CHAPTER 6
Fisheries and Aquatic Resources

CHAPTER 6
FISHERIES AND AQUATIC RESOURCES

This chapter describes the existing fisheries and aquatic resources conditions, the applicable regulations, and potential impacts from implementation of the Proposed Project Alternative and other alternatives on the fisheries and aquatic resources in the Project Area.

6.1 ENVIRONMENTAL SETTING

This section describes the environmental setting related to fisheries and aquatic resources that may be influenced by implementation of the Proposed Project Alternative or other alternatives in the Project Area including Lake Mary, Mammoth Creek extending from Lake Mary to its confluence with Hot Creek, and Hot Creek from its confluence with Mammoth Creek downstream to the USGS Hot Creek Flume Gage.

6.1.1 LAKE MARY

Lake Mary is a cirque lake (a deep, steep-walled basin on a mountain) formed by the filling of remnant moraine depressions left by receding glaciers (USGS 1999). Lake Mary contains prominent granite features, and cold, clear water, making it a popular angling destination. A "fishing enhancement" program is implemented by both the Town of Mammoth Lakes and CDFG to maintain the lake's appeal as a "trophy" trout destination. The recreational fishery in Lake Mary is maintained by both the Town of Mammoth Lakes and CDFG because of its economic importance to the Mammoth Lakes Basin (Mammoth City Concierge 2010).

Lake Mary has been, and continues to be managed as a put-and-take recreational fishery. Hatchery rainbow trout have been regularly planted by CDFG beginning in the late spring and extending through the summer. The lake also is often planted with "Alpers trout." The Alpers trout is a genetic hybrid of rainbow trout, Kamloops trout and steelhead, raised in the streams and ponds of Alpers Owens River Ranch. Alpers trout are exclusive to the Eastern Sierra. In 1984, local communities requested that Alpers grow and stock bigger trout to supplement fish being stocked by the CDFG. In 2007, the Alpers Owens River Ranch was sold, and the rearing of Alpers trout was relocated to the Conway Ranch Trout Farm.

Hatchery reared trout are generally not produced to provide direct benefits to self-sustaining populations (CDFG 2003). The principal purpose of hatchery trout stocking is to provide angling recreation, but the consideration of potential adverse effects resulting from introducing fish species into waters where they did not originate is receiving greater attention than in the past (CDFG 2003). In response to a legal action challenging its hatchery and stocking operations, CDFG and USFWS recently (January 11, 2010) completed an EIR/EIS that considers species and habitats affected by hatchery-raised rainbow trout. One of the conditions of the EIR/EIS is that waterbodies receiving hatchery plants must go through a Pre-Stocking Evaluation Protocol. This evaluation requires CDFG to consider each sensitive or listed species in each waterbody relative to the stocking of hatchery trout (CDFG 2010a).

As of August 5, 2010, CDFG (2010a) has included Lake Mary as a waterbody for the planting of catchable trout. According to the CDFG Strategic Plan for Trout Management (2003), angling opportunities are enhanced by placing catchable-size trout into waters where, among other factors, natural reproduction does not occur or is not sufficient to support the harvest demand. Also, as of August 5, 2010, CDFG specifically did not include Lake Mary as a waterbody for the planting of juvenile or sub-catchable size trout. Juvenile or sub-catchable size trout are placed in waters where trout populations currently exist, but where limited reproductive habitat prevents the population from being self-sustaining.

Therefore, according to recent CDFG policy and the Strategic Plan for Trout Management: (1) natural reproduction does not occur or is not sufficient to support the harvest demand in Lake Mary; and (2) either natural trout populations do not currently exist, or they do exist but reproductive habitat is not limiting in Lake Mary. Moreover, with one exception, none of the alternatives evaluated in this Draft EIR result in significant or potentially significant hydrologic impacts associated with changes to the frequency of filling Lake Mary, the date on which Lake Mary is filled, or the duration (extending from April 1) at which Lake Mary is at minimum WSEL prior to September 15. The exception is the Permit 17332 Bypass Flow Requirements Alternative, which results in potentially significant impacts to Lake Mary hydrology. However, for all alternatives evaluated in this Draft EIR (including the Permit 17332 Bypass Flow Requirements Alternative) these changes would not be expected to significantly impact the Lake Mary put-and-take fishery. Because Lake Mary has been, and continues to be managed as a put-and-take fishery, and because none of the alternatives evaluated in this Draft EIR would be expected to significantly impact the put-and-take fishery in Lake Mary, potential impacts to fisheries in Lake Mary are not further evaluated in this Draft EIR.

6.1.2 LAKE MAMIE AND TWIN LAKES

Water flows out of Lake Mary downstream into Lake Mamie and Twin Lakes. Lake Mamie and Twin Lakes are popular fishing locations for trout, particularly rainbow and brown trout. Wild rainbow and brown trout are readily caught between the spring and fall seasons, with supplemental rainbow trout broodfish plantings by CDFG beginning during late spring and extending through the summer.

In the 1930s, fishermen transplanted aquatic weeds from Hot Creek in hopes of improving aquatic habitat in Twin Lakes. As a result, Twin Lakes are susceptible to thick weed growth late in the summer, but have increased productivity in damselfly (*Odonata*) and mayfly (*Ephemeroptera*) hatches (Reel Mammoth Adventures 2009).

As previously discussed in Chapter 2 – Proposed Project and Alternatives, the District has no authority to store water or regulate flow from the Lake Mamie or Twin Lakes, nor does the District have jurisdiction of ownership of the dam structures. The USFS manages Lake Mamie and Twin Lakes as flow-through systems with no managed drawdown of the lakes. Any potential USFS diversion to or drawdown from storage in these lakes will be pursuant to future resolution of USFS-initiated water rights application processes for Lake Mamie (Application 31365) and Twin Lakes (Application 31366) and upon SWRCB approval of the storage rights. Thus, as discussed in Chapter 4 – Hydrology, the MCWD Model does not characterize USFS storage operations at either Lake Mamie or Twin Lakes. Consequently, this Draft EIR does not evaluate potential impacts to the fisheries and aquatic resources in Lake Mamie and Twin Lakes associated with implementation of the project alternatives or the No Project Alternative.

6.1.3 MAMMOTH CREEK

The aquatic habitat and fisheries resources of Mammoth Creek have been extensively studied since 1988. Delineation of Mammoth Creek into study reaches and initial characterization of aquatic habitat occurred in 1988. Fish community surveys have been conducted in Mammoth Creek in 1988, 1992 through 1997, and 1999 through 2008. Several entities have been involved in the collection and reporting, including Beak Consultants in 1988 and 1992-1994, UC SNARL in 1995 and 1996, Horseshoe Canyon Biological Consultants in 1999, KDH in 1997 and 2000-2005, and Thomas R. Payne and Associates in 2006-2008. The data used in this Draft EIR were obtained from these surveys. A complete discussion of the fish community surveys and analyses is presented in Appendix E.

In an evaluation of the instream flow needs of the Mammoth Creek fishery (Bratovich et al. 1990), five distinct reaches (see **Figure 6-1**) were identified in the section of Mammoth Creek between the Twin Lakes outlet and the confluence with Hot Creek, based upon an analysis of topographic maps, calculation of gradient profiles, and visual inspection of Mammoth Creek and associated morphological characteristics, tributaries, riparian vegetation, and surrounding topography.

Four of these reaches are located in the lower 8.9 miles of the creek (86% of the entire length), and are characterized by gradients that range from 0.7 to 3.8%. By contrast, a fifth reach representing approximately the upper 1.4 miles (14% of the entire length) is characterized by a gradient of about 12.3%. Habitat in this high-gradient reach (Reach A) typically consisted of a cascade-plunge pool sequence in which the amount of usable fish habitat was not determined by stream discharge, but by sectional (streambed rock) hydraulic controls. Fish surveys were restricted to the remaining four study reaches (Reaches B, C, D and E) comprised of the lower 8.9 miles of Mammoth Creek from the Sherwin Street crossing in the Town of Mammoth Lakes downstream to Mammoth Creek's confluence with Hot Creek.

6.1.3.1 AQUATIC HABITAT

REACH CHARACTERIZATION

The characteristics of aquatic habitat in Mammoth Creek vary considerably among the five reaches because of the unique influences of channel morphology, riparian vegetation, stream gradient, and substrate size and composition in each reach. Over most of its length, the creek flows through a single channel; however, stream channel braiding (flow through multiple channels) occurs in each of the lower four reaches. The formation of most multiple stream channels in the creek is the result of large woody material accumulations (e.g., log jams) in the low gradient areas. A brief description of each of the reaches is presented below.

Reach A: Reach A extends from the outlet of Twin Lakes downstream to the Sherwin Street crossing. The upper section (about 0.9 miles) of the reach is very steep and characterized by bedrock and large boulder streambed elements. Two waterfalls with vertical drops of about 25 ft are contained in the section. Aquatic habitat is dominated by cascades and runs, with low to moderate amounts of overhead cover provided by low-growing alders and willows along the stream margins. At the bottom of the steep canyon section, the stream channel flattens considerably and flows through a forested area with dense riparian cover. The streambed is composed of cobble and gravel and the most abundant aquatic habitat types are riffles, runs, and pools.

Reach B: Reach B extends from the Sherwin Street crossing to the head of the canyon (about 1,300 ft downstream of the Old Mammoth Road crossing). The upper portion of the reach is characterized by a relatively low gradient, extensive woody riparian vegetation with considerable canopy coverage, and numerous small pools created by man-made rock dams. In the mid-portion of Reach B adjacent to the condominium developments, the creek flows through a low gradient area characterized by sparse woody riparian growth. The creek in the remainder of the reach is somewhat larger due to consolidation of braided channels, and contains some woody riparian vegetation but little canopy coverage.

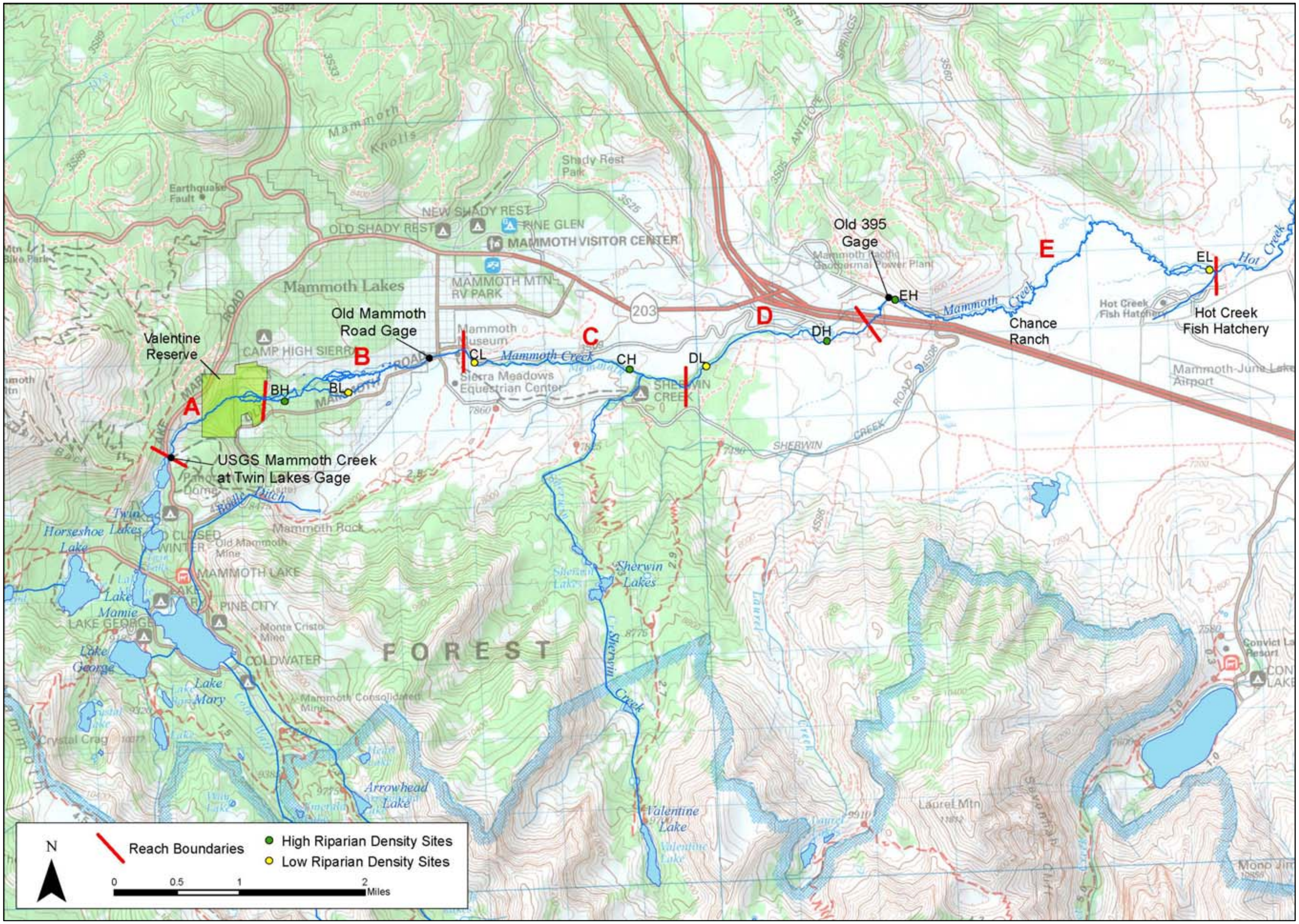

Figure 6-1. The Mammoth Creek Basin and Location of the Eight Fish Sampling Sites

Reach C: Reach C extends from the downstream terminus of Reach B to the footbridge below the Sherwin Creek campground (approximately 2,100 ft downstream of the confluence of Mammoth and Sherwin creeks). The upper portion of the reach is located in a relatively open, high gradient area characterized by large streambed substrate elements and a cascade-plunge pool habitat sequence. A low channel gradient and dense woody riparian vegetation with considerable canopy coverage typifies the lower portion of the reach. Numerous debris dams produced by fallen trees and accumulated woody material encourage braiding of the stream channel throughout a large segment of the lower portion of Reach C.

Reach D: Reach D extends from the lower boundary of Reach C downstream to the Highway 395 crossing. Similar to Reach C, the upper portion of Reach D is restricted to a single channel contained in a relatively steep canyon. The streambed substrate material is composed primarily of bedrock and large boulders, and riparian vegetation is generally sparse with some patchy stands of dense growth. The lower portion of Reach D is characterized by a relatively low gradient, and heavy riparian woody vegetation growth and canopy coverage. Extensive braiding of the stream channel occurs in the lower portion of Reach D, especially in an approximately 2,800 foot-long segment of stream located immediately upstream of Highway 395.

Reach E: Reach E extends from Highway 395 to the confluence of Mammoth Creek and Hot Creek. The segment of Mammoth Creek in Reach E from Highway 395 to Old Highway 395 meanders through pastureland with a general absence of woody riparian vegetation. Long runs and pools are the dominant habitat types. From Old Highway 395 to the old Sheriff's Substation, the creek flows through a relatively low gradient area with moderate stands of riparian growth. The portion of the creek from the old Sheriff's Substation to Hot Creek meanders through Chance Meadow, an area used extensively as pasture/rangeland for cattle. This low-gradient section generally lacks riparian vegetation. The stream channel is characterized by extensive meanders, undercut banks, and small substrate particle size. Habitat units are primarily low velocity glides and pools, separated by occasional short riffles. Luxuriant growths of submerged aquatic vegetation are common in the deeper habitat types.

AQUATIC COVER

Components of aquatic cover can be divided into two main categories: (1) riparian vegetation and its associated canopy cover (also see Chapter 7 – Wildlife and Botanical Resources); and (2) instream cover.

Distinct differences in the amounts of riparian cover within each study reach were observed during the habitat mapping survey conducted in 1988 (Bratovich et al. 1990). To ensure representation of riparian cover and dispersion of sampling sections, fish sampling stations were originally located within "high" and "low" density riparian habitat sites within each study reach. Each sampling site was identified by a two-letter code, with the first letter indicating the reach (B, C, D, or E) and the second letter indicating a "high" (H) or "low" (L) density riparian characterization (see Figure 6-1).

Although sample site locations have remained relatively consistent over the years, riparian cover has changed since establishment of the sample sites in 1988. In addition, the relative amounts of woody riparian cover characterized as "high" or "low" varies among reaches. For example, KDH in their 1997, 2000 and 2004 Mammoth Creek Fish Community Survey reports mention that "*site EH represents a zone of high riparian cover within reach E*" but "*in comparison with other high riparian cover sites, it is characterized by a relatively low amount of riparian cover*". KDH also mentioned that site BL has changed over time by willow tree cover establishments, resulting in increased riparian cover.

Salamunovich (2006) correctly states that "…*Discretion must be used when comparing and interpreting the results between high and low-density riparian cover sites because of between reach variation in riparian density and tree species and changes in the riparian area over time.*" Appropriately, the high and low riparian cover categories were not utilized as strata in the inter-annual trend analyses presented in this Draft EIR because of among-reach differences in the relative amount of riparian cover required for a site to be classified as high or low cover, and because of site-specific changes in the amount of riparian cover over time.

Instream cover includes specific elements and objects in direct contact with the stream including undercut banks, boulders, logs and logjams, and aquatic vegetation. All of these elements exist in Mammoth Creek. A field channel survey of Mammoth Creek conducted during November 2008 included an inventory of woody debris in all reaches (Stillwater Sciences 2009), which is an important component of instream object cover.

Reach B reportedly exhibits considerable variety in pool types. Both boulder and large woody debris were observed as forcing mechanisms for pool formation (Stillwater Sciences 2009). The frequency of occurrence and amount of woody debris in Reach B was significantly lower than in reaches C and D, but slightly more than that found in Reach E. Woody debris loading in Reach B is influenced by development that has reduced the potential hillslope recruitment supply and may also actively remove pieces from the channel as part of property maintenance activities (Stillwater Sciences 2009).

The frequency of occurrence and amount of woody debris in Reach C are much higher than in other reaches, about double the levels in Reach D and 10 times the amount in Reach B (Stillwater Sciences 2009). Woody debris in Reach C results from ample recruitment supply from steep hillslopes that often grade directly into the channel, a high frequency of large roughness elements (e.g., large boulders) that are efficient in trapping debris, and prevalent beaver activity that produces multiple jams throughout Reach C (Stillwater Sciences 2009). In the upper half of Reach C, beaver activity observed in riparian areas was extremely pervasive, resulting in large beaver dams that likely trap nearly all wood fluvially transporting downstream. A series of beaver dams that often contained several hundred pieces of large woody debris and with channel gradient steps > 10 ft have resulted in a series of large, deep dammed pools. Three of the beaver dams were so large that inventorying the estimated several hundred of woody debris pieces in each jam was unfeasible, and the jams are not included in the woody debris results (Stillwater Sciences 2009).

In Reach D, Stillwater Sciences (2009) report that extensive woody debris jams occur as a result of natural entrapment at large roughness elements, and from beaver activity. Man-made channel disturbances were not observed in Reach D. It is also reported that extensive bedrock and large boulder control is present throughout the reach, as well as generally high values of instream cover.

The frequency of occurrence and amount of woody debris are very low in Reach E, as only 7 pieces were inventoried and no jams were observed. In this reach, cattle grazing impacts are prevalent and include trampling of the banks and loss of undercut bank cover habitat (Stillwater Sciences 2009).

WATER TEMPERATURE

Water temperature can influence the suitability and quality of aquatic habitat for fish. Each fish species and individual lifestage has a unique temperature tolerance range that is dependent upon a variety of factors. Temperatures outside of this range may induce stress-related physiological and/or behavioral responses, including mortality.

Monitoring

As part of a comprehensive instream flow study, hourly water temperature data were collected at six locations in Mammoth Creek (Bratovich et al. 1990). The locations where water temperatures were recorded were: (Station No. 1) Sherwin Street crossing (Reach B); (Station No. 2) Old Mammoth Road crossing (Reach B); (Station No. 3) approximately 1,500 ft downstream of the confluence of Mammoth and Sherwin creeks (Reach C); (Station No. 4) approximately 2,300 ft downstream of the confluence of Mammoth and Sherwin creeks (Reach D); (Station No. 5) Highway 395 crossing (Reach D); and (Station No. 6) in Chance Meadow approximately 950 ft upstream of the confluence of Mammoth and Hot creeks (Reach E).

Water temperatures were recorded with Ryan TempMentor thermographs. Thermographs were deployed at Stations 1, 3, 4, and 5 on August 5, 1988, and at Stations 2 and 6 on September 13, 1988. Water temperatures were recorded at hourly intervals with a resolution of 0.1°C (TempMentor Operation Manual, Ryan Instruments, Inc. Kirkland, Washington). Water temperature monitoring at Stations 1, 2, 3, and 6 was discontinued on November 13, 1988. Thermographs at Stations 4 and 5 remained in the creek until the conclusion of water temperature monitoring on September 22, 1989. Water temperature records at Stations 4 and 5 did not include the period April 28, 1989 to June 6, 1989, when available memory in both recording instruments was exceeded.

Monitoring Results

The temperature data collected from the monitoring stations during 1988 and 1989 (see Bratovich et al. 1990) indicate that water temperature in Mammoth Creek fluctuates daily, with the magnitude of the fluctuation dependent upon location and time of year. Daily temperature fluctuations were lowest in the upstream sections of the creek (about 5 to 9°F at Sherwin Street) and greatest at the Chance Meadow site (about 16 to 23°F). The maximum daily fluctuations occurred during the summer months; daily fluctuations were nearly nonexistent during the winter months when water temperature during the entire winter period was near 32°F. Maximum daily temperatures also varied by location and time of year. The highest maximum daily water temperatures occurred in the downstream sections (Reaches D and E - Stations 4, 5 and 6) during the summer, with temperatures of about 68°F recorded on occasion.

The District collected additional water temperature data during 1992 and 1993 (see MCWD and USFS 2000) from two locations: near the Old Highway 395 crossing (Reach D); and near the confluence with Hot Creek (Reach E in Chance Meadow) (MCWD and USFS 2000). These temperature records provided results similar to those found in 1988. Summer maximum temperature fluctuations were lowest at the upstream location (about 13°F at Old Highway 395) and greatest in Chance Meadow (about 23°F). Daily fluctuations were extremely minor during the winter months and greatest in the summer. Maximum daily temperature also varied by location and time of year. The highest maximum daily water temperatures occurred during the summer, with temperatures of about 68°F recorded on occasion near Old Highway 395 and temperatures near 79°F occasionally recorded in Chance Meadow.

Lifestage Considerations

Brown trout (*Salmo trutta*) is the dominant fish species in Mammoth Creek. Water temperature requirements of each life stage of brown trout were compiled by Raleigh et al. (1986). Most of the information on brown trout water temperature requirements presented herein was extracted directly from the Raleigh et al. (1986) compilation.

The upper limiting near lethal water temperature for adult brown trout has been reported as 81.0°F (Needham 1969), at which temperature naturally reproducing, viable stream populations would not be maintained (Raleigh et al. 1986). The optimal water temperature range for good growth and survival of adult brown trout is 53.6 to 66.2°F (Frost and Brown 1967; Mills 1971; Brown 1973; Tebo 1975). In Convict Creek, located near Mammoth Creek in the Owens River Drainage, adult brown trout have been reported to have a water temperature tolerance range of 32 to 80.6°F (Maciolek and Needham 1952).

Spawning migration of adult brown trout begins in the fall at water temperatures of 42.8 to 44.6°F (Frost and Brown 1967; Mills 1971) or 44.6 to 55.0°F (Hooper 1973). Spawning has been reported to occur at water temperatures of 44.6 to 48.2°F (Mansell 1966).

The optimal water temperature range for brown trout egg development, hatching success, and fry emergence has been variously reported as 44.6 to 53.6°F by Frost and Brown (1967), 43.9 to 55.0°F by Markus (1962), and 41.0 to 55.4°F for the embryo stage by Frost and Brown (1967). Raleigh et al. (1986) report an optimal water temperature range of 35.6 to 55.4°F for brown trout embryo incubation, with a tolerance range of 32 to 59°F.

In their compilation of water temperature information available for brown trout fry, Raleigh et al. (1986) report an optimal temperature range of 44.6 to 59°F, with an overall temperature tolerance of 41 to 77.9°F. Raleigh et al. (1986) report an optimal temperature range of 44.6 to 66.2°F, with a temperature tolerance range or 32 to 80.6°F for brown trout juveniles.

Water temperatures recorded in Mammoth Creek during 1988 and 1989 were generally within the optimal ranges reported for fry, juvenile, and adult life stages of brown trout during the summer, and were less than optimal but generally within the tolerance range during fall and spring (MCWD and USFS 2000). Water temperatures during winter were generally at or slightly below the reported tolerance range for all lifestages. Extended periods of low temperatures (near freezing) generally result in brown trout (and other fish species) seeking shelter, often within the interstitial spaces in the substrate (Maki-Petays et al. 1997; Heggenes et al. 1993; Heggenes and Saltveit 1990; Riehle and Griffith 1993; Campbell and Neuner 1985 as cited in MCWD and USFS 2000). Near freezing temperatures are not generally lethal, but energy derived from feeding may be insufficient to offset the costs of maintenance metabolism, resulting in a decline in the condition factor of trout (Cunjack and Power 1987 as cited in MCWD and USFS 2000).

