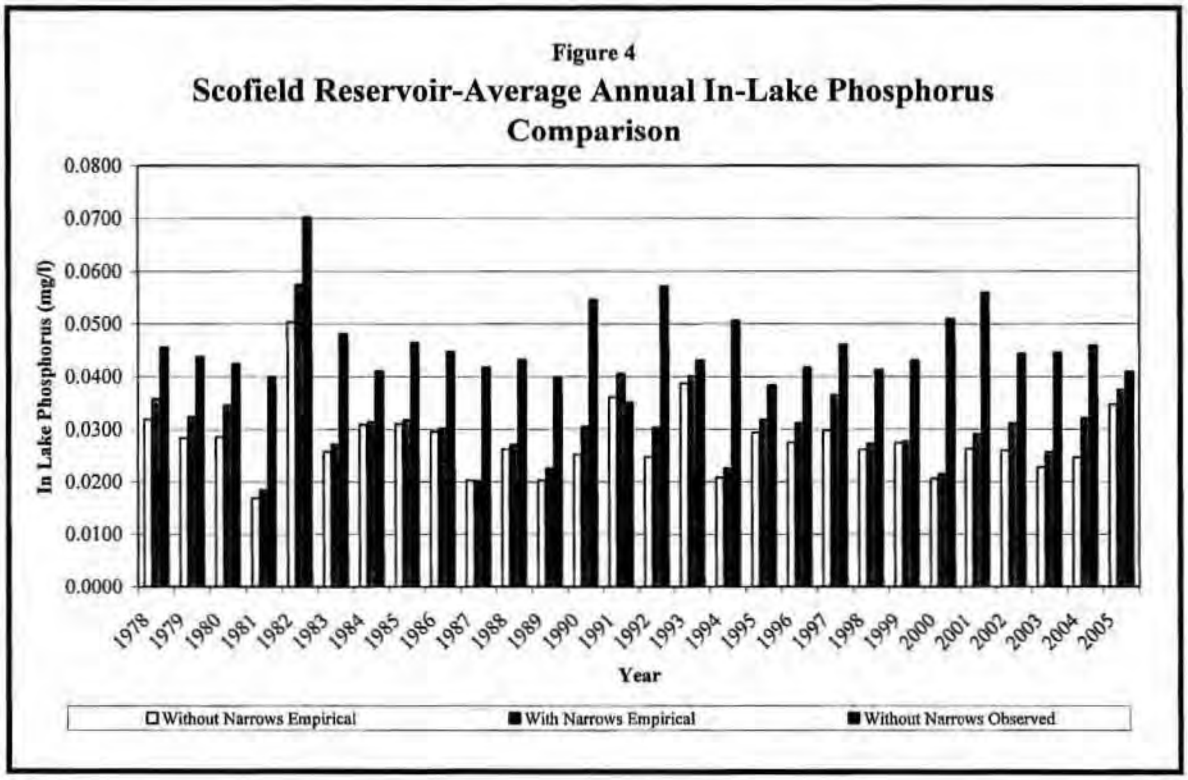
Figure 4
Scofield Reservoir-Average Annual In-Lake Phosphorus Comparison
In Lake Phosphorus (mg/l)
0.0800
0.0700
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year
Without Narrows Empirical
With Narrows Empirical
Without Narrows Observed

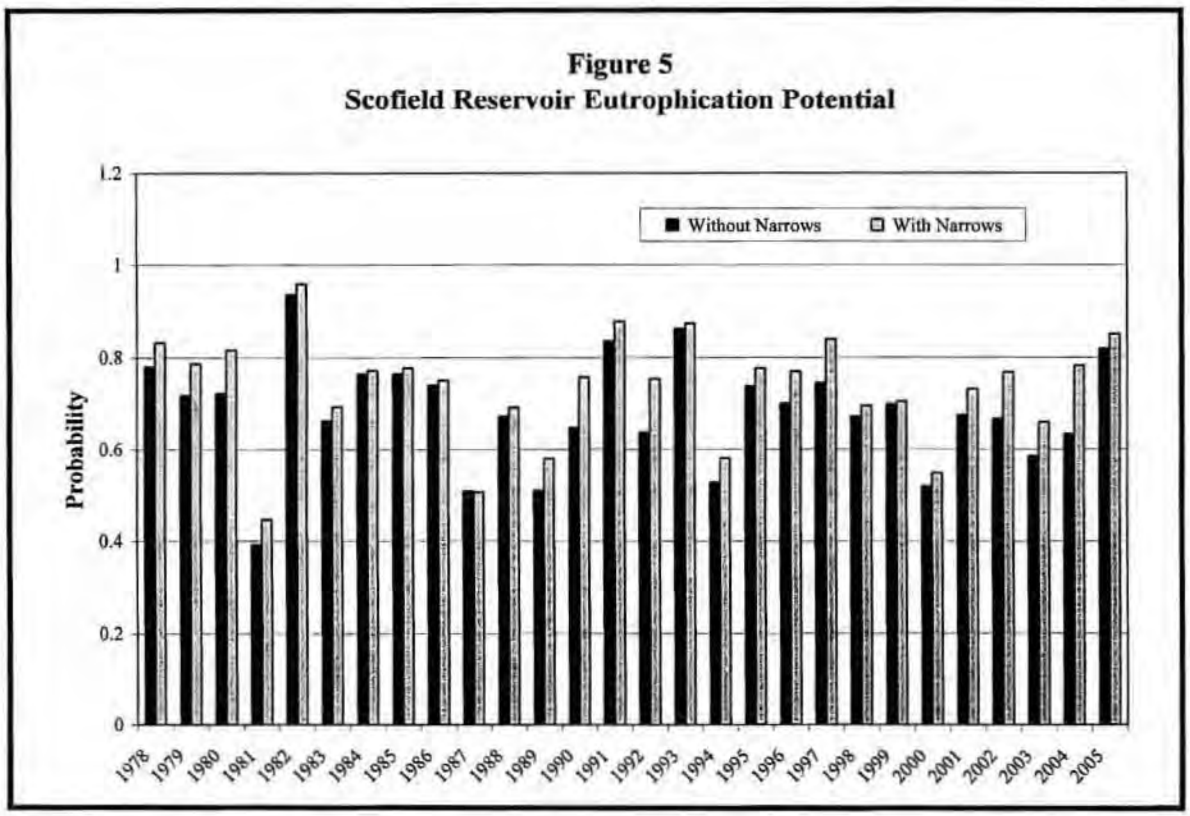
Figure 5
Scofield Reservoir Eutrophication Potential
Probability
1.2
1
0.8
0.6
0.4
0.2
0
Without Narrows
With Narrows
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005

Table A-1

Date: September 25, 2006

Flow and Phosphorus Routing WITHOUT Narrows Project
Narrows Reservoir Site Operation

		(Fransen-Noble) Natural Flow-Gooseberry Creek Near Fairview			(Fransen-Noble) Diversion by Cottonwood-Gooseberry			(Fransen-Noble) Other Inflow at Narrows Reservoir Site			(CALC) Net Flow at Narrows Reservoir Site			(Fransen-Noble) Stream Flow below Narrows Reservoir Site			(CALC) Reach Gains Between Narrows Reservoir Site and Lower Gooseberry Reservoir		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams
	Oct	96	0.0209	2,475	17	0.0209	438	8	0.0209	200	104	0.0209	2,675	87	0.0209	2,237	61	0.0209	1,610
	Nov	104	0.0198	2,540	18	0.0198	440	8	0.0198	206	112	0.0198	2,746	94	0.0198	2,306	68	0.0198	1,650
	Dec	87	0.0187	2,007	18	0.0187	415	7	0.0187	163	94	0.0187	2,169	76	0.0187	1,754	88	0.0187	2,029
1978	Jan	84	0.0176	1,824	17	0.0176	369	9	0.0176	148	91	0.0176	1,971	74	0.0176	1,602	80	0.0176	1,741
	Feb	83	0.0165	1,689	16	0.0165	326	7	0.0165	137	90	0.0165	1,826	74	0.0165	1,500	73	0.0165	1,491
	Mar	103	0.0154	1,957	21	0.0154	399	8	0.0154	158	111	0.0154	2,115	90	0.0154	1,716	101	0.0154	1,912
	Apr	582	0.0143	10,266	114	0.0143	2,011	47	0.0143	832	629	0.0143	11,097	515	0.0143	9,087	515	0.0143	9,082
	May	4,143	0.0131	66,946	715	0.0131	11,553	336	0.0131	5,423	4,479	0.0131	72,368	3,764	0.0131	60,815	2,716	0.0131	43,894
	Jun	5,070	0.0141	88,178	799	0.0141	13,896	411	0.0141	7,142	5,481	0.0141	95,321	4,682	0.0141	81,425	2,558	0.0141	44,495
	Jul	649	0.0110	8,805	101	0.0110	1,370	53	0.0110	713	702	0.0110	9,519	601	0.0110	8,149	313	0.0110	4,251
	Aug	378	0.0176	8,206	60	0.0176	1,303	31	0.0176	665	409	0.0176	8,871	349	0.0176	7,568	197	0.0176	4,285
	Sep	171	0.0240	5,062	28	0.0240	829	14	0.0240	410	185	0.0240	5,472	157	0.0240	4,643	99	0.0240	2,935
WY	Total	11,550	0.0140	199,955	1,924	0.0140	33,349	936	0.0140	16,196	12,486	0.0140	216,151	10,562	0.0140	182,802	6,872	0.0140	119,397
	Oct	34	0.0208	877	6	0.0209	155	3	0.0209	71	37	0.0209	948	31	0.0209	793	9	0.0209	238
	Nov	153	0.0198	3,737	42	0.0198	1,026	12	0.0198	303	165	0.0198	4,039	123	0.0198	3,014	138	0.0198	3,361
	Dec	97	0.0187	2,237	28	0.0187	646	8	0.0187	181	105	0.0187	2,419	77	0.0187	1,773	96	0.0187	2,218
1979	Jan	93	0.0176	2,019	28	0.0176	608	8	0.0176	164	101	0.0176	2,183	73	0.0176	1,575	99	0.0176	2,159
	Feb	88	0.0165	1,791	25	0.0165	509	7	0.0165	145	95	0.0165	1,936	70	0.0165	1,427	86	0.0165	1,748
	Mar	99	0.0154	1,881	28	0.0154	532	8	0.0154	152	107	0.0154	2,033	79	0.0154	1,501	93	0.0154	1,766
	Apr	294	0.0143	5,186	76	0.0143	1,341	24	0.0143	420	318	0.0143	5,606	242	0.0143	4,265	234	0.0143	4,131
	May	4,186	0.0131	67,640	1,006	0.0131	16,256	339	0.0131	5,479	4,525	0.0131	73,119	3,519	0.0131	56,864	2,761	0.0131	44,613
	Jun	2,256	0.0141	39,237	489	0.0141	8,505	183	0.0141	3,178	2,439	0.0141	42,415	1,950	0.0141	33,910	1,100	0.0141	19,136
	Jul	471	0.0110	6,391	98	0.0110	1,330	38	0.0110	518	509	0.0110	6,908	411	0.0110	5,579	198	0.0110	2,684
	Aug	247	0.0176	5,362	52	0.0176	1,129	20	0.0176	434	267	0.0176	5,797	215	0.0176	4,668	112	0.0176	2,431
	Sep	137	0.0240	4,056	32	0.0240	947	11	0.0240	329	148	0.0240	4,384	116	0.0240	3,437	84	0.0240	2,484
WY	Total	8,155	0.0140	140,413	1,910	0.0140	32,982	661	0.0140	11,373	8,816	0.0140	151,786	6,906	0.0140	118,805	5,010	0.0140	86,970
	Oct	139	0.0209	3,583	22	0.0209	567	11	0.0209	290	150	0.0209	3,874	128	0.0209	3,307	101	0.0209	2,597
	Nov	120	0.0198	2,931	19	0.0198	464	10	0.0198	237	130	0.0198	3,168	111	0.0198	2,704	90	0.0198	2,205
	Dec	116	0.0187	2,676	21	0.0187	484	9	0.0187	217	125	0.0187	2,892	104	0.0187	2,408	111	0.0187	2,551
1980	Jan	104	0.0176	2,258	21	0.0176	456	8	0.0176	183	112	0.0176	2,441	91	0.0176	1,985	124	0.0176	2,683
	Feb	99	0.0165	2,015	19	0.0165	387	8	0.0165	163	107	0.0165	2,178	88	0.0165	1,791	113	0.0165	2,299
	Mar	112	0.0154	2,128	21	0.0154	399	9	0.0154	172	121	0.0154	2,300	100	0.0154	1,901	115	0.0154	2,183
	Apr	530	0.0143	9,349	91	0.0143	1,605	43	0.0143	757	573	0.0143	10,106	482	0.0143	8,501	464	0.0143	8,186
	May	4,179	0.0131	67,527	640	0.0131	10,342	338	0.0131	5,470	4,517	0.0131	72,997	3,877	0.0131	62,655	2,753	0.0131	44,477
	Jun	5,391	0.0141	93,761	753	0.0141	13,096	437	0.0141	7,595	5,828	0.0141	101,356	5,075	0.0141	88,260	2,725	0.0141	47,399
	Jul	727	0.0110	9,864	101	0.0110	1,370	59	0.0110	799	786	0.0110	10,663	685	0.0110	9,293	365	0.0110	4,954
	Aug	302	0.0176	6,556	42	0.0176	912	24	0.0176	531	326	0.0176	7,087	284	0.0176	6,176	148	0.0176	3,203
	Sep	235	0.0240	6,957	33	0.0240	977	19	0.0240	564	254	0.0240	7,520	221	0.0240	6,543	125	0.0240	3,699
WY	Total	12,054	0.0141	209,605	1,783	0.0141	31,059	976	0.0141	16,978	13,030	0.0141	226,583	11,247	0.0141	195,523	7,233	0.0141	126,437

Table A-1

Date: September 25, 2006

Flow and Phosphorus Routing WITHOUT Narrows Project
Narrows Reservoir Site Operation

		(Franson-Noble) Natural Flow-Gooseberry Creek Near Fairview			(Franson-Noble) Diversion by Cottonwood-Gooseberry			(Franson-Noble) Other Inflow at Narrows Reservoir Site			(CALC) Net Flow at Narrows Reservoir Site			(Franson-Noble) Stream Flow below Narrows Reservoir Site			(CALC) Reach Gains Between Narrows Reservoir Site and Lower Gooseberry Reservoir		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams
	Oct	196	0.0209	5,053	55	0.0209	1,418	16	0.0209	409	212	0.0209	5,462	157	0.0209	4,044	152	0.0209	3,922
	Nov	165	0.0198	4,030	50	0.0198	1,221	13	0.0198	326	178	0.0198	4,356	128	0.0198	3,135	154	0.0198	3,752
	Dec	138	0.0187	3,183	42	0.0187	969	11	0.0187	258	149	0.0187	3,441	107	0.0187	2,472	130	0.0187	2,995
1981	Jan	113	0.0176	2,453	40	0.0176	868	9	0.0176	199	122	0.0176	2,652	82	0.0176	1,783	144	0.0176	3,123
	Feb	106	0.0165	2,157	36	0.0165	733	9	0.0165	175	115	0.0165	2,332	79	0.0165	1,599	126	0.0165	2,573
	Mar	162	0.0154	3,077	56	0.0154	1,064	13	0.0154	249	175	0.0154	3,327	119	0.0154	2,263	198	0.0154	3,759
	Apr	891	0.0143	15,716	268	0.0143	4,727	72	0.0143	1,273	963	0.0143	16,989	695	0.0143	12,262	815	0.0143	14,373
	May	2,753	0.0131	44,485	649	0.0131	10,487	223	0.0131	3,603	2,976	0.0131	48,088	2,327	0.0131	37,601	1,323	0.0131	21,378
	Jun	1,214	0.0100	14,975	283	0.0100	3,491	98	0.0100	1,213	1,312	0.0100	16,187	1,029	0.0100	12,697	561	0.0100	6,916
	Jul	361	0.0110	4,898	78	0.0110	1,058	29	0.0110	397	390	0.0110	5,295	312	0.0110	4,237	125	0.0110	1,693
	Aug	189	0.0176	4,103	42	0.0176	912	15	0.0176	332	204	0.0176	4,435	162	0.0176	3,524	75	0.0176	1,621
	Sep	149	0.0240	4,411	38	0.0240	1,125	12	0.0240	357	161	0.0240	4,768	123	0.0240	3,643	90	0.0240	2,662
WY	Total	6,437	0.0137	108,542	1,637	0.0137	28,073	521	0.0137	8,792	6,958	0.0137	117,333	5,321	0.0137	89,261	3,892	0.0137	68,766
	Oct	205	0.0209	5,285	44	0.0209	1,134	17	0.0209	428	222	0.0209	5,713	178	0.0209	4,579	159	0.0209	4,109
	Nov	147	0.0198	3,590	33	0.0198	806	12	0.0198	291	159	0.0198	3,881	126	0.0198	3,075	129	0.0198	3,153
	Dec	101	0.0187	2,330	24	0.0187	554	8	0.0187	189	109	0.0187	2,518	85	0.0187	1,965	100	0.0187	2,302
1982	Jan	80	0.0176	1,737	18	0.0176	391	6	0.0176	141	86	0.0176	1,877	68	0.0176	1,487	72	0.0176	1,553
	Feb	76	0.0165	1,547	16	0.0165	326	6	0.0165	125	82	0.0165	1,672	66	0.0165	1,346	57	0.0165	1,157
	Mar	102	0.0154	1,938	24	0.0154	456	8	0.0154	157	110	0.0154	2,095	86	0.0154	1,639	99	0.0154	1,876
	Apr	664	0.0143	11,712	152	0.0143	2,681	54	0.0143	949	718	0.0143	12,661	566	0.0143	9,980	594	0.0143	10,481
	May	5,446	0.0131	88,000	1,150	0.0131	18,583	441	0.0131	7,128	5,887	0.0131	95,128	4,737	0.0131	76,546	4,023	0.0131	65,004
	Jun	3,227	0.0141	56,125	591	0.0141	10,279	261	0.0141	4,546	3,488	0.0141	60,671	2,897	0.0141	50,392	1,603	0.0141	27,873
	Jul	788	0.0110	10,692	146	0.0110	1,981	64	0.0110	866	852	0.0110	11,558	706	0.0110	9,577	404	0.0110	5,484
	Aug	360	0.0176	7,815	67	0.0176	1,455	29	0.0176	633	389	0.0176	8,448	322	0.0176	6,994	186	0.0176	4,034
	Sep	357	0.0240	10,569	65	0.0240	1,924	29	0.0240	856	386	0.0240	11,425	321	0.0240	9,500	177	0.0240	5,242
WY	Total	11,553	0.0141	201,339	2,330	0.0141	40,568	936	0.0141	16,308	12,489	0.0141	217,647	10,159	0.0141	177,079	7,602	0.0141	132,269
	Oct	453	0.0209	11,678	37	0.0209	954	37	0.0209	946	490	0.0209	12,624	453	0.0209	11,670	377	0.0209	9,727
	Nov	322	0.0198	7,864	31	0.0198	757	26	0.0198	637	348	0.0198	8,501	317	0.0198	7,744	374	0.0198	9,132
	Dec	268	0.0187	6,182	22	0.0187	507	22	0.0187	501	290	0.0187	6,682	268	0.0187	6,175	232	0.0187	5,358
1983	Jan	167	0.0176	3,625	19	0.0176	412	14	0.0176	294	181	0.0176	3,919	162	0.0176	3,507	265	0.0176	5,763
	Feb	149	0.0165	3,033	17	0.0165	346	12	0.0165	246	161	0.0165	3,278	144	0.0165	2,932	230	0.0165	4,680
	Mar	213	0.0154	4,046	22	0.0154	418	17	0.0154	328	230	0.0154	4,374	208	0.0154	3,956	283	0.0154	5,371
	Apr	350	0.0143	6,174	29	0.0143	512	28	0.0143	500	378	0.0143	6,674	349	0.0143	6,162	289	0.0143	5,091
	May	2,961	0.0131	47,846	203	0.0131	3,280	240	0.0131	3,876	3,201	0.0131	51,721	2,998	0.0131	48,441	1,532	0.0131	24,758
	Jun	9,328	0.0141	162,234	638	0.0141	11,096	756	0.0141	13,141	10,084	0.0141	175,375	9,446	0.0141	164,279	4,764	0.0141	82,864
	Jul	1,841	0.0100	22,709	132	0.0100	1,628	149	0.0100	1,839	1,990	0.0100	24,548	1,858	0.0100	22,920	1,092	0.0100	13,468
	Aug	548	0.0176	11,897	39	0.0176	847	44	0.0176	964	592	0.0176	12,860	553	0.0176	12,014	308	0.0176	6,678
	Sep	399	0.0240	11,812	27	0.0240	799	32	0.0240	957	431	0.0240	12,769	404	0.0240	11,969	195	0.0240	5,763
WY	Total	16,999	0.0143	299,099	1,216	0.0143	21,557	1,377	0.0143	24,227	18,376	0.0143	323,327	17,160	0.0143	301,770	9,941	0.0143	178,654

Date September 25, 2006

Table A-1

Flow and Phosphorus Routing WITHOUT Narrows Project

Narrows Reservoir Site Operation

		(Franson-Noble)									(CALC.)			(Franson-Noble)			(CALC) Reach Gains Between		
		Natural Flow-Gooseberry Creek Near Fairview			Diversion by Cottonwood-Gooseberry			Other Inflow at Narrows Reservoir Site			Net Flow at Narrows Reservoir Site			Stream Flow below Narrows Reservoir Site			Narrows Reservoir Site and Lower Gooseberry Reservoir		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams
	Oct	361	0.0209	9,307	62	0.0209	1,598	29	0.0209	754	390	0.0209	10,060	328	0.0209	8,462	296	0.0209	7,625
	Nov	262	0.0198	6,399	52	0.0198	1,270	21	0.0198	518	283	0.0198	6,917	231	0.0198	5,647	289	0.0198	7,053
	Dec	313	0.0187	7,220	55	0.0187	1,269	25	0.0187	585	338	0.0187	7,805	283	0.0187	6,536	269	0.0187	6,197
1984	Jan	192	0.0176	4,168	48	0.0176	1,042	16	0.0176	338	208	0.0176	4,506	160	0.0176	3,464	321	0.0176	6,978
	Feb	171	0.0165	3,480	42	0.0165	855	14	0.0165	282	185	0.0165	3,762	143	0.0165	2,907	281	0.0165	5,722
	Mar	197	0.0154	3,742	42	0.0154	798	16	0.0154	303	213	0.0154	4,045	171	0.0154	3,247	256	0.0154	4,864
	Apr	380	0.0143	6,703	66	0.0143	1,164	31	0.0143	543	411	0.0143	7,246	345	0.0143	6,082	318	0.0143	5,613
	May	7,142	0.0131	115,405	1,215	0.0131	19,633	579	0.0131	9,348	7,721	0.0131	124,753	6,506	0.0131	105,120	5,724	0.0131	92,500
	Jun	6,656	0.0141	115,762	956	0.0141	16,627	539	0.0141	9,377	7,195	0.0141	125,139	6,239	0.0141	108,512	3,381	0.0141	58,801
	Jul	1,002	0.0110	13,596	147	0.0110	1,995	81	0.0110	1,101	1,083	0.0110	14,697	936	0.0110	12,702	544	0.0110	7,379
	Aug	443	0.0176	9,617	65	0.0176	1,411	36	0.0176	779	479	0.0176	10,396	414	0.0176	8,985	240	0.0176	5,213
	Sep	304	0.0240	9,000	44	0.0240	1,303	25	0.0240	729	329	0.0240	9,728	285	0.0240	8,426	154	0.0240	4,570
WY	Total	17,423	0.0142	304,399	2,794	0.0142	48,964	1,411	0.0142	24,656	18,834	0.0142	329,055	16,040	0.0142	250,091	12,074	0.0142	212,515
	Oct	333	0.0209	8,585	71	0.0209	1,830	27	0.0209	695	360	0.0209	9,280	289	0.0209	7,450	272	0.0209	7,013
	Nov	239	0.0198	5,837	58	0.0198	1,417	19	0.0198	473	258	0.0198	6,310	200	0.0198	4,893	258	0.0198	6,292
	Dec	268	0.0187	6,182	58	0.0187	1,338	22	0.0187	501	290	0.0187	6,682	232	0.0187	5,345	232	0.0187	5,358
1985	Jan	182	0.0176	3,951	55	0.0176	1,194	15	0.0176	320	197	0.0176	4,271	142	0.0176	3,077	298	0.0176	6,475
	Feb	146	0.0165	2,971	43	0.0165	875	12	0.0165	241	158	0.0165	3,212	115	0.0165	2,337	223	0.0165	4,542
	Mar	176	0.0154	3,343	46	0.0154	874	14	0.0154	271	190	0.0154	3,614	144	0.0154	2,740	222	0.0154	4,212
	Apr	1,675	0.0143	29,545	379	0.0143	6,685	136	0.0143	2,393	1,811	0.0143	31,938	1,432	0.0143	25,253	1,578	0.0143	27,840
	May	6,282	0.0131	101,509	1,303	0.0131	21,055	509	0.0131	8,222	6,791	0.0131	109,731	5,488	0.0131	88,676	4,862	0.0131	78,566
	Jun	1,733	0.0141	30,141	302	0.0141	5,252	140	0.0141	2,441	1,873	0.0141	32,582	1,571	0.0141	27,330	829	0.0141	14,412
	Jul	657	0.0110	8,914	115	0.0110	1,560	53	0.0110	722	710	0.0110	9,636	595	0.0110	8,076	319	0.0110	4,325
	Aug	311	0.0176	6,752	55	0.0176	1,194	25	0.0176	547	336	0.0176	7,299	281	0.0176	6,104	153	0.0176	3,317
	Sep	218	0.0240	6,454	40	0.0240	1,184	18	0.0240	523	236	0.0240	6,976	196	0.0240	5,792	118	0.0240	3,503
WY	Total	12,220	0.0142	214,184	2,525	0.0142	44,459	990	0.0142	17,349	13,210	0.0142	231,533	10,685	0.0142	187,074	9,364	0.0142	165,857
	Oct	231	0.0209	5,955	46	0.0209	1,186	19	0.0209	482	250	0.0209	6,438	204	0.0209	5,252	182	0.0209	4,699
	Nov	202	0.0198	4,933	45	0.0198	1,099	16	0.0198	400	218	0.0198	5,333	173	0.0198	4,234	207	0.0198	5,047
	Dec	196	0.0187	4,521	41	0.0187	946	16	0.0187	366	212	0.0187	4,887	171	0.0187	3,941	176	0.0187	4,063
1986	Jan	150	0.0176	3,256	41	0.0176	890	12	0.0176	264	162	0.0176	3,520	121	0.0176	2,630	227	0.0176	4,925
	Feb	151	0.0165	3,073	42	0.0165	855	12	0.0165	249	163	0.0165	3,322	121	0.0165	2,467	236	0.0165	4,799
	Mar	243	0.0154	4,616	63	0.0154	1,197	20	0.0154	374	263	0.0154	4,990	200	0.0154	3,793	333	0.0154	6,332
	Apr	1,050	0.0143	18,521	224	0.0143	3,951	85	0.0143	1,500	1,135	0.0143	20,021	911	0.0143	16,070	960	0.0143	17,091
	May	6,624	0.0131	107,035	1,315	0.0131	21,249	537	0.0131	8,670	7,161	0.0131	115,705	5,846	0.0131	94,456	5,204	0.0131	84,097
	Jun	5,312	0.0141	92,387	896	0.0141	15,583	430	0.0141	7,483	5,742	0.0141	99,871	4,846	0.0141	84,287	2,684	0.0141	46,676
	Jul	644	0.0110	8,738	107	0.0110	1,452	52	0.0110	708	696	0.0110	9,446	589	0.0110	7,994	311	0.0110	4,218
	Aug	324	0.0176	7,034	55	0.0176	1,194	26	0.0176	570	350	0.0176	7,604	295	0.0176	6,410	163	0.0176	3,533
	Sep	252	0.0240	7,460	43	0.0240	1,273	20	0.0240	604	272	0.0240	8,064	229	0.0240	6,791	133	0.0240	3,925
WY	Total	15,379	0.0141	267,531	2,918	0.0141	50,874	1,246	0.0141	21,670	16,625	0.0141	289,201	13,707	0.0141	238,326	10,824	0.0141	189,404

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Narrows Reservoir Site Operation

		(Fransson-Noble)									(CALC.)			(Fransson-Noble)			(CALC) Reach Gains Between		
		Natural Flow-Gooseberry Creek Near Fairview			Diversion by Cottonwood-Gooseberry			Other Inflow at Narrows Reservoir Site			Net Flow at Narrows Reservoir Site			Stream Flow below Narrows Reservoir Site			Narrows Reservoir Site and Lower Gooseberry Reservoir		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams
	Oct	296	0.0209	7,631	111	0.0209	2,862	24	0.0209	618	320	0.0209	8,249	209	0.0209	5,387	239	0.0209	6,162
	Nov	231	0.0198	5,642	99	0.0198	2,418	19	0.0198	457	250	0.0198	6,099	151	0.0198	3,681	247	0.0198	6,040
	Dec	170	0.0187	3,921	67	0.0187	1,545	14	0.0187	318	184	0.0187	4,239	117	0.0187	2,693	154	0.0187	3,558
1987	Jan	89	0.0176	1,932	37	0.0176	803	7	0.0176	157	96	0.0176	2,089	59	0.0176	1,285	91	0.0176	1,971
	Feb	81	0.0165	1,649	31	0.0165	631	7	0.0165	134	88	0.0165	1,782	57	0.0165	1,151	69	0.0165	1,413
	Mar	109	0.0154	2,071	45	0.0154	855	9	0.0154	168	118	0.0154	2,238	73	0.0154	1,383	110	0.0154	2,093
	Apr	1,083	0.0143	19,103	433	0.0143	7,638	88	0.0143	1,547	1,171	0.0143	20,650	738	0.0143	13,013	1,002	0.0143	17,679
	May	2,577	0.0131	41,641	783	0.0131	12,652	209	0.0131	3,373	2,786	0.0131	45,014	2,003	0.0131	32,362	1,147	0.0131	18,538
	Jun	757	0.0141	13,166	227	0.0141	3,948	61	0.0141	1,066	818	0.0141	14,232	591	0.0141	10,284	324	0.0141	5,630
	Jul	396	0.0110	5,373	115	0.0110	1,560	32	0.0110	435	428	0.0110	5,808	313	0.0110	4,248	148	0.0110	2,007
	Aug	215	0.0176	4,668	64	0.0176	1,380	17	0.0176	378	232	0.0176	5,046	168	0.0176	3,656	91	0.0176	1,967
	Sep	152	0.0240	4,500	51	0.0240	1,510	12	0.0240	364	164	0.0240	4,864	113	0.0240	3,354	91	0.0240	2,685
WY	Total	6,156	0.0147	111,295	2,063	0.0147	37,811	499	0.0147	9,015	6,655	0.0147	120,310	4,592	0.0147	82,499	3,713	0.0147	69,741
	Oct	144	0.0209	3,712	47	0.0209	1,212	12	0.0209	301	156	0.0209	4,013	109	0.0209	2,801	105	0.0209	2,716
	Nov	126	0.0198	3,077	42	0.0198	1,026	10	0.0198	249	136	0.0198	3,327	94	0.0198	2,301	99	0.0198	2,413
	Dec	99	0.0187	2,284	37	0.0187	853	8	0.0187	185	107	0.0187	2,469	70	0.0187	1,615	98	0.0187	2,260
1988	Jan	102	0.0176	2,214	41	0.0176	890	8	0.0176	179	110	0.0176	2,394	69	0.0176	1,504	119	0.0176	2,578
	Feb	98	0.0165	1,995	39	0.0165	794	8	0.0165	162	106	0.0165	2,156	67	0.0165	1,362	109	0.0165	2,220
	Mar	125	0.0154	2,374	49	0.0154	931	10	0.0154	192	135	0.0154	2,567	86	0.0154	1,636	136	0.0154	2,581
	Apr	564	0.0143	9,948	199	0.0143	3,510	46	0.0143	806	610	0.0143	10,754	411	0.0143	7,244	496	0.0143	8,754
	May	3,714	0.0131	60,013	1,132	0.0131	18,292	301	0.0131	4,861	4,015	0.0131	64,875	2,883	0.0131	46,583	2,287	0.0131	36,958
	Jun	958	0.0141	16,662	263	0.0141	4,574	78	0.0141	1,350	1,036	0.0141	18,011	773	0.0141	13,437	427	0.0141	7,433
	Jul	358	0.0110	4,857	92	0.0110	1,248	29	0.0110	393	387	0.0110	5,251	295	0.0110	4,003	123	0.0110	1,669
	Aug	209	0.0176	4,537	56	0.0176	1,216	17	0.0176	368	226	0.0176	4,905	170	0.0176	3,689	87	0.0176	1,890
	Sep	142	0.0240	4,204	43	0.0240	1,273	12	0.0240	341	154	0.0240	4,544	111	0.0240	3,271	86	0.0240	2,561
WY	Total	6,639	0.0142	115,879	2,040	0.0142	35,818	538	0.0142	9,386	7,177	0.0142	125,265	5,137	0.0142	89,446	4,173	0.0142	74,032
	Oct	153	0.0209	3,944	49	0.0209	1,263	12	0.0209	310	165	0.0209	4,264	116	0.0209	3,001	115	0.0209	2,955
	Nov	167	0.0198	4,079	59	0.0198	1,441	14	0.0198	330	181	0.0198	4,409	122	0.0198	2,968	156	0.0198	3,822
	Dec	150	0.0187	3,460	53	0.0187	1,223	12	0.0187	280	162	0.0187	3,740	109	0.0187	2,518	139	0.0187	3,203
1989	Jan	121	0.0176	2,627	51	0.0176	1,107	10	0.0176	213	131	0.0176	2,840	80	0.0176	1,732	161	0.0176	3,500
	Feb	101	0.0165	2,056	39	0.0165	794	8	0.0165	167	109	0.0165	2,222	70	0.0165	1,428	118	0.0165	2,357
	Mar	166	0.0154	3,153	67	0.0154	1,273	13	0.0154	255	179	0.0154	3,409	112	0.0154	2,136	206	0.0154	3,905
	Apr	1,312	0.0143	23,142	462	0.0143	8,149	106	0.0143	1,875	1,418	0.0143	25,017	956	0.0143	16,868	1,224	0.0143	21,585
	May	2,470	0.0131	39,912	649	0.0131	10,487	200	0.0131	3,233	2,670	0.0131	43,145	2,021	0.0131	32,658	1,039	0.0131	16,788
	Jun	763	0.0141	13,270	202	0.0141	3,513	62	0.0141	1,075	825	0.0141	14,345	623	0.0141	10,832	327	0.0141	5,691
	Jul	368	0.0110	4,993	92	0.0110	1,248	29	0.0110	393	397	0.0110	5,387	305	0.0110	4,138	131	0.0110	1,777
	Aug	180	0.0176	3,908	46	0.0176	999	15	0.0176	317	195	0.0176	4,224	149	0.0176	3,226	68	0.0176	1,485
	Sep	161	0.0240	4,766	47	0.0240	1,391	13	0.0240	386	174	0.0240	5,152	127	0.0240	3,761	94	0.0240	2,782
WY	Total	6,112	0.0145	109,310	1,816	0.0145	32,888	494	0.0145	8,843	6,606	0.0145	118,153	4,790	0.0145	85,265	3,776	0.0145	69,848

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Flow and Phosphorus Routing WITHOUT Narrows Project

Narrows Reservoir Site Operation

		Natural Flow-Gooseberry Creek Near Fairview			(Franson-Noble) Diversion by Cottonwood-Gooseberry			Other Inflow at Narrows Reservoir Site			(CALC) Net Flow at Narrows Reservoir Site			(Franson-Noble) Stream Flow below Narrows Reservoir Site			(CALC) Reach Gains Between Narrows Reservoir Site and Lower Gooseberry Reservoir		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams
	Oct	132	0.0209	3,401	59	0.0209	1,532	11	0.0209	275	143	0.0209	3,676	83	0.0209	2,144	95	0.0209	2,460
	Nov	230	0.0198	5,628	72	0.0198	1,747	19	0.0198	456	249	0.0198	6,084	178	0.0198	4,337	245	0.0198	5,992
	Dec	114	0.0187	2,632	64	0.0187	1,472	9	0.0187	213	123	0.0187	2,845	60	0.0187	1,374	110	0.0187	2,534
1990	Jan	101	0.0176	2,185	62	0.0176	1,346	8	0.0176	177	109	0.0176	2,361	47	0.0176	1,016	117	0.0176	2,542
	Feb	97	0.0165	1,970	48	0.0165	974	8	0.0165	160	105	0.0165	2,130	57	0.0165	1,156	106	0.0165	2,161
	Mar	128	0.0154	2,424	82	0.0154	1,554	10	0.0154	196	138	0.0154	2,621	56	0.0154	1,067	141	0.0154	2,676
	Apr	1,120	0.0143	19,751	561	0.0143	9,892	91	0.0143	1,600	1,210	0.0143	21,351	650	0.0143	11,460	1,037	0.0143	18,296
	May	2,564	0.0131	41,432	787	0.0131	12,719	208	0.0131	3,356	2,772	0.0131	44,787	1,985	0.0131	32,068	1,134	0.0131	18,317
	Jun	913	0.0230	25,895	244	0.0230	6,933	74	0.0230	2,098	987	0.0230	27,993	742	0.0230	21,060	404	0.0230	11,464
	Jul	401	0.0110	5,439	112	0.0110	1,522	32	0.0110	441	433	0.0110	5,879	321	0.0110	4,358	151	0.0110	2,055
	Aug	174	0.0280	6,020	56	0.0280	1,928	14	0.0280	488	188	0.0280	6,507	133	0.0280	4,579	64	0.0280	2,226
	Sep	127	0.0240	3,747	57	0.0240	1,683	10	0.0240	303	137	0.0240	4,050	80	0.0240	2,367	80	0.0240	2,363
WY	Total	6,100	0.0160	120,524	2,204	0.0160	43,301	494	0.0160	9,762	6,594	0.0160	130,286	4,390	0.0160	86,986	3,685	0.0160	73,087
	Oct	150	0.0209	3,878	70	0.0209	1,801	12	0.0209	314	163	0.0209	4,192	93	0.0209	2,391	112	0.0209	2,879
	Nov	144	0.0198	3,509	165	0.0198	4,040	12	0.0198	284	155	0.0198	3,793	-10	0.0198	-247	124	0.0198	3,033
	Dec	120	0.0187	2,760	66	0.0187	1,528	10	0.0187	224	129	0.0187	2,984	63	0.0187	1,456	114	0.0187	2,636
1991	Jan	106	0.0176	2,298	64	0.0176	1,392	9	0.0176	186	114	0.0176	2,485	50	0.0176	1,093	129	0.0176	2,798
	Feb	104	0.0165	2,116	64	0.0165	1,298	8	0.0165	171	112	0.0165	2,288	49	0.0165	990	123	0.0165	2,508
	Mar	125	0.0154	2,383	77	0.0154	1,464	10	0.0154	193	136	0.0154	2,576	59	0.0154	1,112	137	0.0154	2,607
	Apr	504	0.0143	8,889	660	0.0143	11,639	41	0.0143	720	545	0.0143	9,609	-115	0.0143	-2,030	438	0.0143	7,730
	May	3,864	0.0131	62,444	1,220	0.0131	19,708	313	0.0131	5,058	4,177	0.0131	67,502	2,958	0.0131	47,794	2,438	0.0131	39,387
	Jun	2,537	0.0190	59,463	448	0.0190	10,509	206	0.0190	4,816	2,743	0.0190	64,279	2,294	0.0190	53,770	1,246	0.0190	29,200
	Jul	567	0.0110	7,688	185	0.0110	2,508	46	0.0110	623	613	0.0110	8,311	428	0.0110	5,803	260	0.0110	3,525
	Aug	296	0.0050	1,824	77	0.0050	475	24	0.0050	148	320	0.0050	1,971	243	0.0050	1,496	144	0.0050	885
	Sep	249	0.0240	7,374	62	0.0240	1,850	20	0.0240	597	269	0.0240	7,972	207	0.0240	6,122	131	0.0240	3,884
WY	Total	8,766	0.0152	164,627	3,159	0.0152	58,213	710	0.0152	13,335	9,476	0.0152	177,962	6,317	0.0152	119,749	5,396	0.0152	101,071
	Oct	154	0.0400	7,619	24	0.0400	1,199	13	0.0400	617	167	0.0400	8,236	143	0.0400	7,037	115	0.0400	5,682
	Nov	145	0.0198	3,534	14	0.0198	331	12	0.0198	286	156	0.0198	3,820	143	0.0198	3,489	126	0.0198	3,068
	Dec	124	0.0187	2,854	21	0.0187	486	10	0.0187	231	134	0.0187	3,085	113	0.0187	2,599	118	0.0187	2,711
1992	Jan	90	0.0176	1,951	21	0.0176	462	7	0.0176	158	97	0.0176	2,109	76	0.0176	1,646	93	0.0176	2,018
	Feb	82	0.0165	1,660	20	0.0165	416	7	0.0165	134	88	0.0165	1,795	68	0.0165	1,379	70	0.0165	1,426
	Mar	141	0.0154	2,682	23	0.0154	442	11	0.0154	217	153	0.0154	2,900	129	0.0154	2,457	163	0.0154	3,104
	Apr	741	0.0143	13,071	38	0.0143	677	60	0.0143	1,059	801	0.0143	14,130	763	0.0143	13,453	669	0.0143	11,798
	May	1,705	0.0131	27,544	641	0.0131	10,362	138	0.0131	2,231	1,843	0.0131	29,775	1,201	0.0131	19,413	272	0.0131	4,391
	Jun	654	0.0090	7,255	421	0.0090	4,671	53	0.0090	588	706	0.0090	7,842	286	0.0090	3,171	270	0.0090	2,994
	Jul	263	0.0110	3,568	82	0.0110	1,109	21	0.0110	289	284	0.0110	3,857	203	0.0110	2,748	61	0.0110	833
	Aug	136	0.0210	3,513	46	0.0210	1,189	11	0.0210	285	147	0.0210	3,797	101	0.0210	2,609	39	0.0210	1,016
	Sep	118	0.0240	3,488	40	0.0240	1,189	10	0.0240	283	127	0.0240	3,771	87	0.0240	2,581	76	0.0240	2,254
WY	Total	4,351	0.0147	78,739	1,392	0.0147	22,534	332	0.0147	6,378	4,703	0.0147	85,117	3,311	0.0147	62,583	2,072	0.0147	41,296

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Flow and Phosphorus Routing WITHOUT Narrows Project
Narrows Reservoir Site Operation

		(Fransen-Noble) Natural Flow-Gooseberry Creek Near Fairview			(Fransen-Noble) Diversion by Cottonwood-Gooseberry			(Fransen-Noble) Other Inflow at Narrows Reservoir Site			(CALC) Net Flow at Narrows Reservoir Site			(Fransen-Noble) Stream Flow below Narrows Reservoir Site			(CALC) Reach Gains Between Narrows Reservoir Site and Lower Gooseberry Reservoir		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams
	Oct	235	0.0209	6,063	195	0.0209	5,036	19	0.0209	491	254	0.0209	6,554	59	0.0209	1,518	186	0.0209	4,795
	Nov	176	0.0198	4,305	203	0.0198	4,969	14	0.0198	349	191	0.0198	4,654	-13	0.0198	-315	170	0.0198	4,145
	Dec	160	0.0187	3,689	174	0.0187	4,023	13	0.0187	299	173	0.0187	3,987	-2	0.0187	-36	146	0.0187	3,377
1993	Jan	127	0.0176	2,755	128	0.0176	2,777	10	0.0176	223	137	0.0176	2,978	9	0.0176	202	176	0.0176	3,823
	Feb	127	0.0165	2,575	104	0.0165	2,125	10	0.0165	209	137	0.0165	2,784	32	0.0165	658	177	0.0165	3,596
	Mar	234	0.0154	4,454	222	0.0154	4,214	19	0.0154	361	253	0.0154	4,814	32	0.0154	600	318	0.0154	6,046
	Apr	993	0.0143	17,518	1,085	0.0143	19,134	80	0.0143	1,419	1,074	0.0143	18,937	-11	0.0143	-197	914	0.0143	16,123
	May	5,968	0.0131	96,436	1,116	0.0131	18,037	483	0.0131	7,811	6,451	0.0131	104,247	5,335	0.0131	86,210	4,547	0.0131	73,473
	Jun	2,602	0.0150	48,137	421	0.0150	7,787	211	0.0150	3,899	2,812	0.0150	52,036	2,392	0.0150	44,250	1,279	0.0150	23,671
	Jul	632	0.0110	8,575	200	0.0110	2,714	51	0.0110	695	683	0.0110	9,270	483	0.0110	6,556	302	0.0110	4,104
	Aug	305	0.0050	1,883	106	0.0050	654	25	0.0050	153	330	0.0050	2,036	224	0.0050	1,382	150	0.0050	924
	Sep	226	0.0240	6,685	124	0.0240	3,664	18	0.0240	541	244	0.0240	7,226	120	0.0240	3,562	121	0.0240	3,595
WY	Total	11,785	0.0140	203,075	4,079	0.0140	75,135	955	0.0140	16,449	12,740	0.0140	219,524	8,661	0.0140	144,389	8,487	0.0140	147,672
	Oct	180	0.0209	4,708	27	0.0209	689	15	0.0209	381	197	0.0209	5,089	171	0.0209	4,400	140	0.0209	3,607
	Nov	142	0.0198	3,470	17	0.0198	418	12	0.0198	281	154	0.0198	3,751	136	0.0198	3,333	122	0.0198	2,978
	Dec	134	0.0187	3,083	16	0.0187	365	11	0.0187	250	144	0.0187	3,333	129	0.0187	2,968	125	0.0187	2,894
1994	Jan	99	0.0176	2,140	20	0.0176	439	8	0.0176	173	107	0.0176	2,314	86	0.0176	1,874	113	0.0176	2,443
	Feb	94	0.0165	1,908	23	0.0165	464	8	0.0165	155	101	0.0165	2,062	79	0.0165	1,598	99	0.0165	2,013
	Mar	129	0.0154	2,445	38	0.0154	725	10	0.0154	198	139	0.0154	2,644	101	0.0154	1,918	143	0.0154	2,711
	Apr	652	0.0143	11,496	99	0.0143	1,758	53	0.0143	931	705	0.0143	12,427	606	0.0143	10,689	582	0.0143	10,266
	May	3,411	0.0131	55,114	1,079	0.0131	17,428	276	0.0131	4,464	3,687	0.0131	59,579	2,609	0.0131	42,151	1,983	0.0131	32,037
	Jun	936	0.0141	16,282	401	0.0141	6,968	76	0.0141	1,319	1,012	0.0141	17,601	611	0.0141	10,633	416	0.0141	7,239
	Jul	294	0.0190	6,881	86	0.0190	2,010	24	0.0190	557	317	0.0190	7,438	232	0.0190	5,429	81	0.0190	1,908
	Aug	206	0.0220	5,581	41	0.0220	1,107	17	0.0220	452	222	0.0220	6,033	182	0.0220	4,926	85	0.0220	2,303
	Sep	162	0.0240	4,787	26	0.0240	781	13	0.0240	388	175	0.0240	5,174	148	0.0240	4,393	95	0.0240	2,799
WY	Total	6,439	0.0148	117,895	1,872	0.0148	33,132	522	0.0148	9,550	6,961	0.0148	127,445	5,089	0.0148	94,312	3,981	0.0148	73,197
	Oct	217	0.0209	5,587	76	0.0209	1,968	18	0.0209	453	234	0.0209	6,040	158	0.0209	4,072	170	0.0209	4,375
	Nov	148	0.0198	3,617	64	0.0198	1,351	12	0.0198	293	160	0.0198	3,910	97	0.0198	2,358	130	0.0198	3,183
	Dec	154	0.0187	3,550	62	0.0187	1,441	12	0.0187	288	166	0.0187	3,838	104	0.0187	2,397	142	0.0187	3,266
1995	Jan	121	0.0176	2,628	49	0.0176	1,061	10	0.0176	213	131	0.0176	2,841	82	0.0176	1,780	163	0.0176	3,537
	Feb	113	0.0165	2,298	44	0.0165	888	9	0.0165	186	122	0.0165	2,484	78	0.0165	1,597	144	0.0165	2,939
	Mar	196	0.0154	3,723	60	0.0154	1,138	16	0.0154	302	212	0.0154	4,024	152	0.0154	2,886	254	0.0154	4,832
	Apr	570	0.0143	10,046	292	0.0143	5,151	46	0.0143	814	616	0.0143	10,860	324	0.0143	5,709	502	0.0143	8,855
	May	4,413	0.0131	71,304	1,129	0.0131	18,235	357	0.0131	5,776	4,770	0.0131	77,080	3,642	0.0131	58,845	2,987	0.0131	48,272
	Jun	6,590	0.0141	114,608	253	0.0141	4,393	534	0.0141	9,283	7,123	0.0141	123,891	6,871	0.0141	119,498	3,346	0.0141	58,195
	Jul	1,329	0.0050	8,197	77	0.0050	475	108	0.0050	664	1,437	0.0050	8,861	1,360	0.0050	8,386	758	0.0050	4,674
	Aug	513	0.0176	11,127	65	0.0176	1,421	42	0.0176	901	554	0.0176	12,028	489	0.0176	10,607	285	0.0176	6,183
	Sep	284	0.0240	8,398	60	0.0240	1,768	23	0.0240	680	307	0.0240	9,078	247	0.0240	7,310	146	0.0240	4,313
WY	Total	14,646	0.0136	245,082	2,230	0.0136	39,489	1,186	0.0136	19,852	15,832	0.0136	264,934	13,602	0.0136	225,445	9,027	0.0136	152,628

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Flow and Phosphorus Routing WITHOUT Narrows Project

Narrows Reservoir Site Operation

		(Franson-Noble) Natural Flow-Gooseberry Creek Near Fairview			(Franson-Noble) Diversion by Cottonwood-Gooseberry			(Franson-Noble) Other Inflow at Narrows Reservoir Site			(CALC) Net Flow at Narrows Reservoir Site			(Franson-Noble) Stream Flow below Narrows Reservoir Site			(CALC) Reach Gains Between Narrows Reservoir Site and Lower Gooseberry Reservoir		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams
	Oct	179	0.0050	1,106	37	0.0050	231	15	0.0050	90	194	0.0050	1,195	156	0.0050	965	137	0.0050	845
	Nov	162	0.0198	3,960	26	0.0198	632	13	0.0198	321	175	0.0198	4,281	149	0.0198	3,649	150	0.0198	3,663
	Dec	140	0.0187	3,225	28	0.0187	646	11	0.0187	261	151	0.0187	3,486	123	0.0187	2,840	130	0.0187	3,007
1996	Jan	92	0.0176	1,990	28	0.0176	606	7	0.0176	161	99	0.0176	2,151	71	0.0176	1,545	97	0.0176	2,106
	Feb	99	0.0165	2,021	25	0.0165	517	8	0.0165	164	107	0.0165	2,185	82	0.0165	1,668	112	0.0165	2,282
	Mar	140	0.0154	2,668	46	0.0154	880	11	0.0154	216	152	0.0154	2,894	105	0.0154	2,004	162	0.0154	3,080
	Apr	427	0.0143	7,531	94	0.0143	1,661	35	0.0143	610	462	0.0143	8,140	367	0.0143	6,480	363	0.0143	6,408
	May	5,177	0.0131	83,647	756	0.0131	12,216	419	0.0131	6,775	5,596	0.0131	90,422	4,840	0.0131	78,206	3,753	0.0131	60,649
	Jun	2,465	0.0120	36,492	1,165	0.0120	17,247	200	0.0120	2,956	2,665	0.0120	39,448	1,500	0.0120	22,202	1,209	0.0120	17,891
	Jul	519	0.0110	7,037	242	0.0110	3,277	42	0.0110	570	561	0.0110	7,607	319	0.0110	4,330	228	0.0110	3,099
	Aug	206	0.0250	6,344	88	0.0250	2,720	17	0.0250	514	222	0.0250	6,858	134	0.0250	4,138	85	0.0250	2,619
	Sep	142	0.0240	4,200	45	0.0240	1,326	11	0.0240	340	153	0.0240	4,540	109	0.0240	3,215	86	0.0240	2,553
WY	Total	9,748	0.0133	160,221	2,581	0.0133	41,958	790	0.0133	12,978	10,537	0.0133	173,199	7,957	0.0133	131,241	6,513	0.0133	108,202
	Oct	144	0.0209	3,722	37	0.0209	958	12	0.0209	301	156	0.0209	4,023	119	0.0209	3,065	106	0.0209	2,742
	Nov	167	0.0198	4,090	38	0.0198	926	14	0.0198	331	181	0.0198	4,422	143	0.0198	3,496	157	0.0198	3,845
	Dec	147	0.0187	3,396	32	0.0187	741	12	0.0187	275	159	0.0187	3,671	127	0.0187	2,930	136	0.0187	3,143
1997	Jan	116	0.0176	2,520	21	0.0176	463	9	0.0176	204	125	0.0176	2,724	104	0.0176	2,262	152	0.0176	3,295
	Feb	114	0.0165	2,317	25	0.0165	500	9	0.0165	188	123	0.0165	2,505	98	0.0165	2,004	147	0.0165	2,983
	Mar	166	0.0154	3,151	34	0.0154	644	13	0.0154	255	179	0.0154	3,407	145	0.0154	2,763	204	0.0154	3,883
	Apr	634	0.0143	11,190	93	0.0143	1,633	51	0.0143	906	686	0.0143	12,096	593	0.0143	10,464	565	0.0143	9,968
	May	7,428	0.0131	120,020	1,089	0.0131	17,591	602	0.0131	9,722	8,029	0.0131	129,742	6,941	0.0131	112,151	6,011	0.0131	97,123
	Jun	3,025	0.0141	52,608	343	0.0141	5,968	245	0.0141	4,261	3,270	0.0141	56,869	2,927	0.0141	50,901	1,499	0.0141	26,064
	Jul	543	0.0110	7,361	69	0.0110	941	44	0.0110	596	586	0.0110	7,957	517	0.0110	7,016	244	0.0110	3,311
	Aug	248	0.0176	5,394	28	0.0176	603	20	0.0176	437	269	0.0176	5,830	241	0.0176	5,228	113	0.0176	2,448
	Sep	255	0.0240	7,542	25	0.0240	731	21	0.0240	611	275	0.0240	8,153	251	0.0240	7,423	134	0.0240	3,955
WY	Total	12,987	0.0139	223,312	1,833	0.0139	31,698	1,052	0.0139	18,088	14,039	0.0139	241,400	12,206	0.0139	209,702	9,467	0.0139	162,760
	Oct	210	0.0209	5,404	19	0.0209	485	17	0.0209	438	227	0.0209	5,841	208	0.0209	5,356	164	0.0209	4,217
	Nov	170	0.0198	4,146	25	0.0198	613	14	0.0198	336	183	0.0198	4,481	158	0.0198	3,868	161	0.0198	3,922
	Dec	168	0.0187	3,875	22	0.0187	507	14	0.0187	314	182	0.0187	4,188	160	0.0187	3,681	153	0.0187	3,525
1998	Jan	130	0.0176	2,813	21	0.0176	464	10	0.0176	228	140	0.0176	3,041	119	0.0176	2,577	182	0.0176	3,952
	Feb	140	0.0165	2,851	20	0.0165	416	11	0.0165	231	151	0.0165	3,082	131	0.0165	2,666	209	0.0165	4,251
	Mar	204	0.0154	3,867	29	0.0154	555	16	0.0154	313	220	0.0154	4,181	191	0.0154	3,626	267	0.0154	5,072
	Apr	642	0.0143	11,328	97	0.0143	1,706	52	0.0143	918	694	0.0143	12,245	597	0.0143	10,539	573	0.0143	10,102
	May	4,626	0.0131	74,747	1,081	0.0131	17,474	375	0.0131	6,054	5,000	0.0131	80,801	3,919	0.0131	63,327	3,201	0.0131	51,724
	Jun	2,818	0.0100	34,765	370	0.0100	4,558	228	0.0100	2,816	3,047	0.0100	37,581	2,677	0.0100	33,023	1,392	0.0100	17,166
	Jul	759	0.0110	10,293	64	0.0110	862	61	0.0110	834	820	0.0110	11,127	756	0.0110	10,264	385	0.0110	5,226
	Aug	337	0.0176	7,323	30	0.0176	641	27	0.0176	593	365	0.0176	7,916	335	0.0176	7,275	171	0.0176	3,705
	Sep	240	0.0150	4,446	32	0.0150	594	19	0.0150	360	260	0.0150	4,807	228	0.0150	4,213	128	0.0150	2,359
WY	Total	10,443	0.0129	165,857	1,810	0.0129	28,875	946	0.0129	13,434	11,289	0.0129	179,291	9,479	0.0129	150,416	6,984	0.0129	115,222

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Narrows Reservoir Site Operation

		(Franson-Noble) Natural Flow-Gooseberry Creek Near Fairview			(Franson-Noble) Diversion by Cottonwood-Gooseberry			(Franson-Noble) Other Inflow at Narrows Reservoir Site			(CALC) Net Flow at Narrows Reservoir Site			(Franson-Noble) Stream Flow below Narrows Reservoir Site			(CALC) Reach Gains Between Narrows Reservoir Site and Lower Gooseberry Reservoir		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams
	Oct	197	0.0209	5,084	33	0.0209	855	16	0.0209	412	213	0.0209	5,495	180	0.0209	4,640	153	0.0209	3,936
	Nov	167	0.0198	4,079	28	0.0198	696	14	0.0198	330	181	0.0198	4,410	152	0.0198	3,714	157	0.0198	3,830
	Dec	85	0.0187	1,966	28	0.0187	644	7	0.0187	159	92	0.0187	2,125	64	0.0187	1,481	87	0.0187	2,002
1999	Jan	67	0.0176	1,458	27	0.0176	583	5	0.0176	118	73	0.0176	1,576	46	0.0176	993	42	0.0176	913
	Feb	85	0.0165	1,737	30	0.0165	618	7	0.0165	141	92	0.0165	1,877	62	0.0165	1,259	79	0.0165	1,607
	Mar	127	0.0154	2,413	41	0.0154	777	10	0.0154	195	137	0.0154	2,609	96	0.0154	1,832	140	0.0154	2,657
	Apr	339	0.0143	5,977	105	0.0143	1,844	27	0.0143	484	366	0.0143	6,461	262	0.0143	4,617	278	0.0143	4,896
	May	3,776	0.0131	61,012	636	0.0131	10,277	306	0.0131	4,942	4,082	0.0131	65,954	3,446	0.0131	55,677	2,349	0.0131	37,951
	Jun	2,882	0.0230	81,749	363	0.0230	10,311	233	0.0230	6,622	3,115	0.0230	88,371	2,751	0.0230	78,059	1,424	0.0230	40,410
	Jul	618	0.0110	8,385	102	0.0110	1,384	50	0.0110	679	668	0.0110	9,064	566	0.0110	7,680	293	0.0110	3,980
	Aug	416	0.0250	12,822	45	0.0250	1,393	34	0.0250	1,039	449	0.0250	13,861	404	0.0250	12,467	222	0.0250	6,839
	Sep	293	0.0240	8,678	32	0.0240	939	24	0.0240	703	317	0.0240	9,381	285	0.0240	8,441	150	0.0240	4,431
WY	Total	9,052	0.0175	195,359	1,471	0.0175	30,321	733	0.0175	15,824	9,785	0.0175	211,183	8,315	0.0175	180,861	5,372	0.0175	113,451
	Oct	158	0.0209	4,077	41	0.0209	1,053	13	0.0209	330	171	0.0209	4,408	130	0.0209	3,355	118	0.0209	3,058
	Nov	139	0.0198	3,394	38	0.0198	926	11	0.0198	275	150	0.0198	3,669	112	0.0198	2,742	118	0.0198	2,872
	Dec	94	0.0187	2,159	19	0.0187	428	8	0.0187	175	101	0.0187	2,334	83	0.0187	1,907	93	0.0187	2,157
2000	Jan	82	0.0176	1,790	11	0.0176	234	7	0.0176	145	89	0.0176	1,935	78	0.0176	1,701	76	0.0176	1,657
	Feb	80	0.0165	1,635	17	0.0165	352	7	0.0165	132	87	0.0165	1,767	70	0.0165	1,416	67	0.0165	1,366
	Mar	123	0.0154	2,331	29	0.0154	551	10	0.0154	189	133	0.0154	2,520	104	0.0154	1,969	133	0.0154	2,520
	Apr	821	0.0143	14,484	66	0.0143	1,168	67	0.0143	1,173	888	0.0143	15,657	821	0.0143	14,489	747	0.0143	13,172
	May	3,179	0.0131	51,363	711	0.0131	11,496	257	0.0131	4,160	3,436	0.0131	55,524	2,725	0.0131	44,028	1,750	0.0131	28,276
	Jun	1,040	0.0100	12,825	513	0.0100	6,324	84	0.0100	1,039	1,124	0.0100	13,864	611	0.0100	7,539	470	0.0100	5,796
	Jul	322	0.0110	4,364	106	0.0110	1,432	26	0.0110	353	348	0.0110	4,717	242	0.0110	3,286	100	0.0110	1,353
	Aug	196	0.0180	4,360	77	0.0180	1,707	16	0.0180	353	212	0.0180	4,713	135	0.0180	3,006	79	0.0180	1,750
	Sep	150	0.0240	4,429	53	0.0240	1,580	12	0.0240	359	162	0.0240	4,787	108	0.0240	3,207	89	0.0240	2,649
WY	Total	6,383	0.0136	107,211	1,681	0.0136	27,252	517	0.0136	8,684	6,900	0.0136	115,895	5,220	0.0136	88,643	3,840	0.0136	66,621
	Oct	153	0.0209	3,956	49	0.0209	1,259	12	0.0209	320	166	0.0209	4,277	117	0.0209	3,018	114	0.0209	2,948
	Nov	127	0.0198	3,090	45	0.0198	1,103	10	0.0198	250	137	0.0198	3,341	92	0.0198	2,228	100	0.0198	2,448
	Dec	38	0.0187	887	35	0.0187	798	3	0.0187	72	42	0.0187	959	7	0.0187	161	49	0.0187	1,142
2001	Jan	46	0.0176	996	30	0.0176	660	4	0.0176	81	50	0.0176	1,077	19	0.0176	417	-6	0.0176	-124
	Feb	58	0.0165	1,180	27	0.0165	546	5	0.0165	96	63	0.0165	1,279	36	0.0165	733	14	0.0165	294
	Mar	131	0.0154	2,494	46	0.0154	882	11	0.0154	202	142	0.0154	2,696	96	0.0154	1,814	147	0.0154	2,791
	Apr	907	0.0143	15,999	308	0.0143	5,434	73	0.0143	1,296	981	0.0143	17,295	672	0.0143	11,862	830	0.0143	14,646
	May	3,624	0.0131	58,565	879	0.0131	14,205	294	0.0131	4,744	3,918	0.0131	63,309	3,039	0.0131	49,105	2,197	0.0131	35,497
	Jun	696	0.0100	8,584	212	0.0100	2,620	56	0.0100	695	752	0.0100	9,279	540	0.0100	6,660	292	0.0100	3,598
	Jul	277	0.0110	3,757	67	0.0110	911	22	0.0110	304	299	0.0110	4,061	232	0.0110	3,150	70	0.0110	955
	Aug	184	0.0100	2,273	42	0.0100	519	15	0.0100	184	199	0.0100	2,459	157	0.0100	1,940	71	0.0100	876
	Sep	110	0.0240	3,263	39	0.0240	1,150	9	0.0240	264	119	0.0240	3,527	80	0.0240	2,377	73	0.0240	2,160
WY	Total	6,353	0.0134	105,050	1,780	0.0134	30,085	315	0.0134	8,509	6,867	0.0134	113,559	5,087	0.0134	83,474	3,953	0.0134	67,233

