Chirila, Myra E. Item 35 10-25-16

From: Alice A Rich PhD <alice@aarichandassociates.com>
Sent: Tuesday, October 25, 2016 1:54 PM
To: Seifert, Linda J.; Hannigan, Erin; Thomson, Skip; Spering, Jim P.; Vasquez, John M.; CAO-Clerk
Cc: Amber Kemble; Alice A Rich, Ph.D.
Subject: UGH Letter to BOS
Attachments: AAR Letter to Supervisors.10-25-16. AARFINAL.pdf; AAR RESUME 2016.pdf; AAR SOQ 2016.pdf; Leidy.2005.Historical Distribution.pdf

To: Solano County:

I am submitting the attached on behalf of Amber Kemble, attorney for the Upper Green Valley Homeowners Association. Please see attached.

Thank you.

Alice A. Rich, Ph.D.

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October 25, 2016

Board of Supervisors, Solano
County 675 Texas Street, Suite
6500
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RE: Middle Green Valley Specific Plan Project - Second Revised Re-Circulated Draft Environmental Impact Report (SCH# 2009062048)/Potential Significant Impacts on the Threatened Central California Coast Steelhead (*Oncorhynchus mykiss*); California Red-Legged Frog (*Rana draytonii)*; and, Western Pond Turtle (*Actinemys marmorata*), in Green Valley Creek.

Dear Supervisors:

Approximately two years ago I submitted a comment letter for the Middle Green Valley Specific Plan ("MGVSP" or "Project") (SCH#: 2009062048), stating that the Project could result in significant adverse impacts to the *Threatened* Central California Coast steelhead (*Oncorhynchus mykiss*) (CCC steelhead)[1], and their critical habitat (Federal Register, 2005). I also opined that the Project could result in significant adverse impacts to the California Red-Legged Frog (*Rana draytonii)* (CRLF) and, Western Pond Turtle (*Actinemys marmorata*) (WPT). Despite the new information set forth in the Second Revised Re-Circulated Draft Environmental Impact report (SRRDEIR), my professional opinion remains that there are several potentially significant impacts to these protected species. Further, these protective species have not been sufficiently studied in Green Valley Creek, mitigation is insufficient or absent, and impacts to species must be better avoided.

Much of my prior comment letter from two years ago is repeated here because it is still applicable to the SRRDEIR. I have also included my updated analysis, based on my review of the DEIR, the Revised Re-circulated DEIR ("RRDEIR"), related documents for the MGVSP, a letter (dated August 11, 2014) prepared by hydrologist, Gregory R. Kamman (2014), and

[1] As part of the Endangered Species Act (ESA), in 1991, NOAA Fisheries issued a policy for delineating distinct population segments of Pacific salmon, including steelhead (56 FR 58612; November 20, 1991). Under this policy, a group of Pacific salmonid (salmon and steelhead) populations is considered an ''evolutionarily significant unit'' (ESU) if it is substantially reproductively isolated from other same-species populations, and it represents an important component in the evolutionary legacy of the biological species. Further, an ESU is considered to be a "distinct population segment" (DPS). The CCC steelhead DPS comprises winter-run steelhead populations from: (1) The Russian River (inclusive) in Sonoma County stretching south to Aptos Creek (inclusive) in Santa Cruz County; and, (2) The tributaries to the San Francisco/San Pablo Bay system (Federal Register, 2006, 1997; NOAA Fisheries, 2011). In addition, Critical Habitat was designated for the CCC steelhead (Federal Register, 2005).

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supporting scientific documents.[2] I have also reviewed the SRRDEIR, including its Appendix A, "Analysis of Potential Effects to Surface Biological Resources from Groundwater Pumping Middle Green Valley Project", by Vollmar Natural Lands Consulting (2016) (Vollmar Report).

My Résumé is attached as Exhibit A to this letter and my Statement of Qualifications is attached as Exhibit B to this letter.

1. Proposed Groundwater Extraction may have Significant Impacts on the CCC Steelhead, including Restricting their Range and Reducing their Numbers

CCC steelhead are present in Green Valley Creek (DEIR, pp. 6-35 to 6-36).[3] To spawn, hatch, grow, and continue to reproduce for subsequent generations, the CCC steelhead requires water *throughout the year in creeks and rivers*. "Steelhead is an anadromous salmonid, typically migrating to marine waters after spending two years in the fresh water. Following out-migration to the ocean, individual Steelhead remain there for two years.... before returning to their natal stream to spawn.... Preferred spawning is found in perennial streams with cooler-temperature water, high dissolved oxygen levels, and substantial flow...." "Steelhead has been documented in Green Valley Creek and its tributaries" (cited Leidy et al., 2005).

The Vollmar Report (p. 2) acknowledged that, "Any reduction in current Green Valley Creek dry season (May to October) flow that this species uses for juvenile rearing could have potentially significant impacts." I agree with this statement and would add that water temperatures in Green Valley Creek may be affected by water quantity in summer. This is because there is less water in the creek during the dry months of the year.

[2] The references cited in this letter are listed as an Attachment A to the letter.

[3] The DEIR states, "Steelhead (*Oncorhynchus mykiss irideus*) -- Central California Coast ESU, Federal Threatened (FT), National Marine Fisheries Service (NMFS), Essential Fish Habitat (EFH) The central California coast Evolutionary Significant Unit (ESU) includes ... Steelhead...in California streams from the Russian River to Aptos Creek, and the drainages of San Francisco and San Pablo bays eastward to the Napa River (inclusive), excluding the Sacramento-San Joaquin River Basin."

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Mr. Vollmar's analysis is incomplete because he fails to acknowledge the impacts of water withdrawal from that natural regime at other times of the year on steelhead. Reduction of water to Green Valley Creek, and delay of water reaching Green Valley Creek and its intermittent tributaries, could have significant impacts on all life stages (not just juveniles) of the CCC steelhead. Thus, these impacts could occur year-round and not just during the dry season. Any potential reduction to instream flows may restrict the steelhead's range during that particular life stage.

Steelhead inhabit portions, including the mid to upper portions, of the 4.7 mile-long creek year round (SRRDEIR, p. 6-37). Steelhead benefit from flowing water and cool temperatures. In many other streams throughout California groundwater withdrawal, among other things, adversely impacts steelhead by altering their natural habitat. The alteration of natural habitat, such as from loss of instream flows, has severely restricted the range of steelhead in California. This is because steelhead require sufficient cool water to thrive.

Steelhead require natural water flow year-round. If the natural flow regime is altered, it could restrict the steelhead's range in Green Valley Creek. This is especially true in Green Valley Creek because: (1) It is a relatively short creek; and, (2) It drops to relatively low flows during the summer months. This occurs near Mangels Boulevard, where the Department of Water Resources stream gauge is located. In the rainy season, the steelhead immigrate past the stream gauge downstream of the Project site to Via Palo Linda Bridge and proceed further upstream.

CCC Steelhead have been particularly susceptible to dewatering of creeks later into the fall. In part, this is because they immigrate after rainfall, in response to stream flow changes. Steelhead migrate in relation to the quantity of stream flow. Neuroblasts on their lateral sides react to increased stream flow as they progressively make their way through San Pablo Bay to Suisun Bay to Cordelia Slough and on to Green Valley Creek. There are potential foreseeable impacts to steelhead if the intermittent portions of Green Valley Creek remain drier for longer periods of time, as a result of less stream flow. Any portions of Green Valley Creek that remain drier or shallower longer could result in a restriction in the steelhead's range. Any stream flow reduction may reduce the overall numbers of steelhead.

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There are also impacts to the steelhead's response to the reduction of streamflow at any time of year, including fall and winter. During the wet season, issues with steelhead may pertain to stream depths. Steelhead tend to immigrate as far as it can into creeks. Green Valley Creek is a relatively short creek at only 4.7 miles long. There are few streams in Solano County that support steelhead (Leidy et al. 2005). If steelhead spawning or rearing habitat were eliminated from any portion(s) of Green Valley Creek, due to loss of stream flows, it could restrict the range, or reduce the number of steelhead in the creek. Reduced flows could also interfere substantially with the movement of any native resident or migratory fish, MGVSP. Reduced stream flow can prevent adult immigration. However, there are no scientific studies on fish barriers in the Green Valley Creek watershed. The existing anadromous fish barriers within the Green Valley Creek Watershed should be analyzed. In my 2014 letter I opined that any alteration of the streamflow in the Green Valley Creek watershed could cause significant impacts.