In addition to water temperatures below the reported optimal range, water temperatures exceeding optimum can result in chronic or acute stress. Water temperature monitoring in Mammoth Creek during 1988, 1989, 1992 and 1993, indicates that of the six water temperature stations monitored in Mammoth Creek, maximum water temperatures only at the lowermost station (near the confluence with Hot Creek) appear to be potentially stressful to brown trout, although high water temperatures do not appear to be a significant problem in Mammoth Creek (MCWD and USFS 2000). Review of the information presented in MCWD and USFS (2000) suggests that maximum daily water temperatures in the lowermost section of Mammoth Creek near its confluence with Hot Creek can reach stressful levels during the summer, although those temperatures are present only for relatively short periods due to the substantial diurnal fluctuations.

Water temperature is often strongly influenced by stream flow, with increased flows generally resulting in decreased water temperatures. However, over the range of water temperatures and discharge levels examined in Mammoth Creek, water temperature appears to be more closely associated with air temperature than with stream flow (MCWD and USFS 2000). Statistical comparisons of mean daily water temperatures with stream flows recorded over the same time period showed a weak correlation ($r = 0.37$). Furthermore, a positive correlation (i.e., increased water temperature associated with increased stream flow) was observed rather than the expected negative association. By contrast, water temperature was strongly correlated ($r = 0.90$) with average air temperature (i.e., average of daily maximum and minimum) over the same time period, as recorded by the USFS at Mammoth Lakes.

Because: (1) of the greater influence of air temperature on water temperatures in Mammoth Creek rather than flow levels; (2) the project alternatives would not result in significantly lower flows during summer in the lower section (represented by the OLD395 Gage) relative to the Existing Condition (see Chapter 4 – Hydrology); and (3) the Existing Condition has resulted in the fishery resources of Mammoth Creek being in "good condition" pursuant to Fish and Game Code 5937 (see below), water temperature increases in Mammoth Creek would not be expected to occur and, therefore, additional specific water temperature analyses are not presented in this Draft EIR.

6.1.3.2 FISHERIES RESOURCES

During the 17 annual fall surveys conducted from 1988 to 2008, fish were collected at each sampling site by electrofishing using a multiple-pass removal method, with each site closed on the day of sampling using 0.25-inch mesh block nets placed simultaneously across the upstream and downstream boundaries. A good description of field sampling methods is provided in Salamunovich (2006).

Fish species diversity in Mammoth Creek is relatively low. Only five fish species have been reported to occur in Mammoth Creek, including brown trout, rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), tui chub (*Gila bicolor*), and Owens sucker (*Catostomus fumeiventris*).

The 17 annual surveys have shown that the species composition at Mammoth Creek consists primarily of brown trout, an introduced species that is now naturally reproducing in the creek and that, year-after-year, has generally represented at least 50% of the catch collected in the annual electrofishing surveys.

Rainbow trout is the second most abundant species in Mammoth Creek, but its numbers rarely exceed 30% of the catch collected in the annual electrofishing surveys. This species is represented by naturally reproducing descendants from hatchery rainbow trout planted in past years, as well as by hatchery rainbow trout planted during each survey year.

The occurrence of brook trout in Mammoth Creek is rare. Only one brook trout was captured during each of five (1993, 2002, 2003, 2006, and 2008) of the 17 annual fish community surveys, with each capture occurring at the uppermost sampling site (BH) in Mammoth Creek. Hood (2006a) suggested that because brook trout were so rarely observed, and the few observations occurred at the uppermost sampling site in Mammoth Creek, that brook trout in Mammoth Creek may result from spillovers from Twin Lakes.

OVERVIEW OF NATIVE FISH SPECIES

Mammoth Creek is part of the Owens Subprovince of the Great Basin Province (Moyle 2002). Historically, trout are believed to have not been present in the Owens River watershed, including the Mammoth Lakes Basin. Moyle et al. (1996) suggested that native fishes in the Owens River Basin, with the exception of the Owens sucker, generally did not occur in streams above 4,900 ft in elevation. However, relict populations of tui chub have been reported to occur at Hot Creek at an elevation of 7,080 ft and speckled dace at Whitmore Marsh (6,990 ft.) (S. Parmenter, CDFG pers. comm. 2008).

Special-status, native fish species considered in this section are those that are state or federally listed as threatened or endangered, proposed for state or federal listing as threatened or endangered, federal species of concern, and state species of special concern. Special-status fish species potentially occurring in the Project Area were identified by MCWD and USFS (2000), which incorporated searches of the California Natural Diversity Database (1997), a list of species potentially occurring in the project area prepared by the USFWS (letter dated July 15, 1997), a list of sensitive species on the Inyo National Forest prepared by the USFS, and through review of environmental documents for other projects in the region.

Volcano Creek golden trout were identified as a sensitive species on the USFS list; however, this species is limited to the Kern River drainage, does not occur in the Mammoth Creek Project Area and, therefore, is not further addressed in this Draft EIR.

Owens speckled dace was historically distributed in most small streams and springs in the Owens Basin. Owens speckled dace is a federal species of concern and a state species of special concern. However, its range has been greatly restricted by the introduction of alien trouts and water development (Moyle 2002). The remaining populations are small and isolated. The nearest populations of Owens speckled dace are located outside of the Project Area in Whitmore Hot Springs and Little Alkali Lake in Long Valley (Moyle et al. 1995 as cited in MCWD and USFS 2000) and relict populations of speckled dace have been reported to occur at Whitmore Marsh (6,990 ft) (S. Parmenter, CDFG pers. comm. 2008). Therefore, this species is not further addressed in this Draft EIR.

Owens tui chub is a federal and state endangered species. Critical Habitat has been designated at two sites: (1) 8 miles of Owens River and 50 ft of riparian vegetation on either side of the river, encompassing a total of approximately 97 acres in the Owens Gorge; and (2) two spring provinces, and 50 ft of riparian vegetation on each side of the springbrooks, encompassing approximately 5 acres at the Hot Creek Fish Hatchery (USFS 2003).

Historically, Owens tui chub was likely an abundant native fish in the Project Area. Because of the introduction of Lahontan tui chubs into the Owens Valley, the only pure populations of Owens tui chub are restricted to locations where they remain isolated from interaction with Lahontan tui chubs or hybridized populations. The nearest pure populations of Owens tui chub occur at the Hot Creek Headsprings immediately upstream of the Hot Creek Fish Hatchery and at Little Hot Creek Pond (MCWD and USFS 2000).

Suggested by MCWD and USFS (2000), and confirmed by a 2003 genetics study (S. Parmenter, CDFG pers. comm. 2008), tui chub in Mammoth Creek are hybrids of the native Owens tui chub (*Gila bicolor snyderi*) and the closely related introduced Lahontan tui chub (*Gila bicolor obesa*), and that tui chub found in the lower section of Mammoth Creek are believed to represent a hybridized population of Owens tui chub and Lahontan tui chub. Nonetheless, tui chub in Mammoth Creek are referred to as Owens tui chub in this Draft EIR.

Owens sucker is a state species of special concern. Owens suckers are widely distributed in the Owens Valley and are found in the lower reach of Mammoth Creek above the confluence with Hot Creek. According to Moyle et al. (1995) …"*Owens suckers have adapted well to the damming of the Owens River and creation of Crowley Reservoir, so they still have large populations in a good portion of their native range*." Although the Owens sucker population appears to be stable and not in need of special management at the time, Moyle et al. (1995) recommend continued regular monitoring of population status.

Native Fish Abundance

During the 17 years of Mammoth Creek fishery survey records, catches of the two native fish species, Owens sucker and tui chub were almost entirely restricted to Reach E, particularly to the lowermost site EL. Over the 17 years of electrofishing surveys, 99.8% of the Owens sucker and 100% of the Owens tui chub were caught in Reach E. Only in the 1999 Mammoth Creek fishery survey were two Owens suckers caught outside of Reach E, at the next lowermost site (DH).

Because only the total catches per site of Owens sucker and tui chub were reported for the 17 years of Mammoth Creek fishery surveys, but records of the site-specific catch removal patterns of the two species were not kept or reported during the 1988, 1992-1994, 2000 and 2005 fishery surveys, the estimation of site-specific population abundances of the species using *Microfish 3.0 for Windows* was not possible during those years, and consequently the estimation of annual abundance estimates of the species was precluded (see Appendix E). Consequently, analyses of the annual abundances of Owens sucker and tui chub in Mammoth Creek were represented by the annual averages of the standardized abundances of the species at sites EL and EH, where standardized abundances are the numbers of the species annually caught at sites EL or EH divided by the length in miles of the particular sampling site (see **Table 6-1**).

Potential Relationships of Owens Sucker and Tui Chub with Trout Abundances

The series of 17 annual standardized abundances of Owens sucker and tui chub indicate that the highest abundances of both species occurred in the years 1992 through 1994 when trout abundances in Reach E were relatively moderate to low (see **Figure 6-2**). Conversely, low to very low Owens sucker and tui chub abundances occurred in the years 1997, 1999, 2000 and 2007 when the Reach E abundances of brown and/or rainbow trout were at their highest.

The multiple linear regression analysis of Owens sucker standardized abundance as a function of the standardized abundances for tui chub, brown trout and "wild" rainbow trout showed a strong and highly significant multiple correlation coefficient ($R = 0.865$; $P = 0.0003$).

However, the partial regression coefficients for brown and "wild" rainbow trout could not be considered statistically different from zero ($P = 0.909$ and $P = 0.404$, respectively), indicating that the standardized abundance of Owens sucker is not significantly related to the standardized abundance estimates of brown or "wild" rainbow trout.

The multiple linear regression analysis of Owens tui chub standardized abundance as a function of the standardized abundances for Owens sucker, brown trout and "wild" rainbow trout also showed a high and highly significant multiple correlation coefficient ($R = 0.86$; $P = 0.0005$).

Table 6-1. Standardized Abundances of Owens Sucker and Tui Chub for the 17 Annual Electrofishing Surveys Conducted in Mammoth Creek Reach E

Site / Year	Owens Sucker Standardized Abundance (Fish / mile)			Tui Chub Standardized Abundance (Fish / mile)		
	EH	EL	Reach E Average	EH	EL	Reach E Average
1988	0	1,954	977	0	1,003	502
1992	0	3,608	1,804	0	7,339	3,670
1993	0	7,480	3,740	0	15,048	7,524
1994	0	9,222	4,611	0	6,899	3,450
1995	18	1,003	510	0	1,214	607
1996	0	1,478	739	0	845	422
1997	0	35	18	18	18	18
1999	0	862	431	0	106	53
2000	18	317	167	0	35	18
2001	0	106	53	0	35	18
2002	0	35	18	0	35	18
2003	0	950	475	229	106	167
2004	0	2,147	1,074	0	528	264
2005	0	317	158	0	35	18
2006	0	192	96	0	105	52
2007	0	704	352	0	17	8
2008	0	189	94	0	86	43

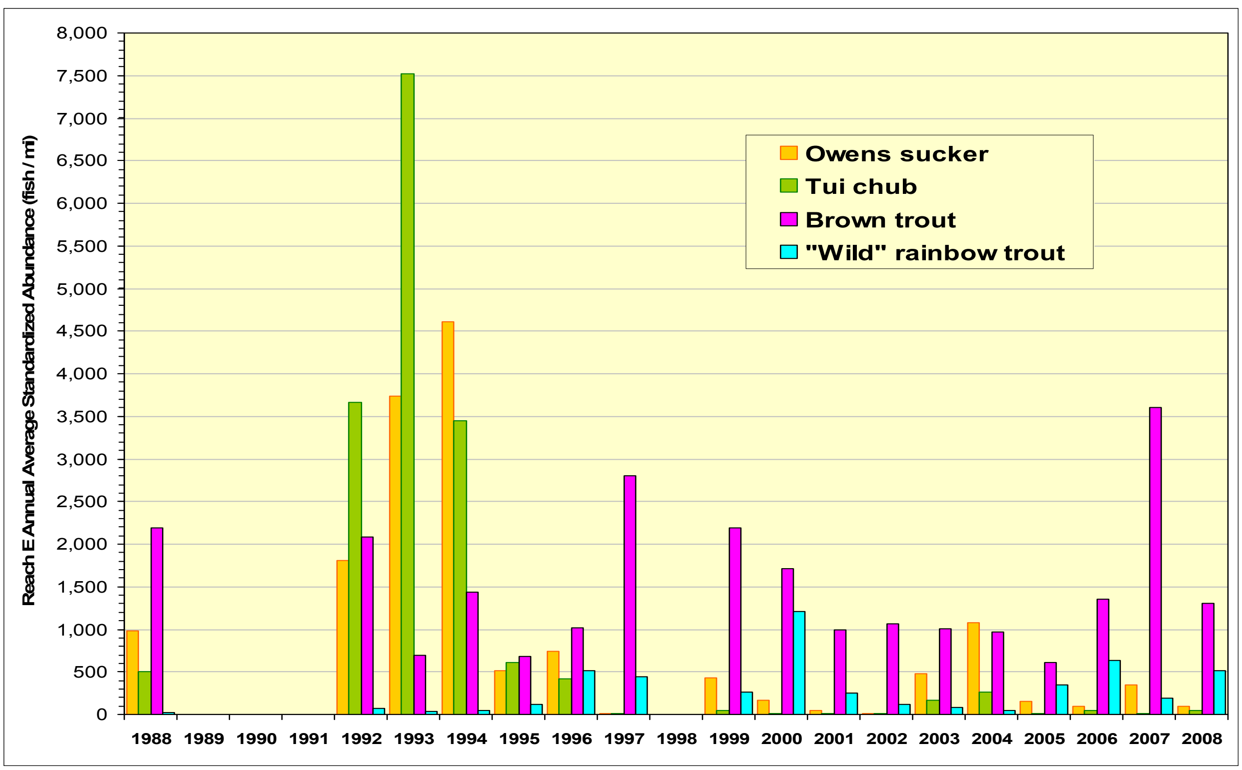

Figure 6-2. Annual Standardized Abundance Estimates (Fish/Mile) of Owens Sucker, Owens Tui Chub, Brown Trout and "Wild" Rainbow Trout in Reach E of Mammoth Creek, 1988-2008

Although decreases in the abundance of Owens tui chub with increases in trout abundances were expected given that Owens tui chub are potential prey for trout, the degree of change expressed in the partial regression coefficients for brown and "wild" rainbow trout could not be considered statistically different from zero (P = 0.668 and P = 0.970, respectively), indicating that the standardized abundance of Owens tui chub is not significantly related to the standardized abundance estimates of brown or "wild" rainbow trout.

Potential Relationships of Owens Sucker and Tui Chub with OLD395 Flow

The 17 annual standardized abundances of Owens sucker and tui chub were compared with flows at the OLD395 Gage because these fishes were almost exclusively caught in Reach E of Mammoth Creek, and the OLD395 Gage is also is located in Reach E. The annual values of OLD395 high flow and OLD395 low flow suggest that the highest abundances (1992 through 1994) occurred during a period when the values of both annual expressions of OLD395 flows were at relatively low to intermediate values (see **Figure 6-3**). In 1995 and 2006 OLD395 flows (both high and low) were the first and second highest over the 17-year period, and Owens sucker and tui chub abundances were relatively low. It should be noted, however, that the specific sampling sites in Reach E were moved in 1995 due to access restrictions to Chance Ranch, and these results may be confounded by the change in sampling locations.

The annual standardized abundances of Owens sucker and tui chub in Reach E during the period 1988 through 2008 were regressed against the lowest average monthly OLD395 flows (among August, September, and October for each year to assess potential relationships between the annual abundances and the low Mammoth Creek flows of late summer and autumn, which precede the surveys each year. The results of the regression analysis for both Owens sucker (see **Figure 6-4**) and tui chub (see **Figure 6-5**) suggested decreasing abundances with increasing OLD395 low flow; however, the slopes of the regression lines cannot be considered significantly different from zero (P = 0.438 for the Owens sucker regression and P = 0.710 for the Owens tui chub regression), and both fitted lines explained less than four percent of the abundance variability (r^2 = 0.041 and r^2 = 0.009 for Owens sucker and tui chub, respectively).

The annual standardized abundances of Owens sucker and tui chub were also regressed against OLD395 high flow to assess potential relationships between the annual densities and the peak Mammoth Creek flows of late spring/early summer. The results of the analysis for both Owens sucker (see **Figure 6-6**) and tui chub (see **Figure 6-7**) suggested decreasing abundances with increasing

OLD395 high flow, but both fitted lines explained only a very small percentage of the abundance variability (r^2 = 0.062 and r^2 = 0.015 for Owens sucker and tui chub, respectively), and both slopes cannot be considered significantly different from zero (P = 0.334 and P = 0.605, for the Owens sucker and tui chub regressions, respectively)

Native Fish Abundance Discussion

Salamunovich (2009) suggested that the relatively high numbers of native fish captured in lower Mammoth Creek from 1992-1994 may have been due to lower stream flows that prevailed in the Basin during the extended six-year long drought (1987-1992) immediately prior to those years. As previously discussed, however, the specific sampling sites in Reach E were moved in 1995 due to access restrictions to Chance Ranch, and these results may be confounded by the change in sampling locations. Moyle et al. (1996) state that with a few exceptions, native non-game fishes in the Owens River Basin do not generally occur in streams above 4,900 ft elevation.

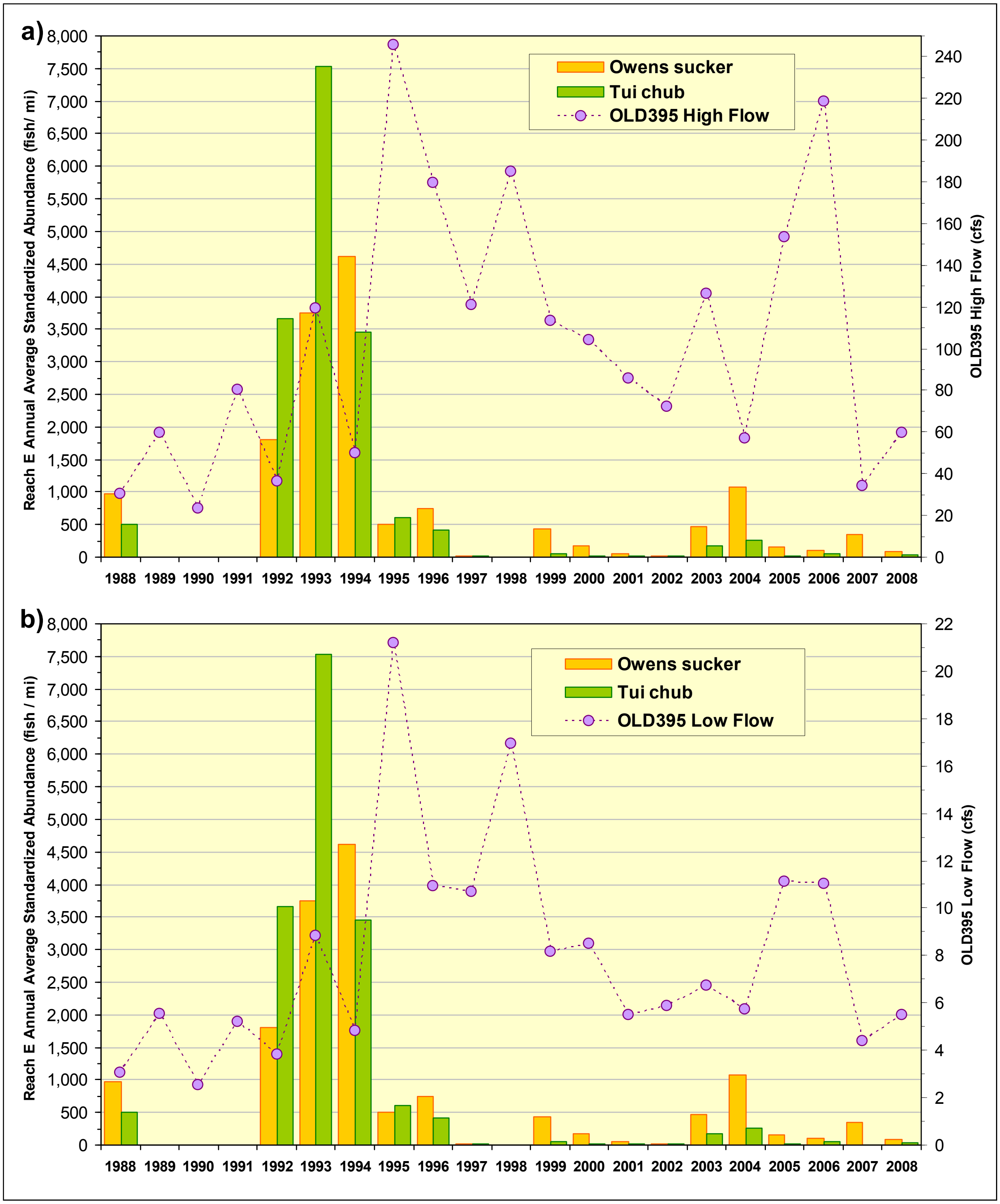

Figure 6-3. Annual Standardized Abundance Estimates (Fish/Mile) of Owens Sucker and Tui Chub, in Reach E of Mammoth Creek and Two Annual Expressions of OLD395 Flows during 1988-2008: (a) OLD395 High Flow and (b) OLD395 Low Flow

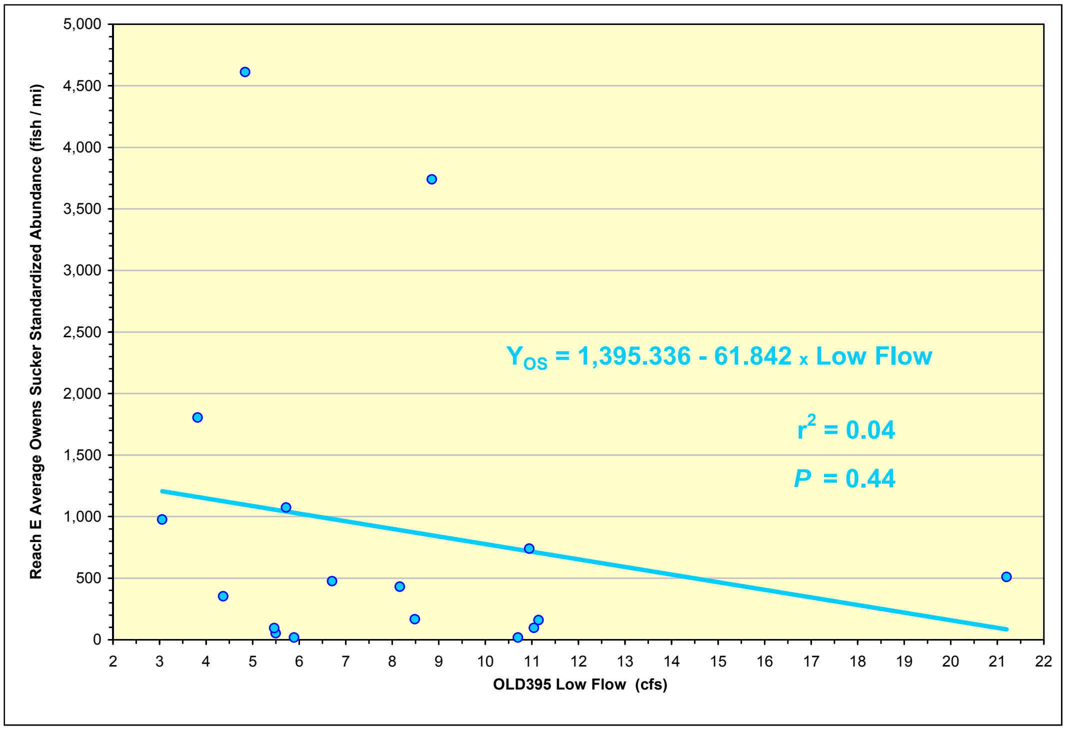

Figure 6-4. Annual Standardized Abundance of Owens Sucker (Fish/Mile) as a Function of OLD395 Low Flow (cfs) and Corresponding Fitted Linear Regression Line for the Period 1988 through 2008

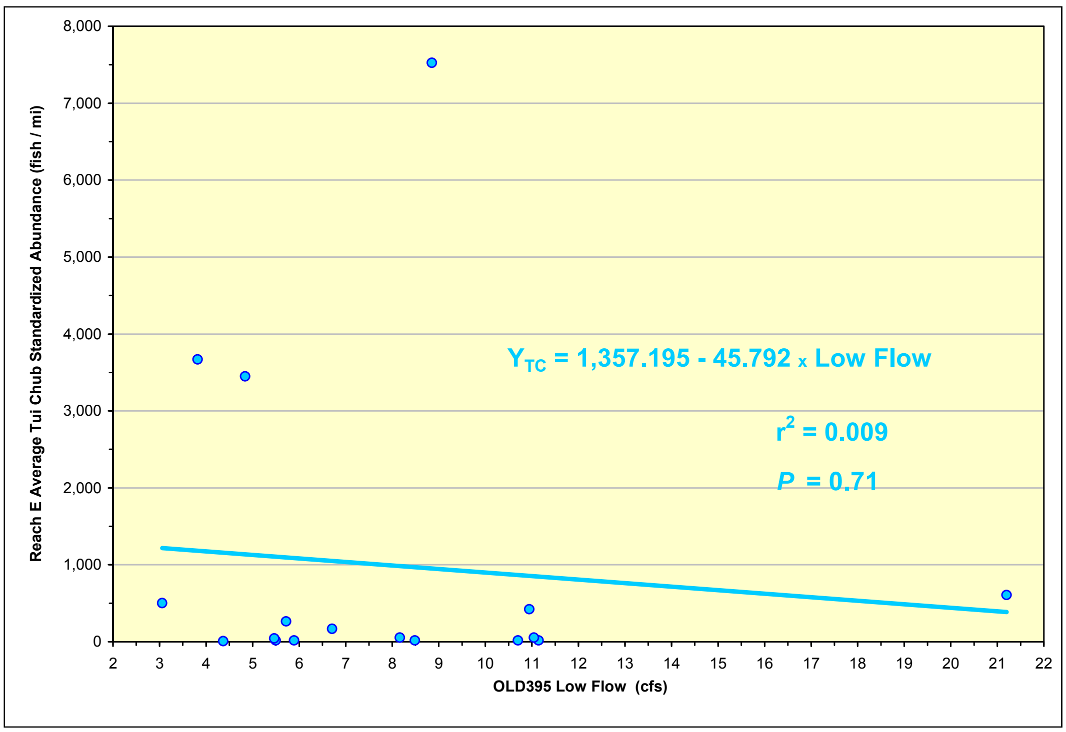

Figure 6-5. Annual Standardized Abundance of Owens Tui Chub (Fish/Mile) as a Function of OLD395 Low Flow (cfs) and Corresponding Fitted Linear Regression Line for the Period 1988 through 2008