Table A-1

Date September 25, 2006

Flow and Phosphorus Routing WITHOUT Narrows Project

Narrows Reservoir Site Operation

		(Fransen-Noble)									(CALC)			(Fransen-Noble)			(CALC) Reach Gain Between		
		Natural Flow-Gooseberry Creek Near Fairview			Diversion by Cottonwood-Gooseberry			Other Inflow at Narrows Reservoir Site			Net Flow at Narrows Reservoir Site			Stream Flow below Narrows Reservoir Site			Narrows Reservoir Site and Lower Gooseberry Reservoir		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams
	Oct	92	0.0209	2,384	28	0.0209	712	7	0.0209	193	100	0.0209	2,577	72	0.0209	1,865	61	0.0209	1,560
	Nov	121	0.0198	2,953	23	0.0198	559	10	0.0198	239	131	0.0198	3,192	108	0.0198	2,633	92	0.0198	2,256
	Dec	79	0.0187	1,834	7	0.0187	155	6	0.0187	149	86	0.0187	1,982	79	0.0187	1,827	82	0.0187	1,897
2002	Jan	56	0.0176	1,209	2	0.0176	35	5	0.0176	98	60	0.0176	1,307	59	0.0176	1,272	16	0.0176	354
	Feb	46	0.0165	936	6	0.0165	123	4	0.0165	76	50	0.0165	1,012	44	0.0165	890	-14	0.0165	-292
	Mar	58	0.0154	1,097	29	0.0154	550	5	0.0154	89	62	0.0154	1,186	34	0.0154	636	25	0.0154	471
	Apr	740	0.0143	13,057	179	0.0143	3,163	60	0.0143	1,058	800	0.0143	14,115	621	0.0143	10,952	668	0.0143	11,784
	May	2,448	0.0131	39,554	625	0.0131	10,096	198	0.0131	3,204	2,646	0.0131	42,757	2,021	0.0131	32,662	1,017	0.0131	16,433
	Jun	503	0.0141	8,741	99	0.0141	1,726	41	0.0141	708	543	0.0141	9,449	444	0.0141	7,723	192	0.0141	3,331
	Jul	232	0.0110	3,149	36	0.0110	490	19	0.0110	255	251	0.0110	3,404	215	0.0110	2,914	41	0.0110	559
	Aug	114	0.0176	2,464	27	0.0176	592	9	0.0176	200	123	0.0176	2,664	95	0.0176	2,072	25	0.0176	539
	Sep	104	0.0240	3,080	18	0.0240	541	8	0.0240	249	112	0.0240	3,329	94	0.0240	2,788	70	0.0240	2,083
WY	Total	4,593	0.0142	80,458	1,079	0.0142	18,741	372	0.0142	6,517	4,965	0.0142	86,975	3,886	0.0142	68,234	2,275	0.0142	40,985
	Oct	60	0.0209	1,538	58	0.0209	1,483	5	0.0209	125	64	0.0209	1,663	7	0.0209	180	180	0.0209	4,631
	Nov	53	0.0198	1,293	48	0.0198	1,165	4	0.0198	105	57	0.0198	1,398	10	0.0198	233	115	0.0198	2,814
	Dec	14	0.0187	323	14	0.0187	324	1	0.0187	26	15	0.0187	349	1	0.0187	25	26	0.0187	592
2003	Jan	45	0.0176	968	3	0.0176	73	4	0.0176	78	48	0.0176	1,046	45	0.0176	974	9	0.0176	194
	Feb	52	0.0165	1,055	13	0.0165	255	4	0.0165	85	56	0.0165	1,141	43	0.0165	885	54	0.0165	1,089
	Mar	60	0.0154	1,140	60	0.0154	1,145	5	0.0154	92	65	0.0154	1,232	5	0.0154	87	130	0.0154	2,478
	Apr	374	0.0143	6,597	374	0.0143	6,590	30	0.0143	534	404	0.0143	7,131	31	0.0143	541	712	0.0143	12,556
	May	2,638	0.0131	42,626	1,302	0.0131	21,033	214	0.0131	3,453	2,852	0.0131	46,079	1,550	0.0131	25,046	4,355	0.0131	70,367
	Jun	704	0.0180	15,623	207	0.0180	4,590	57	0.0180	1,265	761	0.0180	16,888	554	0.0180	12,298	1,163	0.0180	25,817
	Jul	169	0.0173	3,615	75	0.0173	1,605	14	0.0173	293	183	0.0173	3,908	108	0.0173	2,303	245	0.0173	5,229
	Aug	125	0.0160	2,473	57	0.0160	1,120	10	0.0160	200	135	0.0160	2,673	79	0.0160	1,553	155	0.0160	3,051
	Sep	61	0.0240	1,815	38	0.0240	1,128	5	0.0240	147	66	0.0240	1,963	28	0.0240	835	139	0.0240	4,124
WY	Total	4,355	0.0147	79,067	2,248	0.0147	40,512	353	0.0147	6,404	4,707	0.0147	85,471	2,460	0.0147	44,950	7,282	0.0147	132,940
	Oct	37	0.0209	954	37	0.0209	948	3	0.0209	77	40	0.0209	1,031	3	0.0209	83	113	0.0209	2,965
	Nov	75	0.0198	1,836	30	0.0198	744	6	0.0198	149	81	0.0198	1,985	51	0.0198	1,240	122	0.0198	2,983
	Dec	51	0.0187	1,186	9	0.0187	207	4	0.0187	86	56	0.0187	1,282	47	0.0187	1,075	86	0.0187	1,994
2004	Jan	60	0.0176	1,312	2	0.0176	47	5	0.0176	106	65	0.0176	1,419	63	0.0176	1,372	73	0.0176	1,582
	Feb	62	0.0165	1,257	8	0.0165	163	5	0.0165	102	67	0.0165	1,359	59	0.0165	1,106	86	0.0165	1,749
	Mar	87	0.0154	1,644	39	0.0154	732	7	0.0154	131	94	0.0154	1,777	55	0.0154	1,046	198	0.0154	3,768
	Apr	674	0.0143	11,894	239	0.0143	4,211	55	0.0143	963	729	0.0143	12,859	490	0.0143	8,647	1,193	0.0143	21,050
	May	1,854	0.0131	29,956	832	0.0131	13,440	150	0.0131	2,426	2,004	0.0131	32,382	1,172	0.0131	18,942	2,558	0.0131	41,333
	Jun	377	0.0195	9,076	132	0.0195	3,178	31	0.0195	735	408	0.0195	9,811	276	0.0195	6,633	840	0.0195	20,203
	Jul	169	0.0173	3,608	48	0.0173	1,026	14	0.0173	292	183	0.0173	3,900	135	0.0173	2,874	190	0.0173	4,058
	Aug	111	0.0211	2,890	36	0.0211	944	9	0.0211	234	120	0.0211	3,124	84	0.0211	2,180	81	0.0211	2,121
	Sep	52	0.0240	1,552	24	0.0240	721	4	0.0240	126	57	0.0240	1,678	32	0.0240	957	105	0.0240	3,098
WY	Total	3,610	0.0151	67,166	1,436	0.0151	26,360	292	0.0151	5,440	3,903	0.0151	72,606	2,467	0.0151	46,247	5,648	0.0151	106,903

Date September 25, 2006

Table A-1

Flow and Phosphorus Routing WITHOUT Narrows Project
Narrows Reservoir Site Operation

		(Frasson-Noble)									(CALC.)			(Frasson-Noble)			(CALC) Reach Gains Between		
		Natural Flow-Gooseberry Creek Near Fairview			Diversion by Cottonwood-Gooseberry			Other Inflow at Narrows Reservoir Site			Net Flow at Narrows Reservoir Site			Stream Flow below Narrows Reservoir Site			Narrows Reservoir Site and Lower Gooseberry Reservoir		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams
	Oct	84	0.0209	2,154	55	0.0209	1,414	7	0.0209	174	90	0.0209	2,329	35	0.0209	914	196	0.0209	5,059
	Nov	67	0.0198	1,642	45	0.0198	1,111	5	0.0198	133	73	0.0198	1,775	27	0.0198	664	137	0.0198	3,355
	Dec	52	0.0187	1,193	13	0.0187	309	4	0.0187	97	56	0.0187	1,290	43	0.0187	981	96	0.0187	2,207
2005	Jan	61	0.0176	1,321	3	0.0176	70	5	0.0176	107	66	0.0176	1,428	63	0.0176	1,359	77	0.0176	1,664
	Feb	61	0.0165	1,251	12	0.0165	243	5	0.0165	101	66	0.0165	1,353	54	0.0165	1,109	91	0.0165	1,886
	Mar	66	0.0154	1,251	57	0.0154	1,092	5	0.0154	101	71	0.0154	1,352	14	0.0154	261	190	0.0154	3,603
	Apr	356	0.0143	6,279	356	0.0143	6,285	29	0.0143	509	385	0.0143	6,788	29	0.0143	503	817	0.0143	14,410
	May	4,223	0.0131	68,235	1,241	0.0131	20,058	342	0.0131	5,527	4,565	0.0131	73,762	3,324	0.0131	53,704	5,966	0.0131	96,405
	Jun	2,544	0.0195	61,179	197	0.0195	4,742	206	0.0195	4,956	2,750	0.0195	66,135	2,552	0.0195	61,393	2,122	0.0195	51,046
	Jul	310	0.0100	3,822	72	0.0100	885	25	0.0100	310	335	0.0100	4,131	263	0.0100	3,247	466	0.0100	5,748
	Aug	191	0.0100	2,360	54	0.0100	668	15	0.0100	191	207	0.0100	2,551	153	0.0100	1,883	298	0.0100	3,675
	Sep	124	0.0100	1,533	36	0.0100	448	10	0.0100	124	134	0.0100	1,657	98	0.0100	1,209	187	0.0100	2,301
WY	Total	8,138	0.0152	152,220	2,143	0.0152	37,324	659	0.0152	12,330	8,798	0.0152	164,550	6,654	0.0152	127,226	10,644	0.0152	191,356
78-05	Total	258,427		4,547,412	57,951		1,023,333	20,932		368,329	279,358		4,915,741	221,407		3,892,408	179,105		3,188,314
78-05	Average	9,230	0.0143	162,408	2,070	0.0143	36,548	748	0.0143	13,155	9,977	0.0143	175,562	7,907	0.0143	139,015	6,397	0.0144	113,875
78-89	Total	130,677		2,281,550	24,956		438,403	10,584		184,795	141,261		2,466,344	116,305		2,027,942	84,475		1,493,889
78-89	Average	10,890	0.0142	190,129	2,080	0.0142	36,534	882	0.0142	15,400	11,772	0.0142	205,529	9,692	0.0141	168,995	7,040	0.0143	124,491

NOTE: Average Annual Concentrations are Flow Weighted. Highlighted cells represent actual measurements.

Table A-2

Date September 25,2006

Flow and Phosphorus Routing WITHOUT Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			[redacted]		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l From Table 3	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l From Table B-1	Weight grams
	Oct	150	0.0209	3,867	150	0.0129	2,389			1,478	150	0.0129	2,389
	Nov	162	0.0198	3,957	162	0.0129	2,580			1,376	162	0.0129	2,580
	Dec	164	0.0187	3,783	164	0,0129	2,612			1,171	164	0.0129	2,612
1978	Jan	154	0.0176	3,343	154	0.0129	2,453			890	154	0.0129	2,453
	Feb	147	0.0165	2,992	147	0.0129	2,341			651	147	0.0129	2,341
	Mar	191	0.0154	3,628	191	0.0129	3,042			586	191	0.0129	3,042
	Apr	1,030	0.0143	18,168	1,030	0.0129	16,405			1,763	1,030	0.0129	16,405
	May	6,480	0.0131	104,708	6,480	0.0129	103,208			1,500	6,480	0.0129	103,208
	Jun	7,240	0.0141	125,919	7,240	0.0129	115,313			10,607	7,240	0.0129	115,313
	Jul	914	0.0110	12,401	914	0.0129	14,557			-2,156	914	0.0129	14,557
	Aug	546	0.0176	11,853	546	0.0129	8,696			3,157	546	0.0129	8,696
	Sep	256	0.0240	7,579	256	0.0129	4,077			3,501	256	0.0129	4,077
WY	Total	17,434	0.0140	302,199	17,434	0.0129	277,674			24,525	17,434	0.0129	277,674
	Oct	40	0.0209	1,031	40	0.0127	626			405	40	0.0127	626
	Nov	261	0.0198	6,374	261	0.0127	4,086			2,288	261	0.0127	4,086
	Dec	173	0.0187	3,990	173	0.0127	2,708			1,282	173	0.0127	2,708
1979	Jan	172	0.0176	3,734	172	0.0127	2,693			1,041	172	0.0127	2,693
	Feb	156	0.0165	3,175	156	0.0127	2,442			733	156	0.0127	2,442
	Mar	172	0.0154	3,267	172	0.0127	2,693			575	172	0,0127	2,693
	Apr	476	0.0143	8,396	476	0.0127	7,452			944	476	0.0127	7,452
	May	6,280	0.0131	101,477	6,280	0.0127	98,317			3,160	6,280	0,0127	98,317
	Jun	3,050	0.0141	53,046	3,050	0.0127	47,749			5,297	3,050	0.0127	47,749
	Jul	609	0.0110	8,263	609	0.0127	9,534			-1,271	609	0,0127	9,534
	Aug	327	0.0176	7,099	327	0.0127	5,119			1,980	327	0.0127	5,119
	Sep	200	0.0240	5,921	200	0.0127	3,131			2,790	200	0.0127	3,131
WY	Total	11,916	0.0140	205,774	11,916	0.0127	186,551			19,223	11,916	0.0127	186,551
	Oct	229	0.0209	5,904	229	0.0130	3,672			2,232	229	0.0130	3,672
	Nov	201	0.0198	4,909	201	0.0130	3,223			1,686	201	0,0130	3,223
	Dec	215	0.0187	4,959	215	0.0130	3,448			1,512	215	0.0130	3,448
1980	Jan	215	0.0176	4,668	215	0.0130	3,448			1,220	215	0.0130	3,448
	Feb	201	0.0165	4,091	201	0.0130	3,223			868	201	0.0130	3,223
	Mar	215	0.0154	4,084	215	0.0130	3,448			637	215	0.0130	3,448
	Apr	946	0.0143	16,686	946	0.0130	15,169			1,517	946	0.0130	15,169
	May	6,630	0.0131	107,132	6,630	0.0130	106,313			819	6,630	0.0130	106,313
	Jun	7,800	0.0141	135,659	7,800	0.0130	125,075			10,584	7,800	0.0130	125,075
	Jul	1,050	0.0110	14,247	1,050	0.0130	16,837			-2,590	1,050	0.0130	16,837
	Aug	432	0.0176	9,378	432	0.0130	6,927			2,451	432	0.0130	6,927
	Sep	346	0.0240	10,243	346	0.0130	5,548			4,695	346	0.0130	5,548
WY	Total	18,480	0.0141	321,960	18,480	0.0130	296,331			25,630	18,480	0.0130	296,331

Table A-2

Date: September 25,2006

Flow and Phosphorus Routing WITHOUT Narrows Project

Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			[illegible]		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l From Table 3	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l From Table B-1	Weight grams
	Oct	309	0.0209	7,966	309	0.0125	4,757			3,209	309	0.0125	4,757
	Nov	282	0.0198	6,887	282	0.0125	4,342			2,546	282	0.0125	4,342
	Dec	237	0.0187	5,467	237	0.0125	3,649			1,818	237	0.0125	3,649
1981	Jan	226	0.0176	4,906	226	0.0125	3,480			1,427	226	0.0125	3,480
	Feb	205	0.0165	4,172	205	0.0125	3,156			1,016	205	0.0125	3,156
	Mar	317	0.0154	6,022	317	0.0125	4,881			1,141	317	0.0125	4,881
	Apr	1,510	0.0143	26,635	1,510	0.0125	23,248			3,387	1,510	0.0125	23,248
	May	3,650	0.0131	58,979	3,650	0.0125	56,196			2,783	3,650	0.0125	56,196
	Jun	1,590	0.0100	19,612	1,590	0.0125	24,480			-4,867	1,590	0.0125	24,480
	Jul	437	0.0110	5,929	437	0.0125	6,728			-799	437	0.0125	6,728
	Aug	237	0.0176	5,145	237	0.0125	3,649			1,496	237	0.0125	3,649
	Sep	213	0.0240	6,306	213	0.0125	3,279			3,026	213	0.0125	3,279
WY	Total	9,213	0.0137	158,027	9,213	0.0125	141,845			16,182	9,213	0.0125	141,845
	Oct	337	0.0209	8,688	337	0.0130	5,395			3,292	337	0.0130	5,395
	Nov	255	0.0198	6,228	255	0.0130	4,083			2,145	255	0.0130	4,083
	Dec	185	0.0187	4,267	185	0.0130	2,962			1,305	185	0.0130	2,962
1982	Jan	140	0.0176	3,039	140	0.0130	2,241			798	140	0.0130	2,241
	Feb	123	0.0165	2,503	123	0.0130	1,969			534	123	0.0130	1,969
	Mar	185	0.0154	3,514	185	0.0130	2,962			552	185	0.0130	2,962
	Apr	1,160	0.0143	20,461	1,160	0.0130	18,572			1,889	1,160	0.0130	18,572
	May	8,760	0.0131	141,550	8,760	0.0130	140,248			1,302	8,760	0.0130	140,248
	Jun	4,500	0.0141	78,265	4,500	0.0130	72,045			6,220	4,500	0.0130	72,045
	Jul	1,110	0.0110	15,061	1,110	0.0130	17,771			-2,710	1,110	0.0130	17,771
	Aug	508	0.0176	11,028	508	0.0130	8,133			2,895	508	0.0130	8,133
	Sep	498	0.0240	14,743	498	0.0130	7,973			6,770	498	0.0130	7,973
WY	Total	17,761	0.0141	309,348	17,761	0.0130	284,354			24,994	17,761	0.0130	284,354
	Oct	830	0.0209	21,397	830	0.0134	13,691			7,706	830	0.0134	13,691
	Nov	691	0.0198	16,876	691	0.0134	11,398			5,478	691	0.0134	11,398
	Dec	500	0.0187	11,533	500	0.0134	8,248			3,285	500	0.0134	8,248
1983	Jan	427	0.0176	9,270	427	0.0134	7,044			2,226	427	0.0134	7,044
	Feb	374	0.0165	7,612	374	0.0134	6,169			1,442	374	0.0134	6,169
	Mar	491	0.0154	9,327	491	0.0134	8,099			1,228	491	0.0134	8,099
	Apr	638	0.0143	11,254	638	0.0134	10,524			729	638	0.0134	10,524
	May	4,530	0.0131	73,199	4,530	0.0134	74,725			-1,526	4,530	0.0134	74,725
	Jun	14,210	0.0141	247,143	14,210	0.0134	234,403			12,740	14,210	0.0134	234,403
	Jul	2,950	0.0100	36,388	2,950	0.0134	48,662			-12,274	2,950	0.0134	48,662
	Aug	861	0.0176	18,692	861	0.0134	14,203			4,489	861	0.0134	14,203
	Sep	599	0.0240	17,733	599	0.0134	9,881			7,852	599	0.0134	9,881
WY	Total	27,101	0.0142	480,423	27,101	0.0134	447,049			33.375	27.101	0.0134	447,049

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Flow and Phosphorus Routing WITHOUT Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			[redacted]		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l From Table 3	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l From Table B-1	Weight grams
	Oct	624	0.0209	16,087	624	0.0132	10,189			5,897	624	0.0132	10,189
	Nov	520	0.0198	12,700	520	0.0132	8,491			4,209	520	0.0132	8,491
	Dec	552	0.0187	12,733	552	0.0132	9,014			3,719	552	0.0132	9,014
1984	Jan	481	0.0176	10,442	481	0.0132	7,854			2,588	481	0.0132	7,854
	Feb	424	0.0165	8,629	424	0.0132	6,924			1,706	424	0.0132	6,924
	Mar	427	0.0154	8,111	427	0.0132	6,973			1,139	427	0.0132	6,973
	Apr	663	0.0143	11,695	663	0.0132	10,826			868	663	0.0132	10,826
	May	12,230	0.0131	197,621	12,230	0.0132	199,705			-2,084	12,230	0.0132	199,705
	Jun	9,620	0.0141	167,313	9,620	0.0132	157,086			10,227	9,620	0.0132	157,086
	Jul	1,480	0.0110	20,081	1,480	0.0132	24,167			-4,086	1,480	0.0132	24,167
	Aug	654	0.0176	14,198	654	0.0132	10,679			3,519	654	0.0132	10,679
	Sep	439	0.0240	12,996	439	0.0132	7,168			5,828	439	0.0132	7,168
WY	Total	28,114	0.0142	492,606	28,114	0.0132	459,077			33,529	28,114	0.0132	459,077
	Oct	561	0.0209	14,463	561	0.0132	9,109			5,354	561	0.0132	9,109
	Nov	458	0.0198	11,186	458	0.0132	7,437			3,749	458	0.0132	7,437
	Dec	464	0.0187	10,703	464	0.0132	7,534			3,169	464	0.0132	7,534
1985	Jan	440	0.0176	9,552	440	0.0132	7,144			2,408	440	0.0132	7,144
	Feb	338	0.0165	6,879	338	0.0132	5,488			1,391	338	0.0132	5,488
	Mar	366	0.0154	6,952	366	0.0132	5,943			1,010	366	0.0132	5,943
	Apr	3,010	0.0143	53,093	3,010	0.0132	48,873			4,220	3,010	0.0132	48,873
	May	10,350	0.0131	167,243	10,350	0.0132	168,053			-811	10,350	0.0132	168,053
	Jun	2,400	0.0141	41,741	2,400	0.0132	38,969			2,772	2,400	0.0132	38,969
	Jul	914	0.0110	12,401	914	0.0132	14,841			-2,439	914	0.0132	14,841
	Aug	434	0.0176	9,422	434	0.0132	7,047			2,375	434	0.0132	7,047
	Sep	314	0.0240	9,296	314	0.0132	5,098			4,197	314	0.0132	5,098
WY	Total	20,049	0.0142	352,931	20,049	0.0132	325,536			27,395	20,049	0.0132	325,536
	Oct	386	0.0209	9,951	386	0.0131	6,249			3,702	386	0.0131	6,249
	Nov	380	0.0198	9,281	380	0.0131	6,152			3,129	380	0.0131	6,152
	Dec	347	0.0187	8,004	347	0.0131	5,618			2,386	347	0.0131	5,618
1986	Jan	348	0.0176	7,555	348	0.0131	5,634			1,921	348	0.0131	5,634
	Feb	357	0.0165	7,266	357	0.0131	5,780			1,486	357	0.0131	5,780
	Mar	533	0.0154	10,125	533	0.0131	8,629			1,496	533	0.0131	8,629
	Apr	1,880	0.0143	33,161	1,880	0.0131	30,436			2,725	1,880	0.0131	30,436
	May	11,050	0.0131	178,554	11,050	0.0131	178,893			-339	11,050	0.0131	178,893
	Jun	7,530	0.0141	130,963	7,530	0.0131	121,906			9,057	7,530	0.0131	121,906
	Jul	900	0.0110	12,212	900	0.0131	14,570			-2,359	900	0.0131	14,570
	Aug	458	0.0176	9,943	458	0.0131	7,415			2,528	458	0.0131	7,415
	Sep	362	0.0240	10,717	362	0.0131	5,861			4,856	362	0.0131	5,861
WY	Total	24,531	0.0141	427,730	24,531	0.0131	397,142			30,589	24,531	0.0131	397,142

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Flow and Phosphorus Routing WITHOUT Narrows Project

Lower Gooseberry Reservoir Operation

Year	Month	Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			[illegible]		
		Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l From Table 3	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l From Table B-1	Weight grams
	Oct	448	0.0209	11,549	448	0.0132	7,308			4,242	448	0.0132	7,308
	Nov	398	0.0198	9,720	398	0.0132	6,492			3,228	398	0.0132	6,492
	Dec	271	0.0187	6,251	271	0.0132	4,420			1,830	271	0.0132	4,420
1987	Jan	150	0.0176	3,256	150	0.0132	2,447			810	150	0.0132	2,447
	Feb	126	0.0165	2,564	126	0.0132	2,055			509	126	0.0132	2,055
	Mar	183	0.0154	3,476	183	0.0132	2,985			491	183	0.0132	2,985
	Apr	1,740	0.0143	30,692	1,740	0.0132	28,382			2,309	1,740	0.0132	28,382
	May	3,150	0.0131	50,900	3,150	0.0132	51,382			-482	3,150	0.0132	51,382
	Jun	915	0.0141	15,914	915	0.0132	14,925			989	915	0.0132	14,925
	Jul	461	0.0110	6,255	461	0.0132	7,520			-1,265	461	0.0132	7,520
	Aug	259	0.0176	5,623	259	0.0132	4,225			1,398	259	0.0132	4,225
	Sep	204	0.0240	6,039	204	0.0132	3,328			2,712	204	0.0132	3,328
WY	Total	8,305	0.0147	152,240	8,305	0.0132	135,468			16,772	8,305	0.0132	135,468
	Oct	214	0.0209	5,517	214	0.0128	3,370			2,147	214	0.0128	3,370
	Nov	193	0.0198	4,714	193	0.0128	3,039			1,675	193	0.0128	3,039
	Dec	168	0.0187	3,875	168	0.0128	2,645			1,230	168	0.0128	2,645
1988	Jan	188	0.0176	4,081	188	0.0128	2,960			1,121	188	0.0128	2,960
	Feb	176	0.0165	3,582	176	0.0128	2,771			811	176	0.0128	2,771
	Mar	222	0.0154	4,217	222	0.0128	3,496			721	222	0.0128	3,496
	Apr	907	0.0143	15,998	907	0.0128	14,282			1,717	907	0.0128	14,282
	May	5,170	0.0131	83,541	5,170	0.0128	81,407			2,134	5,170	0.0128	81,407
	Jun	1,200	0.0141	20,871	1,200	0.0128	18,895			1,975	1,200	0.0128	18,895
	Jul	418	0.0110	5,672	418	0.0128	6,582			-910	418	0.0128	6,582
	Aug	257	0.0176	5,579	257	0.0128	4,047			1,533	257	0.0128	4,047
	Sep	197	0.0240	5,832	197	0.0128	3,102			2,730	197	0.0128	3,102
WY	Total	9,310	0.0142	163,479	9,310	0.0128	146,595			16,884	9,310	0.0128	146,595
	Oct	231	0.0209	5,955	231	0.0131	3,730			2,225	231	0.0131	3,730
	Nov	278	0.0198	6,790	278	0.0131	4,489			2,300	278	0.0131	4,489
	Dec	248	0.0187	5,720	248	0.0131	4,005			1,716	248	0.0131	4,005
1989	Jan	241	0.0176	5,232	241	0.0131	3,892			1,340	241	0.0131	3,892
	Feb	186	0.0165	3,786	186	0.0131	3,004			782	186	0.0131	3,004
	Mar	318	0.0154	6,041	318	0.0131	5,135			905	318	0.0131	5,135
	Apr	2,180	0.0143	38,453	2,180	0.0131	35,203			3,250	2,180	0.0131	35,203
	May	3,060	0.0131	49,446	3,060	0.0131	49,414			32	3,060	0.0131	49,414
	Jun	950	0.0141	16,523	950	0.0131	15,341			1,182	950	0.0131	15,341
	Jul	436	0.0110	5,916	436	0.0131	7,041			-1,125	436	0.0131	7,041
	Aug	217	0.0176	4,711	217	0.0131	3,504			1,207	217	0.0131	3,504
	Sep	221	0.0240	6,542	221	0.0131	3,569			2,974	221	0.0131	3,569
WY	Total	8,566	0.0145	155,114	8,566	0.0131	138,326			16,788	8,566	0.0131	138,326

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Flow and Phosphorus Routing WITHOUT Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			[illegible]		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l From Table 3	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l From Table D-1	Weight grams
	Oct	179	0.0209	4,605	179	0.0142	3,130			1,475	179	0.0142	3,130
	Nov	423	0.0198	10,329	423	0.0142	7,411			2,918	423	0.0142	7,411
	Dec	169	0.0187	3,908	169	0.0142	2,969			939	169	0.0142	2,969
1990	Jan	164	0.0176	3,558	164	0.0142	2,872			686	164	0.0142	2,872
	Feb	163	0.0165	3,317	163	0.0142	2,856			461	163	0.0142	2,856
	Mar	197	0.0154	3,743	197	0.0142	3,453			290	197	0.0142	3,453
	Apr	1,687	0.0143	29,756	1,687	0.0142	29,561			195	1,687	0.0142	29,561
	May	3,118	0.0131	50,385	3,118	0.0142	54,639			-4,255	3,118	0.0142	54,639
	Jun	1,146	0.0230	32,524	1,146	0.0142	20,089			12,435	1,146	0.0142	20,089
	Jul	473	0.0110	6,413	473	0.0142	8,282			-1,869	473	0.0142	8,282
	Aug	197	0.0280	6,805	197	0.0142	3,453			3,352	197	0.0142	3,453
	Sep	160	0.0240	4,730	160	0.0142	2,800			1,930	160	0.0142	2,800
WY	Total	8,076	0.0160	160,072	8,076	0.0142	141,514			18,558	8,076	0.0142	141,514
	Oct	204	0.0209	5,269	204	0.0138	3,474			1,796	204	0.0138	3,474
	Nov	114	0.0198	2,785	114	0.0138	1,938			847	114	0.0138	1,938
	Dec	177	0.0187	4,092	177	0.0138	3,015			1,077	177	0.0138	3,015
1991	Jan	179	0.0176	3,891	179	0.0138	3,046			845	179	0.0138	3,046
	Feb	172	0.0165	3,498	172	0.0138	2,921			577	172	0.0138	2,921
	Mar	196	0.0154	3,719	196	0.0138	3,328			392	196	0.0138	3,328
	Apr	323	0.0143	5,700	323	0.0138	5,492			208	323	0.0138	5,492
	May	5,395	0.0131	87,181	5,395	0.0138	91,695			-4,514	5,395	0.0138	91,695
	Jun	3,540	0.0190	82,970	3,540	0.0138	60,168			22,802	3,540	0.0138	60,168
	Jul	687	0.0110	9,328	687	0.0138	11,684			-2,356	687	0.0138	11,684
	Aug	386	0.0050	2,381	386	0.0138	6,562			-4,180	386	0.0138	6,562
	Sep	338	0.0240	10,006	338	0.0138	5,744			4,261	338	0.0138	5,744
WY	Total	11,713	0.0152	220,820	11,713	0.0138	199,066			21,754	11,713	0.0138	199,066
	Oct	258	0.0400	12,720	258	0.0136	4,316			8,403	258	0.0136	4,316
	Nov	268	0.0198	6,557	268	0.0136	4,495			2,062	268	0.0136	4,495
	Dec	230	0.0187	5,309	230	0.0136	3,854			1,455	230	0.0136	3,854
1992	Jan	169	0.0176	3,664	169	0.0136	2,826			838	169	0.0136	2,826
	Feb	138	0.0165	2,805	138	0.0136	2,307			497	138	0.0136	2,307
	Mar	293	0.0154	5,562	293	0.0136	4,902			659	293	0.0136	4,902
	Apr	1,432	0.0143	25,251	1,432	0.0136	23,969			1,281	1,432	0.0136	23,969
	May	1,473	0.0131	23,804	1,473	0.0136	24,666			-862	1,473	0.0136	24,666
	Jun	555	0.0090	6,166	555	0.0136	9,299			-3,134	555	0.0136	9,299
	Jul	264	0.0110	3,581	264	0.0136	4,419			-838	264	0.0136	4,419
	Aug	140	0.0210	3,625	140	0.0136	2,343			1,282	140	0.0136	2,343
	Sep	163	0.0240	4,836	163	0.0136	2,735			2,101	163	0.0136	2,735
WY	Total	5,383	0.0147	103,879	5,383	0.0136	90,134			13,745	5,383	0.0136	90,134

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Flow and Phosphorus Routing WITHOUT Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			[redacted]		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l From Table 3	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l From Table B-1	Weight grams
	Oct	245	0.0209	6,314	245	0.0127	3,834			2,480	245	0.0127	3,834
	Nov	157	0.0198	3,830	157	0.0127	2,455			1,375	157	0.0127	2,455
	Dec	145	0.0187	3,341	145	0.0127	2,268			1,074	145	0.0127	2,268
1993	Jan	185	0.0176	4,024	185	0.0127	2,902			1,122	185	0.0127	2,902
	Feb	209	0.0165	4,254	209	0.0127	3,272			982	209	0.0127	3,272
	Mar	350	0.0154	6,646	350	0.0127	5,477			1,169	350	0.0127	5,477
	Apr	903	0.0143	15,926	903	0.0127	14,134			1,792	903	0.0127	14,134
	May	9,882	0.0131	159,683	9,882	0.0127	154,696			4,987	9,882	0.0127	154,696
	Jun	3,671	0.0150	67,921	3,671	0.0127	57,465			10,456	3,671	0.0127	57,465
	Jul	786	0.0110	10,660	786	0.0127	12,299			-1,639	786	0.0127	12,299
	Aug	374	0.0050	2,305	374	0.0127	5,852			-3,546	374	0.0127	5,852
	Sep	242	0.0240	7,157	242	0.0127	3,784			3,372	242	0.0127	3,784
WY	Total	17,148	0.0140	292,061	17,148	0.0127	268,437			23,625	17,148	0.0127	268,437
	Oct	311	0.0209	8,007	311	0.0134	5,121			2,886	311	0.0134	5,121
	Nov	258	0.0198	6,311	258	0.0134	4,260			2,051	258	0.0134	4,260
	Dec	254	0.0187	5,861	254	0.0134	4,190			1,672	254	0.0134	4,190
1994	Jan	199	0.0176	4,317	199	0.0134	3,279			1,039	199	0.0134	3,279
	Feb	177	0.0165	3,611	177	0.0134	2,925			686	177	0.0134	2,925
	Mar	244	0.0154	4,629	244	0.0134	4,018			611	244	0.0134	4,018
	Apr	1,188	0.0143	20,955	1,188	0.0134	19,587			1,368	1,188	0.0134	19,587
	May	4,591	0.0131	74,188	4,591	0.0134	75,696			-1,508	4,591	0.0134	75,696
	Jun	1,028	0.0141	17,873	1,028	0.0134	16,942			930	1,028	0.0134	16,942
	Jul	313	0.0190	7,336	313	0.0134	5,161			2,175	313	0.0134	5,161
	Aug	266	0.0220	7,229	266	0.0134	4,392			2,837	266	0.0134	4,392
	Sep	243	0.0240	7,192	243	0.0134	4,005			3,187	243	0.0134	4,005
WY	Total	9,072	0.0148	167,509	9,072	0.0134	149,575			17,934	9,072	0.0134	149,575
	Oct	328	0.0209	8,450	328	0.0126	5,082			3,368	328	0.0126	5,082
	Nov	227	0.0198	5,542	227	0.0126	3,518			2,024	227	0.0126	3,518
	Dec	246	0.0187	5,663	246	0.0126	3,806			1,857	246	0.0126	3,806
1995	Jan	245	0.0176	5,317	245	0.0126	3,797			1,520	245	0.0126	3,797
	Feb	223	0.0165	4,536	223	0.0126	3,455			1,081	223	0.0126	3,455
	Mar	406	0.0154	7,719	406	0.0126	6,300			1,419	406	0.0126	6,300
	Apr	826	0.0143	14,564	826	0.0126	12,801			1,763	826	0.0126	12,801
	May	6,629	0.0131	107,117	6,629	0.0126	102,773			4,344	6,629	0.0126	102,773
	Jun	10,217	0.0141	177,693	10,217	0.0126	158,395			19,297	10,217	0.0126	158,395
	Jul	2,118	0.0050	13,060	2,118	0.0126	32,830			-19,770	2,118	0.0126	32,830
	Aug	773	0.0176	16,790	773	0.0126	11,990			4,800	773	0.0126	11,990
	Sep	393	0.0240	11,623	393	0.0126	6,087			5,536	393	0.0126	6,087
WY	Total	22,629	0.0136	378,073	22,629	0.0126	350,834			27,239	22,629	0.0126	350,834

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Date: September 25,2006

Flow and Phosphorus Routing WITHOUT Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			[redacted]		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l From Table 5	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l From Table B-1	Weight grams
	Oct	293	0.0050	1,810	293	0.0123	4,443			-2,633	293	0.0123	4,443
	Nov	299	0.0198	7,312	299	0.0123	4,533			2,778	299	0.0123	4,533
	Dec	253	0.0187	5,847	253	0.0123	3,839			2,009	253	0.0123	3,839
1996	Jan	168	0.0176	3,651	168	0.0123	2,547			1,104	168	0.0123	2,547
	Feb	194	0.0165	3,950	194	0.0123	2,939			1,011	194	0.0123	2,939
	Mar	268	0.0154	5,084	268	0.0123	4,052			1,031	268	0.0123	4,052
	Apr	731	0.0143	12,887	731	0.0123	11,063			1,824	731	0.0123	11,063
	May	8,593	0.0131	138,855	8,593	0.0123	130,123			8,732	8,593	0.0123	130,123
	Jun	2,709	0.0120	40,093	2,709	0.0123	41,016			-923	2,709	0.0123	41,016
	Jul	548	0.0110	7,429	548	0.0123	8,291			-862	548	0.0123	8,291
	Aug	219	0.0250	6,757	219	0.0123	3,318			3,439	219	0.0123	3,318
	Sep	195	0.0240	5,768	195	0.0123	2,950			2,818	195	0.0123	2,950
WY	Total	14,470	0.0133	239,442	14,470	0.0123	219,113			20,329	14,470	0.0123	219,113
	Oct	225	0.0209	5,807	225	0.0129	3,583			2,224	225	0.0129	3,583
	Nov	301	0.0198	7,341	301	0.0129	4,781			2,560	301	0.0129	4,781
	Dec	263	0.0187	6,074	263	0.0129	4,189			1,885	263	0.0129	4,189
1997	Jan	256	0.0176	5,557	256	0.0129	4,071			1,485	256	0.0129	4,071
	Feb	245	0.0165	4,987	245	0.0129	3,898			1,089	245	0.0129	3,898
	Mar	350	0.0154	6,646	350	0.0129	5,565			1,081	350	0.0129	5,565
	Apr	1,158	0.0143	20,431	1,158	0.0129	18,425			2,006	1,158	0.0129	18,425
	May	12,951	0.0131	209,274	12,951	0.0129	206,011			3,263	12,951	0.0129	206,011
	Jun	4,425	0.0141	76,966	4,425	0.0129	70,392			6,573	4,425	0.0129	70,392
	Jul	761	0.0110	10,327	761	0.0129	12,107			-1,780	761	0.0129	12,107
	Aug	354	0.0176	7,675	354	0.0129	5,624			2,052	354	0.0129	5,624
	Sep	384	0.0240	11,377	384	0.0129	6,113			5,264	384	0.0129	6,113
WY	Total	21,674	0.0139	372,462	21,674	0.0129	344,760			27,703	21,674	0.0129	344,760
	Oct	371	0.0209	9,573	371	0.0120	5,514			4,059	371	0.0120	5,514
	Nov	319	0.0198	7,790	319	0.0120	4,736			3,054	319	0.0120	4,736
	Dec	312	0.0187	7,206	312	0.0120	4,639			2,568	312	0.0120	4,639
1998	Jan	301	0.0176	6,529	301	0.0120	4,466			2,064	301	0.0120	4,466
	Feb	340	0.0165	6,917	340	0.0120	5,046			1,871	340	0.0120	5,046
	Mar	458	0.0154	8,698	458	0.0120	6,799			1,899	458	0.0120	6,799
	Apr	1,170	0.0143	20,641	1,170	0.0120	17,375			3,266	1,170	0.0120	17,375
	May	7,120	0.0131	115,051	7,120	0.0120	105,721			9,331	7,120	0.0120	105,721
	Jun	4,069	0.0100	50,189	4,069	0.0120	60,416			-10,227	4,069	0.0120	60,416
	Jul	1,142	0.0110	15,491	1,142	0.0120	16,952			-1,461	1,142	0.0120	16,952
	Aug	506	0.0176	10,980	506	0.0120	7,510			3,470	506	0.0120	7,510
	Sep	355	0.0150	6,572	355	0.0120	5,274			1,298	355	0.0120	5,274
WY	Total	16,463	0.0129	265,639	16,463	0.0120	244,448			21,191	16,463	0.0120	244,448

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Date: September 25,2006

Flow and Phosphorus Routing WITHOUT Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			[redacted]		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l From Table 3	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l From Table B-1	Weight grams
	Oct	333	0.0209	8,576	333	0.0157	6,440			2,136	333	0.0157	6,440
	Nov	309	0.0198	7,544	309	0.0157	5,980			1,564	309	0.0157	5,980
	Dec	151	0.0187	3,483	151	0.0157	2,923			560	151	0.0157	2,923
1999	Jan	88	0.0176	1,906	88	0.0157	1,699			206	88	0.0157	1,699
	Feb	141	0.0165	2,866	141	0.0157	2,726			140	141	0.0157	2,726
	Mar	236	0.0154	4,489	236	0.0157	4,575			-86	236	0.0157	4,575
	Apr	539	0.0143	9,514	539	0.0157	10,441			-928	539	0.0157	10,441
	May	5,794	0.0131	93,628	5,794	0.0157	112,169			-18,542	5,794	0.0157	112,169
	Jun	4,176	0.0230	118,469	4,176	0.0157	80,838			37,631	4,176	0.0157	80,838
	Jul	859	0.0110	11,660	859	0.0157	16,635			-4,976	859	0.0157	16,635
	Aug	626	0.0250	19,306	626	0.0157	12,120			7,186	626	0.0157	12,120
	Sep	435	0.0240	12,872	435	0.0157	8,417			4,455	435	0.0157	8,417
WY	Total	13,687	0.0175	294,312	13,687	0.0157	264,964			29,348	13,687	0.0157	264,964
	Oct	249	0.0209	6,409	249	0.0125	3,821			2,587	249	0.0125	3,821
	Nov	230	0.0198	5,614	230	0.0125	3,534			2,081	230	0.0125	3,534
	Dec	176	0.0187	4,063	176	0.0125	2,708			1,355	176	0.0125	2,708
2000	Jan	155	0.0176	3,358	155	0.0125	2,378			980	155	0.0125	2,378
	Feb	137	0.0165	2,781	137	0.0125	2,101			681	137	0.0125	2,101
	Mar	236	0.0154	4,489	236	0.0125	3,633			856	236	0.0125	3,633
	Apr	1,568	0.0143	27,661	1,568	0.0125	24,106			3,554	1,568	0.0125	24,106
	May	4,475	0.0131	72,304	4,475	0.0125	68,785			3,518	4,475	0.0125	68,785
	Jun	1,081	0.0100	13,335	1,081	0.0125	16,619			-3,284	1,081	0.0125	16,619
	Jul	342	0.0110	4,639	342	0.0125	5,256			-617	342	0.0125	5,256
	Aug	214	0.0180	4,756	214	0.0125	3,293			1,463	214	0.0125	3,293
	Sep	198	0.0240	5,856	198	0.0125	3,041			2,815	198	0.0125	3,041
WY	Total	9,060	0.0136	155,265	9,060	0.0125	139,274			15,990	9,060	0.0125	139,274
	Oct	231	0.0209	5,966	231	0.0121	3,466			2,500	231	0.0121	3,466
	Nov	192	0.0198	4,686	192	0.0121	2,874			1,812	192	0.0121	2,874
	Dec	56	0.0187	1,303	56	0.0121	846			457	56	0.0121	846
2001	Jan	14	0.0176	293	14	0.0121	202			91	14	0.0121	202
	Feb	50	0.0165	1,027	50	0.0121	756			271	50	0.0121	756
	Mar	242	0.0154	4,606	242	0.0121	3,631			974	242	0.0121	3,631
	Apr	1,503	0.0143	26,508	1,503	0.0121	22,508			4,000	1,503	0.0121	22,508
	May	5,236	0.0131	84,602	5,236	0.0121	78,415			6,187	5,236	0.0121	78,415
	Jun	832	0.0100	10,258	832	0.0121	12,455			-2,197	832	0.0121	12,455
	Jul	303	0.0110	4,106	303	0.0121	4,532			-426	303	0.0121	4,532
	Aug	228	0.0100	2,816	228	0.0121	3,420			-603	228	0.0121	3,420
	Sep	153	0.0240	4,537	153	0.0121	2,295			2,242	153	0.0121	2,295
WY	Total	9,040	0.0134	150,707	9,040	0.0121	135,399			15,308	9,040	0.0121	135,399

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Flow and Phosphorus Routing WITHOUT Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			[redacted]		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l From Table 3	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l From Table B-1	Weight grams
	Oct	133	0.0209	3,434	133	0.0126	2,076			1,358	133	0.0126	2,076
	Nov	200	0.0198	4,889	200	0.0126	3,120			1,769	200	0.0126	3,120
	Dec	161	0.0187	3,724	161	0.0126	2,516			1,207	161	0.0126	2,516
2002	Jan	75	0.0176	1,626	75	0.0126	1,167			458	75	0.0126	1,167
	Feb	29	0.0165	598	29	0.0126	458			140	29	0.0126	458
	Mar	58	0.0154	1,108	58	0.0126	909			199	58	0.0126	909
	Apr	1,289	0.0143	22,736	1,289	0.0126	20,093			2,644	1,289	0.0126	20,093
	May	3,038	0.0131	49,095	3,038	0.0126	47,361			1,734	3,038	0.0126	47,361
	Jun	636	0.0141	11,054	636	0.0126	9,907			1,147	636	0.0126	9,907
	Jul	256	0.0110	3,473	256	0.0126	3,990			-517	256	0.0126	3,990
	Aug	120	0.0176	2,612	120	0.0126	1,875			736	120	0.0126	1,875
	Sep	165	0.0240	4,871	165	0.0126	2,565			2,306	165	0.0126	2,565
WY	Total	6,161	0.0142	109,219	6,161	0.0126	96,039			13,180	6,161	0.0126	96,039
	Oct	187	0.0209	4,810	187	0.0133	3,054			1,756	187	0.0133	3,054
	Nov	125	0.0198	3,047	125	0.0133	2,042			1,005	125	0.0133	2,042
	Dec	27	0.0187	617	27	0.0133	438			179	27	0.0133	438
2003	Jan	54	0.0176	1,167	54	0.0133	880			287	54	0.0133	880
	Feb	97	0.0165	1,975	97	0.0133	1,588			387	97	0.0133	1,588
	Mar	135	0.0154	2,565	135	0.0133	2,210			355	135	0.0133	2,210
	Apr	743	0.0143	13,097	743	0.0133	12,153			943	743	0.0133	12,153
	May	5,905	0.0131	95,413	5,905	0.0133	96,651			-1,238	5,905	0.0133	96,651
	Jun	1,717	0.0180	38,115	1,717	0.0133	28,099			10,016	1,717	0.0133	28,099
	Jul	353	0.0173	7,531	353	0.0133	5,777			1,754	353	0.0133	5,777
	Aug	233	0.0160	4,603	233	0.0133	3,818			785	233	0.0133	3,818
	Sep	168	0.0240	4,959	168	0.0133	2,742			2,217	168	0.0133	2,742
WY	Total	9,742	0.0147	177,900	9,742	0.0133	159,452			18,447	9,742	0.0133	159,452
	Oct	118	0.0209	3,049	118	0.0136	1,980			1,069	118	0.0136	1,980
	Nov	173	0.0198	4,223	173	0.0136	2,895			1,328	173	0.0136	2,895
	Dec	133	0.0187	3,069	133	0.0136	2,228			841	133	0.0136	2,228
2004	Jan	136	0.0176	2,954	136	0.0136	2,278			676	136	0.0136	2,278
	Feb	145	0.0165	2,945	145	0.0136	2,423			522	145	0.0136	2,423
	Mar	253	0.0154	4,814	253	0.0136	4,243			571	253	0.0136	4,243
	Apr	1,684	0.0143	29,696	1,684	0.0136	28,189			1,507	1,684	0.0136	28,189
	May	3,730	0.0131	60,275	3,730	0.0136	62,456			-2,182	3,730	0.0136	62,456
	Jun	1,116	0.0195	26,836	1,116	0.0136	18,681			8,155	1,116	0.0136	18,681
	Jul	325	0.0173	6,932	325	0.0136	5,439			1,493	325	0.0136	5,439
	Aug	165	0.0211	4,301	165	0.0136	2,767			1,534	165	0.0136	2,767
	Sep	137	0.0240	4,055	137	0.0136	2,293			1,761	137	0.0136	2,293
WY	Total	8,115	0.0151	153,150	8,115	0.0136	135,874			17,276	8,115	0.0136	135,874

Table A-2 Date: September 25,2006

Flow and Phosphorus Routing WITHOUT Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			[redacted]		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l From Table 3	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l From Table B-1	Weight grams
	Oct	232	0.0209	5,973	232	0.0137	3,909			2,065	232	0.0137	3,909
	Nov	165	0.0198	4,019	165	0.0137	2,776			1,243	165	0.0137	2,776
	Dec	138	0.0187	3,188	138	0.0137	2,331			857	138	0.0137	2,331
2005	Jan	139	0.0176	3,022	139	0.0137	2,348			674	139	0.0137	2,348
	Feb	147	0.0165	2,995	147	0.0137	2,482			513	147	0.0137	2,482
	Mar	203	0.0154	3,863	203	0.0137	3,431			433	203	0.0137	3,431
	Apr	845	0.0143	14,914	845	0.0137	14,262			652	845	0.0137	14,262
	May	9,290	0.0131	150,109	9,290	0.0137	156,700			-6,591	9,290	0.0137	156,700
	Jun	4,675	0.0195	112,439	4,675	0.0137	78,852			33,586	4,675	0.0137	78,852
	Jul	729	0.0100	8,992	729	0.0137	12,296			-3,305	729	0.0137	12,296
	Aug	451	0.0100	5,558	451	0.0137	7,601			-2,043	451	0.0137	7,601
	Sep	285	0.0100	3,510	285	0.0137	4,799			-1,290	285	0.0137	4,799
WY	Total	17,298	0.0152	318,582	17,298	0.0137	291,788			26,794	17,298	0.0137	291,788
78-05	Total	400,512		7,080,922	400,512		6,466,618			614,305	400,512		6,466,618
78-05	Average	14,304	0.0143	252,890	14,304	0.0131	230,951			21,939	14,304	0.0131	230,951
78-89	Total	200,780		3,521,831	200,780		3,235,948			285,883	200,780		3,235,948
78-89	Average	16,732	0.0142	293,486	16,732	0.0131	269,662			23,824	16,732	0.0131	269,662

NOTE: Average Annual Concentrations are Flow Weighted

Date September 25, 2006

Table A-3

Flow and Phosphorus Routing WITHOUT Narrows Project Using Empirical Reservoir Model

Scofield Reservoir Operation

Year	Month	[redacted]			(Calculated) Gains for Fish Creek Above Fish Creek Above Scofield Reservoir			[redacted]			Stream Flow-Mud Creek Above Scofield Reservoir			Stream Flow-Pondtown Creek Above Scofield Reservoir			(CALC.) Other Reservoir Inflow Scofield Reservoir (Includes errors, uptake, P recycle, etc.)			(CALC.) Total Inflow Above Scofield Reservoir		(Vollenweider/Nürnberg) Scofield Reservoir					Price River Below Scofield Dam	
		[illegible]	[illegible]	[illegible]	Flow Acre-Feet	Concentration mg/l	Weight Grams	[illegible]	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Weight Grams	Evaporation Acre-Feet	Phosphorus Uptake Grams	End of Month Content: Total Acre-Feet	End of Month Content: mg/l	End of Month Content: Weight Grams	Acre-Feet	Weight Grams
1978	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1980	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1981	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table A-3

Date: September 25, 2006

Flow and Phosphorus Routing WITHOUT Narrows Project Using Empirical Reservoir Model

Scofield Reservoir Operation

Year	Month	[redacted]			(Calculated) Gains for Fish Creek Above Fish Creek Above Scofield Reservoir			[redacted]			Stream Flow-Mud Creek Above Scofield Reservoir			Stream Flow-Pondtown Creek Above Scofield Reservoir			(CALC.) Other Reservoir Inflow Scofield Reservoir (includes precip, uptake, P recycle, etc.)			(CALC.) Total Inflow Above Scofield Reservoir		(Freemon-Nebb) Scofield Reservoir					Price River Below Scofield Dam	
		Flow Acre-Feet	mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Weight Grams	Evaporation Acre-Feet	Phosphorus Uptake/Change	End of Month Content Total Acre-Feet	Measured P	Weight Grams	Flow Acre-Feet	Weight Grams
	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1982	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1984	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1985	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Date September 21, 2006

Table A-3

Flow and Phosphorus Routing WITHOUT Narrows Project Using Empirical Reservoir Model

Scofield Reservoir Operation

	[redacted]			(Calculated) Gains for Fish Creek Above Fish Creek Above Scofield Reservoir			[redacted]			Stream Flow Hwd Creek Above Scofield Reservoir			Stream Flow Pondtown Creek Above Scofield Reservoir			(CALC) Other Reservoir Inflow Scofield Reservoir (Includes errors, springs, P recycle, etc.)			(CALC) Total Inflow Above Scofield Reservoir		(Forecast/Model) Scofield Reservoir					Price River Below Scofield Dam	
Year Month	Flow Acre-Feet	Conc (Table 1)	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Weight Grams	Evaporation Acre-Feet	Phosphorus Grams	End of Month Content Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Weight Grams
Oct	380	0.0131	6,205	654	0.0791	47,793	1,040	0.0348	70,042	303	0.0700	43,411	116	0.0150	4,594	777	0.0270	32,062	2,394	171,070	400	-328,308	46,150	0.0643	3,414,681	672	49,734
Nov	380	0.0131	6,152	321	0.0413	16,572	901	0.0294	32,674	475	0.0659	39,255	97	0.0190	2,324	951	0.0408	47,846	2,426	122,100	122	2,640,033	46,138	0.0537	993,597	509	3,531
Dec	347	0.0131	5,618	434	0.0343	19,468	781	0.0252	24,084	550	0.0700	48,859	86	0.0500	5,309	796	0.0422	41,346	2,115	109,596	0	-518,387	49,834	0.0241	1,499,923	615	18,588
1986 Jan	348	0.0131	5,634	606	0.0167	14,097	946	0.0167	19,463	484	0.0500	17,964	105	0.0500	6,483	768	0.0231	31,918	2,315	66,080	0	-356,317	51,314	[illegible]	1,899,679	615	22,738
Feb	357	0.0131	5,780	597	0.0323	23,639	934	0.0250	29,419	485	0.0700	41,877	105	0.0500	6,471	1,136	0.0408	58,303	2,900	146,072	0	-1,633,077	53,914	0.0650	1,656,604	392	20,333
Mar	533	0.0131	8,629	2,097	0.0348	88,083	2,630	0.0300	97,322	423	0.0800	91,213	287	0.0500	17,730	993	0.0423	46,935	4,535	243,201	0	-1,140,466	57,668	0.0688	4,903,377	921	79,296
Apr	1,880	0.0131	30,436	6,370	0.0301	236,491	8,250	0.0263	267,127	1,957	0.1000	241,214	900	0.0600	66,578	2,773	0.0420	143,608	15,830	718,706	0	282,441	58,721	0.0612	5,187,730	2,807	211,998
May	11,050	0.0131	178,893	17,310	0.1011	2,184,936	28,360	0.0671	2,363,829	6,053	0.1320	983,878	3,112	0.1020	391,491	6,994	0.0604	493,619	44,721	4,434,814	1,042	2,856,683	73,300	0.0448	4,424,278	38,990	2,341,587
Jun	7,530	0.0131	121,906	6,640	0.0346	283,596	14,170	0.0232	405,502	3,152	0.0720	279,913	1,594	0.0430	81,932	15,414	0.0330	626,921	34,280	1,394,268	1,294	2,514,807	71,500	0.0250	2,266,536	32,066	1,917,203
Jul	900	0.0131	14,570	2,010	0.0412	102,087	2,910	0.0325	116,657	880	0.0420	45,596	319	0.0520	20,395	1,012	0.0360	45,606	5,120	227,647	1,330	-1,983,471	63,363	0.0470	3,791,359	11,987	600,290
Aug	458	0.0131	7,415	902	0.0256	28,485	1,360	0.0214	33,869	567	0.0700	48,957	149	0.0750	13,798	590	0.0385	18,547	2,456	117,207	1,132	-1,029,667	54,923	0.0800	4,064,421	11,774	871,390
Sep	362	0.0131	5,861	708	0.1142	99,726	1,070	0.0802	105,587	569	0.0100	6,278	116	0.0500	10,151	36	0.0583	2,580	1,712	124,396	820	1,778,882	46,010	0.0552	3,415,686	6,625	294,850
Total/Average	24,311	0.0131	397,342	39,051	0.0658	3,170,085	63,382	0.0435	3,567,856	16,342	0.0924	1,870,043	6,937	0.0733	627,577	32,134	0.0457	1,800,239	118,353	7,873,247	6,173	2,909,308	57,053	0.0447	3,383,277	108,023	5,045,313
Oct	448	0.0132	7,308	712	0.0989	70,417	1,160	0.0546	78,124	327	0.0700	45,328	127	0.0250	3,499	616	0.0577	40,703	2,428	172,829	422	-1,487,074	51,521	0.0880	3,375,843	495	56,709
Nov	398	0.0132	6,492	570	0.0407	28,612	968	0.0294	35,104	488	0.0670	40,750	106	0.0190	2,493	-134	0.0464	-6,759	1,428	71,226	125	2,851,402	51,824	0.0456	955,868	0	0
Dec	271	0.0132	4,430	500	0.0314	19,333	771	0.0250	23,776	448	0.0700	38,682	87	0.0500	5,242	496	0.0421	25,711	1,800	93,453	0	-368,235	53,624	0.0345	1,420,549	0	0
1987 Jan	150	0.0132	2,447	444	0.0179	9,788	594	0.0167	12,235	413	0.0660	19,358	66	0.0500	4,753	1,027	0.0259	36,538	2,100	69,785	0	-639,782	53,724	0.0336	2,230,123	0	0
Feb	126	0.0132	2,055	340	0.0294	12,313	466	0.0250	14,370	387	0.0700	33,401	52	0.0500	3,193	855	0.0467	50,640	1,850	101,817	0	-913,069	53,524	0.0714	3,518,447	2	0
Mar	183	0.0132	2,991	454	0.0368	20,587	637	0.0300	23,572	421	0.0600	41,544	70	0.0500	4,342	1,272	0.0499	78,272	2,400	147,730	0	-1,495,348	53,924	0.0800	5,150,524	2	0
Apr	1,740	0.0132	28,382	2,400	0.0197	110,667	4,140	0.0262	134,049	1,128	0.1000	139,118	952	0.0500	33,447	781	0.0435	41,872	6,500	348,586	0	693,424	65,324	0.0612	4,574,291	1,281	83,154
May	3,180	0.0132	51,782	1,720	0.0004	414,092	4,970	0.0326	466,074	1,579	0.0800	180,310	745	0.0650	55,453	392	0.0617	28,103	9,680	757,050	1,024	2,474,428	66,405	0.0532	3,868,593	7,223	329,090
Jun	913	0.0132	14,925	995	0.0206	40,221	1,939	0.0249	43,148	982	0.0720	58,795	200	0.0500	12,536	24	0.0335	1,048	3,777	117,342	1,247	363,338	66,427	0.0525	2,422,420	7,488	309,183
Jul	461	0.0132	7,520	481	0.0010	30,244	942	0.0325	37,760	483	0.0420	25,019	104	0.0520	6,646	843	0.0368	38,252	2,373	107,714	1,364	-1,037,287	53,296	0.0870	5,551,779	9,239	525,625
Aug	259	0.0132	4,225	318	0.0427	17,127	577	0.0300	21,352	409	0.0700	35,315	64	0.0700	5,515	-226	0.0383	13,407	823	48,794	1,043	-78,897	45,473	0.0495	2,299,627	6,585	399,628
Sep	204	0.0132	3,329	258	0.0633	20,835	462	0.0424	24,162	306	0.0110	14,750	51	0.0500	3,337	-302	0.0383	-14,203	577	28,074	776	-61,444	40,603	0.0316	2,338,819	4,634	291,327
Total/Average	8,305	0.0132	135,468	11,112	0.0569	780,200	18,417	0.0382	915,720	7,411	0.0900	678,254	3,127	0.0540	141,598	5,070	0.0441	308,291	34,647	2,043,873	5,919	370,141	24,083	0.0417	3,524,829	37,075	1,971,883
Oct	214	0.0128	3,370	342	0.0409	17,205	556	0.0360	20,575	495	0.0700	14,909	92	0.0400	3,038	-110	0.0464	-4,250	913	52,286	397	-477,261	39,369	0.0600	3,928,481	1,609	119,061
Nov	193	0.0128	3,039	371	0.0381	17,414	564	0.0294	20,453	407	0.0670	33,696	61	0.0195	1,464	186	0.0436	10,013	1,220	65,505	116	2,241,501	40,473	0.0050	752,845	0	0
Dec	168	0.0128	2,645	332	0.0312	12,773	500	0.0250	15,419	304	0.0700	24,020	55	0.0500	3,422	751	0.0451	41,783	1,700	98,643	0	-433,344	42,375	0.0045	1,280,532	0	0
1988 Jan	188	0.0128	2,960	306	0.0191	7,210	494	0.0167	10,176	393	0.0380	18,421	55	0.0500	3,388	958	0.0275	32,513	1,900	64,512	0	-506,283	44,277	0.0039	1,851,286	0	0
Feb	176	0.0128	2,771	320	0.0317	12,524	496	0.0250	15,295	391	0.0700	33,933	55	0.0500	3,395	236	0.0453	14,207	1,200	86,891	0	-465,665	45,473	0.0625	2,383,844	0	0
Mar	223	0.0128	3,496	455	0.0384	21,668	680	0.0300	25,162	430	0.0800	42,472	75	0.0500	4,631	815	0.0494	89,666	2,000	121,892	0	-1,587,572	47,473	0.0800	4,087,308	0	0
Apr	907	0.0128	14,282	9,043	0.0276	307,890	9,950	0.0263	322,172	2,300	0.1000	283,702	1,088	0.0600	80,280	-4,233	0.0417	-435,727	9,100	262,437	0	381,024	52,373	0.0612	3,968,310	0	0
May	5,170	0.0128	81,407	4,980	0.1702	1,045,366	10,150	0.0900	1,126,792	2,341	0.1320	381,102	1,107	0.1500	204,729	1,519	0.1023	191,368	15,117	1,904,050	982	1,203,864	61,833	0.0661	4,329,526	4,895	342,551
Jun	1,200	0.0128	18,895	1,800	0.0302	66,956	3,000	0.0232	85,851	898	0.0720	79,752	328	0.0430	17,383	45	0.0351	1,966	4,271	184,935	1,219	2,308,815	55,713	0.0230	1,718,088	9,170	282,777
Jul	418	0.0128	6,582	612	0.0400	34,709	1,030	0.0325	41,291	503	0.0420	25,955	113	0.0520	7,263	-537	0.0502	-25,240	1,087	49,268	1,235	-1,434,080	44,560	0.0870	2,382,316	11,007	438,729
Aug	257	0.0128	4,047	395	-0.0042	-2,036	652	0.0025	2,011	424	0.0700	36,610	75	0.1000	8,888	-763	0.0334	-31,560	385	15,937	1,012	1,330,338	36,017	0.0256	1,048,458	7,916	250,437
Sep	199	0.0128	3,102	454	0.0533	30,845	653	0.0424	34,047	424	0.0211	10,213	75	0.0510	4,702	-700	0.0389	-33,304	445	21,398	716	-1,176,915	31,989	0.0010	2,307,325	3,834	241,441
Total/Average	9,319	0.0128	146,595	19,412	0.0607	1,570,650	28,725	0.0485	1,713,245	9,211	0.0880	1,020,607	3,141	0.0864	342,579	-4,833	0.0240	-178,823	25,330	2,983,804	5,636	1,006,287	45,203	0.0433	2,411,252	38,435	1,854,207
Oct	231	0.0131	3,750	283	0.0863	30,887	514	0.0546	34,637	197	0.0700	14,279	37	0.0600	2,815	-346	0.0601	-23,608	432	46,591	360	775,091	31,420	0.1013	1,228,887	748	29,540
Nov	276	0.0131	4,489	252	0.0474	14,731	530	0.0294	19,220	409	0.0670	33,058	59	0.0190	1,577	-192	0.0446	-3,537	687	48,117	196	609,910	31,925	0.0098	390,665	276	5,107
Dec	248	0.0131	4,085	344	0.0336	14,251	592	0.0250	18,256	412	0.0760	35,558	66	0.0500	4,066	554	0.0479	30,003	1,620	87,872	0	-338,209	33,025	0.0092	1,910,121	124	3,747
1989 Jan	241	0.0131	3,902	209	0.0209	5,378	450	0.0167	9,280	364	0.0380	17,099	90	0.0500	3,086	340	0.0278	18,540	1,424	48,895	0	-398,206	34,925	0.0039	1,632,097	124	5,187
Feb	186	0.0131	3,004	181	0.0372	8,314	367	0.0250	11,417	367	0.0700	31,488	47	0.0500	2,928	457	0.0476	49,177	1,612	94,731	0	-918,423	36,225	0.0538	2,667,371	112	3,996
Mar	319	0.0131	5,115	202	0.0565	14,144	521	0.0300	19,279	466	0.0800	39,276	98	0.0500	3,562	1,047	0.0516	135,832	2,924	185,949	0	-727,112	39,025	0.0689	3,329,939	124	10,670
Apr	2,160	0.0131	35,303	2,440	0.0380	114,588	4,600	0.0263	149,991	1,223	0.1000	151,108	508	0.0600	37,316	198	0.0432	21,177	6,747	359,187	0	263,837	41,825	0.0612	3,457,382	3,047	293,937
May	3,060	0.0131	49,414	4,280	0.0112	59,233	3,340	0.0726	108,646	1,774	0.1320	289,844	800	0.1427	140,204	-1,114	0.0400	-60,435	8,800	477,230	997	1,658,852	29,933	0.1723	1,593,609	9,795	390,549
Jun	950	0.0131	15,341	800	-0.0024	-2,388	1,750	0.0062	12,952	946	0.1200	234,087	172	0.0960	22,041	143	0.0311	18,585	2,931	329,152	1,060	1,692,591	33,003	0.0585	546,379	7,992	81,832
Jul	436	0.0131	7,045	237	0.1151	33,836	673	0.0490	40,677	429	0.0900	49,317	74	0.0910	8,343	-1,013	0.0677	-84,494	163	73,738	1,049	-431,990	23,910	0.0525	575,319	9,009	210,694
Aug	217	0.0131	3,504	767	0.0464	20,998	984	0.0201	24,492	413	0.0200	10,368	65	0.0910	7,295	-12	0.0780	-1,554	1,027	49,658	790	-1,734,520	18,083	0.0772	1,834,517	3,165	508,561
Sep	221	0.0131	3,569	451	0.0174	7,694	672	0.0160	11,262	429	0.0300	17,550	74	0.0380	3,479	-743	0.0240	-21,997	430	12,104	738	518,516	10,088	0.0473	1,141,026	2,787	197,670
Total/Average	8,608	0.0131	138,336	10,047	0.0583	333,234	18,613	0.0203	461,570	7,271	0.1085	973,331	2,060	0.0941	236,039	1,289	0.0522	81,868	29,193	1,753,174	4,811	658,939	31,779	0.0390	1,383,872	40,203	1,750,334

