Flow Recommendations to the State Water Resources Control Board

Prepared by:

The California Department of Fish and Game
Water Branch

May 22, 2008

State of California
Department of Fish and Game

Flex your POWER

Memorandum

Date: May 27, 2008

To: Tam Doduc, Chair
State Water Resources Control Board

From: Donald Koch, Director
Department of Fish and Game

Subject: Instream Flow Recommendations Prepared by the Department of Fish and Game. Pursuant to Public Resources Code Section 10000-10005

Pursuant to Public Resources Code (PRC) Section 10001, in the early 1980s the Department of Fish and Game (DFG), in coordination with all regional DFG offices, identified 21 streams and watercourses for which minimum flow levels needed to be established in order to assure the continued viability of stream-related fish and wildlife resources. Over approximately 20 years, DFG investigated the instream flow needs of these listed streams and watercourses. The investigations included field studies, data analyses, and consultations with local, state and federal agencies and interested individuals and organizations. As a result of the investigations, DFG prepared Instream Flow Recommendations for the listed streams.

The attached transmittal summarizes the flow recommendations prepared by DFG pursuant to PRC 10000. Submission of these recommendations to the State Water Resources Control Board (SWRCB), complies with PRC Section 10002. As will be evident upon review, the attached flow recommendations are intended to supplement, but not replace, current administrative records. The attached flow recommendations should not be implemented by SWRCB without further investigation and consideration of all supporting information that would identify constraints or limitations that qualify each recommendation. In addition, as noted on each recommendation, some studies were done many years ago using early methods. DFG has established an administrative file in the Water Branch that contains the resource documents cited in the flow recommendations. We will make these files available to your staff upon request.

If you have any questions regarding this memorandum or the attached flow recommendations, please contact Ms. Annie Manji, at (916) 685-8459 or Mr. Robert Holmes, Instream Flow Coordinator at (916) 324-0838.

Attachment

Preface

Pursuant to Public Resources Code (PRC) Section 10001, in the early 1980s the Department of Fish and Game (DFG) identified 21 streams and watercourses for which minimum flow levels needed to be established in order to assure the continued viability of stream-related fish and wildlife resources. The following list of streams with high priority for the development of flow recommendations was developed in coordination with all DFG regional offices:

Carmel River, Monterey County
Redwood Creek, Marin County
Brush Creek, Mendocino County
Lower American River, Sacramento County
Lagunitas Creek, Marin County
Lake Tahoe Basin, multiple counties
North Fork Feather River, multiple counties
Upper West Fork of the San Gabriel River, Los Angeles County
Yuba River, Yuba County
Rush Creek, Mono County
Lower Mokelumne River, San Joaquin County
Parker Creek, Mono County
South Parker Creek, Mono County
Walker Creek, Mono County
Upper Owens River, Mono County
Lee Vining Creek, Mono County
Merced River, Merced County
Scott Creek, Santa Cruz County
Mill Creek, Mono County
Truckee River Basin, multiple counties
Battle Creek, Shasta and Tehama counties

Over approximately 20 years, DFG investigated the instream flow needs of these listed streams and watercourses. The investigations included field studies, data analyses, and consultations with local, state and federal agencies and interested individuals and organizations. As a result of the investigations, DFG prepared instream flow recommendations for the streams as listed. This transmittal summarizes the streamflow recommendations prepared by DFG.

The following recommendations are organized by date, with the oldest recommendations appearing first. Each recommendation begins with a citation of a document that provides background information. Each recommendation includes a brief statement describing why the stream or watercourse was considered a priority and which flow assessment tools were used.

Many of the earlier recommendations may not reflect the most current understanding or scientific methods due to the development of new assessment tools, completion of additional studies, newly proposed developments, and/or settlement agreements. Given this context, the attached flow recommendations are intended to supplement, but not replace, current administrative records. These flow recommendations should not be implemented by the State Water Resources Control Board without considering all supporting information that might identify constraints or limitations that qualify each recommendation. This would include, but not be limited to, the complete text of the resource documents cited in the flow recommendations. In addition, prior to implementation of any DFG flow recommendation, a literature review should be conducted to identify recent flow studies or analyses so that the best available information is used.

DFG has established an administrative file in the Water Branch that contains all referenced documents.

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Carmel River

Department of Fish and Game, September 1983, Reconnaissance of the Steelhead Resource of the Carmel River Drainage, Monterey County, Environmental Services Branch Administrative Report No. 83-3, 41 pp.

The Carmel River in Monterey County supports one of the largest, self-sustaining populations of steelhead rainbow trout (*Oncorhynchus mykiss*) south of San Francisco Bay. DFG selected the Carmel River as a priority stream for determination of steelhead flow needs because of the economically important sport fishery that it supports. Production of sea-run steelhead adults in the Carmel River has declined by an estimated 75% since San Clemente Dam was built in the 1920's. The decline in steelhead abundance has primarily been attributed to degradation or loss of instream habitat, due to the effects of water diversion from the river to the Monterey Peninsula. Water development in the Carmel River watershed included the addition of Los Padres Dam in 1949.

Based on a Biological Response (i.e. adult steelhead numbers) to Flow Correlation Method, in 1983 DFG recommended the following instream flows for the Carmel River, Monterey County:

- Maintain a minimum perennial flow of 50 cubic feet per second (cfs) from San Clemente Dam to Highway 1 to increase total production of sea-run adult steelhead by an estimated 177%.
- Alternatively, maintain a minimum perennial flow of 25 to 50 cfs from only San Clemente Dam to Tularcitos Creek to increase total production of sea-run adult steelhead by an estimated 29% to 36%.