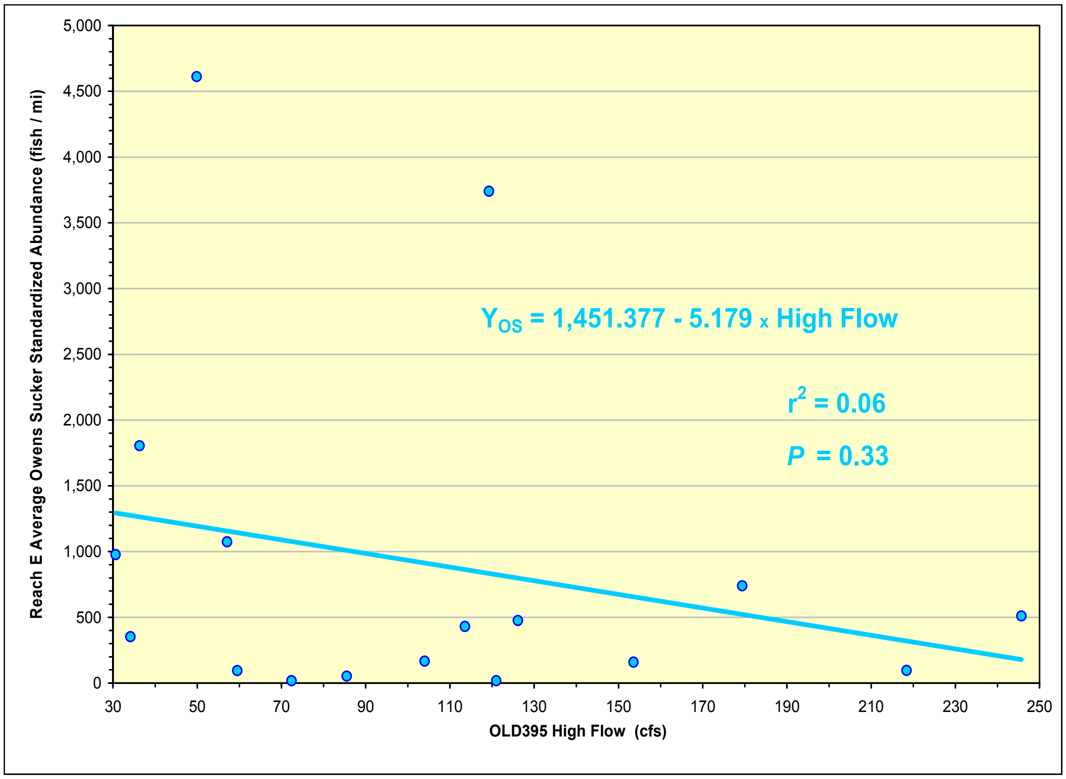

Figure 6-6. Annual standardized abundance of Owens sucker (fish/mile) as a function of OLD395 high flow (cfs) and corresponding fitted linear regression line for the period 1988 through 2008

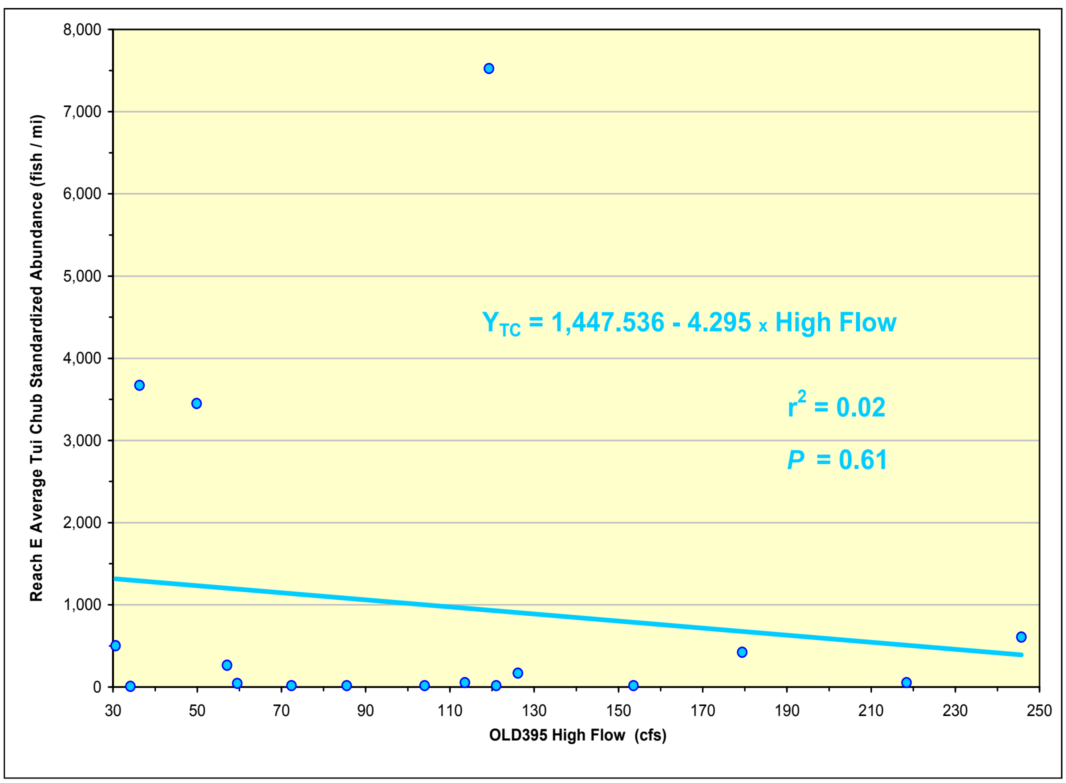

Figure 6-7. Annual standardized abundance of Owens tui chub (fish/mile) as a function of OLD395 high flow (cfs) and corresponding fitted linear regression line for the period 1988 through 2008

Salamunovich (2009) suggested that the native fishes in lower Mammoth Creek (elevation 7,100-7,200 ft) are probably near the limits of their physical range and are able to expand their population range into higher elevation areas during those periods when stream flows remain low for extended periods of time. Examination of potential relationships between standardized abundance estimates of Owens sucker and tui chub and expressions of both high and low flow at the OLD395 Gage did not result in the identification of statistically significant relationships. Clearly, however, native fishes were more abundant from 1992-1994 than during later years.

Salamunovich (2009) further suggested that possible Owens sucker and tui chub population expansion may also be a response to reduced predation pressure from resident trout during drought periods. Multiple regression examination of the relationships between Owens sucker and tui chub abundance, and the abundance of brown and rainbow trout, did not identify statistically significant relationships over the 17-year period of analysis. Nonetheless, the series of 17 annual standardized abundances of Owens sucker and tui chub indicate that the highest abundances of both species occurred in the years 1992 through 1994 when trout abundances in Reach E were relatively moderate to low. Conversely, low to very low Owens sucker and tui chub abundances occurred in the years 1997, 1999, 2000 and 2007 when the Reach E abundances of brown and/or rainbow trout were at their highest.

In summary: (1) the two native fish species, Owens sucker and tui chub are almost entirely restricted to Reach E, particularly to the lowermost site EL; (2) the native fishes in lower Mammoth Creek (elevation 7,100-7,200 ft) are probably near the limits of their physical range and are able to expand their population range into higher elevation areas during those periods when stream flows remain low for extended periods of time (Salamunovich 2009); (3) the results of the analyses for both Owens sucker and tui chub suggest an inverse relationship between their abundance and flow (i.e., relatively high abundance associated with relatively low flows), although these relationships are not statistically significant; and (4) possible Owens sucker and tui chub population expansion may also be a response to reduced predation pressure from resident trout during drought periods (Salamunovich 2009). Although the relationships between Owens sucker and tui chub abundance, and the abundance of brown and rainbow trout, are not statistically significant, the highest Owens sucker and tui chub abundances occur when trout abundances are relatively moderate to low, and the lowest abundances of Owens sucker and tui chub occur when abundances of brown and/or rainbow trout are relatively high.

OVERVIEW OF NON-NATIVE FISH SPECIES

Presently, Mammoth Creek supports brown trout and rainbow trout along much of its length. It is unknown when rainbow trout were introduced into the Mammoth Lakes Basin, but Jenkins et al. (1999) suggested that brown trout were probably introduced into the basin in the 1890s. In the past, CDFG planted brown trout from the Hot Creek Hatchery into Mammoth Creek, although brown trout have not been planted in the creek since 1982. CDFG also annually planted rainbow trout in Mammoth Creek from Hot Creek Hatchery stocks until 2007, then shifted the planting of rainbow trout to stocks from the Mount Whitney Hatchery. Naturalized (or "wild") populations of rainbow trout and brown trout presently occur in Mammoth Creek.

Mammoth Creek supports two types of recreational fisheries, a self-sustaining brown trout fishery, and a hatchery-supported rainbow trout fishery along much of its length (MCWD 1988).

Standardized Trout Abundance

Rainbow Trout

For the 17-year period of record, the overall annual abundance of "wild" rainbow trout averages 370 fish per mile (see **Table 6-2**). By far, the highest annual average was during 2000, when about 4.5 times the annual average number of "wild" rainbow trout per mile (1,377) were present, relative to overall annual average (307 trout per mile) for the remaining 16 years of monitoring. Overall average annual abundance (number/mile) of "wild" rainbow trout was generally highest in the reaches (C and D) located in the "middle" of Mammoth Creek.

Table 6-2. Standardized Abundance Estimates (Number/Mile) for "Wild" Rainbow Trout Captured at Each of the Mammoth Creek Electrofishing Sites, 1988-2008. Bold Numbers Indicate the Highest Value for Each Site (Modified from Salamunovich 2009)

	Sample Site								
	BH	BL	CH	CL	DH	DL	EH	EL	Annual Mean
2008	617	0	69	17	95	340	718	309	271
2007	680	55	121	83	421	428	222	168	272
2006	819	110	282	239	413	359	902	366	436
2005	493	282	70	0	158	158	211	475	231
2004	422	246	123	35	229	246	88	18	176
2003	669	194	106	35	211	282	176	0	209
2002	**1,038**	**810**	141	123	528	475	229	18	420
2001	616	106	88	722	563	422	493	18	378
2000	35	616	405	**6,354**	528	669	**2,253**	158	**1,377**
1999	123	669	546	1,179	686	510	334	194	530
1997	123	123	810	845	722	**1,021**	810	88	568
1996	282	18	**1,690**	528	**933**	229	458	**563**	587
1995	158	0	53	59	18	88	53	194	78
1994	18	0	581	1,654	387	616	106	0	420
1993	18	0	70	0	299	35	53	18	62
1992	70	0	141	651	546	229	141	0	222
1988	53	0	106	0	106	158	53	0	59
1988-2008	367	190	318	737	402	369	429	152	370

Visual examination of potential temporal trends in the average annual abundance (number/mile) of "wild" rainbow trout was facilitated by locally weighted regression smoothing obtained with S-plus© function loess (see **Figure 6-8**). Examination of Figure 6-8 suggests that "wild" rainbow trout abundance (fish/mile) is somewhat cyclic over the 17-year period of record. The locally weighted regression smoothing suggests a period of increasing abundance from 1995 to 2000. From 2001, "wild" rainbow trout abundance declined to 2004. During the last 4 years, "wild" rainbow trout appear to have undergone a new period of increasing abundance until 2006, followed by a decrease during 2007 and 2008. However, "wild" rainbow trout data must be interpreted with caution because of the confounding influences associated with the identification of "wild" versus hatchery rainbow trout, and the unaccounted for variation in hatchery planting practices and recreational angling harvest.

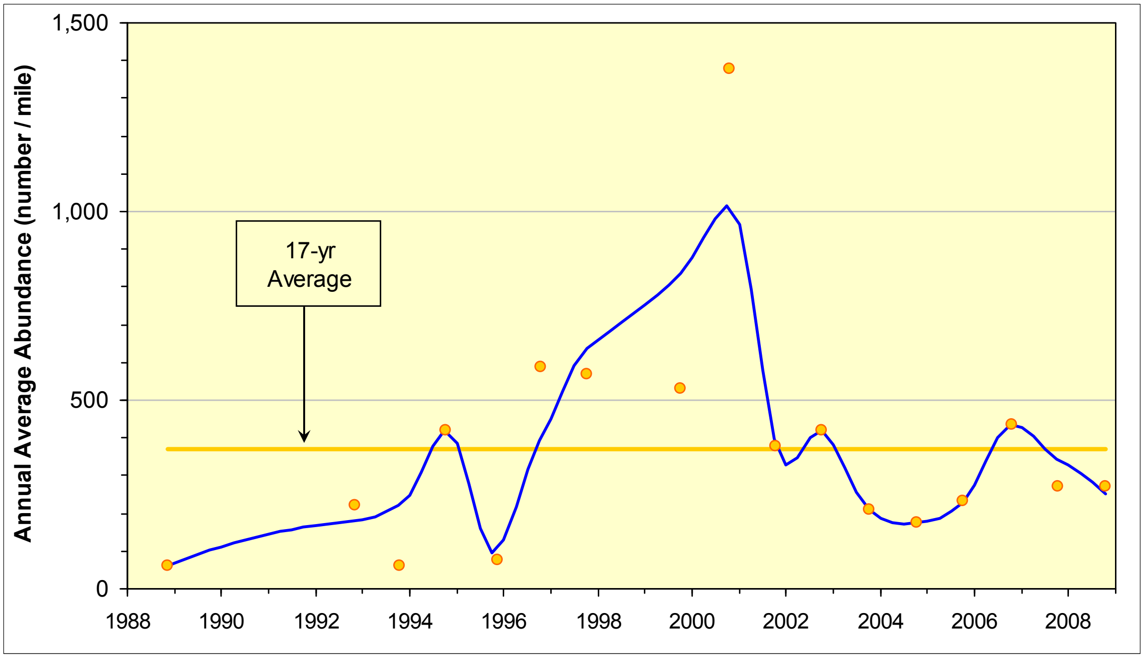

Figure 6-8. Standardized Average Annual Abundance Estimates (Number/Mile) for "Wild" Rainbow Trout during Each Year of Monitoring, Compared to the Overall Annual Average Abundance over the 17-year Period of Record. The Blue Line Is the Locally Weighted Regression Smoothing of the Standardized Average Annual Abundance Estimates Obtained with S-plus© Function Loess (Span = 0.3)

Brown Trout

Relative to "wild" rainbow trout, brown trout are much more abundant in Mammoth Creek. For the 17-year period of record, the overall annual abundance of brown trout averages 1,555 fish per mile (see **Table 6-3**). Overall average annual abundance (number/mile) of brown trout is generally highest in the uppermost reach (Reach B) of Mammoth Creek.

Visual examination of potential temporal trends in the average annual abundance (number/mile) of brown trout (see **Figure 6-9**) also suggests a somewhat cyclic fluctuation about the long-term (17-year) average, as was suggested for "wild" rainbow trout. The average annual abundance of brown trout exhibits a decrease from 1994 through 1995, followed by a short period of increased abundance to 1997. From 1999 through 2005 brown trout abundance consistently declined. During 2006 and 2007, brown trout appear to have initiated a new period of increasing abundance followed by a decrease in 2008.

Trout Length-Frequency

Although site-specific variation in the abundance of size (and presumably age) classes is evident among years, multiple size classes of "wild" rainbow trout are present annually in Mammoth Creek over the 17-year period of record. A discussion of site-specific variation in the abundance of "wild" rainbow trout size classes is presented for the 2006-2008 surveys in Salamunovich (2006, 2007 and 2009). In general, most of the "wild" trout are represented by young-of-year (YOY) size class fish. Examination of brown trout length-frequencies demonstrates that multiple size/age classes are generally present at all of the 8 sampling sites during the 17 annual fish surveys in Mammoth Creek. It is evident that the YOY size class dominates the brown trout populations in each reach of Mammoth Creek. Overall, the YOY size class comprised approximately 70% of all brown trout captured over the 17 years of sampling in Mammoth Creek.

Table 6-3. Standardized abundance estimates (number/mile) for brown trout captured at each of the Mammoth Creek electrofishing sites, 1988-2008. Bold numbers indicate the highest value for each site (Modified from Salamunovich 2009)

	Sample Site								
	BH	BL	CH	CL	DH	DL	EH	EL	Annual Mean
2008	3,549	552	1,070	482	872	251	1,598	1,011	1,173
2007	4,949	238	1,691	731	3,142	**1,766**	**4,302**	**2,900**	**2,465**
2006	3,241	313	475	290	1,155	287	1,297	1,411	1,059
2005	1,320	792	634	194	387	862	669	563	678
2004	3,186	440	1,302	845	880	1,549	1,355	581	1,267
2003	2,869	458	**1,901**	933	616	1,426	1,390	616	1,276
2002	5,826	898	1,056	246	563	1,672	1,866	264	1,549
2001	4,717	1,707	1,496	246	1,144	1,162	1,461	528	1,558
2000	6,670	634	1,056	88	810	1,162	1,179	2,253	1,731
1999	5,333	1,338	1,707	299	2,200	616	2,182	2,200	1,984
1997	**8,589**	704	1,690	211	616	1,654	3,819	1,795	2,385
1996	4,858	158	1,302	158	1,901	634	898	1,144	1,382
1995	1,760	546	334	88	616	18	334	1,038	592
1994	4,171	2,253	810	528	**4,418**	1,584	2,464	405	2,079
1993	2,957	2,658	510	1,232	1,056	510	1,232	158	1,289
1992	3,045	1,848	563	845	1,390	1,584	3,978	194	1,681
1988	3,168	**4,699**	1,109	**1,901**	2,006	1,056	4,277	106	2,290
1988-2008	4,130	1,190	1,100	548	1,398	1,047	2,018	1,010	1,555

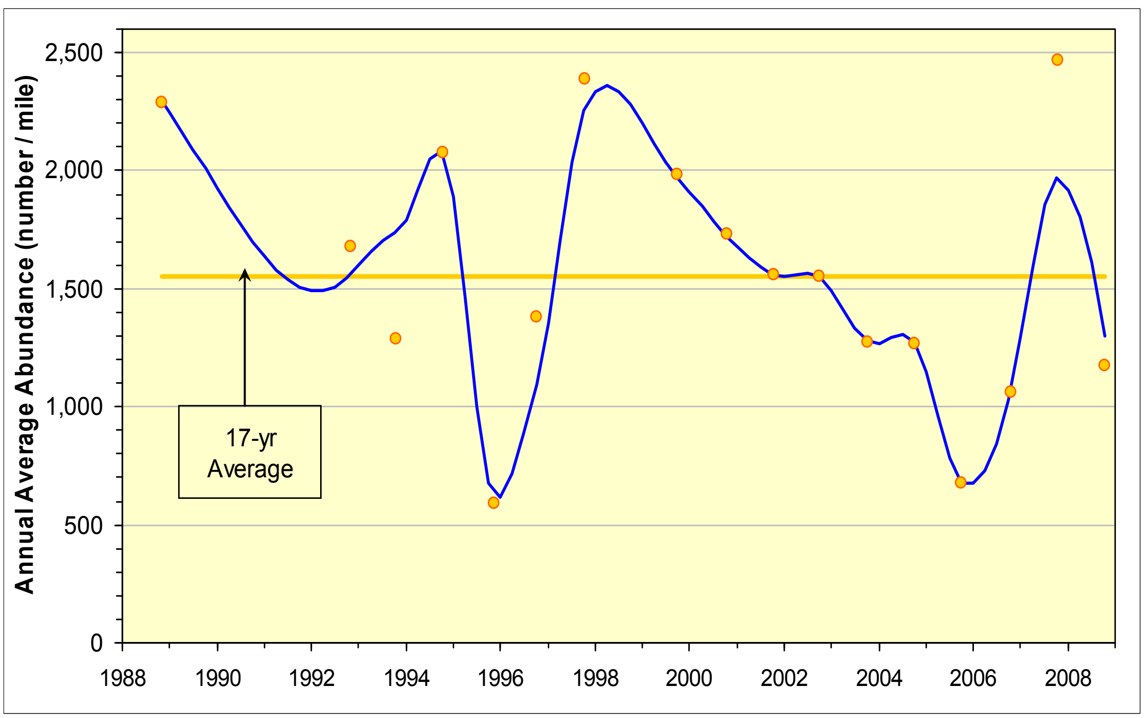

Figure 6-9. Standardized Average Annual Abundance Estimates (Number/Mile) for Brown Trout during Each Year of Monitoring, Compared to the Overall Annual Average Abundance over the 17-year Period of Record. The Blue Line Is the Locally Weighted Regression Smoothing of the Standardized Average Annual Abundance Estimates Obtained with S-plus© Function Loess (Span = 0.3)

Brown Trout Abundance Temporal Trends

Annual brown trout abundance estimates for Mammoth Creek and their 95% confidence intervals are displayed in **Figure 6-10**. The annual abundance estimates exhibit a slight decreasing trend over time which is extremely weak (r^2 =0.07) and non-significant (P =0.30).

Figure 6-11 displays the estimated annual abundances for all brown trout with fork lengths smaller that 120 mm, considered to be YOY brown trout, and their estimated 95% confidence intervals, in Mammoth Creek from 1988 through 2008. Annual YOY abundance estimates exhibit a decreasing trend which is extremely weak (r^2 =0.03) and non-significant (P =0.48).

YOY Brown Trout Density Temporal Trends

Annual YOY brown trout densities, expressed as fish/mile and averaged over the entire Mammoth Creek exhibit a slight decreasing trend over time, although the trend is extremely weak (r^2 =0.04) and non-significant (P = 0.45) (see **Figure 6-12**). The reach-by-reach annual average densities also exhibit extremely weak decreasing trends, none of which are significant (see **Figure 6-13**).

Additional trend analyses of YOY brown trout densities emphasized recent years (1999 through 2008). **Figure 6-14** displays the non-significant (P = 0.47) and extremely weak (r^2 = 0.07) decreasing linear temporal trend in the annual average YOY brown trout densities over the period 1999 through 2008. The reach-by-reach trend analysis of annual average YOY brown trout densities over the period 1999-2008 (see **Figure 6-15**) indicates a weak to moderate decreasing linear trend that is significant for Reach B (r^2 =0.39, P = 0.05). By contrast, the remaining three reaches exhibit decreasing (Reach D) or increasing (Reaches C and E) but extremely weak trends in annual average YOY brown trout densities (r^2 ranging from 0.002 to 0.0001), none of which were significant (P ranging from 0.90 to 0.98).

Because the recent annual average YOY brown trout densities displayed in Figure 6-14 result from averaging the eight sample site densities (two per reach) of each year, and because the reach-by-reach trend analysis of annual average YOY brown trout densities displayed substantial differences among reaches (see Figure 6-15), the relative importance of each particular reach (and associated temporal trend) in the average annual densities for the entire creek was appraised by removing the annual densities of a particular reach, one at a time, recalculating annual average YOY brown trout densities for the creek (now based on only three reaches each year), and repeating the regression analysis to obtain corresponding temporal trends. **Figure 6-16** displays the results of this evaluation.

The estimated decreasing trends (i.e., the regression slopes) are particularly affected when the annual YOY brown trout densities of Reach B are removed. When the relatively high annual densities of Reach B that display a moderate to weak decreasing trend (see Figure 6-15) are removed from the annual averaging, the resulting creek annual average YOY brown trout densities (green bars) display a nearly horizontal and very weak increasing temporal trend. This result indicates that, due to the relatively high densities of YOY brown trout in Reach B, combined with the moderate to weak, but significant decreasing trend in YOY density in Reach B from 1999 through 2008, the overall slight declining trend in YOY density in Mammoth Creek in recent years is most strongly influenced by Reach B. The removal of the annual densities of Reach C, D or E does not appear to substantially affect the temporal trends of the resulting creek annual average YOY brown trout densities in recent years (see blue, pink and violet bars and lines in Figure 6-16).