Table A-3

Date: September 25, 2006

Flow and Phosphorus Routing WITHOUT Narrows Project Using Empirical Reservoir Model

Scofield Reservoir Operation

Year	Month	[redacted]			(Calculated) Gain in Fish Creek Above Fish Creek Above Scofield Reservoir			[redacted]		
		Flow	Concentration	Weight	Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)
	Oct	179	0.0142	3,130	250	0.0079	3,142	409	[illegible]	5,292
	Nov	423	0.0142	7,411	293	-0.0145	-5,309	714	[illegible]	2,202
	Dec	169	0.0142	3,060	304	0.0318	13,617	473	0.0250	14,586
1990	Jan	164	0.0142	2,972	239	0.0185	5,842	433	0.0167	8,711
	Feb	163	0.0142	2,856	149	0.0168	6,761	332	0.0250	9,625
	Mar	197	0.0142	3,453	187	0.0466	10,757	384	0.0300	14,210
	Apr	1,687	0.0142	29,561	3,193	0.0326	128,449	4,880	0.0283	158,010
	May	3,118	0.0142	54,639	5,452	0.0974	654,675	8,570	0.0671	709,314
	Jun	1,146	0.0142	20,089	1,754	0.0291	62,900	2,900	0.0232	82,989
	Jul	473	0.0142	8,282	727	0.0444	39,824	1,200	0.0325	48,106
	Aug	197	0.0142	3,457	358	0.0254	11,198	555	0.0214	14,656
	Sep	160	0.0142	2,800	296	0.0576	21,049	456	0.0434	27,849
Total/Average		8,076	0.0142	141,514	13,220	0.0583	950,028	21,296	0.0411	1,091,542
1991	Oct–Sep, Total/Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1992	Oct–Sep, Total/Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1993	Oct–Sep, Total/Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table A-3

Flow and Phosphorus Routing WITHOUT Narrows Project Using Empirical Reservoir Model

Scofield Reservoir Operation

September 25, 2006

Year	Month	[redacted] Flow Acre-Feet	[redacted] Total P	[redacted] Weight Grams	(Calculated) Gain for Fish Creek Above Fish Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	[redacted] Flow Acre-Feet	Concentration mg/l	Weight Grams	Stream Flow-Mud Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	Stream Flow-Pondtown Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Other Reservoir Inflow Scofield Reservoir (Includes errors, uptake, P recycle, etc.): Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Total Inflow Above Scofield Reservoir: Flow Acre-Feet	Weight Grams	(Frenzen-Nobles) Scofield Reservoir: Evaporation Acre-Feet	Phosphorus Uptake Grams	End of Month Content: Total Acre-Feet	mg/l Meas.	Weight Grams	Price River Inflow below Scofield Dam: Acre-Feet	Weight Grams
					0																							
	Oct	311	0.0134	5,125	365	0.0897	40,352	675	0.0546	45,472	429	0.0700	37,050	75	0.0350	3,219	-139	0.0590	-10,079	1,040	75,603	390	-400,232	18,080	0.0606	2,418,374	1,103	31,657
	Nov	258	0.0134	4,260	211	0.0490	12,757	469	0.0294	17,018	388	0.0670	32,029	52	0.0190	1,222	35	0.0443	1,917	944	52,185	114	2,150,548	18,537	0.0150	713,022	373	6,893
	Dec	254	0.0134	4,190	275	0.0358	12,126	529	0.0250	16,316	400	0.0700	34,503	59	0.0500	3,617	683	0.0447	37,660	1,670	92,098	0	-409,961	19,900	0.0345	1,205,888	307	9,275
1994	Jan	198	0.0134	3,279	323	0.0187	7,506	524	0.0167	10,783	399	0.0380	18,670	58	0.0500	3,580	15	0.0273	507	995	33,552	0	-470,698	30,380	0.0339	1,647,225	307	12,833
	Feb	177	0.0134	2,925	398	0.0271	33,319	1,375	0.0250	36,244	530	0.0700	45,762	129	0.0500	7,958	-164	0.0398	-8,048	1,670	81,910	0	-1,087,782	41,986	0.0550	2,848,387	273	18,337
	Mar	244	0.0134	4,018	1,538	0.0328	61,851	1,782	0.0300	65,869	632	0.0800	64,338	195	0.0500	12,030	-1,162	0.0429	-62,911	1,865	79,318	0	-817,238	43,397	0.0648	3,736,387	51	-4,603
	Apr	1,188	0.0134	19,547	2,228	0.0311	91,008	3,416	0.0263	110,591	982	0.1000	121,131	373	0.0600	27,607	-556	0.0461	-30,207	4,215	229,113	0	371,298	41,084	0.0612	3,481,830	2,348	192,371
	May	6,391	0.0134	73,096	4,992	0.1287	615,338	8,399	0.0671	711,234	2,027	0.1320	329,959	937	0.1020	117,885	-495	0.0813	-49,639	10,052	1,308,713	919	1,227,843	47,761	0.0488	2,874,909	8,436	507,795
	Jun	1,028	0.0134	15,942	962	0.0317	40,002	1,990	0.0232	56,943	694	0.0720	61,665	216	0.0430	11,550	-132	0.0364	-5,945	2,769	124,214	1,132	1,475,833	39,640	0.0230	1,322,390	9,758	300,900
	Jul	213	0.0134	3,161	344	0.0241	10,231	637	0.0190	15,392	425	0.0460	24,136	73	0.0670	5,996	-1,071	0.0320	-42,227	84	7,298	1,112	-2,598,735	27,706	0.0895	2,744,291	10,905	1,080,132
	Aug	260	0.0134	4,292	207	-0.0058	-1,473	471	0.0060	2,019	388	0.0455	50,598	53	0.0370	2,606	-148	0.0241	-4,405	766	33,808	844	-1,571,174	19,818	0.1278	3,131,689	7,810	1,226,384
	Sep	243	0.0134	4,005	97	0.1153	13,764	340	0.0424	17,770	369	0.0310	15,020	38	0.0530	2,480	-326	0.0324	-24,233	214	9,843	556	1,890,173	17,170	0.0510	1,078,166	2,343	147,393
					0																							
Total/Average		9,072	0.0134	149,375	11,549	0.0672	956,979	30,621	0.0438	1,106,553	7,675	0.0849	803,663	2,258	0.0721	200,833	-2,670	0.0299	-98,332	27,884	2,012,720	5,083	-200,178	96,633	0.0500	2,287,715	44,217	3,588,772
					0																							
	Oct	328	0.0126	5,082	236	0.1130	32,867	563	0.0546	37,949	407	0.0700	35,104	62	0.0350	2,694	362	0.0595	26,553	1,394	105,290	272	-174,045	17,602	0.0600	1,307,132	598	14,358
	Nov	227	0.0126	3,518	231	0.0437	13,220	462	0.0294	16,737	388	0.0670	37,000	51	0.0190	1,202	193	0.0450	10,606	1,090	60,405	81	1,022,141	18,027	0.0150	337,850	649	12,000
	Dec	240	0.0126	3,806	260	0.0368	11,771	505	0.0250	15,578	395	0.0700	34,088	56	0.0500	3,456	241	0.0450	13,387	1,197	66,509	0	-190,847	18,912	0.0249	591,531	307	9,275
1995	Jan	245	0.0126	3,797	276	0.0204	6,918	521	0.0167	10,735	398	0.0180	18,650	58	0.0500	3,564	478	0.0273	16,132	1,455	89,080	0	-231,042	20,184	0.0339	844,147	180	7,513
	Feb	223	0.0126	3,435	359	0.0327	14,496	582	0.0250	17,951	410	0.0700	35,429	64	0.0500	3,973	107	0.0440	9,073	1,224	66,676	0	-542,029	21,201	0.0550	1,445,080	111	7,322
	Mar	404	0.0126	6,300	1,196	0.0454	92,983	1,600	0.0300	59,282	618	0.0800	60,794	176	0.0500	10,824	1,610	0.0443	88,384	4,010	219,294	0	-514,884	25,184	0.0678	2,168,599	123	10,569
	Apr	426	0.0126	12,804	2,816	0.0301	105,009	3,641	0.0253	117,899	1,027	0.1000	126,739	398	0.0600	29,427	148	0.0439	7,874	5,212	281,938	0	155,689	30,069	0.0612	2,269,887	331	24,981
	May	6,625	0.0126	102,773	12,337	0.0964	1,467,023	18,966	0.0671	1,569,796	4,119	0.1320	670,703	2,067	0.1020	260,029	-894	0.0806	-88,839	24,259	2,414,669	791	1,458,995	53,814	0.0488	5,245,192	121	7,389
	Jun	10,217	0.0126	158,399	14,731	0.0082	149,335	24,948	0.0106	307,731	5,326	0.0800	525,569	2,718	0.0200	67,058	-1,523	0.0221	-41,554	31,470	858,805	1,170	1,492,590	71,343	0.0230	2,199,963	12,372	381,300
	Jul	2,118	0.0126	32,830	2,289	0.0509	143,645	4,407	0.0325	176,673	1,182	0.0420	61,235	481	0.0520	30,853	4,768	0.0350	211,133	10,838	479,879	1,334	1,433,328	60,405	0.0125	931,402	20,438	215,128
	Aug	773	0.0126	11,990	657	0.0070	5,651	1,430	0.0100	17,641	381	0.0500	21,513	157	0.0200	3,868	1,330	0.0161	26,394	3,499	69,417	1,106	-1,842,096	51,446	0.0387	2,339,716	11,313	512,200
	Sep	395	0.0126	6,087	528	0.0646	42,063	921	0.0424	48,153	479	0.0310	18,305	101	0.0530	6,623	-318	0.0395	-4,724	1,363	66,351	605	-476,866	45,302	0.0510	2,681,292	8,242	392,643
					0																							
Total/Average		22,629	0.0126	350,834	35,920	0.0462	2,045,290	58,549	0.0332	2,396,134	13,327	0.0868	1,640,932	6,389	0.0517	423,571	4,745	0.0327	272,397	67,010	4,772,124	5,359	1,203,923	36,149	0.0383	3,708,201	32,788	1,725,074
					0																							
	Oct	293	0.0123	4,441	560	0.0765	53,018	853	0.0546	57,461	483	0.0700	49,150	84	0.0350	4,096	-763	0.0584	-53,522	660	48,143	413	-479,236	42,430	0.0600	3,143,171	3,587	265,303
	Nov	299	0.0123	4,533	473	0.0402	23,470	772	0.0294	28,004	449	0.0670	37,080	85	0.0100	1,005	226	0.0416	11,627	1,532	78,708	119	2,409,025	43,114	0.0150	797,789	770	14,242
	Dec	257	0.0123	3,899	379	0.0335	15,657	632	0.0250	19,498	420	0.0700	36,301	70	0.0500	4,310	585	0.0494	31,329	1,708	91,436	0	-465,384	44,208	0.0343	1,385,970	814	16,549
1996	Jan	168	0.0123	2,547	513	0.0181	11,488	681	0.0167	14,033	430	0.0180	20,171	75	0.0500	4,640	275	0.0261	8,996	1,464	47,833	0	-525,859	45,318	0.0339	1,894,974	351	14,696
	Feb	194	0.0123	2,939	518	0.0298	19,018	712	0.0250	21,956	437	0.0700	37,691	79	0.0500	4,846	705	0.0430	38,910	1,907	103,408	0	-1,229,530	46,453	0.0550	3,151,472	833	36,446
	Mar	268	0.0123	4,053	948	0.0350	40,920	1,215	0.0300	44,972	538	0.0800	53,096	131	0.0500	8,227	122	0.0457	6,853	2,006	113,149	0	-997,805	47,511	0.0698	4,093,420	931	79,298
	Apr	731	0.0123	11,063	3,508	0.0292	128,069	4,235	0.0263	137,133	1,147	0.1000	141,520	462	0.0600	34,315	422	0.0434	22,577	6,267	315,645	0	366,692	47,541	0.0612	3,588,810	6,267	471,094
	May	8,305	0.0123	130,123	13,626	0.1017	1,708,926	22,220	0.0671	1,839,049	4,776	0.1320	777,563	2,421	0.1020	304,607	72	0.0805	7,167	29,483	2,928,386	934	1,936,723	73,500	0.0488	4,424,278	2,595	156,209
	Jun	2,709	0.0123	41,016	3,291	0.0264	106,988	5,999	0.0200	148,004	1,503	0.0400	74,169	634	0.0300	24,218	2,114	0.0245	63,847	10,271	310,237	1,294	2,659,134	73,500	0.0196	1,649,493	8,977	225,588
	Jul	548	0.0123	8,291	899	0.0449	49,534	1,447	0.0325	57,923	584	0.0420	30,248	158	0.0520	10,142	590	0.0365	17,528	2,574	115,734	1,330	-2,266,819	63,319	0.0470	3,670,873	11,600	661,182
	Aug	219	0.0123	3,318	438	0.0034	732	657	0.0050	4,051	425	0.0400	20,988	73	0.0300	2,685	-573	0.0195	-13,769	582	13,925	1,121	2,116,079	51,077	0.0200	1,282,253	10,603	266,317
	Sep	199	0.0123	2,950	399	0.0571	28,119	598	0.0424	31,066	413	0.0310	15,782	68	0.0530	4,296	-162	0.0187	-7,733	910	43,415	807	-1,950,558	48,199	0.0510	3,032,090	3,881	244,133
					0																							
Total/Average		19,470	0.0123	239,113	25,344	0.0991	2,182,917	40,014	0.0487	2,403,050	11,587	0.0896	1,254,700	6,370	0.0717	408,237	3,467	0.0313	133,822	39,438	4,229,809	6,098	1,603,354	32,262	0.0417	2,018,687	51,003	2,475,718
					0																							
	Oct	225	0.0129	3,242	444	0.0758	41,470	600	0.0546	45,059	428	0.0700	36,943	74	0.0350	3,190	-64	0.0590	-4,634	1,107	80,558	420	-525,401	47,325	0.0600	3,502,381	1,568	113,768
	Nov	301	0.0129	4,781	484	0.0397	23,653	786	0.0294	28,434	451	0.0670	37,278	46	0.0190	2,025	519	0.0416	26,605	1,841	94,342	121	2,689,269	48,549	0.0150	898,197	495	9,150
	Dec	261	0.0129	4,159	325	0.0348	13,944	558	0.0250	18,133	412	0.0700	35,531	65	0.0500	4,013	917	0.0489	49,703	1,053	107,380	0	-521,375	50,777	0.0345	1,526,935	0	0
1997	Jan	250	0.0129	4,071	322	0.0197	7,839	578	0.0167	11,910	410	0.0180	19,196	64	0.0500	3,947	1,143	0.0270	38,104	2,195	73,158	0	-404,478	52,722	0.0330	2,204,589	0	0
	Feb	245	0.0129	3,898	261	0.0328	15,421	628	0.0250	19,359	419	0.0700	36,201	69	0.0500	4,271	781	0.0435	40,732	1,476	180,573	0	-1,308,842	53,954	0.0553	3,660,547	644	43,650
	Mar	330	0.0129	5,565	438	0.0394	31,003	988	0.0300	36,569	492	0.0800	48,579	101	0.0500	6,701	1,466	0.0469	84,730	3,033	176,555	0	-1,071,422	56,098	0.0698	4,829,028	921	79,296
	Apr	1,158	0.0129	18,425	2,968	0.0314	115,825	4,146	0.0263	134,243	1,129	0.1000	139,303	452	0.0600	33,896	3,484	0.0443	188,700	9,214	495,745	0	993,393	65,299	0.0612	4,929,382	0	0
	May	12,701	0.0129	206,011	15,468	0.1125	2,146,142	28,419	0.0671	2,352,154	6,026	0.1320	981,203	1,096	0.1020	139,534	4,760	0.0604	472,681	42,301	4,195,506	1,021	2,759,320	73,500	0.0488	4,424,279	13,043	1,091,379
	Jun	4,425	0.0129	70,392	4,247	0.0339	177,781	8,672	0.0232	248,178	2,043	0.0920	183,397	646	0.0450	20,153	3,993	0.0334	163,047	15,624	542,773	1,294	2,358,670	73,293	0.0250	2,250,984	14,542	448,530
	Jul	761	0.0129	12,107	1,062	0.0466	60,974	1,823	0.0325	73,085	661	0.0420	34,226	200	0.0520	12,801	396	0.0343	17,716	3,079	137,824	1,398	-1,351,206	62,909	0.0470	3,647,107	12,106	701,817
	Aug	354	0.0129	5,634	770	0.0253	24,026	1,123	0.0214	29,650	318	0.0700	44,855	121	0.0750	11,413	-70	0.0794	-3,717	1,600	82,205	1,119	-968,851	57,738	0.0666	4,474,931	5,723	431,496
	Sep	384	0.0129	6,111	709	0.0584	51,040	1,093	0.0424	57,152	313	0.0310	19,931	125	0.0530	7,849	1,546	0.0197	75,820	3,273	160,402	832	548,088	51,804	0.0510	3,258,461	8,309	326,125
					0																							
Total/Average		21,674	0.0129	344,760	27,837	0.0780	2,706,135	49,311	0.0500	3,053,897	13,501	0.0989	1,614,339	3,408	0.0794	329,819	18,821	0.0494	1,147,516	97,239	5,445,109	6,180	1,777,176	57,809	0.0461	3,284,628	77,474	4,341,223

Table A-3

Date September 25, 2006

Flow and Phosphorus Routing WITHOUT Narrows Project Using Empirical Reservoir Model

Scofield Reservoir Operation

Year Month	[redacted] Flow Acre-Feet	[redacted] mg/l Total P	[redacted] Weight Grams	(Calculated) Gains for Fish Creek Above Fish Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	[redacted] Flow Acre-Feet	Concentration mg/l	Weight Grams	Stream Flow-Mud Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams
Oct	371	0.0120	5,514	386	0.0818	38,551	951	0.0546	64,075	485	0.0700	41,893
Nov	319	0.0120	4,736	501	0.0407	24,994	820	0.0294	29,727	458	0.0670	37,872
Dec	312	0.0120	4,639	344	0.0368	15,814	657	0.0250	20,253	425	0.0700	36,729
1998 Jan	301	0.0120	4,466	331	0.0209	8,557	632	0.0167	13,023	420	0.0380	19,706
Feb	340	0.0120	5,046	452	0.0347	19,401	793	0.0250	24,448	453	0.0700	39,099
Mar	458	0.0120	6,789	696	0.0418	35,902	1,154	0.0300	42,701	326	0.0800	31,473
Apr	1,170	0.0120	17,375	2,020	0.0345	85,907	3,190	0.0263	103,282	936	0.1000	115,504
May	7,120	0.0120	105,721	11,417	0.1014	1,428,513	18,537	0.0671	1,534,234	4,033	0.1320	656,589
Jun	4,069	0.0120	60,416	6,683	0.0300	247,258	10,751	0.0232	307,672	2,462	0.0720	218,647
Jul	1,142	0.0120	16,952	3,609	0.0091	29,308	3,750	0.0106	46,360	1,049	0.0216	27,085
Aug	500	0.0120	7,310	601	0.0383	24,083	1,197	0.0214	31,594	534	0.0700	46,138
Sep	355	0.0120	5,274	447	0.1619	88,694	802	0.0950	93,968	453	0.0220	12,338
Total/Average	16,463	0.0120	244,448	30,771	0.0626	2,066,789	42,234	0.0433	2,311,237	12,237	0.0864	1,303,543
Oct	333	0.0157	6,440	435	0.0844	45,225	767	0.0546	51,673	448	0.0700	38,654
Nov	309	0.0157	5,980	552	0.0371	25,255	861	0.0294	31,235	487	0.0670	38,563
Dec	151	0.0157	2,923	462	0.0280	15,967	613	0.0250	18,890	414	0.0700	35,539
1999 Jan	88	0.0157	1,699	428	0.0169	8,922	516	0.0167	10,621	397	0.0380	18,604
Feb	141	0.0157	2,726	76	0.0187	4,574	217	0.0250	7,300	341	0.0700	29,413
Mar	230	0.0157	4,471	435	0.0377	20,410	675	0.0300	24,985	429	0.0800	42,343
Apr	539	0.0157	10,447	1,326	0.0305	49,951	1,865	0.0263	60,392	669	0.1000	82,541
May	5,794	0.0157	112,689	8,323	0.1029	1,056,287	14,117	0.0671	1,168,456	3,141	0.1320	511,420
Jun	4,176	0.0157	80,823	4,378	0.0304	163,940	8,554	0.0232	244,778	2,019	0.0790	194,207
Jul	859	0.0157	16,631	1,105	0.0466	62,105	1,964	0.0325	78,740	889	0.0420	35,702
Aug	626	0.0157	12,126	559	0.0503	34,639	1,185	0.0320	46,759	332	0.3270	214,535
Sep	435	0.0157	8,417	421	0.0700	36,318	855	0.0424	44,735	465	0.0310	17,708
Total/Average	13,682	0.0157	264,564	19,522	0.0607	1,523,666	33,209	0.0430	1,788,565	10,013	0.1020	1,259,737
Oct	249	0.0125	3,821	525	0.0746	48,265	775	0.0546	52,087	449	0.0700	38,764
Nov	230	0.0125	3,524	625	0.0338	27,485	855	0.0294	31,019	465	0.0670	38,486
Dec	176	0.0125	2,708	505	0.0294	18,302	681	0.0250	21,010	430	0.0700	37,117
2000 Jan	155	0.0125	2,376	563	0.0179	12,416	718	0.0167	14,792	438	0.0380	20,519
Feb	137	0.0125	2,101	529	0.0282	18,439	666	0.0250	20,540	427	0.0700	36,853
Mar	236	0.0125	3,631	545	0.0276	18,315	780	0.0300	28,846	450	0.0800	44,420
Apr	1,568	0.0125	24,196	2,408	0.0392	104,564	3,974	0.0263	128,670	1,095	0.1000	135,010
May	4,475	0.0125	66,785	6,630	0.1361	883,091	[illegible]	0.0671	751,876	2,125	0.1320	346,089
Jun	1,087	0.0125	16,618	1,333	0.0623	102,077	2,405	0.0400	118,696	778	0.0370	35,517
Jul	342	0.0125	5,256	517	0.0457	29,192	859	0.0325	34,449	466	0.0420	24,154
Aug	214	0.0125	3,280	346	0.0297	12,732	560	0.0200	15,625	400	0.0213	10,515
Sep	198	0.0125	3,041	375	0.0501	23,882	553	0.0424	28,922	464	0.0310	15,405
Total/Average	9,068	0.0125	139,794	12,830	0.0697	1,103,420	21,909	0.0461	1,244,704	7,935	0.0805	782,971
Oct	231	0.0121	3,466	393	0.0790	38,308	626	0.0546	42,165	419	0.0700	36,194
Nov	195	0.0121	2,874	455	0.0368	20,391	642	0.0294	23,264	422	0.0670	34,903
Dec	56	0.0121	846	346	0.0271	11,552	402	0.0250	12,398	374	0.0700	32,292
2001 Jan	14	0.0121	202	327	0.0176	4,754	241	0.0167	4,956	341	0.0380	16,003
Feb	50	0.0121	756	105	0.0271	10,220	356	0.0250	10,976	365	0.0700	31,488
Mar	242	0.0121	3,631	457	0.0395	22,262	700	0.0300	25,893	434	0.0800	42,821
Apr	1,504	0.0121	25,508	1,459	0.0277	66,352	3,362	0.0263	108,880	971	0.1000	119,791
May	5,236	0.0121	79,415	5,383	0.1206	800,407	10,619	0.0671	879,882	2,435	0.1320	396,695
Jun	832	0.0121	12,455	1,259	0.0305	47,380	2,091	0.0232	59,835	715	0.0720	63,474
Jul	305	0.0121	4,332	459	0.0459	25,080	761	0.0325	30,512	446	0.0420	23,128
Aug	228	0.0121	3,426	308	0.0398	15,045	535	0.0280	18,485	491	0.0700	34,801
Sep	151	0.0121	2,205	313	0.0442	15,882	366	0.0424	19,137	367	0.0310	14,022
Total/Average	9,069	0.0121	138,979	11,619	0.0702	1,009,908	20,699	0.0484	1,235,343	7,091	0.0891	845,221

Year Month	Stream Flow-Pondtown Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC.) Other Reservoir Inflow Scofield Reservoir (Includes errors, uptake, P recycle, etc.): Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC.) Total Inflow Above Scofield Reservoir: Flow Acre-Feet	Weight Grams	Scofield Reservoir: Evaporation Acre-Feet	Phosphorus Uptake Grams	End of Month Content: Total Acre-Feet	mg/l Measured	Weight Grams	Flow from Below Scofield Dam: Acre-Feet	Weight Grams
Oct	105	0.0350	4,516	448	0.0581	32,141	1,099	142,595	428	-348,009	45,444	0.0600	3,363,309	7,030	386,134
Nov	90	0.0190	2,116	118	0.0417	6,037	1,487	73,752	121	2,572,968	46,410	0.0150	866,083	0	0
Dec	91	0.0390	4,475	99	0.0431	5,285	1,234	68,742	0	-519,681	48,064	0.0241	1,432,516	0	0
1998 Jan	70	0.0500	4,310	993	0.0268	32,792	2,116	69,821	0	-375,952	50,180	0.0339	2,099,384	0	0
Feb	87	0.0500	5,389	-47	0.0419	-2,430	1,286	86,505	0	-1,328,754	51,466	0.0190	1,071,147	0	0
Mar	127	0.0500	7,813	1,086	0.0460	61,551	2,892	160,941	0	-1,024,614	51,437	0.0099	[illegible]	951	71,296
Apr	348	0.0600	25,788	532	0.0447	29,071	5,007	273,646	0	462,569	52,223	0.0612	3,942,699	8,218	469,213
May	2,020	0.1020	254,141	1,175	0.0806	115,660	27,764	2,760,645	360	1,946,053	73,500	0.0488	4,424,279	3,332	313,003
Jun	1,172	0.0430	62,163	1,808	0.0132	38,425	16,254	664,597	1,294	2,363,336	73,500	0.0256	2,266,536	14,999	653,314
Jul	400	0.0520	26,265	-908	0.0155	-17,289	4,301	82,221	1,339	1,198,164	64,804	0.0132	979,211	11,046	173,364
Aug	131	0.0750	12,135	1,085	0.0391	52,363	2,948	142,230	1,129	-3,813,235	55,188	0.0600	4,084,457	11,435	846,260
Sep	49	0.0470	3,123	124	0.0672	10,250	1,469	131,679	821	1,609,616	49,379	0.0371	3,105,546	6,237	290,957
Total/Average	4,731	0.0711	414,257	8,376	0.0589	361,706	68,706	5,632,803	6,104	2,342,665	55,350	0.0433	2,822,601	64,186	3,241,458
Oct	85	0.0350	3,652	-426	0.0586	-30,837	873	53,142	421	-1,333,919	44,990	0.0600	3,328,928	5,049	373,673
Nov	95	0.0190	2,220	423	0.0410	21,408	1,446	93,431	121	2,558,232	46,507	0.0150	860,481	198	3,603
Dec	68	0.0500	4,179	52	0.0436	2,805	1,149	61,832	0	-317,860	47,549	0.0243	1,430,901	307	9,273
1999 Jan	57	0.0500	3,327	180	0.0279	5,432	1,130	38,163	0	-538,083	48,172	0.0339	2,014,331	307	12,837
Feb	27	0.0500	1,653	475	0.0515	30,164	1,079	88,530	0	-1,258,431	45,974	0.0190	1,022,409	277	18,896
Mar	73	0.0500	4,399	2,092	0.0491	127,638	3,271	199,560	0	-976,089	51,819	0.0098	4,461,862	458	26,652
Apr	204	0.0600	15,110	482	0.0466	99,331	3,420	197,374	0	488,893	53,279	0.0612	4,020,474	1,980	149,469
May	1,539	0.1020	193,582	1,272	0.0609	306,211	22,070	2,199,670	365	1,743,899	72,396	0.0488	4,337,821	1,967	118,424
Jun	933	0.0656	74,776	2,073	0.0382	92,577	13,578	606,334	1,286	3,770,637	71,678	0.0160	1,008,966	13,099	192,971
Jul	215	0.0520	13,789	453	0.0062	6,722	3,020	135,001	1,332	-1,057,050	61,914	0.0430	3,360,367	11,947	662,662
Aug	130	0.0250	4,010	553	0.1165	79,462	2,480	344,764	1,114	384,049	55,555	0.0614	3,122,895	7,445	416,515
Sep	96	0.0530	6,137	77	0.0386	3,714	1,491	72,496	820	-354,348	54,094	0.0310	2,001,062	3,528	247,775
Total/Average	3,550	0.0754	327,234	9,584	0.0590	738,649	51,326	4,582,294	5,089	840,548	55,875	0.0431	3,897,598	47,981	2,341,604
Oct	85	0.0190	3,681	-1,326	0.0586	-124,843	-417	-32,115	422	-332,734	44,026	0.0600	3,234,201	6,026	445,981
Nov	94	0.0190	2,307	-940	0.0411	-47,629	475	24,044	120	2,461,222	43,392	0.0150	806,553	139	14,389
Dec	77	0.0500	4,646	-38	0.0429	-1,582	1,157	61,244	0	-434,549	44,649	0.0243	1,342,997	208	8,849
2000 Jan	79	0.0500	4,887	385	0.0294	18,395	1,800	58,593	0	-331,960	48,331	0.0339	1,999,616	198	11,936
Feb	76	0.0500	4,597	956	0.0401	49,603	2,187	113,572	0	-1,226,369	46,012	0.0190	3,237,222	98	3,354
Mar	86	0.0500	3,109	618	0.0464	34,966	1,734	163,952	0	-822,230	43,740	0.0099	4,201,895	0	0
Apr	434	0.0600	33,108	-280	0.0436	-13,849	5,252	382,545	0	413,573	53,944	0.0612	4,072,309	1,034	79,374
May	990	0.1000	124,612	1,402	0.0870	116,894	15,363	1,339,072	380	1,418,118	73,549	0.0488	3,524,280	7,739	408,869
Jun	563	0.0190	12,434	232	0.0392	10,797	3,609	177,615	1,286	-1,197,743	51,402	0.0642	4,145,676	9,615	736,815
Jul	95	0.0520	3,669	84	0.0369	3,815	1,504	68,487	1,208	1,203,440	41,629	0.0430	3,413,409	10,269	909,323
Aug	62	0.0134	2,003	-403	0.0212	-36,019	527	10,328	990	-4,682,739	33,454	0.1800	3,334,231	7,808	778,216
Sep	41	0.0530	4,085	-233	0.0385	-31,047	786	33,346	690	1,261,399	31,987	0.0310	2,603,232	3,037	108,992
Total/Average	2,598	0.0701	297,592	-746	-0.0026	15,998	32,048	3,210,196	5,630	179,335	45,369	0.0555	2,863,654	49,826	3,365,280
Oct	69	0.0350	2,588	360	0.0592	19,634	1,283	190,992	385	-328,763	32,209	0.0600	2,380,214	139	18,747
Nov	75	0.0190	1,662	669	0.0427	24,709	1,603	84,531	107	1,848,098	33,186	0.0150	616,854	139	10,799
Dec	45	0.0500	2,764	-79	0.0469	-4,595	741	42,858	0	-368,428	33,618	0.0245	1,013,961	308	8,349
2001 Jan	27	0.0500	1,679	2,183	0.0301	88,626	2,994	111,265	0	-403,742	36,301	0.0339	1,518,813	189	13,026
Feb	40	0.0500	2,454	100	0.0479	21,799	1,129	60,777	0	-904,757	37,133	0.0190	3,720,351	279	18,955
Mar	77	0.0500	4,763	1,062	0.0492	64,445	2,273	137,931	0	-710,024	39,426	0.0098	3,358,509	0	0
Apr	367	0.0600	27,176	760	0.0441	42,805	5,487	298,632	0	302,605	44,833	0.0612	3,384,443	89	3,007
May	1,158	0.1020	145,689	106	0.0811	10,567	14,317	1,431,384	917	1,310,727	51,639	0.0488	3,228,777	4,598	278,525
Jun	229	0.0370	10,449	-204	0.0357	-8,970	2,831	124,778	1,171	-2,046,813	46,797	0.0290	3,244,836	8,504	853,312
Jul	84	0.0520	5,383	229	0.0371	10,445	1,520	69,468	1,174	2,583,377	38,478	0.0470	2,290,737	8,062	504,217
Aug	39	0.0500	4,531	1,100	0.0469	63,724	2,095	121,321	962	-2,753,663	33,249	0.1342	4,156,904	7,361	848,813
Sep	41	0.0530	2,072	74	0.0378	3,403	847	39,250	686	2,157,285	29,316	0.0518	1,798,941	4,190	257,912
Total/Average	2,267	0.0720	212,151	6,565	0.0410	336,109	37,322	2,629,306	5,392	-190,131	39,022	0.0558	2,613,329	35,477	3,043,704

Date: September 25, 2006

Table A-3

Flow and Phosphorus Routing WITHOUT Narrows Project Using Empirical Reservoir Model

Scofield Reservoir Operation

Year	Month	[redacted] Flow Acre-Feet	[redacted] mg/l Table	[redacted] Weight Grams	(Calculated) Gain for Fish Creek Above Fish Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	[redacted] Flow Acre-Feet	Concentration mg/l	Weight Grams
					0					
	Oct	133	0.0126	2,076	332	0.0714	29,259	[redacted]	0.0546	31,335
	Nov	200	0.0126	3,120	245	0.0451	13,914	445	0.0294	16,134
	Dec	161	0.0126	2,516	166	0.0370	7,572	327	0.0250	10,089
2002	Jan	75	0.0126	1,167	189	0.0183	4,270	264	0.0167	5,437
	Feb	29	0.0126	458	162	0.0252	5,490	191	0.0250	5,898
	Mar	58	0.0126	909	351	0.0329	14,218	409	0.0300	15,127
	Apr	1,299	0.0126	20,093	1,764	0.0362	78,766	3,053	0.0263	98,859
	May	3,038	0.0126	47,361	3,838	0.1102	521,626	6,875	0.0671	568,987
	Jun	636	0.0126	9,907	1,111	0.0085	11,634	1,746	0.0100	21,541
	Jul	256	0.0126	3,990	286	0.0474	16,735	542	0.0310	20,725
	Aug	120	0.0126	1,875	173	0.0607	12,963	293	0.0410	14,838
	Sep	165	0.0126	2,565	277	0.0084	2,879	441	0.0100	5,444
					0					
Total/Average		6,161	0.0126	95,039	8,891	0.0655	718,373	15,052	0.0419	814,411
	Oct	187	0.0133	3,054	262	0.0368	11,889	449	0.0270	14,943
	Nov	125	0.0133	2,042	418	0.0735	38,139	543	0.0600	40,181
	Dec	27	0.0133	438	257	0.0259	11,411	284	0.0250	11,849
2003	Jan	54	0.0133	880	413	0.0096	4,874	466	0.0100	5,754
	Feb	97	0.0133	1,586	267	0.0293	9,627	364	0.0250	11,213
	Mar	135	0.0133	2,210	393	0.0357	17,331	528	0.0300	19,541
	Apr	743	0.0133	12,155	1,608	0.0322	63,965	2,351	0.0263	76,119
	May	5,909	0.0133	96,651	6,371	0.0513	403,045	12,276	0.0330	499,696
	Jun	1,717	0.0133	28,099	2,180	0.0074	19,966	3,897	0.0100	48,065
	Jul	353	0.0133	5,777	586	0.0441	31,871	939	0.0325	37,648
	Aug	233	0.0133	3,818	292	0.0074	2,663	525	0.0100	5,481
	Sep	168	0.0133	2,742	215	0.0075	1,977	384	0.0100	4,719
					0					
Total/Average		9,742	0.0133	159,452	13,363	0.0374	616,757	23,105	0.0272	776,209
	Oct	116	0.0136	1,980	215	0.0080	2,108	331	0.0100	4,088
	Nov	173	0.0136	2,895	262	0.0198	12,894	435	0.0294	15,789
	Dec	133	0.0136	2,229	226	0.0717	6,843	359	0.0250	11,073
2004	Jan	136	0.0136	2,278	219	0.0186	5,042	355	0.0167	7,321
	Feb	145	0.0136	2,423	186	0.0339	7,784	331	0.0250	10,206
	Mar	253	0.0136	4,243	495	0.0384	23,453	748	0.0300	27,696
	Apr	1,664	0.0136	28,189	4,619	0.0311	169,361	6,283	0.0263	197,550
	May	3,730	0.0136	62,456	4,869	0.1061	649,286	8,599	0.0671	711,742
	Jun	1,116	0.0136	18,681	738	0.0322	29,325	1,855	0.0210	48,006
	Jul	325	0.0136	5,439	363	0.0495	22,120	687	0.0325	27,559
	Aug	165	0.0136	2,767	121	0.0051	769	287	0.0100	3,536
	Sep	137	0.0136	2,293	142	0.0702	12,308	279	0.0424	14,601
					0					
Total/Average		8,115	0.0136	135,874	12,232	0.0624	893,295	20,348	0.0430	1,070,169
	Oct	232	0.0137	3,909	342	0.0075	3,170	574	0.0100	7,079
	Nov	165	0.0137	2,770	249	0.0398	12,239	414	0.0294	15,014
	Dec	138	0.0137	2,331	234	0.0078	2,257	372	0.0100	4,588
2005	Jan	139	0.0137	2,348	225	0.0186	5,149	364	0.0167	7,498
	Feb	147	0.0137	2,482	195	0.0335	8,066	342	0.0250	10,548
	Mar	203	0.0137	3,431	281	0.0418	14,484	484	0.0300	17,914
	Apr	843	0.0137	14,282	1,809	0.0303	67,506	2,652	0.0250	81,788
	May	9,290	0.0137	156,760	16,655	0.0874	1,795,300	25,945	0.0610	1,952,200
	Jun	4,673	0.0137	78,852	6,736	0.0298	247,688	11,411	0.0232	326,541
	Jul	729	0.0137	12,296	910	0.0071	7,919	1,639	0.0100	20,215
	Aug	451	0.0137	7,601	507	0.0067	4,210	958	0.0100	11,811
	Sep	285	0.0137	4,799	357	0.0071	3,114	642	0.0100	7,913
					0					
Total/Average		17,298	0.0137	291,788	28,498	0.0618	2,171,302	45,796	0.0436	2,463,090
78-05	Total	400,512		6,466,610	648,615		54,259,545	1,049,126		60,726,163
78-05	Average	14,304	0.0131	230,951	23,165	0.0678	1,937,841	37,469	0.0469	2,168,792
78-89	Total	200,780		3,233,948	350,614		30,072,665	551,394		33,306,613
78-89	Average	16,732	0.0131	269,662	29,218	0.0695	2,506,055	45,950	0.0490	2,775,718

Year	Month	Stream Flow-Mud Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	Stream Flow-Pondtown Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Other Reservoir Inflow Scofield Reservoir (Includes minor, intake, P recycle, etc.): Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Total Inflow Above Scofield Reservoir: Flow Acre-Feet	Weight Grams	(Walker-Noble) Scofield Reservoir: Evaporation Acre-Feet	Phosphorus Uptake (Grams)	End of Month Content: Volume Acre-Feet	mg/l Phosphorus	Weight Grams	Price River Below Scofield Dam: Flow Acre-Feet	Weight Grams
	Oct	387	0.0700	33,393	52	0.0350	2,232	417	0.0604	30,889	1,321	97,849	345	-228,639	25,393	0.0600	1,894,106	3,893	273,323
	Nov	383	0.0670	31,623	45	0.0190	1,160	1,270	0.0452	70,811	2,147	119,727	97	1,302,305	26,934	0.0450	498,539	709	13,110
	Dec	359	0.0700	30,987	37	0.0500	2,361	209	0.0466	12,536	932	55,873	0	-287,900	27,556	0.0045	832,562	309	9,349
2002	Jan	346	0.0385	16,224	30	0.0500	1,856	345	0.0298	13,652	984	38,149	0	-354,521	28,231	0.0039	1,180,496	309	12,936
	Feb	331	0.0700	28,620	22	0.0500	1,348	3,370	0.0534	222,527	3,923	258,394	0	-742,542	31,875	0.0658	2,162,875	279	18,956
	Mar	375	0.0800	37,039	46	0.0500	2,809	1,233	0.0377	83,148	2,085	158,124	0	-621,254	33,750	0.0666	2,905,811	210	18,042
	Apr	509	0.1000	112,103	314	0.0600	24,686	246	0.0445	13,641	4,544	249,291	0	-264,272	37,282	0.0612	2,814,417	1,012	76,412
	May	1,480	0.1120	271,509	759	0.1050	94,332	419	0.0816	41,122	9,715	877,947	862	1,015,409	33,834	0.0488	2,036,601	13,299	740,554
	Jun	646	0.0100	23,675	191	0.0250	15,449	369	0.0193	8,414	3,952	57,276	1,005	1,583,084	38,325	0.0118	412,382	7,453	108,510
	Jul	402	0.0420	20,838	60	0.0520	3,832	-732	0.0367	34,023	252	11,391	991	-1,176,386	26,412	0.0470	1,531,387	1,190	65,972
	Aug	352	0.0100	4,341	33	0.0750	3,051	1,272	0.0266	41,600	1,951	63,501	827	134,619	25,143	0.0430	1,333,585	2,395	127,006
	Sep	382	0.0310	14,606	49	0.0530	3,209	1,206	0.0216	12,160	2,079	53,417	816	-284,717	23,254	0.0510	1,588,821	1,550	84,897
Total/Average		6,551	0.0776	627,150	1,652	0.0737	154,222	8,426	0.0461	535,567	32,881	2,131,358	4,725	771,610	29,183	0.0444	1,599,249	31,310	1,531,870
	Oct	383	0.0700	33,104	55	0.0350	2,154	417	0.0461	24,854	1,319	75,056	325	-278,655	25,888	0.0600	1,901,174	559	41,359
	Nov	402	0.0670	33,257	50	0.0190	1,410	632	0.0501	47,010	1,637	121,857	97	1,149,242	26,929	0.0150	498,245	299	5,539
	Dec	370	0.0700	31,982	46	0.0500	2,644	1,891	0.0472	110,189	2,684	156,603	0	-240,135	29,308	0.0045	863,694	309	9,349
2003	Jan	387	0.0300	19,119	52	0.0500	3,197	1,516	0.0243	45,430	2,426	72,520	0	-308,617	31,470	0.0035	1,311,917	310	10,935
	Feb	366	0.0700	31,624	41	0.0500	2,506	819	0.0477	48,219	1,592	93,554	0	-833,255	32,948	0.0050	2,227,359	112	7,598
	Mar	399	0.0800	39,414	59	0.0500	3,610	2,357	0.0514	150,160	3,353	212,758	0	-677,412	36,289	0.0694	3,324,372	12	1,031
	Apr	767	0.1000	94,626	257	0.0600	19,025	590	0.0456	32,189	3,965	222,960	0	308,570	39,955	0.0672	3,014,636	319	24,104
	May	2,770	0.1120	450,933	1,328	0.1020	168,349	-2,193	0.0534	-149,773	14,101	969,205	893	778,984	48,090	0.0481	2,948,923	4,232	253,972
	Jun	1,079	0.0100	13,309	425	0.0240	12,594	3,079	0.0111	42,156	8,470	116,127	1,141	2,092,319	47,776	0.0164	425,026	8,553	147,698
	Jul	482	0.0420	24,988	103	0.0520	6,626	38	0.0348	3,394	1,611	73,254	1,182	-1,896,449	38,126	0.0470	1,210,344	10,080	584,389
	Aug	399	0.0100	4,920	38	0.0750	5,389	-170	0.0139	-2,912	812	13,877	960	-111,594	29,755	0.0484	1,145,432	8,223	392,289
	Sep	270	0.0310	10,139	45	0.0530	2,791	602	0.0221	18,027	1,457	39,086	661	261,355	28,976	0.0510	1,449,497	3,613	227,273
Total/Average		8,176	0.0784	790,449	2,326	0.0738	230,296	9,718	0.0309	370,569	43,528	2,167,525	5,254	154,219	34,512	0.0646	1,599,793	36,394	1,907,059
	Oct	360	0.0700	31,062	37	0.0350	1,603	299	0.0499	15,105	1,028	51,858	337	-298,247	26,192	0.0600	1,938,458	1,434	106,157
	Nov	381	0.0670	31,464	51	0.0190	1,135	595	0.0434	33,327	1,460	81,718	98	1,510,342	27,214	0.0150	380,611	339	6,278
	Dec	365	0.0700	31,543	46	0.0500	2,475	252	0.0478	14,851	1,018	59,944	0	-289,674	27,921	0.0045	841,000	309	9,349
2004	Jan	365	0.0380	17,098	46	0.0500	2,450	437	0.0287	22,510	1,196	69,509	0	-372,761	29,008	0.0035	1,212,993	309	12,936
	Feb	360	0.0700	31,054	37	0.0500	2,286	433	0.0485	25,207	1,050	98,783	0	-288,145	30,299	0.0050	2,053,573	139	24,572
	Mar	444	0.0800	43,801	83	0.0500	5,091	795	0.0487	70,784	2,270	156,571	0	-412,206	32,569	0.0699	2,806,151	0	0
	Apr	1,524	0.1000	187,955	666	0.0600	49,255	-1,963	0.0425	-102,964	6,327	331,796	0	199,668	36,102	0.0612	2,723,358	2,794	330,921
	May	2,028	0.1120	330,183	958	0.1020	117,967	-704	0.0813	-70,365	16,801	1,089,305	831	1,028,976	38,281	0.0483	2,504,300	7,851	471,393
	Jun	667	0.0090	32,076	207	0.0240	12,012	254	0.0274	8,544	3,977	106,678	1,053	1,646,317	33,517	0.0152	632,317	8,648	126,225
	Jul	432	0.0420	22,358	76	0.0520	4,868	-342	0.0372	-15,667	325	39,318	1,043	-1,280,312	26,822	0.0470	1,554,975	6,300	370,994
	Aug	351	0.0100	4,326	73	0.0440	3,750	-491	0.0116	-7,091	178	2,961	832	-665,290	20,767	0.0584	1,903,349	5,992	355,425
	Sep	349	0.0310	13,353	31	0.0530	2,055	-256	0.0349	-11,045	604	18,346	556	660,351	18,426	0.0510	1,159,178	1,498	108,194
Total/Average		7,624	0.0825	776,242	2,221	0.0738	202,948	-199	0.0090	1,478	30,421	2,054,837	4,773	588,011	29,485	0.0459	1,636,851	34,150	2,006,243
	Oct	403	0.0700	35,286	84	0.0350	2,745	981	0.0350	24,179	1,557	69,286	282	-253,341	19,035	0.0600	1,408,296	712	53,091
	Nov	378	0.0670	31,105	48	0.0190	1,081	874	0.0457	49,156	1,711	96,538	84	1,123,008	20,560	0.0150	380,600	102	1,856
	Dec	368	0.0700	31,766	42	0.0500	2,562	585	0.0466	34,140	1,447	73,058	0	-212,193	21,895	0.0045	661,665	132	3,986
2005	Jan	366	0.0380	17,170	41	0.0500	2,508	1,385	0.0286	45,269	2,056	72,484	0	-267,365	23,793	0.0039	994,415	168	7,058
	Feb	342	0.0700	31,247	38	0.0500	2,361	582	0.0482	34,635	1,328	78,392	0	-630,040	24,946	0.0050	1,653,948	167	11,359
	Mar	391	0.0800	39,539	54	0.0500	3,315	1,160	0.0522	74,630	2,088	134,418	0	-500,846	27,022	0.0098	2,226,491	0	115
	Apr	823	0.1000	102,112	290	0.0600	21,450	1,445	0.0442	100,491	5,614	305,823	0	168,668	32,626	0.0612	2,462,644	0	0
	May	5,527	0.1120	899,949	2,427	0.1020	355,682	-1,901	0.0758	-140,422	32,798	3,067,388	639	1,641,582	54,587	0.0488	1,447,759	28	1,691
	Jun	2,595	0.0230	230,461	1,244	0.0450	63,972	-380	0.0311	-9,823	15,009	635,151	1,226	2,084,496	73,500	0.0150	3,266,536	4,860	149,877
	Jul	624	0.0100	7,691	180	0.0250	4,420	277	0.0107	-3,672	2,102	28,680	1,350	362,710	63,897	0.0118	1,596,243	8,416	196,243
	Aug	486	0.0100	5,995	105	0.0100	1,299	497	0.0100	4,891	1,945	23,997	1,135	-1,886,820	59,876	0.0125	4,899,244	8,631	157,611
	Sep	422	0.0100	5,209	71	0.0100	874	110	0.0100	1,717	1,274	15,711	846	2,472,891	54,189	0.0113	3,189,720	8,120	246,836
Total/Average		12,754	0.0913	1,436,314	5,060	0.0751	464,250	5,509	0.0317	315,411	69,858	4,579,396	5,746	2,322,437	30,660	0.0410	2,057,741	27,519	1,230,291
78-05	Total	310,066		35,425,594	114,609		10,485,772	262,562		17,519,835	1,736,364	124,153,364	153,203	39,158,348	1,593,766		57,027,997	1,551,264	84,235,063
78-05	Average	11,074	0.0926	1,265,200	4,093	0.0743	374,420	9,377	0.0541	625,708	62,013	4,434,120	5,472	1,397,727	60,635	0.0455	2,393,857	55,402	3,008,417
78-89	Total	153,418		18,497,096	60,202		5,646,739	165,325		13,177,944	950,849	70,851,292	70,403	24,384,328	678,106		34,711,109	946,351	46,703,310
78-89	Average	12,785	0.0988	1,532,160	5,017	0.0766	470,562	13,461	0.0576	1,098,162	79,212	5,902,608	5,867	2,032,444	56,738	0.0437	2,864,259	78,863	3,891,943

NOTE: Average Annual Concentrations are Flow Weighted. Highlighted cells represent actual measurements

Date: 25-Sep-06

Table B-1

Lower Gooseberry Reservoir (without Narrows) Eutrophication Study

Phosphorus Content and Probability of Eutrophication

Year	Contents of Lower Gooseberry Reservoir Jun - Sep Average	Contents of Lower Gooseberry Reservoir Jun - Sep Average (V)	Surface Area at Volume of Lower Gooseberry	Surface Area at Volume of Lower Gooseberry (A)	Mean Lake Depth of Lower Gooseberry (z)	Reservoir Outflow of Lower Gooseberry	Reservoir Outflow of Lower Gooseberry (Q_o)	Reservoir Hydraulic Detention Time (t)	Annual Mass Inflow Phosphorus (J)	Areal Phosphorus Loading Rate (L)	Sedimentation Coefficient (s)	Phosphorus In Lake Concentration (P)	Standard Normal Variate (S)	Normal Curve Area (Table B-3)*	Probability of Eutrophication
	AF	m^3	Acres	m^2	m	AF	m^3/yr	yr	g/yr	$g/m^2/yr$		mg/L			
1978	212	261,500	57	231,886	1.1277	17,434	21,504,647	0.0122	302,199	1.3032	7.2632	0.0129	0.7225	0.2651	0.2349
1979	212	261,500	57	231,886	1.1277	11,916	14,698,255	0.0178	205,774	0.8874	5.7919	0.0127	0.7509	0.2737	0.2263
1980	212	261,500	57	231,886	1.1277	18,480	22,794,877	0.0115	321,960	1.3884	7.5393	0.0130	0.7114	0.2617	0.2383
1981	212	261,500	57	231,886	1.1277	9,213	11,364,134	0.0230	158,027	0.6815	4.9578	0.0125	0.7785	0.2819	0.2181
1982	212	261,500	57	231,886	1.1277	17,761	21,907,998	0.0119	309,348	1.3341	7.3639	0.0130	0.7140	0.2625	0.2375
1983	212	261,500	57	231,886	1.1277	27,101	33,428,785	0.0078	480,423	2.0718	9.5436	0.0134	0.6646	0.2470	0.2530
1984	212	261,500	57	231,886	1.1277	28,114	34,678,310	0.0075	492,606	2.1243	9.6854	0.0132	0.6814	0.2523	0.2477
1985	212	261,500	57	231,886	1.1277	20,049	24,730,221	0.0106	352,931	1.5220	7.9584	0.0132	0.6907	0.2552	0.2448
1986	212	261,500	57	231,886	1.1277	24,531	30,258,719	0.0086	427,730	1.8446	8.9124	0.0131	0.6956	0.2568	0.2432
1987	212	261,500	57	231,886	1.1277	8,305	10,244,126	0.0255	152,240	0.6565	4.8500	0.0132	0.6831	0.2528	0.2472
1988	212	261,500	57	231,886	1.1277	9,310	11,483,783	0.0228	163,479	0.7050	5.0578	0.0128	0.7414	0.2709	0.2291
1989	212	261,500	57	231,886	1.1277	8,566	10,566,067	0.0247	155,114	0.6689	4.9037	0.0131	0.6998	0.2581	0.2419
1990	212	261,500	57	231,886	1.1277	8,076	9,961,394	0.0263	160,072	0.6903	4.9955	0.0142	0.5648	0.2140	0.2860
1991	212	261,500	57	231,886	1.1277	11,713	14,447,767	0.0181	220,820	0.9523	6.0377	0.0138	0.6153	0.2309	0.2691
1992	212	261,500	57	231,886	1.1277	5,383	6,640,025	0.0394	103,879	0.4480	3.8723	0.0136	0.6400	0.2390	0.2610
1993	212	261,500	57	231,886	1.1277	17,148	21,151,903	0.0124	292,061	1.2595	7.1187	0.0127	0.7511	0.2738	0.2262
1994	212	261,500	57	231,886	1.1277	9,072	11,190,534	0.0234	167,509	0.7224	5.1309	0.0134	0.6655	0.2472	0.2528
1995	212	261,500	57	231,886	1.1277	22,629	27,913,165	0.0094	378,073	1.6304	8.2876	0.0126	0.7671	0.2785	0.2215
1996	212	261,500	57	231,886	1.1277	14,470	17,848,682	0.0147	239,442	1.0326	6.3326	0.0123	0.8060	0.2899	0.2101
1997	212	261,500	57	231,886	1.1277	21,674	26,734,361	0.0098	372,462	1.6062	8.2149	0.0129	0.7247	0.2658	0.2342
1998	212	261,500	57	231,886	1.1277	16,463	20,307,011	0.0129	265,639	1.1456	6.7320	0.0120	0.8384	0.2991	0.2009
1999	212	261,500	57	231,886	1.1277	13,687	16,882,895	0.0155	294,312	1.2692	7.1509	0.0157	0.4003	0.1556	0.3444
2000	212	261,500	57	231,886	1.1277	9,060	11,175,441	0.0234	155,265	0.6696	4.9066	0.0125	0.7811	0.2827	0.2173
2001	212	261,500	57	231,886	1.1277	9,040	11,151,311	0.0235	150,707	0.6499	4.8212	0.0121	0.8241	0.2951	0.2049
2002	212	261,500	57	231,886	1.1277	6,161	7,599,584	0.0344	109,219	0.4710	3.9883	0.0126	0.7581	0.2759	0.2241
2003	212	261,500	57	231,886	1.1277	9,742	12,016,064	0.0218	177,900	0.7672	5.3160	0.0133	0.6774	0.2510	0.2490
2004	212	261,500	57	231,886	1.1277	8,115	10,009,749	0.0261	153,150	0.6605	4.8671	0.0136	0.6400	0.2390	0.2610
2005	212	261,500	57	231,886	1.1277	17,298	21,337,016	0.0123	318,582	1.3739	7.4926	0.0137	0.6277	0.2350	0.2650
Average	212	261,500	57	231,886	1.1277	14,304	17,643,815	0.0181	252,890	1.0906	6.3962	0.0131	0.7006		0.2425

* Table B-3 "Normal Curve Areas for Standard Normal Variate", taken from *Guidelines for Studies of Potential Eutrophication, Bureau of Reclamation, December 1981.*
Formula for Curve Areas was created and is used to calculate the number

Table B-2

Scofield Reservoir (without Narrows) Eutrophication Study

Phosphorus Content and Probability of Eutrophication

Year	Contents of Scofield Reservoir Jun - Sep Average (AF)	Contents of Scofield Reservoir Jun - Sep Average (V) (m³)	Surface Area at Volume of Scofield (Acres)	Surface Area of Scofield (A) (m²)	Mean Lake Depth of Scofield (z) (m)	Reservoir Outflow of Scofield (AF)	Reservoir Outflow of Scofield (Q_o) (m³/yr)	Reservoir Hydraulic Detention Time (t) (yr)	Annual Mass Inflow Phosphorus (J) (g/yr)	Areal Phosphorus Loading Rate (L) (g/m²/yr)	Sedimentation Coefficient (a)	Phosphorus In Lake Concentration (P) (mg/L)	Standard Normal Variate (S)	Normal Curve Area (Table B-3)*	Probability of Eutrophication
1978	53,241	65,671,688	2,530	10,240,284	6.4131	35,827	44,192,210	1.4860	4,160,196	0.4063	1.3133	0.0319	-0.7707	0.2796	0.7796
1979	58,459	72,108,232	2,606	10,546,854	6.8369	45,190	55,741,368	1.2936	4,103,569	0.3891	1.2329	0.0284	-0.5773	0.2183	0.7183
1980	61,625	76,014,344	2,651	10,729,108	7.0849	71,195	87,818,352	0.8656	5,639,686	0.5256	1.4413	0.0286	-0.5890	0.2222	0.7222
1981	42,591	52,535,532	2,355	9,530,608	5.5123	42,659	52,619,407	0.9984	1,670,914	0.1753	0.8752	0.0169	0.2735	0.1077	0.3923
1982	62,436	77,014,326	2,662	10,771,813	7.1496	73,962	91,231,704	0.8442	14,122,801	1.3111	2.4561	0.0504	-1.5252	0.4364	0.9364
1983	63,257	78,026,300	2,672	10,813,018	7.2160	148,143	182,732,293	0.4270	8,296,241	0.7672	1.7816	0.0258	-0.4195	0.1626	0.6626
1984	64,040	78,992,354	2,683	10,855,898	7.2764	152,686	188,336,828	0.4194	10,906,614	1.0047	2.0780	0.0309	-0.7206	0.2645	0.7645
1985	56,155	69,266,709	2,573	10,411,750	6.6527	92,353	113,916,223	0.6080	7,355,074	0.7064	1.7802	0.0310	-0.7239	0.2655	0.7655
1986	60,699	74,871,744	2,638	10,675,734	7.0133	108,623	133,984,988	0.5588	7,875,349	0.7377	1.7703	0.0295	-0.6444	0.2405	0.7405
1987	49,714	61,322,242	2,481	10,039,217	6.1083	37,075	45,731,605	1.3409	2,043,871	0.2036	0.8997	0.0203	-0.0210	0.0086	0.5086
1988	42,050	51,868,298	2,339	9,464,806	5.4801	38,435	47,409,150	1.0941	2,903,804	0.3068	1.2211	0.0262	-0.4472	0.1727	0.6727
1989	23,196	28,612,273	1,824	7,380,780	3.8766	40,203	49,589,958	0.5770	1,753,174	0.2375	1.2877	0.0203	-0.0232	0.0095	0.5095
1990	16,533	20,392,855	1,552	6,282,745	3.2459	30,041	37,055,243	0.5503	1,733,187	0.2759	1.5614	0.0252	-0.3788	0.1476	0.6476
1991	22,262	27,460,012	1,781	7,206,771	3.8103	34,843	42,978,457	0.6389	3,522,747	0.4888	1.9900	0.0361	-0.9745	0.3351	0.8351
1992	8,066	9,948,765	1,106	4,476,220	2.2226	19,815	24,441,044	0.4071	1,037,946	0.2319	1.7618	0.0247	-0.3506	0.1370	0.6370
1993	49,108	60,574,047	2,467	9,984,989	6.0665	31,531	38,895,661	1.5574	5,181,866	0.5190	1.5674	0.0387	-1.0908	0.3622	0.8622
1994	26,076	32,164,224	1,911	7,733,967	4.1588	44,217	54,540,601	0.5897	2,012,720	0.2602	1.3038	0.0209	-0.0697	0.0278	0.5278
1995	57,259	70,628,702	2,590	10,479,974	6.7394	52,788	65,113,259	1.0847	4,732,124	0.4515	1.3573	0.0294	-0.6360	0.2377	0.7377
1996	59,249	73,082,643	2,618	10,596,338	6.8970	51,003	62,911,547	1.1617	4,229,869	0.3992	1.2452	0.0235	-0.5248	0.2002	0.7002
1997	61,439	75,784,131	2,648	10,717,928	7.0708	77,474	95,563,869	0.7930	6,345,169	0.5920	1.5477	0.0298	-0.6590	0.2452	0.7452
1998	60,768	74,956,433	2,639	10,680,375	7.0181	64,886	80,036,229	0.9365	4,630,803	0.4336	1.2940	0.0262	-0.4433	0.1713	0.6713
1999	60,060	74,083,582	2,629	10,641,031	6.9621	47,941	59,135,096	1.2528	4,080,204	0.3834	1.2093	0.0274	-0.5219	0.1992	0.6992
2000	39,648	48,905,604	2,296	9,291,865	5.2633	45,426	56,032,108	0.8728	2,250,104	0.2422	1.0878	0.0206	-0.0488	0.0195	0.5195
2001	36,458	44,970,755	2,228	9,016,956	4.9874	35,437	43,710,992	1.0288	2,629,306	0.2916	1.2527	0.0263	-0.4510	0.1741	0.6741
2002	26,285	32,421,676	1,963	7,942,298	4.0822	31,210	38,497,045	0.8422	2,131,358	0.2684	1.3422	0.0260	-0.4325	0.1673	0.6673
2003	35,648	43,971,758	2,201	8,909,004	4.9357	36,594	45,138,570	0.9742	2,167,523	0.2433	1.1329	0.0228	-0.2184	0.0863	0.5863
2004	24,758	30,538,544	1,888	7,641,494	3.9964	34,158	42,133,065	0.7248	2,059,837	0.2696	1.3627	0.0246	-0.3416	0.1336	0.6336
2005	63,365	78,160,427	2,674	10,820,592	7.2233	27,549	33,981,801	2.3001	4,579,309	0.4232	1.2542	0.0347	-0.9094	0.3184	0.8184
Average	45,873	56,583,864	2,329	9,424,372	5.7607	55,402	68,338,095	0.9367	4,434,120	0.4480	1.4431	0.0279	-0.5086	0	0.6834