Steelhead require water throughout the year. Despite my making comments in 2014, the SRRDEIR fails to **adequately address the issue** of delay in aquifer recovery. Therefore, I raise the issue of the potential impact of delay in groundwater reaching the creek in fall. Notably, the Vollmar Report (p. 44) admits that it did not review my 2014 comment letter.

In summary, the groundwater extraction proposed by options B and C in the MGVSP could result in the de-watering of Green Valley Creek. Such extraction would likely result in significant impacts on the sensitive CCC steelhead. As is further explained below, to determine the extent to which groundwater extraction for the proposed MGVSP would result in significant impacts on the CCC steelhead, further studies and analyses are required.

2. The CCC Steelhead is Likely to be on the Brink of Extinction in the Near Future

The failures of the environmental review are especially egregious for CCC steelhead. Being listed as *Threatened*,[4] the CCC steelhead is likely to be at the brink of extinction in the near

[4] Defined under the ESA as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." (www.nmfs.noaa.gov/pr/glossary.htm#species)

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future. If it is re-listed as *Endangered*,[5] then it would be likely to be at the brink of extinction at that time. NOAA Fisheries is in the process of drafting a multi-species Recovery Plan that includes the CCC steelhead (NOAA Fisheries, 2011). Currently, there are extremely limited data to assess the status of the CCC steelhead (NOAA Fisheries, 2011), and virtually no data on the population in Green Valley Creek (Rich, 2013). Thus, if groundwater extractions resulted in any de-watering of Green Valley Creek during any time of year, the negative impacts of that action on the CCC steelhead could be significant and result in its further decline or, at worse, its extinction.

3. Specific Life Cycle and Life Stage Requirements of the CCC Steelhead in Green Valley Creek Must be Studied and Analyzed before Potential Impacts and Mitigation Measures can be Determined.

As noted in my prior letter, the steelhead is the anadromous form of the resident rainbow trout. An anadromous fish is one that begins life in a freshwater stream or river, migrates out to sea to grow and mature, and then returns to its natal stream or river to spawn. Except for their ocean-going habits and larger spawning size, the steelhead is visually indistinguishable from its non-migratory counterpart, the rainbow trout; only genetic studies can provide the necessary information that differentiates the two forms (Utter et al., 1980; Allendorf, 1975; Behnke, 1972). Whether or not a particular stream supports an anadromous or resident trout population, or both, appears to be the result of local adaptation to geographic location. Steelhead have well-developed homing abilities and usually spawn in the same stream in which they were born.

The CCC steelhead, similar to other salmonids (steelhead and salmon), has specific life stage requirements. Life stages for the steelhead include: (1) Adult immigration/passage; (2) Spawning; (3) Egg/alevin (yolk sac not absorbed) incubation; (4) Fry/juvenile rearing; and, (5) Juvenile smoltification/emigration (NOAA Fisheries, 2011; DFG, 1996; Barnhart, 1986). If any natural, or man-made, factor in a creek, such as Green Valley Creek,

[5] Defined under the ESA as "any species which is in danger of extinction throughout all or a significant portion of its range." (www.nmfs.noaa.gov/pr/glossary.htm#species)

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negatively impacts any of these life stages, the future of that CCC steelhead population may be in jeopardy.

Environmental factors that affect the various life stages of steelhead include stream flows, water temperature, dissolved oxygen concentrations, suitability of spawning and rearing habitat (i.e., size of gravel, percentage of silt and fines), angling pressure, phase of the moon, and photoperiod (Moyle, 2002; DFG, 1996; Barnhart, 1986; Folmar and Dickhoff, 1982; Grau et al., 1981). Depending upon the geographical location and the interaction of environmental factors, included those caused by humans, both the timing of each life stage, and the requirements for each of those life stages, vary.

For Green Valley Creek, there are no data on the CCC steelhead, except for a few adult sightings in the past (SRRDEIR 2016, Leidy et al., 2005; Leidy, 2002; Pinkham and Johnson, 1976; Week, 1975). Thus, before one could determine potential impacts of the MGVSP on the CCC steelhead, the following two types of studies must be conducted: (1) Studies to determine existing steelhead life stage habitat conditions in Green Valley Creek (e.g., water temperature monitoring, habitat surveys, food availability studies, etc.); and, (2) Instream flow studies. The results of those studies would then be used to determine the potential impacts of streamflow alterations on each of the life stages of the CCC steelhead during the year and under different water years. This critical information remains missing from the SRRDEIR.

As noted previously, there are potentially significant impacts, based on the delay in recovery of the aquifer to Green Valley Creek. The Vollmar Report (p 26) appears to confirm this impact, stating, "Direct and indirect effects caused by modification of natural flow regimes have had significant negative impacts on steelhead in this DPS (e.g., mortality of adults/juveniles, alterations of fish communities and impacts to migration, spawning, rearing and refugia)" (NMFS 2011). However, despite acknowledging the significant impact of groundwater altering the natural flow regime, the Vollmar Report fails to examine how this impact would affect steelhead. The Vollmar Report failed to disclose when steelhead would be present in Green Valley Creek for each of its life stages. Instead, to analyze the impacts to steelhead, the Vollmar Report (p. 27) confirmed that the annual life cycle of steelhead had not been adequately studied, stating, "Outside of these general habitat requirements, steelhead display a "dizzying array of life history variation" (Satterthwaite et al. 2009), and 32 possible life history trajectories have been identified for steelhead (Thorpe 2007). Central California coast steelhead show a tremendous

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amount of juvenile and adult life history variation, though all adult runs occur during the winter (Moyle et al. 2008)."

I agree that there are many relevant and unknown specifics, regarding each of the life stages of steelhead in Green Valley Creek. For example, we do not know when the critical life stages of steelhead occur in Green Valley Creek, such as when they immigrate up the Creek in winter, when they smolt in spring, when juveniles emigrate out, etc. We don't know if water temperatures are stressful to any of the life stages of the steelhead. The quantity of water in Green Valley Creek would affect the water temperatures and that change could have a significant negative effect on steelhead.

The SRRDEIR fails to assess the steelhead habitat in Green Valley Creek and its tributaries in the Plan area. Thus, it is not known (1) Whether or not habitat would be affected by a reduction in overall yearly groundwater flow; (2), How a delay in the aquifer recovery would affect stream flow; and, (3) How streamflow would affect steelhead habitat. For example, to immigrate up rivers and creeks, steelhead in the ocean are triggered by stream flow. They respond to an increase in streamflow, via their lateral line system via neuroblasts in the lateral line canals that are located along either side of their bodies, below the skin. To assess the impacts and mitigation of those impacts for steelhead from groundwater pumping, information relevant to the steelhead's life stages in Green Valley Creek is required Moreover, it is necessary to determine if all potentially significant impacts to steelhead are avoidable.

4. How Does the Groundwater Extraction Affect the Timing of Aquifer's Recovery and Increase in Flow of Groundwater to Green Valley Creek?

The question remains as to how the additional year-round extraction of 186 afy would affect the timing of the aquifer's recovery and commensurate increase in flow of groundwater to Green Valley Creek, even if the aquifer fully rebounds by spring. In turn, until this information is disclosed, scientists cannot adequately assess impacts to steelhead, and whether or nor those impacts could be avoided by mitigation, such as changing the timing of the pumping at some wells, and using storage.

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5. The SRRDEIR is Incomplete, Mistates Facts and Relies on an Incorrect Assumption that Safe Yield for Human Consumption is the same as Sustainable Yield for Wildlife.

The Vollmar Report provided some additional analysis pertaining to groundwater pumping on steelhead. It concluded that, "Any reduction in current Green Valley Creek dry season flow would represent a potential impact to central California coast steelhead because juvenile steelhead that may be present require at least intermittently fairly fast-moving water to maintain the food supplies necessary for growth." (p. 35). However, the Vollmar Report was incomplete because it ignored the details of the various life stages of steelhead in Green Valley Creek, such as adults immigrating into Green Valley Creek in late fall/winter. In reality, there are impacts to steelhead throughout the year as a result of the reduction of water quantity, from the eggs in the substrate, to juveniles within the pools and riffles year-round, to the adults immigrating into Green Valley Creek.

To analyze and mitigate for how the rebound aquafer impacts the steelhead, it is critical to identify when the various stages of the steelhead life cycle take place and the requirements of those life stages. Thus, I agree with the conclusion made in the Vollmar Report that any reduction in the dry season could have significant impacts on the steelhead. However, the Vollmar analysis ignores the impact of a delay in the natural flow from the aquifer to Green Valley Creek.