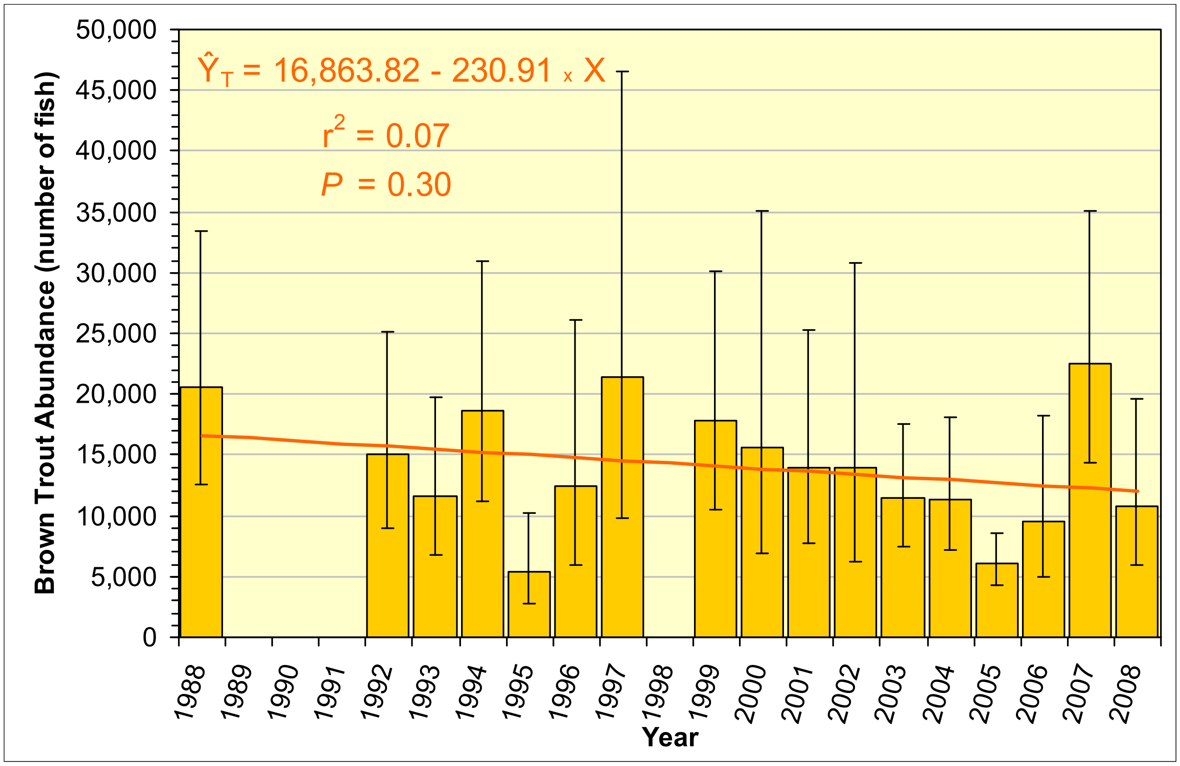

Figure 6-10. Annual Brown Trout Abundance Estimates (Bars), Estimated 95% Confidence Intervals (Error Bars) and Fitted Regression Line for Mammoth Creek between Sherwin St. and the Confluence with Hot Creek

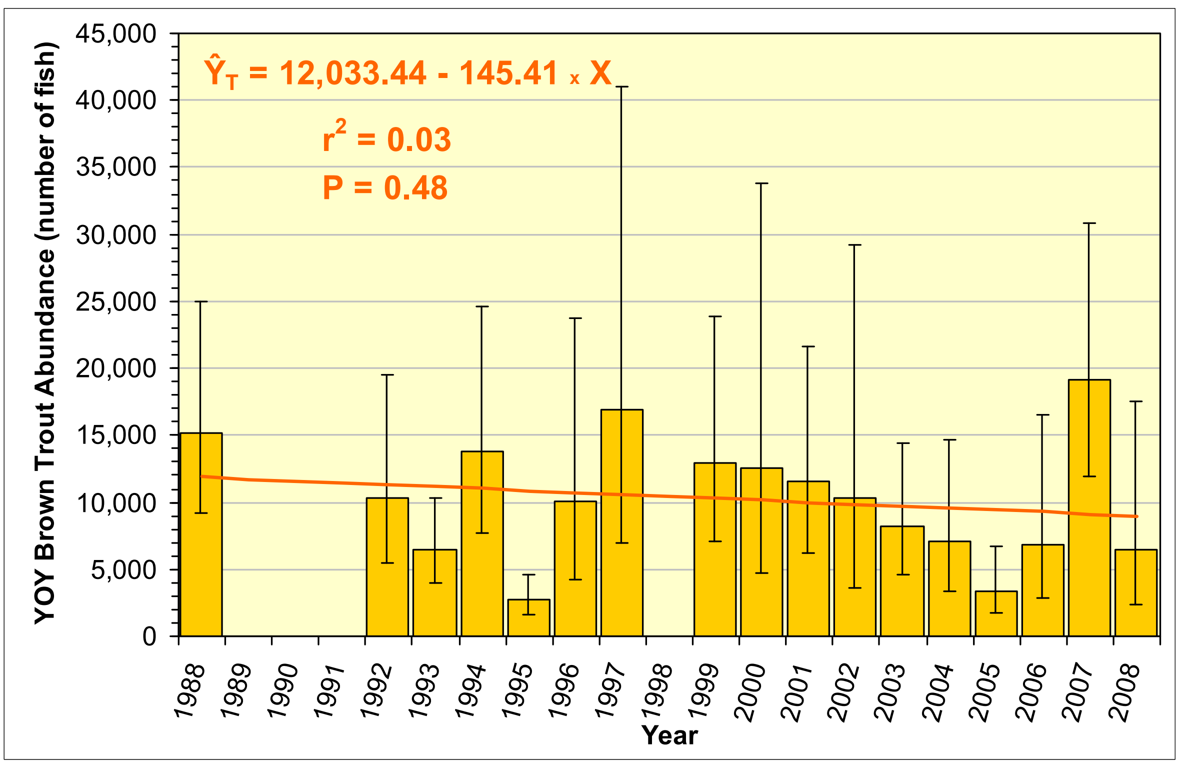

Figure 6-11. Annual YOY Brown Trout Abundance Estimates (Bars), Estimated 95% Confidence Intervals (Error Bars) and Fitted Regression Line for Mammoth Creek between Sherwin St. and the Confluence with Hot Creek

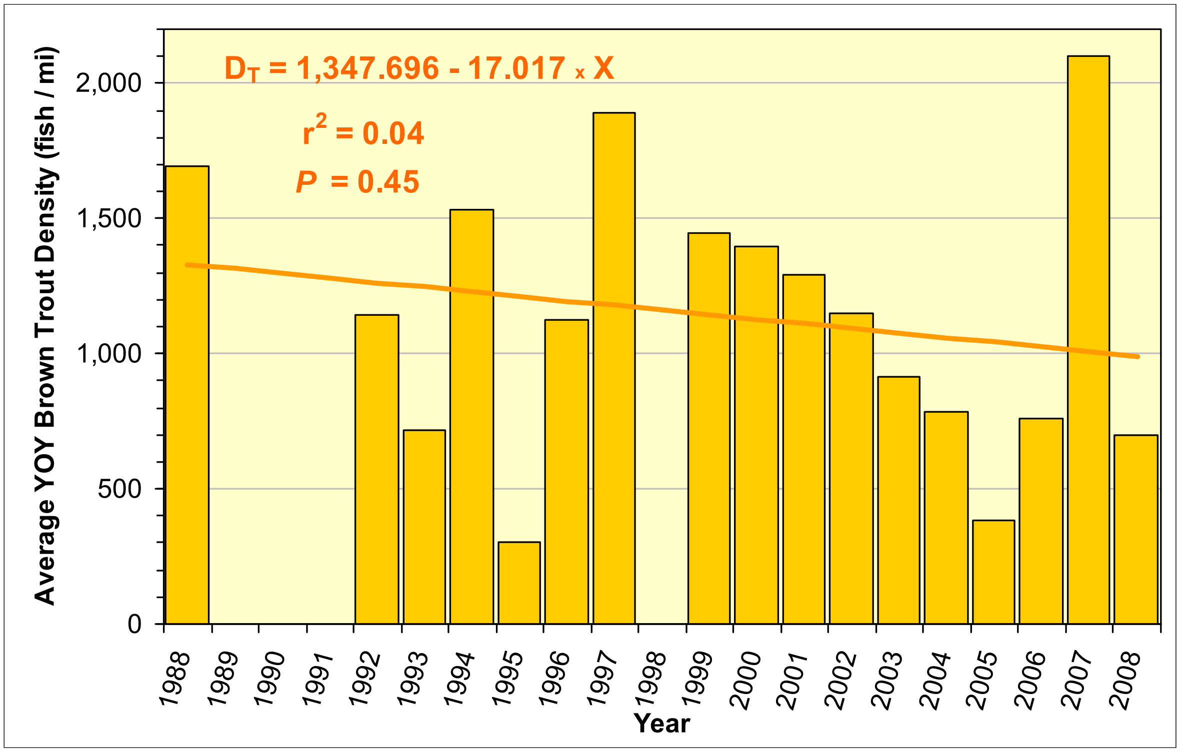

Figure 6-12. Annual Average YOY Brown Trout Density Estimates (Bars) and Fitted Regression Line for Mammoth Creek between Sherwin St. and the Confluence with Hot Creek

Potential Relationships Between YOY Brown Trout Density and Flow

The annual average YOY brown trout densities for all reaches of Mammoth Creek during the period 1988 through 2008 were regressed against OMR low flow quartile to assess potential relationships between the annual densities and the low Mammoth Creek flows of late summer and autumn, which precede the surveys each year. The observed distribution of the data set and resultant slope of the linear regression suggest that YOY brown trout density decreases as the flows during the summer/autumn period increase (see **Figure 6-17**). However, the relationship is not significant ($P = 0.12$) and weak ($r^2 = 0.15$).

The annual average YOY brown trout densities for all reaches of Mammoth Creek during the period 1988 through 2008 also were regressed against the lowest average monthly OMR flows (among August, September, and October) for each year to assess potential relationships between the annual densities and the low Mammoth Creek flows of late summer and autumn, which precede the surveys each year. As described for the regression using the low flow quartile as the explanatory variable each year, the linear regression suggests that the annual average YOY brown trout densities are negatively correlated with the lowest average monthly Mammoth Creek flows at the OMR Gage (see **Figure 6-18**). The observed distribution of the data set and resultant slope of the linear regression suggests that YOY brown trout density decreases as the flows during the summer/autumn period increase. This relationship is highly significant ($P = 0.01$) and weak to moderate ($r^2 = 0.34$).

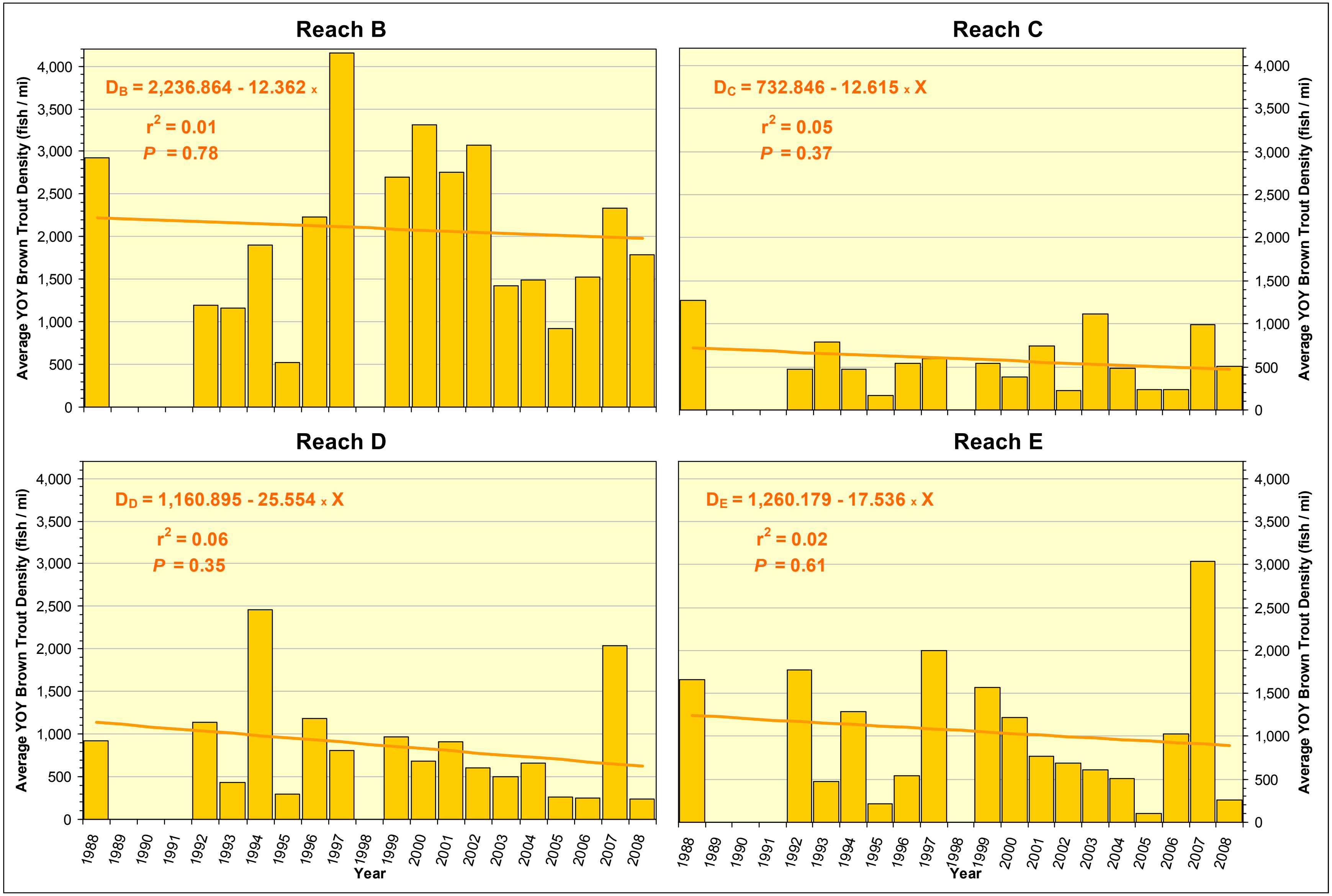

Figure 6-13. Annual Average YOY Brown Trout Density Estimates (Bars) and Fitted Regression Lines in the Four Surveyed Reaches of Mammoth Creek from 1988 through 2008

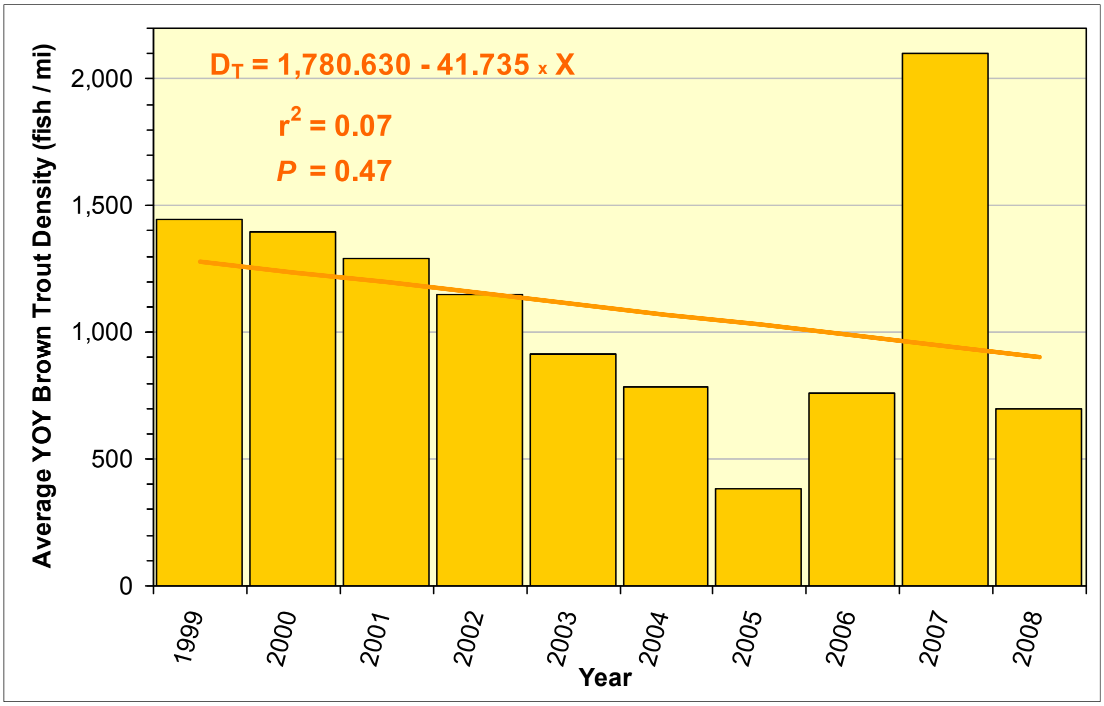

Figure 6-14. Annual Average YOY Brown Trout Density Estimates (Bars) in Mammoth Creek and the Fitted Regression Line for the Period 1999-2008

The annual average YOY brown trout densities for the entire Mammoth Creek during the period 1988 through 2008 also were regressed against OMR High Flow to assess potential relationships between the annual fall densities and the peak Mammoth Creek flows of the preceding late spring/early summer. The linear regression suggests that the annual average YOY brown trout densities are negatively correlated with the Mammoth Creek late spring/early summer peak flows (see **Figure 6-19**). The linear relationship was weak to moderate (r^2 = 0.34), and highly significant (P = 0.01). In other words, the highly significant negative correlation between annual average YOY brown trout density and peak runoff flows during late spring/early summer indicate that high peak flows are associated with low YOY brown trout densities the following autumn. Presumably, high peak runoff flows may scour the streambed and result in the dislodgement of incubating embryos, and/or flushing or displacement of post-emergent YOY brown trout from their habitats.

It was suggested by the Technical Team that streambed cleansing (via scouring flows) may result in additional substrate interstitial space availability for the colonization of benthic macroinvertebrates. It was further suggested that these potentially “improved” habitat conditions (i.e., increased macroinvertebrate production as a food supply) for YOY trout rearing may not be evident in YOY trout densities within a year due to potential embryo dislodgement, or flushing (or displacement) of YOY trout from their habitats, but may be reflected by YOY trout densities in the subsequent year. To examine this potential phenomenon, OMR high flow variables were lagged backward by one year, then regressed against the annual average YOY brown trout densities for the entire creek for the 17-year period of record. The observed distribution of the data set and resultant slope of the linear regression suggest that YOY brown trout density increases with an increase in peak runoff flow that occurred 1 year previously (see **Figure 6-20**). Although the relationship is significant (P = 0.02), it is weak to moderate (r^2 = 0.30).

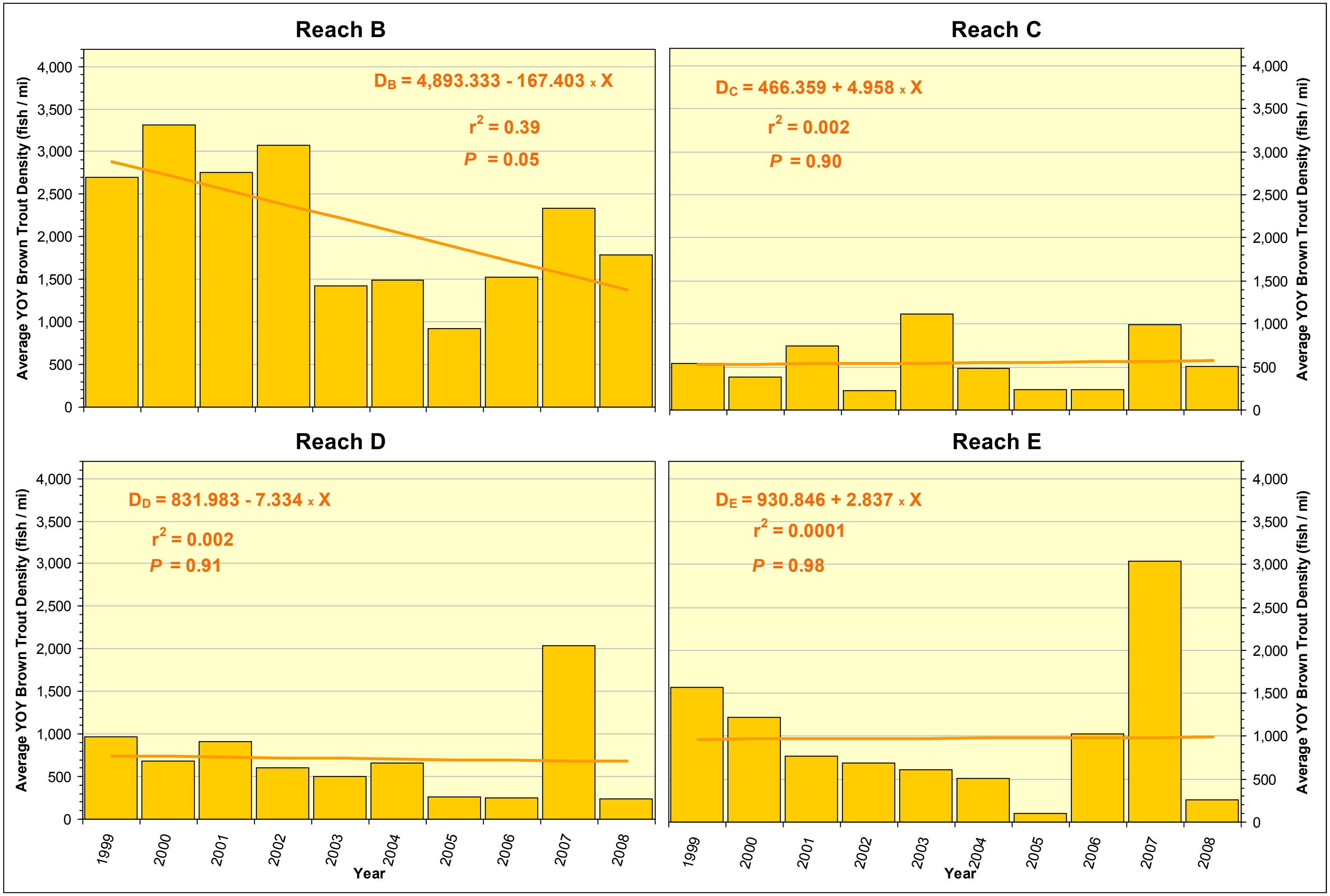

Figure 6-15. Annual Average YOY Brown Trout Density Estimates (Bars) and Fitted Regression Lines in the Four Surveyed Reaches of Mammoth Creek for the Period 1999-2008

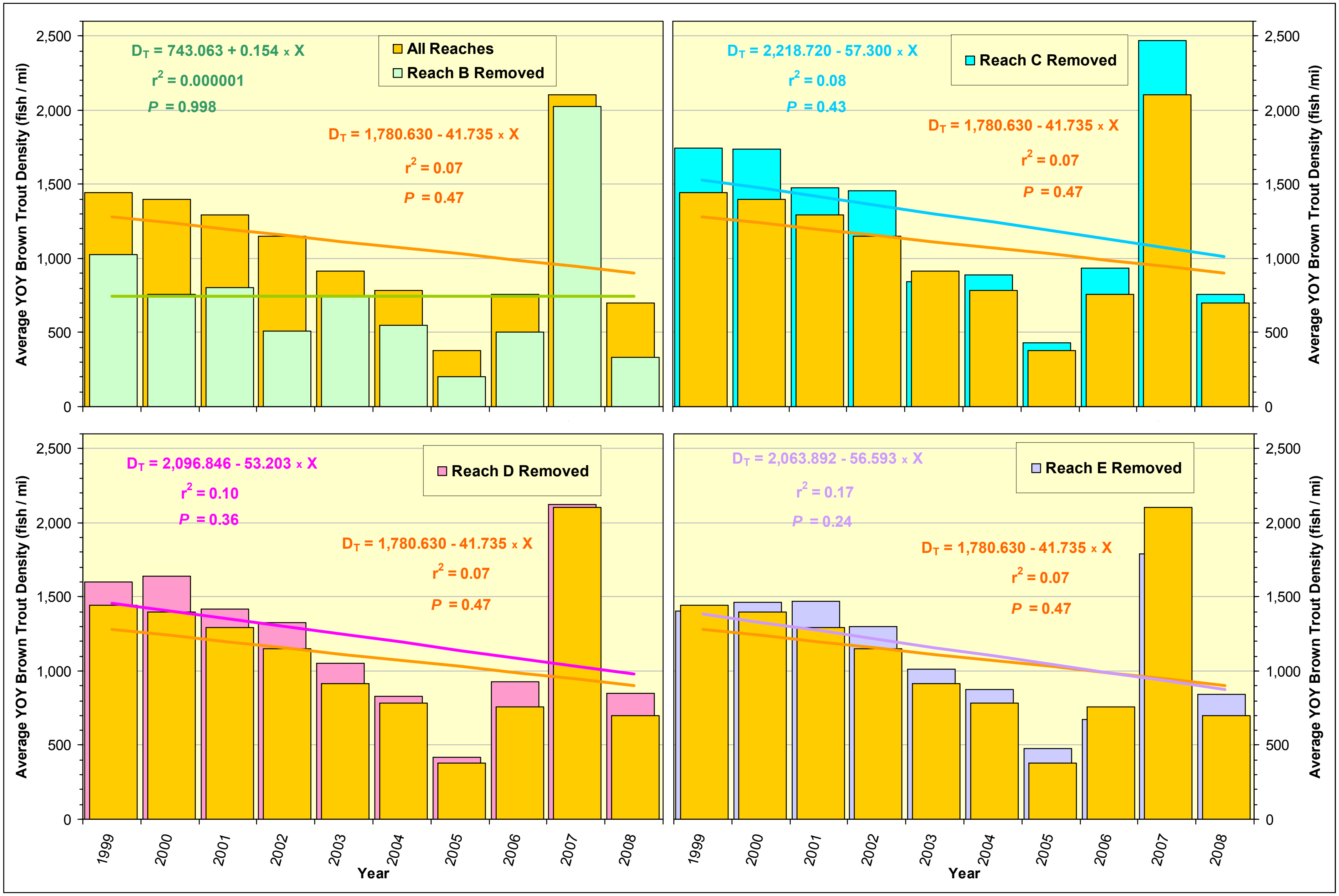

Figure 6-16. Influence of Annual Average Reach Densities on Annual Average YOY Brown Trout Density Trends in Mammoth Creek during 1999-2008. Orange Bars and Regression Lines Indicate the Trend of Creek Annual Average YOY Brown Trout Density with all Sampled Reaches; Bars and Lines in Green, Blue, Pink and Violet Indicate the Trends of the Creek Average Density after Removing Densities from Reaches B, C, D and E, Respectively