* Table B-3 "Normal Curve Areas for Standard Normal Variate", taken from *Guidelines for Studies of Potential Eutrophication, Bureau of Reclamation, December 1981.*
Formula for Curve Areas was created and is used to calculate the number

Table C-1

Date September 25, 2006

Flow and Phosphorus Routing WITH Proposed Narrows Project

Narrows Reservoir Operation

	(Fontenelle) Natural Flow-Gooseberry Creek Near Fairview			Other Inflow at Narrows Reservoir			(CALC.) Total Inflow at Narrows Reservoir			Narrows Reservoir: Diversion by Cottonwood-Gooseberry			Reservoir Evaporation	Project Irrigation Delivery			(CALC.) Phosphorus Uptake	End of Month Contents	Phosphorus		(Fontenelle) Stream Flow below Narrows Reservoir			(CALC.) Reach Gains Between Narrows Reservoir Site and Lower Gooseberry Reservoir		
Year Month	Flows Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Acre-Feet	Acre-Feet	mg/l	grams	grams	Total Acre-Feet	mg/l Table D-1	grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams
																		4377	0.0121	63,300						
Oct	96	0.0209	2,475	8	0.0209	200	104	0.0209	2,675	17	0.0121	254	32	123	0.0121	1,838	1,606	3,956	0.0121	58,812	272	0.0121	4,066	63	0.0209	1,630
Nov	104	0.0198	2,540	8	0.0198	206	112	0.0198	2,746	18	0.0121	269	9	119	0.0121	1,778	1,197	3,843	0.0121	57,425	59	0.0121	888	68	0.0198	1,658
Dec	87	0.0187	2,007	7	0.0187	163	94	0.0187	2,169	18	0.0121	269	0	123	0.0121	1,838	764	3,733	0.0121	55,007	61	0.0121	917	88	0.0187	2,028
1978 Jan	84	0.0176	1,824	7	0.0176	148	91	0.0176	1,971	17	0.0121	254	0	123	0.0121	1,838	683	3,656	0.0121	54,555	61	0.0121	917	82	0.0176	1,781
Feb	83	0.0165	1,689	7	0.0165	137	90	0.0165	1,826	16	0.0121	239	0	111	0.0121	1,659	485	3,557	0.0121	52,760	55	0.0121	828	73	0.0165	1,491
Mar	103	0.0154	1,957	8	0.0154	158	111	0.0154	2,115	21	0.0121	314	5	123	0.0121	1,838	451	3,438	0.0121	51,264	61	0.0121	917	101	0.0154	1,915
Apr	582	0.0143	10,266	47	0.0143	832	629	0.0143	11,097	114	0.0121	1,703	0	0	0.0121	0	1,697	3,893	0.0121	58,178	59	0.0121	888	515	0.0143	9,082
May	4,143	0.0131	66,946	336	0.0131	5,423	4,479	0.0131	72,368	715	0.0121	10,683	66	0	0.0121	0	4,419	7,229	0.0121	108,019	361	0.0121	5,400	2,716	0.0131	43,894
Jun	5,070	0.0141	88,178	411	0.0141	7,142	5,481	0.0141	95,321	799	0.0121	11,939	137	537	0.0121	8,021	15,475	11,178	0.0121	167,018	59	0.0121	888	2,159	0.0141	44,495
Jul	649	0.0110	8,806	53	0.0110	713	702	0.0110	9,519	101	0.0121	1,509	102	1,892	0.0121	28,270	2,052	9,623	0.0121	143,790	61	0.0121	917	313	0.0110	4,233
Aug	378	0.0176	8,206	31	0.0176	665	409	0.0176	8,871	60	0.0121	897	138	1,913	0.0121	28,591	3,119	7,840	0.0121	117,147	61	0.0121	917	197	0.0176	4,283
Sep	171	0.0240	5,062	14	0.0240	410	185	0.0240	5,472	28	0.0121	418	102	336	0.0121	5,022	3,272	7,500	0.0121	112,060	59	0.0121	888	99	0.0240	2,935
WY Total/Average	11,550	0.0140	199,933	936	0.0140	16,199	12,486	0.0140	216,131	1,924	0.0121	28,748	705	5,400	0.0121	80,682	40,132	5,781	0.0121	86,378	1,210	0.0121	18,430	6,972	0.0141	119,397
Oct	34	0.0209	877	3	0.0209	71	37	0.0209	948	6	0.0094	70	32	219	0.0094	2,515	25,196	7,169	0.0094	83,494	51	0.0094	712	9	0.0209	236
Nov	153	0.0198	3,737	12	0.0198	303	165	0.0198	4,039	42	0.0094	487	13	119	0.0094	1,380	2,293	7,129	0.0094	82,684	59	0.0094	689	138	0.0198	3,363
Dec	97	0.0187	2,237	8	0.0187	181	105	0.0187	2,419	28	0.0094	325	0	123	0.0094	1,427	1,202	7,021	0.0094	81,437	61	0.0094	712	96	0.0187	2,215
1979 Jan	93	0.0176	2,019	8	0.0176	164	101	0.0176	2,183	28	0.0094	325	0	123	0.0094	1,427	1,016	6,902	0.0094	80,140	61	0.0094	712	99	0.0176	2,159
Feb	88	0.0165	1,791	7	0.0165	145	95	0.0165	1,936	25	0.0094	290	0	111	0.0094	1,287	833	6,813	0.0094	79,023	55	0.0094	643	86	0.0165	1,748
Mar	99	0.0154	1,881	8	0.0154	132	107	0.0154	2,033	28	0.0094	325	0	123	0.0094	1,427	792	6,700	0.0094	77,801	61	0.0094	712	93	0.0154	1,766
Apr	294	0.0143	5,186	24	0.0143	420	318	0.0143	5,606	76	0.0094	882	0	0	0.0094	0	1,920	6,890	0.0094	79,916	59	0.0094	689	234	0.0143	4,133
May	4,186	0.0131	67,640	339	0.0131	5,479	4,525	0.0131	73,119	1,006	0.0094	11,669	100	0	0.0094	0	21,893	9,939	0.0094	115,283	361	0.0094	4,192	2,761	0.0131	44,613
Jun	2,256	0.0141	39,237	183	0.0141	3,178	2,439	0.0141	42,415	489	0.0094	5,672	177	321	0.0094	6,066	16,180	11,170	0.0094	129,060	59	0.0094	689	1,100	0.0141	19,130
Jul	471	0.0110	6,391	38	0.0110	518	509	0.0110	6,908	99	0.0094	1,137	201	1,825	0.0094	21,172	3,736	9,453	0.0094	109,643	61	0.0094	712	198	0.0110	2,684
Aug	247	0.0176	5,362	20	0.0176	434	267	0.0176	5,797	52	0.0094	603	183	1,883	0.0094	21,844	4,301	7,568	0.0094	87,776	61	0.0094	712	112	0.0176	2,431
Sep	177	0.0240	4,156	11	0.0240	325	148	0.0240	4,384	32	0.0094	371	99	357	0.0094	4,069	3,814	7,173	0.0094	83,210	59	0.0094	689	84	0.0240	2,484
WY Total/Average	8,215	0.0140	142,415	663	0.0140	11,551	8,874	0.0140	151,786	1,910	0.0094	22,154	808	5,400	0.0094	62,631	83,979	7,020	0.0094	90,702	1,022	0.0094	11,862	5,010	0.0141	86,970
Oct	139	0.0209	3,583	11	0.0209	290	150	0.0209	3,874	22	0.0121	328	50	123	0.0121	1,832	-21,231	7,066	0.0121	105,251	61	0.0121	914	161	0.0209	3,597
Nov	120	0.0198	2,931	10	0.0198	237	130	0.0198	3,168	19	0.0121	283	15	119	0.0121	1,772	1,454	6,986	0.0121	104,035	59	0.0121	886	90	0.0198	2,201
Dec	116	0.0187	2,676	9	0.0187	217	125	0.0187	2,892	21	0.0121	313	0	123	0.0121	1,832	1,025	6,906	0.0121	102,874	61	0.0121	914	111	0.0187	2,351
1980 Jan	104	0.0176	2,258	8	0.0176	183	112	0.0176	2,441	21	0.0121	313	0	123	0.0121	1,832	787	6,815	0.0121	101,450	61	0.0121	914	134	0.0176	2,883
Feb	99	0.0165	2,015	8	0.0165	163	107	0.0165	2,178	19	0.0121	283	0	111	0.0121	1,653	565	6,730	0.0121	100,232	55	0.0121	826	113	0.0165	2,299
Mar	112	0.0154	2,128	9	0.0154	172	121	0.0154	2,300	21	0.0121	313	0	123	0.0121	1,832	497	6,650	0.0121	99,027	61	0.0121	914	115	0.0154	2,187
Apr	530	0.0143	9,349	43	0.0143	757	573	0.0143	10,106	91	0.0121	1,355	0	0	0.0121	0	1,575	7,071	0.0121	105,310	59	0.0121	884	464	0.0143	8,180
May	4,179	0.0131	67,527	338	0.0131	5,470	4,517	0.0131	72,997	640	0.0121	9,530	111	0	0.0121	0	7,782	10,478	0.0121	156,022	361	0.0121	5,381	2,753	0.0131	44,477
Jun	5,391	0.0141	93,761	437	0.0141	7,595	5,828	0.0141	101,356	753	0.0121	11,213	194	364	0.0121	5,419	17,322	14,965	0.0121	222,540	59	0.0121	884	2,725	0.0141	47,399
Jul	727	0.0110	9,864	59	0.0110	799	786	0.0110	10,663	101	0.0121	1,504	247	1,827	0.0121	27,205	2,626	13,495	0.0121	200,944	61	0.0121	914	365	0.0110	4,954
Aug	302	0.0176	6,556	24	0.0176	531	326	0.0176	7,087	42	0.0121	625	202	1,799	0.0121	26,792	5,239	11,717	0.0121	174,466	61	0.0121	914	148	0.0176	3,303
Sep	235	0.0240	6,957	19	0.0240	564	254	0.0240	7,520	33	0.0121	491	139	688	0.0121	10,242	5,811	11,051	0.0121	164,557	59	0.0121	884	475	0.0240	3,688
WY Total/Average	12,054	0.0141	209,605	976	0.0141	16,979	13,030	0.0141	226,583	1,783	0.0121	26,550	958	5,400	0.0121	80,410	23,857	9,189	0.0121	136,395	1,023	0.0121	15,225	7,233	0.0142	125,437
Oct	196	0.0209	5,053	16	0.0209	409	212	0.0209	5,462	53	0.0076	516	71	123	0.0076	1,158	84,617	10,953	0.0076	105,148	61	0.0076	578	152	0.0209	3,922
Nov	165	0.0198	4,030	13	0.0198	326	178	0.0198	4,356	50	0.0076	471	21	119	0.0076	1,121	2,873	10,882	0.0076	102,482	59	0.0076	559	154	0.0198	3,753
Dec	138	0.0187	3,183	11	0.0187	258	149	0.0187	3,441	42	0.0076	396	0	123	0.0076	1,158	2,036	10,800	0.0076	101,755	61	0.0076	578	130	0.0187	2,985
1981 Jan	113	0.0176	2,453	9	0.0176	199	122	0.0176	2,652	40	0.0076	377	0	123	0.0076	1,158	1,501	10,702	0.0076	100,792	61	0.0076	578	144	0.0176	3,123
Feb	106	0.0165	2,157	9	0.0165	175	115	0.0165	2,332	36	0.0076	339	0	111	0.0076	1,045	1,253	10,615	0.0076	99,968	55	0.0076	522	126	0.0165	2,572
Mar	162	0.0154	3,077	13	0.0154	249	175	0.0154	3,327	56	0.0076	527	0	123	0.0076	1,158	1,677	10,549	0.0076	99,330	61	0.0076	578	198	0.0154	3,759
Apr	891	0.0143	15,716	72	0.0143	1,273	963	0.0143	16,989	268	0.0076	2,524	0	0	0.0076	0	7,919	11,183	0.0076	105,337	59	0.0076	559	813	0.0143	14,333
May	2,753	0.0131	44,485	223	0.0131	3,603	2,976	0.0131	48,088	649	0.0076	6,112	160	0	0.0076	0	21,567	12,990	0.0076	122,343	361	0.0076	3,403	1,323	0.0131	21,378
Jun	1,214	0.0100	14,975	98	0.0100	1,213	1,312	0.0100	16,187	283	0.0076	2,665	215	420	0.0076	3,941	5,858	13,125	0.0076	123,607	59	0.0076	559	564	0.0100	6,956
Jul	361	0.0110	4,898	29	0.0110	397	390	0.0110	5,295	78	0.0076	735	226	1,942	0.0076	18,291	3,752	11,207	0.0076	105,546	61	0.0076	578	125	0.0110	1,693
Aug	189	0.0176	4,103	15	0.0176	332	204	0.0176	4,435	42	0.0076	396	177	2,113	0.0076	19,898	4,177	9,016	0.0076	84,922	61	0.0076	578	75	0.0176	1,631
Sep	149	0.0240	4,411	12	0.0240	357	161	0.0240	4,768	38	0.0076	358	116	5	0.0076	24	4,325	8,996	0.0076	84,433	59	0.0076	559	90	0.0240	2,602
WY Total/Average	8,637	0.0137	156,542	571	0.0137	8,792	8,958	0.0137	117,333	1,637	0.0076	15,417	986	5,400	0.0076	50,833	121,558	10,917	0.0076	102,808	1,023	0.0076	9,633	3,892	0.0145	68,786

Table C-1

Date: September 25, 2006

Flow and Phosphorus Routing WITH Proposed Narrows Project

Narrows Reservoir Operation

Year	Month	(Preston-Nobles) Natural Flow-Gooseberry Creek Near Fairview: Flow Acre-Feet	Concentration mg/l	Weight grams	Other Inflow at Narrows Reservoir: Flow Acre-Feet	Concentration mg/l	Weight grams	(CALC) Total Inflow at Narrows Reservoir: Flow Acre-Feet	Concentration mg/l	Weight grams	Narrows Reservoir: Diversion by Cottonwood-Gooseberry: Flow Acre-Feet	Concentration mg/l	Weight grams	Reservoir Evaporation Acre-Feet	Project Irrigation Delivery: Flow Acre-Feet	Concentration mg/l	Weight grams	(CALC) Phosphorus Uptake grams	End of Month: Contents Total Acre-Feet	Phosphorus mg/l (Table D-)	Phosphorus grams	(Preston-Nobles) Stream Flow below Narrows Reservoir: Flow Acre-Feet	Concentration mg/l	Weight grams	(CALC) Reach Gains Between Narrows Reservoir Site and Lower Gooseberry Reservoir: Flow Acre-Feet	Concentration mg/l	Weight grams
																			4,077	0.0123	63,900						
	Oct	209	0.0209	5,285	17	0.0209	428	222	0.0209	5,713	64	0.0113	411	60	123	0.0113	1,707	16,327	8,806	0.0113	123,499	61	0.0113	852	159	0.0209	4,109
	Nov	147	0.0198	3,590	12	0.0198	291	159	0.0198	3,581	33	0.0113	458	18	119	0.0113	1,652	1,020	8,828	0.0113	122,529	59	0.0113	824	129	0.0198	3,153
	Dec	101	0.0187	2,330	8	0.0187	185	109	0.0187	2,515	24	0.0113	333	0	123	0.0113	1,707	1,005	8,729	0.0113	121,149	61	0.0113	852	108	0.0187	2,502
1982	Jan	80	0.0176	1,737	6	0.0176	141	86	0.0176	1,877	18	0.0113	250	0	123	0.0113	1,707	677	8,613	0.0113	119,540	61	0.0113	852	72	0.0176	1,553
	Feb	76	0.0165	1,547	6	0.0165	125	82	0.0165	1,672	16	0.0113	222	0	111	0.0113	1,541	392	8,511	0.0113	118,148	55	0.0113	769	57	0.0165	1,157
	Mar	102	0.0154	1,938	8	0.0154	157	110	0.0154	2,095	24	0.0113	333	0	123	0.0113	1,707	564	8,415	0.0113	116,787	61	0.0113	852	99	0.0154	1,876
	Apr	664	0.0143	11,712	54	0.0143	949	718	0.0143	12,661	152	0.0113	2,119	0	0	0.0113	0	2,609	8,921	0.0113	123,814	59	0.0113	824	594	0.0143	10,481
	May	5,440	0.0131	88,000	441	0.0131	7,128	5,881	0.0131	95,128	1,156	0.0113	15,960	134	0	0.0113	0	13,286	13,103	0.0113	182,681	361	0.0113	5,015	4,023	0.0131	65,004
	Jun	3,227	0.0141	56,125	261	0.0141	4,546	3,488	0.0141	60,671	591	0.0113	8,202	217	604	0.0113	8,385	15,274	15,179	0.0113	210,665	59	0.0113	824	1,603	0.0141	27,879
	Jul	788	0.0110	10,692	64	0.0110	866	852	0.0110	11,558	146	0.0113	2,026	249	1,749	0.0113	24,274	3,193	13,825	0.0113	191,875	61	0.0113	852	404	0.0110	5,486
	Aug	360	0.0176	7,815	29	0.0176	633	389	0.0176	8,448	67	0.0113	930	205	1,837	0.0113	25,501	3,596	12,041	0.0113	167,145	61	0.0113	852	186	0.0176	4,034
	Sep	357	0.0240	10,569	29	0.0240	856	386	0.0240	11,425	65	0.0113	902	142	488	0.0113	6,769	8,340	11,675	0.0113	162,034	59	0.0113	824	177	0.0240	3,242
WY Total/Average		11,533	0.0141	201,339	936	0.0141	16,308	12,469	0.0141	217,647	2,330	0.0113	32,337	1,026	5,400	0.0113	74,955	18,560	10,567	0.0113	146,655	1,023	0.0113	14,194	7,502	0.0141	132,269
	Oct	453	0.0209	11,678	37	0.0209	946	490	0.0209	12,624	37	0.0113	517	74	123	0.0113	1,718	3,703	11,870	0.0113	165,802	61	0.0113	857	377	0.0209	8,727
	Nov	322	0.0198	7,854	26	0.0198	637	348	0.0198	8,501	33	0.0113	453	32	119	0.0113	1,662	3,340	11,986	0.0113	167,433	59	0.0113	830	374	0.0198	9,132
	Dec	268	0.0187	6,182	22	0.0187	501	290	0.0187	6,682	22	0.0113	307	0	123	0.0113	1,718	2,606	12,070	0.0113	168,597	61	0.0113	857	232	0.0187	5,358
1983	Jan	167	0.0176	3,623	14	0.0176	296	183	0.0176	3,519	19	0.0113	269	0	123	0.0113	1,718	1,397	12,067	0.0113	168,277	61	0.0113	857	265	0.0176	5,763
	Feb	149	0.0165	3,035	12	0.0165	246	161	0.0165	3,276	17	0.0113	237	0	111	0.0113	1,551	1,028	12,024	0.0113	167,965	55	0.0113	774	230	0.0165	4,680
	Mar	213	0.0154	4,046	17	0.0154	328	230	0.0154	4,374	22	0.0113	307	0	123	0.0113	1,718	1,457	12,068	0.0113	168,298	61	0.0113	857	283	0.0154	5,371
	Apr	350	0.0143	6,174	28	0.0143	500	378	0.0143	6,674	29	0.0113	409	0	0	0.0113	0	1,389	12,339	0.0113	172,260	59	0.0113	830	289	0.0143	5,091
	May	2,903	0.0131	47,846	249	0.0131	3,876	3,251	0.0131	51,721	209	0.0113	2,836	172	0	0.0113	0	9,408	14,803	0.0113	206,779	361	0.0113	5,066	1,532	0.0131	24,758
	Jun	9,328	0.0141	162,234	756	0.0141	13,141	10,084	0.0141	175,375	639	0.0113	8,912	235	779	0.0113	10,879	17,393	17,000	0.0113	237,468	6,034	0.0113	84,290	4,764	0.0141	82,866
	Jul	1,841	0.0100	22,709	149	0.0100	1,839	1,990	0.0100	24,548	132	0.0113	1,848	267	1,708	0.0113	23,836	471	16,822	0.0113	234,984	61	0.0113	857	1,092	0.0100	13,468
	Aug	569	0.0176	11,887	44	0.0176	964	592	0.0176	12,860	35	0.0113	585	232	2,189	0.0113	30,617	7,827	15,891	0.0113	221,996	61	0.0113	857	308	0.0176	6,678
	Sep	389	0.0240	11,812	32	0.0240	957	421	0.0240	12,769	27	0.0113	377	171	601	0.0113	11,191	8,852	15,268	0.0113	213,234	59	0.0113	830	195	0.0240	5,767
WY Total/Average		16,959	0.0143	299,099	1,377	0.0143	24,227	18,336	0.0143	323,327	1,216	0.0113	16,990	1,172	5,600	0.0113	78,424	81,303	13,680	0.0113	191,098	6,998	0.0113	97,746	9,941	0.0146	178,654
	Oct	361	0.0209	9,397	29	0.0209	754	390	0.0209	10,060	62	0.0092	703	89	123	0.0092	1,394	46,912	15,320	0.0092	173,594	61	0.0092	699	296	0.0209	7,625
	Nov	252	0.0198	6,395	21	0.0198	518	283	0.0198	6,917	32	0.0092	369	26	119	0.0092	1,348	4,004	15,341	0.0092	173,894	59	0.0092	673	289	0.0198	7,053
	Dec	313	0.0187	7,220	25	0.0187	583	338	0.0187	7,803	55	0.0092	623	0	123	0.0092	1,394	3,971	15,440	0.0092	173,015	61	0.0092	699	309	0.0187	6,197
1984	Jan	192	0.0176	4,168	16	0.0176	338	208	0.0176	4,506	48	0.0092	544	0	123	0.0092	1,394	2,154	15,421	0.0092	174,734	61	0.0092	699	321	0.0176	6,978
	Feb	171	0.0165	3,480	14	0.0165	282	185	0.0165	3,762	42	0.0092	476	0	111	0.0092	1,258	1,668	15,398	0.0092	174,467	55	0.0092	629	291	0.0165	5,723
	Mar	197	0.0154	3,742	16	0.0154	303	213	0.0154	4,045	42	0.0092	476	0	123	0.0092	1,394	1,632	15,384	0.0092	174,314	61	0.0092	695	256	0.0154	4,864
	Apr	380	0.0143	6,703	31	0.0143	543	411	0.0143	7,246	66	0.0092	748	0	0	0.0092	0	3,591	15,670	0.0092	177,548	59	0.0092	673	318	0.0143	5,613
	May	7,142	0.0131	115,405	579	0.0131	9,348	7,721	0.0131	124,753	1,215	0.0092	13,707	581	0	0.0092	0	39,353	17,000	0.0092	192,622	4,974	0.0092	56,338	5,724	0.0131	92,500
	Jun	6,656	0.0141	115,762	539	0.0141	9,377	7,195	0.0141	125,139	956	0.0092	10,832	256	14	0.0092	157	46,310	17,000	0.0092	192,622	5,970	0.0092	67,640	3,181	0.0141	58,801
	Jul	1,002	0.0110	13,594	81	0.0110	1,104	1,083	0.0110	14,697	147	0.0092	1,666	267	2,094	0.0092	23,784	5,447	15,606	0.0092	176,807	61	0.0092	695	544	0.0110	7,379
	Aug	443	0.0176	9,617	36	0.0176	779	479	0.0176	10,396	65	0.0092	736	222	1,794	0.0092	20,328	7,434	13,961	0.0092	157,959	61	0.0092	695	240	0.0176	5,213
	Sep	304	0.0240	9,000	25	0.0240	729	329	0.0240	9,729	44	0.0092	499	157	866	0.0092	9,816	7,783	13,142	0.0092	148,913	59	0.0092	673	154	0.0240	4,570
WY Total/Average		17,423	0.0142	304,399	1,411	0.0142	24,656	18,834	0.0142	329,055	2,794	0.0092	31,658	1,218	5,400	0.0092	61,180	169,716	15,390	0.0092	174,374	11,945	0.0092	130,816	12,034	0.0143	312,517
	Oct	133	0.0209	8,585	27	0.0209	695	160	0.0209	9,280	71	0.0093	817	90	123	0.0093	1,415	3,366	13,167	0.0093	151,310	61	0.0093	700	272	0.0209	7,915
	Nov	229	0.0198	5,537	19	0.0198	473	228	0.0198	6,510	58	0.0093	667	24	119	0.0093	1,369	3,609	13,165	0.0093	151,491	59	0.0093	664	238	0.0198	6,292
	Dec	268	0.0187	6,182	22	0.0187	501	290	0.0187	6,682	58	0.0093	667	0	123	0.0093	1,415	3,244	13,212	0.0093	152,074	61	0.0093	700	232	0.0187	5,328
1985	Jan	182	0.0176	3,951	15	0.0176	320	197	0.0176	4,271	53	0.0093	613	0	123	0.0093	1,415	2,009	13,170	0.0093	151,345	61	0.0093	700	296	0.0176	6,475
	Feb	146	0.0165	2,971	12	0.0165	241	158	0.0165	3,212	43	0.0093	495	0	111	0.0093	1,277	1,306	13,118	0.0093	150,954	55	0.0093	644	223	0.0165	4,542
	Mar	176	0.0154	3,343	14	0.0154	271	190	0.0154	3,614	46	0.0093	529	0	123	0.0093	1,415	1,425	13,078	0.0093	150,489	61	0.0093	700	222	0.0154	4,212
	Apr	1,675	0.0143	29,545	136	0.0143	2,393	1,811	0.0143	31,938	379	0.0093	4,361	0	0	0.0093	0	11,633	14,450	0.0093	166,283	59	0.0093	684	1,578	0.0143	27,840
	May	6,282	0.0131	101,500	509	0.0131	8,222	6,791	0.0131	109,721	1,303	0.0093	14,998	191	0	0.0093	0	35,789	17,000	0.0093	195,620	2,347	0.0093	31,609	4,862	0.0131	78,566
	Jun	1,733	0.0141	30,141	140	0.0141	2,441	1,873	0.0141	32,582	503	0.0093	5,475	236	14	0.0093	159	15,967	17,000	0.0093	195,625	1,502	0.0093	18,960	829	0.0141	14,412
	Jul	651	0.0110	8,914	53	0.0110	722	710	0.0110	9,636	115	0.0093	1,322	297	1,448	0.0093	16,891	6,534	15,799	0.0093	181,802	61	0.0093	706	319	0.0110	4,322
	Aug	313	0.0176	6,752	25	0.0176	547	336	0.0176	7,299	55	0.0093	633	224	1,615	0.0093	18,844	6,005	13,983	0.0093	160,875	61	0.0093	706	152	0.0176	3,317
	Sep	218	0.0240	6,454	16	0.0240	523	236	0.0240	6,976	40	0.0093	460	158	1,132	0.0093	13,066	5,008	12,578	0.0093	144,739	59	0.0093	684	118	0.0240	3,502
WY Total/Average		13,320	0.0142	214,184	990	0.0142	17,349	13,210	0.0142	231,533	2,525	0.0093	29,033	1,195	5,400	0.0093	62,142	91,003	14,151	0.0093	162,746	4,631	0.0093	53,316	9,366	0.0144	165,852

Date: September 25, 2006

Table C-1

Flow and Phosphorus Routing WITH Proposed Narrows Project

Narrows Reservoir Operation

Year	Month	(Frances-Natie) Natural Flow-Gooseberry Creek Near Fairview: Flow Acre-Feet	Concentration mg/l	Weight grams	Other Inflow at Narrows Reservoir: Flow Acre-Feet	Concentration mg/l	Weight grams	(CALC) Total Inflow at Narrows Reservoir: Flow Acre-Feet	Concentration mg/l	Weight grams	Narrows Reservoir: Diversion by Cottonwood-Gooseberry: Flow Acre-Feet	Concentration mg/l	Weight grams	Reservoir Evaporation Acre-Feet	Project Irrigation Delivery: Acre-Feet	mg/l	grams	(CALC) Phosphorus Uptake grams	End of Month: Contents Total Acre-Feet	Phosphorus mg/l (Table D-1)	Phosphorus grams	(Frances-Natie) Stream Flow below Narrows Reservoir: Flow Acre-Feet	Concentration mg/l	Weight grams	(CALC) Reach Gain Between Narrows Reservoir Site and Lower Gooseberry Reservoir: Flow Acre-Feet	Concentration mg/l	Weight grams
																			4277	0.0121	63,300						
	Oct	231	0.0209	3,955	19	0.0209	482	250	0.0209	6,438	46	0.0098	555	78	121	0.0098	1,485	-2,711	12,519	0.0098	151,098	61	0.0098	741	182	0.0209	4,699
	Nov	202	0.0198	4,933	16	0.0198	400	218	0.0198	5,333	45	0.0098	543	23	119	0.0098	1,456	2,973	12,491	0.0098	150,761	59	0.0098	717	207	0.0198	5,047
	Dec	196	0.0187	4,521	16	0.0187	366	212	0.0187	4,887	41	0.0098	495	0	123	0.0098	1,485	2,330	12,478	0.0098	150,598	61	0.0098	741	176	0.0187	4,063
1986	Jan	150	0.0176	3,256	12	0.0176	264	162	0.0176	3,520	41	0.0098	495	0	123	0.0098	1,485	1,363	12,416	0.0098	149,833	61	0.0098	741	227	0.0176	4,925
	Feb	151	0.0165	3,073	12	0.0165	249	163	0.0165	3,322	42	0.0098	507	0	111	0.0098	1,340	1,352	12,369	0.0098	149,290	55	0.0098	669	236	0.0165	4,799
	Mar	243	0.0154	4,616	20	0.0154	374	263	0.0154	4,990	63	0.0098	760	0	123	0.0098	1,485	1,819	12,384	0.0098	149,474	61	0.0098	741	333	0.0154	6,332
	Apr	1,050	0.0143	18,521	83	0.0143	1,500	1,133	0.0143	20,021	224	0.0098	2,704	0	0	0.0098	0	8,323	13,236	0.0098	159,753	59	0.0098	713	989	0.0143	17,091
	May	6,624	0.0131	107,035	537	0.0131	8,670	7,161	0.0131	115,705	1,315	0.0098	15,871	190	0	0.0098	0	31,457	17,000	0.0098	205,181	1,901	0.0098	22,949	5,204	0.0131	84,097
	Jun	5,312	0.0141	92,387	430	0.0141	7,483	5,742	0.0141	99,871	896	0.0098	10,816	256	14	0.0098	167	33,030	17,000	0.0098	205,181	4,577	0.0098	55,239	2,684	0.0141	46,676
	Jul	644	0.0110	8,738	52	0.0110	708	696	0.0110	9,446	107	0.0098	1,291	267	1,784	0.0098	21,528	4,363	15,477	0.0098	186,803	61	0.0098	741	311	0.0110	4,218
	Aug	324	0.0176	7,034	26	0.0176	570	350	0.0176	7,604	55	0.0098	664	221	1,865	0.0098	22,511	6,081	13,625	0.0098	164,450	61	0.0098	741	163	0.0176	3,533
	Sep	252	0.0240	7,460	20	0.0240	604	273	0.0240	8,064	43	0.0098	519	155	1,015	0.0098	12,254	8,646	12,625	0.0098	152,378	59	0.0098	717	133	0.0240	3,925
WY Total/Average		13,379	0.0141	257,531	1,246	0.0141	21,670	14,625	0.0141	289,201	2,918	0.0098	35,219	1,179	5,400	0.0098	65,175	95,306	13,615	0.0098	154,567	7,080	0.0098	85,452	10,824	0.0142	189,404
	Oct	296	0.0209	7,631	24	0.0209	618	320	0.0209	8,249	111	0.0075	1,023	76	123	0.0075	1,132	82,211	12,572	0.0075	115,696	61	0.0075	565	239	0.0209	6,162
	Nov	231	0.0198	5,642	19	0.0198	457	250	0.0198	6,099	99	0.0075	911	23	119	0.0075	1,095	4,011	12,521	0.0075	115,232	59	0.0075	547	247	0.0198	6,040
	Dec	170	0.0187	3,921	14	0.0187	316	184	0.0187	4,239	67	0.0075	617	0	123	0.0075	1,132	2,548	12,453	0.0075	114,610	61	0.0075	565	154	0.0187	3,558
1987	Jan	89	0.0176	1,932	7	0.0176	157	96	0.0176	2,089	37	0.0075	341	6	123	0.0075	1,132	1,209	12,328	0.0075	113,456	61	0.0075	565	91	0.0176	1,971
	Feb	81	0.0165	1,648	7	0.0165	154	88	0.0165	1,782	31	0.0075	285	0	111	0.0075	1,022	976	12,218	0.0075	112,447	55	0.0075	510	69	0.0165	1,413
	Mar	109	0.0154	2,071	9	0.0154	168	118	0.0154	2,238	45	0.0075	414	0	123	0.0075	1,132	1,354	12,107	0.0075	111,420	61	0.0075	565	110	0.0154	2,093
	Apr	1,083	0.0143	19,103	88	0.0143	1,547	1,171	0.0143	20,650	433	0.0075	3,985	6	0	0.0075	0	9,876	12,785	0.0075	117,663	59	0.0075	547	1,002	0.0143	17,679
	May	2,577	0.0131	41,641	209	0.0131	3,371	2,786	0.0131	45,014	783	0.0075	7,206	176	0	0.0075	0	20,997	14,251	0.0075	131,149	361	0.0075	3,326	1,147	0.0131	18,535
	Jun	757	0.0141	13,156	61	0.0141	1,066	818	0.0141	14,222	227	0.0075	2,089	229	850	0.0075	7,821	5,812	13,701	0.0075	126,112	59	0.0075	547	324	0.0141	5,630
	Jul	395	0.0110	5,373	32	0.0110	435	428	0.0110	5,808	115	0.0075	1,058	233	1,795	0.0075	16,527	4,015	11,926	0.0075	109,755	61	0.0075	565	148	0.0110	2,007
	Aug	215	0.0176	4,683	17	0.0176	375	232	0.0176	5,046	64	0.0075	589	183	2,030	0.0075	18,680	4,011	9,818	0.0075	90,356	61	0.0075	565	91	0.0176	1,967
	Sep	152	0.0240	4,500	12	0.0240	364	164	0.0240	4,864	51	0.0075	469	122	3	0.0075	24	8,474	9,747	0.0075	89,707	59	0.0075	547	91	0.0240	2,683
WY Total/Average		6,156	0.0147	111,239	499	0.0147	9,011	6,655	0.0147	120,310	2,063	0.0075	18,985	1,047	5,400	0.0075	49,697	104,887	12,203	0.0075	112,301	1,023	0.0075	9,412	3,713	0.0152	68,741
	Oct	149	0.0209	3,712	12	0.0209	301	156	0.0209	4,013	47	0.0079	461	68	123	0.0079	1,206	-2,740	9,607	0.0079	94,192	61	0.0079	603	105	0.0209	2,716
	Nov	126	0.0198	3,077	10	0.0198	249	136	0.0198	3,327	42	0.0079	415	19	119	0.0079	1,167	2,115	9,504	0.0079	93,182	59	0.0079	582	99	0.0198	2,413
	Dec	98	0.0187	2,254	8	0.0187	185	107	0.0187	2,439	37	0.0079	363	0	123	0.0079	1,206	1,619	9,390	0.0079	92,061	61	0.0079	603	99	0.0187	2,260
1988	Jan	102	0.0176	2,214	8	0.0176	179	110	0.0176	2,394	41	0.0079	402	0	123	0.0079	1,206	1,313	9,275	0.0079	90,933	61	0.0079	602	119	0.0176	2,578
	Feb	98	0.0165	1,995	8	0.0165	162	106	0.0165	2,156	39	0.0079	382	0	111	0.0079	1,088	1,117	9,175	0.0079	89,957	55	0.0079	544	109	0.0165	2,220
	Mar	125	0.0154	2,374	10	0.0154	192	135	0.0154	2,567	49	0.0079	482	0	123	0.0079	1,206	1,242	9,077	0.0079	88,994	61	0.0079	602	136	0.0154	2,581
	Apr	564	0.0143	9,948	46	0.0143	806	610	0.0143	10,754	199	0.0079	1,951	8	0	0.0079	0	4,777	9,428	0.0079	92,438	59	0.0079	582	496	0.0143	8,754
	May	3,714	0.0131	60,013	301	0.0131	4,861	4,015	0.0131	64,875	1,132	0.0079	11,098	140	0	0.0079	0	26,888	11,810	0.0079	115,783	361	0.0079	3,543	2,287	0.0131	36,955
	Jun	958	0.0141	16,662	78	0.0141	1,350	1,036	0.0141	18,011	263	0.0079	2,578	201	657	0.0079	6,438	9,832	11,666	0.0079	114,368	59	0.0079	587	427	0.0141	7,431
	Jul	358	0.0110	4,857	29	0.0110	393	387	0.0110	5,251	92	0.0079	907	208	1,804	0.0079	17,691	3,498	9,806	0.0079	96,921	61	0.0079	602	123	0.0110	1,669
	Aug	209	0.0176	4,537	17	0.0176	368	226	0.0176	4,905	56	0.0079	549	161	2,214	0.0079	21,709	4,267	7,619	0.0079	74,700	61	0.0079	602	87	0.0176	1,890
	Sep	142	0.0240	4,204	12	0.0240	341	154	0.0240	4,544	43	0.0079	422	99	3	0.0079	25	4,014	7,564	0.0079	74,200	59	0.0079	582	86	0.0240	2,561
WY Total/Average		6,639	0.0142	115,839	538	0.0142	9,386	7,177	0.0142	125,266	2,040	0.0079	20,000	850	5,400	0.0079	52,942	57,802	9,500	0.0079	93,148	1,023	0.0079	10,027	4,173	0.0144	74,032
	Oct	153	0.0209	3,944	12	0.0209	319	165	0.0209	4,264	49	0.0078	471	33	123	0.0078	1,181	4,696	7,446	0.0078	71,526	61	0.0078	589	115	0.0209	2,955
	Nov	167	0.0198	4,079	14	0.0198	330	181	0.0198	4,409	59	0.0078	567	15	119	0.0078	1,143	2,822	7,376	0.0078	70,833	59	0.0078	570	156	0.0198	3,822
	Dec	150	0.0187	3,460	12	0.0187	280	162	0.0187	3,740	53	0.0078	509	0	123	0.0078	1,181	2,187	7,300	0.0078	70,121	61	0.0078	589	139	0.0187	3,203
1989	Jan	121	0.0176	2,627	10	0.0176	213	131	0.0176	2,840	51	0.0078	490	0	123	0.0078	1,181	1,383	7,196	0.0078	69,106	61	0.0078	589	151	0.0176	3,300
	Feb	101	0.0165	2,056	8	0.0165	167	109	0.0165	2,222	39	0.0078	375	0	111	0.0078	1,066	1,174	7,100	0.0078	68,182	55	0.0078	532	116	0.0165	2,333
	Mar	166	0.0154	3,153	13	0.0154	255	179	0.0154	3,409	67	0.0078	643	0	123	0.0078	1,181	1,685	7,028	0.0078	67,491	61	0.0078	589	206	0.0154	3,905
	Apr	1,312	0.0143	23,142	106	0.0143	1,873	1,418	0.0143	25,017	462	0.0078	4,437	0	0	0.0078	0	11,390	7,924	0.0078	76,104	59	0.0078	570	1,224	0.0143	21,585
	May	2,470	0.0131	39,912	200	0.0131	3,233	2,670	0.0131	43,145	649	0.0078	6,233	122	0	0.0078	0	18,674	9,462	0.0078	90,872	361	0.0078	3,471	1,039	0.0131	16,788
	Jun	763	0.0141	13,270	62	0.0141	1,075	825	0.0141	14,345	203	0.0078	1,940	170	735	0.0078	7,055	8,059	9,121	0.0078	87,593	59	0.0078	570	327	0.0141	5,681
	Jul	368	0.0110	4,993	29	0.0110	393	397	0.0110	5,387	92	0.0078	884	173	1,738	0.0078	16,881	3,224	7,433	0.0078	71,402	61	0.0078	589	131	0.0110	1,777
	Aug	180	0.0176	3,908	15	0.0176	317	195	0.0176	4,224	46	0.0078	442	128	2,187	0.0078	20,960	3,384	5,211	0.0078	50,045	61	0.0078	586	68	0.0176	1,483
	Sep	161	0.0240	4,766	13	0.0240	386	174	0.0240	5,152	47	0.0078	451	72	3	0.0078	25	6,173	4,787	0.0078	45,976	476	0.0078	4,572	94	0.0240	2,782
WY Total/Average		6,112	0.0145	109,310	494	0.0145	8,843	6,606	0.0145	118,153	1,816	0.0078	17,440	733	5,400	0.0078	51,800	63,251	7,282	0.0078	69,937	1,439	0.0078	13,824	3,378	0.0150	69,848

Table C-1

Date: September 25, 2006

Flow and Phosphorus Routing WITH Proposed Narrows Project
Narrows Reservoir Operation

Year Month	(Franson-Noble) Natural Flow-Gooseberry Creek Near Fairview Flow Acre-Feet	Concentration mg/l	Weight grams	Other Inflow at Narrows Reservoir Flow Acre-Feet	Concentration mg/l	Weight grams	(CALC.) Total Inflow at Narrows Reservoir Flow Acre-Feet	Concentration mg/l	Weight grams	Narrows Reservoir: Diversion by Cottonwood-Gooseberry Flow Acre-Feet	Concentration mg/l	Weight grams	Reservoir Evaporation Acre-Feet	Project Irrigation Delivery Acre-Feet	mg/l	grams	(CALC.) Phosphorus Uptake grams	End of Month Contents Total Acre-Feet	Phosphorus mg/l, Table D-1	grams	(Franson-Noble) Stream Flow below Narrows Reservoir Flow Acre-Feet	Concentration mg/l	Weight grams	(CALC.) Reach Gains Between Narrows Reservoir Site and Lower Gooseberry Reservoir Flow Acre-Feet	Concentration mg/l	Weight grams
																		4,277	0.0121	63,900						
Oct	132	0.0209	3,401	11	0.0209	275	143	0.0209	3,676	59	0.0101	738	36	123	0.0101	1,527	-13,109	4,651	0.0101	57,735	61	0.0101	762	95	0.0209	2,460
Nov	230	0.0198	5,628	19	0.0198	456	248	0.0198	6,084	72	0.0101	888	10	119	0.0101	1,477	3,118	4,640	0.0101	57,598	59	0.0101	737	245	0.0198	5,992
Dec	114	0.0187	2,632	9	0.0187	215	123	0.0187	2,845	64	0.0101	792	0	123	0.0101	1,527	1,314	4,515	0.0101	56,048	61	0.0101	752	110	0.0187	2,534
1990 Jan	101	0.0176	2,185	8	0.0176	177	109	0.0176	2,361	62	0.0101	772	0	123	0.0101	1,527	1,011	4,377	0.0101	54,340	61	0.0101	762	117	0.0176	2,542
Feb	97	0.0165	1,970	8	0.0165	160	105	0.0165	2,130	46	0.0101	573	0	111	0.0101	1,378	831	4,268	0.0101	52,979	55	0.0101	685	106	0.0165	2,161
Mar	128	0.0154	2,424	10	0.0154	196	138	0.0154	2,621	82	0.0101	1,016	0	123	0.0101	1,527	908	4,139	0.0101	51,387	61	0.0101	762	141	0.0154	2,676
Apr	1,120	0.0143	19,751	91	0.0143	1,600	1,210	0.0143	21,351	551	0.0101	6,862	0	0	0.0101	0	6,324	4,730	0.0101	58,715	59	0.0101	737	1,037	0.0143	18,292
May	2,564	0.0131	41,432	208	0.0131	3,356	2,772	0.0131	44,787	787	0.0101	9,772	79	0	0.0101	0	11,354	6,278	0.0101	77,890	361	0.0101	4,486	1,134	0.0131	18,317
Jun	913	0.0230	25,895	74	0.0230	2,098	987	0.0230	27,993	244	0.0101	3,034	121	657	0.0101	8,152	17,252	6,179	0.0101	76,708	59	0.0101	737	404	0.0230	11,464
Jul	401	0.0110	5,439	33	0.0110	441	433	0.0110	5,879	112	0.0101	1,392	125	1,647	0.0101	20,447	2,053	4,667	0.0101	57,933	61	0.0101	762	151	0.0110	2,055
Aug	174	0.0280	6,020	14	0.0280	484	188	0.0280	6,507	56	0.0101	691	88	0	0.0101	0	5,234	4,123	0.0101	51,184	590	0.0101	7,329	64	0.0280	2,226
Sep	127	0.0240	3,747	10	0.0240	303	137	0.0240	4,050	57	0.0101	706	59	0	0.0101	0	3,080	3,735	0.0101	46,119	429	0.0101	5,331	80	0.0240	2,361
WY Total/Average	6,109	0.0160	120,524	494	0.0160	9,762	6,594	0.0160	130,286	2,204	0.0101	27,356	518	3,026	0.0101	37,562	41,370	4,650	0.0101	58,220	1,922	0.0101	23,857	3,685	0.0161	71,093
Oct	150	0.0209	3,878	12	0.0209	314	163	0.0209	4,192	70	0.0105	909	28	123	0.0105	1,593	241	3,379	0.0105	43,952	277	0.0105	3,608	112	0.0209	2,879
Nov	144	0.0198	3,509	12	0.0198	284	155	0.0198	3,793	165	0.0105	2,152	8	119	0.0105	1,548	1,873	3,183	0.0105	41,399	59	0.0105	773	124	0.0198	3,033
Dec	120	0.0187	2,760	10	0.0187	224	129	0.0187	2,984	66	0.0105	862	0	123	0.0105	1,600	1,301	3,061	0.0105	39,822	61	0.0105	798	114	0.0187	2,636
1991 Jan	106	0.0176	2,298	9	0.0176	186	114	0.0176	2,485	64	0.0105	834	0	123	0.0105	1,600	996	2,927	0.0105	38,078	61	0.0105	798	129	0.0176	2,799
Feb	104	0.0165	2,116	8	0.0165	171	112	0.0165	2,288	64	0.0105	829	0	111	0.0105	1,444	826	2,809	0.0105	36,546	55	0.0105	721	123	0.0165	2,508
Mar	125	0.0154	2,383	10	0.0154	193	136	0.0154	2,576	77	0.0105	1,003	0	123	0.0105	1,600	812	2,684	0.0105	34,909	61	0.0105	798	137	0.0154	2,607
Apr	504	0.0143	8,889	41	0.0143	730	545	0.0143	9,609	660	0.0105	8,583	0	0	0.0105	0	2,523	2,509	0.0105	32,640	59	0.0105	773	438	0.0143	7,730
May	3,864	0.0131	62,444	313	0.0131	5,058	4,177	0.0131	67,502	1,220	0.0105	15,865	43	0	0.0105	0	13,744	5,061	0.0105	65,832	361	0.0105	4,703	2,438	0.0131	39,387
Jun	2,537	0.0190	59,465	206	0.0190	4,816	2,743	0.0190	64,279	448	0.0105	5,833	101	735	0.0105	9,558	29,915	6,460	0.0105	84,035	59	0.0105	773	1,246	0.0190	29,200
Jul	567	0.0110	7,688	46	0.0110	623	613	0.0110	8,271	185	0.0105	2,405	120	1,758	0.0105	22,865	2,034	4,939	0.0105	64,244	61	0.0105	798	260	0.0110	3,525
Aug	296	0.0050	1,824	28	0.0050	148	320	0.0050	1,971	77	0.0105	1,003	90	2,163	0.0105	28,138	1,017	2,847	0.0105	37,029	61	0.0105	798	144	0.0050	885
Sep	249	0.0240	7,374	20	0.0240	597	269	0.0240	7,972	62	0.0105	813	42	3	0.0105	34	5,016	2,949	0.0105	38,364	59	0.0105	773	131	0.0240	3,884
WY Total/Average	8,766	0.0152	164,627	710	0.0152	13,335	9,476	0.0152	177,962	3,159	0.0105	41,091	444	3,400	0.0105	78,244	58,267	3,507	0.0105	46,404	1,229	0.0105	16,113	5,396	0.0152	101,071
Oct	154	0.0400	7,619	13	0.0400	617	167	0.0400	8,236	24	0.0099	298	33	123	0.0099	1,508	8,682	2,616	0.0099	32,097	327	0.0099	4,015	119	0.0400	5,882
Nov	145	0.0198	3,534	12	0.0198	286	156	0.0198	3,820	14	0.0099	166	6	119	0.0099	1,459	1,978	2,577	0.0099	31,587	59	0.0099	728	126	0.0198	3,068
Dec	124	0.0187	2,854	10	0.0187	231	134	0.0187	3,085	21	0.0099	258	0	123	0.0099	1,508	1,445	2,505	0.0099	30,707	61	0.0099	752	118	0.0187	2,711
1992 Jan	90	0.0176	1,951	7	0.0176	158	97	0.0176	2,109	21	0.0099	261	0	19	0.0099	236	918	2,500	0.0099	30,648	61	0.0099	752	93	0.0176	2,018
Feb	82	0.0165	1,660	7	0.0165	134	88	0.0165	1,793	20	0.0099	250	0	12	0.0099	153	716	2,500	0.0099	30,648	55	0.0099	680	70	0.0165	1,426
Mar	141	0.0154	2,682	11	0.0154	217	153	0.0154	2,900	23	0.0099	285	0	68	0.0099	834	1,028	2,500	0.0099	30,648	61	0.0099	752	163	0.0154	3,104
Apr	741	0.0143	13,071	60	0.0143	1,059	801	0.0143	14,130	38	0.0099	471	0	0	0.0099	0	4,310	3,203	0.0099	39,270	59	0.0099	728	669	0.0143	11,799
May	1,705	0.0131	27,544	138	0.0131	2,231	1,843	0.0131	29,775	641	0.0099	7,862	56	0	0.0099	0	7,868	3,988	0.0099	48,885	361	0.0099	4,430	272	0.0131	4,391
Jun	654	0.0090	7,255	53	0.0090	588	706	0.0090	7,842	421	0.0099	5,159	82	611	0.0099	7,490	186	3,521	0.0099	43,164	59	0.0099	728	270	0.0090	2,994
Jul	263	0.0110	3,568	21	0.0110	289	284	0.0110	3,857	82	0.0099	1,002	77	0	0.0099	0	1,310	2,921	0.0099	35,809	726	0.0099	8,906	61	0.0110	833
Aug	136	0.0210	3,511	11	0.0210	285	147	0.0210	3,797	46	0.0099	563	57	0	0.0099	0	2,695	2,510	0.0099	30,767	455	0.0099	5,581	39	0.0210	1,016
Sep	118	0.0240	3,488	10	0.0240	283	127	0.0240	3,771	40	0.0099	492	38	0	0.0099	0	2,672	2,500	0.0099	30,646	59	0.0099	728	76	0.0240	2,254
WY Total/Average	4,353	0.0147	78,739	352	0.0147	6,378	4,705	0.0147	85,117	1,392	0.0099	17,067	338	1,076	0.0099	13,186	33,806	2,820	0.0099	34,573	2,247	0.0099	28,770	2,073	0.0162	41,296
Oct	235	0.0209	6,063	19	0.0209	491	254	0.0209	6,554	195	0.0119	2,879	80	0	0.0119	0	-2,970	2,477	0.0119	36,398	61	0.0119	902	185	0.0209	4,775
Nov	176	0.0198	4,305	14	0.0198	349	191	0.0198	4,654	201	0.0119	2,989	6	0	0.0119	0	1,940	2,399	0.0119	35,250	59	0.0119	873	170	0.0198	4,145
Dec	160	0.0187	3,689	13	0.0187	299	173	0.0187	3,987	174	0.0119	2,563	0	0	0.0119	0	1,448	2,336	0.0119	34,320	61	0.0119	902	146	0.0187	3,377
1993 Jan	127	0.0176	2,755	10	0.0176	223	137	0.0176	2,978	128	0.0119	1,879	0	0	0.0119	0	967	2,284	0.0119	33,560	61	0.0119	902	176	0.0176	3,822
Feb	127	0.0165	2,575	10	0.0165	205	137	0.0165	2,784	104	0.0119	1,534	0	0	0.0119	0	779	2,261	0.0119	33,221	55	0.0119	815	177	0.0165	3,596
Mar	234	0.0154	4,454	19	0.0154	361	253	0.0154	4,814	223	0.0119	3,260	0	0	0.0119	0	1,091	2,231	0.0119	32,783	61	0.0119	902	318	0.0154	6,046
Apr	993	0.0143	17,518	80	0.0143	1,419	1,074	0.0143	18,937	1,085	0.0119	15,938	0	0	0.0119	0	3,167	2,161	0.0119	31,746	59	0.0119	873	914	0.0143	16,123
May	5,968	0.0131	96,436	483	0.0131	7,811	6,451	0.0131	104,247	1,116	0.0119	16,401	39	0	0.0119	0	10,036	7,095	0.0119	104,247	361	0.0119	5,310	4,547	0.0131	73,473
Jun	2,602	0.0150	48,137	211	0.0150	3,899	2,812	0.0150	52,036	421	0.0119	6,185	135	735	0.0119	10,791	13,695	8,558	0.0119	125,739	59	0.0119	873	1,279	0.0150	23,071
Jul	632	0.0110	8,575	51	0.0110	695	683	0.0110	9,270	200	0.0119	2,938	164	1,758	0.0119	25,825	1,642	7,058	0.0119	103,701	61	0.0119	902	302	0.0110	4,104
Aug	305	0.0050	1,887	25	0.0050	153	330	0.0050	2,036	106	0.0119	1,558	123	2,183	0.0119	32,074	-1,614	4,915	0.0119	72,216	61	0.0119	902	150	0.0050	924
Sep	226	0.0240	6,685	18	0.0240	541	244	0.0240	7,226	124	0.0119	1,819	68	1	0.0119	18	4,646	4,905	0.0119	72,067	59	0.0119	873	121	0.0240	3,595
WY Total/Average	11,785	0.0140	203,073	955	0.0140	16,449	12,740	0.0140	219,524	4,079	0.0119	59,932	555	4,675	0.0119	68,731	34,413	4,057	0.0119	59,605	1,023	0.0119	15,026	8,487	0.0141	147,072

Table C-1

Date: September 25, 2006

Flow and Phosphorus Routing WITH Proposed Narrows Project

Narrows Reservoir Operation

		(Franson-Noble)						(CALC)			Narrows Reservoir												(Franson-Noble)			(CALC) Reach Gains Between Narrows Reservoir Site and Lower Gooseberry Reservoir		
		Natural Flow-Gooseberry Creek Near Fairview			Other Inflow at Narrows Reservoir			Total Inflow at Narrows Reservoir			Diversion by Cottonwood-Gooseberry			Reservoir Evaporation	Project Irrigation Delivery			(CALC) Phosphorus Uptake	End of Month Contents Total	End of Month Phosphorus		Stream Flow below Narrows Reservoir					
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Acre-Feet	Acre-Feet	mg/l	grams	grams	Acre-Feet	mg/l Table D-1	grams	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	Concentration mg/l	Weight grams
																			4297	0.0121	63,500						
	Oct	182	0.0209	4,708	15	0.0209	381	197	0.0209	5,089	27	0.0089	295	30	121	0.0089	1,358	21,242	4,833	0.0089	53,584	61	0.0089	677	140	0.0209	3,607
	Nov	142	0.0198	3,470	12	0.0198	281	154	0.0198	3,751	17	0.0089	189	11	119	0.0089	1,311	2,171	4,893	0.0089	53,004	59	0.0089	656	122	0.0198	2,979
	Dec	134	0.0187	3,083	11	0.0187	250	144	0.0187	3,333	16	0.0089	174	0	123	0.0089	1,355	3,728	4,747	0.0089	52,390	61	0.0089	677	125	0.0187	2,898
1994	Jan	99	0.0176	2,140	8	0.0176	173	107	0.0176	2,314	20	0.0089	223	0	123	0.0089	1,358	4,197	4,640	0.0089	51,308	61	0.0089	677	113	0.0176	2,443
	Feb	94	0.0165	1,908	8	0.0165	155	101	0.0165	2,062	23	0.0089	252	0	111	0.0089	1,225	944	4,561	0.0089	50,337	55	0.0089	612	99	0.0165	2,017
	Mar	129	0.0154	2,445	10	0.0154	198	139	0.0154	2,644	38	0.0089	421	0	123	0.0089	1,358	1,108	4,477	0.0089	49,417	61	0.0089	677	143	0.0154	2,711
	Apr	652	0.0143	11,496	53	0.0143	931	705	0.0143	12,427	99	0.0089	1,088	0	0	0.0089	0	4,652	5,024	0.0089	55,447	59	0.0089	656	582	0.0143	10,266
	May	3,411	0.0131	55,114	276	0.0131	4,464	3,687	0.0131	59,579	1,019	0.0089	11,304	83	0	0.0089	0	19,800	7,188	0.0089	79,326	361	0.0089	3,988	1,983	0.0131	32,057
	Jun	938	0.0141	16,282	76	0.0141	1,319	1,012	0.0141	17,601	401	0.0089	4,422	138	735	0.0089	8,108	7,936	6,870	0.0089	75,817	59	0.0089	656	416	0.0141	7,239
	Jul	294	0.0190	6,881	24	0.0190	557	317	0.0190	7,438	86	0.0089	946	137	1,758	0.0089	19,399	5,446	5,145	0.0089	56,786	61	0.0089	677	81	0.0190	1,908
	Aug	200	0.0220	5,581	17	0.0220	452	222	0.0220	6,033	41	0.0089	450	94	2,183	0.0089	24,094	4,611	2,985	0.0089	32,980	61	0.0089	677	85	0.0220	2,303
	Sep	162	0.0240	4,787	13	0.0240	388	175	0.0240	5,174	26	0.0089	291	44	3	0.0089	39	3,733	3,031	0.0089	33,453	59	0.0089	656	95	0.0240	2,799
WY Total/Average		6,439	0.0149	117,895	522	0.0148	9,550	6,961	0.0148	127,445	1,872	0.0089	20,656	540	5,400	0.0089	59,598	74,518	4,882	0.0089	53,656	1,023	0.0089	11,287	3,983	0.0149	73,197
	Oct	217	0.0209	5,587	18	0.0209	453	234	0.0209	6,040	76	0.0136	1,283	68	123	0.0136	2,067	-14,992	2,981	0.0136	50,103	61	0.0136	1,032	170	0.0209	4,378
	Nov	148	0.0198	3,617	12	0.0198	293	160	0.0198	3,910	64	0.0136	1,068	7	119	0.0136	2,000	1,335	2,892	0.0136	48,612	59	0.0136	998	130	0.0198	3,183
	Dec	154	0.0187	3,530	12	0.0187	288	166	0.0187	3,818	62	0.0136	1,050	0	123	0.0136	2,067	1,041	2,812	0.0136	47,260	61	0.0136	1,032	142	0.0187	3,266
1995	Jan	121	0.0176	2,628	10	0.0176	213	131	0.0176	2,841	49	0.0136	822	0	123	0.0136	2,067	641	2,709	0.0136	45,538	61	0.0136	1,032	163	0.0176	3,537
	Feb	113	0.0165	2,298	9	0.0165	186	122	0.0165	2,484	44	0.0136	733	0	111	0.0136	1,866	433	2,621	0.0136	44,060	55	0.0136	932	144	0.0165	2,939
	Mar	196	0.0154	3,723	16	0.0154	302	212	0.0154	4,024	60	0.0136	1,007	0	123	0.0136	2,067	463	2,589	0.0136	43,515	61	0.0136	1,032	254	0.0154	4,832
	Apr	570	0.0143	10,046	46	0.0143	814	616	0.0143	10,860	272	0.0136	4,506	0	0	0.0136	0	313	2,853	0.0136	47,956	59	0.0136	998	502	0.0143	8,855
	May	4,413	0.0131	71,304	357	0.0131	5,776	4,770	0.0131	77,080	1,129	0.0136	18,968	50	0	0.0136	0	2,253	6,083	0.0136	102,247	361	0.0136	6,078	2,987	0.0131	48,272
	Jun	6,590	0.0141	114,608	534	0.0141	9,283	7,123	0.0141	123,891	253	0.0136	4,245	118	751	0.0136	12,347	6,150	12,042	0.0136	202,397	59	0.0136	998	3,348	0.0141	58,195
	Jul	1,329	0.0050	8,197	108	0.0050	664	1,437	0.0050	8,861	77	0.0136	1,293	231	1,756	0.0136	29,548	-11,706	11,369	0.0136	191,084	61	0.0136	1,032	758	0.0050	4,074
	Aug	513	0.0176	11,127	42	0.0176	901	554	0.0176	12,028	65	0.0136	1,101	179	2,183	0.0136	36,693	5,721	9,433	0.0136	158,577	61	0.0136	1,032	285	0.0176	6,183
	Sep	284	0.0240	8,398	23	0.0240	680	307	0.0240	9,078	60	0.0136	1,004	118	3	0.0136	44	5,916	9,501	0.0136	159,690	59	0.0136	998	166	0.0240	4,313
WY Total/Average		14,546	0.0136	245,082	1,186	0.0136	19,852	15,832	0.0136	264,934	2,210	0.0136	31,481	709	5,600	0.0136	90,763	-6,746	5,657	0.0136	95,088	1,023	0.0136	17,390	9,027	0.0139	152,628
	Oct	179	0.0050	1,106	13	0.0050	90	194	0.0050	1,195	37	0.0095	438	63	121	0.0095	1,443	47,922	9,410	0.0095	110,371	61	0.0095	720	137	0.0050	845
	Nov	152	0.0198	3,960	13	0.0198	323	175	0.0198	4,281	26	0.0095	306	18	119	0.0095	1,396	2,441	9,367	0.0095	109,814	59	0.0095	697	150	0.0198	3,663
	Dec	140	0.0187	3,225	11	0.0187	261	151	0.0187	3,486	28	0.0095	328	0	121	0.0095	1,443	1,714	9,302	0.0095	109,096	61	0.0095	720	130	0.0187	3,007
1996	Jan	92	0.0176	1,990	7	0.0176	161	99	0.0176	2,151	28	0.0095	328	0	121	0.0095	1,443	989	9,183	0.0095	107,768	61	0.0095	720	97	0.0176	2,106
	Feb	99	0.0165	2,021	8	0.0165	164	107	0.0165	2,185	25	0.0095	298	0	111	0.0095	1,302	926	9,104	0.0095	106,777	55	0.0095	650	112	0.0165	2,232
	Mar	140	0.0154	2,668	11	0.0154	216	152	0.0154	2,884	46	0.0095	544	0	121	0.0095	1,443	1,103	9,023	0.0095	105,852	61	0.0095	720	162	0.0154	3,080
	Apr	427	0.0143	7,531	35	0.0143	610	462	0.0143	8,140	94	0.0095	1,104	0	0	0.0095	0	2,728	9,333	0.0095	109,464	59	0.0095	697	403	0.0143	6,928
	May	5,177	0.0131	83,647	419	0.0131	6,773	5,596	0.0131	90,422	756	0.0095	8,867	137	0	0.0095	0	16,421	13,672	0.0095	160,359	361	0.0095	4,239	3,733	0.0131	60,689
	Jun	2,465	0.0120	36,492	200	0.0120	2,956	2,665	0.0120	39,448	1,165	0.0095	13,666	223	735	0.0095	8,616	10,807	14,155	0.0095	166,021	58	0.0095	697	1,209	0.0120	17,891
	Jul	519	0.0110	7,037	42	0.0110	570	561	0.0110	7,607	242	0.0095	2,833	238	1,756	0.0095	20,616	3,826	12,417	0.0095	145,633	61	0.0095	720	228	0.0110	3,099
	Aug	206	0.0250	6,344	17	0.0250	514	222	0.0250	6,858	88	0.0095	1,034	191	2,183	0.0095	25,605	6,485	10,116	0.0095	118,647	61	0.0095	720	85	0.0250	2,619
	Sep	142	0.0240	4,200	11	0.0240	340	153	0.0240	4,540	45	0.0095	525	125	3	0.0095	30	4,205	10,038	0.0095	117,731	59	0.0095	697	86	0.0240	2,553
WY Total/Average		9,744	0.0133	160,221	790	0.0133	12,978	10,537	0.0133	173,199	2,581	0.0095	30,269	997	5,600	0.0095	65,715	109,567	10,427	0.0096	122,294	1,023	0.0095	11,995	6,513	0.0133	108,202
	Oct	144	0.0209	3,722	12	0.0209	301	156	0.0209	4,023	37	0.0112	515	66	121	0.0112	1,705	-18,629	9,906	0.0112	137,312	61	0.0112	851	106	0.0209	2,742
	Nov	167	0.0198	4,090	14	0.0198	331	181	0.0198	4,432	38	0.0112	526	19	119	0.0112	1,649	2,178	9,852	0.0112	136,557	59	0.0112	823	157	0.0198	3,845
	Dec	147	0.0187	3,396	12	0.0187	275	159	0.0187	3,671	32	0.0112	445	0	121	0.0112	1,701	1,465	9,793	0.0112	135,763	61	0.0112	851	136	0.0187	3,143
1997	Jan	116	0.0176	2,520	9	0.0176	204	125	0.0176	2,724	21	0.0112	295	0	121	0.0112	1,705	985	9,714	0.0112	134,651	61	0.0112	851	152	0.0176	3,293
	Feb	114	0.0165	2,317	9	0.0165	188	123	0.0165	2,505	25	0.0112	341	0	111	0.0112	1,539	799	9,646	0.0112	133,709	55	0.0112	768	187	0.0165	2,983
	Mar	166	0.0154	3,151	13	0.0154	255	179	0.0154	3,407	34	0.0112	470	0	121	0.0112	1,705	921	9,608	0.0112	133,169	61	0.0112	851	204	0.0154	3,883
	Apr	634	0.0143	11,190	51	0.0143	906	686	0.0143	12,096	93	0.0112	1,283	0	0	0.0112	0	2,591	10,141	0.0112	140,568	59	0.0112	823	563	0.0143	9,968
	May	7,426	0.0131	120,020	602	0.0131	9,722	8,029	0.0131	129,742	1,089	0.0112	15,089	148	0	0.0112	0	20,507	16,572	0.0112	229,705	361	0.0112	5,009	6,013	0.0131	97,125
	Jun	3,025	0.0141	52,608	245	0.0141	4,261	3,270	0.0141	56,869	343	0.0112	4,756	252	735	0.0112	10,182	15,039	17,000	0.0112	235,635	1,512	0.0112	20,961	1,499	0.0141	26,064
	Jul	545	0.0110	7,367	44	0.0110	596	586	0.0110	7,957	69	0.0112	961	267	1,759	0.0112	24,384	3,526	15,433	0.0112	213,891	61	0.0112	851	244	0.0110	3,311
	Aug	248	0.0176	5,394	20	0.0176	437	269	0.0176	5,830	28	0.0112	385	220	2,183	0.0112	30,259	5,102	13,207	0.0112	183,064	61	0.0112	851	113	0.0176	2,448
	Sep	255	0.0240	7,542	21	0.0240	611	275	0.0240	8,153	25	0.0112	342	152	3	0.0112	36	6,637	13,284	0.0112	183,578	59	0.0112	823	114	0.0240	1,935
WY Total/Average		12,987	0.0139	221,312	1,052	0.0139	18,088	14,039	0.0139	241,400	1,833	0.0112	25,409	1,124	5,300	0.0112	74,849	40,581	12,010	0.0112	166,487	2,476	0.0112	34,311	9,467	0.0139	162,760