Finally, the Vollmar Report fails to discuss the extremely important issue of variations in water temperatures, in connection with stream flows. Stream flows can affect water temperatures and water temperatures can affect steelhead during *all stages* of their lives.

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6. <u>The Water Supply Options in the MGVSP Could Result in De-Watering of Green Valley Creek</u>

Following are some of the conclusions that Kamman (2014) made in his hydrological assessment of the proposed MGVSP that could negatively impact the CCC steelhead.

- *" .. annual variability groundwater demands are likely to continue."*
- *" with highest pumping rates occurring during dryer years and less groundwater pumping during relatively wetter years....*
- *"... it is not unreasonable to assume that a majority of area and existing environment may be susceptible to potential adverse impacts from groundwater pumping (e.g., well interference, dewatering creeks and wetlands, poor aquifer conditions limiting well yields, etc.)"*
- *" Additionally, site specific aquifer tests are necessary to analyze water availability in the Green Valley aquifer, which shows significant spatial variability."*

As streamflow significantly affects each life stage, groundwater extractions that alter creek flows *at any time of the year* could result in significant negative impacts on the CCC steelhead during any of their freshwater life stages. Following are examples of how the CCC steelhead could be significantly negatively impacted if groundwater extractions reduced creek flows in Green Valley Creek.

a. In late fall and winter, adult steelhead immigrate to their spawning areas in "waves" or pulses, coinciding with storm events (Shapovolov and Taft, 1954). Thus, if streamflows were reduced as a result of groundwater extraction, those adults might not be able to immigrate up Green Valley Creek and reach their spawning grounds.

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b. In fall and winter,,if there were adult steelhead that had immigrated into Green Valley Creek and flows were reduced as a result of groundwater extraction, the steelhead might not be able to immigrate over a shallow riffle, or dry area of the creek, and, hence, would not be able to reach their spawning grounds.

c. In spring, reduced flows can result in dried-up steelhead redds (nests), or newly-layed eggs being deprived of oxygen (Reiser and White,1982; Coble, 1961). Thus, if groundwater extraction reduced creek flows in Green Valley Creek during the time when the steelhead eggs were in the gravel, the eggs could be dessicated, or be deprived of oxygen, and die.

d. In spring, one of the most sensitive times of the year for juvenile anadromous salmonids is when they prepare to change from a freshwater to a marine fish. This process is called the "parr-smolt transformation", or "smoltification" (Folmar et al., 1982). For the CCC steelhead, smoltification occurs during the spring (March through mid-June). One of the factors that stimulates the beginning of smoltification is streamflow (Wedemeyer et al., 1980; Folmar et al., 1982). If flows are reduced and anadromous steelhead are prevented from emigrating out of watersheds and, hence, from completing the parr-smolt transformation, they can revert to the "parr" (freshwater fish) stage and die (Folmar et al., 1982; Adams et al., 1973).

   Thus, if groundwater extractions reduced flows in Green Valley Creek and the juvenile steelhead were unable to emigrate out of the system, they could revert to the "parr" (freshwater) stage and die in Green Valley Creek.

e. Suitable water temperature is probably the most important requirement for the thermally temperate-water salmonids, including the CCC steelhead (Rich, 1987; Brett, 1956, 1952). The reason is that fish are poikilotherms ("cold blooded" animals) and, as such, water temperature controls all aspects of a fish's life, including its physiology and biology. And, although lethal temperatures are often cited as the water temperatures that kill fishes, sublethal water temperatures have a far greater effect on the overall survival of salmonid populations (Brett, 1956). The optimal water temperature is a site-specific phenomenon controlled, to a great extent, on the amount of food available for the life stage of a species of fish.

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> If the water temperatures increased in Green Valley Creek during at any time of year, especially in the summer months, as a result of reduced streamflows caused by groundwater extraction, the higher water temperatures could negatively impact the steelhead. The steelhead's metabolism would increase as a result of the increased water temperatures and they would, thus, require additional food. If there was little food, or water temperatures increased to lethal levels, the steelhead could be harmed or, at the worst, die (Wurtsbaugh, 1973; Brett, 1952).

In summary, the SRRDEIR was incomplete, making it impossible to assess whether or not the Project would reduce steelhead habitat and numbers or its range by interfering with steelhead habitat in Green Valley Creek. The Project could also interfere substantially with the movement of any native resident or migratory fish. There have been no significant scientific studies of upper steelhead spawning reaches since 1975 (Leidy 2005, Habitat site is attached as Exhibit C to this letter) (See Attachment C).

7. **The Project's Proposed Mitigations are Inadequate to Reduce Potentially Significant Impacts to CCC Steelhead. Other basic Mititgations for Steelhead impacts are ignored.**

The Project acknowledged that pumping groundwater for the Project could result in potentially significant impacts, "If pumping from multiple wells were to combine to create substantial drawdown such that the water table were to drop below levels sufficient to support riparian vegetation, or below levels sufficient to maintain surface water flows that support fish and aquatic species, this would represent a ***potentially significant cumulative impact*** (see criteria [a] through [f] under Subsection 6.3.1, "Significance Criteria," above).

However, this impact is too narrow because it focuses exclusively on chronic drawdown over years, but fails to address the potentially significant impact associated with the time it takes for the aquifer to rebound (from fall to spring). A delay in the aquifer rebounding could impact total water quantity in Green Valley Creek from fall to spring. Moreover, as pumping would occur throughout the year, the removal of that water could have a significant impact to steelhead (Vollmar report, p. 2).

More mitigations must be utilized. For example, additional mitigations that must be considered include: reducing the size of the Project before it is built, based on the future site specific studies; and, (2) Improving creek habitat (e.g., installing baffles, removing invasive plants, restoring

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habitat (installing logs, planting native riparian plants, removing trash, replacing all roads, especially unpaved that are adjacent to the Creek to prevent sediment runoff)

8. **The Water Supply Options in the MGVSP Could Result in De-Watering of Green Valley Creek and Fail to Mitigate Potentially Significant Impacts to California Red- Legged Frog and the Western Pond Turtle.**

California red-legged frog (*Rana draytonii)* (CRLF) is federally-listed as *Threatened* and state-listed as a *Species of Special Concern* (DEIR p. 6-29). The DEIR describes the life cycle of the CRLF as wholly water dependent at all stages of its life (DEIR, p. 6-40).

The importance of the CRLF and its habitat in the MGVSP is identified throughout Chapter 6 of the DEIR:

a. In its summary of the types of aquatic communities in the Plan Area, the DEIR states that there are: 17.1 acres of Stock Ponds and Reservoirs; 13.0 acres Wetlands; and, 6.8 acres Ephemeral, Intermittent, and Perennial Streams (DEIR,
p. 6-4, Table 6.1). All of these aquatic habitats are habitats used by the CRLF during the different stages of its life.

b. Figure 6.4 shows *critical habitat* for the red-legged frog (DEIR p. 6-34).

c. DEIR acknowledges that there is "*High Potential*" for the presence of CRLF – "Both the higher-elevation ponds in the Plan Area Hills and Green Valley Creek and surrounding irrigation channels in the Plan Area Valley provide moderate to high quality habitat (varying between specific sites). There are two recent documented occurrences (including breeding) approximately 0.7 and 0.8 miles south of the Plan area, respectively." (DEIR, p. 6-29)

d. "Suitable aquatic habitats include ponds (ephemeral and permanent), streams/creeks (e.g., ephemeral and permanent), seasonal wetlands, springs, seeps, human-made features (e.g., stock ponds, roadside ditches), marshes, dune ponds, and lagoons." (DEIR, p 6-40) "Typical CRLF breeding habitat is characterized by deep and still or slow – moving water associated with emergent marsh and/or riparian vegetation." DEIR, p. 6-40)

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e. The DEIR further acknowledges that, "Portions of the Draft Specific Plan- proposed development areas are ADHCP-designated conservation areas for Priority Drainages and Watersheds (Green Valley Creek), ...California Red- legged Frog, ..." (DEIR, p. 6-55)

f. Additionally, Figure 6.8 on p 6-70 of the DEIR shows that Green Valley Creek is habitat for protected species, including the CRLF.

Despite the considerable appropriate habitat and presence of the protected CRLF in the vicinity of the Plan Area, the DEIR and related documents fail to identify, disclose and scientifically analyze potentially significant environmental impacts to the CRLF, related to the water supply options that include groundwater pumping from the local basin. In my professional opinion, the information presented by Kamman (2014) related to the potential to dewater the area, and the new proposals to provide all or a portion of groundwater in Options B and C, creates a potentially significant impact to the CRLF and WPT. The DEIR, RRDEIR, the SRRDEIR, and related documents fail to disclose, analyze and mitigate potentially significant impacts to the CRLF and WPT.