Please refer to DFG Environmental Services Branch Administrative Report No. 83-3, Reconnaissance of the Steelhead Resource of the Carmel River Drainage, Monterey County, for details of the information collected and analyzed by DFG in support of these recommendations.

Redwood Creek

Department of Fish and Game, March 1984, An Assessment of Coho and Steelhead Resource Requirements in Redwood Creek, Marin County, Environmental Services Branch Administrative Report No 84-1, 19 pp.

DFG entered into an agreement with the Department of Parks and Recreation (DPR) to develop stream flow and fish habitat data for Redwood Creek, Marin County, pertinent to a proposed development within Mount Tamalpias State Park that could include diversion of underflow from Redwood Creek. Redwood Creek supports coho salmon (*Oncorhyncus kisutc*h) and steelhead trout.

Based on a Toe-of-Bank-Width Method, in 1984 DFG recommended the following:

1) The water supply for any further developments within Mount Tamalpias State Park be obtained from Marin Municipal Water District, not Redwood Creek.

2) If underflow from Redwood Creek is the only possible water source, diversion should not occur when natural flow is below 25 cubic feet per second (cfs) in November; below 46 cfs December through April; or below 9 cfs May through October. No diversion shall cause an abrupt reduction in the flow existing on April 1st to 9 cfs on May 1st.

Please refer to the 1984 DFG Assessment of Coho Salmon and Steelhead Resource Requirements in Redwood Creek, Marin County, Environmental Services Branch Administrative Report 84-1 for details of the information collected and analyzed by DFG in support of these recommendations.

Brush Creek

Department of Fish and Game, September 1985, Instream Flow Requirements Brush Creek, Mendocino County, Stream Evaluation Report 85-1, 33 pp.

The instream flow dependent habitat requirements of coho salmon and steelhead trout were evaluated in Brush Creek, Mendocino County pursuant to proposed increases in water diversions. Additional flow diversion could substantially reduce or even eliminate flow in portions of lower Brush Creek, where critical habitat exists. DFG initiated an instream flow study of lower Brush Creek to identify the flow conditions required to optimize and protect the stream's anadromous resources.

Based on an Instream Flow Incremental Methodology assessing Physical Habitat Simulations, fish populations, water temperature modeling and navigability, in 1985 DFG recommended the following instream flow regime, as measured in cubic feet per second (cfs), be implemented in Brush Creek, Mendocino County, downstream of Highway One:

Time Period	Flow in cfs
June 1 - September 30	3
October	8
November 1 – March 31	30
April	15
May	8

Please refer to the 1985 DFG Instream Flow Requirements Brush Creek, Mendocino County Stream Evaluation Report 85-1 for details of the information collected and analyzed by DFG in support of these recommendations.

Lower American River

Department of Fish and Game, March 1986, Instream Flow Requirements Lower American River, Sacramento County, Stream Evaluation Report 86-1, 32 pp.

The lower American River, downstream of Nimbus Dam, sustains a diversity of recreationally and economically important fish and riparian resources, including Chinook salmon (*Oncorhynchus tshawytscha*), steelhead, American shad (*Alosa sapidissima*), and striped bass (*Morone saxatalis*). The importance of the river and its aquatic resources has been recognized by its inclusion in both the state and national wild and scenic river systems. Water development has substantially altered these resources. Proposed increases in water development could reduce or even eliminate natural production if suitable flow dependent habitat is not maintained.

Based on a Biological Response (Chinook salmon, steelhead, American shad, and striped bass numbers) to Flow Correlation Method, in 1986 DFG recommended the following instream flow ranges, as measured in cubic feet per second (cfs), be maintained in the lower American River, Sacramento County:

Time Period	Flow Range in cfs
Oct 15 – Mar 1	1,750 – 4000
Mar 1 – Jul 1	3,000 – 6,000
Jul 1 – Oct 15	1,500

Please refer to the 1986 DFG Instream Flow Requirements Lower American River Sacramento County Stream Evaluation Report 86-1 for details of the information collected and analyzed by DFG in support of these recommendations.

Lagunitas Creek

Department of Fish and Game, April 1986, Instream Flow Requirements Anadromous Salmonids Spawning and Rearing, Lagunitas Creek, Marin County, Stream Evaluation Report 86-2, 40 pp.

Lagunitas Creek, Marin County supports several important aquatic resources. These resources have been adversely affected by alteration of the watershed. Historic steelhead and coho salmon populations have been greatly reduced, as have populations of the endangered freshwater shrimp (*Syncaris pacifica*).

In response to an application to appropriate more Lagunitas Creek water and export it out of basin, DFG conducted an investigation to assess the fish habitat/streamflow relationships within Lagunitas Creek and to develop flow recommendations which would lead to restoration of the anadromous resources.

Based on an Instream Flow Incremental Methodology assessing Physical Habitat Simulations and a synthesized unimpaired hydrology, in 1986 DFG recommended the following instream flow regime, as measured in cubic feet per second (cfs) at Taylor State Park, be implemented in Lagunitas Creek, Marin County:

Time Period	Flow in cfs
Oct 1 – Oct 31	15
Nov 1 – Nov 30	30
Dec 1 – Dec 31	35
Jan 1 – Jan 15	40
Jan 16 – Mar 15	50
Mar 16 – Mar 31	40
Apr 1 – Apr 30	30
May 1 – May 31	15
Jun 1 – Jun 30	12
Jul 1- Sep 30	10

(Note: this is equivalent to a total of 18,267 acre feet in a one year period).