Table C-1

Date September 25, 2006

Flow and Phosphorus Routing WITH Proposed Narrows Project
Narrows Reservoir Operation

Year	Month	Natural Flow-Gooseberry Creek Near Fairview Flow Acre-Feet	Concentration mg/l	Weight grams	Other Inflow at Narrows Reservoir Flow Acre-Feet	Concentration mg/l	Weight grams	(CALC.) Total Inflow at Narrows Reservoir Flow Acre-Feet	Concentration mg/l	Weight grams	Diversion by Cottonwood-Gooseberry Flow Acre-Feet	Concentration mg/l	Weight grams	Reservoir Evaporation Acre-Feet	Project Irrigation Delivery Acre-Feet	mg/l	grams	(CALC.) Phosphorus Uptake grams	End of Month Content Total Acre-Feet	Phosphorus mg/l & Table D-1	Phosphorus grams	Stream Flow below Narrows Reservoir Flow Acre-Feet	Concentration mg/l	Weight grams	(CALC.) Reach Gain Between Narrows Reservoir Site and Lower Gooseberry Reservoir Flow Acre-Feet	Concentration mg/l	Weight grams
																			6277	0.0121	63,900						
	Oct	210	0.0209	5,404	17	0.0209	438	227	0.0209	5,841	19	0.0089	207	41	123	0.0089	1,334	42,179	13,187	0.0089	145,086	61	0.0089	673	164	0.0209	4,213
	Nov	170	0.0198	4,146	14	0.0198	336	183	0.0198	4,481	25	0.0089	276	24	119	0.0089	1,309	2,724	13,143	0.0089	144,326	59	0.0089	653	161	0.0198	3,922
	Dec	168	0.0187	3,873	14	0.0187	314	182	0.0187	4,188	22	0.0089	242	0	123	0.0089	1,351	2,192	13,119	0.0089	144,254	61	0.0089	675	153	0.0187	3,525
1998	Jan	130	0.0176	2,813	10	0.0176	228	140	0.0176	3,041	21	0.0089	233	0	123	0.0089	1,353	1,501	13,053	0.0089	143,531	61	0.0089	675	182	0.0176	3,952
	Feb	140	0.0165	2,851	11	0.0165	231	151	0.0165	3,082	20	0.0089	225	0	111	0.0089	1,221	1,417	13,017	0.0089	143,141	55	0.0089	610	209	0.0165	4,251
	Mar	204	0.0154	3,867	16	0.0154	313	220	0.0154	4,181	29	0.0089	321	0	123	0.0089	1,353	1,761	13,024	0.0089	143,213	61	0.0089	675	263	0.0154	5,072
	Apr	643	0.0143	11,328	52	0.0143	918	694	0.0143	12,245	97	0.0089	1,064	0	0	0.0089	0	4,611	13,562	0.0089	149,130	59	0.0089	653	573	0.0143	10,102
	May	4,626	0.0131	74,747	373	0.0131	6,034	5,000	0.0131	80,801	1,091	0.0089	11,991	183	0	0.0089	0	27,831	16,936	0.0089	186,235	361	0.0089	3,974	3,201	0.0131	51,724
	Jun	2,818	0.0100	34,765	228	0.0100	2,816	3,047	0.0100	37,581	370	0.0089	4,063	253	735	0.0089	8,078	6,864	17,000	0.0089	186,934	1,624	0.0089	17,856	1,392	0.0100	17,166
	Jul	759	0.0110	10,293	61	0.0110	834	820	0.0110	11,127	64	0.0089	699	307	1,758	0.0089	19,328	5,043	15,671	0.0089	172,316	61	0.0089	673	385	0.0110	5,226
	Aug	337	0.0176	7,323	27	0.0176	593	365	0.0176	7,916	30	0.0089	325	232	2,183	0.0089	24,003	6,353	13,539	0.0089	148,875	61	0.0089	673	171	0.0176	3,703
	Sep	240	0.0150	4,440	19	0.0150	360	260	0.0150	4,807	32	0.0089	353	134	3	0.0089	29	3,046	13,550	0.0089	149,001	59	0.0089	653	128	0.0150	2,359
WY Total/Average		10,443	0.0129	165,857	846	0.0129	13,434	11,289	0.0129	179,291	1,810	0.0089	19,900	1,186	5,400	0.0089	59,379	106,141	14,067	0.0089	154,680	2,587	0.0089	28,449	6,984	0.0134	115,222
	Oct	197	0.0209	5,084	16	0.0209	412	213	0.0209	5,495	33	0.0108	443	82	123	0.0108	1,642	-28,127	13,464	0.0108	179,719	61	0.0108	819	153	0.0209	3,936
	Nov	167	0.0198	4,079	14	0.0198	330	181	0.0198	4,410	29	0.0108	390	24	119	0.0108	1,588	2,320	13,413	0.0108	179,047	59	0.0108	793	157	0.0198	3,830
	Dec	85	0.0187	1,966	7	0.0187	159	92	0.0187	2,125	28	0.0108	373	0	123	0.0108	1,642	895	13,293	0.0108	177,443	61	0.0108	819	87	0.0187	2,002
1999	Jan	67	0.0176	1,458	5	0.0176	118	73	0.0176	1,576	27	0.0108	359	0	123	0.0108	1,642	607	13,155	0.0108	175,593	61	0.0108	819	42	0.0176	913
	Feb	85	0.0165	1,737	7	0.0165	141	95	0.0165	1,877	30	0.0108	403	0	111	0.0108	1,482	666	13,050	0.0108	174,197	55	0.0108	740	79	0.0165	1,607
	Mar	127	0.0154	2,413	10	0.0154	193	137	0.0154	2,609	43	0.0108	546	0	123	0.0108	1,642	776	12,962	0.0108	173,023	61	0.0108	819	140	0.0154	2,657
	Apr	339	0.0143	5,977	27	0.0143	484	366	0.0143	6,461	105	0.0108	1,395	0	0	0.0108	0	1,572	13,165	0.0108	175,724	59	0.0108	793	278	0.0143	4,890
	May	3,776	0.0131	61,012	306	0.0131	4,942	4,082	0.0131	65,954	634	0.0108	8,490	180	0	0.0108	0	13,009	16,007	0.0108	214,495	361	0.0108	4,824	2,349	0.0131	37,951
	Jun	2,882	0.0230	81,749	233	0.0230	6,621	3,115	0.0230	88,371	367	0.0108	4,831	247	735	0.0108	9,806	80,095	17,000	0.0108	226,919	839	0.0108	11,193	1,424	0.0230	40,410
	Jul	619	0.0110	8,385	50	0.0110	679	668	0.0110	9,064	102	0.0108	1,361	287	1,758	0.0108	23,462	3,708	15,460	0.0108	206,631	61	0.0108	819	293	0.0110	3,980
	Aug	416	0.0250	12,823	34	0.0250	1,039	449	0.0250	13,851	45	0.0108	603	221	2,183	0.0108	29,140	10,690	13,419	0.0108	179,122	61	0.0108	819	222	0.0250	6,859
	Sep	293	0.0240	8,678	24	0.0240	701	317	0.0240	9,383	32	0.0108	424	133	3	0.0108	33	7,167	13,489	0.0108	180,054	59	0.0108	793	139	0.0240	4,431
WY Total/Average		9,052	0.0175	195,539	733	0.0175	15,824	9,785	0.0175	211,183	1,471	0.0108	19,630	1,174	5,400	0.0108	72,080	64,366	13,597	0.0108	186,831	1,802	0.0108	24,054	8,372	0.0171	113,421
	Oct	138	0.0209	4,077	13	0.0209	330	171	0.0209	4,408	41	0.0073	369	82	120	0.0073	1,111	41,833	13,353	0.0073	120,593	64	0.0073	554	148	0.0209	3,054
	Nov	139	0.0198	3,394	11	0.0198	275	150	0.0198	3,669	38	0.0073	343	24	119	0.0073	1,075	2,538	13,253	0.0073	119,780	59	0.0073	536	118	0.0198	2,872
	Dec	94	0.0187	2,159	8	0.0187	175	101	0.0187	2,334	19	0.0073	167	0	123	0.0073	1,111	1,620	13,161	0.0073	118,882	64	0.0073	554	92	0.0187	2,137
2000	Jan	82	0.0176	1,790	7	0.0176	145	89	0.0176	1,935	11	0.0073	97	0	123	0.0073	1,111	1,330	13,053	0.0073	117,904	61	0.0073	554	75	0.0176	1,627
	Feb	80	0.0165	1,635	7	0.0165	132	87	0.0165	1,767	17	0.0073	156	0	111	0.0073	1,002	993	12,958	0.0073	117,029	55	0.0073	501	65	0.0165	1,266
	Mar	123	0.0154	2,331	10	0.0154	189	133	0.0154	2,520	29	0.0073	263	0	123	0.0073	1,111	1,232	12,878	0.0073	116,300	61	0.0073	554	137	0.0154	2,520
	Apr	821	0.0143	14,484	67	0.0143	1,173	888	0.0143	15,657	66	0.0073	598	0	0	0.0073	0	7,641	13,640	0.0073	123,182	59	0.0073	536	755	0.0143	13,372
	May	3,179	0.0131	51,343	257	0.0131	4,160	3,436	0.0131	55,524	711	0.0073	6,425	184	0	0.0073	0	28,134	15,819	0.0073	142,863	364	0.0073	3,294	1,756	0.0131	28,274
	Jun	1,040	0.0100	12,835	84	0.0100	1,039	1,124	0.0100	13,864	513	0.0073	4,631	245	735	0.0073	6,638	5,926	15,291	0.0073	138,999	59	0.0073	536	470	0.0100	5,796
	Jul	323	0.0110	4,394	26	0.0110	351	349	0.0110	4,717	106	0.0073	953	231	1,758	0.0073	15,874	3,340	13,563	0.0073	122,487	61	0.0073	554	100	0.0110	1,353
	Aug	196	0.0180	4,360	16	0.0180	353	212	0.0180	4,713	77	0.0073	694	203	2,183	0.0073	19,715	4,626	11,231	0.0073	101,610	61	0.0073	554	79	0.0180	1,750
	Sep	150	0.0240	4,429	13	0.0240	359	162	0.0240	4,787	33	0.0073	482	153	3	0.0073	23	4,548	11,162	0.0073	100,807	59	0.0073	536	89	0.0240	2,669
WY Total/Average		6,383	0.0136	107,231	517	0.0136	8,684	6,900	0.0136	115,895	1,681	0.0073	15,177	1,124	5,400	0.0073	48,768	123,961	13,291	0.0073	120,035	1,023	0.0073	9,236	3,846	0.0141	66,621
	Oct	153	0.0209	3,950	12	0.0209	320	166	0.0209	4,277	49	0.0074	443	71	123	0.0074	1,117	2,853	11,026	0.0074	100,115	61	0.0074	557	114	0.0209	2,946
	Nov	127	0.0198	3,090	10	0.0198	250	137	0.0198	3,341	45	0.0074	410	23	119	0.0074	1,081	2,287	10,916	0.0074	99,136	59	0.0074	539	100	0.0198	2,448
	Dec	39	0.0187	887	3	0.0187	72	42	0.0187	959	35	0.0074	314	0	123	0.0074	1,117	582	10,739	0.0074	97,525	61	0.0074	557	49	0.0187	1,132
2001	Jan	46	0.0176	996	4	0.0176	81	50	0.0176	1,077	30	0.0074	276	0	123	0.0074	1,117	626	10,573	0.0074	96,025	61	0.0074	557	-6	0.0176	-123
	Feb	58	0.0165	1,183	5	0.0165	96	63	0.0165	1,279	27	0.0074	244	0	111	0.0074	1,008	708	10,443	0.0074	94,840	55	0.0074	503	14	0.0165	284
	Mar	131	0.0154	2,494	11	0.0154	202	142	0.0154	2,696	46	0.0074	422	0	123	0.0074	1,117	1,409	10,354	0.0074	94,033	61	0.0074	557	147	0.0154	2,791
	Apr	907	0.0143	15,999	73	0.0143	1,296	981	0.0143	17,295	308	0.0074	2,798	0	0	0.0074	0	8,371	10,967	0.0074	99,601	59	0.0074	539	830	0.0143	14,646
	May	3,624	0.0131	58,565	294	0.0131	4,744	3,918	0.0131	63,309	879	0.0074	7,983	158	0	0.0074	0	29,157	13,487	0.0074	122,487	361	0.0074	3,282	2,193	0.0131	35,497
	Jun	696	0.0100	8,584	56	0.0100	695	753	0.0100	9,279	212	0.0074	1,926	221	735	0.0074	6,672	4,453	13,012	0.0074	118,171	59	0.0074	539	295	0.0100	3,398
	Jul	277	0.0110	3,757	22	0.0110	304	299	0.0110	4,061	67	0.0074	610	225	1,758	0.0074	15,963	3,187	11,200	0.0074	101,715	61	0.0074	557	70	0.0110	950
	Aug	184	0.0100	2,275	15	0.0100	184	199	0.0100	2,459	42	0.0074	382	177	2,183	0.0074	19,826	2,254	8,938	0.0074	81,156	61	0.0074	557	71	0.0100	876
	Sep	110	0.0240	3,263	9	0.0240	264	119	0.0240	3,527	39	0.0074	353	113	3	0.0074	24	3,473	8,841	0.0074	80,292	59	0.0074	539	73	0.0240	2,160
WY Total/Average		6,353	0.0134	105,050	515	0.0134	8,509	6,867	0.0134	113,559	1,780	0.0074	16,161	998	5,400	0.0074	49,041	59,582	10,874	0.0074	98,758	1,023	0.0074	9,208	3,993	0.0128	67,233

Table C-1

Date: September 25, 2006

Flow and Phosphorus Routing WITH Proposed Narrows Project
Narrows Reservoir Operation

Year Month	(Franson Noble) Natural Flow-Gooseberry Creek Nap Tailrace: Flow Acre-Feet	Concentration mg/l	Weight grams	Other Inflow at Narrows Reservoir: Flow Acre-Feet	Concentration mg/l	Weight grams	(CALC) Total Inflow at Narrows Reservoir: Flow Acre-Feet	Concentration mg/l	Weight grams	Narrows Reservoir: Diversion by Gooseberry-Narrows: Flow Acre-Feet	Concentration mg/l	Weight grams	Reservoir Evaporation Acre-Feet	Project Irrigation Delivery: Acre-Feet	mg/l	grams	(CALC) Phosphorus Uptake grams	End of Month: Contents Total Acre-Feet	Phosphorus mg/l Table D-1	Phosphorus grams	(Franson Noble) Stream Flow below Narrows Reservoir: Flow Acre-Feet	Concentration mg/l	Weight grams	(CALC) Reach Gains Between Narrows Reservoir Site and Lower Gooseberry Reservoir: Flow Acre-Feet	Concentration mg/l	Weight grams
																		4281	0.0121	63,900						
Oct	92	0.0209	2,384	7	0.0209	193	100	0.0209	2,577	28	0.0066	226	49	123	0.0066	1,005	10,273	8,600	0.0066	70,863	61	0.0066	502	61	0.0209	1,598
Nov	121	0.0198	2,933	10	0.0198	239	131	0.0198	3,192	23	0.0066	187	17	110	0.0066	971	2,265	8,582	0.0066	70,145	59	0.0066	486	92	0.0198	2,236
Dec	79	0.0187	1,834	6	0.0187	149	86	0.0187	1,982	7	0.0066	55	8	123	0.0066	1,005	1,290	8,476	0.0066	69,285	61	0.0066	502	82	0.0187	1,897
2002 Jan	56	0.0176	1,209	4	0.0176	98	60	0.0176	1,307	2	0.0066	13	8	123	0.0066	1,005	815	8,351	0.0066	68,257	61	0.0066	502	16	0.0176	354
Feb	46	0.0165	936	4	0.0165	76	50	0.0165	1,012	6	0.0066	49	9	111	0.0066	907	606	8,223	0.0066	67,254	55	0.0066	453	-14	0.0165	-292
Mar	58	0.0154	1,097	5	0.0154	89	62	0.0154	1,186	29	0.0066	236	9	123	0.0066	1,005	676	8,077	0.0066	66,021	61	0.0066	502	25	0.0154	474
Apr	746	0.0143	13,057	60	0.0143	1,058	806	0.0143	14,115	179	0.0066	1,466	8	0	0.0066	0	7,374	8,638	0.0066	70,610	59	0.0066	486	668	0.0143	11,784
May	2,448	0.0131	39,554	199	0.0131	3,204	2,646	0.0131	42,757	625	0.0066	5,107	131	0	0.0066	0	22,198	10,168	0.0066	83,109	361	0.0066	2,954	1,017	0.0131	16,433
Jun	505	0.0141	8,741	41	0.0141	708	547	0.0141	9,449	99	0.0066	811	180	732	0.0066	6,003	6,480	9,638	0.0066	78,777	59	0.0066	486	192	0.0141	3,311
Jul	232	0.0110	3,149	19	0.0110	255	251	0.0110	3,404	36	0.0066	295	198	1,758	0.0066	14,367	2,826	7,853	0.0066	64,190	61	0.0066	502	41	0.0110	559
Aug	114	0.0176	2,464	9	0.0176	200	123	0.0176	2,664	27	0.0066	223	138	2,187	0.0066	17,884	3,755	5,570	0.0066	45,530	61	0.0066	502	22	0.0176	339
Sep	104	0.0240	3,080	8	0.0240	249	112	0.0240	3,329	18	0.0066	149	76	3	0.0066	21	3,034	5,526	0.0066	45,170	59	0.0066	486	70	0.0240	2,083
WY Total/Average	4,593	0.0142	80,458	372	0.0142	6,517	4,965	0.0142	86,975	1,079	0.0066	8,818	778	5,400	0.0066	44,119	60,780	8,148	0.0066	66,601	1,023	0.0066	8,360	2,371	0.0146	40,985
Oct	60	0.0209	1,538	3	0.0209	125	64	0.0209	1,663	58	0.0072	509	40	123	0.0072	1,087	12,237	5,308	0.0072	46,931	61	0.0072	543	180	0.0209	4,631
Nov	53	0.0198	1,293	4	0.0198	105	57	0.0198	1,398	49	0.0072	422	11	119	0.0072	1,052	993	5,128	0.0072	45,337	59	0.0072	525	115	0.0198	2,814
Dec	14	0.0187	323	1	0.0187	26	15	0.0187	349	14	0.0072	124	9	123	0.0072	1,087	245	4,945	0.0072	43,717	61	0.0072	543	26	0.0187	592
2003 Jan	45	0.0176	968	4	0.0176	78	48	0.0176	1,046	3	0.0072	30	0	123	0.0072	1,087	620	4,805	0.0072	42,483	61	0.0072	543	9	0.0176	194
Feb	52	0.0165	1,055	4	0.0165	85	56	0.0165	1,141	13	0.0072	111	6	111	0.0072	981	645	4,682	0.0072	41,396	55	0.0072	490	54	0.0165	1,099
Mar	60	0.0154	1,140	5	0.0154	92	65	0.0154	1,232	60	0.0072	533	8	123	0.0072	1,087	659	4,502	0.0072	39,806	61	0.0072	543	130	0.0154	2,478
Apr	374	0.0143	6,597	30	0.0143	534	404	0.0143	7,131	374	0.0072	3,303	8	0	0.0072	0	3,557	4,474	0.0072	39,553	59	0.0072	525	712	0.0143	12,556
May	2,638	0.0131	42,626	214	0.0131	3,453	2,852	0.0131	46,079	1,302	0.0072	11,508	75	0	0.0072	0	21,350	5,886	0.0072	52,052	61	0.0072	543	4,365	0.0131	70,567
Jun	704	0.0180	15,623	57	0.0180	1,263	761	0.0180	16,888	207	0.0072	1,828	115	731	0.0072	6,495	11,181	5,532	0.0072	48,912	59	0.0072	525	1,165	0.0180	25,817
Jul	169	0.0173	3,613	14	0.0173	299	183	0.0173	3,908	75	0.0072	665	118	1,708	0.0072	15,540	3,295	3,707	0.0072	32,777	61	0.0072	543	245	0.0173	5,229
Aug	125	0.0160	2,473	10	0.0160	200	135	0.0160	2,673	57	0.0072	502	70	1,155	0.0072	10,209	2,095	2,500	0.0072	22,105	61	0.0072	543	155	0.0160	3,071
Sep	61	0.0240	1,815	5	0.0240	147	66	0.0240	1,963	38	0.0072	337	38	0	0.0072	0	1,709	2,431	0.0072	21,494	59	0.0072	525	139	0.0240	4,124
WY Total/Average	4,355	0.0147	79,067	351	0.0147	6,404	4,707	0.0147	85,471	2,248	0.0072	19,870	463	4,569	0.0072	39,020	44,261	4,402	0.0072	39,713	723	0.0072	6,389	7,282	0.0147	132,940
Oct	37	0.0209	954	3	0.0209	77	40	0.0209	1,031	57	0.0107	486	19	0	0.0107	0	9,882	2,354	0.0107	31,110	61	0.0107	811	113	0.0209	2,065
Nov	75	0.0198	1,836	6	0.0198	149	81	0.0198	1,985	50	0.0107	403	6	0	0.0107	0	984	2,319	0.0107	30,923	59	0.0107	785	102	0.0198	2,483
Dec	53	0.0187	1,186	4	0.0187	96	56	0.0187	1,282	9	0.0107	119	0	0	0.0107	0	347	2,325	0.0107	30,727	61	0.0107	811	86	0.0187	1,994
2004 Jan	60	0.0176	1,312	5	0.0176	106	65	0.0176	1,419	2	0.0107	28	0	0	0.0107	0	333	2,320	0.0107	30,712	61	0.0107	811	73	0.0176	1,582
Feb	62	0.0165	1,257	5	0.0165	102	67	0.0165	1,359	8	0.0107	106	0	0	0.0107	0	476	2,330	0.0107	30,795	55	0.0107	733	86	0.0165	1,749
Mar	87	0.0154	1,644	7	0.0154	133	94	0.0154	1,777	39	0.0107	509	0	0	0.0107	0	541	2,323	0.0107	30,712	61	0.0107	811	199	0.0154	3,769
Apr	674	0.0143	11,894	55	0.0143	963	729	0.0143	12,858	239	0.0107	3,156	0	0	0.0107	0	3,220	2,754	0.0107	36,406	59	0.0107	785	1,193	0.0143	21,050
May	1,854	0.0131	29,955	150	0.0131	2,426	2,004	0.0131	32,382	832	0.0107	10,994	49	0	0.0107	0	6,536	3,816	0.0107	50,446	61	0.0107	811	2,538	0.0131	41,332
Jun	377	0.0195	9,076	31	0.0195	738	408	0.0195	9,813	132	0.0107	1,746	99	735	0.0107	9,716	5,461	3,710	0.0107	[illegible]	59	0.0107	785	440	0.0195	[illegible]
Jul	169	0.0173	3,609	14	0.0173	252	183	0.0173	3,900	48	0.0107	635	71	722	0.0107	9,545	2,418	2,500	0.0107	33,045	61	0.0107	811	190	0.0173	4,058
Aug	111	0.0211	2,890	9	0.0211	234	120	0.0211	3,124	36	0.0107	479	49	0	0.0107	0	2,190	2,473	0.0107	32,669	61	0.0107	811	81	0.0211	2,137
Sep	52	0.0240	1,512	4	0.0240	136	57	0.0240	1,676	24	0.0107	322	37	0	0.0107	0	1,421	2,409	0.0107	31,870	59	0.0107	782	105	0.0240	3,098
WY Total/Average	3,610	0.0121	67,100	292	0.0151	5,440	3,903	0.0151	72,606	1,435	0.0107	18,964	339	1,857	0.0107	19,259	14,470	2,597	0.0107	34,335	723	0.0107	9,553	5,648	0.0151	105,969
Oct	84	0.0209	2,154	7	0.0209	174	90	0.0209	2,329	55	0.0115	778	19	0	0.0115	0	-1,009	2,352	0.0115	33,519	61	0.0115	870	196	0.0209	5,059
Nov	67	0.0198	1,642	5	0.0198	133	73	0.0198	1,775	45	0.0115	645	8	0	0.0115	0	824	2,326	0.0115	32,983	59	0.0115	842	177	0.0198	4,355
Dec	52	0.0187	1,193	4	0.0187	97	56	0.0187	1,290	13	0.0115	190	0	0	0.0115	0	497	2,307	0.0115	32,715	61	0.0115	870	96	0.0187	2,207
2005 Jan	61	0.0176	1,321	5	0.0176	107	66	0.0176	1,428	3	0.0115	45	0	0	0.0115	0	495	2,308	0.0115	32,732	61	0.0115	870	77	0.0176	1,664
Feb	61	0.0165	1,251	5	0.0165	101	66	0.0165	1,353	12	0.0115	179	0	0	0.0115	0	410	2,307	0.0115	32,719	55	0.0115	786	93	0.0165	1,896
Mar	66	0.0154	1,251	5	0.0154	101	71	0.0154	1,352	57	0.0115	815	0	0	0.0115	0	343	2,259	0.0115	32,043	61	0.0115	870	190	0.0154	3,602
Apr	356	0.0143	6,279	29	0.0143	509	385	0.0143	6,788	336	0.0115	5,093	0	0	0.0115	0	1,350	2,229	0.0115	31,605	59	0.0115	842	817	0.0143	14,410
May	4,223	0.0131	68,235	342	0.0131	5,527	4,565	0.0131	73,762	1,241	0.0115	17,606	40	0	0.0115	0	9,396	5,150	0.0115	73,043	561	0.0115	8,123	3,066	0.0131	49,493
Jun	2,544	0.0195	61,179	206	0.0195	4,956	2,750	0.0195	66,135	197	0.0115	2,796	108	711	0.0115	10,418	25,393	6,606	0.0115	96,526	59	0.0115	842	2,122	0.0195	51,048
Jul	310	0.0100	3,822	25	0.0100	310	335	0.0100	4,131	72	0.0115	1,017	156	1,750	0.0115	24,922	1,307	5,115	0.0115	72,535	61	0.0115	870	466	0.0100	5,743
Aug	191	0.0100	2,360	15	0.0100	191	207	0.0100	2,551	54	0.0115	768	93	2,183	0.0115	30,960	937	2,930	0.0115	41,550	61	0.0115	870	298	0.0100	3,675
Sep	124	0.0100	1,533	10	0.0100	124	134	0.0100	1,657	36	0.0115	515	43	3	0.0115	27	366	2,923	0.0115	41,446	59	0.0115	842	187	0.0100	2,301
WY Total/Average	8,136	0.0152	152,220	659	0.0152	12,330	8,795	0.0152	164,550	2,143	0.0115	30,396	440	4,678	0.0115	66,345	43,700	3,252	0.0115	46,118	1,023	0.0115	14,504	10,644	0.0152	191,356
78-05 Total	258,427		4,547,412	20,932		368,329	279,358		4,915,741	57,951		702,749	23,596	136,081		1,643,864	1,853,052			2,914,558	61,082		738,330	179,103		3,188,314
78-05 Average	9,230	0.0143	162,408	748	0.0143	13,155	9,977	0.0143	175,562	2,070	0.0099	25,098	843	4,972	0.0097	58,709	66,180	8,889	0.0095	104,092	2,182	0.0099	26,370	6,397	0.0144	113,875
78-89 Total	130,677		2,281,393	10,584		184,793	141,261		2,466,344	24,936		294,350	11,892	64,901		767,964	951,613	130,085		1,531,192	19,083		470,141	84,475		1,493,899
Average	10,890	0.0142	190,129	855	0.0142	15,400	11,772	0.0142	205,529	2,080	0.0096	24,546	991	5,400	0.0096	63,997	79,301	10,840	0.0095	127,599	3,257	0.0098	39,179	7,040	0.0143	124,491

NOTE: Average Annual Concentrations are Flow Weighted

Table C-2

Date: September 25, 2006

Flow and Phosphorus Routing WITH Proposed Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			(CALC) Stream Flow-Gooseberry Creek Near Scofield		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l Table 3	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l Table D-2	Weight grams
	Oct	335	0.0138	5,696	335	0.0123	5,093			603	335	0.0123	5,093
	Nov	127	0.0162	2,538	127	0.0123	1,928			610	127	0.0123	1,928
	Dec	149	0.0160	2,946	149	0.0123	2,268			678	149	0.0123	2,268
1978	Jan	142	0.0152	2,658	142	0.0123	2,150			508	142	0.0123	2,150
	Feb	129	0.0146	2,320	129	0.0123	1,955			365	129	0.0123	1,955
	Mar	162	0.0142	2,829	162	0.0123	2,461			368	162	0.0123	2,461
	Apr	574	0.0141	9,969	574	0.0123	8,721			1,248	574	0.0123	8,721
	May	3,078	0.0130	49,293	3,078	0.0123	46,741			2,552	3,078	0.0123	46,741
	Jun	2,618	0.0141	45,383	2,618	0.0123	39,754			5,628	2,618	0.0123	39,754
	Jul	375	0.0112	5,170	375	0.0123	5,692			-522	375	0.0123	5,692
	Aug	259	0.0163	5,202	259	0.0123	3,930			1,272	259	0.0123	3,930
	Sep	159	0.0195	3,823	159	0.0123	2,408			1,415	159	0.0123	2,408
WY	Total	8,106	0.0138	137,827	8,106	0.0123	123,101			14,726	8,106	0.0123	123,101
	Oct	71	0.0109	950	71	0.0117	1,022			-72	71	0.0117	1,022
	Nov	197	0.0167	4,050	197	0.0117	2,851			1,199	197	0.0117	2,851
	Dec	158	0.0151	2,930	158	0.0117	2,279			650	158	0.0117	2,279
1979	Jan	161	0.0145	2,871	161	0.0117	2,327			544	161	0.0117	2,327
	Feb	141	0.0137	2,391	141	0.0117	2,045			346	141	0.0117	2,045
	Mar	154	0.0130	2,478	154	0.0117	2,234			245	154	0.0117	2,234
	Apr	294	0.0133	4,820	294	0.0117	4,248			572	294	0.0117	4,248
	May	3,122	0.0127	48,805	3,122	0.0117	45,178			3,626	3,122	0.0117	45,178
	Jun	1,160	0.0139	19,825	1,160	0.0117	16,780			3,045	1,160	0.0117	16,780
	Jul	259	0.0106	3,396	259	0.0117	3,751			-354	259	0.0117	3,751
	Aug	173	0.0147	3,143	173	0.0117	2,509			635	173	0.0117	2,509
	Sep	143	0.0179	3,173	143	0.0117	2,074			1,099	143	0.0117	2,074
WY	Total	6,033	0.0133	98,832	6,033	0.0117	87,297			11,535	6,033	0.0117	87,297
	Oct	162	0.0176	3,511	162	0.0124	2,485			1,026	162	0.0124	2,485
	Nov	150	0.0167	3,089	150	0.0124	2,295			795	150	0.0124	2,295
	Dec	172	0.0163	3,465	172	0.0124	2,637			829	172	0.0124	2,637
1980	Jan	185	0.0158	3,597	185	0.0124	2,835			761	185	0.0124	2,835
	Feb	168	0.0150	3,125	168	0.0124	2,582			543	168	0.0124	2,582
	Mar	176	0.0142	3,097	176	0.0124	2,703			394	176	0.0124	2,703
	Apr	523	0.0140	9,070	523	0.0124	8,025			1,045	523	0.0124	8,025
	May	3,114	0.0130	49,858	3,114	0.0124	47,737			2,121	3,114	0.0124	47,737
	Jun	2,785	0.0141	48,284	2,785	0.0124	42,691			5,593	2,785	0.0124	42,691
	Jul	426	0.0112	5,868	426	0.0124	6,538			-670	426	0.0124	6,538
	Aug	209	0.0160	4,117	209	0.0124	3,203			914	209	0.0124	3,203
	Sep	184	0.0202	4,584	184	0.0124	2,826			1,758	184	0.0124	2,826
WY	Total	8,255	0.0139	141,665	8,255	0.0124	126,557			15,108	8,255	0.0124	126,557

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Date: September 25, 2006

Flow and Phosphorus Routing WITH Proposed Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			(CALC) Stream Flow-Gooseberry Creek Near Scofield		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l Table 5	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l Table D-2	Weight grams
	Oct	214	0.0171	4,500	214	0.0113	2,984			1,516	214	0.0113	2,984
	Nov	213	0.0164	4,312	213	0.0113	2,977			1,334	213	0.0113	2,977
	Dec	191	0.0151	3,573	191	0.0113	2,672			901	191	0.0113	2,672
1981	Jan	205	0.0146	3,701	205	0.0113	2,868			833	205	0.0113	2,868
	Feb	182	0.0138	3,095	182	0.0113	2,541			554	182	0.0113	2,541
	Mar	259	0.0136	4,337	259	0.0113	3,623			714	259	0.0113	3,623
	Apr	874	0.0138	14,932	874	0.0113	12,217			2,715	874	0.0113	12,217
	May	1,684	0.0119	24,781	1,684	0.0113	23,539			1,242	1,684	0.0113	23,539
	Jun	620	0.0098	7,475	620	0.0113	8,665			-1,190	620	0.0113	8,665
	Jul	186	0.0099	2,271	186	0.0113	2,601			-330	186	0.0113	2,601
	Aug	136	0.0131	2,200	136	0.0113	1,902			298	136	0.0113	1,902
	Sep	149	0.0175	3,222	149	0.0113	2,087			1,135	149	0.0113	2,087
WY	Total	4,914	0.0129	78,397	4,914	0.0113	68,677			9,720	4,914	0.0113	68,677
	Oct	221	0.0182	4,961	221	0.0123	3,358			1,603	221	0.0123	3,358
	Nov	188	0.0171	3,977	188	0.0123	2,867			1,110	188	0.0123	2,867
	Dec	161	0.0159	3,154	161	0.0123	2,452			703	161	0.0123	2,452
1982	Jan	133	0.0147	2,405	133	0.0123	2,021			383	133	0.0123	2,021
	Feb	112	0.0139	1,926	112	0.0123	1,708			219	112	0.0123	1,708
	Mar	160	0.0138	2,727	160	0.0123	2,435			292	160	0.0123	2,435
	Apr	654	0.0140	11,306	654	0.0123	9,941			1,365	654	0.0123	9,941
	May	4,384	0.0129	70,020	4,384	0.0123	66,681			3,339	4,384	0.0123	66,681
	Jun	1,662	0.0140	28,697	1,662	0.0123	25,278			3,420	1,662	0.0123	25,278
	Jul	466	0.0110	6,336	466	0.0123	7,081			-745	466	0.0123	7,081
	Aug	247	0.0160	4,886	247	0.0123	3,760			1,126	247	0.0123	3,760
	Sep	236	0.0208	6,067	236	0.0123	3,597			2,470	236	0.0123	3,597
WY	Total	8,625	0.0138	146,463	8,625	0.0123	131,177			15,286	8,625	0.0123	131,177
	Oct	439	0.0196	10,584	439	0.0122	6,590			3,994	439	0.0122	6,590
	Nov	433	0.0186	9,962	433	0.0122	6,509			3,453	433	0.0122	6,509
	Dec	294	0.0172	6,216	294	0.0122	4,412			1,804	294	0.0122	4,412
1983	Jan	327	0.0164	6,621	327	0.0122	4,910			1,711	327	0.0122	4,910
	Feb	285	0.0155	5,454	285	0.0122	4,287			1,167	285	0.0122	4,287
	Mar	344	0.0147	6,228	344	0.0122	5,170			1,059	344	0.0122	5,170
	Apr	348	0.0138	5,921	348	0.0122	5,228			693	348	0.0122	5,228
	May	1,894	0.0128	29,806	1,894	0.0122	28,445			1,361	1,894	0.0122	28,445
	Jun	10,799	0.0125	167,154	10,799	0.0122	162,219			4,936	10,799	0.0122	162,219
	Jul	1,153	0.0101	14,326	1,153	0.0122	17,324			-2,999	1,153	0.0122	17,324
	Aug	369	0.0166	7,535	369	0.0122	5,543			1,992	369	0.0122	5,543
	Sep	254	0.0210	6,593	254	0.0122	3,817			2,776	254	0.0122	3,817
WY	Total	16,939	0.0132	276,400	16,939	0.0122	254,453			21,947	16,939	0.0122	254,453

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Flow and Phosphorus Routing WITH Proposed Narrows Project

Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			(CALC) Stream Flow-Gooseberry Creek Near Scofield		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l Table 5	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l Table D-2	Weight grams
	Oct	357	0.0189	8,320	357	0.0110	4,851			3,470	357	0.0110	4,851
	Nov	348	0.0180	7,726	348	0.0110	4,729			2,997	348	0.0110	4,729
	Dec	330	0.0169	6,892	330	0.0110	4,482			2,410	330	0.0110	4,482
1984	Jan	383	0.0163	7,674	383	0.0110	5,199			2,474	383	0.0110	5,199
	Feb	337	0.0153	6,350	337	0.0110	4,571			1,779	337	0.0110	4,571
	Mar	317	0.0142	5,559	317	0.0110	4,311			1,248	317	0.0110	4,311
	Apr	378	0.0135	6,286	378	0.0110	5,129			1,157	378	0.0110	5,129
	May	10,698	0.0113	148,858	10,698	0.0110	145,302			3,557	10,698	0.0110	145,302
	Jun	9,350	0.0110	126,440	9,350	0.0110	126,995			-554	9,350	0.0110	126,995
	Jul	605	0.0108	8,074	605	0.0110	8,220			-145	605	0.0110	8,220
	Aug	301	0.0159	5,908	301	0.0110	4,095			1,813	301	0.0110	4,095
	Sep	214	0.0199	5,243	214	0.0110	2,903			2,340	214	0.0110	2,903
WY	Total	23,619	0.0118	343,332	23,619	0.0110	320,787			22,545	23,619	0.0110	320,787
	Oct	333	0.0188	7,719	333	0.0116	4,784			2,936	333	0.0116	4,784
	Nov	317	0.0178	6,976	317	0.0116	4,549			2,427	317	0.0116	4,549
	Dec	294	0.0167	6,064	294	0.0116	4,213			1,851	294	0.0116	4,213
1985	Jan	360	0.0162	7,181	360	0.0116	5,160			2,021	360	0.0116	5,160
	Feb	279	0.0151	5,180	279	0.0116	3,997			1,183	279	0.0116	3,997
	Mar	283	0.0141	4,918	283	0.0116	4,062			856	283	0.0116	4,062
	Apr	1,638	0.0141	28,523	1,638	0.0116	23,497			5,026	1,638	0.0116	23,497
	May	7,609	0.0117	110,175	7,609	0.0116	109,172			1,004	7,609	0.0116	109,172
	Jun	2,130	0.0112	29,392	2,130	0.0116	30,567			-1,175	2,130	0.0116	30,567
	Jul	380	0.0107	5,032	380	0.0116	5,454			-423	380	0.0116	5,454
	Aug	214	0.0152	4,024	214	0.0116	3,073			951	214	0.0116	3,073
	Sep	178	0.0191	4,187	178	0.0116	2,550			1,637	178	0.0116	2,550
WY	Total	14,015	0.0127	219,372	14,015	0.0116	201,079			18,294	14,015	0.0116	201,079
	Oct	244	0.0181	5,440	244	0.0115	3,459			1,981	244	0.0115	3,459
	Nov	266	0.0176	5,764	266	0.0115	3,777			1,987	266	0.0115	3,777
	Dec	238	0.0164	4,803	238	0.0115	3,372			1,432	238	0.0115	3,372
1986	Jan	288	0.0159	5,666	288	0.0115	4,092			1,574	288	0.0115	4,092
	Feb	291	0.0152	5,468	291	0.0115	4,134			1,333	291	0.0115	4,134
	Mar	395	0.0145	7,072	395	0.0115	5,603			1,469	395	0.0115	5,603
	Apr	1,028	0.0140	17,808	1,028	0.0115	14,599			3,209	1,028	0.0115	14,599
	May	7,106	0.0122	107,046	7,106	0.0115	100,880			6,166	7,106	0.0115	100,880
	Jun	7,260	0.0114	101,915	7,260	0.0115	103,075			-1,160	7,260	0.0115	103,075
	Jul	372	0.0108	4,958	372	0.0115	5,284			-326	372	0.0115	5,284
	Aug	224	0.0155	4,274	224	0.0115	3,182			1,092	224	0.0115	3,182
	Sep	192	0.0196	4,642	192	0.0115	2,726			1,916	192	0.0115	2,726
WY	Total	17,904	0.0124	274,856	17,904	0.0115	254,184			20,673	17,904	0.0115	254,184

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Flow and Phosphorus Routing WITH Proposed Narrows Project

Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			(CALC) Stream Flow-Gooseberry Creek Near Scofield		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l Table 5	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l Table D-2	Weight grams
	Oct	300	0.0182	6,727	300	0.0118	4,375			2,352	300	0.0118	4,375
	Nov	307	0.0174	6,586	307	0.0118	4,466			2,120	307	0.0118	4,466
	Dec	216	0.0155	4,122	216	0.0118	3,140			983	216	0.0118	3,140
1987	Jan	152	0.0135	2,536	152	0.0118	2,216			320	152	0.0118	2,216
	Feb	125	0.0125	1,923	125	0.0118	1,819			105	125	0.0118	1,819
	Mar	172	0.0126	2,658	172	0.0118	2,498			160	172	0.0118	2,498
	Apr	1,062	0.0139	18,226	1,062	0.0118	15,460			2,765	1,062	0.0118	15,460
	May	1,509	0.0117	21,864	1,509	0.0118	21,969			-105	1,509	0.0118	21,969
	Jun	383	0.0131	6,176	383	0.0118	5,579			598	383	0.0118	5,579
	Jul	209	0.0100	2,572	209	0.0118	3,048			-476	209	0.0118	3,048
	Aug	152	0.0135	2,531	152	0.0118	2,213			318	152	0.0118	2,213
	Sep	150	0.0175	3,231	150	0.0118	2,186			1,046	150	0.0118	2,186
WY	Total	4,736	0.0135	79,153	4,736	0.0118	68,968			10,186	4,736	0.0118	68,968
	Oct	167	0.0161	3,317	167	0.0115	2,367			950	167	0.0115	2,367
	Nov	158	0.0153	2,995	158	0.0115	2,246			749	158	0.0115	2,246
	Dec	159	0.0146	2,862	159	0.0115	2,263			599	159	0.0115	2,263
1988	Jan	180	0.0143	3,180	180	0.0115	2,557			622	180	0.0115	2,557
	Feb	165	0.0136	2,763	165	0.0115	2,336			428	165	0.0115	2,336
	Mar	197	0.0131	3,183	197	0.0115	2,801			382	197	0.0115	2,801
	Apr	556	0.0136	9,337	556	0.0115	7,890			1,447	556	0.0115	7,890
	May	2,649	0.0124	40,501	2,649	0.0115	37,603			2,898	2,649	0.0115	37,603
	Jun	487	0.0133	8,016	487	0.0115	6,911			1,104	487	0.0115	6,911
	Jul	184	0.0100	2,271	184	0.0115	2,618			-347	184	0.0115	2,618
	Aug	148	0.0136	2,492	148	0.0115	2,108			384	148	0.0115	2,108
	Sep	146	0.0175	3,143	146	0.0115	2,071			1,072	146	0.0115	2,071
WY	Total	5,196	0.0131	84,059	5,196	0.0115	73,770			10,289	5,196	0.0115	73,770
	Oct	176	0.0163	3,544	176	0.0114	2,480			1,064	176	0.0114	2,480
	Nov	216	0.0165	4,392	216	0.0114	3,042			1,350	216	0.0114	3,042
	Dec	200	0.0154	3,792	200	0.0114	2,821			971	200	0.0114	2,821
1989	Jan	223	0.0149	4,089	223	0.0114	3,136			953	223	0.0114	3,136
	Feb	171	0.0137	2,890	171	0.0114	2,413			476	171	0.0114	2,413
	Mar	267	0.0136	4,494	267	0.0114	3,761			733	267	0.0114	3,761
	Apr	1,283	0.0140	22,156	1,283	0.0114	18,081			4,075	1,283	0.0114	18,081
	May	1,400	0.0117	20,258	1,400	0.0114	19,732			526	1,400	0.0114	19,732
	Jun	387	0.0131	6,261	387	0.0114	5,448			813	387	0.0114	5,448
	Jul	192	0.0100	2,367	192	0.0114	2,711			-344	192	0.0114	2,711
	Aug	130	0.0130	2,075	130	0.0114	1,829			246	130	0.0114	1,829
	Sep	570	0.0105	7,354	570	0.0114	8,033			-679	570	0.0114	8,033
WY	Total	5,215	0.0130	83,672	5,215	0.0114	73,488			10,184	5,215	0.0114	73,488

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Flow and Phosphorus Routing WITH Proposed Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			(CALC) Stream Flow-Gooseberry Creek Near Scofield		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l Table 5	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l Table D-2	Weight grams
	Oct	157	0.0167	3,222	157	0.0123	2,377			845	157	0.0123	2,377
	Nov	305	0.0179	6,730	305	0.0123	4,620			2,110	305	0.0123	4,620
	Dec	171	0.0156	3,296	171	0.0123	2,596			700	171	0.0123	2,596
1990	Jan	178	0.0150	3,304	178	0.0123	2,706			599	178	0.0123	2,706
	Feb	162	0.0143	2,849	162	0.0123	2,450			399	162	0.0123	2,450
	Mar	202	0.0138	3,438	202	0.0123	3,066			372	202	0.0123	3,066
	Apr	1,097	0.0141	19,034	1,097	0.0123	16,624			2,410	1,097	0.0123	16,624
	May	1,495	0.0124	22,803	1,495	0.0123	22,661			142	1,495	0.0123	22,661
	Jun	463	0.0213	12,202	463	0.0123	7,026			5,176	463	0.0123	7,026
	Jul	213	0.0107	2,817	213	0.0123	3,226			-409	213	0.0123	3,226
	Aug	655	0.0118	9,555	655	0.0123	9,926			-371	655	0.0123	9,926
	Sep	509	0.0122	7,694	509	0.0123	7,719			-25	509	0.0123	7,719
WY	Total	5,607	0.0140	96,944	5,607	0.0123	84,996			11,948	5,607	0.0123	84,996
	Oct	389	0.0135	6,487	389	0.0126	6,066			421	389	0.0126	6,066
	Nov	184	0.0168	3,805	184	0.0126	2,862			943	184	0.0126	2,862
	Dec	176	0.0159	3,435	176	0.0126	2,739			696	176	0.0126	2,739
1991	Jan	190	0.0153	3,596	190	0.0126	2,967			630	190	0.0126	2,967
	Feb	179	0.0147	3,229	179	0.0126	2,786			443	179	0.0126	2,786
	Mar	199	0.0139	3,406	199	0.0126	3,097			309	199	0.0126	3,097
	Apr	498	0.0139	8,502	498	0.0126	7,759			743	498	0.0126	7,759
	May	2,799	0.0128	44,088	2,799	0.0126	43,640			448	2,799	0.0126	43,640
	Jun	1,305	0.0186	29,973	1,305	0.0126	20,353			9,620	1,305	0.0126	20,353
	Jul	321	0.0109	4,323	321	0.0126	5,008			-684	321	0.0126	5,008
	Aug	205	0.0067	1,684	205	0.0126	3,195			-1,511	205	0.0126	3,195
	Sep	191	0.0198	4,657	191	0.0126	2,972			1,685	191	0.0126	2,972
WY	Total	6,634	0.0143	117,184	6,634	0.0126	103,443			13,742	6,634	0.0126	103,443
	Oct	443	0.0178	9,697	443	0.0112	6,118			3,579	443	0.0112	6,118
	Nov	185	0.0166	3,796	185	0.0112	2,557			1,239	185	0.0112	2,557
	Dec	179	0.0157	3,463	179	0.0112	2,472			991	179	0.0112	2,472
1992	Jan	154	0.0146	2,771	154	0.0112	2,133			638	154	0.0112	2,133
	Feb	125	0.0136	2,105	125	0.0112	1,734			371	125	0.0112	1,734
	Mar	225	0.0139	3,857	225	0.0112	3,107			750	225	0.0112	3,107
	Apr	728	0.0139	12,526	728	0.0112	10,065			2,461	728	0.0112	10,065
	May	633	0.0113	8,821	633	0.0112	8,750			71	633	0.0112	8,750
	Jun	329	0.0092	3,723	329	0.0112	4,549			-826	329	0.0112	4,549
	Jul	787	0.0100	9,733	787	0.0112	10,882			-1,149	787	0.0112	10,882
	Aug	495	0.0108	6,598	495	0.0112	6,834			-237	495	0.0112	6,834
	Sep	136	0.0178	2,983	136	0.0112	1,873			1,109	136	0.0112	1,873
WY	Total	4,419	0.0129	70,072	4,419	0.0112	61,075			8,997	4,419	0.0112	61,075

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Flow and Phosphorus Routing WITH Proposed Narrows Project

Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			(CALC) Stream Flow-Gooseberry Creek Near Scofield		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l Table 5	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l Table D-2	Weight grams
	Oct	247	0.0187	5,697	247	0.0125	3,805			1,893	247	0.0125	3,805
	Nov	229	0.0178	5,018	229	0.0125	3,524			1,494	229	0.0125	3,524
	Dec	208	0.0167	4,279	208	0.0125	3,195			1,083	208	0.0125	3,195
1993	Jan	237	0.0161	4,724	237	0.0125	3,652			1,073	237	0.0125	3,652
	Feb	232	0.0154	4,410	232	0.0125	3,570			841	232	0.0125	3,570
	Mar	380	0.0148	6,948	380	0.0125	5,839			1,109	380	0.0125	5,839
	Apr	973	0.0142	16,996	973	0.0125	14,971			2,025	973	0.0125	14,971
	May	4,908	0.0130	78,783	4,908	0.0125	75,486			3,297	4,908	0.0125	75,486
	Jun	1,339	0.0149	24,544	1,339	0.0125	20,589			3,955	1,339	0.0125	20,589
	Jul	364	0.0112	5,006	364	0.0125	5,596			-590	364	0.0125	5,596
	Aug	211	0.0070	1,826	211	0.0125	3,248			-1,422	211	0.0125	3,248
	Sep	181	0.0200	4,468	181	0.0125	2,781			1,687	181	0.0125	2,781
WY	Total	9,510	0.0139	162,698	9,510	0.0125	146,254			16,444	9,510	0.0125	146,254
	Oct	201	0.0173	4,284	201	0.0119	2,966			1,318	201	0.0119	2,966
	Nov	181	0.0162	3,634	181	0.0119	2,672			961	181	0.0119	2,672
	Dec	187	0.0155	3,571	187	0.0119	2,753			818	187	0.0119	2,753
1994	Jan	174	0.0145	3,120	174	0.0119	2,563			557	174	0.0119	2,563
	Feb	154	0.0138	2,625	154	0.0119	2,274			350	154	0.0119	2,274
	Mar	204	0.0135	3,388	204	0.0119	3,008			381	204	0.0119	3,008
	Apr	641	0.0138	10,921	641	0.0119	9,452			1,469	641	0.0119	9,452
	May	2,344	0.0125	36,026	2,344	0.0119	34,545			1,481	2,344	0.0119	34,545
	Jun	476	0.0135	7,895	476	0.0119	7,010			885	476	0.0119	7,010
	Jul	143	0.0147	2,585	143	0.0119	2,104			481	143	0.0119	2,104
	Aug	146	0.0165	2,981	146	0.0119	2,155			825	146	0.0119	2,155
	Sep	154	0.0182	3,454	154	0.0119	2,269			1,186	154	0.0119	2,269
WY	Total	5,006	0.0137	84,484	5,006	0.0119	73,772			10,712	5,006	0.0119	73,772
	Oct	231	0.0190	5,410	231	0.0124	3,522			1,887	231	0.0124	3,522
	Nov	190	0.0179	4,182	190	0.0124	2,891			1,291	190	0.0124	2,891
	Dec	203	0.0172	4,298	203	0.0124	3,093			1,206	203	0.0124	3,093
1995	Jan	224	0.0165	4,569	224	0.0124	3,417			1,151	224	0.0124	3,417
	Feb	200	0.0157	3,871	200	0.0124	3,045			826	200	0.0124	3,045
	Mar	316	0.0151	5,864	316	0.0124	4,811			1,053	316	0.0124	4,811
	Apr	561	0.0142	9,853	561	0.0124	8,553			1,300	561	0.0124	8,553
	May	3,349	0.0132	54,346	3,349	0.0124	51,018			3,328	3,349	0.0124	51,018
	Jun	3,405	0.0141	59,193	3,405	0.0124	51,882			7,311	3,405	0.0124	51,882
	Jul	819	0.0056	5,706	819	0.0124	12,481			-6,775	819	0.0124	12,481
	Aug	346	0.0169	7,215	346	0.0124	5,274			1,940	346	0.0124	5,274
	Sep	205	0.0210	5,312	205	0.0124	3,125			2,187	205	0.0124	3,125
WY	Total	10,050	0.0137	169,818	10,050	0.0124	153,111			16,706	10,050	0.0124	153,111

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Flow and Phosphorus Routing WITH Proposed Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			(CALC) Stream Flow-Gooseberry Creek Near Scofield		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l Table 5	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l Table D-2	Weight grams
	Oct	198	0.0064	1,565	198	0.0116	2,828			-1,263	198	0.0116	2,828
	Nov	209	0.0169	4,360	209	0.0116	2,985			1,375	209	0.0116	2,985
	Dec	192	0.0158	3,727	192	0.0116	2,734			993	192	0.0116	2,734
1996	Jan	158	0.0145	2,826	158	0.0116	2,258			568	158	0.0116	2,258
	Feb	168	0.0142	2,932	168	0.0116	2,389			543	168	0.0116	2,389
	Mar	224	0.0138	3,800	224	0.0116	3,187			613	224	0.0116	3,187
	Apr	423	0.0136	7,104	423	0.0116	6,026			1,078	423	0.0116	6,026
	May	4,115	0.0128	64,887	4,115	0.0116	58,663			6,225	4,115	0.0116	58,663
	Jun	1,268	0.0119	18,588	1,268	0.0116	18,079			509	1,268	0.0116	18,079
	Jul	290	0.0107	3,819	290	0.0116	4,131			-312	290	0.0116	4,131
	Aug	146	0.0185	3,339	146	0.0116	2,086			1,253	146	0.0116	2,086
	Sep	146	0.0181	3,250	146	0.0116	2,076			1,173	146	0.0116	2,076
WY	Total	7,536	0.0129	120,197	7,536	0.0116	107,443			12,754	7,536	0.0116	107,443
	Oct	168	0.0174	3,593	168	0.0122	2,516			1,077	168	0.0122	2,516
	Nov	217	0.0175	4,668	217	0.0122	3,252			1,416	217	0.0122	3,252
	Dec	198	0.0164	3,994	198	0.0122	2,964			1,030	198	0.0122	2,964
1997	Jan	213	0.0158	4,146	213	0.0122	3,197			949	213	0.0122	3,197
	Feb	202	0.0151	3,752	202	0.0122	3,030			722	202	0.0122	3,030
	Mar	266	0.0144	4,734	266	0.0122	3,987			747	266	0.0122	3,987
	Apr	624	0.0140	10,791	624	0.0122	9,366			1,425	624	0.0122	9,366
	May	6,372	0.0130	102,132	6,372	0.0122	95,566			6,566	6,372	0.0122	95,566
	Jun	3,011	0.0127	47,026	3,011	0.0122	45,157			1,869	3,011	0.0122	45,157
	Jul	305	0.0110	4,162	305	0.0122	4,580			-419	305	0.0122	4,580
	Aug	174	0.0154	3,298	174	0.0122	2,611			687	174	0.0122	2,611
	Sep	193	0.0201	4,778	193	0.0122	2,894			1,884	193	0.0122	2,894
WY	Total	11,943	0.0134	197,074	11,943	0.0122	179,121			17,953	11,943	0.0122	179,121
	Oct	225	0.0176	4,892	225	0.0110	3,059			1,833	225	0.0110	3,059
	Nov	220	0.0169	4,575	220	0.0110	2,992			1,584	220	0.0110	2,992
	Dec	214	0.0159	4,200	214	0.0110	2,913			1,287	214	0.0110	2,913
1998	Jan	243	0.0154	4,627	243	0.0110	3,311			1,317	243	0.0110	3,311
	Feb	264	0.0149	4,861	264	0.0110	3,594			1,266	264	0.0110	3,594
	Mar	328	0.0142	5,747	328	0.0110	4,466			1,281	328	0.0110	4,466
	Apr	632	0.0138	10,755	632	0.0110	8,596			2,159	632	0.0110	8,596
	May	3,562	0.0127	55,698	3,562	0.0110	48,446			7,252	3,562	0.0110	48,446
	Jun	3,016	0.0094	35,023	3,016	0.0110	41,010			-5,987	3,016	0.0110	41,010
	Jul	447	0.0107	5,901	447	0.0110	6,073			-172	447	0.0110	6,073
	Aug	232	0.0153	4,380	232	0.0110	3,155			1,224	232	0.0110	3,155
	Sep	187	0.0131	3,013	187	0.0110	2,542			471	187	0.0110	2,542
WY	Total	9,571	0.0122	143,671	9,571	0.0110	130,157			13,514	9,571	0.0110	130,157