Similar to CRLF, the Western Pond Turtle (WPT) is federally-listed as *Threatened,* and state-listed as a *Species of Special Concern,* and is present in the Plan Area (DEIR, p. 6-29). As stated in the DEIR, "The Western Pont Turtle (WPT) is the only freshwater turtle native to northern California, and is associated with rivers, streams, lakes, and ponds throughout much of the state." (DEIR, p. 6-35).

The importance of the WPT and its habitat in the MGVSP is identified in Chapter 6 of the DEIR. "Green Valley Creek (and associated drainages) as well as irrigation canals in the plan area may support this species." (DEIR, p. 6-35).

a. "Some of the aquatic features within the plan area valley (e.g., Green Valley Creek) provide suitable habitat and may also be occupied by WPT." (DEIR, p. 6- 74)

b. "WPT (including one immature turtle less than two years old) was observed within the two large, perennial ponds in the middle of the portion of the plan area's hill during the site visit. The plan area provides high-quality aquatic habitat for the WPT,..." (DEIR, p. 6-35)

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c. "The plan area provides high-quality aquatic habitat for WPT..." (DEIR p. 6-35)

Despite the actual presence of the protected WPT, Impact and Mitigation 6-11 provide little to no information, with respect to the foreseeable potentially significant impacts to this species from groundwater extraction.

a. Impact 6-11 acknowledges that, "Alteration of hydrology and water quality during construction and following development may indirectly affect WPT by influencing habitat characteristics." (DEIR, p 6-74)

b. Mitigation 6-11 also states that, "Alteration of hydrology and water quality during construction and following development may indirectly affect WPT by influencing habitat characteristics." Mitigation 6-11 also states that "Indirect hydrology and water quality impacts on WPT shall be mitigated through implementation of mitigation measures recommended in chapter 11, Hydrology and Water Quality, of this EIR." (DEIR, p. 6-75). But, those mitigations fall short of sound statistically-based studies that would determine whether or not the impacts could be reduced to less than significant.

The Vollmar Report stated that,"California red-legged frog and western pond turtle would be impacted once ponded riparian refugia dried up. If the radial extent of the cone of depression in the unconfined aquifer adjacent to a proposed Option B groundwater pumping well extended to the edge of the stream channel, where a hydraulic connection was present between the stream and the unconfined aquifer, causing induced recharge, this could result in a small reduction in surface flow. However, due to the documented surplus of groundwater in the Project Area (Luhdorff and Scalmanini 2013; Section 3.5) ponded riparian refugia would not dry up entirely due to the scale of pumping proposed in Option B. Therefore, the impacts to California red-legged frog and western pond turtle in Green Valley Creek due to the groundwater pumping proposed in Option B would be less than significant."

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The Vollmar Report's analysis falls short because a biologist would not be able to determine if the CRLF and WPT habitat or its numbers have been reduced, or its range restricted. This is because, although Green Valley Creek might not dry up completely, it could dry up in places and that might be exacerbated at times, especially in fall as the aquifer and the creek are rebounding. Notably, the CRLF and WPT occupy habitat near the upstream reaches of the Project. (SRRDEIR 6-63). This potentially significant impact to the CRLF is not addressed in the SRRDEIR.

The main mitigation for CRLF and WPT (6-11) calls for federal consultation, but this is inadequate because a well does not require a federal permit and, therefore, does not require federal consultation, if placed outside critical habitat. However, impacts from the well may indirectly reach the CRLF and WPT habitat. Mitigation 6-11 admitted that, "Indirect hydrology and water quality impacts on WPT shall be mitigated through implementation of mitigation measures recommended in chapter 11, Hydrology and Water Quality, of this EIR." (DEIR, p. 6-75). Similarly the SRRDEIR acknowledges, " Alteration of hydrology and water quality during construction and following development may indirectly affect CRLF and WPT by influencing habitat characteristics." Yet despite this finding the mitigation 6-11 focuses only on the phantom consultation, which is not required for the indirect impacts associated with well impacts. Similarly, the mitigations set forth in Chapter 11 (ie for flooding and direct impacts) do not address indirect impacts, especially the two unstudied impacts (1.) direct impacts from year-round pumping; and, 2) a delay to water reaching the Creek from fall to spring).

The mitigations for CRLF and WPT are not effective. The SRRDEIR is incomplete.

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9. Conclusion

In summary, groundwater extractions, as part of the proposed SRRDEIR for the MGVSP, have the potential to result in reduced flows (year round), and delay flows into Green Valley Creek and other important water features of the area (especially in fall to spring time period). These extractions continue to pose potential significant negative impacts on the CCC steelhead, the Red Legged Frog, and the Western Pond Turtle. Further studies, such as those relating to the steelhead's life stages during different times of year/water events.

If you have any questions, or wish to discuss this letter further, please do not hesitate to contact me.

Sincerely,

Alice A. Rich, Ph.D.

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ALICE A. RICH, PH.D., PRINCIPAL

RÉSUMÉ

Dr. Rich, who founded ***AAR*** in 1983, has had over 30 years of technical and administrative project management experience in a wide range of fisheries-related projects. Dr. Rich's professional experience encompasses work as an expert witness on fisheries issues, fisheries consultant, fisheries biologist, fish physiologist, analytical chemist, and university lecturer. Dr. Rich has worked on projects involving federal, state, and local agencies, private companies, law firms, and environmental non-profit organizations throughout the western states, Maine, British Columbia, and the Bahamas. Dr. Rich has designed and supervised projects involving pollution and water temperature issues, environmental disasters (human-induced and natural), mining (gravel, gold limestone and phosphate), hydropower (dams and diversions), lagoons, bridges, dredging and pile driving, road construction, timber harvest, and other types of human land use activities that affect sensitive fish species. She has supervised hundreds of fish impact studies and analyses, including threatened and endangered fish species surveys and analyses, ESA Section 7 Consultations with federal agencies, fishery resources technical reports for EIR's, EIS's, and other environmental documents, fish risk assessments (mining), instream flow analyses, fish habitat and populations surveys and analyses, fish mitigation and rehabilitation, fish collection/salvage/relocation, fish age determination, fish limiting factor analysis, expert witness testimony, water quality and water temperature monitoring and impact analyses, fish physiology studies, and macro-invertebrate sampling and analyses. In addition, Dr. Rich is an expert in fish physiology and toxicology and has been called upon as an expert witness on the stressful impacts of pollution, water temperature, environmental disasters, dams, diversions and hydroelectric power, salmonid migration barriers, timber harvest, catch-and-release fishing, transportation and handling on fishes, and other factors that can be detrimental to federal- and state-listed fish species.

REPRESENTATIVE EXPERIENCE

- Provided expert witness testimony on wide range of federal- and state-listed fish species on water quality, water temperature, environmental disasters, mining, fish migration, logging, land development, and other factors that affect sensitive fish species.
- Designed and supervised over 50 water temperature and water quality monitoring studies that focused on salmon, steelhead, and other threatened- and endangered-listed fish species.
- Supervised hundreds of studies on threatened, endangered, and candidate fish species throughout California, Nevada, and Idaho, including the threatened Central California Coast steelhead, endangered Southern steelhead, threatened Northern California steelhead, endangered Central California Coast coho salmon, threatened Southern Oregon/Northern California coast coho salmon, threatened Central Valley spring-run Chinook salmon, endangered Sacramento River winter-run Chinook salmon, endangered razorback sucker, Owens pupfish, endangered Owens tui chub, threatened delta smelt, endangered tidewater goby, threatened South Central California Coast steelhead, North American green sturgeon, threatened North American green sturgeon, threatened Lahontan cutthroat trout, endangered Pahranagat roundtail chub, and other federal- and state-listed fish species.
- Determined impacts of stormwater runoff and golf course discharge on threatened and endangered fish species (delta smelt, Chinook salmon, steelhead, green sturgeon) in the South Delta.
- Determined impacts of ammonia from sanitary district on the threatened delta smelt and its primary food source, species of copepods, in the Sacramento River.
- Determined impacts of water temperature changes, as a result of the River Islands development in the South Delta on threatened and endangered fish species (delta smelt, Chinook salmon, steelhead, green sturgeon) in the South Delta.