Please refer to the 1986 DFG Instream Flow Requirements Anadromous Salmonids Spawning and Rearing, Lagunitas Creek, Marin County Stream Evaluation Report 86-2 for details of the information collected and analyzed by DFG in support of these recommendations.

Streams in the Lake Tahoe Basin

Department of Fish and Game, April 1987, Instream Flow Requirements Lake Tahoe Basin, Stream Evaluation Report 87-1, 100 pp. (page 1 of 2)

The Lake Tahoe Basin supports a variety of important fishery resources, including rainbow trout (*Oncorhyncus mykiss*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*) and kokanee salmon (*O. nerka*). Most depend upon suitable flow conditions within the Lake's 59 tributaries for required spawning and rearing habitat. Spawning and rearing flow requirements need to be identified in order to incorporate valid flow maintenance objectives into impending, basin wide water management plans.

Based on an Instream Flow Incremental Methodology assessing Physical Habitat Simulations and stream specific habitat preference criteria, in 1987 DFG recommended the following instream flow requirements for tributaries within the Lake Tahoe Basin:

Tributary	**Time period**	**Flow requirement**
Burton Creek (representing medium sized streams in the northwestern portion of the Tahoe Basin)	Year round	Natural flow
Wood Creek (NV Stream) (representing small streams in the northern portion of the Tahoe Basin)	Apr 1- Jul 15	6 cubic feet per second (cfs)
Wood Creek (NV Stream)	Jul 16 – Mar 31	3 cfs
Third Creek (NV Stream) (representing medium sized streams in the northern portion of the Tahoe Basin).	Apr 1- Jul 15	12-14 cfs
Third Creek (NV Stream)	Jul 16 – Mar 31	Natural flow
Trout Creek (extra large stream)		
Trout Creek Segment 1 (low gradient, rainbow and brown trout)	Apr 1 – Jul 15	30 cfs
Trout Creek Segment 1	Jul 16 – Mar 31	30 cfs
Trout Creek Segment 2 (low gradient, rainbow and brook trout)	Apr 1 – Jul 15	30 cfs
Trout Creek Segment 2	Jul 16 – Mar 31	15 cfs
Trout Creek Segment 3 (high gradient, rainbow trout)	Apr 1- Jul 15	Natural flow
Trout Creek Segment 3	Jul 16 – Mar 31	20 cfs
Upper (U.) Truckee River (extra large stream)		
U. Truckee River Segment 1 (low gradient, meadow)	Oct 1 – Jul 15	120 cfs

Department of Fish and Game, April 1987, Instream Flow Requirements Lake Tahoe Basin, Stream Evaluation Report 87-1, 100 pp. (page 2 of 2)

U. Truckee River Segment 1	Jul 16 – Sep 30	40 cfs
U. Truckee River Segment 2 (low gradient, wide channel)	Apr 1- Jul 15	140 cfs
U. Truckee River Segment 2	Jul 16 – Sep 30	20 cfs
U. Truckee River Segment 2	Oct 1 – Mar 31	40 cfs
U. Truckee River Segment 3 (low gradient, narrow channel)	Apr 1- Jul 15	80 cfs
U. Truckee River Segment 3	Jul 16 – Mar 31	30 cfs
U. Truckee River Segment 4 (low gradient)	Apr 1 – Jul 15	140 cfs
U. Truckee River Segment 4	Jul 16 – Mar 31	100 cfs
Taylor Creek (extra large stream with kokanee)	Apr 1- Jun 30	90 cfs
Taylor Creek	Jul 1- Sep 17	20 cfs
Taylor Creek	Sep 16 – Mar 31	30 cfs
General Creek (large stream on western portion of the Tahoe Basin)	Apr 1 – Jul 15	45 cfs
General Creek	Jul 16 – Sep 30	15 cfs
General Creek	Oct 1 – Mar 31	25 cfs
McKinney Creek (representing medium sized streams on western portion of Tahoe Basin)		
McKinney Creek Segment 2 (moderate gradient)	Apr 1 – Jul 15	45 cfs
McKinney Creek Segment 2	Jul 16 – Mar 31	40 cfs
McKinney Creek Segment 3 (high gradient)	Apr 1- Jul 15	25 cfs
McKinney Creek Segment 3	Jul 16 – Mar 31	5 cfs
Ward Creek (large stream on the western portion of the Tahoe Basin)	Apr 1 – Jul 15	60 cfs
Ward Creek	Jul 16 – Mar 31	35 cfs

Please refer to the DFG 1987 Instream Flow Requirements Lake Tahoe Basin Stream Evaluation Report 87-1 for details of the information collected and analyzed by DFG in support of these recommendations.

North Fork Feather River

Department of Fish and Game, August 1987, North Fork Feather River Fisheries Management Plan, 51 pp.

The North Fork Feather River is the main tributary of the Feather River system which is a major tributary of the Sacramento River. The North Fork Feather River originates on the southeast slopes of Mt. Lassen and flows south for approximately 101 kilometers before reaching Lake Oroville in Butte County. The North Fork Feather River was once recognized as a prime trout stream. The trophy rainbow trout fishery was severely impacted by reduced stream flows and stream fluctuations associated with completion of hydroelectric developments owned and operated by Pacific Gas and Electric Company (PG&E) in the 1950s. In July of 1980, PG&E agreed to conduct a six year study of the North Forth Feather River stream sections impacted by their hydroelectric projects and to determine necessary mitigation measures.