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Flow and Phosphorus Routing WITH Proposed Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			(CALC) Stream Flow-Gooseberry Creek Near Scofield		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l Table 5	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l Table D-2	Weight grams
	Oct	214	0.0180	4,756	214	0.0137	3,615			1,141	214	0.0137	3,615
	Nov	216	0.0173	4,623	216	0.0137	3,651			972	216	0.0137	3,651
	Dec	148	0.0154	2,821	148	0.0137	2,502			319	148	0.0137	2,502
1999	Jan	103	0.0136	1,732	103	0.0137	1,746			-14	103	0.0137	1,746
	Feb	134	0.0142	2,347	134	0.0137	2,269			77	134	0.0137	2,269
	Mar	201	0.0140	3,477	201	0.0137	3,399			78	201	0.0137	3,399
	Apr	337	0.0137	5,689	337	0.0137	5,691			-1	337	0.0137	5,691
	May	2,710	0.0128	42,775	2,710	0.0137	45,763			-2,988	2,710	0.0137	45,763
	Jun	2,263	0.0185	51,605	2,263	0.0137	38,215			13,389	2,263	0.0137	38,215
	Jul	355	0.0110	4,799	355	0.0137	5,989			-1,190	355	0.0137	5,989
	Aug	283	0.0219	7,658	283	0.0137	4,782			2,877	283	0.0137	4,782
	Sep	209	0.0203	5,224	209	0.0137	3,530			1,693	209	0.0137	3,530
WY	Total	7,175	0.0155	137,504	7,175	0.0137	121,152			16,352	7,175	0.0137	121,152
	Oct	180	0.0163	3,608	180	0.0111	2,460			1,148	180	0.0111	2,460
	Nov	177	0.0156	3,408	177	0.0111	2,421			987	177	0.0111	2,421
	Dec	155	0.0142	2,711	155	0.0111	2,119			592	155	0.0111	2,119
2000	Jan	138	0.0130	2,211	138	0.0111	1,884			327	138	0.0111	1,884
	Feb	123	0.0123	1,867	123	0.0111	1,676			190	123	0.0111	1,676
	Mar	194	0.0128	3,075	194	0.0111	2,655			420	194	0.0111	2,655
	Apr	806	0.0138	13,708	806	0.0111	11,028			2,680	806	0.0111	11,028
	May	2,111	0.0121	31,540	2,111	0.0111	28,883			2,657	2,111	0.0111	28,883
	Jun	529	0.0097	6,332	529	0.0111	7,241			-908	529	0.0111	7,241
	Jul	161	0.0096	1,907	161	0.0111	2,204			-297	161	0.0111	2,204
	Aug	140	0.0133	2,304	140	0.0111	1,918			386	140	0.0111	1,918
	Sep	149	0.0173	3,185	149	0.0111	2,037			1,149	149	0.0111	2,037
WY	Total	4,863	0.0126	75,857	4,863	0.0111	66,525			9,332	4,863	0.0111	66,525
	Oct	176	0.0162	3,505	176	0.0110	2,375			1,130	176	0.0110	2,375
	Nov	160	0.0152	2,988	160	0.0110	2,158			830	160	0.0110	2,158
	Dec	111	0.0124	1,699	111	0.0110	1,499			200	111	0.0110	1,499
2001	Jan	56	0.0063	433	56	0.0110	752			-319	56	0.0110	752
	Feb	70	0.0093	798	70	0.0110	945			-147	70	0.0110	945
	Mar	208	0.0130	3,349	208	0.0110	2,816			533	208	0.0110	2,816
	Apr	890	0.0138	15,186	890	0.0110	12,026			3,160	890	0.0110	12,026
	May	2,558	0.0123	38,779	2,558	0.0110	34,577			4,203	2,558	0.0110	34,577
	Jun	351	0.0096	4,138	351	0.0110	4,746			-608	351	0.0110	4,746
	Jul	132	0.0093	1,514	132	0.0110	1,782			-269	132	0.0110	1,782
	Aug	132	0.0088	1,434	132	0.0110	1,790			-356	132	0.0110	1,790
	Sep	132	0.0165	2,699	132	0.0110	1,789			910	132	0.0110	1,789
WY	Total	4,976	0.0125	76,521	4,976	0.0110	67,253			9,268	4,976	0.0110	67,253

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Flow and Phosphorus Routing WITH Proposed Narrows Project

Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			(CALC) Stream Flow-Gooseberry Creek Near Scofield		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l Table 5	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l Table D-2	Weight grams
	Oct	122	0.0137	2,070	122	0.0105	1,576			495	122	0.0105	1,576
	Nov	152	0.0146	2,742	152	0.0105	1,957			785	152	0.0105	1,957
	Dec	144	0.0135	2,398	144	0.0105	1,851			547	144	0.0105	1,851
2002	Jan	78	0.0089	855	78	0.0105	1,001			-146	78	0.0105	1,001
	Feb	41	0.0032	162	41	0.0105	530			-368	41	0.0105	530
	Mar	86	0.0092	973	86	0.0105	1,111			-138	86	0.0105	1,111
	Apr	727	0.0137	12,270	727	0.0105	9,379			2,891	727	0.0105	9,379
	May	1,378	0.0114	19,387	1,378	0.0105	17,770			1,617	1,378	0.0105	17,770
	Jun	251	0.0123	3,817	251	0.0105	3,235			582	251	0.0105	3,235
	Jul	103	0.0084	1,061	103	0.0105	1,323			-262	103	0.0105	1,323
	Aug	86	0.0098	1,041	86	0.0105	1,112			-71	86	0.0105	1,112
	Sep	130	0.0160	2,569	130	0.0105	1,673			896	130	0.0105	1,673
WY	Total	3,298	0.0121	49,344	3,298	0.0105	42,518			6,827	3,298	0.0105	42,518
	Oct	241	0.0174	5,173	241	0.0126	3,739			1,434	241	0.0126	3,739
	Nov	175	0.0155	3,339	175	0.0126	2,709			630	175	0.0126	2,709
	Dec	87	0.0106	1,135	87	0.0126	1,351			-216	87	0.0126	1,351
2003	Jan	70	0.0085	736	70	0.0126	1,091			-354	70	0.0126	1,091
	Feb	109	0.0118	1,579	109	0.0126	1,691			-111	109	0.0126	1,691
	Mar	192	0.0128	3,021	192	0.0126	2,976			44	192	0.0126	2,976
	Apr	771	0.0138	13,081	771	0.0126	11,966			1,115	771	0.0126	11,966
	May	4,416	0.0130	70,909	4,416	0.0126	68,517			2,393	4,416	0.0126	68,517
	Jun	1,222	0.0175	26,342	1,222	0.0126	18,962			7,380	1,222	0.0126	18,962
	Jul	306	0.0153	5,771	306	0.0126	4,754			1,017	306	0.0126	4,754
	Aug	216	0.0135	3,593	216	0.0126	3,350			243	216	0.0126	3,350
	Sep	199	0.0190	4,649	199	0.0126	3,083			1,566	199	0.0126	3,083
WY	Total	8,004	0.0141	139,329	8,004	0.0126	124,188			15,141	8,004	0.0126	124,188
	Oct	176	0.0174	3,777	176	0.0130	2,834			943	176	0.0130	2,834
	Nov	182	0.0168	3,768	182	0.0130	2,916			852	182	0.0130	2,916
	Dec	148	0.0154	2,806	148	0.0130	2,375			431	148	0.0130	2,375
2004	Jan	134	0.0145	2,393	134	0.0130	2,157			237	134	0.0130	2,157
	Feb	141	0.0142	2,482	141	0.0130	2,271			211	141	0.0130	2,271
	Mar	260	0.0143	4,579	260	0.0130	4,173			407	260	0.0130	4,173
	Apr	1,253	0.0141	21,835	1,253	0.0130	20,126			1,709	1,253	0.0130	20,126
	May	2,619	0.0130	42,144	2,619	0.0130	42,079			65	2,619	0.0130	42,079
	Jun	899	0.0189	20,988	899	0.0130	14,448			6,540	899	0.0130	14,448
	Jul	252	0.0157	4,869	252	0.0130	4,041			828	252	0.0130	4,041
	Aug	143	0.0166	2,932	143	0.0130	2,295			637	143	0.0130	2,295
	Sep	164	0.0192	3,883	164	0.0130	2,635			1,248	164	0.0130	2,635
WY	Total	6,371	0.0148	116,456	6,371	0.0130	102,350			14,106	6,371	0.0130	102,350

Table C-2

Date: September 25, 2006

Flow and Phosphorus Routing WITH Proposed Narrows Project
Lower Gooseberry Reservoir Operation

		Net Inflow to Lower Gooseberry Reservoir			(EST.) Stream Flow Gooseberry Creek below Lower Gooseberry Reservoir			Lower Gooseberry Reservoir Phosphorus Uptake			(CALC) Stream Flow-Gooseberry Creek Near Scofield		
Year	Month	Flow Acre-Feet	Concentration mg/l	Weight grams	Flow Acre-Feet	mg/l Table 5	Weight grams	Flow Acre-Feet	Concentration mg/l	(CALC) grams	Flow Acre-Feet	mg/l Table D-2	Weight grams
	Oct	258	0.0187	5,930	258	0.0129	4,113			1,817	258	0.0129	4,113
	Nov	197	0.0173	4,197	197	0.0129	3,141			1,056	197	0.0129	3,141
	Dec	157	0.0159	3,078	157	0.0129	2,508			570	157	0.0129	2,508
2004	Jan	138	0.0149	2,534	138	0.0129	2,203			331	138	0.0129	2,203
	Feb	148	0.0146	2,672	148	0.0129	2,364			308	148	0.0129	2,364
	Mar	251	0.0144	4,473	251	0.0129	4,008			465	251	0.0129	4,008
	Apr	876	0.0141	15,253	876	0.0129	13,991			1,262	876	0.0129	13,991
	May	6,327	0.0130	101,530	6,327	0.0129	101,016			513	6,327	0.0129	101,016
	Jun	2,182	0.0193	51,889	2,182	0.0129	34,829			17,059	2,182	0.0129	34,829
	Jul	527	0.0102	6,616	527	0.0129	8,416			-1,800	527	0.0129	8,416
	Aug	359	0.0103	4,546	359	0.0129	5,737			-1,191	359	0.0129	5,737
	Sep	246	0.0104	3,143	246	0.0129	3,926			-783	246	0.0129	3,926
WY	Total	11,666	0.0143	205,859	11,666	0.0129	186,252			19,608	11,666	0.0129	186,252
78-05	Total	240,187		3,927,044	240,187		3,533,147			393,897	240,187		3,533,147
78-05	Averag	8,578	0.0133	140,252	8,578	0.0119	126,184			14,068	8,578	0.0119	126,184
78-89	Total	123,558		1,964,030	123,558		1,783,537			180,493	123,558		1,783,537
78-89	Averag	10,296	0.0129	163,669	10,296	0.0117	148,628			15,041	10,296	0.0117	148,628

NOTE: Average Annual Concentrations are Flow Weighted

Date: September 25, 2006

Table C-3
Flow and Phosphorus Routing WITH Proposed Narrows Project
Scofield Reservoir Operation

Year	Month	(CALC) Stream Flow-Gooseberry Creek Near Scofield: Flow Acre-Feet	Concentration mg/l	Weight Grams	(Calibrated) Gains for Fish Creek Above Fish Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Stream Flow-Fish Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams
	Oct	335	0.0123	5,093	178	0.0887	19,701	513	0.0392	24,794
	Nov	127	0.0122	1,928	209	0.0422	10,874	336	0.0300	12,802
	Dec	149	0.0123	2,268	321	0.0312	12,344	470	0.0252	14,612
1978	Jan	141	0.0123	2,150	338	0.0184	7,682	480	0.0168	9,832
	Feb	129	0.0123	1,955	329	0.0304	12,337	458	0.0253	14,292
	Mar	162	0.0123	2,461	869	0.0337	36,923	1,031	0.0304	39,384
	Apr	574	0.0123	8,721	2,030	0.0330	82,675	2,604	0.0285	91,396
	May	3,078	0.0123	46,741	14,480	0.0913	1,631,591	17,558	0.0775	1,678,333
	Jun	3,618	0.0124	99,754	9,310	0.0312	358,298	11,928	0.0271	398,052
	Jul	375	0.0123	5,692	1,236	0.0470	71,633	1,611	0.0389	77,325
	Aug	259	0.0123	3,980	414	0.0336	18,045	673	0.0248	20,374
	Sep	159	0.0123	2,408	393	0.0621	29,342	542	0.0475	31,750
WY Total/Average		9,106	0.0123	121,101	30,117	0.0616	2,290,044	38,223	0.0532	2,413,145
	Oct	71	0.0117	1,022	348	0.0584	25,508	419	0.0514	26,537
	Nov	197	0.0117	2,851	304	0.0437	16,403	501	0.0310	19,254
	Dec	158	0.0117	2,279	220	0.0347	9,411	378	0.0251	11,690
1979	Jan	161	0.0117	2,327	33	0.0376	1,550	194	0.0161	3,857
	Feb	141	0.0117	2,045	55	0.0509	4,004	196	0.0252	6,109
	Mar	154	0.0117	2,224	340	0.0426	12,889	402	0.0304	15,093
	Apr	294	0.0117	4,268	1,814	0.0316	47,269	1,908	0.0277	51,517
	May	3,122	0.0117	45,178	14,350	0.0909	1,609,169	17,472	0.0768	1,654,347
	Jun	1,160	0.0117	18,780	5,010	0.0401	250,508	6,170	0.0351	267,288
	Jul	250	0.0117	3,751	1,061	0.0440	57,013	1,310	0.0376	60,763
	Aug	173	0.0117	2,909	407	0.0281	14,150	576	0.0234	16,659
	Sep	143	0.0117	2,074	249	0.0250	7,990	392	0.0207	10,019
WY Total/Average		8,023	0.0117	87,291	21,485	0.0771	2,055,817	29,518	0.0580	2,143,114
	Oct	162	0.0124	2,480	272	0.0890	30,079	434	0.0600	32,553
	Nov	150	0.0124	2,295	345	0.0390	16,577	495	0.0309	18,872
	Dec	172	0.0124	2,657	379	0.0318	14,470	551	0.0258	17,508
1980	Jan	155	0.0124	2,835	370	0.0189	8,603	555	0.0567	11,438
	Feb	168	0.0124	2,592	365	0.0310	14,221	533	0.0256	16,913
	Mar	176	0.0124	2,703	381	0.0386	18,607	557	0.0330	21,310
	Apr	523	0.0124	8,025	3,614	0.0297	132,479	4,137	0.0275	140,504
	May	3,114	0.0124	47,717	22,640	0.0820	2,336,280	25,754	0.0741	2,384,017
	Jun	2,785	0.0124	42,007	11,970	0.0411	668,510	14,755	0.0357	648,250
	Jul	436	0.0124	4,838	1,610	0.0240	48,785	2,046	0.0220	53,323
	Aug	209	0.0124	3,201	648	0.0270	21,585	857	0.0234	24,764
	Sep	184	0.0124	2,820	592	0.1500	110,151	776	0.1180	112,979
WY Total/Average		8,255	0.0124	126,557	45,186	0.0627	3,338,244	51,441	0.0546	3,465,301
	Oct	214	0.0113	2,984	130	0.0792	31,748	344	0.0597	34,732
	Nov	233	0.0113	2,977	445	0.0329	18,077	658	0.0259	21,094
	Dec	191	0.0113	2,672	689	0.0289	24,906	880	0.0234	27,578
1981	Jan	205	0.0113	2,864	381	0.0324	15,239	586	0.0250	18,103
	Feb	182	0.0113	2,541	568	0.0395	29,684	750	0.0251	23,222
	Mar	259	0.0113	3,623	743	0.0373	34,544	1,002	0.0307	37,968
	Apr	874	0.0113	13,217	2,510	0.0357	110,625	3,384	0.0294	122,832
	May	1,684	0.0113	25,330	3,770	0.1091	465,496	5,454	0.0737	489,055
	Jun	620	0.0113	8,660	2,690	0.0483	160,297	3,310	0.0414	168,962
	Jul	186	0.0113	1,664	528	0.0228	16,606	714	0.0196	17,299
	Aug	136	0.0113	1,905	409	-0.0013	-442	419	0.0028	1,460
	Sep	149	0.0113	2,087	397	0.0087	4,245	546	0.0094	6,322
WY Total/Average		4,914	0.0113	69,677	13,234	0.0551	919,925	18,448	0.0434	983,601

Year	Month	Stream Flow-Mud Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	Stream Flow-Pondtown Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Other Reservoir Inflow Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Total Inflow Above Scofield Reservoir: Flow Acre-Feet	Weight Grams
	Oct	359	0.0700	30,998	37	0.0350	1,587	318	0.0612	24,032	1,227	81,411
	Nov	368	0.0670	30,413	41	0.0190	971	-311	0.0465	-17,885	434	26,302
	Dec	391	0.0700	33,761	34	0.0500	3,321	-862	0.0454	-31,405	353	20,230
1978	Jan	392	0.0380	18,374	58	0.0500	3,398	-671	0.0273	-19,379	356	12,195
	Feb	350	0.0700	31,388	53	0.0500	3,268	-585	0.0455	-32,813	315	18,107
	Mar	511	0.0600	50,425	119	0.0500	7,318	848	0.0463	48,312	2,526	145,439
	Apr	910	0.1000	112,243	134	0.0600	24,743	2,096	0.0443	114,958	5,944	343,323
	May	4,521	0.1320	736,112	2,204	0.1020	297,347	-8,975	0.0807	-315,858	21,787	2,445,931
	Jun	3,632	0.0720	332,562	1,804	0.0420	93,661	-351	0.0329	-14,238	17,012	802,037
	Jul	727	0.0420	37,663	249	0.0300	8,707	-1,055	0.0345	-44,915	1,518	76,776
	Aug	487	0.0700	42,030	106	0.0750	9,708	-993	0.0401	-47,357	312	25,035
	Sep	423	0.0310	10,137	71	0.0500	4,339	-958	0.0386	-45,627	76	-8,615
WY Total/Average		13,106	0.0806	1,464,325	3,491	0.0951	450,401	-4,061	0.0560	-322,353	51,862	4,005,622
	Oct	371	0.0730	32,034	41	0.0350	1,809	-34	0.0607	-4,022	779	56,406
	Nov	407	0.0670	33,630	61	0.0400	1,466	204	0.0418	10,981	1,175	65,337
	Dec	372	0.0700	32,120	44	0.0500	2,791	635	0.0471	36,964	1,429	83,377
1979	Jan	334	0.0380	15,655	23	0.0300	1,440	1,122	0.0307	42,521	1,673	63,474
	Feb	351	0.0600	28,925	38	0.0400	1,483	834	0.0855	35,303	1,409	91,418
	Mar	378	0.0690	37,301	47	0.0500	2,464	839	0.0515	55,363	1,666	110,632
	Apr	834	0.1000	78,203	187	0.0600	13,898	793	0.0474	45,467	3,112	189,285
	May	4,455	0.1120	725,360	2,348	0.1020	283,823	-1,569	0.0805	-155,955	22,606	2,506,643
	Jun	1,919	0.0720	170,420	879	0.0500	54,204	3,019	0.0292	101,688	11,986	733,609
	Jul	628	0.0420	33,355	182	0.0520	11,665	-1,106	0.0364	-49,577	1,014	55,960
	Aug	441	0.0700	37,093	81	0.0750	7,450	-124	0.0423	-6,456	573	55,665
	Sep	382	0.0339	14,645	98	0.0506	3,264	-1,073	0.0358	-35,228	-247	-7,300
WY Total/Average		10,656	0.0943	1,234,640	3,368	0.0807	344,948	3,320	0.0549	237,434	49,573	4,004,315
	Oct	194	0.0700	15,751	56	0.0350	2,409	557	0.0577	39,005	1,257	92,706
	Nov	200	0.0870	16,329	68	0.0390	1,419	218	0.0379	11,148	983	47,964
	Dec	172	0.0706	14,853	66	0.0800	4,053	407	0.0363	18,227	1,196	54,620
1980	Jan	120	0.0540	3,427	61	0.0500	3,097	1,336	0.0228	37,616	2,070	58,072
	Feb	224	0.0700	10,361	63	0.0600	3,865	819	0.0387	39,079	1,639	79,085
	Mar	272	0.0900	26,841	66	0.0600	4,067	1,307	0.0462	78,565	2,200	130,782
	Apr	1,032	0.1000	127,048	408	0.0600	36,933	-408	0.0411	-20,403	5,277	233,524
	May	4,330	0.1320	705,033	1,199	0.1020	401,220	-3,488	0.0778	333,620	26,782	3,231,620
	Jun	3,330	0.0720	470,609	1,154	0.0900	26,573	-4,082	0.9168	-47,917	25,147	1,098,354
	Jul	900	0.0420	46,620	201	0.0500	17,051	619	0.0274	35,932	3,946	340,812
	Aug	376	0.0900	32,724	149	0.0750	10,977	-394	0.0373	-18,042	960	50,443
	Sep	337	0.0510	13,651	100	0.9800	12,750	627	0.0824	63,799	1,804	204,118
WY Total/Average		11,419	0.0960	1,691,598	4,728	0.0424	524,607	1,635	-0.0083	-17,340	75,507	5,460,912
	Oct	344	0.0900	28,702	92	0.0350	1,899	-340	0.0771	-24,024	840	54,399
	Nov	276	0.0500	17,145	80	0.0250	2,475	141	0.0018	5,400	1,157	46,142
	Dec	273	0.0700	23,372	108	0.0500	6,283	8	0.0364	233	1,261	57,709
1981	Jan	223	0.0500	13,793	67	0.0500	4,141	210	0.0311	8,515	1,086	44,565
	Feb	170	0.0700	17,006	83	0.0450	3,256	222	0.0316	9,699	1,252	53,273
	Mar	297	0.0900	29,118	116	0.0500	7,183	275	0.0416	14,089	1,688	58,350
	Apr	562	0.0750	52,084	439	0.0700	36,390	-412	0.0326	-12,557	4,974	179,613
	May	696	0.0700	60,096	899	0.0870	80,825	1,300	0.0607	112,354	8,419	748,320
	Jun	463	0.0350	19,989	457	0.0300	17,268	-1,246	0.0340	-53,122	2,994	153,117
	Jul	231	0.0400	10,441	106	0.0300	3,927	-187	0.0226	-5,220	844	25,416
	Aug	236	0.1400	40,734	58	0.2200	15,647	976	0.0504	67,838	1,628	125,680
	Sep	217	0.0360	9,353	67	0.0600	3,329	-323	0.0147	-5,837	506	9,657
WY Total/Average		3,993	0.0647	319,067	2,490	0.0562	172,595	871	0.1994	117,488	25,806	1,597,247

Year	Month	Scofield Reservoir: Evaporation Acre-Feet	Phosphorus Uptake Grams	End of Month Content: Total Acre-Feet	mg/l Table D-7	Weight Grams	Flow River Below Scofield Dam: Acre-Feet	Weight Grams
				8,414	0.0358	371,823		
	Oct	192	15,654	8,335	0.0358	368,311	118	49,270
	Nov	55	9,600	8,340	0.0358	368,530	579	18,482
	Dec	3	4,037	8,325	0.0358	367,893	369	16,261
1978	Jan	0	-3,517	8,313	0.0358	367,233	308	16,261
	Feb	0	4,400	8,295	0.0358	366,525	335	14,713
	Mar	0	33,817	10,666	0.0358	471,208	116	6,840
	Apr	0	80,033	16,610	0.0358	733,967	0	0
	May	591	1,509,814	37,709	0.0358	1,670,260	0	0
	Jun	1,040	96,603	45,298	0.0358	2,001,661	940	374,057
	Jul	1,167	63,043	34,258	0.0358	1,513,660	1160	502,730
	Aug	922	51,081	24,994	0.0358	1,104,866	890	382,232
	Sep	615	10,371	19,887	0.0358	877,440	600	201,368
WY Total/Average		4,505	1,916,881	19,257	0.0358	810,945	33,827	1,383,146
	Oct	230	120,594	19,101	0.0324	763,682	240	49,570
	Nov	94	21,741	19,976	0.0324	798,364	218	8,713
	Dec	5	26,270	21,161	0.0324	845,916	244	9,754
1979	Jan	2	-3,399	22,849	0.0324	903,431	146	7,350
	Feb	0	35,479	23,635	0.0324	944,823	434	15,050
	Mar	5	44,033	25,117	0.0324	1,004,083	188	7,350
	Apr	8	64,897	23,135	0.0324	924,813	1096	203,056
	May	703	1,691,057	44,838	0.0324	1,795,506	98	3,913
	Jun	1,110	218,867	44,539	0.0324	1,780,502	1,016	526,704
	Jul	1,126	61,054	34,422	0.0324	1,370,856	805	399,761
	Aug	924	33,724	27,033	0.0320	1,060,655	908	297,342
	Sep	656	27,990	19,335	0.0324	772,922	893	272,497
WY Total/Average		4,901	2,302,315	21,979	0.0324	1,082,908	49,130	1,908,017
	Oct	280	-294	19,098	0.0345	730,777	746	93,075
	Nov	82	8,189	18,958	0.0345	751,433	421	18,050
	Dec	2	1,703	19,345	0.0345	827,869	426	18,696
1980	Jan	2	-29,749	21,015	0.0345	893,015	448	11,591
	Feb	0	8,309	22,283	0.0343	998,597	371	13,003
	Mar	6	33,047	23,642	0.0349	1,006,681	409	19,229
	Apr	5	59,617	23,223	0.0345	988,895	846	144,909
	May	755	1,950,548	53,308	0.0342	2,206,909	0	0
	Jun	1,169	247,698	56,813	0.0343	2,419,563	1488	760,261
	Jul	1,282	29,888	47,957	0.0342	2,042,424	1188	608,662
	Aug	1,003	35,622	37,892	0.0343	1,853,744	880	427,391
	Sep	756	154,814	33,222	0.0343	1,520,041	850	163,698
WY Total/Average		5,251	2,522,039	31,448	0.0343	1,339,316	52,845	3,220,779
	Oct	377	713,799	38,284	0.0183	783,814	180	25,027
	Nov	196	22,286	35,133	0.0183	800,085	294	6,786
	Dec	8	28,987	36,687	0.0180	821,812	382	6,991
1981	Jan	0	19,829	36,887	0.0183	879,577	307	6,991
	Feb	0	26,090	37,843	0.0183	661,803	270	9,351
	Mar	0	49,904	39,486	0.0181	890,092	449	11,153
	Apr	0	85,837	41,950	0.0183	958,219	1218	27,353
	May	898	578,121	40,601	0.0183	924,611	892	293,906
	Jun	1,075	109,417	32,951	0.0185	773,175	898	195,181
	Jul	1,055	31,113	23,528	0.0185	535,864	1027	157,679
	Aug	784	109,234	15,614	0.0185	358,525	696	107,693
	Sep	488	8,716	13,566	0.0181	309,199	547	46,618
WY Total/Average		4,782	1,819,925	32,386	0.0185	737,526	43,659	971,487

Date September 25, 2006

Table C-3
Flow and Phosphorus Routing WITH Proposed Narrows Project
Scofield Reservoir Operation

Year	Month	(CALC) Stream Flow-Gooseberry Creek near Scofield: Flow Acre-Feet	Concentration mg/l	Weight Grams	(Calculated) Data for Fish Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Stream Flow-Pole Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	Stream Flow-Mud Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	Stream Flow-Pondtown Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Other Reservoir Inflow Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Total Inflow Above Scofield Reservoir: Flow Acre-Feet	Weight Grams	Scofield Reservoir: Evaporation Acre-Feet	Phosphorus Uptake Grams	End of Month Content: Total Acre-Feet	mg/l	Weight Grams	Price River Below Scofield Dam: Acre-Feet	Weight Grams
																								8,419	0.0335	271,325		
	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	149,924	242	-11,705	14,717	0.0575	1,043,203	573	47,642
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	58,381	76	-47,119	13,792	0.0575	1,119,590	300	21,269
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	66,709	0	-23,760	16,768	0.0575	1,188,805	320	21,269
1982	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	73,184	0	-75,195	18,563	0.0575	1,315,915	320	21,269
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	72,727	0	-47,018	18,950	0.0575	1,414,411	320	21,269
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	117,692	0	-15,510	21,825	0.0575	1,526,081	320	21,269
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	605,199	0	401,341	26,919	0.0575	1,908,470	320	21,269
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9,302,286	754	6,503,313	69,524	0.0575	4,645,443	0	0
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,344,718	1,241	734,782	65,940	0.0575	4,675,576	2283	1,579,609
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	473,023	1,298	123,702	57,728	0.0575	4,092,536	1101	932,560
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	256,395	1,002	203,113	49,181	0.0575	3,486,790	8090	650,084
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	257,948	792	161,846	44,210	0.0575	3,137,171	5990	475,237
WY Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13,769,624	5,400	5,170,140	34,719	0.0575	2,462,846	33,200	3,771,711
	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	114,274	912	0.2500	108,734	180	0.0350	7,756	323	0.1060	42,207	2,303	352,945	409	1,043,182	45,292	0.0271	1,519,750	475	27,220
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	77,125	408	0.0670	33,719	187	0.0150	4,289	724	0.0354	31,455	2,772	126,685	121	17,960	47,794	0.0271	1,508,699	388	9,677
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30,393	276	0.0700	23,803	122	0.0500	7,519	-24	0.0337	-1,067	1,279	60,703	0	17,936	94,338	0.0271	1,618,375	466	22,903
1983	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18,736	104	0.0500	13,550	108	0.0500	6,671	582	0.0240	17,679	1,949	60,017	0	-5,234	49,300	0.0271	1,692,788	425	30,836
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	28,792	345	0.0700	29,849	95	0.0500	5,874	1,057	0.0387	50,407	2,271	119,690	0	14,643	55,809	0.0271	1,300,079	432	27,836
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	60,368	476	0.0800	46,973	128	0.0500	7,922	820	0.0640	45,664	2,453	149,941	0	28,809	73,337	0.0271	1,752,275	425	30,836
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	62,377	728	0.1000	89,759	229	0.0600	16,923	1,090	0.0604	97,100	4,453	266,377	0	117,197	52,049	0.0271	1,342,567	4748	118,796
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,502,136	4,000	0.1120	768,977	2,040	0.1020	256,652	3,899	0.0813	392,547	26,620	2,901,294	939	2,002,165	75,500	0.0271	2,490,915	4208	140,891
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,132,225	7,090	0.0720	709,002	4,741	0.0430	251,462	22,223	0.0318	871,640	75,061	3,005,934	1,296	336,175	75,500	0.0271	2,460,615	25907	2,460,780
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	214,023	1,890	0.0420	97,914	508	0.0520	42,829	5,464	0.0564	414,078	16,345	775,833	1,330	273,774	96,815	0.0271	2,210,215	2980	152,641
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	62,317	897	0.0700	77,431	252	0.0750	23,370	635	0.0379	29,400	3,357	162,598	1,106	100,184	58,334	0.0271	1,959,753	9842	372,862
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	35,408	780	0.0400	38,314	175	0.0750	15,784	877	0.0297	32,090	3,096	119,925	853	44,449	48,288	0.0271	1,616,650	12486	412,430
WY Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7,323,532	19,375	0.0880	3,103,065	8,326	0.0586	647,145	42,771	0.0389	2,030,306	162,270	8,512,640	6,104	3,203,121	55,489	0.0271	1,857,791	132,107	4,423,906
	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	90,970	601	0.0700	51,897	157	0.0400	7,735	1,453	0.0579	92,151	3,073	232,740	435	-121,045	19,421	0.0314	1,458,189	1202	484,292
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	39,755	549	0.0670	45,371	137	0.0190	3,087	2,251	0.0396	110,065	3,939	198,278	115	49,552	41,375	0.0314	1,600,450	85	14,465
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31,837	554	0.0700	47,835	130	0.0500	7,990	1,336	0.0401	66,131	2,978	153,842	0	36,817	44,353	0.0314	1,713,645	0	0
1984	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20,004	524	0.0180	24,381	121	0.0500	7,452	555	0.0254	17,396	2,202	69,413	0	-15,757	46,555	0.0314	1,800,815	0	0
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	32,602	529	0.0700	45,300	125	0.0500	7,725	-199	0.0405	-9,931	1,513	76,362	0	18,073	48,068	0.0314	1,859,324	0	0
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	40,024	379	0.0800	37,130	128	0.0500	7,922	2,854	0.0468	140,502	4,203	246,254	0	83,059	51,210	0.0314	1,996,293	321	35,020
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	87,584	1,300	0.1000	160,554	315	0.0840	33,291	-73	0.0490	-4,479	8,137	266,720	0	106,709	51,065	0.0314	1,975,234	4422	171,049
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,204,340	8,700	0.1320	1,416,519	4,288	0.1020	539,485	12,250	0.0807	1,218,881	63,054	6,378,215	954	3,976,078	73,500	0.0314	2,843,087	39005	1,534,303
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	391,755	5,790	0.0720	515,935	2,368	0.0430	125,585	37,823	0.0342	1,104,610	37,208	2,393,502	1,204	335,670	74,500	0.0314	2,847,087	6014	2,162,832
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	145,020	1,600	0.0420	82,890	448	0.0120	20,219	5,482	0.0364	264,379	11,083	521,097	1,358	154,707	60,115	0.0314	2,357,444	17915	662,032
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	77,762	956	0.0700	85,153	184	0.0750	17,022	536	0.0417	27,349	3,033	167,468	1,137	94,098	60,200	0.0314	2,331,187	7746	299,627
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	61,110	638	0.0310	24,018	137	0.0530	8,067	-412	0.0700	-20,857	1,179	64,234	942	53,326	52,738	0.0314	2,030,965	7866	304,230
WY Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,383,121	22,307	0.0828	2,532,870	8,534	0.0346	784,477	53,173	0.0465	2,947,850	157,620	10,768,324	6,117	4,656,591	53,442	0.0314	2,080,512	147,059	5,648,457
	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	36,607	372	0.0700	64,031	154	0.0230	7,097	207	0.0581	14,521	2,302	193,246	431	78,840	46,776	0.0318	1,309,840	3082	236,215
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	44,619	583	0.0670	40,387	144	0.0190	3,368	246	0.0395	16,959	2,240	113,292	124	90,067	49,946	0.0318	1,358,123	85	34,930
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	23,867	359	0.0200	31,029	136	0.0500	7,990	1,691	0.0407	84,911	3,422	178,977	0	42,850	55,970	0.0318	2,061,213	702	33,040
1985	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18,615	518	0.0500	19,257	110	0.0500	6,789	377	0.0232	10,916	1,920	55,176	0	-20,085	54,697	0.0318	2,136,472	0	0
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19,757	425	0.0700	36,534	76	0.0500	4,685	913	0.0426	48,019	2,041	108,953	0	28,953	56,538	0.0318	2,216,471	0	0
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	40,902	595	0.0600	38,214	145	0.0500	8,930	832	0.0418	47,067	2,800	161,873	0	31,547	58,555	0.0318	2,295,546	792	31,049
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	252,113	2,420	0.1000	299,304	554	0.0620	69,156	1,080	0.0470	58,082	11,522	673,833	0	220,987	62,862	0.0318	2,502,839	6294	245,576
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,712,460	5,410	0.1300	867,313	2,377	0.1620	324,633	9,086	0.1007	1,197,366	37,994	5,351,094	1,017	3,852,077	75,500	0.0318	2,881,440	27276	1,071,008
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	129,843	2,710	0.0100	35,628	580	0.0100	7,160	3,338	0.0182	106,439	17,679	239,567	1,294	-353,075	69,337	0.0318	2,718,250	18566	848,719
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	73,592	1,042	0.0420	53,979	271	0.0530	14,377	382	0.0366	17,349	3,129	156,997	1,320	86,681	60,270	0.0318	2,362,730	10876	426,478
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,255	621	0.0100	7,808	111	0.0450	5,478	-455	0.0080	-4,454	1,082	10,516	1,105	11,395	48,107	0.0318	1,883,945	12141	475,608
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18,306	716	0.0100	8,669	75	0.0266	6,919	-720	0.0173	-13,011	600	18,275	789	17,637	43,670	0.0318	1,712,908	4452	174,573
WY Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,439,347	16,377	0.0766	1,548,602	5,289	0.1022	666,196	15,059	0.0672	1,576,471	85,079	7,250,616	6,099	4,184,810	56,400	0.0318	2,220,883	86,078	3,375,361

Date: September 25, 2006

Table C-3
Flow and Phosphorus Routing WITH Proposed Narrows Project
Scofield Reservoir Operation

Year	Month	(CALC) Stream Flow-Gooseberry Creek Near Scofield			(Calculated) Gains for Fish Creek Above Fish Creek Above Scofield Reservoir			(CALC) Stream Flow-Fish Creek Above Scofield Reservoir			Stream Flow-Mud Creek Above Scofield Reservoir			Stream Flow-Pondtown Creek Above Scofield Reservoir			(CALC) Other Reservoir Inflow Above Scofield Reservoir			(CALC) Total Inflow Above Scofield Reservoir		Scofield Reservoir					Price River Below Scofield Dam	
		Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Concentration mg/l	Weight Grams	Flow Acre-Feet	Weight Grams	Evaporation Acre-Feet	Phosphorus Uptake Grams	End of Month Content Total Acre-Feet	End of Month Content mg/l Table D-3	End of Month Content Weight Grams	Acre-Feet	Weight Grams
																								8,414	0.0359	371,325		
	Oct	344	0.0115	3,959	654	0.0391	42,793	898	0.0607	67,253	507	0.0700	43,451	114	0.0350	4,934	737	0.0579	52,662	2,252	168,230	407	185,849	44,843	0.0302	1,669,423	472	25,017
	Nov	266	0.0115	3,777	521	0.0403	26,522	787	0.0312	10,299	475	0.0670	39,256	99	0.0190	2,324	951	0.0408	47,846	2,312	119,734	121	38,157	46,784	0.0302	1,759,822	300	11,168
	Dec	238	0.0115	3,372	434	0.0345	18,496	672	0.0264	21,878	450	0.0700	38,853	86	0.0500	5,309	799	0.0420	81,346	2,066	107,148	0	32,097	48,125	0.0302	1,791,388	455	22,493
1986	Jan	288	0.0115	4,092	608	0.0187	14,059	896	0.0164	18,121	456	0.0300	17,984	105	0.0500	6,485	768	0.0231	21,918	2,255	68,538	0	-19,420	49,765	0.0302	1,852,650	449	22,955
	Feb	291	0.0115	4,134	597	0.0321	23,639	888	0.0253	27,773	485	0.0700	41,877	105	0.0500	6,471	1,356	0.0408	68,205	2,834	144,426	0	38,914	52,299	0.0302	1,945,994	300	11,158
	Mar	355	0.0115	3,600	2,097	0.0343	88,693	2,452	0.0307	94,297	923	0.0800	91,215	287	0.0500	17,730	895	0.0425	46,937	4,497	240,176	0	72,773	55,875	0.0302	2,080,111	301	14,287
	Apr	1,028	0.0115	14,599	6,370	0.0301	236,691	7,398	0.0275	251,291	1,957	0.1000	241,394	900	0.0600	66,576	2,773	0.0420	143,608	11,028	702,809	0	217,848	66,096	0.0302	2,460,028	280	136,504
	May	7,108	0.0115	100,980	17,518	0.1012	2,184,930	24,616	0.0753	2,285,838	6,055	0.1320	985,878	3,112	0.1030	395,491	8,994	0.0804	893,815	43,777	4,356,801	1,028	2,877,032	73,500	0.0302	2,736,269	32,948	1,204,128
	Jun	7,260	0.0115	107,038	6,640	0.0346	283,596	13,900	0.0226	186,674	3,152	0.0720	279,933	1,544	0.0430	81,912	15,414	0.0330	626,921	34,011	1,373,437	1,294	117,855	73,500	0.0302	2,736,269	32,711	1,217,992
	Jul	372	0.0115	5,284	2,010	0.0412	102,087	2,382	0.0365	107,373	868	0.0420	45,590	318	0.0520	20,395	1,012	0.0360	45,066	4,392	218,361	1,350	97,838	64,835	0.0302	2,413,698	11,887	443,275
	Aug	224	0.0115	3,182	902	0.0256	28,485	1,126	0.0228	31,567	387	0.0700	48,957	149	0.0730	13,799	300	0.0385	18,547	2,233	112,969	1,130	71,905	54,164	0.0302	2,010,437	11,174	438,324
	Sep	192	0.0115	2,720	708	0.1143	99,726	900	0.0923	102,455	509	0.0100	6,278	118	0.0700	10,153	38	0.0587	2,530	1,662	121,461	817	65,704	48,083	0.0302	1,790,112	882	234,082
WY Total/Average		17,959	0.0115	254,164	39,051	0.0658	3,170,693	56,933	0.0488	3,428,874	16,343	0.0928	1,870,547	6,937	0.0733	627,577	32,124	0.0457	1,809,289	112,359	7,732,391	6,146	3,864,560	56,485	0.0302	2,102,835	103,297	3,789,727
	Oct	300	0.0118	4,335	712	0.0806	70,817	1,012	0.0602	75,191	527	0.0700	45,503	127	0.0350	5,499	614	0.0577	43,703	2,281	169,896	459	715,361	49,450	0.0292	1,232,287	490	12,580
	Nov	307	0.0118	4,466	570	0.0407	28,612	877	0.0306	33,078	488	0.0670	40,330	106	0.0190	2,495	-134	0.0404	-6,703	1,337	69,300	124	38,987	50,683	0.0292	1,262,500	2	0
	Dec	210	0.0118	3,140	500	0.0314	19,353	716	0.0255	22,497	449	0.0700	38,682	85	0.0500	5,242	496	0.0421	25,751	1,245	92,170	0	48,695	52,407	0.0292	1,305,975	2	0
1987	Jan	152	0.0118	2,216	444	0.0179	9,789	596	0.0163	12,005	413	0.0380	19,359	66	0.0500	4,051	1,027	0.0269	34,138	2,102	69,554	0	17,169	54,510	0.0292	1,354,360	0	0
	Feb	125	0.0118	1,819	340	0.0294	12,315	465	0.0246	18,113	387	0.0700	33,415	52	0.0500	3,193	695	0.0457	30,040	1,799	101,182	0	36,333	56,309	0.0292	1,403,187	0	0
	Mar	172	0.0118	2,498	454	0.0368	20,587	626	0.0299	23,085	421	0.0800	41,544	70	0.0500	4,340	1,272	0.0497	78,272	2,389	147,243	0	87,721	58,697	0.0292	1,462,709	2	0
	Apr	1,062	0.0118	15,460	2,400	0.0357	105,667	3,462	0.0284	121,127	1,128	0.1000	139,138	432	0.0600	33,447	781	0.0435	41,872	5,825	335,584	0	190,483	63,419	0.0292	1,580,371	105	37,436
	May	1,509	0.0118	21,967	3,720	0.0888	414,972	5,229	0.0677	436,661	1,679	0.0900	180,393	749	0.0600	55,453	382	0.0617	29,101	8,039	707,608	1,033	532,058	67,908	0.0292	1,567,640	7,535	187,769
	Jun	383	0.0118	5,579	915	0.0284	30,221	1,298	0.0224	35,799	662	0.0720	58,791	200	0.0500	12,336	24	0.0350	1,048	2,125	107,996	1,320	84,009	56,379	0.0292	1,404,940	7,688	180,358
	Jul	209	0.0118	3,048	481	0.0510	30,244	890	0.0391	33,292	483	0.0420	25,023	104	0.0520	6,646	843	0.0368	38,252	2,120	105,243	1,339	81,299	49,020	0.0292	1,196,651	5,918	239,232
	Aug	152	0.0118	2,211	316	0.0437	17,127	470	0.0334	19,340	409	0.0700	35,315	64	0.0700	5,515	-226	0.0480	-13,407	716	40,702	1,035	54,710	41,116	0.0292	1,034,607	5,950	164,096
	Sep	150	0.0118	2,186	256	0.0653	20,833	400	0.0457	23,001	386	0.0310	14,762	51	0.0530	3,357	-602	0.0191	-14,205	541	28,932	751	32,107	36,278	0.0292	904,029	4,891	115,403
WY Total/Average		6,736	0.0118	98,064	11,112	0.0569	780,260	15,848	0.0434	849,228	7,431	0.0740	678,254	2,127	0.0540	141,598	5,672	0.0441	508,251	31,079	1,977,390	5,810	1,339,559	52,513	0.0292	1,309,605	37,075	923,875
	Oct	167	0.0115	2,367	342	0.0400	17,205	509	0.0312	19,372	405	0.0700	34,969	62	0.0400	3,058	-110	0.0464	-6,298	865	51,284	382	-273,032	35,153	0.0271	1,174,601	1,620	53,764
	Nov	158	0.0117	2,246	371	0.0381	17,414	529	0.0301	19,860	407	0.0670	33,636	62	0.0190	1,464	186	0.0436	10,013	1,185	64,772	144	28,885	36,227	0.0271	1,210,489	2	0
	Dec	159	0.0115	2,203	332	0.0312	12,773	497	0.0248	15,086	394	0.0700	34,020	55	0.0500	3,422	751	0.0451	41,783	1,091	94,261	0	37,745	37,918	0.0271	1,267,004	2	0
1988	Jan	160	0.0115	2,357	306	0.0191	7,216	486	0.0162	9,773	390	0.0380	18,421	55	0.0500	3,332	958	0.0273	32,333	1,892	64,109	0	985	39,810	0.0271	1,340,228	2	0
	Feb	165	0.0115	2,336	320	0.0317	12,524	485	0.0249	14,660	393	0.0700	33,903	55	0.0500	3,397	250	0.0452	14,267	1,189	66,455	0	26,742	40,999	0.0271	1,350,941	2	0
	Mar	197	0.0115	2,801	458	0.0384	21,608	655	0.0302	24,408	430	0.0800	42,432	75	0.0500	4,611	615	0.0494	49,666	1,975	121,197	0	55,195	42,974	0.0271	1,435,943	2	0
	Apr	558	0.0115	7,890	9,043	0.0276	307,800	9,599	0.0267	313,780	2,300	0.1000	283,702	1,085	0.0600	80,280	-8,273	0.0417	-423,727	4,749	236,085	0	97,300	47,723	0.0271	1,594,616	2	0
	May	2,649	0.0115	37,603	4,980	0.1932	1,045,586	7,629	0.1151	1,082,999	2,341	0.1320	381,163	1,107	0.1500	204,729	1,519	0.1021	191,366	12,595	1,860,247	935	1,470,626	54,486	0.0271	1,820,672	4,895	163,967
	Jun	487	0.0115	6,841	1,900	0.0202	66,956	2,287	0.0262	73,067	898	0.0720	79,752	328	0.0430	17,389	45	0.0351	1,966	3,558	172,971	1,175	93,383	47,700	0.0271	1,593,832	9,970	306,400
	Jul	184	0.0115	2,618	612	0.0460	34,709	396	0.0380	37,327	301	0.0420	25,953	113	0.0520	7,261	-557	0.0367	-25,240	854	45,304	1,181	56,242	36,365	0.0271	1,216,128	11,087	367,791
	Aug	148	0.0115	2,108	395	-0.0042	-2,036	943	0.0001	72	424	0.0700	36,610	72	0.1000	8,886	-703	0.0335	-31,390	270	13,978	944	36,279	27,782	0.0271	928,314	7,915	264,588
	Sep	140	0.0115	2,071	454	0.0553	30,945	600	0.0445	33,017	424	0.0310	16,213	72	0.0530	4,702	-700	0.0389	-33,564	395	20,368	664	28,076	23,693	0.0271	791,782	5,039	133,244
WY Total/Average		5,196	0.0115	73,770	19,443	0.0657	1,572,650	24,609	0.0542	1,846,420	9,310	0.0869	1,020,807	3,141	0.0884	342,375	-5,825	0.0248	-178,823	31,225	2,830,979	5,172	1,658,867	39,236	0.0271	1,311,066	38,435	1,284,278
	Oct	178	0.0114	2,480	283	0.0085	30,837	459	0.0380	33,307	397	0.0700	34,279	57	0.0400	2,813	-340	0.0601	-25,608	567	44,850	118	168,819	23,196	0.0226	646,911	148	20,661
	Nov	216	0.0114	3,002	252	0.0476	14,731	468	0.0308	17,773	400	0.0670	33,058	39	0.0190	1,377	-102	0.0440	-5,537	825	46,670	93	28,257	23,652	0.0226	659,648	279	7,697
	Dec	200	0.0114	2,821	344	0.0336	14,251	546	0.0254	17,072	412	0.0700	35,574	66	0.0500	4,040	354	0.0459	30,003	1,576	85,689	0	42,729	25,105	0.0226	700,150	124	3,438
1989	Jan	222	0.0114	3,136	209	0.0209	5,328	452	0.0160	8,314	384	0.0380	17,999	50	0.0500	3,086	540	0.0278	18,540	1,498	48,160	0	8,939	26,386	0.0226	735,802	124	3,858
	Feb	171	0.0114	2,413	181	0.0372	8,314	352	0.0247	10,727	367	0.0700	31,688	41	0.0500	2,528	827	0.0476	49,177	1,597	94,121	0	49,574	27,871	0.0226	777,315	119	3,124
	Mar	267	0.0114	3,701	303	0.0563	14,144	470	0.0309	17,906	398	0.0800	39,274	58	0.0500	3,565	1,947	0.0516	123,832	2,873	184,575	0	104,451	30,620	0.0226	853,981	124	3,458
	Apr	1,283	0.0114	18,061	2,440	0.0380	114,388	1,723	0.0288	132,469	1,225	0.1000	151,102	504	0.0600	37,319	398	0.0432	21,177	5,850	342,065	0	178,908	32,523	0.0226	907,055	2,047	110,079
	May	1,400	0.0114	19,732	4,280	0.0112	59,252	5,000	0.0133	78,984	1,754	0.1320	285,844	800	0.1420	140,204	-1,114	0.0440	-60,435	7,140	447,577	817	271,233	29,051	0.0226	810,223	6,095	273,176
	Jun	387	0.0114	5,444	800	-0.0024	-2,389	1,187	0.0021	3,058	646	0.3200	254,987	192	0.0960	22,691	343	0.0911	38,563	2,368	119,298	944	279,597	22,483	0.0226	627,016	7,901	222,892
	Jul	192	0.0114	2,711	337	0.1151	33,650	429	0.0686	36,347	429	0.0930	49,213	74	0.0910	8,343	-1,012	0.0677	-84,494	-79	9,405	877	36,061	12,518	0.0226	349,128	9,089	251,255
	Aug	139	0.0114	1,829	307	0.0464	20,988	497	0.0372	22,817	411	0.0380	19,265	86	0.0910	7,235	-32	0.0390	-1,554	940	47,783	574	37,562	7,800	0.0226	217,517	5,088	141,811
	Sep	170	0.0114	8,013	451	0.0174	9,604	1,021	0.0141	17,720	428	0.0340	17,950	74	0.0380	3,479	-742	0.0240	-21,977	779	17,158	349	5,165	7,800	0.0226	217,517	430	11,992
WY Total/Average		5,215	0.0114	75,488	10,097	0.0361	323,254	11,282	0.0211	396,741	7,274	0.1069	977,233	2,086	0.0881	236,995	1,260	0.0522	81,888	25,842	1,608,738	3,971	1,209,297	22,417	0.0226	625,201	37,798	1,053,286

Date: September 25, 2006

Table C-3
Flow and Phosphorus Routing WITH Proposed Narrows Project
Scofield Reservoir Operation

Year	Month	(CALC) Stream Flow-Gooseberry Creek Near Scofield: Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	(Calculated) Gains for Fish Creek Above Fish Creek Above Scofield Reservoir: Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	(CALC) Stream Flow-Fish Creek Above Scofield Reservoir: Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	Stream Flow-Mud Creek Above Scofield Reservoir: Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	Stream Flow-Pondtown Creek Above Scofield Reservoir: Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	(CALC) Other Reservoir Inflow Above Scofield Reservoir: Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	(CALC) Total Inflow Above Scofield Reservoir: Flow (Acre-Feet)	Weight (Grams)	Scofield Reservoir: Evaporation (Acre-Feet)	Phosphorus Uptake (Grams)	End of Month Content: Total (Acre-Feet)	Phosphorus Conc. (mg/l)	Weight (Grams)	Flow From Below Scofield Dam: Flow (Acre-Feet)	Weight (Grams)
																								6,414	0.0358	171,425		
	Oct	157	0.0123	2,377	250	0.0070	2,102	407	0.0090	4,539	370	0.0700	72,761	88	0.0200	4,178	475	0.0171	-40,111	-41	-1,032	183	-69,243	7,574	0.0105	383,149	6	0
	Nov	303	0.0123	4,020	291	-0.0143	-5,209	596	-0.0008	-599	437	0.1300	70,061	79	0.0027	243	-288	0.0478	-16,968	824	12,748	54	23,735	8,165	0.0105	387,680	178	3,759
	Dec	171	0.0123	2,596	304	0.0310	11,617	473	0.0243	14,213	369	0.0700	33,526	53	0.0500	3,260	-203	0.0456	-11,309	733	39,582	0	12,743	8,687	0.0105	327,047	181	7,194
1990	Jan	178	0.0123	2,700	259	0.0183	5,842	438	0.0158	8,547	378	0.0500	13,996	47	0.0200	1,530	-124	0.0231	-3,549	739	-20,504	0	-7,304	9,221	0.0105	397,174	204	7,681
	Feb	102	0.0123	1,450	149	0.0368	6,761	311	0.0240	9,215	356	0.0700	30,723	35	0.0500	2,159	68	0.0480	4,123	776	46,220	0	17,243	9,946	0.0105	376,590	51	1,920
	Mar	203	0.0123	3,060	187	0.0466	10,757	389	0.0288	13,823	376	0.0200	11,827	41	0.0240	1,268	460	0.0278	-16,087	1,271	43,036	0	-4,803	11,033	0.0105	413,465	178	6,606
	Apr	1,097	0.0123	16,624	3,193	0.0326	128,449	4,290	0.0274	145,073	1,277	0.1000	157,560	551	0.0600	39,412	2,495	0.0430	-132,396	8,595	474,447	0	150,659	17,433	0.0105	450,412	2,106	82,641
	May	1,495	0.0123	28,661	3,452	0.0974	658,073	6,947	0.0790	672,335	2,022	0.0410	107,236	984	0.0550	65,395	-1,071	0.0019	-127,544	9,292	720,422	611	433,544	17,436	0.0105	655,722	708	287,568
	Jun	463	0.0123	7,056	1,754	0.0291	62,906	2,217	0.0256	69,926	878	0.0720	77,971	317	0.0610	16,807	-459	0.0352	-19,932	2,953	144,773	744	61,512	14,481	0.0105	385,000	1,447	193,783
	Jul	213	0.0123	3,226	727	0.0444	39,824	940	0.0371	43,051	535	0.0420	27,715	135	0.0025	408	-311	0.0331	-8,397	1,396	62,374	700	36,151	7,600	0.0105	293,667	792	277,555
	Aug	655	0.0123	9,930	358	0.0254	11,198	1,013	0.0169	21,124	405	0.0700	34,936	61	0.0750	5,607	-453	0.0439	-24,499	1,027	17,268	458	15,848	7,600	0.0105	293,667	88	21,430
	Sep	509	0.0123	7,719	299	0.0570	21,040	805	0.0290	28,768	385	0.0310	14,717	51	0.0210	1,314	-215	0.0381	-10,092	1,026	36,706	547	11,203	7,600	0.0105	293,667	677	25,505
WY Total/Average		5,607	0.0123	84,996	13,220	0.0583	930,028	18,827	0.0466	1,015,054	7,811	0.0656	613,112	2,332	0.0484	138,616	-1,486	0.0609	-410,086	27,504	1,676,668	2,105	681,309	10,613	0.0105	799,567	24,399	918,620
	Oct	389	0.0126	6,066	305	0.0620	20,907	694	0.0431	36,673	390	0.0700	34,155	56	0.0350	2,438	-620	0.0598	-46,369	517	27,096	183	-43,630	7,800	0.0405	390,010	60	16,384
	Nov	184	0.0126	2,862	287	0.0356	12,604	471	0.0266	15,466	374	0.0670	30,893	43	0.0190	1,046	-444	0.0460	-25,160	445	22,244	54	3,785	8,028	0.0405	401,419	181	7,050
	Dec	176	0.0126	2,739	282	0.0321	11,140	457	0.0246	13,879	395	0.0700	33,264	51	0.0500	3,149	-781	0.0458	-44,445	112	6,164	0	550	8,026	0.0405	401,333	114	5,700
1991	Jan	190	0.0126	2,967	362	0.0181	8,098	552	0.0162	11,065	402	0.0500	18,844	60	0.0500	3,607	-111	0.0272	-3,727	902	29,679	0	-16,278	8,497	0.0405	424,883	60	21,601
	Feb	179	0.0126	2,786	377	0.0351	14,269	556	0.0285	16,794	404	0.0700	34,852	44	0.0500	2,751	-272	0.0444	-14,929	746	40,468	0	3,077	9,136	0.0405	456,735	111	5,550
	Mar	190	0.0126	5,097	430	0.0374	19,837	609	0.0290	23,934	419	0.0800	41,364	69	0.0500	4,268	398	0.0500	24,424	1,513	92,590	0	17,247	10,007	0.0405	350,968	40	2,000
	Apr	409	0.0126	7,759	1,787	0.0251	62,624	2,284	0.0250	70,587	719	0.1000	88,684	231	0.0600	17,088	1,261	0.0461	71,711	4,494	248,016	0	31,081	12,776	0.0405	688,401	119	18,501
	May	2,799	0.0126	43,040	6,625	0.2029	1,657,836	9,424	0.1464	1,701,475	2,718	0.0780	261,492	1,310	0.1300	210,758	1,307	0.1127	181,622	14,758	2,364,378	544	1,053,674	22,960	0.0405	1,193,098	488	299,418
	Jun	1,309	0.0126	20,353	3,920	0.0317	153,315	5,225	0.0509	173,667	1,799	0.0720	170,674	848	0.0430	44,140	2,117	0.0335	87,495	9,903	463,986	822	7,935	24,959	0.0405	1,344,790	809	314,300
	Jul	321	0.0126	5,088	1,323	0.0490	60,876	1,644	0.0270	65,964	608	0.0420	34,091	198	0.0020	13,710	-1,483	0.0393	-66,200	819	45,307	910	51,409	15,433	0.0405	770,566	899	464,012
	Aug	205	0.0126	3,195	471	0.0287	16,605	676	0.0239	19,889	466	0.0495	28,152	94	0.0509	4,190	-340	0.0518	-15,531	896	39,881	637	25,031	8,629	0.0405	431,455	796	352,259
	Sep	191	0.0126	2,972	361	0.0602	30,813	552	0.0497	33,785	434	0.0310	16,532	77	0.0450	3,864	-333	0.0590	-8,756	880	46,623	360	20,891	7,800	0.0405	390,010	1,240	67,171
WY Total/Average		6,634	0.0126	103,445	16,330	0.1012	2,078,857	22,962	0.0770	2,182,300	9,172	0.0691	782,022	3,066	0.0847	310,314	879	0.1378	142,487	36,099	3,427,124	3,518	1,734,393	12,036	0.0405	666,801	12,325	1,616,198
	Oct	443	0.0112	6,118	67	0.2121	17,572	510	0.0377	23,689	358	0.0700	40,950	36	0.0050	1,872	-460	0.0603	-31,432	224	4,779	183	-90,197	7,800	0.0005	391,906	339	12,683
	Nov	185	0.0112	2,557	434	0.0372	20,963	619	0.0308	23,510	435	0.0670	35,989	77	0.0190	1,816	92	0.0422	4,303	1,213	65,547	54	22,184	8,658	0.0005	324,008	365	11,265
	Dec	179	0.0112	2,472	344	0.0326	13,843	523	0.0253	16,319	409	0.0700	35,287	64	0.0500	3,939	-119	0.0441	-6,485	876	49,040	0	16,267	9,226	0.0002	343,288	387	11,489
1992	Jan	154	0.0112	2,143	291	0.0183	6,649	446	0.0160	8,782	386	0.0500	38,079	51	0.0500	3,153	220	0.0278	7,539	1,103	37,553	0	-3,709	10,022	0.0012	379,041	387	11,489
	Feb	125	0.0112	1,784	271	0.0358	10,205	395	0.0246	12,008	315	0.0700	32,413	46	0.0500	3,811	108	0.0467	8,227	706	33,490	0	18,847	10,660	0.0005	398,125	496	16,779
	Mar	225	0.0112	3,107	529	0.0386	25,859	754	0.0308	28,955	463	0.0800	41,455	92	0.0500	5,682	546	0.0480	32,281	1,862	112,396	3	42,705	12,492	0.0003	467,112	40	1,497
	Apr	729	0.0112	10,064	2,118	0.0388	96,976	2,847	0.0288	111,041	1,009	0.1000	124,449	308	0.0600	28,604	-563	0.0439	-30,100	3,681	225,701	3	85,054	17,568	0.0003	507,781	386	97,077
	May	633	0.0112	8,736	1,867	0.1093	253,777	2,500	0.0845	264,524	967	0.1320	157,408	309	0.1020	63,898	-1,063	0.0832	-107,471	2,785	376,353	586	272,350	6,098	0.0007	325,248	408	254,540
	Jun	329	0.0112	4,349	715	-0.0017	-1,467	1,044	0.0024	3,082	540	0.0210	14,214	139	0.0200	4,460	-1,050	0.0116	-22,343	63	-588	554	16,235	7,800	0.0005	291,906	79	20,431
	Jul	787	0.0112	10,865	425	0.0463	23,202	1,212	0.0228	34,084	432	0.0420	22,376	76	0.0520	4,879	-405	0.0375	-19,620	1,314	42,708	525	13,103	7,800	0.0003	291,906	76	29,002
	Aug	497	0.0112	6,834	126	0.0305	1,594	623	0.0105	8,425	347	0.0710	30,248	30	0.2600	9,800	-277	0.0556	-19,034	726	29,549	658	19,743	7,800	0.0002	291,906	202	9,827
	Sep	146	0.0112	1,873	196	0.0603	16,041	353	0.0435	17,934	385	0.0310	13,909	40	0.0650	2,623	-1	0.0078	-367	733	14,345	340	18,957	7,800	0.0003	291,906	94	14,783
WY Total/Average		4,419	0.0112	61,095	7,393	0.0523	477,343	11,812	0.0370	538,438	6,092	0.0746	500,856	1,456	0.0666	113,298	-3,799	0.0446	-205,305	15,519	1,006,887	2,646	503,937	9,181	0.0100	351,270	11,175	465,854
	Oct	247	0.0123	3,865	224	0.1004	27,740	471	0.0542	31,554	387	0.0700	33,477	52	0.0350	2,249	-279	0.0609	-20,581	627	46,679	183	-48,561	7,126	0.0400	390,397	62	20,853
	Nov	229	0.0123	3,334	232	0.0418	10,922	467	0.0265	14,456	367	0.0670	30,355	41	0.0190	964	144	0.0466	19,790	1,194	65,536	55	10,695	8,306	0.0400	423,846	332	11,456
	Dec	208	0.0123	3,199	245	0.0323	9,752	453	0.0232	12,945	372	0.0700	32,078	63	0.0500	3,681	159	0.0471	9,056	1,023	56,302	0	6,944	9,180	0.0400	467,128	366	16,518
1993	Jan	237	0.0123	3,652	217	0.0201	5,305	454	0.0161	9,033	356	0.0500	17,530	44	0.0500	2,764	385	0.0282	13,705	1,250	42,720	0	-19,331	10,327	0.0400	369,953	369	15,275
	Feb	232	0.0123	3,570	106	0.0415	7,975	338	0.0241	11,347	368	0.0700	31,643	41	0.0500	2,514	589	0.0477	34,626	1,264	80,329	0	12,300	17,431	0.0400	564,637	376	13,796
	Mar	390	0.0123	3,839	399	0.0452	22,236	779	0.0292	28,072	444	0.0800	43,809	63	0.0500	3,895	930	0.0487	55,858	2,236	132,803	0	33,481	17,490	0.0400	866,154	177	8,716
	Apr	977	0.0123	14,973	1,391	0.0357	57,223	2,274	0.0257	72,192	737	0.1000	86,967	241	0.0600	17,840	2,614	0.0458	148,244	5,872	329,243	0	43,665	19,270	0.0400	971,491	8	0
	May	4,908	0.0123	75,888	17,739	0.0076	2,131,414	22,647	0.0790	2,206,900	5,885	0.1320	954,992	3,009	0.1020	378,914	-499	0.0804	-46,428	30,913	3,480,087	644	1,985,249	49,539	0.0400	2,446,020	8	0
	Jun	1,339	0.0123	20,569	4,983	0.0217	144,392	6,281	0.0313	164,961	2,033	0.0910	227,923	919	0.0427	46,612	1,873	0.0335	77,339	11,433	518,895	1,143	26,207	54,875	0.0400	2,709,514	662	229,100
	Jul	364	0.0123	5,596	1,123	0.0464	54,227	1,487	0.0331	59,823	679	0.0420	35,128	109	0.0520	13,401	-608	0.0363	-29,782	1,708	88,567	1,235	64,944	44,311	0.0400	2,187,879	1,940	545,258
	Aug	211	0.0123	3,248	541	0.0586	33,632	752	0.0398	36,880	477	0.1590	93,624	101	0.0770	8,310	491	0.0774	46,874	1,821	186,691	1,010	146,582	36,544	0.0400	1,894,261	878	421,347
	Sep	191	0.0123	2,761	307	0.0488	24,890	467	0.0460	27,671	403	0.0310	15,429	61	0.0510	3,971	-332	0.0185	-15,775	519	31,295	720	16,274	30,939	0.0400	1,337,143	1,014	272,239
WY Total/Average		9,510	0.0123	146,254	27,403	0.0131	2,379,789	36,913	0.0590	2,646,043	12,505	0.1041	1,606,973	4,860	0.0813	488,604	5,501	0.0411	275,044	58,783	5,059,003	4,988	2,257,355	24,719	0.0400	1,220,519	11,537	1,550,889