ALICE A. RICH, PH.D., PRINCIPAL

RÉSUMÉ

***REPRESENTATIVE EXPERIENCE* (cont.)**

- Determined impacts of water temperature changes, as a result of the Brookside Development in the South Delta on threatened and endangered fish species (delta smelt, Chinook salmon, steelhead, green sturgeon) in the South Delta.
- Designed and supervised studies (fish habitat and population surveys; heavy metal analysis; fish bioenergetics-growth studies; macro-invertebrate bioassessment) on the impacts of the expansion of a gold mine on spring-run Chinook salmon, steelhead trout, bull trout, and westslope cutthroat trout in the Salmon River Watershed, Idaho.
- Designed and supervised studies (fish habitat and population surveys; heavy metal analysis; fish bioenergetics-growth studies; macro-invertebrate bioassessment) on the impacts of the expansion of a gold mine and mine tailings on fishes and invertebrates in the Humboldt River Basin, Nevada.
- Designed and implemented toxicity studies (bioaccumulation, growth, bioenergetics) on the effects of phosphate mine tailings on fishes and invertebrates in Idaho.
- Expert witness testimony on the effects of discharge effluent from a scrap metal company on salmon and steelhead in the Feather River.
- Determined the impacts (habitat, macro-invertebrate sampling, water quality analysis) of propylene glycol spill on benthic invertebrates in Seward Creek, Mendocino County
- Assessed the content of rubber tires and the potential impacts of the decay of the tires (heavy metals, rubber) on largemouth bass.
- Provided expert opinion on the cause of steelhead mortalities in Bear Gulch Creek as a result of a broken main water where 11,000 gallons of chlorinated water flowed into Bear Gulch Creek, Woodside, California, and killed about 20 endangered Central Coast steelhead (*Oncorhynchus mykiss*).
- Assessment of potential impacts on salmonids, delta smelt, and Sacramento splittail of diverting 15,000 acre-feet per year of Sacramento Municipal Utility District's American River entitlement to Sacramento County, California.
- Determined on-site restoration measures to provide additional habitat for a variety of Threatened and Endangered fish species including steelhead, delta smelt, winter-run Chinook salmon, spring-run Chinook salmon, Central Valley fall and late-fall Chinook salmon, North American green sturgeon, longfin smelt, and Sacramento splittail, and razorback suckers in the Sacramento-San Joaquin River System.
- Supervised studies on the impacts of gravel mining on salmon and trout in the Mad and Eel Rivers Watershed in northern California.
- Designed and supervised thermal physiology studies to determine the optimal growth temperature for juvenile Chinook salmon in the Central Valley, California.
- Expert witness testimony on the thermal impacts of PG&E's De Sabla-Centerville project on spring-run Chinook salmon in the Butte Creek and west Branch Feather River systems.
- Assessment and expert witness testimony of fishery resources impacts of multi-year flow/water temperature studies on the American River, California.
- Biological Assessment and fish relocation and Section 7 Consultation assistance with NOAA Fisheries, U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers
- Designed and supervised hundreds of fish habitat (e.g.,habitat typing, Essential Fish Habitat, Shaded Riverine Aquatic Habitat, etc.) and population surveys throughout the Central Valley and other parts of California and the other western states.

ALICE A. RICH, PH.D., PRINCIPAL

RÉSUMÉ

REPRESENTATIVE EXPERIENCE (cont.)

- Assessment of thermal impacts of reduced flows on Chinook salmon and steelhead in the Yuba River, California.
- Written over 100 Biological Assessments and fishery resources technical reports for EIR's, EIS's, and other environmental documents on the effects of a variety of land uses on threatened and endangered fish species throughout California.
- Designed and implemented multi-year studies that focused on the impacts of streamflows, water quality and water temperature from hydropower, dams and diversions, pile driving, mining, dredging, oil and other pollutants, pile driving, road construction, levee construction, boat docks, boat activities, and marinas involving Federal- and state-listed fish species.
- Collaborated extensively with federal, state, and local agencies and facilitated permitting and other agreements with applicants/clients throughout all phases of projects for over 30 years.
- Supervised fish habitat and population (electrofishing, beach seining, snorkeling, fyke nets) studies on over 100 projects involving salmon and trout and other Federal- and state-listed fish species.
- Designed watershed-based fish restoration projects for over 30 years.
- Trained field crews for over 30 years on minimizing handling and transportation stress on fishes in marine, estuarine, and freshwater ecosystems.
- Designed and supervised projects involving fish migration, including mapping (GIS) potential migration barriers and follow-up studies to determine whether or not barriers prevented fish (anadromous and resident) migration.
- Supervised fish rescue and relocation of dozens of construction-related projects, involving federal- and state-listed fish species.
- Analyzed methods used to determine behavioral impacts of dredging on fishes throughout the world.
- Supervised a study on the impacts of past, present, and future gravel mining on steelhead in the Upper Russian River Watershed.
- Dredge-related ESA Section 7 Consultations with NOAA Fisheries, U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers for the River Islands Development Project in Lathrop, California.
- Impacts of boat docks on salmonids in the Calaveras River Watershed in connection with the Brookside Estates Project, Stockton, California.
- Impacts of maintenance dredging by the Sacramento Yacht Club on the North American Green sturgeon in West Sacramento, California.
- Impacts of dredging activities on the behavior of federal- and state-listed fishes in San Francisco Bay.
- Impacts of suspended sediments resulting from dredging activities on federal- and state-listed fishes in San Francisco Bay.
- Supervised fish age studies (scales, otoliths, fin rays) in numerous freshwater and marine fishes.
- Trained in the Instream Flow Incremental Methodology (IFIM) and Habitat Evaluation Procedures (HEP).

ALICE A. RICH, PH.D., PRINCIPAL

RÉSUMÉ

EXPERT WITNESS TESTIMONY

- Impacts of ammonia released by Sacramento Regional Sanitary District into the Sacramento River on the threatened delta smelt and their primary food source, species of copepods (*Alston and Bird, Attorneys, Sacramento, California)*
- Impacts of overcrowding and handling stress on koi fish (*Technical Advisory Services for Attorneys, TASA, Blue Bell, Pennsylvania*)
- Impacts of effluent from a scrap metal facility on federal- and state-listed fish species (*Cannata, Ching & O'Toole, LLP, San Francisco, California*)
- Analysis of City of Napa's Mitigated Negative Declaration for the Napa Creek Apartments Project, Napa (*Dan Muller, Attorney, Walnut Creek, California*)
- Thermal Impacts from Diversions from the Delta Wetlands Project on Chinook Salmon and other Fishes of the Sacramento-San Joaquin River System (*Central Delta Water District, Stockton, California*)
- Thermal Impacts of Yuba County Water Agency's Proposal to Reduce Flows in the Lower Yuba River on Chinook Salmon and Steelhead Trout in the Yuba River (*California Department of Fish and Game, Sacramento, California)*
- Impacts of Reduced Flows on the Fishery Resource Habitat of the Lower American River (*County of Sacramento, California*
- Thermal Impacts of Altered Stream Flows on the Fishery Resources of the Lower American River (*County of Sacramento, California*)
- Thermal Impacts from Diversions from the Delta Wetlands Project on Chinook Salmon and other Fishes of the Sacramento-San Joaquin River System (*California Department of Fish and Game, Sacramento, California*)
- Impacts of Proposed Board of Forestry's Amendment to the Board of Forestry Rules on Salmon and Trout (*California Forestry Association, Sacramento, California*)
- Impacts of Sediment Associated with Timber Harvesting on Salmonids (*California Forestry Association, Sacramento, California*)
- Impacts of Sediment Associated with Vineyard Development on Salmonids (*Morrison and Foerster, Attorneys, San Francisco, California*)
- Impacts of Streamflow Alterations on Emigrating Salmonids *(North Marin County Water District, Novato, California)*
- Impacts of Streamflow Alterations on Emigrating and Resident Salmonids (*Casa de Fruta, Hollister, California)*
- Impacts of Summer Dams on Aquatic Species (*North Marin Water District, Novato, California)*
- Impacts of Handling and Transportation on Fresh Salmon (Alaska Airlines, Seattle, Washington)
- Stressful Impacts of Handling and Transportation on Salmonids (*Bangor Hydro-Electric Company, Bangor, Maine)*
- Impacts of Timber Harvest Practices on Salmonids *(East Bay Municipal Water District, Oakland, California)*
- Impacts of Timber Harvest Practices on Salmonids (*Barnum Timber Company, Eureka, California*)

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RÉSUMÉ

EXPERT WITNESS TESTIMONY (cont.)