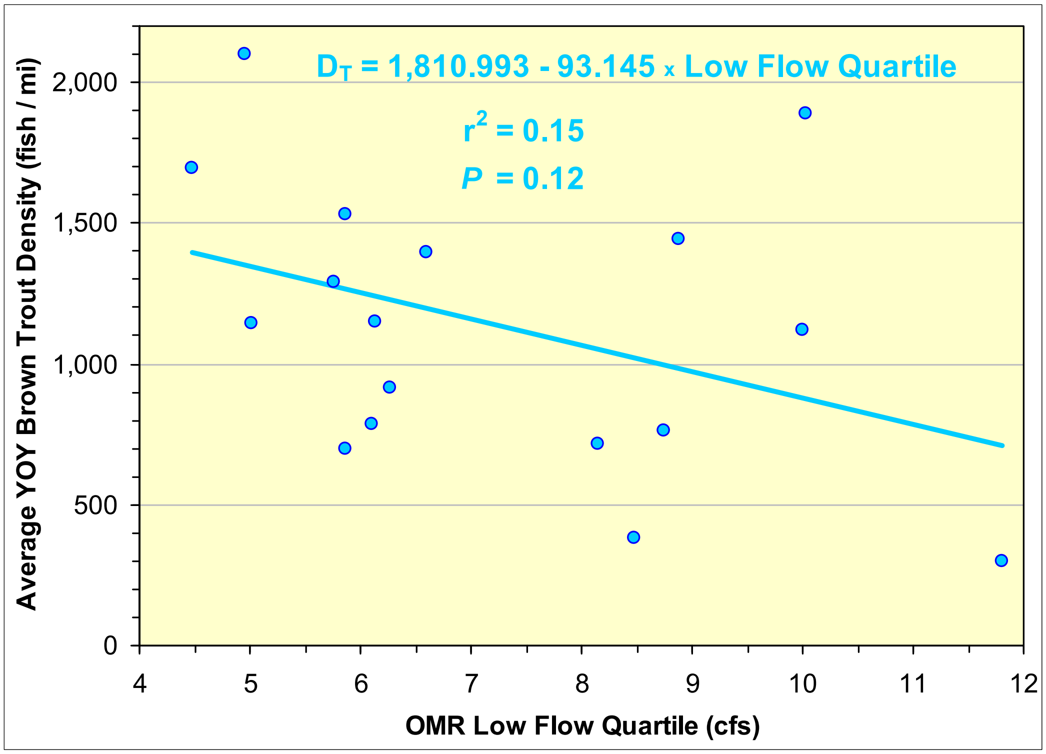

Figure 6-17. Annual Mammoth Creek Average YOY Brown Trout Density as a Function of OMR Low Flow Quartile and Corresponding Fitted Linear Regression Line for the Period 1988 through 2008

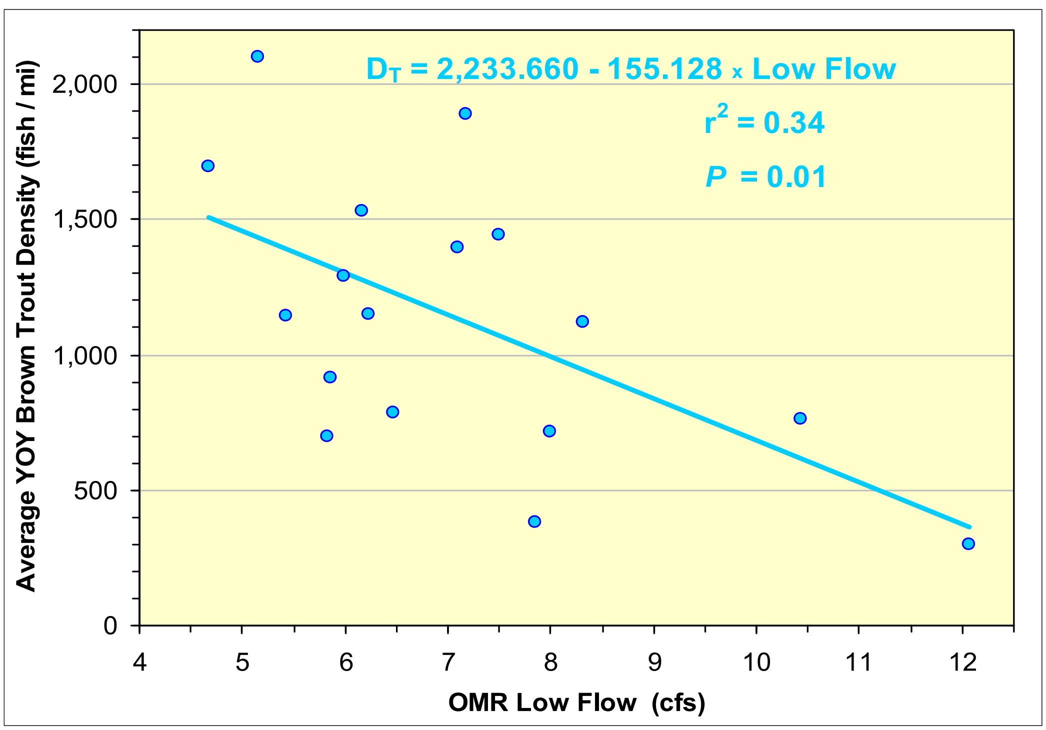

Figure 6-18. Annual Mammoth Creek Average YOY Brown Trout Density as a Function of OMR Low Flow and Corresponding Fitted Linear Regression Line for the Period 1988 through 2008

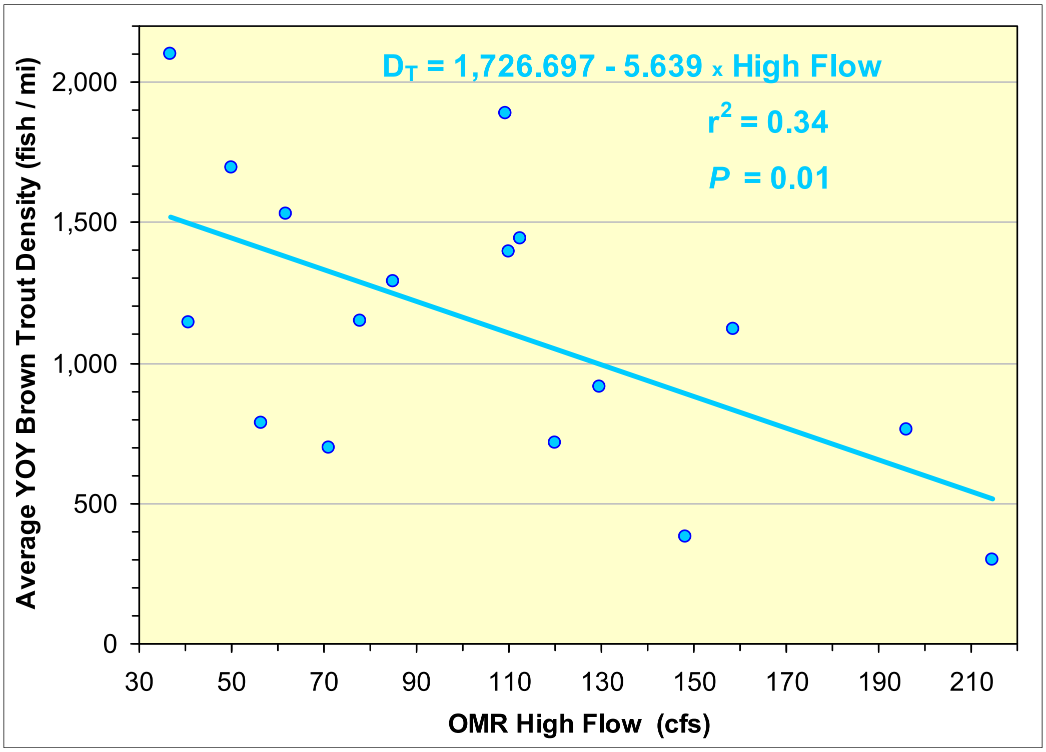

Figure 6-19. Annual Mammoth Creek Average YOY Brown Trout Density as a Function of OMR High Flow and Corresponding Fitted Linear Regression Line for the Period 1988 through 2008

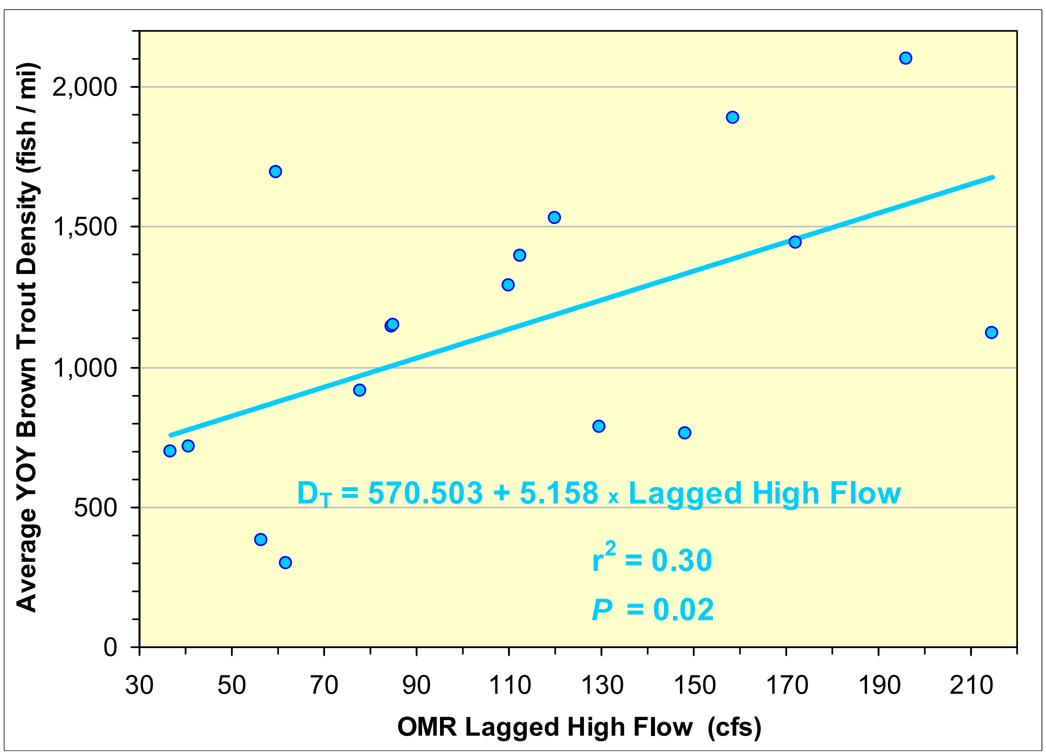

Figure 6-20. Annual Mammoth Creek Average YOY Brown Trout Density as a Function of One-Year-Lagged OMR High Flow and Corresponding Fitted Linear Regression Line for the Period 1988 through 2008

DISCUSSION – CALIFORNIA FISH AND GAME CODE SECTIONS 5937 AND 5946

California Fish and Game Code (Sections 5937 and 5946) stipulates that the owner of a dam is required to allow sufficient water to pass the dam in order to keep fish[1] in the stream below the dam in good condition. The District is obligated to meet this requirement. The term "good condition" implies a variety of biotic and abiotic factors that influence the aquatic community. CDFG's testimony before the SWRCB regarding the maintenance of fish in good condition and stream flow requirements in streams tributary to Mono Lake was as follows:

> *"[t]he instream flows necessary to keep fish in good condition include those which will maintain a self-sustaining population of desirably-sized adult vertebrate fish which are in good physical condition i.e. well proportioned, and disease-free. Fish populations should not be limited by lack of cover, food availability, poor water quality (including temperature), or lack of habitat necessary for reproduction. The fish populations should contain good numbers of different age classes, and habitat for these life stages should not be limiting.*
>
> *Therefore, the "good condition" requirement must include the protection and maintenance of the physical, geological, and chemical parameters that constitute the ecology of the stream. The ecological health of the stream will determine if fish, both vertebrates and invertebrates, are to be kept in good condition.'*[2]

CDFG's definition of necessary instream flows focuses on the ecological health of the stream as the indicator of good condition, and identifies the factors that indicate ecological health. These factors include: (1) attributes of the fish population such as a self-sustaining population with multiple age classes and appropriate abundance, in good physical condition; and (2) various stream characteristics including availability of food, cover, habitat, suitable water quality conditions, and the maintenance of these conditions. This definition also specifies that invertebrates as well as vertebrate fish are to be maintained in good condition.

Abundance

Data obtained over the 17 years of fish community surveys in Mammoth Creek demonstrate considerable variation in trout abundance among years, and among sample sites within years. Variation in trout abundance is most likely in response to variable environmental conditions (e.g., stream flows, habitat availability and suitability), variable biologic responses (e.g., reproductive success, over-winter survival, food availability, growth, year-class strength and recruitment potential), and variable anthropogenic influences (e.g., hatchery stocking practices, recreational angling, land use and development).

Insight to the recent status of trout abundance in Mammoth Creek can be gained by comparison to estimates of abundance in nearby creeks during the 1970s and 1980s, prior to development in the Mammoth Lakes Basin (particularly in the Town of Mammoth Lakes) and the increased recreational use that has occurred over the last three decades.

Salamunovich (2006, 2007, 2009) reported biomass estimates for the 2006, 2007 and 2008 fish surveys, although the overall lack of complete and accurate measurement of fish weights and sample site areas prohibit the accurate calculation of area-based biomass (i.e., fish pounds per acre) for previous survey years. He reported that seven of the eight sample sites in Mammoth

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[1] The term "fish" as defined in California Fish and Game Code Section 45 includes both vertebrate and invertebrate aquatic life.

[2] Taken from CDFG testimony at SWRCB hearings for Mono Lake and the Mono Basin in September 1990 (from MCWD and USFS 2000).

Creek range from 11-20 ft in width, and in 2006 provided an average wild trout (both brown and rainbow) biomass estimate of 92.9 pounds per acre, which ranged from a low of 46.5 pounds per acre at site CL to a high of 156.5 pounds per acre at site DH. In 2007, those seven sites provided an average wild trout biomass estimate of 96.6 pounds per acre, and ranged from a low of 27.7 (site CL) to a high of 143.8 pounds per acre (site DH), while in 2008 they provided an average wild trout biomass estimate of 81.5 pounds per acre, and ranged from a low of 25.9 (Site CL) to a high of 140.2 pounds per acre (Site EL).These biomass estimates exceed the approximate 33 to 35 pounds per acre for similarly-sized Sierra streams reported by Gerstung (1973). The eighth sample site (BL) in Mammoth Creek was characterized by a mean width of less than 10 ft, and provided wild trout biomass estimates of 70 pounds per acre during 2006, 35.0 pounds per acre during 2007, and 57.9 pounds per acre during 2008, which were respectively 100, 50 and 83% of Gerstung's biomass estimate for streams of similar sizes (Salamunovich 2006, 2007, 2009).

CDFG conducted a survey of fish populations in streams of the Owens River drainage in 1983 and 1984 (Deinstadt et al. 1985). Fish populations were estimated within pre-selected sampling sections and then, based upon the length of each individual sampling section, directly extrapolated and expressed as the number of trout per mile. In creeks near Mammoth Creek, CDFG estimated from 877 to 4,822 brown trout per mile in four sections of Convict Creek, and from 600 to 1,109 brown trout per mile in McGee Creek. In addition to nearby creeks, CDFG also estimated brown trout abundance in Mammoth Creek itself. CDFG's estimates for five sections of Mammoth Creek ranged from 493 to 2,798 brown trout per mile. By comparison, although subject to inter-annual variability, annual average abundance of brown trout at individual sample sites ranges from 548 brown trout per mile at sample site CL to 4,130 brown trout per mile at sample site BH, with an overall average of 1,555 per mile for the recent 17-year period of monitoring. These comparisons indicate that brown trout abundance in recent years is comparable to abundance estimates from over 20 years ago in nearby creeks, as well as from Mammoth Creek itself.

Rainbow trout also exhibit inter- and intra-annual (among site) variability in abundance in Mammoth Creek, and are much less abundant than brown trout. Examination of the data suggests that "wild" rainbow trout abundance (fish/mile) is somewhat cyclic over the 17-year period of record, with generally distinguishable 4-5 year cycles when "wild" rainbow trout abundance fluctuates about the long-term (17-year) average. "Wild" rainbow trout abundance increased from 2004 through 2006, and decreased in 2007 and 2008. As previously mentioned, however, "wild" rainbow trout data must be interpreted with caution because of the problems associated with the identification of "wild" versus hatchery rainbow trout, the unaccounted for variations in hatchery planting practices, and recreational angling harvest.

Resilience

Population resilience (i.e., the ability of the population to recover from episodic environmental events that reduce population numbers) also is an important indicator of the condition of the population and the quality of the habitat. Fish populations with relatively high reproductive potential that inhabit streams where spawning habitat is not limiting can recover quickly from short-term reductions in numbers and maintain a relatively stable long-term population. By contrast, populations with low reproductive potential or that occupy streams where spawning habitat, or habitat for early life stages is limiting, may remain depressed for longer periods following isolated events that reduce population numbers (MCWD and USFS 2000).

For the 17 years of fish survey data, the brown trout indicators of population annual average abundance (number per mile) and YOY density (number/mile) for Mammoth Creek exhibit considerable inter-annual variation. Examination of the data demonstrates that the brown trout population has the ability to recover (i.e., exhibit increased abundance) relatively quickly following episodic reduced abundance levels in specific years. For example, the lowest abundance among all 17 years of sampling for all brown trout, as well as for YOY brown trout, occurred in 1995. However, by 1997 the second highest abundance of brown trout (and YOY brown trout) occurred, over a four-fold increase over 1995 levels. The second-lowest year of brown trout abundance occurred in 2005, yet the abundance of all brown trout and of YOY brown trout increased substantially in 2006, and in 2007 achieved over a four-fold increase of 2005 levels, for the highest annual abundance of all 17 years. These trends indicate the resiliency of the brown trout populations in Mammoth Creek.

Size/Age Structure

Examination of brown trout length-frequencies demonstrates that multiple size/age classes were generally present during each of the 17 annual fish surveys in Mammoth Creek. It is evident that the YOY size class dominates the brown trout populations in each reach of Mammoth Creek. Overall, the YOY size class comprised approximately 70% of all brown trout captured over the 17 years of sampling in Mammoth Creek.

The largest group each year most likely represents YOY fish from 50 to 120 mm in fork length (FL), the group from about 120 to about 180 mm FL probably represents 1-year old fish (Age I), the group from about 180 to 260 mm FL are most likely 2-year old fish (Age II), and fish in the 260 to 320 mm FL size range may represent 3-year old fish (Age III). Older fish may be represented by the few fish captured that were larger than 320 mm (up to 462 mm) FL.

The observed length groups correspond well with previous investigations, although ages of fish were not directly estimated from these studies. Average length at annulus formation for brown trout in east slope Sierra Nevada streams has been reported to range from 84-139 mm FL (Age I) 160-257 mm FL (Age II), and 252-318 mm FL (Age III). In nearby Hot Creek, the average length at annulus formation was reported to range from 133-157 mm FL (Age I), 227-243 mm FL (Age II), and 291-317 mm FL (Age III) (Snider and Linden 1981).

Available data demonstrate that Mammoth Creek supports a self-sustaining population of brown trout of multiple size/age classes, including adult-sized fish.

Physical Condition

The previously described CDFG interpretation of "good condition" included fish in good physical condition (i.e., well-proportioned and disease-free). Over the 17 years of fish community surveys in Mammoth Creek, general reporting of visual examination of fish for external indicators of disease or fish "health" (i.e., lesions, tumors, parasites) is lacking. However, physical condition in terms of physiologic proportion, expressed as Fulton's Condition Factor (K), is reported for the first and last three survey years. The condition factor compares an individual fish's weight-length relationship, with values of 1.0 or more generally considered normal for a healthy trout population (Salamunovich 2009).

For the earliest (1988) survey, 93% of all brown trout collected exhibited condition factors equal to or exceeding a value of 1.0. For the 2006 survey, reported condition factors for both brown and "wild" rainbow trout at all sampling sites were well above the 1.0 "healthy" trout level (Salamunovich 2006). For the 2007 survey, 97% of all brown trout and "wild" rainbow trout collected, and for the 2008 survey, 98% of all brown trout and 95% of all "wild" rainbow trout collected exhibited condition factors equal to or exceeding a value of 1.0 (Salamunovich 2009). Thus, available information indicates that resident trout in Mammoth Creek are in good physical condition.

Habitat

Habitat considerations also were included in CDFG's interpretation of good condition – specifically, that fish populations should not be limited by lack of cover, poor water quality (including water temperature), or lack of habitat necessary for reproduction.

Fish cover can be characterized as instream cover including factors such as surface water turbulence, instream object cover (hydraulic roughness elements generally in the form of large substrates or woody material), undercut banks, aquatic vegetation, and overhanging vegetation proximate to the water surface. Fish cover also can be characterized as riparian vegetation and its associated canopy cover. Although the dominant cover type varies among sample sites, all of the sample sites contain some forms of instream cover (Salamunovich 2006). With the exception of the lowest reach (Reach E), which is in active pastureland, Mammoth Creek supports riparian communities. As previously discussed, anecdotal observations suggest that riparian cover may have increased at certain sampling sites since 1988 through the establishment of willows.

As previously discussed, available water temperature information for Mammoth Creek indicates that water temperatures were generally within the optimal ranges reported for fry, juvenile, and adult life stages of brown trout during the summer, and were less than optimal but generally within the tolerance range during fall and spring. Water temperatures during winter were generally at or slightly below the reported tolerance range for all life stages. High water temperatures do not appear to be a significant problem in Mammoth Creek, although maximum daily water temperatures in the lowermost section of Mammoth Creek near its confluence with Hot Creek can reach stressful levels during the summer, but those temperatures are present only for relatively short periods due to the substantial diurnal fluctuations.

It is clear that habitat necessary for reproduction is not lacking in Mammoth Creek. The dominance of YOY trout each year of the 17 annual surveys demonstrates successful reproduction.

Available information indicates that the trout populations in Mammoth Creek, particularly the brown trout population, are not limited by lack of cover, poor water quality (including water temperature) or lack of habitat necessary for reproduction.

Aquatic Macroinvertebrates

The previously described CDFG interpretation of maintaining fish in "good condition" addresses the macroinvertebrate community, and the term "fish" as defined in California Fish and Game Code Section 45 includes both vertebrate and invertebrate aquatic life. A thorough examination and discussion of available benthic macroinvertebrate community information for Mammoth Creek is presented in **Attachment A** to Appendix E. Following is a brief summary of that information.

MCWD and USFS (2000) reported that the aquatic invertebrate sampling conducted from 1992 to 1994 suggests that the aquatic invertebrate community in Mammoth Creek is relatively healthy, being composed of a relatively large number of taxa (around 20), representing a number of different families (around 15), and with good representation of the more sensitive taxa within the EPT orders.

Benthic macroinvertebrate (BMI) sampling conducted as a requirement of the Hot Creek Hatchery NPDES Permit from 2000 through 2004 indicated that six of twelve metrics strongly support the hypothesis that the Hot Creek Hatchery springbrook inflows have lower biotic integrity than Mammoth Creek (Jellison et al. 2005a). Jellison et al. (2007) conducted a re-analysis of BMI data across all years employing comparable data sets collected from 2000-2006. Biotic integrity (i.e., richness) was higher in Mammoth Creek compared to the springbrooks above the hatchery. EPT Index[3] was higher at Mammoth Creek compared to CD springbrook ($p<0.05$) and probably AB springbrook ($p<0.1$). The percent of the benthic macroinvertebrate community comprised of tolerant organisms was much lower in Mammoth Creek than in Hot Creek, including the headsprings. Six of eleven commonly used metrics indicate statistically significant lower biotic integrity at springbrooks *above* the hatchery compared to Mammoth Creek and none indicated higher biotic integrity. Jellison et al. (2007) note that only the sites located in the lowermost section of Mammoth Creek (by contrast to Hot Creek) exhibited index of biotic integrity (IBI) scores approaching those in reference streams in the Lahontan Region. However, Jellison et al. (2007) further note that this 12-metric IBI was developed to discriminate between impaired and reference streams where impairment was due to land development and/or grazing, and that the 12-metric IBI is simply another way to summarize and visualize the Hot Creek bioassessment data.

For Mammoth Creek, available benthic macroinvertebrate data and information is focused on the lowermost sections of the creek. The lowermost section of Mammoth Creek exhibits higher benthic macroinvertebrate biotic integrity than in Hot Creek below the Hot Creek Hatchery, above the Hot Creek Hatchery and even in the headsprings area which serves as inflow to the hatchery. The lowermost section of Mammoth Creek would be most subject to the cumulative influences of contaminant inputs, nutrient loading, livestock grazing effects and associated sediment deposition, due to the downstream location and low-gradient nature of this section of the creek. The lowermost section of Mammoth Creek could be expected to exhibit the lowest benthic macroinvertebrate biotic integrity of the entire creek. Therefore, it is reasonable to assume that the sections of Mammoth Creek located upstream of the lowermost section would exhibit higher indices of benthic macroinvertebrate biotic integrity, and that Mammoth Creek benthic macroinvertebrates are in good condition.