Based in part on information obtained from that effort (an Instream Flow Incremental Methodology assessing Physical Habitat Simulations and water temperature modeling), in 1987 DFG recommended the following instream flows as measured in cubic feet per second (cfs), be maintained in the North Fork Feather River:

The minimum flow release from Rock Creek dam shall be 260 cfs, all year.
The minimum flow release from Cresta Dam shall be 325 cfs, all year.

Please refer to the 1987 North Fork Feather River Fisheries Management Plan for details of analysis performed by DFG in support of these recommendations.

West Fork San Gabriel River

US Forest Service, Los Angeles County Department of Public Works, Department of Fish and Game, California Trout, Main San Gabriel Basin Watermaster, San Gabriel Valley Protective Association and San Gabriel River Water Committee, May 1989, Long-Term Management Plan, West Fork San Gabriel River, 16 pp.

The West Fork of the San Gabriel River supports the most important coldwater fishery in Los Angeles County. It sustains a catch and release and special-regulations-only fishery in the upper section and a put-and-take fishery in the lower portion. It also is home to the federally threatened Santa Ana sucker, two fish species of special concern (speckled dace and the arroyo chub) and a population of western pond turtles (also a special concern species).

The fisheries habitat provided by the West Fork of the San Gabriel River has been degraded by flood control activities, overuse by the recreating public and major wildfires. The private consulting firm, Trihey and Associates was contracted to perform an instream flow study to determine the flow needs of the native aquatic species. Based on the results of that flow study which entailed an Instream Flow Incremental Methodology assessing Physical Habitat Simulations and water temperature modeling, in 1989 DFG cooperated with multiple other stakeholders in the preparation of a Long-Term Management Plan which included the following flow recommendations:

Month	Normal Water Year Release in cfs	Dry Water Year Release in cfs
January	10	3
February	10	3
March	10	3
April	10	3
May	10	3
June	15	5
July	20	10
August	20	10
September	15	10
October	15	5
November	10	5
December	10	3

Please refer to the 1989 Long-Term Management Plan, West Fork San Gabriel River for details of the information collected and analyzed by DFG in support of these recommendations.

Lower Yuba River

Department of Fish and Game, February 1991, Lower Yuba River Fisheries Management Plan, 197 pp.

The lower Yuba River between Englebright Dam and its confluence with the Feather River near Marysville (approximately 24 river miles), is recognized as a significant producer of naturally spawned salmon and steelhead and was once known nationwide for its outstanding shad fishery. Water developments and diversions have had significant impacts on fisheries of the Yuba River. Flow reductions have affected salmon reproduction, growth and migration and shad attraction, passage and spawning. In an effort to develop solutions to fisheries problems in the Yuba River, data on stream temperature, flow-habitat relationships, water quality, fish populations, fish passage, fish growth, riparian habitat and impacts of diversions was collected under contract to DFG.

As a result of the above research and an Instream Flow Incremental Methodology, in 1991 DFG recommended the following instream flows as measured in cubic feet per second (cfs), be maintained in lower Yuba River:

Time Period	Minimum Flow at Marysville gage in cfs
Oct 1-14	450
Oct 15 – 31	700
Nov 1 – Mar 31	700
April	1,000
May	2,000
June	1,500
July	450
August	450
September	450

Please refer to the 1991 Lower Yuba River Fisheries Management Plan for details of the information collected and analyzed by DFG in support of these recommendations.

Rush Creek

Department of Fish and Game, August 1991, Rush Creek Stream Evaluation Report 91-2, Volume 1, 115 pp. (page 1 of 2)

Rush Creek is Mono Lake's largest tributary and, as such, historically provided the greatest contribution to maintaining the lake. Rush Creek has a long history of water diversions for agricultural, municipal and industrial purposes. Since 1941 water was diverted and transferred out of the Rush Creek drainage to the Los Angeles metropolitan area for municipal and industrial uses. This resulted in the virtual desiccation of lower Rush Creek, degradation of riparian vegetation and elimination of trout populations.

In the early 1980s, wetter than average hydrologic conditions resulted in uncontrolled spills past Grant Lake dam into lower Rush Creek and the reestablishment of riparian and aquatic habitats. By the mid 1980s less wet conditions threatened to desiccate the stream again. A lawsuit was filed to require the Los Angeles Department of Water and Power to release sufficient water into lower Rush Creek to maintain the aquatic resources that had re-colonized the stream. The Mono County Superior Court of California granted a preliminary injunction and mandated that 19 cubic feet per second (cfs) be maintained in lower Rush Creek, pending trial. The court also requested DFG to participate in a cooperative investigation to identify the instream flow needs to maintain Rush Creek's fish population.

Based on an Instream Flow Incremental Methodology assessing habitat typing, hydrology, stream specific habitat suitability, Physical Habitat Simulations, fish populations and water temperature modeling, in 1991 DFG recommended the following instream flows as measured in cubic feet per second (cfs), be maintained in lower Rush Creek, Mono County:

	Dry water years	Normal water years	Wet water years
Month	**Flow in cfs**	**Flow in cfs**	**Flow in cfs**
Apr	35	59	84
May	75	100	100
Jun	72	100	100
Jul	45	100	100
Aug	42	93	100
Sep	40	69	100
Oct	36	58	93
Nov	30	40	71
Dec	30	40	71

Department of Fish and Game, August 1991, Rush Creek Stream Evaluation Report 91-2, Volume 1, 115 pp. (page 2 of 2)

Jan	31	44	57
Feb	32	48	54
Mar	34	52	54

Please refer to the 1991 Rush Creek Stream Evaluation Report 91-2 for details of the information collected and analyzed by DFG in support of these recommendations.