Date: September 25, 2000

Table C-3
Flow and Phosphorus Routing WITH Proposed Narrows Project
Scofield Reservoir Operation

Year	Month	(CALC) Stream Flow-Gooseberry Creek Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	(Calculated) Gains for Fish Creek Above Fish Creek Above Scofield Reservoir Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	(CALC) Stream Flow-Fish Creek Above Scofield Reservoir Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	Stream Flow-Mud Creek Above Scofield Reservoir Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	Stream Flow Above Scofield Reservoir Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	(CALC) Other Inflow Above Scofield Reservoir Flow (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	(CALC) Total Inflow Above Scofield Reservoir Flow (Acre-Feet)	Weight (Grams)	Scofield Reservoir Evaporation (Acre-Feet)	Phosphorus Uptake (Grams)	End of Month Content Total (Acre-Feet)	Concentration (mg/l)	Weight (Grams)	Price River Below Scofield Dam Flow (Acre-Feet)	Phosphorus Weight (Grams)
																								8,418	0.0208	371,823		
	Oct	203	0.0119	2,906	365	0.0877	40,352	566	0.0621	43,378	425	0.0700	37,050	72	0.0250	3,218	-119	0.0090	-10,079	851	73,508	318	720,573	20,598	0.0226	848,866	102	20,830
	Nov	181	0.0119	2,672	231	0.0650	13,757	392	0.0319	15,430	388	0.0676	32,030	52	0.0190	1,222	18	0.0448	2,017	867	50,597	105	29,920	20,788	0.0226	859,740	171	10,404
	Dec	183	0.0119	2,253	275	0.0158	12,120	462	0.0261	14,830	400	0.0700	34,905	59	0.0500	3,617	163	0.0447	17,660	1,603	90,662	0	45,635	12,088	0.0226	505,937	307	8,570
1994	Jan	174	0.0119	2,563	325	0.0187	7,306	499	0.0104	10,069	390	0.0350	18,079	58	0.0500	3,580	11	0.0275	507	970	32,836	0	3,743	12,747	0.0226	514,460	307	8,570
	Feb	154	0.0119	2,274	998	0.0077	13,319	1,152	0.0050	15,593	530	0.0300	46,762	120	0.0500	7,058	-164	0.0308	-6,048	1,647	81,266	0	58,268	14,121	0.0226	952,827	275	7,630
	Mar	209	0.0119	3,008	1,536	0.0126	61,851	1,745	0.0302	64,859	653	0.0400	65,838	193	0.0500	12,020	-1,162	0.0410	-63,911	1,425	78,506	0	38,505	15,495	0.0226	991,117	53	1,843
	Apr	641	0.0119	9,452	2,228	0.0131	91,004	2,869	0.0234	100,456	982	0.1000	121,121	373	0.0600	27,607	-336	0.0444	-40,207	3,666	218,978	0	116,548	16,613	0.0226	1,022,498	268	71,113
	May	2,344	0.0119	34,545	4,002	0.1287	635,518	6,346	0.0856	670,083	2,027	0.1320	329,059	937	0.1020	117,853	495	0.0813	49,639	9,904	1,167,564	656	917,677	17,136	0.0226	1,056,725	848	235,511
	Jun	475	0.0119	7,010	962	0.0357	40,002	1,438	0.0255	47,012	694	0.0720	61,661	218	0.0430	11,550	-133	0.0364	-5,945	2,317	114,281	1,041	91,477	20,544	0.0226	797,088	976	272,441
	Jul	143	0.0119	2,104	344	0.0241	10,231	487	0.0206	12,333	423	0.0460	24,136	73	0.0670	5,996	-1,071	0.0120	-42,227	-87	241	978	29,918	10,177	0.0226	402,851	1092	394,520
	Aug	148	0.0119	2,155	207	-0.0078	-1,473	355	0.0046	682	348	0.0470	20,598	53	0.0570	3,690	-148	0.0241	-4,405	645	30,972	660	20,970	8,750	0.0226	244,255	780	218,098
	Sep	154	0.0119	2,209	97	0.1155	14,764	251	0.0518	16,033	361	0.0310	13,820	38	0.0520	2,486	-326	0.0174	-24,233	125	9,196	568	14,895	7,600	0.0226	247,813	732	19,755
WY Total/Average		3,009	0.0119	71,777	11,599	0.0673	966,896	16,554	0.0421	1,030,753	7,675	0.0840	802,663	2,258	0.0721	200,835	-2,696	0.0099	-59,332	22,917	1,950,917	4,365	2,057,184	27,587	0.0226	770,330	42,561	1,189,065
	Oct	233	0.0124	3,522	236	0.1100	32,867	467	0.0632	36,390	495	0.0700	35,364	42	0.0450	2,694	562	0.0395	24,535	1,296	100,740	183	-30,403	8,315	0.0317	335,489	58	23,457
	Nov	190	0.0124	2,901	235	0.0657	12,230	424	0.0628	16,310	386	0.0670	31,900	51	0.0190	1,202	191	0.0564	10,660	1,053	59,818	56	20,789	8,661	0.0317	339,113	68	23,400
	Dec	203	0.0124	3,093	200	0.0348	11,771	403	0.0290	14,864	398	0.0700	34,083	58	0.0500	3,436	247	0.0400	13,147	1,154	65,795	0	20,037	9,509	0.0317	372,294	102	12,010
1995	Jan	224	0.0124	3,417	276	0.0248	6,438	501	0.0158	10,135	398	0.0300	18,658	58	0.0500	3,564	476	0.0275	16,132	1,435	48,707	0	-7,481	10,760	0.0317	421,426	98	7,658
	Feb	200	0.0124	3,045	158	0.0527	18,496	358	0.0254	17,540	439	0.0700	37,429	54	0.0500	3,973	187	0.0460	8,072	1,281	50,016	0	28,081	11,834	0.0317	464,110	111	4,341
	Mar	316	0.0124	4,811	1,290	0.0070	32,983	4,511	0.0160	37,791	836	0.0800	80,794	176	0.0500	26,024	1,616	0.0441	68,384	3,919	212,791	0	64,348	15,650	0.0317	642,753	120	4,823
	Apr	562	0.0124	8,553	2,815	0.0302	105,099	3,377	0.0273	113,652	1,025	0.1000	128,759	198	0.0600	29,437	148	0.0420	2,874	4,948	277,691	0	83,079	20,507	0.0317	759,522	201	12,940
	May	3,360	0.0124	51,018	12,317	0.0984	1,697,023	15,680	0.0785	1,758,041	4,119	0.1320	675,780	2,067	0.1020	260,329	-694	0.0500	-45,852	20,979	2,338,934	602	1,568,397	40,461	0.0317	1,584,255	151	4,820
	Jun	3,400	0.0124	51,882	14,737	0.0082	149,335	18,137	0.0080	201,217	3,356	0.0600	325,569	2,718	0.0200	67,038	-1,325	0.0323	-41,334	24,658	732,290	1,054	-177,329	36,036	0.0317	2,024,278	1270	484,345
	Jul	810	0.0124	12,481	2,299	0.0599	143,843	3,109	0.0408	156,324	1,182	0.0420	61,235	483	0.0520	30,853	4,768	0.0350	213,113	9,540	459,525	1,209	131,644	29,908	0.0317	1,340,225	2048	808,225
	Aug	340	0.0124	5,274	657	0.0050	3,651	1,007	0.0048	10,925	581	0.0400	21,515	157	0.0500	3,868	1,586	0.0161	56,394	3,871	92,701	972	-19,469	30,353	0.0317	1,188,369	1152	443,004
	Sep	206	0.0124	3,125	528	0.0640	42,065	733	0.0500	45,190	479	0.0310	18,302	103	0.0530	8,633	-336	0.0095	-6,724	1,175	63,399	640	63,580	24,617	0.0317	963,831	624	244,378
WY Total/Average		10,050	0.0124	153,113	35,920	0.0462	2,545,290	45,970	0.0386	2,598,403	13,327	0.0868	1,640,012	6,389	0.0537	422,371	4,547	0.0322	272,397	74,430	4,524,461	4,826	1,771,536	22,641	0.0317	886,475	51,788	2,066,828
	Oct	198	0.0116	2,828	580	0.0708	55,018	738	0.0597	53,846	463	0.0708	40,150	99	0.0350	4,056	-142	0.0384	-13,922	974	46,920	524	31,848	21,279	0.0312	820,210	262	158,284
	Nov	209	0.0116	2,985	473	0.0692	33,439	582	0.0514	26,455	449	0.0678	37,080	85	0.0190	1,995	226	0.0416	11,627	1,442	73,157	89	24,987	21,843	0.0312	842,770	770	29,618
	Dec	192	0.0116	2,734	379	0.0333	15,657	570	0.0261	18,391	430	0.0700	36,101	75	0.0500	4,370	183	0.0434	11,329	1,646	39,331	0	26,890	22,895	0.0312	882,511	614	23,602
1996	Jan	158	0.0116	2,258	512	0.0181	11,968	672	0.0166	13,746	430	0.0400	20,171	71	0.0500	4,449	275	0.0265	6,986	1,452	47,542	0	-8,612	23,995	0.0312	924,923	397	13,847
	Feb	168	0.0116	2,389	518	0.0298	19,018	686	0.0251	21,457	437	0.0700	37,691	79	0.0500	4,849	748	0.0420	38,910	1,941	102,634	0	28,078	25,104	0.0312	987,606	832	32,071
	Mar	224	0.0116	3,187	948	0.0350	40,920	1,171	0.0265	44,107	738	0.0800	33,096	132	0.0500	8,227	122	0.0457	6,853	1,964	132,283	0	34,565	26,147	0.0312	1,007,883	821	25,501
	Apr	423	0.0116	6,026	3,505	0.0292	136,608	3,927	0.0273	152,095	1,147	0.1000	141,820	460	0.0600	34,215	422	0.0434	22,877	5,959	550,469	0	100,722	23,879	0.0312	996,011	882	241,535
	May	4,115	0.0116	58,663	13,626	0.1017	1,708,926	17,741	0.0806	1,767,589	4,776	0.1320	777,500	2,421	0.1020	304,087	72	0.0809	7,187	25,010	2,856,926	740	1,921,421	48,128	0.0312	1,870,957	1071	60,535
	Jun	1,268	0.0116	18,079	3,291	0.0284	106,988	4,559	0.0222	125,068	1,303	0.0600	74,169	654	0.0300	24,218	2,114	0.0245	63,847	8,630	287,201	1,138	-9,222	48,093	0.0312	1,853,797	858	313,083
	Jul	290	0.0116	4,111	895	0.0449	49,534	1,185	0.0347	53,665	584	0.0429	30,149	158	0.0530	10,142	390	0.0363	17,328	2,317	111,085	1,194	67,924	13,821	0.0312	1,457,844	1168	439,619
	Aug	146	0.0116	2,090	430	0.0014	712	568	0.0039	2,818	425	0.0400	20,988	73	0.0460	2,083	-175	0.0389	-13,749	500	12,742	957	20,010	26,369	0.0312	1,024,146	1263	416,631
	Sep	140	0.0116	2,076	399	0.0573	28,116	545	0.0449	30,152	441	0.0310	15,782	66	0.0530	4,296	-162	0.0387	-7,735	481	42,539	831	31,684	22,914	0.0312	853,400	384	169,591
WY Total/Average		7,530	0.0116	107,443	25,544	0.0997	2,165,937	33,080	0.0502	2,291,379	11,587	0.0898	1,384,160	4,570	0.0757	498,257	1,467	0.0313	133,822	22,505	4,111,199	5,063	2,564,461	20,235	0.0312	1,127,675	49,140	1,894,180
	Oct	168	0.0122	2,516	441	0.0778	41,426	612	0.0581	43,992	438	0.0790	38,942	74	0.0250	3,109	-44	0.0790	-4,636	1,095	79,490	313	-106,781	22,990	0.0365	993,342	184	78,338
	Nov	217	0.0122	3,252	484	0.0397	23,655	700	0.0311	26,905	451	0.0678	37,278	66	0.0190	2,025	519	0.0416	26,685	1,257	92,813	91	17,881	22,202	0.0365	1,046,015	442	22,276
	Dec	198	0.0122	2,864	325	0.0348	13,044	522	0.0262	18,999	412	0.0700	35,331	65	0.0500	4,013	817	0.0470	49,707	1,916	105,156	0	19,082	25,178	0.0365	1,152,188	0	0
1997	Jan	213	0.0122	3,197	322	0.0177	7,859	535	0.0167	11,058	411	0.0300	19,056	64	0.0500	3,947	1,143	0.0370	38,184	2,152	72,283	0	-24,496	27,310	0.0365	1,225,968	0	0
	Feb	202	0.0122	3,050	381	0.0348	15,421	583	0.0251	18,471	419	0.0700	36,207	89	0.0500	4,271	765	0.0457	40,782	1,852	99,705	0	17,303	28,519	0.0365	1,282,433	444	28,927
	Mar	266	0.0122	3,982	638	0.0306	31,002	904	0.0314	34,992	420	0.0600	48,575	109	0.0500	6,703	1,466	0.0460	84,710	2,971	174,976	0	83,089	30,509	0.0365	1,374,605	821	41,413
	Apr	624	0.0122	9,366	2,388	0.0319	115,823	3,012	0.0281	125,189	1,129	0.1100	139,509	853	0.0600	33,486	3,482	0.0433	150,780	8,677	464,698	0	99,930	39,246	0.0365	1,764,797	0	0
	May	4,572	0.0122	55,566	15,468	0.1123	2,186,142	21,040	0.0822	2,241,708	4,005	0.1320	981,220	3,096	0.1020	389,538	4,766	0.0804	472,083	33,729	4,085,100	478	2,517,978	73,300	0.0365	3,205,113	697	20,875
	Jun	3,017	0.0122	45,157	4,247	0.0339	177,785	7,258	0.0240	222,942	2,043	0.0526	183,397	996	0.0450	58,133	2,861	0.0334	183,047	14,200	637,539	1,294	20,771	73,870	0.0365	3,231,828	4646	654,073
	Jul	305	0.0122	4,580	1,062	0.0460	60,974	1,367	0.0392	65,554	883	0.0449	34,226	298	0.0520	12,804	398	0.0363	17,716	2,623	130,298	1,038	72,502	61,050	0.0365	2,745,236	4748	844,357
	Aug	174	0.0122	2,611	770	0.0233	24,026	944	0.0229	26,669	119	0.0700	44,853	123	0.0750	13,453	-76	0.0396	-3,717	1,310	79,188	1,109	61,153	55,739	0.0365	2,509,080	5722	255,315
	Sep	193	0.0122	2,894	389	0.0684	51,049	582	0.0483	53,943	313	0.0310	19,631	120	0.0530	7,649	1,546	0.0397	71,826	3,082	157,243	823	35,309	60,397	0.0365	2,210,611	636	173,512
WY Total/Average		11,963	0.0122	170,121	27,837	0.0789	2,700,135	39,780	0.0389	2,882,256	11,869	0.0893	1,614,339	5,405	0.0794	529,475	18,821	0.0404	1,147,516	77,588	6,179,534	7,844	3,000,679	41,320	0.0365	1,007,379	64,989	2,023,049

Date September 25, 2006

Table C-3
Flow and Phosphorus Routing WITH Proposed Narrows Project
Scofield Reservoir Operation

Year Month	(CALC) Stream Flow-Cottonwood Creek Near Scofield: Flow Acre-Feet	Concentration mg/l	Weight Grams	(Calculated) Gains for Fish Creek Above Fish Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Stream Flow-Fish Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams
Oct	125	0.0110	3,059	380	0.1816	58,361	805	0.0621	[illegible]
Nov	220	0.0110	2,992	501	0.0405	24,991	721	0.0315	[illegible]
Dec	214	0.0110	2,913	344	0.0388	13,614	559	0.0269	[illegible]
1998 Jan	343	0.0110	3,331	331	0.0209	8,553	575	0.0167	[illegible]
Feb	264	0.0110	3,594	453	0.0347	19,401	717	0.0260	[illegible]
Mar	328	0.0110	4,466	696	0.0418	35,900	1,024	0.0319	[illegible]
Apr	632	0.0110	8,596	2,020	0.0345	83,997	2,652	0.0289	[illegible]
May	3,362	0.0110	45,446	11,417	0.1014	1,428,513	14,979	0.0799	[illegible]
Jun	3,016	0.0110	41,010	6,683	0.0300	247,256	9,699	0.0241	[illegible]
Jul	447	0.0110	6,073	2,609	0.0091	29,308	3,055	0.0094	[illegible]
Aug	232	0.0110	3,153	681	0.0285	24,085	923	0.0239	[illegible]
Sep	187	0.0110	2,542	447	0.1810	88,694	634	0.1167	[illegible]
WY Total/Average	9,371	0.0110	130,157	26,771	0.0626	2,066,789	36,342	0.0490	[illegible]
Oct	314	0.0137	3,595	455	0.0844	45,233	649	0.0611	[illegible]
Nov	316	0.0137	5,051	553	0.0971	23,235	769	0.0505	[illegible]
Dec	448	0.0137	2,502	462	0.0280	15,967	610	0.0546	[illegible]
1999 Jan	109	0.0137	1,746	428	0.0169	8,922	531	0.0153	[illegible]
Feb	118	0.0137	2,209	96	0.0587	4,376	230	0.0241	[illegible]
Mar	201	0.0137	3,399	439	0.0377	20,410	640	0.0302	[illegible]
Apr	377	0.0137	5,601	1,326	[illegible]	49,051	1,460	0.0271	[illegible]
May	2,710	0.0137	45,753	8,329	0.1109	1,058,287	11,023	0.0840	[illegible]
Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WY Total/Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0584	30,725
Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0302	29,907
Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0251	20,421
2000 Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0165	14,209
Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0250	20,116
Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0306	27,868
Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0292	115,592
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0859	711,973
Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0478	199,318
Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0375	31,397
Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0208	12,450
Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0449	27,619
WY Total/Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0536	1,171,907
Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0584	41,075
Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0300	22,549
Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0232	13,051
2001 Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0150	5,307
Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0241	11,163
Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0355	25,078
Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0290	98,378
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0852	435,044
Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0282	52,125
Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0201	27,702
Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0511	18,825
Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0428	16,633
WY Total/Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0966	1,167,257

Year Month	Stream Flow-Mud Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	Stream Flow-Pondtown Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Other Reservoir Inflow Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams
Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12,141
Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,917
Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,283
1998 Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	32,782
Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-2,410
Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	61,851
Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	29,071
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	115,600
Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	76,423
Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17,303
Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	52,163
Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10,230
WY Total/Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	401,768
Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-30,837
Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31,400
Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,805
1999 Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5,442
Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	40,164
Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	127,654
Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	89,331
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	148,211
Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	95,573
Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,772
Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	79,462
Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,714
WY Total/Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	754,609
Oct	449	0.0700	38,761	85	0.0350	3,681	-1,724	0.0586	-124,641
Nov	465	0.0670	38,460	94	0.0250	2,207	-940	0.0411	-47,629
Dec	439	0.0700	37,157	75	0.0500	4,646	-30	0.0439	-1,302
2000 Jan	476	0.0440	20,519	79	0.0500	4,887	561	0.0264	18,395
Feb	427	0.0790	36,893	74	0.0500	4,537	934	0.0431	49,601
Mar	850	0.0800	44,420	85	0.0500	5,276	418	0.0484	24,986
Apr	1,095	0.1000	135,016	134	0.0600	12,108	-270	0.0430	-12,449
May	2,126	0.1320	346,089	990	0.1020	124,612	1,163	0.0812	116,404
Jun	778	0.0370	35,517	203	0.0390	12,034	322	0.0292	10,747
Jul	466	0.0420	24,154	95	0.0520	6,069	84	0.0369	3,813
Aug	406	0.0210	10,512	62	0.0340	2,601	-605	0.0212	-10,615
Sep	404	0.0310	15,467	61	0.0530	4,023	-333	0.0385	-11,047
WY Total/Average	7,035	0.0800	782,971	2,209	0.0700	207,592	[illegible]	[illegible]	13,098
Oct	419	0.0700	36,194	64	0.0350	3,088	269	0.0582	19,624
Nov	422	0.0670	34,893	71	0.0190	1,662	449	0.0427	24,705
Dec	394	0.0700	32,292	45	0.0500	2,764	-78	0.0460	-4,505
2001 Jan	341	0.0300	13,000	27	0.0500	1,659	2,787	0.0391	88,626
Feb	363	0.0790	31,468	40	0.0500	2,454	369	0.0479	21,799
Mar	434	0.0900	42,831	77	0.0500	4,753	1,092	0.0492	54,445
Apr	971	0.1000	119,790	367	0.0600	27,176	798	0.0441	42,401
May	2,619	0.1020	306,696	1,178	0.1020	145,090	406	0.0813	40,567
Jun	715	0.0700	62,474	229	0.0370	10,448	-958	0.0357	-8,979
Jul	448	0.0420	23,128	84	0.0320	3,323	229	0.0371	20,445
Aug	401	0.0700	24,661	59	0.0620	4,533	1,100	0.0609	82,726
Sep	367	0.0310	14,052	51	0.0530	2,672	74	0.0376	5,405
								0.0000	0
WY Total/Average	7,891	0.0697	815,231	2,257	0.0759	212,153	6,565	0.0498	336,999

Year Month	(CALC) Total Inflow Above Scofield Reservoir: Flow Acre-Feet	Weight Grams	Scofield Reservoir: Evaporation Acre-Feet	Δ Phosphorus Grams	End of Month Contents: Total Acre-Feet	mg/l Total P	Weight Grams	Price River Below Scofield Dam: Flow Acre-Feet	Weight Grams
					8,434	0.0318	371,825		
Oct	1,693	190,141	421	616,248	40,091	0.0272	1,447,803	908	246,100
Nov	1,388	74,007	119	51,164	44,360	0.0272	1,490,428	8	9
Dec	1,156	65,016	0	38,163	45,516	0.0272	1,539,259	8	0
1998 Jan	2,059	68,666	0	-503	47,574	0.0272	1,598,427	0	0
Feb	1,240	65,053	0	24,163	48,785	0.0272	1,639,097	0	0
Mar	2,783	161,608	0	68,785	50,626	0.0272	1,700,976	107	30,044
Apr	4,408	264,887	0	114,733	48,879	0.0272	1,642,273	1250	208,831
May	24,206	2,703,370	962	1,921,711	73,132	0.0273	2,423,199	22	772
Jun	15,200	645,501	1,264	177,938	73,757	0.0272	2,444,512	1332	446,250
Jul	3,000	71,443	1,343	-4,530	63,371	0.0273	2,129,164	1108	391,101
Aug	2,674	137,895	1,132	85,739	53,489	0.0272	1,797,158	1548	394,183
Sep	1,300	118,946	914	107,604	47,719	0.0272	1,603,281	1257	210,219
WY Total/Average	61,672	4,516,513	5,048	3,204,678	53,191	0.0272	1,787,132	57,606	1,939,564
Oct	754	40,316	416	20,204	43,986	0.0277	1,470,646	3040	172,637
Nov	1,753	91,102	119	55,228	44,442	0.0277	1,519,740	78	6,771
Dec	1,140	61,411	0	22,210	45,231	0.0277	1,548,446	327	18,493
1999 Jan	1,146	38,210	0	-963	46,120	0.0277	1,577,124	251	18,455
Feb	1,079	68,073	0	33,380	46,915	0.0277	1,608,330	277	9,479
Mar	3,236	158,584	0	87,756	49,325	0.0277	1,750,422	428	14,577
Apr	3,218	192,624	0	82,593	50,863	0.0277	1,792,742	980	47,309
May	13,086	2,153,203	857	1,560,610	67,709	0.0277	2,292,160	982	47,235
Jun	11,645	363,711	1,221	209,773	64,455	0.0277	2,203,956	1302	444,893
Jul	2,115	124,355	1,288	42,408	54,212	0.0277	1,852,850	1147	397,403
Aug	2,057	137,425	1,072	103,764	47,312	0.0277	1,632,927	748	234,684
Sep	1,286	67,518	788	71,183	42,701	0.0277	1,460,233	528	189,048
WY Total/Average	40,614	3,936,392	5,896	2,640,005	30,247	0.0277	1,717,183	47,941	1,609,617
Oct	-485	-31,476	404	117,510	33,786	0.0253	951,060	808	103,150
Nov	422	22,951	112	14,972	35,308	0.0235	938,362	798	20,996
Dec	1,136	60,655	0	10,462	36,135	0.0235	950,334	306	8,222
2000 Jan	1,783	58,101	0	10,707	37,609	0.0235	979,508	303	8,223
Feb	2,087	111,147	0	15,688	39,676	0.0235	1,034,439	26	530
Mar	1,692	102,574	0	17,013	41,367	0.0235	1,099,400	6	0
Apr	4,490	269,267	0	110,926	44,603	0.0235	1,190,715	104	28,013
May	10,990	1,290,169	917	1,014,215	47,098	0.0235	1,251,658	7798	207,011
Jun	3,117	168,236	1,427	110,356	39,671	0.0235	1,034,324	9415	250,215
Jul	1,323	65,430	1,132	39,841	39,613	0.0245	787,010	1059	272,909
Aug	549	14,953	869	23,452	31,485	0.0235	570,994	782	207,516
Sep	737	36,342	592	31,049	20,013	0.0235	531,881	1825	43,511
WY Total/Average	27,651	2,177,323	3,744	1,898,449	37,714	0.0235	960,441	45,406	1,207,399
Oct	1,326	99,891	255	-123,181	20,389	0.0291	731,329	554	23,626
Nov	1,571	83,815	37	20,387	21,294	0.0291	763,707	529	10,781
Dec	756	43,511	0	14,968	21,780	0.0291	781,243	319	11,096
2001 Jan	3,037	111,815	0	3,691	24,513	0.0291	870,249	356	11,606
Feb	1,149	66,906	0	23,697	25,389	0.0291	870,455	278	10,822
Mar	5,239	137,137	0	56,671	27,622	0.0291	990,761	0	0
Apr	4,874	288,153	0	113,337	32,466	0.0291	1,162,745	80	2,645
May	11,640	1,387,745	416	999,323	28,645	0.0292	1,380,157	426	164,778
Jun	2,350	157,065	1,237	70,686	31,435	0.0291	1,127,592	956	395,097
Jul	1,348	46,778	1,058	34,841	23,103	0.0291	828,678	682	310,725
Aug	1,996	113,891	777	73,833	16,964	0.0291	608,498	780	264,027
Sep	835	59,730	300	27,935	18,186	0.0291	472,606	498	147,077
WY Total/Average	33,157	2,561,160	4,358	1,340,146	24,727	0.0291	990,936	35,437	1,271,087

Date: September 25, 2006

Table C-3
Flow and Phosphorus Routing WITH Proposed Narrows Project
Scofield Reservoir Operation

Year	Month	(CALC) Stream Flow-Gooseberry Creek Near Scofield: Flow Acre-Feet	Concentration mg/l	Weight Grams	(Calculated) Gains for Fish Creek Above Fish Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Stream Flow-Fish Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	Stream Flow-Mud Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	Stream Flow-Pondtown Creek Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Other Reservoir Inflow Above Scofield Reservoir: Flow Acre-Feet	Concentration mg/l	Weight Grams	(CALC) Total Inflow Above Scofield Reservoir: Flow Acre-Feet	Weight Grams	Scofield Reservoir: Evaporation Acre-Feet	Phosphorus Uptake Grams	End of Month Contents: Total Acre-Feet	mg/l Table D-7	Weight Grams	Flow River Below Scofield Dam: Acre-Feet	Weight Grams
																								6,414	0.0358	371,825		
	Oct	122	0.0105	1,576	311	0.0714	29,258	454	0.0550	30,854	387	0.0700	33,193	52	0.0350	2,232	417	0.0001	20,484	1,310	97,348	228	22,373	10,360	0.0312	455,843	883	141,934
	Nov	152	0.0105	1,957	245	0.0431	13,014	397	0.0306	14,971	383	0.0670	31,623	49	0.0190	1,160	1,270	0.0432	70,811	2,098	118,564	63	40,357	11,887	0.0312	456,837	706	27,232
	Dec	144	0.0105	1,851	166	0.0310	7,572	209	0.0247	7,624	359	0.0780	30,987	37	0.0500	2,261	209	0.0486	12,536	914	53,208	0	20,083	12,491	0.0312	460,073	305	11,896
2002	Jan	78	0.0105	1,001	188	0.0152	4,570	267	0.0160	5,271	346	0.0380	16,224	30	0.0500	1,830	148	0.0298	17,652	987	31,980	0	-1,956	11,160	0.0312	306,122	308	11,890
	Feb	41	0.0105	530	162	0.0272	5,440	200	0.0238	5,970	331	0.0700	28,620	22	0.0500	1,348	3,379	0.0534	222,527	3,935	258,466	0	106,675	14,839	0.0312	647,174	270	10,738
	Mar	86	0.0105	1,111	350	0.0329	14,218	437	0.0283	15,329	375	0.0800	37,059	46	0.0500	2,809	1,255	0.0537	83,148	2,112	138,326	0	57,138	18,742	0.0312	720,369	290	8,051
	Apr	727	0.0105	9,379	1,764	0.0362	78,766	2,492	0.0287	88,145	909	0.1000	112,105	194	0.0600	24,886	249	0.0443	13,641	3,983	238,577	0	83,308	21,712	0.0312	834,474	972	18,903
	May	1,378	0.0105	17,770	3,836	0.1102	521,626	5,215	0.0839	539,377	1,680	0.1320	273,505	750	0.1020	94,332	498	0.0916	41,122	8,053	948,355	562	665,097	16,784	0.0312	645,027	1229	472,705
	Jun	251	0.0105	3,233	1,111	0.0085	11,638	1,362	0.0089	14,869	645	0.0300	23,875	191	0.0570	13,445	109	0.0185	8,414	2,567	60,603	728	-10,099	13,168	0.0312	429,205	1488	286,524
	Jul	103	0.0105	1,323	286	0.0474	16,735	389	0.0377	18,057	460	0.0420	20,838	60	0.0520	3,852	-712	0.0367	-34,023	99	8,324	630	28,753	9,457	0.0312	361,451	1190	45,724
	Aug	86	0.0105	1,113	173	0.0607	12,963	259	0.0440	14,074	352	0.0100	4,343	33	0.0750	3,051	1,272	0.0266	41,690	1,917	63,159	506	8,727	9,478	0.0312	325,952	2288	93,010
	Sep	130	0.0105	1,671	237	0.0084	2,479	407	0.0091	4,552	382	0.0310	14,604	49	0.0530	3,209	1,206	0.0216	32,160	2,044	54,525	362	-10,105	8,810	0.0312	339,645	1860	51,867
WY Total/Average		1,298	0.0105	42,518	8,891	0.0655	718,375	12,189	0.0506	760,892	6,551	0.0778	627,158	1,052	0.0757	154,222	9,026	0.0451	335,567	30,918	2,077,837	3,194	1,012,512	13,341	0.0312	512,746	31,210	1,199,996
	Oct	341	0.0126	4,759	262	0.0368	11,869	503	0.0232	15,628	387	0	33,104	50	0	2,154	437	0.0461	24,854	1,273	75,741	199	88,599	9730	0.0257	308,064	359	17,049
	Nov	172	0.0126	2,909	418	0.0739	38,129	593	0.0559	40,848	402	0	33,237	60	0	1,410	652	0.0602	47,010	1,687	122,524	60	71,010	11058	0.0257	330,080	290	9,478
	Dec	87	0.0126	1,354	257	0.0259	11,611	445	0.0233	13,761	370	0	31,982	43	0	2,644	1,891	0.0472	110,189	2,749	137,576	0	70,272	13506	0.0257	427,590	309	9,794
2003	Jan	70	0.0126	1,091	413	0.0096	4,878	483	0.0100	5,965	387	0	18,135	32	0	3,197	1,118	0.0243	85,436	2,440	72,771	0	-4,525	15664	0.0257	496,502	252	8,280
	Feb	109	0.0126	1,691	267	0.0293	9,622	376	0.0244	11,318	366	0	31,624	41	0	3,556	419	0.0477	48,219	1,602	93,667	0	42,950	17124	0.0257	543,733	112	3,540
	Mar	192	0.0126	2,978	393	0.0357	17,331	585	0.0281	20,307	399	0	39,614	37	0	3,610	2,347	0.0554	150,190	2,410	231,521	0	105,018	20580	0.0257	651,836	12	380
	Apr	771	0.0126	11,966	1,609	0.0322	63,965	2,380	0.0259	75,931	767	0	94,628	257	0	19,825	590	0.0496	33,189	3,994	222,772	0	88,556	24509	0.0257	775,942	318	10,110
	May	4,418	0.0126	68,517	6,371	0.0513	403,041	10,787	0.0354	471,562	2,770	0	480,953	1,338	0	168,349	-2,193	0.0554	-149,773	12,702	941,071	725	361,807	32236	0.0257	1,030,576	4372	134,631
	Jun	1,222	0.0125	18,962	2,160	0.0074	19,966	3,402	0.0093	38,928	1,079	0	43,309	425	0	12,599	3,078	0.0111	42,154	7,963	106,986	986	114,590	30681	0.0257	971,308	8553	270,733
	Jul	306	0.0126	4,754	586	0.0441	31,871	893	0.0333	36,624	482	0	24,388	105	0	6,626	88	0.0368	3,994	1,566	72,233	1008	54,566	21159	0.0257	660,858	10091	319,137
	Aug	216	0.0126	3,350	292	0.0074	2,665	508	0.0096	6,014	399	0	4,930	58	0	1,309	-178	0.0139	-2,913	795	13,410	745	11,832	12966	0.0257	411,122	8223	260,354
	Sep	199	0.0126	3,083	215	0.0075	1,977	414	0.0099	5,060	370	0	14,750	41	0	1,700	662	0.0221	18,037	1,468	40,937	445	6,959	10416	0.0257	325,768	3413	114,343
WY Total/Average		5,004	0.0126	124,188	13,361	0.0774	616,757	23,367	0.0281	750,945	8,176	0	750,449	2,529	0	230,000	9,718	0.0309	370,509	41,790	2,132,259	4166	982,539	18,311	0.0257	579,712	36594	1,158,567
	Oct	176	0.0130	2,834	213	0.0080	2,109	390	0.0103	4,943	360	0	31,082	17	0	1,603	299	0.0409	15,105	1,086	52,712	212	-64,058	9958	0.0321	389,811	1454	56,728
	Nov	182	0.0130	2,916	262	0.0398	12,894	444	0.0289	15,811	381	0	31,484	49	0	1,125	595	0.0454	33,327	1,469	81,737	61	26,057	10025	0.0321	432,072	339	13,419
	Dec	144	0.0130	2,375	226	0.0317	8,845	370	0.0243	11,220	365	0	37,563	40	0	2,475	252	0.0478	14,853	1,031	80,098	0	19,311	11647	0.0321	460,616	330	12,235
2004	Jan	154	0.0130	2,157	219	0.0186	3,042	354	0.0165	7,199	365	0	17,080	86	0	2,450	637	0.0283	22,310	1,395	49,248	0	-5,004	12772	0.0321	508,534	309	12,235
	Feb	141	0.0130	2,271	166	0.0239	5,794	328	0.0249	10,055	360	0	31,054	37	0	2,286	922	0.0485	55,207	1,647	98,702	0	33,688	14020	0.0321	554,460	359	14,208
	Mar	260	0.0130	4,173	493	0.0384	23,453	755	0.0297	27,625	444	0	48,301	83	0	4,091	995	0.0487	59,784	2,275	116,301	0	46,273	16298	0.0321	644,486	0	0
	Apr	1,251	0.0130	20,126	4,418	0.0311	169,361	5,670	0.0271	189,487	1,524	0	187,955	886	0	49,255	-1,903	0.0425	-102,984	5,890	323,733	0	90,543	19298	0.0321	757,174	2794	110,501
	May	2,619	0.0130	42,079	4,869	0.1081	649,290	7,488	0.0748	691,365	2,020	0	339,161	398	0	117,907	-704	0.0813	-70,565	9,750	1,068,928	646	708,806	20671	0.0321	817,323	7831	109,714
	Jun	899	0.0130	14,449	738	0.0322	29,323	1,637	0.0217	43,773	667	0	32,078	203	0	12,019	254	0.0274	8,594	2,760	96,448	897	39,181	15937	0.0321	830,270	5689	264,515
	Jul	252	0.0130	4,041	363	0.0495	22,120	615	0.0345	26,162	432	0	22,838	78	0	4,888	-342	0.0372	-15,667	780	37,720	740	36,340	9476	0.0321	374,672	8503	257,178
	Aug	163	0.0130	2,295	121	0.0051	769	284	0.0094	3,064	331	0	4,326	32	0	1,750	-491	0.0116	-7,051	158	2,087	901	15,725	7890	0.0321	308,480	1929	92,557
	Sep	164	0.0130	2,635	142	0.0702	12,359	306	0.0395	14,963	349	0	13,353	11	0	3,203	-356	0.0259	-11,683	437	18,706	349	15,456	7902	0.0321	308,480	82	3,250
WY Total/Average		6,371	0.0130	102,350	12,253	0.0624	943,395	18,624	0.0455	1,045,640	7,624	0	776,242	2,231	0	282,948	199	0.0060	1,476	28,677	2,026,319	3312	941,064	13,046	0.0321	515,963	27979	1,106,537
	Oct	258	0.0129	3,118	142	0.0075	3,170	600	0.0098	7,283	408	0	32,286	64	0	3,343	561	0.0030	24,179	1,633	68,451	185	-49,477	8531	0.0375	394,379	717	33,129
	Nov	197	0.0129	3,141	240	0.0398	12,229	442	0.0279	15,380	376	0	31,168	38	0	1,081	874	0.0457	49,376	1,743	98,904	37	15,353	10118	0.0375	407,378	102	4,712
	Dec	157	0.0129	2,508	234	0.0078	2,247	391	0.0099	4,764	368	0	31,768	42	0	2,562	685	0.0404	34,140	1,466	73,334	0	4,384	11469	0.0375	530,169	132	6,087
2005	Jan	138	0.0129	2,209	225	0.0186	5,149	363	0.0164	7,353	300	0	17,170	43	0	2,598	1,285	0.0236	45,308	2,055	72,339	0	-32,659	13350	0.0375	617,270	168	7,781
	Feb	148	0.0129	2,364	195	0.0335	4,068	343	0.0247	10,430	362	0	31,247	38	0	2,361	582	0.0442	34,035	1,325	78,674	0	17,498	14514	0.0375	670,904	167	7,739
	Mar	251	0.0129	4,008	281	0.0418	14,484	532	0.0282	18,492	391	0	18,339	54	0	3,315	1,180	0.0522	74,690	2,136	134,995	0	36,275	16643	0.0375	769,248	6	276
	Apr	876	0.0129	13,957	1,806	0.0301	67,564	2,682	0.0246	81,492	828	0	102,112	250	0	33,459	1,645	0.0442	100,491	5,645	835,556	0	37,124	22450	0.0375	1,037,775	0	0
	May	6,327	0.0129	101,916	16,656	0.0874	1,795,900	22,983	0.0669	1,896,516	5,527	0	499,949	2,827	0	355,442	-1,901	0.0734	-148,422	29,836	3,011,703	693	1,664,596	31565	0.0375	2,283,583	20	1,259
	Jun	2,182	0.0129	34,829	6,736	0.0298	247,648	8,918	0.0257	282,317	2,595	0	230,661	1,244	0	82,972	-240	0.0031	-9,823	12,516	569,127	1158	34,094	39359	0.0375	2,753,135	1166	155,464
	Jul	527	0.0129	8,436	910	0.0071	7,919	1,437	0.0092	16,354	624	0	7,691	180	0	4,429	-277	0.0101	-3,672	1,963	24,781	1239	-7,767	33145	0.0375	2,396,567	4418	389,118
	Aug	359	0.0129	5,737	507	0.0067	4,210	866	0.0093	9,947	480	0	3,993	103	0	1,299	397	0.0100	-4,891	1,834	22,133	1059	-14,631	45810	0.0375	2,117,556	6431	315,774
	Sep	246	0.0129	3,926	357	0.0071	3,118	603	0.0095	7,040	422	0	3,290	71	0	879	139	0.0100	1,717	1,233	18,840	778	-8,313	40144	0.0375	1,853,829	6120	282,881
WY Total/Average		11,060	0.0129	186,232	28,496	0.0618	2,171,200	40,164	0.0470	2,357,554	12,754	0	1,436,574	5,000	0	464,256	3,509	0.0117	415,431	63,427	4,473,773	3189	1,722,135	28,834	0.0375	1,332,846	26093	1,204,290
78-05	Total	280,187		3,518,147	848,615		54,289,545	688,802		37,792,692	310,066		15,425,594	114,609		10,083,772	282,362		17,519,033	1,576,059	121,271,894	110,471	66,364,400	897,578		35,328,776	1,408,583	33,372,090
78-05	Average	8,578	0.0119	126,184	23,165	0.0878	1,917,843	31,741	0.0527	2,064,025	11,074	0.0929	1,265,200	4,093	0.0142	374,420	9,377	0.0541	625,708	56,287	4,329,353	4,874	2,370,171	32,056	0.0303	1,437,455	50,307	1,908,182
78-89	Total	121,518		1,785,537	350,614		30,872,605	474,172		31,858,202	133,418		18,697,996	60,303		5,646,739	185,335		13,177,944	873,327	69,378,832	54,623	74,643,165	481,020		17,983,238	909,318	30,898,004
78-89	Average	16,298	0.0117	148,628	29,218	0.0805	2,506,055	39,514	0.0542	2,654,684	12,793	0.0980	1,559,168	5,017	0.0360	470,562	15,461	0.0578	1,098,162	72,777	5,781,573	5,383	3,220,264	40,135	0.0301	1,498,771	87,443	2,574,167

NOTE: Average Annual Concentrations are Flow Weighted

Table D-1

Narrows Reservoir Eutrophication Study

Phosphorus Content and Probability of Eutrophication

Year	Contents of Narrows Reservoir Jun - Sep Average	Contents of Narrows Reservoir Jun - Sep Average (V)	Surface Area at Volume of Narrows	Surface Area at Volume of Narrows (A)	Mean Lake Depth of Narrows (z)	Reservoir Outflow of Narrows	Reservoir Outflow of Narrows (Q_o)	Reservoir Hydraulic Detention Time (t)	Annual Mass Inflow Phosphorus (J)	Areal Phosphorus Loading Rate (L)	Sedimentation Coefficient (s)	Phosphorus In Lake Concentration (P)	Standard Normal Variate (S)	Normal Curve Area (Table D-4)*	Probability of Eutrophication
	AF	m^3	Acres	m^2	m	AF	m^3/yr	yr	g/yr	$g/m^2/yr$		mg/L			
1978	9,035	11,144,901	395	1,596,776	6.9796	8,557	10,555,205	1.0559	216,151	0.1354	0.6540	0.0121	0.8280	0.2962	0.2038
1979	8,831	10,893,126	387	1,566,665	6.9531	8,333	10,278,292	1.0598	151,786	0.0969	0.5383	0.0094	1.2462	0.3935	0.1065
1980	12,802	15,790,962	513	2,076,384	7.6050	8,206	10,121,767	1.5601	226,583	0.1091	0.5476	0.0121	0.8337	0.2978	0.2022
1981	10,579	13,049,278	446	1,803,098	7.2371	8,060	9,941,549	1.3126	117,333	0.0651	0.4158	0.0076	1.5902	0.4441	0.0559
1982	13,181	16,258,230	524	2,120,215	7.6682	8,753	10,796,826	1.5058	217,647	0.1027	0.5257	0.0113	0.9499	0.3289	0.1711
1983	16,245	20,037,941	601	2,432,199	8.2386	13,614	16,792,106	1.1933	323,327	0.1329	0.5868	0.0113	0.9392	0.3262	0.1738
1984	14,922	18,405,964	569	2,301,895	7.9960	19,739	24,348,370	0.7559	329,055	0.1429	0.6234	0.0092	1.2848	0.4005	0.0995
1985	14,839	18,304,135	566	2,291,449	7.9880	12,576	15,512,420	1.1800	231,533	0.1010	0.5084	0.0093	1.2593	0.3959	0.1041
1986	14,682	18,109,984	562	2,275,837	7.9575	15,398	18,993,322	0.9535	289,201	0.1271	0.5833	0.0098	1.1805	0.3810	0.1190
1987	11,299	13,936,763	468	1,895,742	7.3516	8,486	10,467,016	1.3315	120,310	0.0635	0.4060	0.0075	1.6283	0.4483	0.0517
1988	9,185	11,328,997	399	1,615,056	7.0146	8,463	10,438,645	1.0853	125,265	0.0776	0.4697	0.0079	1.5238	0.4362	0.0638
1989	6,638	8,188,477	305	1,234,664	6.6321	8,655	10,676,327	0.7670	118,153	0.0957	0.5494	0.0078	1.5579	0.4404	0.0596
1990	4,671	5,761,414	227	916,905	6.2835	7,151	8,820,539	0.6532	130,286	0.1421	0.7159	0.0101	1.1340	0.3715	0.1285
1991	4,299	5,302,358	209	847,168	6.2589	9,798	12,085,121	0.4388	177,962	0.2101	0.9033	0.0105	1.0568	0.3546	0.1454
1992	2,863	3,531,322	147	595,508	5.9299	4,815	5,939,369	0.5946	85,117	0.1429	0.7433	0.0099	1.1548	0.3758	0.1242
1993	6,359	7,843,933	295	1,192,607	6.5771	9,780	12,063,285	0.6502	219,524	0.1841	0.8117	0.0119	0.8558	0.3040	0.1960
1994	4,509	5,561,328	218	882,497	6.3018	8,294	10,230,852	0.5426	127,445	0.1444	0.7215	0.0089	1.3282	0.4079	0.0921
1995	10,587	13,058,583	447	1,810,115	7.2142	8,653	10,672,931	1.2235	264,934	0.1464	0.6716	0.0136	0.6336	0.2370	0.2630
1996	11,681	14,408,864	480	1,942,012	7.4196	9,003	11,105,678	1.2974	173,199	0.0892	0.4934	0.0095	1.2278	0.3901	0.1099
1997	14,721	18,157,815	564	2,280,789	7.9612	9,709	11,975,564	1.5162	241,400	0.1058	0.5236	0.0112	0.9520	0.3294	0.1706
1998	14,940	18,428,249	569	2,303,892	7.9987	9,797	12,084,367	1.5250	179,291	0.0778	0.4356	0.0089	1.3343	0.4089	0.0911
1999	14,847	18,313,742	567	2,294,502	7.9816	8,673	10,697,548	1.7120	211,183	0.0920	0.4815	0.0108	1.0142	0.3447	0.1553
2000	12,842	15,840,268	514	2,078,171	7.6222	8,103	9,995,303	1.5848	115,895	0.0558	0.3683	0.0073	1.6594	0.4515	0.0485
2001	10,497	12,948,229	443	1,792,356	7.2241	8,202	10,117,653	1.2798	113,559	0.0634	0.4098	0.0074	1.6502	0.4506	0.0494
2002	7,147	8,815,368	325	1,314,641	6.7055	7,501	9,253,006	0.9527	86,975	0.0662	0.4392	0.0066	1.8241	0.4660	0.0340
2003	3,543	4,369,925	177	715,014	6.1117	7,339	9,052,754	0.4827	85,471	0.1195	0.6572	0.0072	1.6945	0.4550	0.0450
2004	2,650	3,269,126	137	556,104	5.8786	3,616	4,459,807	0.7330	72,606	0.1306	0.7083	0.0107	1.0304	0.3485	0.1515
2005	4,443	5,480,750	215	870,978	6.2926	7,844	9,675,523	0.5665	164,550	0.1889	0.8460	0.0115	0.9142	0.3197	0.1803
Average	9,744	12,019,287	402	1,628,687	7.1208	9,183	11,326,827	1.0541	175,562	0.1146	0.5835	0.0097	1.2245		0.1213

* Table D-4 "Normal Curve Areas for Standard Normal Variate", taken from *Guidelines for Studies of Potential Eutrophication, Bureau of Reclamation, December 1981.*
Formula for Curve Areas was created and is used to calculate the number

Table D-2

Lower Gooseberry Reservoir (with Narrows) Eutrophication Study

Phosphorus Content and Probability of Eutrophication

Year	Contents of Lower Gooseberry Reservoir Jun - Sep Average	Contents of Lower Gooseberry Reservoir Jun - Sep Average (V)	Surface Area at Volume of Lower Gooseberry	Surface Area at Volume of Lower Gooseberry (A)	Mean Lake Depth of Lower Gooseberry (z)	Reservoir Outflow of Lower Gooseberry	Reservoir Outflow of Lower Gooseberry (Q_s)	Reservoir Hydraulic Detention Time (t)	Annual Mass Inflow Phosphorus (J)	Areal Phosphorus Loading Rate (L)	Sedimentation Coefficient (s)	Phosphorus In Lake Concentration (P)	Standard Normal Variate (S)	Normal Curve Area (Table D-4)*	Probability of Eutrophication
	AF	m^3	Acres	m^2	m	AF	m^3/yr	yr	g/yr	$g/m^2/yr$		mg/L			
1978	212	261,500	57	231,886	1.1277	8,106	9,998,566	0.0262	137,827	0.5944	4.5741	0.0123	0.8012	0.2885	0.2115
1979	212	261,500	57	231,886	1.1277	6,033	7,441,818	0.0351	98,832	0.4262	3.7604	0.0117	0.8810	0.3109	0.1891
1980	212	261,500	57	231,886	1.1277	8,255	10,182,854	0.0257	141,665	0.6109	4.6487	0.0124	0.7856	0.2840	0.2160
1981	212	261,500	57	231,886	1.1277	4,914	6,061,739	0.0431	78,397	0.3381	3.2808	0.0113	0.9385	0.3260	0.1740
1982	212	261,500	57	231,886	1.1277	8,625	10,638,728	0.0246	146,463	0.6316	4.7408	0.0123	0.7987	0.2878	0.2122
1983	212	261,500	57	231,886	1.1277	16,939	20,893,583	0.0125	276,400	1.1920	6.8913	0.0122	0.8191	0.2937	0.2063
1984	212	261,500	57	231,886	1.1277	23,619	29,133,985	0.0090	343,332	1.4806	7.8302	0.0110	0.9856	0.3378	0.1622
1985	212	261,500	57	231,886	1.1277	14,015	17,287,211	0.0151	219,372	0.9460	6.0144	0.0116	0.8950	0.3146	0.1854
1986	212	261,500	57	231,886	1.1277	17,904	22,084,818	0.0118	274,856	1.1853	6.8686	0.0115	0.9125	0.3192	0.1808
1987	212	261,500	57	231,886	1.1277	4,736	5,841,883	0.0448	79,153	0.3413	3.2994	0.0118	0.8705	0.3080	0.1920
1988	212	261,500	57	231,886	1.1277	5,196	6,409,136	0.0408	84,059	0.3625	3.4183	0.0115	0.9124	0.3192	0.1808
1989	212	261,500	57	231,886	1.1277	5,215	6,432,804	0.0407	83,672	0.3608	3.4091	0.0114	0.9248	0.3224	0.1776
1990	212	261,500	57	231,886	1.1277	5,607	6,916,340	0.0378	96,944	0.4181	3.7179	0.0123	0.8042	0.2894	0.2106
1991	212	261,500	57	231,886	1.1277	6,634	8,183,371	0.0320	117,184	0.5054	4.1572	0.0126	0.7577	0.2757	0.2243
1992	212	261,500	57	231,886	1.1277	4,419	5,450,984	0.0480	70,072	0.3022	3.0709	0.0112	0.9568	0.3306	0.1694
1993	212	261,500	57	231,886	1.1277	9,510	11,730,463	0.0223	162,698	0.7016	5.0436	0.0125	0.7804	0.2825	0.2175
1994	212	261,500	57	231,886	1.1277	5,006	6,174,633	0.0424	84,484	0.3643	3.4285	0.0119	0.8507	0.3026	0.1974
1995	212	261,500	57	231,886	1.1277	10,050	12,396,513	0.0211	169,818	0.7323	5.1724	0.0124	0.7959	0.2870	0.2130
1996	212	261,500	57	231,886	1.1277	7,536	9,295,801	0.0281	120,197	0.5183	4.2198	0.0116	0.9055	0.3174	0.1826
1997	212	261,500	57	231,886	1.1277	11,943	14,731,625	0.0178	197,074	0.8499	5.6464	0.0122	0.8218	0.2944	0.2056
1998	212	261,500	57	231,886	1.1277	9,571	11,805,534	0.0222	143,671	0.6196	4.6873	0.0110	0.9834	0.3373	0.1627
1999	212	261,500	57	231,886	1.1277	7,175	8,849,680	0.0295	137,504	0.5930	4.5678	0.0137	0.6260	0.2344	0.2656
2000	212	261,500	57	231,886	1.1277	4,863	5,998,345	0.0436	75,857	0.3271	3.2178	0.0111	0.9737	0.3348	0.1652
2001	212	261,500	57	231,886	1.1277	4,976	6,137,565	0.0426	76,521	0.3300	3.2343	0.0110	0.9936	0.3397	0.1603
2002	212	261,500	57	231,886	1.1277	3,298	4,067,980	0.0643	49,344	0.2128	2.4978	0.0105	1.0716	0.3580	0.1420
2003	212	261,500	57	231,886	1.1277	8,004	9,873,239	0.0265	139,329	0.6009	4.6034	0.0126	0.7658	0.2782	0.2218
2004	212	261,500	57	231,886	1.1277	6,371	7,858,555	0.0333	116,456	0.5022	4.1419	0.0130	0.7083	0.2607	0.2393
2005	212	261,500	57	231,886	1.1277	11,666	14,390,490	0.0182	205,859	0.8878	5.7933	0.0129	0.7186	0.2639	0.2361
Average	212	261,500	57	231,886	1.1277	8,578	10,581,009	0.0307	140,252	0.6048	4.4977	0.0119	0.8585		0.1965

* Table D-4 "Normal Curve Areas for Standard Normal Variate", taken from *Guidelines for Studies of Potential Eutrophication, Bureau of Reclamation, December 1981.*
Formula for Curve Areas was created and is used to calculate the number

Table D-3

Scofield Reservoir (with Narrows) Eutrophication Study

Phosphorus Content and Probability of Eutrophication

Year	Contents of Scofield Reservoir Jun - Sep Average	Contents of Scofield Reservoir Jun - Sep Average (V)	Surface Area at Volume of Scofield	Surface Area of Scofield (A)	Mean Lake Depth of Scofield (z)	Reservoir Outflow of Scofield	Reservoir Outflow of Scofield (Q_o)	Reservoir Hydraulic Detention Time (t)	Annual Mass Inflow Phosphorus (J)	Areal Phosphorus Loading Rate (L)	Sedimentation Coefficient (s)	Phosphorus in Lake Concentration (P)	Standard Normal Variate (S)	Normal Curve Area (Table D-4)*	Probability of Eutrophication
	AF	m^3	Acres	m^2	m	AF	m^3/yr	yr	g/yr	$g/m^2/yr$		mg/L			
1978	31,101	38,362,523	2,064	8,352,998	4.5927	35,827	44,192,210	0.8681	4,005,622	0.4795	1.7627	0.0358	-0.9625	0.3321	0.8321
1979	31,332	38,647,827	2,074	8,391,825	4.6054	45,190	55,741,368	0.6933	4,004,315	0.4772	1.7547	0.0324	-0.7971	0.2874	0.7874
1980	44,471	54,854,276	2,388	9,663,565	5.6764	52,145	64,320,292	0.8528	5,469,912	0.5660	1.7155	0.0345	-0.9016	0.3164	0.8164
1981	21,670	26,729,688	1,751	7,084,806	3.7728	42,659	52,619,407	0.5080	1,597,747	0.2255	1.2691	0.0185	0.1321	0.0524	0.4476
1982	54,276	66,949,395	2,547	10,309,110	6.4942	53,200	65,621,880	1.0202	13,969,624	1.3551	2.6502	0.0575	-1.7432	0.4594	0.9594
1983	61,584	75,963,415	2,649	10,720,460	7.0858	132,107	162,952,566	0.4662	8,103,646	0.7559	1.7851	0.0271	-0.5043	0.1931	0.6931
1984	63,155	77,900,781	2,671	10,808,744	7.2072	147,059	181,395,663	0.4295	10,768,324	0.9963	2.0794	0.0314	-0.7427	0.2713	0.7713
1985	55,346	68,268,651	2,560	10,361,989	6.5884	86,058	106,151,568	0.6431	7,230,616	0.6978	1.7776	0.0318	-0.7649	0.2779	0.7779
1986	60,146	74,189,600	2,630	10,644,437	6.9698	101,797	125,565,946	0.5908	7,732,351	0.7264	1.7608	0.0302	-0.6795	0.2517	0.7517
1987	45,448	56,060,109	2,410	9,750,953	5.7492	37,075	45,731,605	1.2259	1,977,370	0.2028	0.9302	0.0202	-0.0166	0.0069	0.5069
1988	33,886	41,797,502	2,148	8,692,200	4.8086	38,435	47,409,150	0.8816	2,830,979	0.3257	1.3660	0.0271	-0.5010	0.1919	0.6919
1989	12,650	15,604,025	1,343	5,434,420	2.8713	37,766	46,583,667	0.3350	1,688,336	0.3107	1.8000	0.0226	-0.2026	0.0801	0.5801
1990	9,470	11,681,409	1,185	4,793,772	2.4368	24,399	30,096,404	0.3881	1,676,668	0.3498	2.1260	0.0305	-0.6981	0.2575	0.7575
1991	14,185	17,496,734	1,416	5,728,802	3.0542	32,323	39,870,245	0.4388	3,427,124	0.5982	2.5533	0.0405	-1.1666	0.3782	0.8782
1992	7,800	9,621,214	1,090	4,409,878	2.1817	13,175	16,251,052	0.5920	1,008,887	0.2288	1.7671	0.0303	-0.6881	0.2544	0.7544
1993	41,665	51,392,992	2,331	9,434,126	5.4476	31,531	38,893,661	1.3214	5,059,683	0.5363	1.7027	0.0400	-1.1458	0.3740	0.8740
1994	15,417	19,017,174	1,462	5,915,686	3.2147	42,581	52,523,148	0.3621	1,936,917	0.3274	1.7371	0.0226	-0.2047	0.0809	0.5809
1995	36,553	45,088,000	2,208	8,934,585	5.0465	52,788	65,113,259	0.6925	4,534,401	0.5075	1.7241	0.0317	-0.7628	0.2773	0.7773
1996	33,850	41,753,749	2,140	8,661,770	4.8205	49,140	60,613,377	0.6889	4,118,199	0.4754	1.7045	0.0312	-0.7370	0.2695	0.7695
1997	59,560	73,466,619	2,623	10,613,498	6.9220	44,989	55,493,520	1.3239	6,179,530	0.5822	1.5519	0.0365	-0.9914	0.3392	0.8392
1998	59,334	73,187,778	2,619	10,598,626	6.9054	57,698	71,169,709	1.0284	4,516,513	0.4261	1.2932	0.0272	-0.5101	0.1951	0.6951
1999	52,274	64,479,836	2,519	10,193,102	6.3258	47,941	59,135,096	1.0904	3,936,392	0.3862	1.2850	0.0277	-0.5392	0.2052	0.7052
2000	27,696	34,162,220	1,975	7,992,842	4.2741	45,426	56,032,108	0.6097	2,177,355	0.2724	1.3180	0.0215	-0.1229	0.0488	0.5488
2001	21,171	26,113,926	1,741	7,045,059	3.7067	35,437	43,710,992	0.5974	2,561,160	0.3635	1.6989	0.0291	-0.6181	0.2319	0.7319
2002	9,478	11,691,348	1,192	4,822,494	2.4243	31,210	38,497,045	0.3037	2,077,837	0.4309	2.4112	0.0312	-0.7321	0.2680	0.7680
2003	18,811	23,202,610	1,628	6,589,290	3.5213	36,594	45,138,570	0.5140	2,132,259	0.3236	1.6350	0.0257	-0.4120	0.1598	0.6598
2004	10,253	12,646,422	1,228	4,970,879	2.5441	27,979	34,511,910	0.3664	2,026,313	0.4076	2.2684	0.0321	-0.7793	0.2822	0.7822
2005	49,340	60,860,926	2,475	10,017,120	6.0757	26,053	32,135,696	1.8939	4,473,773	0.4466	1.4335	0.0375	-1.0369	0.3500	0.8500
Average	35,069	43,256,812	2,038	8,247,751	4.8330	50,307	62,052,540	0.7402	4,329,353	0.4922	1.7450	0.0309	-0.6725		0.7353

* Table D-4 "Normal Curve Areas for Standard Normal Variate", taken from *Guidelines for Studies of Potential Eutrophication, Bureau of Reclamation, December 1981.*
Formula for Curve Areas was created and is used to calculate the number

Table D-4 Normal curve areas for values of z (from Mendenhall, 1975)

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0 0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0 0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

Appendix E - Supplemental Information

Phosphorus Data Development

This section is provided to document the development of phosphorus data for Gooseberry Creek and Fish Creek. The Utah State Department of Water Quality collects water quality samples about twice per bi-annually on most Utah streams. The laboratory analytical results from these samples are posted on STORET for public use. In order to estimate phosphorus concentration for the Natural Flow above Narrows Reservoir, all available Total Phosphorus data from Fairview Lakes #2, and Gooseberry Creek above Lower Gooseberry Reservoir were evaluated to generate a composite monthly concentration for all points above Lower Gooseberry Reservoir (see Table E-1). Sample results for Lower Gooseberry Reservoir have been included in Table E-1 to allow comparison of the composite monthly concentrations with the reservoir measurements.

Substantially more data for Fish Creek are available. See Table E-2 for a list of Total Phosphorus at Fish Creek above Scofield Reservoir that is used in this study. A typical monthly distribution was estimated for both Gooseberry Creek and Fish Creek based on all sample results posted on STORET. This typical monthly distribution was used when measured data was not available. Previously the typical monthly distribution was estimated using the procedures outlined in the *State of Utah Scofield Reservoir Phase I Clean Lakes Study, December 1983*. This monthly distribution was based on only 4 years of data. The additional 24 years of data collected since this study was published warranted the update of the monthly distribution.