- Impacts of Roads, Bridge, and Vineyard on Salmonids (*Friends of West Union Creek, Woodside, California)*
- Impacts of Construction of an Oil Rig Platform on the Fishery Resources (primarily herring) of Northern Puget Sound (*Kiewit Construction Company, Bellingham, Washington*
- Impacts of Dropping Crates of Fresh Salmon on the Marketability of the Salmon as Food (*Alaska Airlines, Seattle, Washington)*

EDUCATION

- Ph.D., 1983. Fisheries, University of Washington, Seattle
- M.S., 1979. Fisheries, University of Washington, Seattle
- B.S., 1973. Zoology, University of California, Davis

PROFESSIONAL HISTORY

- A. A. Rich and Associates/Principal (1983-present)
- University of Washington, School of Fisheries/Lecturer (1982-1983)
- University of Washington, School of Fisheries/Teaching Assistant (1976-1983)
- University of Washington, School of Fisheries, Laboratory of Radiation Ecology/Analytical Chemist (1977-1980)
- U.S. Forest Service, Seattle/Fisheries Consultant (1980)
- U.S. Bureau of Reclamation, Sacramento, California/Fisheries Biologist (1975)
- California Department of Fish and Game, Sacramento/Fisheries Biologist (1973-1975)
- IFG 200-Designing and Conducting Studies Using IFIM. Instream Flow Group, U. S. Fish and Wildlife Service, West Virginia, 1984.
- IFG 205-Field Techniques for Instream Analysis. U. S. Fish and Wildlife Service, West Virginia, 1984.
- IFG-210-PHABSIM-Using the Computer-Based Physical Habitat Simulation System. U. S. Fish and Wildlife Service, Colorado, 1984.
- Habitat Evaluation Procedures (HEP), Colorado, 1985.
- Fish Bioenergetics Growth Models, Toronto, Canada, 1988.
- SCUBA, N.A.U.I.

PROFESSIONAL AFFILIATIONS

- American Association for the Advancement of Science
- American Fisheries Society
- American Association of University Women
- Professional Environmental Marketing Association
- Western Dredging Association

ALICE A. RICH, PH.D., PRINCIPAL

RÉSUMÉ

REPRESENTATIVE PUBLICATIONS AND PAPERS PRESENTED

Dr. Rich has published and presented papers on a number of fishery resources topics including: water temperature and water quality impacts of flow alterations on delta smelt, salmon, steelhead, and other Federal- and state-listed fish species throughout the Central Valley; gravel, gold, and phosphate mining on salmonids; water quality requirements for fishes; dredging impacts on fishes; impacts of catch-and-release fishing on salmonids; smoltification of salmonids; enhancement strategies of salmonids in urban and rural areas; impacts of logging on salmon and trout habitat and populations; impacts of rotenone on lake fishery resources; domestication of salmonids; preferred herring spawning substrates; and, exercise physiology of trout. Following is a list of representative publications and papers presented.

Rich, A. A. 2015. Retaining Wall Replacement at 75 Bothin Road, Fairfax, California-Environmental Review and Permitting. Prepared for Millsap Degnan and Associates, Contractors. September 30, 2015.

Rich, A. A. 2015. Village West Pipe Replacement Project, Fairfax, California-Vegetation Monitoring-Second Year. August 28, 2015. 9 pages + Appendices.

Rich, A. A. 2015. Village West Bank Stabilization Project at 21 Banchero Way, Fairfax, California-Vegetation Monitoring-Second Year. August 28, 2015. 10 pages + Appendices.

Rich, A. A. 2015. Replacement of the Oak Ridge Drive Bridge, Roseville, Placer County-Fishery Resources Biological Assessment. Prepared for RF Consulting, Sacramento, California. May 22, 2015

Rich, A. A. 2015. Expert Evaluation of koi mortalities in Derek Aghchav vs Darin Erickson et al. Case. Prepared for Bradley and Gmelich, Attorneys, Glendale, California. March 31, 2015. 4 pages.

Rich, A. A. 2015. Upper North Fork Feather River Hydrolelectric Project Draft Environmental Impact Report-Expert Critique. Prepared for Plumas County Planning and Building Services. March 25, 2015. 24 pages

Rich, A. A. 2014. Expert Testimony - Middle Green Valley Specific Plan Project-DEIR/Potential Significant Impacts on the Threatened Central California Coast Steelhead (*Oncorhynchus mykiss*); California Red-Legged Frog (*Rana draytonii*); and, Western Pond Turtle (*Actinemy marmorata*), in Green Valley Creek. Expert Testimony Prepared for the Solano County Board of Supervisors, Fairfield, California on behalf of the Upper Green Valley Homeowners. November 25, 2014. 10 pages + Attachment and Exhibit.

Rich, A. A. 2014. Replacement of the Oak Ridge Drive Bridge, Roseville, Placer County. Fishery Resources Biological Assessment. Prepared for RBF Consulting, Sacramento, California. October 8, 2014. 36 pages +Appendices.

Rich, A. A. 2014. Study Elements required to Determine Salmonid Habitat and whether or not there are Factors that would Limit Salmonid Production in Permanente Creek Upstream of the Diversion Channel, Santa Clara County, California. Prepared for CSW/Stuber-Stroeh Engineers. March 3, 2014. 24 pages.

REPRESENTATIVE PUBLICATIONS AND PAPERS PRESENTED (cont.)

Rich, A. A. 2014. Knights Landing River Access Boat Launching Facility Renovation, Yolo County-Biological Assessment. Prepared for Yolo County, Woodland. February 19, 2014. 60 pages + Appendices.

Rich, A. A. 2014. Expert Witness Testimony-City of Napa's Revised Initial Study/Mitigated Negative Declaration for Napa Creek Apartments Project. Prepared for Daniel Muller, Attorney, Walnut Creek. June 18, 2013. 5 pages.

Rich, A. A. 2013. Expert Witness Testimony: Declaration of Alice A. Rich, Ph.D. in the matter of the People of the State of California, Petitioner, vs George W. Scott, Sr. Respondent. Prepared for Cannata, Ching & O'Toole LLP, Attorneys, San Francisco, California. May 9, 2013.

Rich, A. A. 2013. Anadromous Salmonid Culvert Analysis I-80 Express Lanes Project. Prepared for the Solano Transportation Authority and CalTrans. October 30, 2013. 13 pages + Appendices.

Rich, A. A. 2013. Bank Stabilization Project at 21 Banchero Way, Fairfax, California. Fish Collection and Relocation Plan. Prepared for Village West, Fairfax, California. August 13, 2013.

Rich, A. A. 2013. Bank Stabilization Project at 48 Broadmoor Avenue, San Anselmo, California. Fish Collection and Relocation Plan. Prepared for the Williamsons, San Anselmo, California. August 12, 2013.

Rich, A. A. 2013. Green Gulch Zen Center Landslide Stabilization Project. Muir Beach, California. Biological Assessment. Prepared for the San Francisco Zen Center, June 20, 2013.

Rich, A. A. 2013. Bank Stabilization Project at 48 Broadmoor Avenue, San Anselmo, California. JARPA and Biological Assessment. Prepared for Brian and Melisa Williamson, San Anselmo, California. June 10, 2013.

Rich, A. A. 2013. Charro Way Pipe Replacement Project, Fairfax, California. JARPA and Biological Assessment. Prepared for Village West Homeowners, Fairfax, California. June 6, 2013.

Rich, A. A. 2013. Bank Stabilization Project at 21 Banchero Way, Fairfax, California. JARPA and Biological Assessment. Prepared for Village West Homeowners, Fairfax, California. May 30, 2013.

Rich, A. A. 2012. Interpreting water temperature impacts from streamflow alterations from hydroelectric power, mining, and other land use activities on coldwater fishes, such as salmon and trout. Prepared for Technical Advisory Services for Attorneys (TASA), December, 2012. Submitted for the TASA January, 2013 Newsletter.

ALICE A. RICH, PH.D., PRINCIPAL

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REPRESENTATIVE PUBLICATIONS AND PAPERS PRESENTED (cont.)

Rich, A. A. 2012. Solano Transportation Authority Project-Salmonid Culvert Migration Analysis-First Pass Surveys. December 31, 2012. Prepared for Condor Country Consulting, Martinez. December 31, 2012. 7 pages + Appendices.