Lower Mokelumne River

Department of Fish and Game, November 1991, Lower Mokelumne River Fisheries Management Plan, 245 pp. (page 1 of 2)

The lower Mokelumne River between Camanche Dam and its confluence with the Sacramento-San Joaquin Delta (approximately 64 river miles) is identified by DFG as a reach of considerable importance for restoration and maintenance of Chinook salmon and steelhead trout.

Based on an Instream Flow Incremental Method assessing habitat typing, comparison of historic and existing hydrology, Physical Habitat Simulations, fish population, food availability, and water temperature modeling, in 1991 DFG recommended the following instream flows as measured in cubic feet per second (cfs), be maintained in the lower Mokelumne River:

Time Period	Minimum flow (cfs) at Highway 99	Minimum flow (cfs) At Woodbridge
Normal water years		
Oct 15 – Feb 29	300*	300
Mar 1 – Mar 31	350	350
Apr 1 – Apr 30	400+	400
May 1 – May 31	450	450
Jun 1 – Jun 30	400	400
Jul 1 – Jul 31	150	150
Aug 1 – Sep 30	100	100
Oct 1 – Oct 14	250	250
Dry water years		
Nov 1 – Mar 31	200	200
Apr 1 – Apr 14	200	200
Apr 15- Apr 30	250	250
May 1 – May 31	300	300
Jun 1 – Sep 30	200	20
Oct 1 – Oct 31	100	20
Wet water years		
Oct 15 – Feb 29	350	350
Mar 1 – Mar 31	400	400
Apr 1 – May 31	450	450
Jun 1 – Oct 14	300	300

* Attraction flow in addition 10/1-11/15 to be 20,000 acre-feet (AF) below Camanche Dam and Woodbridge Dam during wet and normal water years, 10,000 AF during dry years.

Department of Fish and Game, November 1991, Lower Mokelumne River Fisheries Management Plan, 245 pp. (page 2 of 2)

[+] Out migration flow in addition 4/1-6/30 to be 10,000 AF below Camanche Dam and Woodbridge Dam during wet and normal water years and 5,000 AF during dry years.

Please refer to the Lower Mokelumne Fisheries Management Plan for details of the information collected and analyzed by DFG in support of these recommendations.

Parker Creek

Department of Fish and Game, December 1992, Parker Creek Stream Evaluation Report 92-2, Volume 1, 125 pp.

Parker Creek, Mono County, is a tributary of Rush Creek which flows into Mono Lake. The Californian Legislature in 1989 provided funds to DFG to investigate the aquatic and riparian conditions of Parker Creek and other diverted Mono Basin streams. In 1990 the California Superior Court in and for the County of El Dorado (Court) ordered interim flow releases into Parker Creek of 6 cubic feet per second (cfs) October 1 through March 31 and 9 cfs April 1 through September 30. The Court also ordered 23 cfs channel maintenance flow releases to Parker Creek during even years when April to March runoff is forecasted on April 1 to equal or exceed the Mono Basin average annual runoff for the period of 1937 to present. These releases are to occur during a 30 day period starting no earlier than May 1 and no later than July 1. During drier years, releases are to occur for only 3 days, for channel flushing purposes only.

The Court-ordered flows initiated natural recovery of aquatic and riparian habitats in Parker Creek. DFG entered into contracts to evaluate what restoration measures, including instream flow regimes, are necessary to restore and optimize environmental conditions in degraded portions of lower Parker Creek.

Based on modeling of sediment transport and hydrology and subsequent correlation with fish population, water temperature and riparian habitat conditions, in 1992 DFG concluded the current flow regime of 6 cfs from October 1 through March 31 and 9 cfs from April 1 through September 30 would continue to provide productive fish habitat until such time as a more refined flow regime for the watershed was developed. DFG's recommended flow regime differed from the Court-ordered regime only in the flushing/channel maintenance portion. DFG recommended that the flushing flow be for 25 to 40 cfs lasting only 1 to 4 days after certain channel modifications were made.

Please refer to the Parker Creek Stream Evaluation Report 92-2 for details of the information collected and analyzed by DFG in support of these recommendations.

South Parker Creek

Department of Fish and Game, December 1992, South Parker Creek Stream Evaluation Report 92-3, Volume 1, 50 pp.

South Parker Creek, Mono County, is a tributary of Rush Creek which flows into Mono Lake. Diversion of South Parker Creek flows between 1948 and 1990 dewatered the stream channel except during periods of excessive natural runoff or local irrigation. The lack of water eliminated aquatic habitats and biological resources and desiccated riparian habitats.

The Californian Legislature in 1989 provided funds to DFG to investigate the aquatic and riparian conditions of South Parker Creek and other diverted Mono Basin streams. Geomorphic, hydrologic, aquatic and riparian studies of South Parker Creek indicated the habitat and resource losses that had occurred could be restored. In the 1992 South Parker Creek Stream Evaluation Report 92-3, DFG concluded the closure of the South Parker Creek conduit diversion (i.e. the diversion of 0 cubic feet per second (cfs)) should continue with the natural hydrology (averaging 1.6 cfs annually) restored to South Parker Creek.