Table E-3 shows a list of Total Phosphorus at Mud Creek above Scofield Reservoir for 1992 – 2005 and Table E-4 is a list of Total Phosphorus at Pond Town Creek for the same period. As with Fish Creek and Gooseberry Creek, a typical monthly distribution is used when measured data is not available. This typical monthly distribution was generated using all of the available data posted on STORET.

Table E-5 was created to determine whether the model in Table B-2 was accurately predicting the average annual phosphorus concentrations in Scofield Reservoir. Table E-5 contains all of the phosphorus concentration data reported for the Scofield Reservoir in the STORET database. The samples were collected from three sites at various depths. As can be seen in the table the phosphorus concentration can vary by an order of magnitude at different sites for a given month. However, there are months that phosphorus data for the three sites agree very well. The sample results from all three sites have been averaged to estimate a phosphorus concentration for the given month. This monthly data was then used in conjunction with the end of month reservoir contents to determine an actual average reservoir phosphorus concentration that could be compared to the predicted values in Table B-2. The results of the comparison are discussed in the Scofield Reservoir Operation <u>without</u> Narrows Project Section

TABLE E-1
COMPARISON OF TOTAL PHOSPHORUS VALUES AT NARROWS DAMSITE

Date		Fairview Lakes No. 2 mg/L	Fairview Lakes No. 2 Monthly Average	Ab. Lower Gooseberry mg/l	Ab. Lower Gooseberry Monthly Average	Lower Goose abv Dam mg/l	Lower Goose abv Dam Monthly Average	Recommended mg/L
10/31/1980	Phosphorus as P					0.050	0.050	0.050
6/11/1981	Phosphorus as P	0.010		0.010		0.005		
6/11/1981	Phosphorus as P	0.010	0.010		0.010	0.005	0.005	0.010
7/22/1983	Phosphorus as P			0.010	0.010			0.010
6/13/1990	Phosphorus as P	0.019		0.019		0.029		
6/13/1990	Phosphorus as P	0.034	0.027		0.019	0.027	0.028	0.023
8/1/1990	Phosphorus as P	0.053		0.014		0.016		
8/1/1990	Phosphorus as P	0.030	0.042		0.014	0.024	0.020	0.028
6/6/1991	Phosphorus as P			0.019		0.036		
6/6/1991	Phosphorus as P					0.017		
6/6/1991	Phosphorus as P				0.019		0.027	0.019
8/29/1991	Phosphorus as P							
8/29/1991	Phosphorus as P			0.005		0.021		
8/29/1991	Phosphorus as P				0.005	0.005	0.013	0.005
10/7/1991								0.040
6/10/1992	Phosphorus as P	0.005						
6/10/1992	Phosphorus as P	0.012	0.009					0.009
8/18/1992	Phosphorus as P	0.029						
8/18/1992	Phosphorus as P	0.012	0.021					0.021
6/16/1993	Phosphorus as P			0.015		0.019		
6/16/1993	Phosphorus as P				0.015	0.016	0.018	0.015
8/11/1993	Phosphorus as P			0.005		0.014		
8/11/1993	Phosphorus as P				0.005	0.005	0.010	0.005
7/19/1994	Phosphorus as P	0.016						
7/19/1994	Phosphorus as P	0.021	0.019					0.019
8/30/1994	Phosphorus as P	0.023						
8/30/1994	Phosphorus as P	0.020	0.022					0.022
7/1/1995	Phosphorus as P					0.010		
7/6/1995	Phosphorus as P			0.005	0.005	0.010	0.010	0.005
10/3/1995	Phosphorus as P			0.005		0.010		
10/3/1995	Phosphorus as P					0.010		
10/3/1995	Phosphorus as P					0.010		
10/3/1995	Phosphorus as P				0.005	0.010	0.010	0.005
6/25/1996	Phosphorus as P	0.010						
6/25/1996	Phosphorus as P	0.005						
6/25/1996	Phosphorus as P	0.020	0.012					0.012
8/20/1996	Phosphorus as P	0.010						
8/20/1996	Phosphorus as P	0.040	0.025					0.025
6/30/1998	Phosphorus as P	0.010						
6/30/1998	Phosphorus as P	0.010						
6/30/1998	Phosphorus as P	0.010						
6/30/1998	Phosphorus as P	0.010	0.010					0.010
9/1/1998	Phosphorus as P	0.010						
9/1/1998	Phosphorus as P	0.010						
9/1/1998	Phosphorus as P	0.025	0.015					0.015
6/2/1999	Phosphorus as P			0.023		0.021		*
6/2/1999	Phosphorus as P				0.023	0.067	0.044	0.023
8/11/1999	Phosphorus as P			0.025		0.020		
8/11/1999	Phosphorus as P				0.025	0.010	0.010	0.025
6/13/2000	Phosphorus as P	0.010						
6/13/2000	Phosphorus as P	0.010	0.010					0.010
8/9/2000	Phosphorus as P	0.026						
8/9/2000	Phosphorus as P	0.010	0.018					0.018
6/20/2001	Phosphorus as P			0.010	0.010	0.024	0.024	0.010
8/22/2001	Phosphorus as P			0.010	0.010	0.010	0.010	0.010
6/17/2003	Phosphorus as P	0.035				0.010		
6/17/2003	Phosphorus as P	0.010				[illegible]		
6/17/2003	Phosphorus as P	0.029				0.010		
6/17/2003	Phosphorus as P	0.026	0.025	0.010	0.010		0.010	0.018
8/27/2003	Phosphorus as P	0.022	0.022	0.010	0.010	0.020	0.020	0.016
7/5/2005	Phosphorus as P			0.010		0.010		
7/5/2005	Phosphorus as P				0.010	0.025	0.018	0.010
8/23/2005	Phosphorus as P			0.010	0.010	0.010	0.010	0.010
9/20/2005	Phosphorus as P			0.010		0.010		
9/20/2005	Phosphorus as P				0.010	0.010	0.010	0.010

* Measurement at Narrows Dam site.
Note: Non-detect samples have been highlighted. Half the minimum detection limit has been input for non-detect samples.
The recommended column is generated from the Fairview Lakes and Above Lower Gooseberry Res. Data and does not use the Lower Gooseberry above the dam data since this calculation is to determine a phosphorus concentration for the Narrows Reservoir. The phosphorus concentrations measured in Lower Gooseberry Reservoir are included for reference.

TABLE E-2
FISH CREEK ABOVE SCOFIELD RESERVOIR (TOTAL PHOSPHORUS)

Date		mg/L	Monthly Average
6/12/1979	Phosphorus as P	0.03	0.0300
9/25/1979	Phosphorus as P	0.02	0.0200
6/18/1980	Phosphorus as P	0.03	0.0300
7/9/1980	Phosphorus as P	0.02	0.0200
9/18/1980	Phosphorus as P	0.10	0.1000
11/20/1980	Phosphorus as P	0.025	0.0250
1/21/1981	Phosphorus as P	0.025	0.0250
4/2/1981	Phosphorus as P	0.02	
4/21/1981	Phosphorus as P	0.02	
4/28/1981	Phosphorus as P	0.04	0.0267
5/5/1981	Phosphorus as P	0.06	
5/13/1981	Phosphorus as P	0.01	
5/28/1981	Phosphorus as P	0.10	0.0567
6/11/1981	Phosphorus as P	0.01	
6/24/1981	Phosphorus as P	0.06	0.0350
7/8/1981	Phosphorus as P	0.03	
7/22/1981	Phosphorus as P	0.005	0.0050
8/17/1981	Phosphorus as P	0.005	0.0050
9/28/1981	Phosphorus as P	0.01	0.0100
11/3/1981	Phosphorus as P	0.03	0.0300
12/1/1981	Phosphorus as P	0.04	0.0400
5/4/1982	Phosphorus as P	0.15	
5/20/1982	Phosphorus as P	0.15	0.1500
6/3/1982	Phosphorus as P	0.09	
6/15/1982	Phosphorus as P	0.01	
6/30/1982	Phosphorus as P	0.04	0.0467
7/13/1982	Phosphorus as P	0.04	0.0400
7/30/1982	Phosphorus as P	2.3	2.3000
8/19/1982	Phosphorus as P	0.09	0.0900
9/16/1982	Phosphorus as P	0.10	0.1000
10/7/1982	Phosphorus as P	0.06	0.0600
9/6/1983	Phosphorus as P	0.02	0.0200
5/7/1985	Phosphorus as P	0.15	
5/30/1985	Phosphorus as P	0.04	0.0950
6/20/1985	Phosphorus as P	0.02	0.0200
8/14/1985	Phosphorus as P	0.005	0.0050
9/11/1985	Phosphorus as P	0.02	0.0200
9/23/1986	Phosphorus as P	0.08	0.0800
5/6/1987	Phosphorus as P	0.07	
5/21/1987	Phosphorus as P	0.04	0.0550
6/3/1987	Phosphorus as P	0.02	
6/9/1987	Phosphorus as P	0.02	
6/25/1987	Phosphorus as P	0.02	0.0200
8/11/1987	Phosphorus as P	0.03	0.0300
10/14/1987	Phosphorus as P	0.03	0.0300

TABLE E-2
FISH CREEK ABOVE SCOFIELD RESERVOIR (TOTAL PHOSPHORUS)

Date		mg/L	Monthly Average
5/18/1988	Phosphorus as P	0.09	0.0900
8/19/1988	Phosphorus as P	0.0025	
8/19/1988	Phosphorus as P	0.0025	0.0025
5/4/1989	Phosphorus as P	0.031	
5/16/1989	Phosphorus as P	0.0025	
5/16/1989	Phosphorus as P	0.0025	0.0120
6/6/1989	Phosphorus as P	0.006	0.0060
7/3/1989	Phosphorus as P	0.049	0.0490
8/7/1989	Phosphorus as P	0.036	
8/22/1989	Phosphorus as P	0.031	0.0335
9/5/1989	Phosphorus as P	0.016	0.0160
10/24/1989	Phosphorus as P	0.01	0.0100
11/6/1989	Phosphorus as P	0.0025	
11/6/1989	Phosphorus as P	0.0025	0.0025
3/22/1990	Phosphorus as P	0.005	0.0050
5/3/1990	Phosphorus as P	0.031	
5/19/1990	Phosphorus as P	0.04	0.0355
7/25/1990	Phosphorus as P	0.0025	
7/25/1990	Phosphorus as P	0.0025	0.0025
5/21/1991	Phosphorus as P	0.118	0.1180
8/8/1991	Phosphorus as P	0.022	0.0220
6/10/1992	Phosphorus as P	0.005	0.0050
8/18/1992	Phosphorus as P	0.012	0.0120
6/8/1993	Phosphorus as P	0.019	0.0190
8/12/1993	Phosphorus as P	0.035	0.0350
7/13/1994	Phosphorus as P	0.027	
7/18/1994	Phosphorus as P	0.011	0.0190
8/30/1994	Phosphorus as P	0.005	0.0050
6/27/1995	Phosphorus as P	0.01	0.0100
8/30/1995	Phosphorus as P	0.01	0.0100
6/25/1996	Phosphorus as P	0.02	0.0200
8/20/1996	Phosphorus as P	0.005	0.0050
7/2/1998	Phosphorus as P	0.010	0.0100
9/3/1998	Phosphorus as P	0.095	0.0950
8/10/1999	Phosphorus as P	0.032	0.0320
6/13/2000	Phosphorus as P	0.04	0.0400
8/9/2000	Phosphorus as P	0.02	0.0200
8/21/2001	Phosphorus as P	0.028	0.0280
6/6/2002	Phosphorus as P	0.01	0.0100
7/16/2002	Phosphorus as P	0.031	0.0310
8/20/2002	Phosphorus as P	0.071	
8/15/2002	Phosphorus as P	0.01	0.0405

TABLE E-2
FISH CREEK ABOVE SCOFIELD RESERVOIR (TOTAL PHOSPHORUS)

Date		mg/L	Monthly Average
9/17/2002	Phosphorus as P	0.01	0.0100
10/17/2002	Phosphorus as P	0.027	0.0270
11/21/2002	Phosphorus as P	0.06	0.0600
1/21/2003	Phosphorus as P	0.01	0.0100
5/20/2003	Phosphorus as P	0.055	
5/6/2003	Phosphorus as P	0.01	0.0325
6/6/2003	Phosphorus as P	0.01	
6/17/2003	Phosphorus as P	0.01	0.0100
8/26/2003	Phosphorus as P	0.01	0.0100
9/8/2003	Phosphorus as P	0.01	0.0100
10/27/2003	Phosphorus as P	0.01	0.0100
6/29/2004	Phosphorus as P	0.021	0.0210
8/13/2004	Phosphorus as P	0.01	
8/24/2004	Phosphorus as P	0.01	0.0100
10/13/2004	Phosphorus as P	0.01	0.0100
12/15/2004	Phosphorus as P	0.01	0.0100
4/27/2005	Phosphorus as P	0.025	0.0250
5/28/2005	Phosphorus as P	0.061	0.0610
7/5/2005	Phosphorus as P	0.01	0.0100
8/24/2005	Phosphorus as P	0.01	0.0100
9/20/2005	Phosphorus as P	0.01	0.0100

Notes: Non-detect samples have been highlighted.
Half the minimum detection limit has been input for non-detect samples

Table E-3
Mud Creek Above Scofield Reservoir

Date	Phosphorus mg/l	Average (mg/l)
11/20/1980	0.05	0.050
1/21/1981	0.05	0.050
4/21/1981	0.08	
4/28/1981	0.07	0.075
5/5/1981	0.1	
5/13/1981	0.01	
5/28/1981	0.1	0.070
6/11/1981	0.04	
6/24/1981	0.03	0.035
7/8/1981	0.02	
7/22/1981	0.06	0.040
8/10/1981	0.36	
8/17/1981	0.03	
8/31/1981	0.03	0.140
9/28/1991	0.02	0.020
11/3/1981	0.02	0.020
12/1/1981	0.05	0.050
1/12/1982	0.05	0.050
2/17/1982	0.05	0.050
3/23/1982	2.35	Outlier
4/22/1982	0.4	0.400
5/4/1982	1.1	Outlier
5/20/1982	0.29	0.290
6/3/1982	0.22	
6/15/1982	0.1	
6/30/1982	0.12	0.147
7/13/1982	0.07	
7/30/1982	2.9	0.070
8/19/1982	0.15	0.150
9/1/1982	0.15	
9/16/1982	0.05	0.100
10/7/1982	0.25	0.250
9/6/1983	0.04	0.040
3/1/1984	0.08	0.080
1/29/1985	0.03	0.030
5/30/1985	0.13	0.130
6/20/1985	0.01	0.010
8/14/1985	0.01	0.010
9/9/1985	0.01	0.010
1/22/1986	0.03	0.030
9/23/1986	0.01	0.010
5/6/1987	0.09	0.090
6/5/1989	0.32	0.320
7/3/1989	0.093	0.093
8/7/1989	0.038	0.038
9/5/1989	0.034	0.034

Table E-3
Mud Creek Above Scofield Reservoir

Date	Phosphorus mg/l	Average (mg/l)
11/6/1989	0.13	0.130
1/10/1990	0.027	
1/22/1990	0.033	0.030
3/19/1990	0.026	0.026
5/3/1990	0.043	0.043
5/21/1991	0.112	0.078
8/8/1991	0.049	0.049
6/10/1992	0.021	0.021
8/18/1992	0.071	0.071
6/8/1993	0.091	0.091
8/12/1993	0.159	0.159
7/12/1994	0.046	0.046
8/30/1994	0.043	0.043
6/27/1995	0.08	0.080
8/30/1995	0.03	0.030
6/25/1996	0.04	0.040
8/20/1996	0.04	0.040
7/2/1998	0.021	0.021
9/3/1998	0.022	0.022
6/1/1999	0.078	0.078
8/10/1999	0.327	0.327
6/13/2000	0.037	0.037
8/9/2000	0.021	0.021
6/6/2002	0.03	0.030
8/15/2002	0.01	0.010
6/17/2003	0.01	0.010
8/26/2003	0.01	0.01
6/29/2004	0.039	0.039
8/24/2004	0.01	0.010
7/5/2005	0.01	0.010
8/23/2005	0.01	0.010
9/20/2005	0.01	0.010

Notes: Non-detect samples have been highlighted.
Half the minimum detection limit has been input for non-detect samples

Table E-4
Pond Town Creek Above Scofield Reservoir

Date	Phosphorus mg/l	Average (mg/l)
7/4/1978	0.03	0.0300
9/21/1978	0.05	0.0500
6/12/1979	0.05	0.0500
6/18/1980	0.01	0.0100
7/29/1980	0.05	0.0500
9/18/1980	0.1	0.1000
11/20/1980	0.025	0.0250
4/2/1981	0.03	
4/28/1981	0.03	0.0300
5/5/1981	0.15	
5/13/1981	0.01	
5/28/1981	0.1	0.0870
6/11/1981	0.02	
6/24/1981	0.04	0.0300
7/8/1981	0.02	
7/22/1981	0.04	0.0300
8/10/1981	0.6	
8/17/1981	0.03	
8/31/1981	0.03	0.2200
9/28/1981	0.04	0.0400
11/3/1981	0.03	0.0300
12/1/1981	0.03	0.0300
5/20/1982	0.15	0.1500
6/3/1982	0.08	
6/15/1982	0.02	
6/30/1982	0.08	0.0600
7/13/1982	0.06	
7/30/1982	0.25	0.1550
8/19/1982	0.1	0.1000
9/1/1982	0.1	
9/16/1982	0.1	0.1000
9/6/1983	0.02	0.0733
10/12/1983	0.04	0.0400
5/7/1985	0.28	
5/30/1985	0.05	0.1650
6/20/1985	0.01	0.0100
8/14/1985	0.04	0.0400
9/11/1985	0.05	0.0600
9/23/1986	0.07	0.0700
5/6/1987	0.05	
5/21/1987	0.07	0.0600
6/3/1987	0.04	
6/9/1987	0.04	
6/25/1987	0.07	0.0500
8/11/1987	0.07	0.0700
10/14/1987	0.04	0.0400
5/18/1988	0.15	0.1500
8/19/1988	0.1	0.1000
10/6/1988	0.04	0.0400

Table E-4
Pond Town Creek Above Scofield Reservoir

Date	Phosphorus mg/l	Average (mg/l)
5/4/1989	0.014	
5/16/1989	0.27	0.1420
6/5/1989	0.19	
6/6/1989	0.0025	0.0960
7/3/1989	0.091	0.0910
8/7/1989	0.086	
8/22/1989	0.005	0.0910
9/5/1989	0.038	0.0380
10/24/1989	0.02	0.0200
11/6/1989	0.0025	0.0025
1/10/1990	0.026	0.0260
3/22/1990	0.024	0.0240
5/3/1990	0.043	
5/19/1990	0.066	0.0545
7/25/1990	0.0025	0.0025
5/21/1991	0.136	0.1360
8/8/1991	0.036	0.0360
6/10/1992	0.037	
6/10/1992	0.015	0.0260
8/18/1992	0.265	0.2650
6/9/1993	0.042	0.0420
8/11/1993	2.005	Outlier
7/13/1994	0.067	0.0670
8/30/1994	0.057	0.0570
6/27/1995	0.02	0.0200
8/30/1995	0.02	0.0200
6/25/1996	0.03	0.0300
8/20/1996	0.03	0.0300
9/3/1998	0.047	0.0470
6/1/1999	0.065	0.0650
8/10/1999	0.025	0.0250
6/13/2000	0.039	0.0390
8/9/2000	0.034	0.0340
6/20/2001	0.037	0.0370
8/21/2001	0.062	0.0620
6/6/2002	0.057	0.0570
6/17/2003	0.02375	0.0240
6/29/2004	0.048	0.0480
8/24/2004	0.044	0.0440
7/5/2005	0.02	0.0200
8/23/2005	0.01	0.0100
9/20/2005	0.01	0.0100

Notes: Non-detect samples have been highlighted.
Half the minimum detection limit has been input for non-detect samples

TABLE E-5
COMPARISON OF TOTAL PHOSPHORUS VALUES AT SCOFIELD RESERVOIR

Date		SW Perry Boot Camp '04 mg/L	Monthly Average	West Bay '02 mg/l	Monthly Average	South Bay '03 mg/l	Monthly Average	Recommended mg/L
06/12/79	Phosphorus as P			0.020	0.020	0.0200	0.020	0.0200
09/25/79	Phosphorus as P			0.040	0.040	0.0300	0.030	0.0350
06/18/80	Phosphorus as P			0.010		0.0100		
06/18/80	Phosphorus as P			0.010	0.010	0.0100	0.010	0.0100
07/29/80	Phosphorus as P			0.030	0.030	0.0200	0.020	0.0250
09/18/80	Phosphorus as P	0.05		0.070		0.0500		
09/18/80	Phosphorus as P	0.06		0.070		0.0500		
09/18/80	Phosphorus as P	0.05	0.053		0.070		0.050	0.0578
11/20/80	Phosphorus as P	0.025						
11/20/80	Phosphorus as P	0.025						
11/20/80	Phosphorus as P	0.025	0.025					0.0250
05/13/81	Phosphorus as P	0.005		0.010		0.0300		
05/13/81	Phosphorus as P	0.05		0.040		0.0200		
05/13/81	Phosphorus as P	0.01						
05/15/81	Phosphorus as P	0.02						
05/28/81	Phosphorus as P	0.05		0.010		0.0500		
05/28/81	Phosphorus as P	0.04		0.070		0.0300		
05/28/81	Phosphorus as P	0.02						
05/28/81	Phosphorus as P	0.06	0.032		0.033		0.033	0.0323
06/11/81	Phosphorus as P	0.005		0.010		0.0050		
06/11/81	Phosphorus as P	0.01		0.050		0.0100		
06/11/81	Phosphorus as P	0.01						
06/11/81	Phosphorus as P	0.01						
06/24/81	Phosphorus as P	0.03		0.020		0.0300		
06/24/81	Phosphorus as P	0.02		0.020				
06/24/81	Phosphorus as P	0.03		0.040				
06/24/81	Phosphorus as P	0.03	0.018		0.028		0.015	0.0204
07/08/81	Phosphorus as P	0.01		0.040		0.0200		
07/08/81	Phosphorus as P	0.01		0.040		0.0300		
07/08/81	Phosphorus as P	0.01						
07/08/81	Phosphorus as P	0.11						
07/22/81	Phosphorus as P	0.005		0.005		0.0050		
07/22/81	Phosphorus as P	0.005		0.005		0.0050		
07/22/81	Phosphorus as P	0.04						
07/22/81	Phosphorus as P	0.005	0.024		0.023		0.015	0.0206
08/17/81	Phosphorus as P	0.03		0.030		0.0300		
08/17/81	Phosphorus as P	0.04		0.020		0.0300		
08/17/81	Phosphorus as P	0.03						
08/17/81	Phosphorus as P	0.05						
08/31/81	Phosphorus as P	0.1		0.030		0.0100		
08/31/81	Phosphorus as P	0.03		0.010		0.0100		
08/31/81	Phosphorus as P	0.01						
08/31/81	Phosphorus as P	0.02	0.039		0.023		0.020	0.0271
09/28/81	Phosphorus as P	0.03		0.040		0.0400		
09/28/81	Phosphorus as P	0.03		0.050		0.0400		
09/28/81	Phosphorus as P	0.03						
09/28/81	Phosphorus as P	0.04	0.033		0.045		0.040	0.0392
11/03/81	Phosphorus as P	0.01		0.010		0.0100		
11/03/81	Phosphorus as P	0.02		0.020		0.0200		
11/03/81	Phosphorus as P	0.01						
11/03/81	Phosphorus as P	0.02	0.015		0.015		0.015	0.0150
02/17/82	Phosphorus as P	0.05						
02/17/82	Phosphorus as P	0.05						
02/17/82	Phosphorus as P	0.05						
02/17/82	Phosphorus as P	0.07	0.055					0.0550
03/23/82	Phosphorus as P	0.07						
03/23/82	Phosphorus as P	0.05						
03/23/82	Phosphorus as P	0.05						
03/23/82	Phosphorus as P	0.07	0.060					0.0600

TABLE E-5
COMPARISON OF TOTAL PHOSPHORUS VALUES AT SCOFIELD RESERVOIR

Date		SW Perry Boot Camp '04 mg/L	Monthly Average	West Bay '02 mg/l	Monthly Average	South Bay '03 mg/l	Monthly Average	Recommended mg/L
05/20/82	Phosphorus as P	0.05		0.010		0.0600		
05/20/82	Phosphorus as P	0.02		0.050		0.0400		
05/20/82	Phosphorus as P	0.03						
05/20/82	Phosphorus as P	0.05	0.038		0.030		0.050	0.0392
06/03/82	Phosphorus as P	0.03		0.030		0.0300		
06/03/82	Phosphorus as P	0.02		0.030		0.0300		
06/03/82	Phosphorus as P	0.03						
06/03/82	Phosphorus as P	0.04						
06/15/82	Phosphorus as P	0.005		0.010		0.0050		
06/15/82	Phosphorus as P	0.01		0.005		0.1000		
06/15/82	Phosphorus as P	0.01						
06/15/82	Phosphorus as P	0.01						
06/30/82	Phosphorus as P	0.04		0.050		0.1200		
06/30/82	Phosphorus as P	0.07		0.060		0.0700		
06/30/82	Phosphorus as P	0.06						
06/30/82	Phosphorus as P	0.03	0.030		0.031		0.059	0.0399
07/13/82	Phosphorus as P	0.04		0.040		0.0800		
07/13/82	Phosphorus as P	0.04		0.060		0.0700		
07/13/82	Phosphorus as P	0.04						
07/13/82	Phosphorus as P	0.1						
07/30/82	Phosphorus as P	0.67		0.100				
07/30/82	Phosphorus as P	1.5		0.010				
07/30/82	Phosphorus as P	0.1						
07/30/82	Phosphorus as P		0.356		0.053		0.075	0.1611
08/19/82	Phosphorus as P	0.1		0.050				
08/19/82	Phosphorus as P	0.05		0.100				
08/19/82	Phosphorus as P	0.07						
08/19/82	Phosphorus as P	0.25	0.118		0.075			0.0963
09/01/82	Phosphorus as P	0.1		0.100				
09/01/82	Phosphorus as P	0.15		0.100				
09/01/82	Phosphorus as P	0.35						
09/01/82	Phosphorus as P	0.1						
09/06/82	Phosphorus as P			0.180				
09/16/82	Phosphorus as P	0.16		0.100				
09/16/82	Phosphorus as P	0.12						
09/16/82	Phosphorus as P	0.12						
09/16/82	Phosphorus as P	0.29	0.174		0.120			0.1469
10/07/82	Phosphorus as P	0.07		6.190		0.0900		
10/07/82	Phosphorus as P	0.14				0.1600		
10/07/82	Phosphorus as P	0.12						
10/07/82	Phosphorus as P	0.15	0.120				0.125	0.1225
09/07/83	Phosphorus as P	0.02		0.020		0.0200		
09/07/83	Phosphorus as P	0.01		0.020		0.0200		
09/07/83	Phosphorus as P	0.01						
09/07/83	Phosphorus as P	0.02	0.015		0.020		0.020	0.0183
10/12/83	Phosphorus as P	0.03		0.020		0.0400		
10/12/83	Phosphorus as P	0.01		0.040		0.0500		
10/12/83	Phosphorus as P	0.02						
10/12/83	Phosphorus as P	0.03	0.023		0.030		0.045	0.0325
03/01/84	Phosphorus as P	0.03						
03/01/84	Phosphorus as P	0.03						
03/01/84	Phosphorus as P	0.03						
03/01/84	Phosphorus as P	0.03	0.030					0.0300
01/29/85	Phosphorus as P	0.03						
01/29/85	Phosphorus as P	0.02				0.0200		
01/29/85	Phosphorus as P	0.03				0.0500		
01/29/85	Phosphorus as P	0.05	0.033					0.0325
05/30/85	Phosphorus as P	0.13				0.0600		
05/30/85	Phosphorus as P	0.04						
05/30/85	Phosphorus as P	0.03						
05/30/85	Phosphorus as P	0.08	0.070				0.060	0.0650

TABLE E-5
COMPARISON OF TOTAL PHOSPHORUS VALUES AT SCOFIELD RESERVOIR

Date		SW Perry Boot Camp '04 mg/L	Monthly Average	West Bay '02 mg/l	Monthly Average	South Bay '03 mg/l	Monthly Average	Recommended mg/L
06/20/85	Phosphorus as P	0.01				0.0025		
06/20/85	Phosphorus as P	0.01						
06/20/85	Phosphorus as P	0.0025						
06/20/85	Phosphorus as P	0.0025	0.006				0.003	0.0044
08/14/85	Phosphorus as P	0.05				0.0100		
08/14/85	Phosphorus as P	0.02						
08/14/85	Phosphorus as P	0.02	0.030				0.010	0.0200
09/11/85	Phosphorus as P	0.05						
09/11/85	Phosphorus as P	0.05						
09/11/85	Phosphorus as P	0.05						
09/11/85	Phosphorus as P	0.05						
09/14/85	Phosphorus as P		0.050			0.0500	0.050	0.0500
01/22/86	Phosphorus as P	0.02						
01/22/86	Phosphorus as P	0.01						
01/22/86	Phosphorus as P	0.05						
01/22/86	Phosphorus as P	0.04	0.030					0.0300
09/23/86	Phosphorus as P	0.03				0.0400		
09/23/86	Phosphorus as P	0.05						
09/23/86	Phosphorus as P	0.01						
09/23/86	Phosphorus as P	0.03	0.030				0.040	0.0350
02/12/87	Phosphorus as P	0.021				0.0160		
02/12/87	Phosphorus as P	0.015						
02/12/87	Phosphorus as P	0.025						
02/12/87	Phosphorus as P	0.046	0.027				0.016	0.0214
05/06/87	Phosphorus as P	0.03				0.0400		
05/06/87	Phosphorus as P	0.03				0.0400		
05/06/87	Phosphorus as P	0.02						
05/06/87	Phosphorus as P	0.04	0.030				0.040	0.0350
06/24/87	Phosphorus as P	0.02		0.020		0.0300		
06/24/87	Phosphorus as P	0.02		0.050		0.0300		
06/24/87	Phosphorus as P	0.04						
06/24/87	Phosphorus as P	0.05	0.033		0.035		0.030	0.0325
08/11/87	Phosphorus as P	0.02		0.030		0.0200		
08/11/87	Phosphorus as P	0.02		0.060		0.0400		
08/11/87	Phosphorus as P	0.04						
08/11/87	Phosphorus as P	0.21	0.073		0.045		0.030	0.0492
02/04/88	Phosphorus as P	0.02				0.0300		
02/04/88	Phosphorus as P	0.02				0.0700		
02/04/88	Phosphorus as P	0.02						
02/04/88	Phosphorus as P	0.08	0.035				0.050	0.0425
05/18/88	Phosphorus as P	0.11		0.040		0.0500		
05/18/88	Phosphorus as P	0.11		0.070		0.0300		
05/18/88	Phosphorus as P	0.02						
05/18/88	Phosphorus as P	0.06	0.075		0.055		0.040	0.0567
08/19/88	Phosphorus as P	0.02		0.010		0.0200		
08/19/88	Phosphorus as P	0.006		0.090		0.0025		
08/19/88	Phosphorus as P	0.0025						
08/19/88	Phosphorus as P	0.01	0.010		0.050		0.011	0.0236
10/06/88	Phosphorus as P	0.03		0.030		0.0200		
10/06/88	Phosphorus as P	0.02		0.040		0.0400		
10/06/88	Phosphorus as P	0.02						
10/06/88	Phosphorus as P	0.05	0.030		0.035		0.030	0.0317
05/04/89	Phosphorus as P	0.033		0.048		0.0270		
05/04/89	Phosphorus as P	0.031		0.054		0.0210		
05/04/89	Phosphorus as P	0.053						
05/04/89	Phosphorus as P	0.065						
05/15/89	Phosphorus as P	0.042		0.022		0.0200		
05/15/89	Phosphorus as P	0.026		0.027		0.0230		
05/15/89	Phosphorus as P	0.028						
05/15/89	Phosphorus as P	0.012	0.036		0.038		0.023	0.0323

TABLE E-5
COMPARISON OF TOTAL PHOSPHORUS VALUES AT SCOFIELD RESERVOIR

Date		SW Perry Boot Camp '04 mg/L	Monthly Average	West Bay '02 mg/l	Monthly Average	South Bay '03 mg/l	Monthly Average	Recommended mg/L
06/05/89	Phosphorus as P	0.013				0.0180		
06/06/89	Phosphorus as P	0.008		0.005		0.0060		
06/06/89	Phosphorus as P	0.0025		0.015		0.0025		
06/06/89	Phosphorus as P	0.0025						
06/06/89	Phosphorus as P	0.005	0.006		0.010		0.009	0.0083
07/03/89	Phosphorus as P	0.013	0.013			0.0260	0.026	0.0195
08/07/89	Phosphorus as P	0.162				0.1160		
08/22/89	Phosphorus as P	0.045				0.0450		
08/22/89	Phosphorus as P	0.057						
08/22/89	Phosphorus as P	0.071						
08/22/89	Phosphorus as P	0.054	0.078				0.081	0.0792
09/05/89	Phosphorus as P	0.067	0.067			0.0480	0.048	0.0575
10/24/89	Phosphorus as P	0.04						
10/24/89	Phosphorus as P	0.047						
10/24/89	Phosphorus as P	0.049						
10/24/89	Phosphorus as P	0.07	0.052					0.0515
11/06/89	Phosphorus as P	0.031	0.031		0.000	0.0110	0.011	0.0140
01/10/90	Phosphorus as P	0.016						
01/10/90	Phosphorus as P	0.039						
01/25/90	Phosphorus as P	0.041	0.032					0.0320
02/07/90	Phosphorus as P	0.047	0.047					0.0470
03/02/90	Phosphorus as P	0.115						
03/22/90	Phosphorus as P	0.047						
03/22/90	Phosphorus as P	0.037						
03/22/90	Phosphorus as P	0.14						
03/22/90	Phosphorus as P	0.081	0.084					0.0840
04/03/90	Phosphorus as P	0.104	0.104					0.1040
05/03/90	Phosphorus as P	0.044				0.0320		
05/19/90	Phosphorus as P	0.07		0.067		0.0980		
05/19/90	Phosphorus as P	0.089		0.055		0.0630		
05/19/90	Phosphorus as P	0.068						
05/19/90	Phosphorus as P	0.132	0.081		0.061		0.064	0.0686
07/25/90	Phosphorus as P	0.132				0.0025		
07/25/90	Phosphorus as P	0.091				0.0930		
07/25/90	Phosphorus as P	0.0025						
07/25/90	Phosphorus as P	0.104	0.082				0.048	0.0651
11/21/90	Phosphorus as P	0.005	0.005					0.0050
01/09/91	Phosphorus as P	0.05						
01/09/91	Phosphorus as P	0.03	0.040					0.0400
02/07/91	Phosphorus as P	0.039	0.039					0.0390
03/07/91	Phosphorus as P	0.105	0.105					0.1050
04/16/91	Phosphorus as P	0.014						
04/16/91	Phosphorus as P	0.01						
04/16/91	Phosphorus as P	0.031	0.018					0.0183
05/21/91	Phosphorus as P	0.052		0.056		0.0510		
05/21/91	Phosphorus as P	0.076	0.064		0.058	0.0540	0.053	0.0582
08/08/91	Phosphorus as P	0.021				0.0790		
08/08/91	Phosphorus as P	0.027	0.024		0.000		0.079	0.0343
09/24/91	Phosphorus as P	0.068		0.028		0.0350		
09/24/91	Phosphorus as P	0.06		0.051		0.0520		
09/25/91	Phosphorus as P	0.048						
09/25/91	Phosphorus as P	0.036	0.053		0.040		0.044	0.0453
02/25/92	Phosphorus as P	0.052						
02/25/92	Phosphorus as P	0.229	0.141					0.1405
06/10/92	Phosphorus as P	0.018		0.018		0.0340		
06/10/92	Phosphorus as P	0.022	0.020	0.028	0.023	0.0280	0.031	0.0247
08/18/92	Phosphorus as P	0.084						
08/18/92	Phosphorus as P	0.107	0.096					0.0955

TABLE E-5
COMPARISON OF TOTAL PHOSPHORUS VALUES AT SCOFIELD RESERVOIR

Date		SW Perry Boot Camp '04 mg/L	Monthly Average	West Bay '02 mg/l	Monthly Average	South Bay '03 mg/l	Monthly Average	Recommended mg/L
06/08/93	Phosphorus as P	0.017		0.015		0.0180		
06/08/93	Phosphorus as P	0.013				0.0180		
06/08/93	Phosphorus as P	0.013						
06/08/93	Phosphorus as P	0.022						
06/09/93	Phosphorus as P		0.016	0.013	0.014		0.018	0.0161
08/12/93	Phosphorus as P	0.046		0.055		0.0460		
08/12/93	Phosphorus as P	0.049		0.057		0.0490		
08/12/93	Phosphorus as P	0.052						
08/12/93	Phosphorus as P	0.06	0.052		0.056		0.048	0.0518
07/12/94	Phosphorus as P	0.378		0.025		0.1100		
07/12/94	Phosphorus as P	0.017		0.030		0.0830		
07/12/94	Phosphorus as P	0.024						
07/12/94	Phosphorus as P	0.048	0.117		0.028		0.097	0.0803
08/30/94	Phosphorus as P	0.065		0.307		0.0270		
08/30/94	Phosphorus as P	0.049		0.274		0.0330		
08/30/94	Phosphorus as P	0.047						
08/30/94	Phosphorus as P	0.085	0.062		0.291		0.030	0.1273
07/05/95	Phosphorus as P	0.01		0.005		0.0050		
07/05/95	Phosphorus as P	0.01		0.010		0.0100		
07/05/95	Phosphorus as P	0.02						
07/05/95	Phosphorus as P	0.05	0.023		0.008		0.008	0.0125
08/30/95	Phosphorus as P	0.02		0.020		0.0400		
08/30/95	Phosphorus as P	0.04		0.040		0.0300		
08/30/95	Phosphorus as P	0.02						
08/30/95	Phosphorus as P	0.1	0.045		0.030		0.035	0.0367
06/25/96	Phosphorus as P	0.01		0.010		0.0100		
06/25/96	Phosphorus as P	0.005		0.020		0.0200		
06/25/96	Phosphorus as P	0.02						
06/25/96	Phosphorus as P	0.09	0.031		0.015		0.015	0.0204
08/20/96	Phosphorus as P	0.01		0.010		0.0300		
08/20/96	Phosphorus as P	0.01		0.005		0.0500		
08/20/96	Phosphorus as P	0.01						
08/20/96	Phosphorus as P	0.02	0.013		0.008		0.040	0.0200
07/02/98	Phosphorus as P	0.01		0.010		0.0100		
07/02/98	Phosphorus as P	0.01		0.010				
07/02/98	Phosphorus as P	0.03	0.017		0.010		0.010	0.0122
09/03/98	Phosphorus as P	0.031		0.030		0.0310		
09/03/98	Phosphorus as P	0.033	0.032	0.051	0.041	0.0500	0.041	0.0377
06/01/99	Phosphorus as P	0.01		0.010		0.0100		
06/01/99	Phosphorus as P	0.01		0.010		0.0220		
06/01/99	Phosphorus as P	0.01						
06/01/99	Phosphorus as P	0.01	0.010		0.010		0.016	0.0120
08/10/99	Phosphorus as P	0.027		0.024		0.0460		
08/10/99	Phosphorus as P	0.026		0.064		0.0600		
08/10/99	Phosphorus as P	0.078						
08/10/99	Phosphorus as P	0.0261	0.039		0.044		0.053	0.0454
06/13/00	Phosphorus as P	0.021		0.030		0.0250		
06/13/00	Phosphorus as P	0.033		0.028		0.0300		
06/13/00	Phosphorus as P	0.48						
06/13/00	Phosphorus as P	0.021	0.139		0.029		0.028	0.0651
08/09/00	Phosphorus as P	0.093		0.074		0.0920		
08/09/00	Phosphorus as P	0.047		0.082		0.0990		
08/09/00	Phosphorus as P	0.102						
08/09/00	Phosphorus as P	0.034	0.069		0.078		0.096	0.0808
06/20/01	Phosphorus as P	0.028		0.036		0.0350		
06/20/01	Phosphorus as P	0.035		0.075		0.2560		
06/20/01	Phosphorus as P	0.045						
06/20/01	Phosphorus as P	0.179	0.072		0.056		0.146	0.0909
08/21/01	Phosphorus as P	0.109		0.050		0.1070		
08/21/01	Phosphorus as P	0.108		0.071		0.1710		
08/21/01	Phosphorus as P	0.113						
08/21/01	Phosphorus as P	0.126	0.114		0.061		0.139	0.1045

TABLE E-5
COMPARISON OF TOTAL PHOSPHORUS VALUES AT SCOFIELD RESERVOIR

Date		SW Perry Boot Camp '04 mg/L	Monthly Average	West Bay '02 mg/l	Monthly Average	South Bay '03 mg/l	Monthly Average	Recommended mg/L
06/06/02	Phosphorus as P	0.01		0.010		0.0100		
06/06/02	Phosphorus as P	0.01		0.010		0.0210		
06/06/02	Phosphorus as P	0.01						
06/06/02	Phosphorus as P	0.01	0.010		0.010		0.016	0.0118
08/15/02	Phosphorus as P	0.07		0.055				
08/15/02	Phosphorus as P	0.078	0.074		0.055		0.000	0.0430
06/17/03	Phosphorus as P	0.01		0.010		0.0100		
06/17/03	Phosphorus as P	0.01				0.0100		
06/17/03	Phosphorus as P	0.05759						
06/17/03	Phosphorus as P	0.01	0.022		0.010		0.010	0.0140
08/26/03	Phosphorus as P	0.029		0.061		0.0520		
08/26/03	Phosphorus as P	0.041						
08/26/03	Phosphorus as P	0.074						
08/26/03	Phosphorus as P	0.105	0.062		0.061		0.052	0.0584
06/29/04	Phosphorus as P	0.029		0.010		0.0100		
06/29/04	Phosphorus as P	0.025						
06/29/04	Phosphorus as P	0.024						
06/29/04	Phosphorus as P	0.025	0.026		0.010		0.010	0.0153
08/24/04	Phosphorus as P	0.1				0.0340		
08/24/04	Phosphorus as P	0.137	0.119				0.034	0.0763
07/05/05	Phosphorus as P	0.01		0.010		0.0100		
07/05/05	Phosphorus as P	0.01		0.051		0.0100		
07/05/05	Phosphorus as P	0.01						
07/05/05	Phosphorus as P	0.035	0.016		0.031		0.010	0.0189
08/23/05	Phosphorus as P	0.0296		0.035		0.0100		
08/23/05	Phosphorus as P	0.046		0.026		0.0100		
08/23/05	Phosphorus as P	0.029						
08/23/05	Phosphorus as P	0.528	0.158		0.031		0.010	0.0662
09/20/05	Phosphorus as P	0.044		0.050		0.0100		
09/20/05	Phosphorus as P	0.04		0.029		0.0310		
09/20/05	Phosphorus as P	0.032						
09/20/05	Phosphorus as P	0.036	0.038		0.040		0.021	0.0327

Date: 25-Sep-06

Table F-1

Scofield Reservoir (with Narrows) Eutrophication Study

Phosphorus Content and Probability of Eutrophication After Mitigation

Year	Contents of Scofield Reservoir Jun - Sep Average	Contents of Scofield Reservoir Jun - Sep Average (V)	Surface Area at Volume of Scofield	Surface Area of Scofield (A)	Mean Lake Depth of Scofield (z)	Reservoir Outflow of Scofield	Reservoir Outflow of Scofield (Q_o)	Reservoir Hydraulic Detention Time (t)	Annual Mass Inflow Phosphorus (J)	Areal Phosphorus Loading Rate (L)	Sedimentation Coefficient (s)	Phosphorus In Lake Concentration (P)	Standard Normal Variate (S)	Normal Curve Area (Table D-4)*	Probability of Eutrophication
	AF	m^3	Acres	m^2	m	AF	m^3/yr	yr	g/yr	$g/m^2/yr$		mg/L			
1978	31,101	38,362,523	2,064	8,352,998	4.5927	35,827	44,192,210	0.8681	3,390,994	0.4060	1.5980	0.0321	-0.7835	0.2834	0.7834
1979	31,332	38,647,827	2,074	8,391,825	4.6054	45,190	55,741,368	0.6933	3,476,130	0.4142	1.6144	0.0294	-0.6376	0.2382	0.7382
1980	44,471	54,854,276	2,388	9,663,565	5.6764	52,145	64,320,292	0.8528	4,757,181	0.4923	1.5801	0.0315	-0.7504	0.2736	0.7736
1981	21,670	26,729,688	1,751	7,084,806	3.7728	42,659	52,619,407	0.5080	1,417,946	0.2001	1.1829	0.0168	0.2847	0.1120	0.3880
1982	54,276	66,949,395	2,547	10,309,110	6.4942	53,200	65,621,880	1.0202	12,607,697	1.2230	2.4948	0.0542	-1.6460	0.4502	0.9502
1983	61,584	75,963,415	2,649	10,720,460	7.0858	132,107	162,952,566	0.4662	7,231,643	0.6746	1.6693	0.0250	-0.3657	0.1427	0.6427
1984	63,155	77,900,781	2,671	10,808,744	7.2072	147,059	181,395,663	0.4295	9,683,701	0.8959	1.9534	0.0290	-0.6153	0.2309	0.7309
1985	55,346	68,268,651	2,560	10,361,989	6.5884	86,058	106,151,568	0.6431	6,485,585	0.6259	1.6673	0.0295	-0.6409	0.2393	0.7393
1986	60,146	74,189,600	2,630	10,644,437	6.9698	101,797	125,565,946	0.5908	6,913,727	0.6495	1.6485	0.0279	-0.5493	0.2087	0.7087
1987	45,448	56,060,109	2,410	9,750,953	5.7492	37,075	45,731,605	1.2259	1,722,875	0.1767	0.8577	0.0184	0.1408	0.0559	0.4441
1988	33,886	41,797,502	2,148	8,692,200	4.8086	38,435	47,409,150	0.8816	2,400,910	0.2762	1.2397	0.0242	-0.3145	0.1234	0.6234
1989	12,650	15,604,025	1,343	5,434,420	2.8713	37,766	46,583,667	0.3350	1,379,768	0.2539	1.5983	0.0193	0.0596	0.0238	0.4762
1990	9,470	11,681,409	1,185	4,793,772	2.4368	24,399	30,096,404	0.3881	1,424,970	0.2973	1.9318	0.0271	-0.4991	0.1912	0.6912
1991	14,185	17,496,734	1,416	5,728,802	3.0542	32,323	39,870,245	0.4388	3,019,899	0.5271	2.3700	0.0371	-1.0216	0.3464	0.8464
1992	7,800	9,621,214	1,090	4,409,878	2.1817	13,175	16,251,052	0.5920	810,991	0.1839	1.5539	0.0260	-0.4328	0.1674	0.6674
1993	41,665	51,392,992	2,331	9,434,126	5.4476	31,531	38,893,661	1.3214	4,383,288	0.4646	1.5647	0.0367	-1.0042	0.3423	0.8423
1994	15,417	19,017,174	1,462	5,915,686	3.2147	42,581	52,523,148	0.3621	1,628,570	0.2753	1.5684	0.0198	0.0186	0.0077	0.4923
1995	36,553	45,088,000	2,208	8,934,585	5.0465	52,788	65,113,259	0.6925	3,895,978	0.4361	1.5767	0.0286	-0.5909	0.2228	0.7228
1996	33,850	41,753,749	2,140	8,661,770	4.8205	49,140	60,613,377	0.6889	3,563,920	0.4115	1.5654	0.0283	-0.5727	0.2167	0.7167
1997	59,560	73,466,619	2,623	10,613,498	6.9220	44,989	55,493,520	1.3239	5,479,913	0.5163	1.4459	0.0339	-0.8707	0.3080	0.8080
1998	59,334	73,187,778	2,619	10,598,626	6.9054	57,698	71,169,709	1.0284	3,963,717	0.3740	1.1974	0.0250	-0.3658	0.1427	0.6427
1999	52,274	64,479,836	2,519	10,193,102	6.3258	47,941	59,135,096	1.0904	3,449,013	0.3384	1.1887	0.0254	-0.3947	0.1535	0.6535
2000	27,696	34,162,220	1,975	7,992,842	4.2741	45,426	56,032,108	0.6097	1,862,618	0.2330	1.2022	0.0192	0.0689	0.0275	0.4725
2001	21,171	26,113,926	1,741	7,045,059	3.7067	35,437	43,710,992	0.5974	2,230,492	0.3166	1.5660	0.0264	-0.4562	0.1759	0.6759
2002	9,478	11,691,348	1,192	4,822,494	2.4243	31,210	38,497,045	0.3037	1,840,848	0.3817	2.2452	0.0284	-0.5809	0.2195	0.7195
2003	18,811	23,202,610	1,628	6,589,290	3.5213	35,594	45,138,570	0.5140	1,840,848	0.2794	1.4994	0.0230	-0.2330	0.0920	0.5920
2004	10,253	12,646,422	1,228	4,970,879	2.5441	27,979	34,511,910	0.3664	1,723,387	0.3467	2.0620	0.0284	-0.5816	0.2197	0.7197
2005	49,340	60,860,926	2,475	10,017,120	6.0757	26,053	32,135,696	1.8939	3,868,185	0.3862	1.3158	0.0345	-0.8989	0.3156	0.8156
Average	35,069	43,256,812	2,038	8,247,751	4.8330	50,307	62,052,540	0.7402	3,801,957	0.4306	1.6056	0.0280	-0.5083		0.6813

* Table D-4 "Normal Curve Areas for Standard Normal Variate", taken from *Guidelines for Studies of Potential Eutrophication, Bureau of Reclamation, December 1981.*
Formula for Curve Areas was created and is used to calculate the number

Date: September 25, 2006

Table F-2
Flow and Phosphorus Routing WITH Proposed Narrows Project
Scofield Reservoir Operation

Table F-2
Flow and Phosphorus Routing WITH Proposed Narrows Project
Scofield Reservoir Operation

Table F-2
Flow and Phosphorus Routing WITH Proposed Narrows Project
Scofield Reservoir Operation

[illegible]

Year	Month	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1990	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WY Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1991	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WY Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1992	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WY Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1993	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WY Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1994	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WY Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1995	Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WY Total/Average		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Date: September 23, 2008

Table F-2
Flow and Phosphorus Routing WITH Proposed Narrows Project
Scofield Reservoir Operation

Year	Month	Data
	Oct	[illegible]
	Nov	[illegible]
	Dec	[illegible]
1996	Jan	[illegible]
	Feb	[illegible]
	Mar	[illegible]
	Apr	[illegible]
	May	[illegible]
	Jun	[illegible]
	Jul	[illegible]
	Aug	[illegible]
	Sep	[illegible]
WY Total/Average		[illegible]
	Oct	[illegible]
	Nov	[illegible]
	Dec	[illegible]
1997	Jan	[illegible]
	Feb	[illegible]
	Mar	[illegible]
	Apr	[illegible]
	May	[illegible]
	Jun	[illegible]
	Jul	[illegible]
	Aug	[illegible]
	Sep	[illegible]
WY Total/Average		[illegible]
	Oct	[illegible]
	Nov	[illegible]
	Dec	[illegible]
1998	Jan	[illegible]
	Feb	[illegible]
	Mar	[illegible]
	Apr	[illegible]
	May	[illegible]
	Jun	[illegible]
	Jul	[illegible]
	Aug	[illegible]
	Sep	[illegible]
WY Total/Average		[illegible]
	Oct	[illegible]
	Nov	[illegible]
	Dec	[illegible]
1999	Jan	[illegible]
	Feb	[illegible]
	Mar	[illegible]
	Apr	[illegible]
	May	[illegible]
	Jun	[illegible]
	Jul	[illegible]
	Aug	[illegible]
	Sep	[illegible]
WY Total/Average		[illegible]
	Oct	[illegible]
	Nov	[illegible]
	Dec	[illegible]
2000	Jan	[illegible]
	Feb	[illegible]
	Mar	[illegible]
	Apr	[illegible]
	May	[illegible]
	Jun	[illegible]
	Jul	[illegible]
	Aug	[illegible]
	Sep	[illegible]
WY Total/Average		[illegible]
	Oct	[illegible]
	Nov	[illegible]
	Dec	[illegible]
2001	Jan	[illegible]
	Feb	[illegible]
	Mar	[illegible]
	Apr	[illegible]
	May	[illegible]
	Jun	[illegible]
	Jul	[illegible]
	Aug	[illegible]
	Sep	[illegible]
WY Total/Average		[illegible]

Date: September 25, 2006

Table F-2

Flow and Phosphorus Routing WITH Proposed Narrows Project

Scofield Reservoir Operation

NOTE: Average Annual Concentrations are Flow Weighted.

NARROWS PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

APPENDIX G

ENVIRONMENTAL COMMITMENTS

Appendix G

Narrows Project
Final Environmental Impact Statement
Environmental Commitments

When implementing this action, the following specific environmental commitments will be implemented as integral parts of the decision to avoid or minimize adverse effects.

1. Evaluate three previously recorded sites in pool area as to National Register of Historic Places (NRHP) eligibility. Limited testing necessary to evaluate the sites will be accomplished through placing auger holes in a pattern on each site or excavating test units.

2. Inventory for cultural resources any of the pool area, dam construction zone, and road realignments not inventoried in 1979, including ¼-mile zone around pool area that will be impacted by recreational use of the reservoir. In addition to all areas slated for wetlands enhancement, inventory the location of all recreational facilities proposed in the project plan.

3. Inventory for cultural resources the rights-of-way for the proposed East Bench and Oak Creek Pipelines, consisting of 16.1 linear miles of proposed water pipeline near Fairfield in Sanpete County.

4. Inventory for cultural resources and evaluate the existing historic tunnel delivery system on Gooseberry Creek as to its NRHP eligibility.

5. Conduct a cultural resources overview of United States Department of Agriculture Forest Service (USDA Forest Service) information on historic features in and near the project area and evaluate any features within the project area as to their NRHP eligibility.

6. Conduct a paleontological literature search and survey of the project area and its immediate vicinity, with the particular view of assessing the likelihood of recovering Pleistocene fauna during the project (the project area is near the site of the Huntington Mammoth discovery).

7. Consult with the State Historic Preservation Office (SHPO) regarding the NRHP eligibility of any historic or archaeological sites found during work associated with any of the above commitments. If Reclamation and the SHPO jointly reach the conclusion that significant sites will be impacted by the project, the Bureau of Reclamation (Reclamation) will then consult with the SHPO and with the Advisory Council on Historic Preservation to negotiate an memorandum of agreement (MOA) that

outlines mitigation measures to be taken prior to project construction to avoid adverse effects of the project on historic properties.

8. Conduct Class I and Class III cultural resource inventories for the entire area of potential effects, as defined in section 3.16.1, prior to initiation of final design and construction.

9. Conduct consultation with the SHPO and other consulting parties on all findings and determinations made throughout the Section 106 process.

10. In the event that any cultural site, feature, or artifact (historic or prehistoric) is discovered during construction, whether on the surface or as an inadvertent subsurface discovery, construction in the area of discovery shall cease immediately, and it shall be reported immediately to the Provo Area Office archaeologist. Construction in the area of discovery shall not resume until an assessment of the cultural material and an evaluation to determine appropriate actions to prevent loss of significant cultural or scientific value can be made by a professional archaeologist.

11. Any person who knows or has reason to know that he/she has inadvertently discovered possible human remains on Federal land, he/she must provide immediate telephone notification of the discovery to Reclamation's Provo Area Office archaeologist. Work will stop until the proper authorities are able to assess the situation onsite. This action will promptly be followed by written confirmation to the responsible Federal agency official with respect to Federal lands. The Utah SHPO and interested Native American tribal representatives will be promptly notified. Consultation will begin immediately. This requirement is prescribed under the Native American Graves Protection and Repatriation Act (43 Code of Federal Regulations Part 10); and the Archaeological Resources Protection Act of 1979 (16 United States Code 470).

12. Should vertebrate fossils be encountered during ground disturbing actions, construction in the area of discovery must be suspended until a qualified paleontologist can be contacted to assess the find.

13. All construction activities will comply with applicable Federal and State laws, orders, and regulations relating to air and water quality. This will include obtaining proper permits, such as a 402 Storm Water Permit, from the State of Utah, and complying with any limitations imposed by those permits. Best Management Practices, specified in the Nonpoint Source Water Pollution Control Plan for Hydrologic Modification in Utah, will be implemented as a requirement of all construction contracts.

14. All construction contractors will be required to comply with Federal and State laws concerning the use of pesticides and hazardous wastes.

15. The asphalt road surface will be removed from the reservoir basin.

16. All disturbed lands will be re-contoured and re-vegetated using an approved, weed free, native seed mix and appropriate seeding methods. Success of this effort will be evaluated on the basis of percent vegetative cover of the ground surface and level of plant species diversity. The composition of seed mixes will be coordinated with wildlife habitat specialists. Weed control on all disturbed areas will be required.

17. Appropriate steps will be taken to prevent the spread of, and to otherwise control, undesirable plants and animals within areas affected by construction activities. Equipment used for the project will be inspected for reproductive and vegetative parts, foreign soil, mud, or other debris that may cause the spread of weeds, invasive species, and other pests. Such material will be removed before moving vehicles and equipment onto any Federal land. Upon the completion of work, decontamination will be performed within the work area before the vehicle and/or equipment are removed from Federal project lands.

18. Sanpete Water Conservancy District (SWCD) will implement all wildlife measures described in chapter 2 and 3 of the final environmental impact statement (FEIS). SWCD will be responsible for funding and acquiring all lands and easements. SWCD will provide native seed to supplement the USDA Forest Service native seed mixture for the watershed and range improvement project. SWCD will fund and construct all improvements, such as fencing. This work will be performed concurrently with construction of other project facilities such as the dam, tunnel rehabilitation, and pipelines. All lands and rights-of-way will be acquired, and initial construction of wildlife measures will be completed prior to initial filling of the reservoir. SWCD also will be responsible for funding the mitigation monitoring. SWCD will be responsible to enter into MOAs with the Utah Department of Wildlife Resources (UDWR), USDA Forest Service, and other appropriate agencies for all wildlife measures. The MOAs clearly will define the roles and responsibilities of the SWCD, UDWR, USDA Forest Service, and other parties for implementation and maintenance of the wildlife measures.

19. SWCD will implement the wetland mitigation measures described in chapters 2 and 3 of the FEIS. SWCD will be responsible for funding and acquiring all lands and rights-of-way. SWCD will provide and transplant any native plantings needed. SWCD will be responsible to ensure that all fences are in good repair and are maintained properly. SWCD also will be responsible to install and maintain any diversion and/or irrigation facilities. This work will be performed concurrently with construction of other project facilities, such as the dam, tunnel rehabilitation, pipelines, and canals. All lands and rights-of-way will be acquired, and initial construction of wetland measures will be completed prior to initial filling

of the reservoir. SWCD also will be responsible to fund the monitoring of the wetland mitigation. SWCD will be responsible to enter into MOAs with UDWR, United States Army Corps of Engineers (USACE), and other appropriate agencies for all wetland measures. The MOAs will clearly define the roles and responsibilities of SWCD, UDWR, USACE, and other parties for implementation and maintenance of the wetland measures.

20. SWCD will implement all fishery mitigation measures described in chapter 2 and 3 of the FEIS. SWCD will be responsible for funding and acquiring all lands and rights-of-way. SWCD will fund and construct all improvements, such as fencing and stream channel improvements. SWCD will provide water from its water rights or enter into operating agreements for all instream flows described in chapter 2 of the FEIS. This work will be performed concurrently with construction of other project facilities, such as the dam, tunnel rehabilitation, pipelines, and canals. All lands and rights-of-way will be acquired, and initial construction of fishery measures will be completed prior to initial filling of the reservoir. SWCD will be responsible to fund all operation and maintenance costs of mitigation facilities. SWCD will be responsible to enter into a MOA with the UDWR and other appropriate agencies for all fishery measures. The MOA will clearly define roles and responsibilities of SWCD, UDWR, and other parties for implementing, monitoring, and maintaining the fishery measures.

21. SWCD will comply with all existing policies and regulations requiring the preparation, submittal, and implementation of a water conservation plan.

22. A water quality monitoring plan for all project-related features, impacted downstream water bodies, and potential mitigation locations will be developed in coordination with the Utah Division of Water Quality and other parties. Monitoring will begin prior to construction of project facilities and will establish baseline conditions for water quality and phosphorus loading at potential mitigation locations. Monitoring will continue through all phases of construction to determine construction-related impacts, if any. Monitoring also will continue postconstruction to determine the effectiveness of mitigation measures and determine other impacts from operation of the project, if any. SWCD will implement the water quality monitoring plan.

23. SWCD will require all recipients of Narrows Project water to implement conservation practices to be eligible for project water.

24. Re-initiation of the Endangered Species Act Section 7 consultation will be required to discuss additional conservation measures in the event sufficient progress has not been achieved under the Recovery Implementation Program.

25. Prior to design of the Narrows Dam and appurtenant structures, a seismic study, as outlined in the Federal and Utah State Guidelines, will be conducted for the dam and reservoir site that reflects the current standard of care prescribed. Additional geologic field evaluation and assessment of the dam and reservoir site will be completed that address the proximal active faults associated with the site and further characterize the earth materials underlying the dam site, reservoir, and reservoir rim to evaluate their engineering properties to ensure adequate design of features associated with the dam and reservoir. Designs will incorporate maximum accelerations associated with natural and or manmade seismic events that are determined probable to potentially occur in the area. Mitigation for other potential geologic hazards also will be integrated into project design.

26. Prior to dam construction, a reservoir study will be required to determine the possibility of leakage from the reservoir basin into adjacent fault and fissures and into coal veins. This will require drilling or other methods to assess the likely seepage rate into the fault zones through the overlaying material. Permeability testing in the overburden and in the fault zone will be evaluated to assess seepage rates.

27. Standard Reclamation management practices will be applied during construction activities to minimize environmental effects and will be included in construction specifications. Such practices or specifications include sections in the present report on public safety, dust abatement, air pollution, noise abatement, water pollution abatement, waste material disposal, erosion control, archaeological and historical resources, vegetation, and wildlife. All public access roads used during construction will be repaired if needed before construction contractors leave the project area.

28. If the action changes significantly from that described in the FEIS because of additional or new information, or if other construction areas are required outside the areas analyzed in the FEIS, additional environmental analysis will be undertaken if necessary.

29. The SWCD will obtain a Clean Water Act Section 404 permit from the USACE. The USACE regulates all the jurisdictional waters of the United States including jurisdictional wetlands. The conditions and requirements of the 404 permit will be strictly adhered to by SWCD.

30. Best management practices will be implemented to control fugitive dust during construction. The contractor will follow the U.S. Environmental Protection Agency recommended control methods for aggregate storage pile emissions to minimize dust generation, including periodic watering of equipment staging areas, along with dirt and gravel roads. All loads that have the potential of leaving the bed of the truck during transportation will be covered or watered to prevent the generation of fugitive dust. Chemical stabilization will not be allowed.

31. A Utah Pollutant Discharge Elimination System Permit will be obtained by SWCD from the State of Utah before any discharges of water as a point source into any water body.

32. Appropriate measures will be taken to ensure that construction-related sediments will not enter any water bodies either during or after construction.

33. Construction activities will be confined to previously disturbed areas, to the extent practicable. Construction activities occurring within 0.5 mile of raptor nests will be restricted to the hours between 9 a.m. and 4 p.m.

34. Construction sites will be closed to public access. Temporary fencing, along with signs, will be installed to prevent public access.

35. A survey of ground nesting birds will be conducted prior to any ground disturbing activities. This survey will be conducted by a biologist to avoid, to the extent possible, any negative impacts to these birds.