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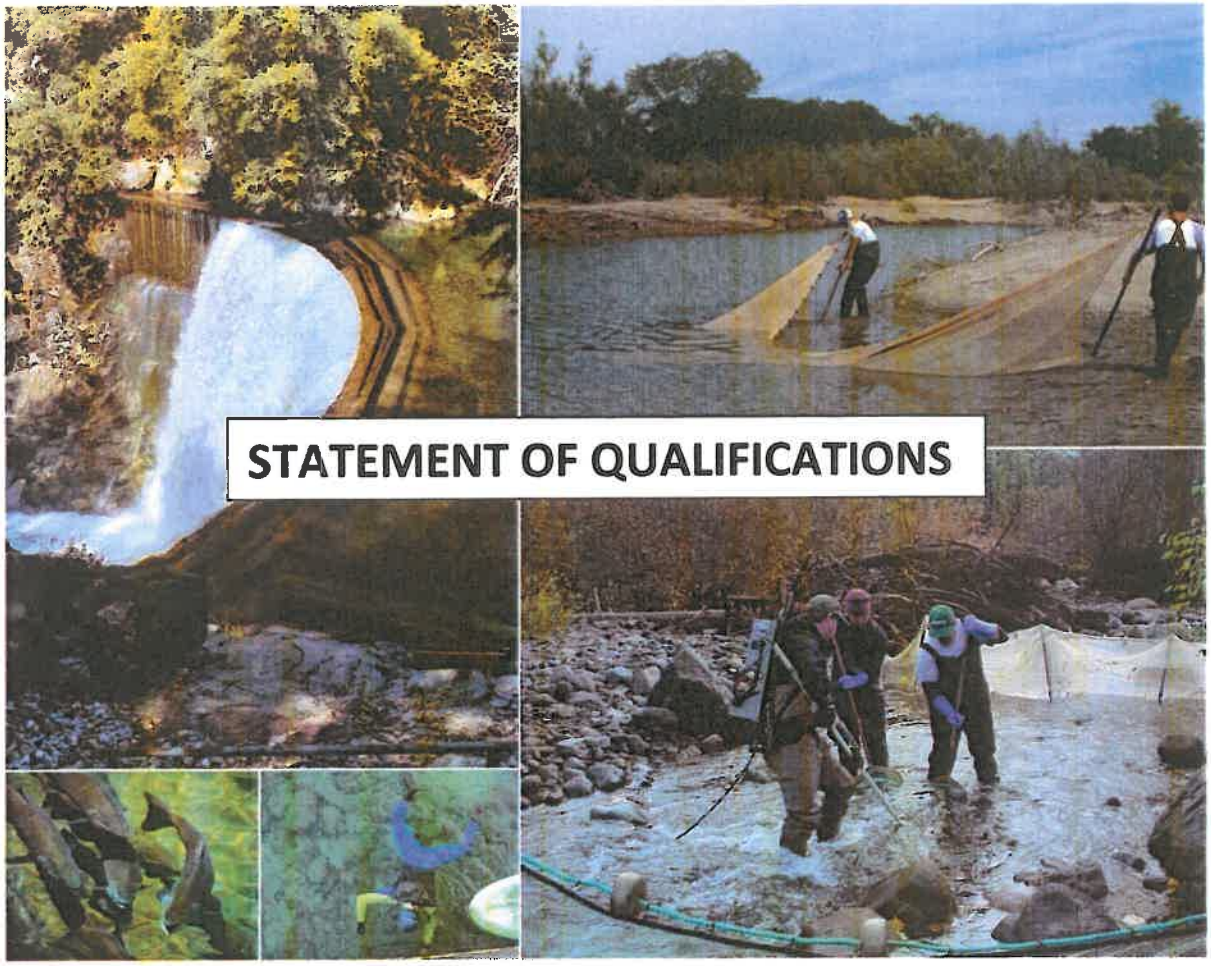

STATEMENT OF QUALIFICATIONS

A.A. RICH AND ASSOCIATES

Fisheries and Ecological Consultants

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INTRODUCTION

A. A. Rich and Associates (AAR) was established as a fisheries and ecological consulting firm in 1983. The firm is a certified (CalTrans UDBE No. 36285) woman-owned sole proprietorship, located in the San Francisco Bay Area, owned and managed by Dr. Alice A. Rich. Dr. Rich has over 30 years of technical and administrative experience on a wide range of projects in fishery resources management. ***AAR*** has completed hundreds of freshwater, estuarine, and marine studies in California, Washington, Oregon, Idaho, Nevada, British Colombia, the Yukon, Maine, and the Bahamas. ***AAR*** provides the following services in fishery resources management:

- Threatened and Endangered Species Surveys and Analyses;
- ESA Section 7 Consultations with Federal Agencies;
- Water Quality and Thermal Impact Studies;
- Expert Witness Testimony;
- Ecological Risk Evaluation of Fishes;
- Limiting Factor Analysis;
- Applied Environmental Physiology and Toxicology
- Biological Assessments;
- Biological Monitoring;
- Fishery Resources Technical Reports for EIR's, EIS's, and other environmental documents;
- Instream Flow Analysis;
- Fish Habitat (e.g., spawning, rearing) and Population Assessments;
- Fish Mitigation and Rehabilitation Studies;
- Fish Age Determination (e.g., otoliths, scales, fin rays);
- Fish Collection, Salvage, and Relocation;
- Permitting; and,
- Macro-invertebrate Collection and Analyses.

AAR is fully equipped to conduct field studies. Equipment includes boats, electroshocking gear, beach seines, fyke nets, block nets, water temperature and water quality supplies and apparatus, IFIM field gear, field computers, etc. To process data, conduct statistical analyses, and produce technical reports, ***AAR*** uses a number of data management and statistical computer programs, including *Sigmaplot, Microsoft Office Access, Excel, Sigmastat, SPSS, ArcView* (GIS Mapping), *Microfish,* and *Microsoft Word.* High quality analysis and products are provided throughout each phase of a study. The following pages highlight ongoing and completed projects conducted by ***AAR***.

SACRAMENTO-SAN JOAQUIN RIVER FISHERY RESOURCES PROJECTS

- Adaptive Management Plans
- Age and Growth Studies
- Biological Assessments and Monitoring
- Dams and Diversions
- De-Watering, Fish Salvage and Relocation
- Dredging and Pile Driving
- Endangered Species Section 7 Consultations
- Endangered Fish Species Surveys
- Expert Witness Testimony
- Fish Habitat and Fish Population Studies
- Housing Developments
- Marinas, Boat Activity, and Piers
- Mitigation Plans
- Rehabilitation Plans
- SCUBA and Snorkeling Surveys
- Stream Flows
- Stress Physiology
- Use of Salmonid Smolt Indicators
- Water Quality and Water Temperature Studies

IMPACTS OF AMMONIA DISCHARGE INTO THE SACRAMENTO RIVER BY THE SACRAMENTO REGIONAL COUNTY SANITATION DISTRICT ON DELTA SMELT (Ahlston & Bird, Attorneys for the Center for Environmental Science, Accuracy and Reliability, Sacramento, CA)

The Sacramento Regional County Sanitation District (District) discharges over 100 million gallons of treated wastewater, including 14 tons of ammonia, into the Delta daily. The Center for Environmental Science, Accuracy and Reliability (CESAR) is suing the District over the impacts of the ammonia on the delta smelt (*Hypomesus transpacificus*), a fish that is endemic to the Delta that is listed as threatened, as well as federal- and state-listed salmon and steelhead. Dr. Rich is providing expert witness testimony, on behalf of CESAR.

LITTLE HASTINGS ISLAND CONSERVATION BANK, SOLANO COUNTY, IDENTIFICATION AND EVALUATION OF RESTORATION MEASURES FOR THREATENED AND ENDANGERED FISH SPECIES (Wildlands, Inc., Rocklin, CA)

The purpose of the Little Hastings Island Conservation Bank is to provide regional compensation for impacts to federal- and/or state-listed fish species, and/or species of concern (Central Valley steelhead, delta smelt, winter-run Chinook salmon, spring-run Chinook salmon, Central Valley fall and late-fall runs Chinook salmon, North American green sturgeon, longfin smelt, Sacramento splittail, white sturgeon, and river lamprey). ***AAR*** is evaluating the habitat to determine whether or not there are on-site restoration measures that would provide additional habitat for these species of fishes.