Please refer to the South Parker Creek Stream Evaluation Report 92-3 for details of the information collected and analyzed by DFG in support of these recommendations.

Walker Creek

Department of Fish and Game, December 1992, Walker Creek Stream Evaluation Report 92-1, Volume 1, 124 pp.

Walker Creek, Mono County, is a tributary of Rush Creek which flows into Mono Lake. The Californian Legislature in 1989 provided funds to DFG to investigate the aquatic and riparian conditions of Walker Creek and other diverted Mono Basin streams. In 1990 the California Superior Court in and for the County of El Dorado (Court) ordered interim flow releases into Walker Creek of: 4.5 cubic feet per second (cfs) October 1 through March 31 and 6 cfs April 1 through September 30. The Court also ordered 15 cfs channel maintenance flow releases to Walker Creek during even years when April to March runoff is forecasted on April 1 to equal or exceed the Mono Basin average annual runoff for the period of 1937 to present. These releases are to occur during a 30 day period starting no earlier than May 1 and no later than July 1. During drier years, releases are to occur for only 3 days, for channel flushing purposes only.

The Court-ordered flows initiated natural recovery of aquatic and riparian habitats in Walker Creek. DFG entered into contracts to evaluate what restoration measures, including instream flow regimes, are necessary to restore and optimize environmental conditions in degraded portions of Walker Creek.

Based on modeling of sediment transport and hydrology and subsequent correlation with aquatic and riparian habitat conditions, in 1992 DFG concluded the current flow regime of 4.5 cfs from October 1 through March 31 and 6 cfs from April 1 through September 30 would continue to provide productive fish habitat until such time as a more refined flow regime for the watershed was developed. DFG's recommended flow regime differed from the Court-ordered regime only in the flushing/channel maintenance portion. DFG recommended that the flushing flow be for 15 to 30 cfs lasting only 1 to 4 days after certain channel modifications were made.

Please refer to the Walker Creek Stream Evaluation Report 92-1 for details of the information collected and analyzed by DFG in support of these recommendations.

Upper Owens River

Department of Fish and Game, June 1993, Upper Owens River Stream Evaluation Report 93-1, Volume 1, 248 pp.

Mono Basin water was diverted from Grant Lake through Mono Craters Tunnel to East Portal and into the upper Owens River between 1941 and 1989. This diversion increased average upper Owens River flow just below East Portal from a baseline of 76 to 168 cubic feet per second (cfs). The increased river flow resulted in channel erosion, widening and straitening, and lead to the construction of artificial channels to bypass the additional high flows. DFG entered into contracts to evaluate the instream flows necessary to optimize conditions in the upper Owens River between East Portal and Lake Crowley, including maximizing habitat area for brown trout and rainbow trout given several constraints, including the availability of water.

Based on an Instream Flow Incremental Method assessing sediment transport and hydrologic modeling, Physical Habitat Simulations, fish habitat criteria, water temperature, bentho-macroinvertebrates and riparian habitat conditions, in 1993 DFG concluded baseline flow conditions should allow for self-perpetuating population of brown and rainbow trout in the upper Owens River. However, the flow regime that would maximize conditions for brown and rainbow trout in the upper Owens River is 200 cfs, just below East Portal, all year. Given that water is not available for such release, DFG recommended a constant release of augmentation flows from Grant Lake based on the water that is available over the year starting July 1, as long as bypass ditches are operated, restoration is preserved, meanders are not cut off, conditions for fish are not otherwise degraded, and such releases do not cause the upper Owens River just below East Portal or the Hot Creek confluence to exceed 200 or 270 cfs, respectively. Absent augmentation, the recommendation was to maintain supplies that provide the baseline flow conditions in the upper Owens River.

Please refer to the Upper Owens River Stream Evaluation Report 93-1 for details of the information collected and analyzed by DFG in support of these recommendations.

Lee Vining Creek

Department of Fish and Game, July 1993, Lee Vining Creek Stream Evaluation Report 93-2, Volume 1, 183 pp.

Lee Vining Creek, Mono County, has a long history of alteration and environmental damage. In 1990, the El Dorado Superior Court ordered steps to be taken to begin to restore pre-1941 aquatic conditions to benefit the fishery of Lee Vining Creek. DFG entered into contracts to evaluate the instream flows necessary to restore and maintain the creek's former level of productivity.

Based on an Instream Flow Incremental Method assessing existing data on aquatic habitat, historic and existing hydrology, weighted usable area and stream discharge relationships, fish populations, fluvial geomorphology, water temperature, riparian vegetation, ice formation and fish food availability, in 1993 DFG recommended the following instream flows as measured in cubic feet per second (cfs), be maintained in lower Lee Vining Creek, Mono County:

	Dry water years	Normal water years	Wet water years
Month	**Flow in cfs**	**Flow in cfs**	**Flow in cfs**
Apr	37	54	54
May	37	54	95
Jun	37	54[a]	95[b]
Jul	37	54	95
Aug	37	54	95
Sep	37	54	54
Oct	25	40	40
Nov	25	40	40
Dec	25	40	40
Jan	25	40	40
Feb	25	40	40
Mar	25	40	40

[a] A channel flushing flow of 160 cfs for a minimum of 3 consecutive days during June is recommended. The channel flushing period should be extended as water is available.

[b] A channel flushing flow of 160 cfs for 30 consecutive days during late-May, June and July is recommended.

Please refer to the Lee Vining Creek Stream Evaluation Report 93-2 for details of the information collected and analyzed by DFG in support of these recommendations.