6.1.3.3 POPULATION TEMPORAL TRENDS/FLOW CONSIDERATIONS

Of all of the various indices of abundance examined for the 17 years of fish survey data, YOY brown trout density is the most reliable indicator of the annual status of trout populations in Mammoth Creek because it is not directly influenced by the planting of hatchery fish, or by recreational angling.

As previously presented, what appears to be a slight trend of declining YOY brown trout abundance over the 17 years of fish survey data is not significant. Moreover, a slight but non-significant decreasing temporal trend in the annual average YOY brown trout densities for the entire (all reaches) Mammoth Creek study area also is evident in recent years (1999-2008). Recent years can be characterized as a relatively "wet" hydrologic period. In fact, over the 17 years included in the analysis, three of the five highest peak spring/early summer runoff flows

[3] The EPT Index is the percentage of organisms in Ephemeroptera, Plecoptera, or Trichoptera taxa.

(expressed as OMR High Flow) have occurred during the last six years, although 2007 was a dry year with the second lowest peak spring/early summer runoff flows in the 17-year study period (OMR High Flow = 36.7 cfs).

As previously discussed, over the 17 years of fish community surveys, brown trout populations have exhibited sporadic years of reduced abundance. MCWD and USFS (2000) attributed the episodic occurrences of low brown trout abundance to the influence of high runoff years that result in low population densities the following autumn. In the 1999 Fish Community Survey Report, Dr. Thomas Jenkins (1999) came to a similar conclusion, stating …

> *"Brown and rainbow trout populations are undergoing natural variations in population density, almost certainly in synchrony with other snow-melt dominated Easter Sierra streams. If minimum flows are not decreased beyond what has occurred in census years (e.g., to the point of exposing spawning gravels), and if the stream is not physically altered, we expect that the future trajectory of Mammoth Creek trout populations will depend primarily on the negative relationship between high stream flows and survival of juvenile trout."*

The analyses of the 17 years of Mammoth Creek fish survey data support these previous conclusions. Evaluation of the data demonstrates that YOY brown trout density is significantly associated with flow during the summer/autumn low-flow period in Mammoth Creek. In fact, the statistically significant trend in the data suggest that annual average YOY brown trout density is negatively associated with flow during the summer/autumn low-flow period (i.e., higher YOY brown trout density is associated with lower flow). This relationship may actually reflect the influence of antecedent spring/early summer peak runoff flows on the establishment of brown trout initial year-class strength in Mammoth Creek. A highly significant, although moderately weak, negative relationship is evident between annual average YOY brown trout density and spring/early summer peak runoff flows (i.e., the higher the peak runoff flow, the lower the YOY brown trout density the following autumn).

The relationships between annual average YOY brown trout density and flow during the summer/autumn low-flow period should not be interpreted to mean that flows during summer and autumn are not important for juvenile rearing trout, or that flow-related habitat availability does not provide the opportunity for the establishment of relatively abundant initial year-classes of trout in Mammoth Creek. Rather, the available data from 1988-2008 most probably reflect the negative influence of spring/early summer peak runoff flows on the number of YOY brown trout present each year to utilize available summer/autumn rearing habitat in Mammoth Creek.

Finally, as previously presented, results indicate that due to the relatively high densities of YOY brown trout in Reach B, combined with the weak to moderate and significant decreasing linear trend in recent YOY brown trout density in Reach B, the overall slight declining linear trend in YOY brown trout density in Mammoth Creek during recent years (1999-2008) is most strongly influenced by Reach B. Also, a weak to moderate, and highly significant negative relationship is evident between annual average YOY brown trout density for the entire creek and spring/early summer peak runoff flows (i.e., the higher the peak runoff flow, the lower the YOY brown trout density the following autumn). However, further examination of the data reveals that annual average YOY brown trout density in Reach B (individually) is not significantly associated (r^2 = 0.11, P = 0.19) with spring/early summer peak runoff flow (expressed as OMR high flow), whereas relatively weak (r^2 = 0.20, 0.29 and 0.26) and often significant (P = 0.07, 0.03, 0.04) negative relationships were found for reaches C, D and E, respectively. This conflicting trend in Reach B, relative to the entire Mammoth Creek, suggests that some other factor or factors contribute, at least partially, to the moderately strong and significant declining linear trend in YOY brown trout density in Reach B during recent years. Potential contributing factors are uncertain, although it is noted that Reach B passes through the Town of Mammoth Lakes, where much of the local area development has occurred during recent years. A discussion of the development and activities that have occurred over the past decade within and along Reach B of Mammoth Creek is presented in **Attachment B** to Appendix E.

6.1.3.4 CONCLUSIONS – CALIFORNIA FISH AND GAME CODE SECTIONS 5937 AND 5946

As previously discussed, CDFG's interpretation of maintenance of fish populations in good condition below a dam focuses on the ecological health of a stream, and identifies several components that contribute to ecological health, including fish population attributes and various stream habitat characteristics. The results of the analysis of 17 years of fish monitoring data in Mammoth Creek and available macroinvertebrate data indicate the following:

- Rainbow and brown trout annually persist in Mammoth Creek, and brown trout abundance is comparable to abundance estimates from 25 to 30 years ago in nearby creeks, as well as within Mammoth Creek itself.
- The brown trout population in Mammoth Creek is resilient and has the ability to recover from episodic occurrences of reduced population numbers.
- Mammoth Creek supports a self-sustaining population of brown trout comprised of multiple size/age classes, including adult-sized fish.
- Resident trout, particularly brown trout, in Mammoth Creek are in good physical condition.
- Habitat conditions in Mammoth Creek include sufficient cover, water quality, and habitat necessary for reproduction.
- Successful reproduction of trout in Mammoth Creek occurs each year.
- Available benthic macroinvertebrate community information suggests: (1) the aquatic invertebrate community from 1992 to 1994 in Mammoth Creek was relatively healthy; (2) sampling from 2000 through 2004 indicated that six of twelve metrics strongly support the hypothesis that Mammoth Creek has higher biotic integrity compared to the Hot Creek Hatchery springbrook inflows; (3) updated analyses of 2000-2006 data demonstrated that biotic integrity (i.e., richness) was higher in lower Mammoth Creek compared to the springbrooks above the Hot Creek Hatchery.

  Available benthic macroinvertebrate data and information is focused on the lowermost sections of Mammoth Creek, which could be expected to exhibit the lowest benthic macroinvertebrate biotic integrity of the entire creek due to cumulative influences of contaminant inputs, nutrient loading, livestock grazing effects and associated sediment deposition. Therefore, it is reasonable to assume that the sections of Mammoth Creek located upstream of the lowermost section would exhibit higher indices of benthic macroinvertebrate biotic integrity, and that Mammoth Creek benthic macroinvertebrates are in good condition.
- YOY brown trout density, the most reliable indicator of the annual status of trout populations in Mammoth Creek, is significantly (albeit weakly to moderately)

negatively associated with one expression of low flow during the summer/autumn low flow period. The relationship indicates that YOY brown trout densities decrease with increased flow during the summer/autumn low flow period. However, this relationship may actually reflect the influence of antecedent spring/early summer peak runoff flows on the establishment of brown trout initial year-class strength.

- For Mammoth Creek overall, YOY brown trout density is weak to moderately (but significantly) negatively associated with spring/early summer peak runoff flows (i.e., high peak runoff flows result in low YOY brown trout densities).
- The lack of a relationship between YOY brown trout densities in Reach B (individually) and flows suggests that other factors contribute, at least partially, to years of relatively low YOY brown trout densities in Reach B, the reach that passes through the Town of Mammoth Lakes.

In conclusion, consideration of all of the above population attributes and stream characteristics indicates that the fish in Mammoth Creek are in good condition.

6.1.4 HOT CREEK

Hot Creek is famous for its fishing. Brown trout and rainbow trout are regularly caught in a catch and release year-round fishery (fly fishing with barbless artificial flies only). According to Hot Creek Ranch publications, trout in excess of 20 inches are not uncommon; 14 to 15 inch trout are the rule rather than the exception, and 12 to 13 inch trout are standard.

Hot Creek has been designated by CDFG as an official Wild Trout Stream (CDFG 2010a). This means that only naturally reproducing trout exist in the stream, and hatchery raised fish are not released into Hot Creek. Besides the introduced (non-native) rainbow, brown and the brook trout, the warm waters of Hot Creek provide habitat for several other fish species, including Owens sucker and tui chub.

Hot Creek is characterized by three fishing sections. The first section is located just below the Hot Creek Hatchery and the confluence of Mammoth Creek. This short 1/4 mile section that is open to the public for catch-and-release fly-fishing has mostly flat smooth water with deep pools. The stream continues to meander through meadows to a wire fence that marks the start of the second fishing section, the private and very popular Hot Creek Ranch, where anglers are allowed to use only dry flies. Hot Creek Ranch is opened from the last Saturday in April to November 15th. Directly downstream of the ranch is the most popular public section of Hot Creek, located in a rocky canyon.

Before 2007, fishing in Hot Creek was closed from November to the end of April. In 2007, the California Fish and Game Commission voted to open Hot Creek and several other streams in the eastern Sierra to year-round catch-and-release fishing.

CDFG manages 19 fish hatcheries throughout California, including the Hot Creek Fish Hatchery, which produces ~280,000 lb (~1.27 metric tons) yr-1 of rainbow trout for planting in Eastern Sierra lakes and streams (Jellison et al. 2007). The potential and actual impacts of fish hatcheries have been well-documented (CDFG 2010) and Hot Creek Fish Hatchery discharges are regulated under NPDES permit number CA102776. Jellison et al. (2007) reports that annual bioassessment monitoring of BMI was implemented in 2000 and a subsequent Lahontan RWQCB staff review of BMI monitoring concluded "*the available information, taken as a whole, indicates impairment of aquatic life beneficial uses in the receiving waters below the hatchery facilities.*"

The spatial extent of the stressor identification conducted from 2000 through 2007 was limited to that of existing benthic macroinvertebrate data from Mammoth and Hot creeks in the vicinity of the hatchery (see **Figure 6-21**). This encompasses Mammoth Creek from its confluence with Hot Creek to the uppermost sampling location approximately 0.4 miles upstream, and Hot Creek from its origin at hatchery source springs to the confluence with Mammoth Creek (~0.6 miles) and then downstream to the lower property line of Hot Creek Ranch (~1.4 miles). A thorough discussion of benthic macroinvertebrate information for Hot Creek is provided in Attachment A to Appendix E and is briefly summarized below.

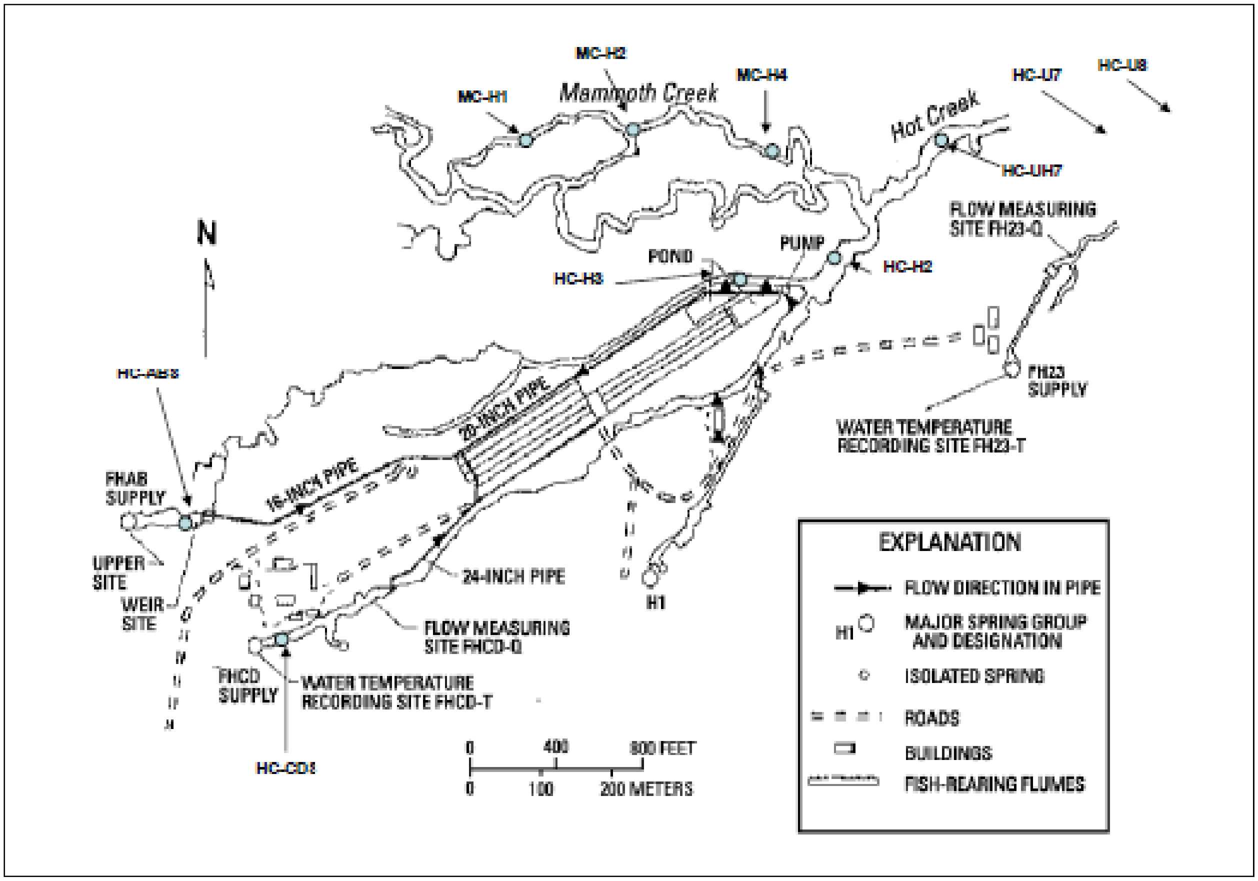

Figure 6-21. Hot Creek Hatchery Bioassessment Monitoring Sites (Jellison et al. 2007)

Jellison et al. (2007) concluded that nutrient enrichment due to phosphorus and nitrogen-rich spring waters is the primary cause of the observed low biotic integrity in Hot Creek. Luxuriant macrophytic growth exists throughout the springbrook reaches and extends below the confluence of Mammoth and Hot Creek. Macrophyte beds alter the benthic environment by attenuating current velocity; increasing depth, deposition, and organic content of the sediments; decreasing light penetration at the expense of periphyton and specialized macroinvertebrates while increasing hiding cover for insectivorous trout. Dissolved inorganic phosphorus concentrations remain in excess of plant growth requirements in Hot Creek waters throughout the study area (i.e. through lower Hot Creek Ranch). Hatchery source springs are also high in nitrate. The relatively pristine biotic integrity of Hot Creek springbrooks *above* the hatchery is markedly lower than that of Mammoth Creek by nearly all measures considered in this study.

Jellison et al. (2007) stated that hatchery metabolic waste products contribute significantly to nitrogen enrichment and are a secondary cause of the observed impacts. These are likely sufficient to cause impacts to biotic integrity in absence of the primary cause. They concluded, based on the available evidence and the scientific literature, that total suspended solids in hatchery discharges are likely to also be a secondary cause of the impacts. However, this is less certain and they recommended water quality measurements be conducted to reduce this uncertainty. Appropriate pond maintenance and solids removal would likely markedly reduce both these stressors.

Jellison et al. (2007) reports that the spatial variation in the BMI metrics and relative abundance of individual taxon clearly indicate that benthic communities supported by hatchery springbrook waters above and below the hatchery are very different from those of Mammoth Creek fed by snowmelt runoff. Despite high year-to-year variability in BMI metrics, six of eleven commonly used metrics indicate statistically significant lower biotic integrity at springbrooks above the hatchery compared to Mammoth Creek, and none indicated higher biotic integrity. Furthermore, most measures of biotic integrity below the confluence of Mammoth and Hot Creek are intermediate to the two sets of reference conditions (Jellison et al. 2007). There is also evidence, although weaker, that biotic integrity decreases between springbrook communities located immediately above and below the hatchery.

In consideration of the above information, snowmelt runoff flows from Mammoth Creek into Hot Creek serve to dilute the nutrient-rich (phosphorus and nitrogen) spring source waters that promote the luxuriant growths of macrophytes and result in low biotic integrity in Hot Creek downstream of the Hot Creek Fish Hatchery.

6.2 REGULATORY SETTING

6.2.1 FEDERAL ENDANGERED SPECIES ACT

The ESA requires that both USFWS and the National Marine Fisheries Service (NMFS) maintain lists of threatened species and endangered species. An "*endangered species*" is defined as "*…any species which is in danger of extinction throughout all or a significant portion of its range*." A "*threatened species*" is defined as "*…any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range*" (16 USC 1532). Section 9 of the ESA makes it illegal to "*take*" (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in such conduct) any endangered species of fish or wildlife, and regulations contain similar provisions for most threatened species of fish and wildlife (16 USC 1538).

Section 7 of the ESA requires all federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. To ensure against jeopardy, each federal agency must consult with USFWS or NMFS, or both, if the federal agency determines that its action might impact a listed species. NMFS jurisdiction under the ESA is limited to the protection of marine mammals and anadromous fishes; all other species are within USFWS jurisdiction. Listed species under NMFS jurisdiction do not occur within the Project Area.

6.2.2 CALIFORNIA ENDANGERED SPECIES ACT

The California Endangered Species Act (CESA, Fish and Game Code Sections 2050 to 2089) establishes various requirements and protections regarding species listed as threatened or endangered under state law. California's Fish and Game Commission is responsible for maintaining lists of threatened and endangered species under CESA. CESA prohibits the "*take*" of listed and candidate (petitioned to be listed) species (Fish and Game Code Section 2080) "*Take*" under California law means to *"…hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch capture, or kill…"* (Fish and Game Code Section 86).

6.2.3 CALIFORNIA FISH AND GAME CODE 5937 AND 5946

As previously discussed in Chapter 1 – Introduction, the California Fish and Game Code provisions are a legislative expression of the Public Trust, primarily with respect to the belief that protecting the State of California's waters as habitat and associated fish resources is in the public interest.

- California Fish and Game Code Section 5937 states that "…*The owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam.*" Section 5937 serves to limit the amount of water that may be appropriated by requiring that sufficient water first be determined, and released to provide habitat conditions to assure that fish, other aquatic life and trust resources below a dam are maintained in good condition (Cal. Trout v. SWRCB, 207 Cal App 3d 585-1989, also called Cal Trout 1).
- California Fish and Game Code Section 5946 states that "…*No permit or license to appropriate water in District 41/2 [in portions of Mono and Inyo counties] shall be issued by the State Water Rights Board after September 9, 1953, unless conditioned upon full compliance with Section 5937. Plans and specifications for any such dam shall not be approved by the Department of Water Resources unless adequate provision is made for full compliance with Section 5937.*"

Before permits or approvals related to water diversions are granted, courts and resource management agencies must consider the effect of such diversions upon interests protected by the Public Trust, and attempt, so far as feasible, to avoid or minimize any harm to those interests.

The SWRCB has a ministerial duty to condition permits and licenses issued after 1953 to require compliance with Fish and Game Code Section 5946 (California Trout Inc. v. State Water Resources Control Board (1990) 218 Cal.App. 187 [266 Cal.Rptr. 7881). The SWRCB complies with Section 5946 (and therefore 5937) in one of two ways. In some instances, the SWRCB includes specific minimum instream flow requirements for protection of fish as a condition of a water right permit or license. In other instances, the SWRCB has included a more general condition requiring bypass of water to maintain fish in good condition (SWRCB 1997).

6.2.4 CALIFORNIA FISH AND GAME CODE 45

California Fish and Game Code Section 45 states that *"…"Fish" means wild fish, mollusks, crustaceans, invertebrates, or amphibians, including any part, spawn, or ova thereof."*

6.3 ENVIRONMENTAL CONSEQUENCES

6.3.1 IMPACT ASSESSMENT METHODS

The impact assessment methods rely on the MCWD Model to provide a quantitative basis from which to assess the potential impacts of the Proposed Project Alternative and other alternatives on the fisheries and aquatic resources, and aquatic habitats within the Project Area. Specifically, the hydrological modeling analyses are utilized to represent the District's operational conditions and resultant hydrologic changes that would occur from implementation of the Proposed Project Alternative and other alternatives, which are compared to modeled data representing operational conditions under the Existing Condition. The methods used to assess potential impacts under the Proposed Project Alternative or other alternatives are described below.

6.3.1.1 MAMMOTH CREEK

As previously discussed, flows experienced under the Existing Condition have resulted in fish in Mammoth Creek being maintained in good condition (per Fish and Game Code Sections 5937 and 5946). Therefore, the impact assessment methods focus on evaluating whether flows expected to occur under the Proposed Project Alternative or other alternatives, relative to the Existing Condition, also would continue to maintain the fisheries and aquatic resources in good condition.

INSTREAM FLOW REGIMES

As described in Chapter 4 – Hydrology, streamflow quantity and timing are critical components of the ecological integrity of river systems (Poff et al. 1997). Streamflow can be considered a master variable that limits the distribution and abundance of riverine species (Power et al. 1995 and Resh et al. 1988 in Poff et al. 1997) and regulates the ecological integrity of flowing water systems.

The five components of the flow regime used to characterize the entire range of flows and specific hydrologic phenomena (e.g., floods and low flows) that are vital to the integrity of river ecosystems include: (1) magnitude; (2) frequency; (3) duration; (4) timing; and (5) rate of change of hydrologic conditions (Poff et al. 1997). Changes to these components associated with the Proposed Project Alternative or other alternatives, relative to the Existing Condition, are evaluated and described in Chapter 4 – Hydrology. These evaluations are applicable to the fisheries and aquatic resources in Mammoth Creek, and the specific methods include calculation of the following parameters.

- ❑ Cumulative exceedance probability distributions of daily flows at the OMR and OLD395 gages under each of the alternatives, and under the Existing Condition, during each month of the 20-year evaluation period.
- ❑ Time series of daily flows at the OMR and OLD395 gages under each of the alternatives, under the Existing Condition, and under the index of unimpaired conditions as a benchmark reference, during each runoff year over the 20-year evaluation period.
- ❑ Total number of events (irrespective of duration) that daily flows equal or exceed the channel maintenance and flushing flow value ($Q_{1.75}$) at the OMR Gage over the 20 years included in the evaluation period.
- ❑ Total number of days that daily flows equal or exceed the channel maintenance and flushing flow value ($Q_{1.75}$) at the OMR Gage over the 20 years included in the evaluation period.

Flow Variability and Trout Population Abundance Relationships

Fish and other aquatic organisms require habitat features that cannot be maintained by minimum flows alone (Poff et al. 1997). A range of flows, within and among years, is necessary to maintain channel and riparian dynamics and, consequently, aquatic habitat.

In addition to comparison of the time series of daily flows at the OMR and OLD395 gages under the Proposed Project Alternative and other alternatives, relative to the Existing Condition (and to the index of unimpaired flows as a benchmark reference), the following analyses also were undertaken to address flow variability and trout population abundance relationships.

For the 17 years of fish survey data, brown trout population abundance in Mammoth Creek exhibits considerable inter-annual variation. Examination of the data demonstrates that the brown trout population has the ability to recover (i.e., exhibit increased abundance) relatively quickly following episodic reduced abundance levels in specific years. These trends indicate the resiliency of the brown trout population in Mammoth Creek.

The following impact assessment methodology focuses on: (1) annual brown trout population abundance presented on a year-to-year basis; and (2) variations in different expressions of flow in Mammoth Creek. Brown trout population abundance was used because variation in annual abundance estimates is not influenced by planting of hatchery fish, by contrast to the planting of rainbow trout in Mammoth Creek. The methodology uses several different expressions of flow (Annual Average OMR Mean Daily Flow, OMR High Flow, OMR Low Flow, OMR Low Flow Quartile), the latter three of which are the same as those that were used to analyze potential relationships between annual brown trout YOY density and flow in Mammoth Creek under the Existing Condition (see Section 6.1.1.2). Using the Cumulative Sums of Variability (CUSUM) statistical approach, these flow-related variables are used as predictors of potential cause-and-effect relationships between hydrologic conditions and annual total brown trout population abundance in Mammoth Creek.

CUSUM is a statistical term used to describe the Cumulative Sums of Variability. The CUSUM approach was originally developed in 1954 (Page 1954). It is widely used in the manufacturing industry and in public health monitoring of clinical outcomes, and is beginning to be used in ecological time series analysis (MacNally and Hart 1997; Breton et al. 2006; Mesnil and Petitgas 2009). For example, it has been applied to long-term nutrient and plankton relationships (Briceño and Boyer 2010; Breton et al. 2006), and examination of relationships between freshwater flow and increased nutrient loading (Glibert et al., in review).

CUSUM is the running total of deviations from normalized values over time. CUSUM charts are relatively easy to calculate. For a time series of a particular variable of interest with size k (i.e., a time series where there are k values of the particular variable (x_i), and where the k values are daily, monthly or annual values), CUSUM calculation involves the following steps:

(1) Calculation of the mean (the average of the k available values, $\bar{X} = \sum_{i=1}^{k} x_i \Big/ k$).