Merced River

Department of Fish and Game, 1994 Draft, Merced River Fish Flow Requirement Investigation Phase 1, 30 pp.

The Merced River is presently the southernmost stream used by Chinook salmon in the San Joaquin River basin. Historically the Merced River supported spring-run and fall-run Chinook salmon and steelhead. The Chinook salmon populations have declined far below historic levels, in part due to water developments. Spawning and rearing habitat in the lower Merced River is considered the most degraded among San Joaquin basin tributaries.

Based on an Instream Flow Incremental Method assessing Physical Habitat Simulations and habitat suitability criteria developed on the Stanislaus and Feather Rivers, in 1994 DFG recommended the following instream flows in cubic feet per second (cfs) be provided in the lower Merced River for five Water Year types*:

Time Period	Critical	Dry	Below Normal	Above Normal	Wet
Oct 1 – 14	200	225	250	275	300
Oct 15 – Dec 31	250	275	300	325	350
Jan 1 – Mar 31	200	250	300	375	350
Apr 1- May 31**	300	350	400	350	500
Jun 1 – Sep 30	200	200	250	300	350

* Water Year types based on the 60-20-20 index for the San Joaquin basin developed by the Water Year Classification Subgroup and adopted by the SWRCB in draft Decision 1630, December 1992.

** Additional spring out-migration flows (April and May) needed are:

Critical WY: 30 days at 340 cfs
Dry WY: 30 days at 680 cfs
Below Normal WY: 30 days at 1,020 cfs

Please refer to the 1994 DFG Draft Merced River Fish Flow Requirement Investigation Phase 1 for details of the information collected and analyzed by DFG in support of this recommendation.

Scott Creek

Department of Fish and Game, April 1995, Stream Flow and Habitat Evaluation Program Report, The Relationship Between Instream Flow and Coho Salmon and Steelhead Habitat Availability in Scott Creek, Santa Cruz County, California. 48 pp.

Scott Creek in Santa Cruz County is determined to be of particular concern as it represents the southern most drainage where there exists a self-sustaining population of coho salmon. It also supports a self-sustaining population of steelhead, provides habitat for several sensitive species including tidewater goby, and provides habitat for many other aquatic species, both vertebrate and invertebrate, indigenous to the central coastal area of California.

Located in the northern portion of Santa Cruz County, Scott Creek has historically been a perennial stream throughout its drainage. However, in the late 1980's starting in 1987, the lower 0.5 mile of Scott Creek was de-watered on several occasions killing about 1400 juvenile coho salmon and steelhead outright and degrading water quality in the lagoon, which also took an unknown toll on the populations. The dewatering event was due to an instream diversion and two wells that were diverting water for agriculture. The most significant deficiencies in flow condition occurring between June and November. Then, in December 1992, a water right application was filed with the State Water Resources Control Board to appropriate water via subsurface diversions adjacent to lower Scott Creek. DFG protested that application based upon the impacts on Scott Creek's anadromous fish populations attributed to existing diversions. The results of the Physical Habitat Simulation presented in the Scott Creek report are intended to be used to develop dismissal terms in the form of flow requirements.

In 1995 DFG recommended the following instream flow regime, measured in cubic feet per second:

Time Period	Flow in cfs
Jan 1 – March 31	40
April 1- April30	25
May 1-May 31	10
June 1-October 31	6
Nov 1- Nov 30	8
Dec 1- Dec 31	12

Please refer to the 1995 DFG Stream Flow and Habitat Evaluation Program Report, The Relationship between Instream Flow and Coho Salmon and Steelhead Habitat Availability in Scott Creek, Santa Cruz County California, for details of the information collected and analyzed by DFG in support of these recommendations.

Mill Creek

Department of Fish and Game, July 1996, Mill Creek Stream Evaluation Report 96-1, Volume 1, 163 pp.

Mill Creek, Mono County originates near the Sierra Nevada Crest and is tributary to Mono Lake. Multiple agencies including DFG, the California Department of Parks and Recreation, the US Fish and Wildlife Service, the Bureau of Land Management and the US Forest Service are committed to developing and maintaining aquatic and riparian habitats in the Mono Basin.

Based on an Instream Flow Incremental Method assessing Physical Habitat Simulations and data on hydrology, geomorphology, water temperature, ice formation, migration barriers, trout populations, bentho macro-invertebrates and riparian habitat, in 1996 DFG recommended the following instantaneous instream flows as measured in cubic feet per second (cfs), be maintained in Mill Creek between Upper Thompson Ditch and Mono Lake:

Time Period	**Minimum flow (cfs)**
Normal water years	
April 1 – Apr 30	17
May 1 – Sep 30	20
Oct 1 – Oct 31	17
Nov 1 - Mar 31	15
Dry water years	
Apr 1 – Apr 30	15
May 1 – Sep 30	16
Oct 1 – Oct 31	15
Nov 1 – Mar 31	13
Wet water years	
Apr 1 – Apr 30	23
May 1 – Sep 30	27
Oct 1 – Oct 31	23
Nov 1 – Mar 31	22

Please refer to the Mill Creek Stream Evaluation Report 96-1 for details of the information collected and analyzed by DFG in support of these recommendations.

Truckee River

Department of Fish and Game, 1996, Instream Flow Requirements Truckee River Basin, 75 pp. (page 1 of 2)

The 140 mile long Truckee River originates in the high Sierra Nevada, flows through Lake Tahoe and terminates at Pyramid Lake in Nevada. There are many competing uses for the water of the Truckee River basin, including agricultural irrigation, municipal supply and recreation. The Truckee River basin in California provides habitat for both rainbow and brown trout, includes a wild trout reach and is considered a high quality trout fishing destination.

Based on a Physical Habitat Simulations using geomorphology and hydrology data, in 1996 DFG recommended the following preferred and minimum instream flows in cubic feet per second for streams within the Truckee River Basin:

Reach	Brown Trout				Rainbow Trout			
	Oct - Jan		Feb - Mar		Apr - Jul		Aug - Sep	
	Spawning + Incubation		Rearing		Spawning + Incubation		Rearing	
	Pref.[1]	Min.[2]	Pref.	Min.	Pref.	Min.	Pref.	Min.
Truckee River Nevada to Boca	200	150	250	150	200	150	250	150
Truckee River Boca to Donner Creek	300	100	250	100	300	100	250	100
Truckee River Donner Creek. To Lake Tahoe	250	75	150	75	300	75	150	75
Donner Creek	50	8	20	8	50	8	10	8
Prosser Creek	50	16	35	16	75	16	30	16
Little Lower Truckee River	125	45	100	45	125	45	100	45
Upper Little Truckee River	90	30	50	14	90	35	30	14
Independence Creek	20	7	10	4	20	8	10	4

[1] Preferred flows represent optimum flow versus habitat conditions.
[2] Minimum flow conditions require improved spawning and rearing conditions within the main-stem and listed tributaries.

Target flows should be identified based upon storage and projected runoff conditions such that flows conditions will be sustained during the life stage period as close to preferred conditions as possible. Flow releases between reaches should be balanced to ameliorate fluctuation in flow conditions resultant from the alternating exclusive use of reservoirs to accommodate downstream needs. Percent variation in flow between regulated reaches should be minimized. Percent variation is the percentage difference between minimum and preferred flow.

Department of Fish and Game, 1996, Instream Flow Requirements Truckee River Basin, 75 pp. (page 2 of 2)

Please refer to the 1996 Instream Flow Requirements Truckee River Basin for details of the information collected and analyzed by DFG in support of these recommendations.

Battle Creek

April 1999, Memorandum of Understanding by and among Bureau of Reclamation, National Marine Fisheries Service, U.S. Fish and Wildlife Service, California Department of Fish and Game, and Pacific Gas and Electric Company in: Appendix A of the Final EIS/EIR for the Battle Creek Salmon and Steelhead Project, 63 pp. (page 1 of 2)

DFG has determined Battle Creek is the only tributary of the Sacramento River capable of being restored to support all four runs of Chinook salmon and steelhead. In the early 1900's numerous diversion dams were built across Battle Creek to provide hydroelectric power to Iron Mountain Mine near Keswick. These dams blocked migrating salmon and steelhead from accessing approximately 42 miles of stream spawning habitat and reduced water quality in Battle Creek to the point where salmon, steelhead and resident trout could barely exist. Pacific Gas and Electric Company (PG&E) eventually acquired the project with its series of dams and canals to produce commercial hydroelectric power.

In order to determine the appropriate flow release to restore salmon and steelhead in Battle Creek, Tom Payne and Associates completed a Physical Habitat Simulation in 1998. Based on the flow study results as well as the historical hydrology, sediment transport modeling and water temperature modeling, a joint proposal was developed in 1999 between DFG, National Marine Fisheries Service, US Fish and Wildlife Service, PG&E and the Bureau of Reclamation, to reestablish salmon and steelhead habitat on Battle Creek and its tributaries. Under the joint restoration proposal, PG&E agreed to make physical and operational modifications to its Battle Creek Hydroelectric Project facilities. Specifically the plan calls for removing five hydroelectric diversion dams, placing new screens and ladders on three other dams to allow fish passage and increasing water flow in the stream.

Based on the results of the studies, appropriate flow releases were proposed to accommodate different life stages of salmon and steelhead. These flows were agreed upon by the parties involved and are presented in Table 1.

April 1999, Memorandum of Understanding by and among Bureau of Reclamation, National Marine Fisheries Service, U.S. Fish and Wildlife Service, California Department of Fish and Game, and Pacific Gas and Electric Company in: Appendix A of the Final EIS/EIR for the Battle Creek Salmon and Steelhead Project, 63 pp. (page 2 of 2)

Table 1. Restoration Project Minimum Instream Flow Requirements

Dam	Monthly Minimum Flow Release (cfs)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
North Fork Battle Creek												
North Battle Creek Feeder	88	88	88	67	47	47	47	47	47	47	47	88
Eagle Canyon	46	46	46	46	35	35	35	35	35	35	35	46
Wildcat	Facility removed; no instream flow requirement											
South Fork Battle Creek												
South	Facility removed; no instream flow requirement											
Inskip	86	86	86	61	40	40	40	40	40	40	40	86
Coleman	Facility removed; no instream flow requirement											
Ripley Creek												
Lower Ripley	Facility removed; no instream flow requirement											
Soap Creek												
Soap	Facility removed; no instream flow requirement											
Baldwin Creek												
Asbury	5	5	5	5	5	5	5	5	5	5	5	5

Please refer to the April 1999, Memorandum of Understanding by and among Bureau of Reclamation, National Marine Fisheries Service, U.S. Fish and Wildlife Service, California Department of Fish and Game, and Pacific Gas and Electric Company in: Appendix A of the Final EIS/EIR for the Battle Creek Salmon and Steelhead Project for details of the information collected and analyzed by CDFG in support of these recommendations.