(2) Calculation of the standard deviation ($S = \sqrt{\sum_{i=1}^{k} \left(x_i - \bar{X}\right)^2 \Big/ \left(k-1\right)}$).

(3) Computation of z scores for each of the k values in the time series ($Z_i = \left(x_i - \bar{X}\right) \Big/ S$).

(4) Computation of the cumulative sum of z scores for each of the k values in the time series.

(5) Plot the cumulative sum of z scores against time to generate the corresponding CUSUM chart.

The intent of these steps is to filter the short-term or seasonal variability, thus revealing the long-term pattern in the data.

To assess potential impacts associated with flow-related predictor variables on the annual total brown trout population abundance of Mammoth Creek, the following steps are undertaken:

- ❑ The time series of values of the response variable (i.e., annual total brown trout population abundance) is transformed to a CUSUM series over the available period of record (i.e., 1988, 1992-1997, 1999-2008) to keep track of the abundance inter-annual variability at each annual time-step.
- ❑ The time series of values of the flow-related predictor variables (Annual Average OMR Mean Daily Flow, OMR High Flow, OMR Low Flow, and OMR Low Flow Quartile) under the Existing Condition and all of the alternatives also are transformed to their corresponding CUSUM series over the available period of record to keep track of the inter-annual variability of the flow related predictor at each annual time-step.
- ❑ The correlation coefficients between the annual total brown trout population abundance CUSUM series and each of the CUSUM series of the flow-related variables, under the Existing Condition, the Proposed Project Alternative and other alternatives, are calculated to infer potential cause-and-effect relationships between Mammoth Creek brown trout abundance and OMR flows.
- ❑ The resulting correlation coefficients are compared in terms of sign, magnitude and statistical significance under the Proposed Project Alternative and other alternatives, relative to the Existing Condition.

The correlations between the annual total brown trout population abundance CUSUM and the CUSUMs of Annual Average Annual OMR Mean Daily Flow, OMR High Flow, OMR Low Flow and OMR Low Flow Quartile under the Existing Condition during the years 1988 to 2007[4] are shown in **Figure 6-22**.

The correlation coefficient between the annual total brown trout population abundance CUSUM and the CUSUM of Annual Average OMR Mean Daily Flow under the Existing Condition is slightly negative, although very weak and not statistically significant.

The remaining flow variables are defined in Section 6.1.1.2 and Appendix E of this Draft EIR. The OMR High Flow is defined as the highest 7-day running average of the mean daily flows during a particular year. It is used as an index of the annual spring/early summer peak runoff. The correlation coefficient between the annual total brown trout population abundance CUSUM and the CUSUM of OMR High Flow under the Existing Condition is slightly negative, although very weak and not statistically significant.

[4] The correlation coefficients were calculated only for 16 data points because although there were 17 annual abundance estimates (1988, 1992-1997, 1999-2008), the CUSUMs of the flow variables from MCWD Model output could not be calculated for 2008 due to the definition of Runoff Years (April 1 through March 31).

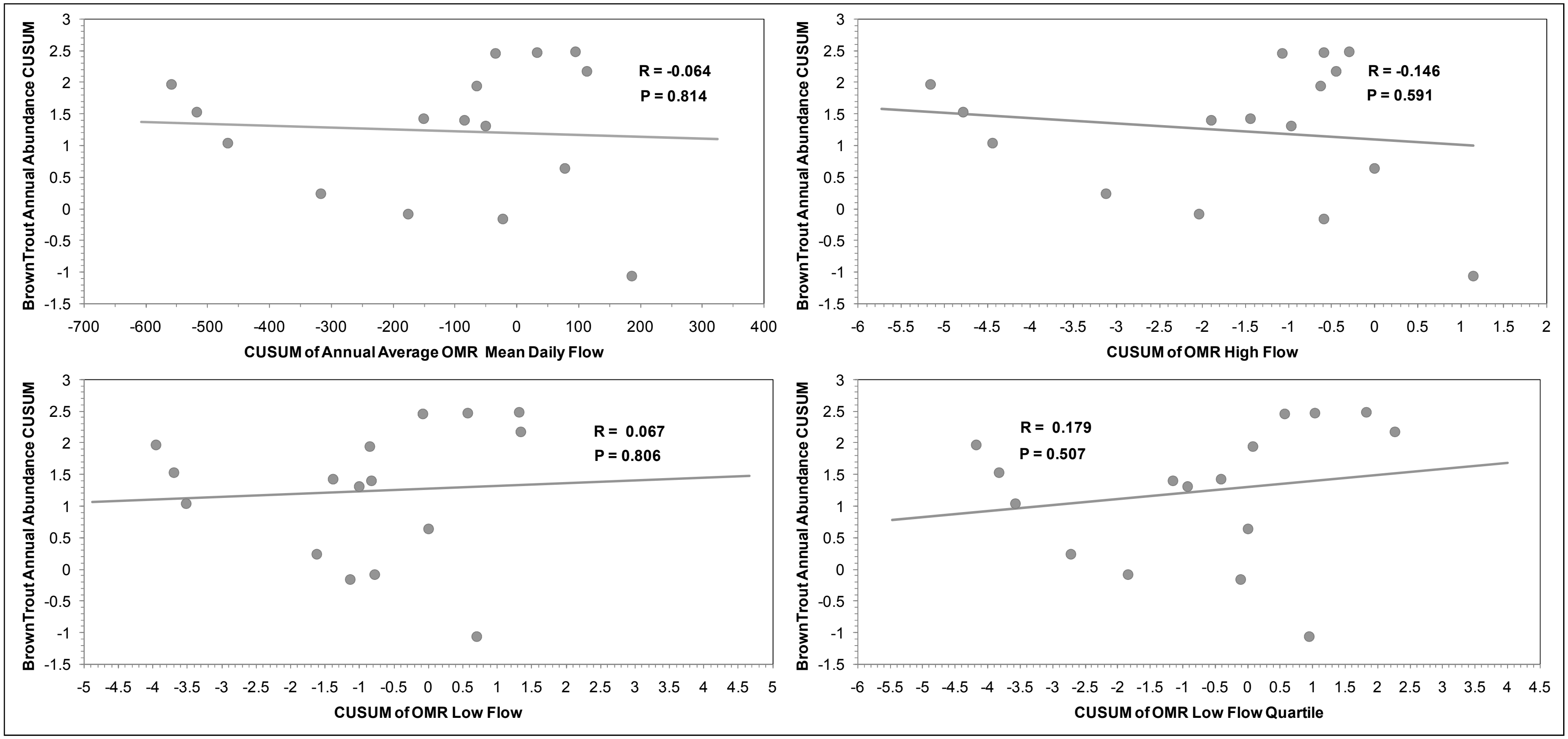

Figure 6-22. Correlation Between the Brown Trout Annual Abundance CUSUM and the CUSUM of Annual Average OMR Mean Daily Flow, OMR High Flow, OMR Low Flow and OMR Low Flow Quartile under the Existing Condition during the Years 1988 to 2007

The OMR Low Flow is defined as the minimum of the averages of OMR daily flows in August, September or October during a particular year. It is used as an index of the annual low flow period. The correlation coefficient between the annual total brown trout population abundance CUSUM and the CUSUM of OMR Low Flow under the Existing Condition is slightly positive, although very weak and not statistically significant.

The OMR Low Flow Quartile is defined as the average of all daily flows lower than the 25th percentile of daily flows from the day of the annual maximum flow through the eve of the annual electrofishing survey each year. It is used as another index of the annual low flow period. The correlation coefficient between the annual total brown trout population abundance CUSUM and the CUSUM of OMR Low Flow Quartile under the Existing Condition is positive, although very weak and not statistically significant.

HABITAT AVAILABILITY

As described in Chapter 1 – Introduction, the Beak Fishery Bypass Flow Requirements were based upon analyses that resulted in a single, functional relationship between total habitat, expressed as WUA, and flow for each life stage of both brown and rainbow trout by month in Mammoth Creek. These analyses focused primarily on the physical characteristics of aquatic habitat to predict the response of aquatic habitat and, indirectly, the response of fish to changes in stream flow.

An additional method to evaluate potential impacts to the fisheries and aquatic resources in Mammoth Creek was developed through collaboration discussions primarily with CalTrout, CDFG and the District, and also with other members of the Mammoth Creek Technical Team. CalTrout retained fisheries specialists (Stillwater Sciences) to provide technical support in the review of the previously conducted instream flow studies, as well as in the consideration of alternative bypass flow requirement scenarios.

Based upon their analysis of available data and information on fish and aquatic habitat in Mammoth Creek, Stillwater Sciences (2008) concluded that the population of adult brown trout in Mammoth Creek appears to be relatively stable and in good condition. Stillwater Sciences (2008) also stated: a resident stream trout population is almost always limited by the amount of habitat available for adults or the mortality at the adult lifestage; it is not the lack of potential recruits that limits the adult population, but rather it is the habitat for the adults themselves; because adult trout require deeper water and access to cover, the amount of deep, complex pools can often limit trout populations; and, that the habitat-flow curves for the adult lifestage should be used to inform decisions regarding flow recommendations for trout in Mammoth Creek.

Consequently, to augment the primary impact assessment method of comparison of flows under the Proposed Project Alternative or other alternatives relative to the Existing Condition, an additional evaluation is conducted in this Draft EIR by comparing the amounts of adult brown trout pool habitat available in Mammoth Creek each day for each of the 20 years included in the evaluation, as follows.

- ❑ Calculating daily estimates of adult brown trout pool habitat availability using MCWD Model output to represent flows under the Existing Condition, the Proposed Project Alternative and other alternatives, as well as under the index of unimpaired hydrology.
- ❑ Comparing the daily time series of adult brown trout pool habitat availability for each of the 20 years included in the evaluation between the Proposed Project Alternative or

other alternatives and the Existing Condition, as well as to the unimpaired flow condition as a benchmark reference.

- Using 90% of maximum (theoretical) adult brown trout pool habitat availability as a benchmark for evaluation of the amount of habitat provided by the Proposed Project Alternative or other alternatives relative to the Existing Condition (as well as the unimpaired flow condition) for each day for all 20 years included in the evaluation.

  The use of 90% of maximum adult brown trout habitat availability as a benchmark in Mammoth Creek bypass flow requirement considerations was agreed upon by CDFG, CalTrout and the District during the collaborative alternatives development process (see Chapter 2 – Proposed Project and Alternatives) in consideration of SWRCB Mono Lake Decision 1631. As part of the SWRCB Mono Lake Decision 1631 process, Dr. Tom Hardy (a fisheries biologist retained by LADWP) testified that …"*no objective criteria has been validated to guide investigators on what percentage reduction in optimal habitat represents a significant impact, or at what exceedance value associated with either optimal or median habitat represents adequate protection for the aquatic resources*." (LADWP 132, pp 2-3). Dr. Hardy testified that several instream flow studies that he had participated in targeted a range of 80 to 85% of the maximum WUA as optimal habitat conditions (LADWP 17, pp 58). Also, as part of the SWRCB Mono Lake Decision 1631 process, the criteria used by CDFG to develop streamflow recommendations for brown trout in lower Lee Vining Creek included provision of 80% of maximum adult habitat for dry hydrologic years, and 90% of maximum adult habitat for normal and wet hydrologic years.

6.3.1.2 HOT CREEK

INSTREAM FLOW REGIMES

As previously discussed, flows experienced under the Existing Condition have resulted in fisheries and aquatic resources in Mammoth Creek being maintained in good condition (per Fish and Game Codes 5937 and 5946). However, data utilized to determine this conclusion are not available, nor are trout habitat-flow relationships available for Hot Creek. Therefore, the impact assessment method for fisheries and aquatic habitat in Hot Creek focuses on evaluating the flow regime components described above for Mammoth Creek, under the Proposed Project Alternative or other alternatives relative to the Existing Condition, including the following.

- Cumulative exceedance probability distributions of daily flows at the USGS Hot Creek Flume Gage under each of the alternatives, and under the Existing Condition, during each month of the 20-year evaluation period.
- Time series of daily flows at the USGS Hot Creek Flume Gage under each of the alternatives, under the Existing Condition, and under the index of unimpaired conditions as a benchmark reference, during each runoff year of the 20-year evaluation period.
- Total number of events (irrespective of duration) that daily flows equal or exceed the channel maintenance and flushing flow value ($Q_{1.75}$) at the USGS Hot Creek Flume Gage over the 20 years included in the evaluation period.
- Total number of days that daily flows equal or exceed the channel maintenance and flushing flow value ($Q_{1.75}$) at the USGS Hot Creek Flume Gage over the 20 years included in the evaluation period.

6.3.2 IMPACT INDICATORS AND SIGNIFICANCE CRITERIA FOR FISHERIES AND AQUATIC RESOURCES

Included in Appendix G of the CEQA Guidelines, a potentially significant impact on biological resources (specific to fisheries) would occur if the project would:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the CDFG or USFWS.
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.

The proposed project does not include alteration or modification of the Mammoth Creek or Hot Creek streambeds. The proposed project would not interfere substantially with the movement of any native resident or migratory fish. To further evaluate potential fisheries and aquatic resources impacts in this Draft EIR, impact indicators are developed as a means to assess potential operational-related effects of the Proposed Project Alternative or other alternatives on fisheries and aquatic habitat, relative to the Existing Condition. For the fisheries and aquatic habitat impact assessment, impact indicators based on MCWD Model output serve as the quantitative basis to evaluate whether potentially significant impacts would occur.

Differences between the Proposed Project Alternative (or other alternatives), relative to the Existing Condition, of a specific impact indicator do not necessarily constitute a potentially significant impact. Impact determinations are based on consideration of all evaluated impact indicators. An impact is considered potentially significant if implementation of the Proposed Project Alternative or other alternatives would adversely impact fisheries and aquatic habitat in Mammoth Creek or Hot Creek, in consideration of all evaluated impact indicators.

MAMMOTH CREEK

Instream Flow Regimes

If maintenance of fish habitat under the Proposed Project Alternative or other alternatives is similar to the Existing Condition, then the alternative would have a less-than-significant impact. Potential impacts to fisheries and aquatic habitat in Mammoth Creek would be considered significant if substantial differences occur under the Proposed Project Alternative or other alternatives, relative to the Existing Condition, in the impact indicators described below.

- Monthly cumulative exceedance probability distributions of daily flows at the OMR and OLD395 gages over of the 20-year evaluation period.
- Trends in the time series of daily flows at the OMR and OLD395 gages relative to the Existing Condition, and to the index of unimpaired conditions as a benchmark reference, during each runoff year over the 20-year evaluation period.
- Total number of events (irrespective of duration) that daily flows equal or exceed the channel maintenance and flushing flow value ($Q_{1.75}$) at the OMR Gage over the 20 years included in the evaluation period.
- Total number of days that daily flows equal or exceed the channel maintenance and flushing flow value ($Q_{1.75}$) at the OMR Gage over the 20 years included in the evaluation period.

- Correlations between the cumulative sums of variance in any of the expressions of flow (Annual Average OMR Mean Daily Flow, OMR High Flow, OMR Low Flow, and OMR Low Flow Quartile) and the cumulative sums of variance of annual brown trout total population abundance.

Habitat Availability

Potential impacts to fisheries and aquatic habitat in Mammoth Creek would be considered significant if substantial differences occur under the Proposed Project Alternative or other alternatives, relative to the Existing Condition, in:

- The frequency (daily time series) of obtaining 90% of maximum (theoretical) adult brown trout pool habitat availability, in consideration of the amount of adult brown trout pool habitat available under the index of unimpaired flow as a reference benchmark.

HOT CREEK

Instream Flow Regimes

Potential impacts to fisheries and aquatic habitat in Hot Creek would be considered significant if substantial differences occur under the Proposed Project Alternative or other alternatives, relative to the Existing Condition, in the impact indicators described below.

- Monthly cumulative exceedance probability distributions of daily flows at the USGS Hot Creek Flume Gage over of the 20-year evaluation period.
- Trends in the time series of daily flows at the USGS Hot Creek Flume Gage relative to the Existing Condition, and to the index of unimpaired conditions as a benchmark reference, during each runoff year over the 20-year evaluation period.
- Total number of events (irrespective of duration) that daily flows equal or exceed the channel maintenance and flushing flow value ($Q_{1.75}$) at the USGS Hot Creek Flume Gage over the 20 years included in the evaluation period.
- Total number of days that daily flows equal or exceed the channel maintenance and flushing flow value ($Q_{1.75}$) at the USGS Hot Creek Flume Gage over the 20 years included in the evaluation period.

6.3.3 ANALYSIS OF ALTERNATIVE COMPARISONS

6.3.3.1 ENVIRONMENTAL IMPACTS OF THE PROPOSED PROJECT ALTERNATIVE COMPARED TO THE EXISTING CONDITION

Impact Consideration 6.3.3.1-1. Potential to Change Mammoth Creek Flows Resulting in a Reduced Ability to Maintain Fisheries and Aquatic Habitat

Changes to the components of the flow regime associated with the Proposed Project Alternative, relative to the Existing Condition, are evaluated and described in Chapter 4 - Hydrology. The conclusions are applicable to the fisheries and aquatic resources in Mammoth Creek. Substantial differences would not occur between the Proposed Project Alternative and the Existing Condition for the following.

- The magnitude, frequency, duration, timing and rate of change of hydrologic conditions at the OMR and OLD395 gages.
- Flow variability, relative to the index of unimpaired flow as a benchmark reference, at the OMR and OLD395 gages.
- The frequency and duration of channel maintenance and flushing flows represented by the index value of $Q_{1.75}$ at the OMR Gage.

In addition, the Proposed Project Alternative exhibits very weak and not statistically significant correlations between CUSUMs of annual brown trout total population abundance and the following expressions of flow: (1) Annual Average OMR Mean Daily Flow (r = -0.078, P = 0.775); (2) OMR High Flow (r = -0.149, P = 0.581); (3) OMR Low Flow (r = -0.040, P = 0.882); and (4) OMR Low Flow Quartile (r = 0.081, P = 0.765). Correlations under the Proposed Project Alternative do not significantly differ from those under the Existing Condition and, therefore, would not significantly change the relationships between flow variability and associated trends in annual brown trout total population abundance.

Therefore, in consideration of the entire suite of analyses described above, potential impacts to fisheries and aquatic habitat, including Owens sucker and tui chub, associated with flows in Mammoth Creek are less than significant under the Proposed Project Alternative, relative to the Existing Condition.

Impact Determination 6.3.3.1-1 – Less Than Significant

Mitigation Measure 6.3.3.1-1 – None Required

Impact Consideration 6.3.3.1-2. Potential to Change Adult Brown Trout Pool Habitat Availability in Mammoth Creek

Examination of the adult brown trout pool habitat daily time series presented in Appendix D-1 demonstrates similar trends in the amount of adult brown trout pool habitat available under the Proposed Project Alternative and the Existing Condition. The daily habitat time series under the Proposed Project Alternative generally conform to the habitat time series under the Existing Condition, particularly with respect to the 90% of maximum (theoretical) habitat value.

Under the Proposed Project Alternative, 92.6% of the maximum (theoretical) average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 90.7% under Dry runoff year types, 93.4% under Normal runoff year types, and 91.9% under Wet runoff year types. By comparison, under the Existing Condition, 92.7% of the maximum (theoretical) average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 90.9% under Dry runoff year types, 93.5% under Normal runoff year types, and 92.1% under Wet runoff year types. As a reference benchmark, under the index of unimpaired flows, 92.9% of the theoretical maximum average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 91.6% under Dry runoff year types, 93.8% under Normal runoff year types, and 91.8% under Wet runoff year types.

Of the 240 average monthly possibilities (12 months x 20 years), 90% of maximum (theoretical) adult brown trout pool habitat availability occurs 179 months (74.6%) under the Proposed Project Alternative, 178 months (74.2%) under the Existing Condition, and 173 months (72.1%) under the index of unimpaired hydrology. Thus, 90% of maximum (theoretical) adult brown trout pool habitat availability is achieved with a similar probability of occurrence under the Proposed Project Alternative relative to the Existing Condition, as well as in comparison to the index of unimpaired flows.

Therefore, minor differences occur in the percentage of maximum (theoretical) daily adult brown trout pool habitat achieved under the Proposed Project Alternative, relative to the Existing Condition, and represent a less than significant impact.

Impact Determination 6.3.3.1-2 – Less Than Significant

Mitigation Measure 6.3.3.1-2 – None Required

Impact Consideration 6.3.3.1-3. Potential to Change Hot Creek Flows at the USGS Hot Creek Flume Gage

The conclusions presented in Chapter 4 – Hydrology are applicable regarding fisheries and aquatic resources in Hot Creek. Substantial differences would not occur between the Proposed Project Alternative and the Existing Condition for the following.

- The magnitude, frequency, duration, timing and rate of change of hydrologic conditions at the USGS Hot Creek Flume Gage.
- Flow variability, relative to the index of unimpaired flow as a benchmark reference, at the USGS Hot Creek Flume Gage.
- The frequency and duration of channel maintenance and flushing flows represented by the index value of $Q_{1.75}$ at the USGS Hot Creek Flume Gage.

Therefore, in consideration of the entire suite of analyses described above, potential impacts to fisheries and aquatic habitat, including Owens sucker and tui chub, associated with flows in Hot Creek are less than significant under the Proposed Project Alternative, relative to the Existing Condition.

Impact Determination 6.3.3.1-3 – Less Than Significant

Mitigation Measure 6.3.3.1-3 – None Required

6.3.3.2 Environmental Impacts of Bypass Flow Requirements Alternative No. 2 Compared to the Existing Condition

Impact Consideration 6.3.3.2-1. Potential to Change Mammoth Creek Flows Resulting in a Reduced Ability to Maintain Fisheries and Aquatic Habitat

Changes to the components of the flow regime associated with Bypass Flow Requirements Alternative No. 2 (BFR Alt 2), relative to the Existing Condition, are evaluated and described in Chapter 4 – Hydrology. The conclusions are applicable to the fisheries and aquatic resources in Mammoth Creek. Substantial differences would not occur between BFR Alt 2 and the Existing Condition for the following.

- The magnitude, frequency, duration, timing and rate of change of hydrologic conditions at the OMR and OLD395 gages.
- Flow variability, relative to the index of unimpaired flow as a benchmark reference, at the OMR and OLD395 gages.
- The frequency and duration of channel maintenance and flushing flows represented by the index value of $Q_{1.75}$ at the OMR Gage.

In addition, BFR Alt 2 exhibits very weak and not statistically significant correlations between CUSUMs of annual brown trout total population abundance and the following expressions of flow: (1) Annual Average OMR Mean Daily Flow (r = -0.077, P = 0.777); (2) OMR High Flow (r = -0.143, P = 0.597); (3) OMR Low Flow (r = -0.138, P = 0.611); and (4) OMR Low Flow Quartile (r = 0.034, P = 0.901). Correlations under BFR Alt 2 do not significantly differ from those under the Existing Condition and, therefore, would not significantly change the relationships between flow variability and associated trends in annual brown trout total population abundance.

Therefore, in consideration of the entire suite of analyses described above, potential impacts to fisheries and aquatic habitat, including Owens sucker and tui chub, associated with flows in Mammoth Creek are less than significant under BFR Alt 2, relative to the Existing Condition.

Impact Determination 6.3.3.2-1 – Less Than Significant

Mitigation Measure 6.3.3.2-1 – None Required

Impact Consideration 6.3.3.2-2. Potential to Change Adult Brown Trout Pool Habitat Availability in Mammoth Creek

Examination of the adult brown trout pool habitat daily time series presented in Appendix D-2 demonstrates generally similar trends in the amount of adult brown trout pool habitat available under BFR Alt 2 and the Existing Condition, particularly with respect to the 90% of maximum (theoretical) habitat value. The daily habitat time series under BFR Alt 2 exhibit somewhat higher amounts of habitat during some the months during the period extending from September through February, and somewhat lower amounts of habitat during the spring months for some of the drier runoff years.

Under BFR Alt 2, 93.0% of the maximum (theoretical) average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 91.3% under Dry runoff year types, 93.8% under Normal runoff year types, and 92.1% under Wet runoff year types. By comparison, under the Existing Condition, 92.7% of the maximum (theoretical) average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 90.9% under Dry runoff year types, 93.5% under Normal runoff year types, and 92.1% under Wet runoff year types. As a reference benchmark, under the index of unimpaired flows, 92.9% of the theoretical maximum average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 91.6% under Dry runoff year types, 93.8% under Normal runoff year types, and 91.8% under Wet runoff year types.

Of the 240 average monthly possibilities (12 months x 20 years), 90% of maximum (theoretical) adult brown trout pool habitat availability occurs 184 months (76.7%) under BFR Alt 2, 178 months (74.2%) under the Existing Condition, and 173 months (72.1%) under the index of unimpaired flows. Thus, 90% of maximum (theoretical) adult brown trout pool habitat availability is achieved with a slightly higher probability of occurrence under BFR Alt 2 relative to the Existing Condition, as well as in comparison to the index of unimpaired flows.

Therefore, minor differences occur in the percentage of maximum (theoretical) daily adult brown trout pool habitat achieved under BFR Alt 2, relative to the Existing Condition, and represent a less than significant impact.

Impact Determination 6.3.3.2-2 – Less Than Significant

Mitigation Measure 6.3.3.2-2 – None Required

Impact Consideration 6.3.3.2-3. Potential to Change Hot Creek Flows at the USGS Hot Creek Flume Gage

The conclusions presented in Chapter 4 – Hydrology are applicable regarding fisheries and aquatic resources in Hot Creek. Substantial differences would not occur between BFR Alt 2 and the Existing Condition for the following.

- The magnitude, frequency, duration, timing and rate of change of hydrologic conditions at the USGS Hot Creek Flume Gage.
- Flow variability, relative to the index of unimpaired flow as a benchmark reference, at the USGS Hot Creek Flume Gage.
- The frequency and duration of channel maintenance and flushing flows represented by the index value of $Q_{1.75}$ at the USGS Hot Creek Flume Gage.

Therefore, in consideration of the entire suite of analyses described above, potential impacts to fisheries and aquatic habitat, including Owens sucker and tui chub, associated with flows in Hot Creek are less than significant under BFR Alt 2, relative to the Existing Condition.

Impact Determination 6.3.3.2-3 – Less Than Significant

Mitigation Measure 6.3.3.2-3 – None Required

6.3.3.3 ENVIRONMENTAL IMPACTS OF THE PERMIT 17332 BYPASS FLOW ALTERNATIVE COMPARED TO THE EXISTING CONDITION

Impact Consideration 6.3.3.3-1. Potential to Change Mammoth Creek Flows Resulting in a Reduced Ability to Maintain Fisheries and Aquatic Habitat

Changes to the components of the flow regime associated with Permit 17332 Bypass Flow Requirements Alternative (P-17332 BFR Alt), relative to the Existing Condition, are evaluated and described in Chapter 4 – Hydrology. The conclusions are applicable to the fisheries and aquatic resources in Mammoth Creek. Substantial differences would not occur between P-17332 BFR Alt and the Existing Condition for the following.

- The magnitude, frequency, duration, timing and rate of change of hydrologic conditions at the OMR and OLD395 gages.
- Flow variability, relative to the index of unimpaired flow as a benchmark reference, at the OMR and OLD395 gages.
- The frequency and duration of channel maintenance and flushing flows represented by the index value of $Q_{1.75}$ at the OMR Gage.

In addition, P-17332 BFR Alt exhibits very weak and not statistically significant correlations between CUSUMs of annual brown trout total population abundance and the following expressions of flow: (1) Annual Average OMR Mean Daily Flow ($r = -0.078$, $P = 0.775$); (2) OMR High Flow ($r = -0.138$, $P = 0.610$); (3) OMR Low Flow ($r = -0.079$, $P = 0.771$); and (4) OMR Low Flow Quartile ($r = 0.095$, $P = 0.726$). Correlations under P-17332 BFR Alt do not significantly differ from those under the Existing Condition and, therefore, would not significantly change the relationships between flow variability and associated trends in annual brown trout total population abundance.

Therefore, in consideration of the entire suite of analyses described above, potential impacts to fisheries and aquatic habitat, including Owens sucker and tui chub, associated with flows in

Mammoth Creek are less than significant under the P-17332 BFR Alt, relative to the Existing Condition.

Impact Determination 6.3.3.3-1 – Less Than Significant

Mitigation Measure 6.3.3.3-1 – None Required

Impact Consideration 6.3.3.3-2. Potential to Change Adult Brown Trout Pool Habitat Availability in Mammoth Creek

Examination of the habitat time series presented in Appendix D-3 demonstrates generally similar overall trends in the amount of adult brown trout pool habitat available under the P-17332 BFR Alt, relative to the Existing Condition, particularly with respect to the 90% of maximum (theoretical) habitat value. However, the daily habitat time series under P-17332 BFR Alt exhibits irregular excursions from the trend exhibited by the Existing Condition, when in some runoff years less habitat is provided primarily during spring months, with more habitat during fall to winter months.

Under the P-17332 BFR Alt, 92.7% of the maximum (theoretical) average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 91.3% under Dry runoff year types, 93.5% under Normal runoff year types, and 91.8% under Wet runoff year types. By comparison, under the Existing Condition, 92.7% of the maximum (theoretical) average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 90.9% under Dry runoff year types, 93.5% under Normal runoff year types, and 92.1% under Wet runoff year types. As a reference benchmark, under the index of unimpaired flows, 92.9% of the theoretical maximum average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 91.6% under Dry runoff year types, 93.8% under Normal runoff year types, and 91.8% under Wet runoff year types.

Of the 240 average monthly possibilities (12 months x 20 years), 90% of maximum (theoretical) adult brown trout pool habitat availability occurs 180 months (75.0%) under the P-17332 BFR Alt, 178 months (74.2%) under the Existing Condition, and 173 months (72.1%) under the index of unimpaired flows. Thus, 90% of maximum (theoretical) adult brown trout pool habitat availability is achieved with a similar probability of occurrence under the P-17332 BFR Alt relative to the Existing Condition, as well as in comparison to the index of unimpaired flows.

Therefore, minor differences occur in the percentage of maximum (theoretical) average daily adult brown trout pool habitat achieved under the P-17332 BFR Alt, relative to the Existing Condition, and represent a less than significant impact.

Impact Determination 6.3.3.3-2 – Less Than Significant

Mitigation Measure 6.3.3.3-2 – None Required

Impact Consideration 6.3.3.3-3. Potential to Change Hot Creek Flows at the USGS Hot Creek Flume Gage

The conclusions presented in Chapter 4 – Hydrology are applicable regarding fisheries and aquatic resources in Hot Creek. Substantial differences would not occur between P-17332 BFR Alt and the Existing Condition for the following.

- ❑ The magnitude, frequency, duration, timing and rate of change of hydrologic conditions at the USGS Hot Creek Flume Gage.

- Flow variability, relative to the index of unimpaired flow as a benchmark reference, at the USGS Hot Creek Flume Gage.
- The frequency and duration of channel maintenance and flushing flows represented by the index value of $Q_{1.75}$ at the USGS Hot Creek Flume Gage.

Therefore, in consideration of the entire suite of analyses described above, potential impacts to fisheries and aquatic habitat, including Owens sucker and tui chub, associated with flows in Hot Creek are less than significant under the P-17332 BFR Alt, relative to the Existing Condition.

Impact Determination 6.3.3.3-3 – Less Than Significant

Mitigation Measure 6.3.3.3-3 – None Required

6.3.3.4 ENVIRONMENTAL IMPACTS OF THE NO PROJECT ALTERNATIVE COMPARED TO THE EXISTING CONDITION

As discussed in Chapter 2 – Proposed Project and Alternatives, the No Project Alternative in this Draft EIR is analyzed at the existing level of development (i.e., current utilization of permitted surface water supplies) and at a future level of development (i.e., projected utilization of permitted surface water supplies at maximum buildout in 2025) to address conditions that would reasonably be expected to occur in the foreseeable future if the proposed project was not approved.

NO PROJECT ALTERNATIVE (EXISTING LEVEL OF DEMAND) COMPARED TO THE EXISTING CONDITION

Impact Consideration 6.3.3.4-1. Potential to Change Mammoth Creek Flows Resulting in a Reduced Ability to Maintain Fisheries and Aquatic Habitat

Changes to the components of the flow regime associated with the No Project Alternative (Existing Level of Demand), relative to the Existing Condition, are evaluated and described in Chapter 4 – Hydrology. The conclusions are applicable to the fisheries and aquatic resources in Mammoth Creek. Substantial differences would not occur between the No Project Alternative (Existing Level of Demand) and the Existing Condition for the following.

- The magnitude, frequency, duration, timing and rate of change of hydrologic conditions at the OMR and OLD395 gages.
- Flow variability, relative to the index of unimpaired flow as a benchmark reference, at the OMR and OLD395 gages.
- The frequency and duration of channel maintenance and flushing flows represented by the index value of $Q_{1.75}$ at the OMR Gage.

In addition, the No Project Alternative (Existing Level of Demand) exhibits very weak and not statistically significant correlations between CUSUMs of annual brown trout total population abundance and the following expressions of flow: (1) Annual Average OMR Mean Daily Flow (r = -0.047, P = 0.861); (2) OMR High Flow (r = -0.131, P = 0.628); (3) OMR Low Flow (r = -0.005, P = 0.986); and (4) OMR Low Flow Quartile (r = 0.177, P = 0.511). Correlations under the No Project Alternative (Existing Level of Demand) do not significantly differ from those under the Existing Condition and, therefore, would not significantly change the relationships between flow variability and associated trends in annual brown trout total population abundance.

Therefore, in consideration of the entire suite of analyses described above, potential impacts to fisheries and aquatic habitat, including Owens sucker and tui chub, associated with flows in Mammoth Creek are less than significant under the No Project Alternative (Existing Level of Demand), relative to the Existing Condition.

Impact Determination 6.3.3.4-1 – Less Than Significant

Mitigation Measure 6.3.3.4-1 – None Required

Impact Consideration 6.3.3.4-2. Potential to Change Adult Brown Trout Pool Habitat Availability in Mammoth Creek

Examination of the habitat time series presented in Appendix D-4 demonstrates similar trends in the amount of adult brown trout pool habitat available under the No Project Alternative (Existing Level of Demand), relative to the Existing Condition. The daily habitat time series under the No Project Alternative (Existing Level of Demand) generally conform to the habitat time series under the Existing Condition, particularly with respect to the 90% of maximum (theoretical) habitat value.

Under the No Project Alternative (Existing Level of Demand), 92.7% of the maximum (theoretical) average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 90.5% under Dry runoff year types, 93.6% under Normal runoff year types, and 92.1% under Wet runoff year types. By comparison, under the Existing Condition, 92.7% of the maximum (theoretical) average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 90.9% under Dry runoff year types, 93.5% under Normal runoff year types, and 92.1% under Wet runoff year types. As a reference benchmark, under the index of unimpaired flows, 92.9% of the theoretical maximum average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 91.6% under Dry runoff year types, 93.8% under Normal runoff year types, and 91.8% under Wet runoff year types.

Of the 240 average monthly possibilities (12 months x 20 years), 90% of maximum (theoretical) adult brown trout pool habitat availability occurs 179 months (74.6%) under the No Project Alternative (Existing Level of Demand), 178 months (74.2%) under the Existing Condition, and 173 months (72.1%) under the index of unimpaired flows. Thus, 90% of maximum (theoretical) adult brown trout pool habitat availability is achieved with a similar probability of occurrence under the No Project Alternative (Existing Level of Demand) relative to the Existing Condition, as well as in comparison to the index of unimpaired flows.

Therefore, minor differences occur in the percentage of maximum (theoretical) daily adult brown trout pool habitat achieved under the No Project Alternative (Existing Level of Demand), relative to the Existing Condition, and represent a less than significant impact.

Impact Determination 6.3.3.4-2 – Less Than Significant

Mitigation Measure 6.3.3.4-2 – None Required

Impact Consideration 6.3.3.4-3. Potential to Change Hot Creek Flows at the USGS Hot Creek Flume Gage

The conclusions presented in Chapter 4 – Hydrology are applicable regarding fisheries and aquatic resources in Hot Creek. Substantial differences would not occur between the No Project Alternative (Existing Level of Demand) and the Existing Condition for the following.

- The magnitude, frequency, duration, timing and rate of change of hydrologic conditions at the USGS Hot Creek Flume Gage.
- Flow variability, relative to the index of unimpaired flow as a benchmark reference, at the USGS Hot Creek Flume Gage.
- The frequency and duration of channel maintenance and flushing flows represented by the index value of $Q_{1.75}$ at the USGS Hot Creek Flume Gage.

Therefore, in consideration of the entire suite of analyses described above, potential impacts to fisheries and aquatic habitat, including Owens sucker and tui chub, associated with flows in Hot Creek are less than significant under the No Project Alternative (Existing Level of Demand), relative to the Existing Condition.

Impact Determination 6.3.3.4-3 – Less Than Significant

Mitigation Measure 6.3.3.4-3 – None Required

NO PROJECT ALTERNATIVE (FUTURE LEVEL OF DEMAND) COMPARED TO THE EXISTING CONDITION

Impact Consideration 6.3.3.4-4. Potential to Change Mammoth Creek Flows Resulting in a Reduced Ability to Maintain Fisheries and Aquatic Habitat

Changes to the components of the flow regime associated with the No Project Alternative (Future Level of Demand), relative to the Existing Condition, are evaluated and described in Chapter 4 – Hydrology. The conclusions are applicable to the fisheries and aquatic resources in Mammoth Creek. Substantial differences would not occur between the No Project Alternative (Future Level of Demand) and the Existing Condition for the following.

- The magnitude, frequency, duration, timing and rate of change of hydrologic conditions at the OMR and OLD395 gages.
- Flow variability, relative to the index of unimpaired flow as a benchmark reference, at the OMR and OLD395 gages.
- The frequency and duration of channel maintenance and flushing flows represented by the index value of $Q_{1.75}$ at the OMR Gage.

In addition, the No Project Alternative (Future Level of Demand) exhibits very weak and not statistically significant correlations between CUSUMs of annual brown trout total population abundance and the following expressions of flow: (1) Annual Average OMR Mean Daily Flow ($r = 0.026$, $P = 0.924$); (2) OMR High Flow ($r = -0.098$, $P = 0.719$); (3) OMR Low Flow ($r = 0.084$, $P = 0.757$); and (4) OMR Low Flow Quartile ($r = 0.303$, $P = 0.255$). Correlations under the No Project Alternative (Future Level of Demand) do not significantly differ from those under the Existing Condition and, therefore, would not significantly change the relationships between flow variability and associated trends in annual brown trout total population abundance.

Therefore, in consideration of the entire suite of analyses described above, potential impacts to fisheries and aquatic habitat, including Owens sucker and tui chub, associated with flows in Mammoth Creek are less than significant under the No Project Alternative (Future Level of Demand), relative to the Existing Condition.

Impact Determination 6.3.3.4-4 – Less than Significant

Mitigation Measure 6.3.3.4-4 – None Required

Impact Consideration 6.3.3.4-5. Potential to Change Adult Brown Trout Pool Habitat Availability in Mammoth Creek

Examination of the habitat time series presented in Appendix D-5 demonstrates generally similar overall trends in the amount of adult brown trout pool habitat available under the No Project Alternative (Future Level of Demand) and the Existing Condition. The daily habitat time series under the No Project Alternative (Future Level of Demand) generally conform to the habitat time series under the Existing Condition, particularly with respect to the 90% of maximum (theoretical) habitat value.

Under the No Project Alternative (Future Level of Demand), 92.4% of the maximum (theoretical) average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 90.0% under Dry runoff year types, 93.3% under Normal runoff year types, and 92.1% under Wet runoff year types. By comparison, under the Existing Condition, 92.7% of the maximum (theoretical) average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 90.9% under Dry runoff year types, 93.5% under Normal runoff year types, and 92.1% under Wet runoff year types. As a reference benchmark, under the index of unimpaired flows, 92.9% of the theoretical maximum average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 91.6% under Dry runoff year types, 93.8% under Normal runoff year types, and 91.8% under Wet runoff year types.

Of the 240 average monthly possibilities (12 months x 20 years), 90% of maximum (theoretical) adult brown trout pool habitat availability occurs 176 months (73.3%) under the No Project Alternative (Future Level of Demand), 178 months (74.2%) under the Existing Condition, and 173 months (72.1%) under the index of unimpaired flows. Thus, 90% of maximum (theoretical) adult brown trout pool habitat availability is achieved with a similar probability of occurrence under the No Project Alternative (Future Level of Demand) relative to the Existing Condition, as well as in comparison to the index of unimpaired flows.

Therefore, minor differences occur in the percentage of maximum (theoretical) daily adult brown trout pool habitat achieved under the No Project Alternative (Future Level of Demand), relative to the Existing Condition, and represent a less than significant impact.

Impact Determination 6.3.3.4-5 – Less Than Significant

Mitigation Measure 6.3.3.4-5 – None Required

Impact Consideration 6.3.3.4-6. Potential to Change Hot Creek Flows at the USGS Hot Creek Flume Gage

The conclusions presented in Chapter 4 – Hydrology are applicable regarding fisheries and aquatic resources in Hot Creek. Substantial differences would not occur between the No Project Alternative (Future Level of Demand) and the Existing Condition for the following.

- The magnitude, frequency, duration, timing and rate of change of hydrologic conditions at the USGS Hot Creek Flume Gage.
- Flow variability, relative to the index of unimpaired flow as a benchmark reference, at the USGS Hot Creek Flume Gage.
- The frequency and duration of channel maintenance and flushing flows represented by the index value of $Q_{1.75}$ at the USGS Hot Creek Flume Gage.

Therefore, in consideration of the entire suite of analyses described above, potential impacts to fisheries and aquatic habitat, including Owens sucker and tui chub, associated with flows in

Hot Creek are less than significant under the No Project Alternative (Future Level of Demand), relative to the Existing Condition.

Impact Determination 6.3.3.4-6 – Less than Significant

Mitigation Measure 6.3.3.4-6 – None Required

6.4 MITIGATION MEASURES

No potentially significant adverse impacts would occur to fisheries and aquatic resources under the Proposed Project Alternative or any of the other alternatives. Thus, no mitigation measures are required.

6.5 POTENTIALLY SIGNIFICANT UNAVOIDABLE IMPACTS

No potentially significant unavoidable adverse impacts would occur to fisheries and aquatic resources under the Proposed Project Alternative or any of the other alternatives.

6.6 CUMULATIVE IMPACTS

For CEQA, the purpose of the cumulative impact analysis is to determine whether the incremental effects of the Proposed Project Alternative would be expected to be "cumulatively considerable" when viewed in connection with the effects of past projects, other current projects, and probable future projects (PRC Section 21083, subdivision (b)(2)).[5]

Some of the projects or programs listed below contain components that cannot be directly, incrementally assessed by application of the MCWD Model. Therefore, a supplemental, qualitative cumulative impact analysis also is conducted to evaluate potential cumulative impacts to fisheries and aquatic resources. For analytical purposes of this Draft EIR, the projects that are considered well-defined and "reasonably foreseeable" are described in Chapter 3 – Overview of Analytical Approach (also see Chapter 3 for a full description of the cumulative impact assessment methods). Only projects that could affect fisheries and aquatic resources are considered in this section.

Although many of the proposed projects/programs described in Chapter 3 could have project-specific impacts that will be addressed in future project-specific environmental documentation, future implementation of these projects/programs is not expected to result in cumulative impacts to water supply operations, or water-related and water-dependent resources (including fisheries and aquatic resources) that also could be affected by the Proposed Project Alternative. For this reason, only a limited number of projects that have the potential to cumulatively impact fisheries and aquatic resources in the Project Area are specifically considered qualitatively in the cumulative impacts analysis. The manner in which the projects listed below could contribute to potentially significant cumulative impacts to fisheries and aquatic resources is related to the manner in which they potentially affect hydrologic considerations, specifically flows in Mammoth and Hot creeks. These considerations for the following projects were discussed in Chapter 4 – Hydrology and are not repeated here.

[5] The "*Guide to the California Environmental Quality Act*" (Remy et al.) states that "*…although a project may cause an "individually limited" or "individually minor" incremental impact that, by itself, is not significant, the increment may be "cumulatively considerable", and thus significant, when viewed against the backdrop of past, present, and probably future projects.*" (CEQA Guidelines, Section 15064, subd. (i)(l), 15065, subd. (c), 15355, subd. (b)).

6.6.1 QUALITATIVE ANALYSIS OF PAST, PRESENT AND FUTURE PROJECTS

- 2005 District Urban Water Management Plan
- 2007 Town of Mammoth Lakes General Plan Update

  Quantitative analysis of future District surface water diversions consistent with the 2007 Town of Mammoth Lakes General Plan Update is presented in 6.6.2.1 below.
- MCWD 2008 Municipal Service Review And Sphere of Influence Recommendation
- USFS Applications for Storage at Mamie and Twin Lakes
- Suggested Declaration of Mammoth Creek as a Fully Appropriated Stream System

6.6.2 QUANTITATIVE ANALYSIS OF PAST, PRESENT AND FUTURE PROJECTS

6.6.2.1 FUTURE DISTRICT SURFACE WATER DIVERSIONS

Water demands associated with maximum buildout projections extending to 2025 identified in the above-mentioned documents have been incorporated into the quantitative component of the fisheries and aquatic resources cumulative impact analyses. Model output for the comparison of the Proposed Project Alternative Future Level of Demand relative to the Existing Condition is presented in Appendix D-6. Potential cumulative impacts to fisheries and aquatic resources can be identified and characterized using the same quantitative methods, impact indicators and significance criteria as those identified for the direct impact analyses discussed above in Section 6.3.

Cumulative Impact Consideration 6.6.2.1-1. Potential to Change Mammoth Creek Flows Resulting in a Reduced Ability to Maintain Fisheries and Aquatic Habitat

Changes to the components of the flow regime associated with the Proposed Project Alternative Future Level of Demand, relative to the Existing Condition, are evaluated and described in Chapter 4 – Hydrology. The conclusions are applicable to the fisheries and aquatic resources in Mammoth Creek. Substantial differences would not occur between the Proposed Project Alternative Future Level of Demand and the Existing Condition for the following.

- The magnitude, frequency, duration, timing and rate of change of hydrologic conditions at the OMR and OLD395 gages.
- Flow variability, relative to the index of unimpaired flow as a benchmark reference, at the OMR and OLD395 gages.
- The frequency and duration of channel maintenance and flushing flows represented by the index value of $Q_{1.75}$ at the OMR Gage.

In addition, the Proposed Project Alternative Future Level of Demand exhibits very weak and not statistically significant correlations between CUSUMs of annual brown trout total population abundance and the following expressions of flow: (1) Annual Average OMR Mean Daily Flow (r = -0.016, P = 0.955); (2) OMR High Flow (r = -0.116, P = 0.668); (3) OMR Low Flow (r = 0.061, P = 0.821); and (4) OMR Low Flow Quartile (r = 0.194, P = 0.472). Correlations under the Proposed Project Alternative Future Level of Demand do not significantly differ from those under the Existing Condition and, therefore, would not significantly change the relationships between flow variability and associated trends in annual brown trout total population abundance.

Therefore, in consideration of the entire suite of analyses described above, potential impacts to fisheries and aquatic habitat, including Owens sucker and tui chub, associated with flows in Mammoth Creek are less than significant under the Proposed Project Alternative Future Level of Demand, relative to the Existing Condition.

Cumulative Impact Determination 6.6.2.1-1 – Less than Significant

Mitigation Measure 6.6.2.1-1 – None Required

Cumulative Impact Consideration 6.6.2.1-2. Potential to Change Adult Brown Trout Pool Habitat Availability in Mammoth Creek

Examination of the habitat time series presented in Appendix D-5 demonstrates generally similar overall trends in the amount of adult brown trout pool habitat available under the Proposed Project Alternative Future Level of Demand and the Existing Condition. The daily habitat time series under the Proposed Project Alternative Future Level of Demand generally conform to the habitat time series under the Existing Condition, particularly with respect to the 90% of maximum (theoretical) habitat value.

Under the Proposed Project Alternative Future Level of Demand, 92.4% of the maximum (theoretical) average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 90.3% under Dry runoff year types, 93.2% under Normal runoff year types, and 92.0% under Wet runoff year types. By comparison, under the Existing Condition, 92.7% of the maximum (theoretical) average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 90.9% under Dry runoff year types, 93.5% under Normal runoff year types, and 92.1% under Wet runoff year types. As a reference benchmark, under the index of unimpaired flows, 92.9% of the theoretical maximum average daily adult brown trout pool habitat occurs over the entire 20-year period of evaluation, 91.6% under Dry runoff year types, 93.8% under Normal runoff year types, and 91.8% under Wet runoff year types.

Of the 240 average monthly possibilities (12 months x 20 years), 90% of maximum (theoretical) adult brown trout pool habitat availability occurs 176 months (73.3%) under the Proposed Project Alternative Future Level of Demand, 178 months (74.2%) under the Existing Condition, and 173 months (72.1%) under the index of unimpaired flows. Thus, 90% of maximum (theoretical) adult brown trout pool habitat availability is achieved with a similar probability of occurrence under the Proposed Project Alternative Future Level of Demand relative to the Existing Condition, as well as in comparison to the index of unimpaired flows.

Therefore, minor differences occur in the percentage of maximum (theoretical) daily adult brown trout pool habitat achieved under the Proposed Project Alternative Future Level of Demand, relative to the Existing Condition, and represent a less than significant impact.

Cumulative Impact Determination 6.6.2.1-2 – Less Than Significant

Mitigation Measure 6.6.2.1-2 – None Required

Cumulative Impact Consideration 6.6.2.1-3. Potential to Change Hot Creek Flows at the USGS Hot Creek Flume Gage

The conclusions presented in Chapter 4 – Hydrology are applicable regarding fisheries and aquatic resources in Hot Creek. Substantial differences would not occur between the Proposed Project Alternative Future Level of Demand and the Existing Condition for the following.

- The magnitude, frequency, duration, timing and rate of change of hydrologic conditions at the USGS Hot Creek Flume Gage.
- Flow variability, relative to the index of unimpaired flow as a benchmark reference, at the USGS Hot Creek Flume Gage.
- The frequency and duration of channel maintenance and flushing flows represented by the index value of $Q_{1.75}$ at the USGS Hot Creek Flume Gage.

Therefore, in consideration of the entire suite of analyses described above, potential impacts to fisheries and aquatic habitat, including Owens sucker and tui chub, associated with flows in Hot Creek are less than significant under the Proposed Project Alternative Future Level of Demand, relative to the Existing Condition.

Cumulative Impact Determination 6.6.2.1-3 – Less Than Significant

Mitigation Measure 6.6.2.1-3 – None Required

No potentially cumulatively significant adverse impacts to fisheries and aquatic resources would occur. Thus, the Proposed Project Alternative does not have an incremental effect that is "cumulatively considerable".