IMPACTS OF THE PROPOSED RIVER ISLANDS PROJECT IN THE SAN JOAQUIN RIVER WATERSHED ON THREATENED AND ENDANGERED FISH SPECIES (Califia Development Company, Lathrop, CA)

Ongoing (over 10 years) assistance with the proposed River Islands at Lathrop project is a large housing development project on Stewart Tract in the South Delta near Stockton. As part of the project, an assessment of potential impacts on fishery resources is required. To that end, ***AAR*** is assisting the Applicant with fishery resources issues. Tasks include: (1) Section 7 Consultation with all agencies to assess impacts of the project on Chinook salmon, steelhead, delta smelt, green sturgeon, and Sacramento splittail; (2) Designing and implementing biological monitoring to limit impacts of boat dock construction on the sensitive fish species; (3) Monitoring of water quality and water temperature; (4) Facilitating the design of a fish screen; (5) Fish Monitoring Plan to assess any impacts of the project on T&E species; and, (6) Periodic Fishery Resources Technical Reports, Water Temperature Reports, and Water Quality Reports.

IMPACTS OF BOAT DOCKS ON SALMONIDS, DELTA SMELT AND OTHER T & E SPECIES IN THE CALAVERAS RIVER WATERSHED IN CONNECTION WITH THE BROOKSIDE PROJECT, STOCKTON (Washburn, Briscoe, and McCarthy, Attorneys, San Francisco, CA)

The Brookside Project is a housing development located in Stockton. As part of the environmental process, the Applicant was required to monitor the effects on fishery resources of the multiple boat dock as associated with the development. ***AAR's*** Tasks included: (1) Section 7 Consultation with all agencies to assess the potential impacts of the project on Chinook salmon, steelhead, delta smelt, and Sacramento splittail; (2) Designing and implementing on-site biological monitoring to limit impacts of boat dock construction on the sensitive fish species; and, (3) Designing and implementing a three-year water quality and water temperature monitoring effort to assess any impacts of the project on the T&E fish species.

RESORT AND HISTORICAL THEME PARK IMPACTS IN THE SAN JOAQUIN RIVER WATERSHED (Califia Development Company, Lathrop, CA)

Project in which ***AAR's*** Tasks included: (1) Inventory of all fishery resources; (2) Site-specific habitat studies; (3) Identification of fish species of special importance (delta smelt, salmonids, and other T & E species and candidate species); (4) Assessment of existing fishery resources conditions; (5) Assessment of potential impacts of the project; and, (6) Development of mitigation measures.

EIR/EIS FOR WATER ENTITLEMENT FROM THE AMERICAN RIVER (Sacramento Municipal Utility District, Sacramento, CA)

AAR conducted a fishery resources assessment of the impacts of diverting 15,000 acre-feet per year of SMUD's American River entitlement to Sacramento County. Issues of concern included: fish screens; fish species of special concern (e.g., winter-run Chinook salmon, delta smelt, Sacramento splittail); and, hydrological impacts. Tasks undertaken by ***AAR*** included: (1) Review of relevant data; and, (2) Analysis, impact assessment, mitigation measures and, recommendations.

KNIGHTS LANDING RIVER ACCESS/BOAT LAUNCHING FACILITY RENOVATION (Yolo County Planning, Resources and Public Works Department, Woodland, CA)

AAR is providing assistance biological and permitting assistance to Yolo County to determine the potential impacts of the Yolo County's renovation of the Knights Landing boat launching facility on biological resources. The BA provided information on existing conditions, potential impacts, and mitigation measures to minimize those impacts on the threatened and endangered (T&E) species that could be affected by the project. The T&E species that could be affected by the project include: (1) Central Valley fall-run Chinook salmon (*Oncorhynchus tshawystcha*); (2) Central Valley steelhead (*O. mykiss*); (3) Delta smelt (*Hypomesus transpacifica*); (4) Western pond turtle (*Clemmy marmoraat marmorata*); and, (5) Swainson's hawk (*Buteo swainsonii*). In addition, ***AAR*** is providing assistance with Section 7 Consultations (NOAA Fisheries, USFWS, Corps of Engineers) and permitting requirements for the state and federal agencies.

SACRAMENTO YACHT CLUB MAINTENANCE DREDGING PROJECTS – IMPACTS ON THE NORTH AMERICAN GREEN STURGEON, DELTA SMELT AND OTHER T & E FISH SPECIES (Sacramento Yacht Club, Sacramento, CA)

AAR assisted the Sacramento Yacht Club with their Maintenance Dredging Permit Application. Tasks include assessing the impacts of the project on the North American green sturgeon and its critical habitat.

HABITAT CONSERVATION AND MANAGEMENT PLAN FOR BEALE AIR FORCE BASE IN THE SACRAMENTO VALLEY, CALIFORNIA (Beale Air Force Base, California)

In connection with revising a Habitat Conservation and Management Plan that addresses natural resources issues at Beale Air Force Base, ***AAR*** is conducting snorkeling surveys for Central Valley steelhead and fall-run Chinook salmon in Dry Creek on the Base.

IMPACTS OF THE RECLAMATION REFORM ACT ON CENTRAL VALLEY FISHERY RESOURCES (U.S. Bureau of Reclamation, Denver, CO)

As part of the Bureau's Reclamation Reform Act (RRA) in the Central Valley, potential impacts on fishery resources had to be addressed. To that end, ***AAR*** completed a Technical Memorandum for Aquatic Resources that included: (1) Aquatic resources habitat and population conditions for the Central Valley, including delta smelt, salmonids, and other T & E fish species; (2) Statistical analysis of potential changes that could have occurred on the aquatic resources as a result of implementation of the RRA; and, (3) Impact Assessment of the RRA on aquatic resources, including: winter-run Chinook salmon, Delta smelt, and striped bass.

IMPACTS OF SCRAP METAL COMPANY EFFLUENT ON AQUATIC ORGANISMS IN THE FEATHER RIVER DRAINAGE, BUTTE COUNTY (Cannata, Ching, & O'Toole, Attorneys, San Francisco, CA)

Dr. Rich was an expert witness in a lawsuit between Butte County and Chico Scrap Metal, Inc. et al., regarding potential impacts of the effluent from the scrap metal company on aquatic organisms in the Feather River Drainage. Dr. Rich analyzed laboratory and in-situ data and testified on behalf of Chico Scrap Metal at the Butte County Courthouse in Oroville, California. Dr. Rich used her knowledge of both the California Toxics Rule and extensive experience on the impacts of pollutants on fishes and invertebrates to assess the potential impacts of the effluent on the aquatic environment.

SAN JOAQUIN COUNTY HABITAT CONSERVATION PLAN AND OPEN SPACE PLAN (San Joaquin County Council of Governments, Stockton, CA)

In connection with the development of the San Joaquin County Habitat Conservation Plan, ***AAR*** conducted a fishery resources assessment, including: (1) Analysis of existing information; (2) Identification of life stage requirements of fish species of special importance (e.g, salmonids, delta smelt and other T & E fish species); (3) Identification of impacts of factors (e.g., urban development, activities undertaken by public agencies, agriculture, water diversions, etc.) affecting fishery resources; (4) Transformation of data into GIS format (ArcInfo); and, (5) Identification of measures to mitigate for the loss of fishery resources and/or habitat.

REPLACEMENT OF OAKRIDGE DRIVE BRIDGE (LINDA CREEK) AND INDUSTRIAL AVENUE BRIDGE (PLEASANT GROVE CREEK) FOR THE CITY OF ROSEVILLE DEPARTMENT OF PUBLIC WORKS/ENGINEERING DIVISION (RBF, Sacramento)

The City of Roseville (Roseville) plans to replace the following two bridges in Roseville: the Oakridge Drive Bridge over Linda Creek and Industrial Avenue Bridge over Pleasant Grove Creek. One of the requirements of the projects is to provide information, including fishery resources information, sufficient to obtain environmental clearance for the project, per CEQA and NEPA requirements. To assist with the CEQA and NEPA process so that the City of Roseville can obtain the necessary permits for the two bridge projects, ***AAR*** is assisting with fisheries issues. To that end, AAR is providing the following: (1) Attended Kick-Off meeting; (2) Conducted a Renaissance-Level Fish Habitat Survey; (3) Collection relevant information and data; (4) Wrote a Fisheries Resources Biological Assessment (BA); (5) Assistance with Section 7 Consultations with NOAA Fisheries and assistance with the California Department of Fish and Wildlife concerns.

REPLACEMENT OF THE MCBEAN PARKWAY BRIDGE OVER AUBURN RAVINE FOR THE CITY OF LINCOLN DEPARTMENT OF PUBLIC WORKS/ENGINEERING DIVISION (Quad Knopf, Roseville, CA)

The City of Lincoln plans to replace the bridge on McBean Parkway over Auburn Ravine. One of the requirements of the project is to provide information, including fishery resources information, sufficient to obtain environmental clearance for the project, per CEQA and NEPA requirements. To assist with the CEA and NEPA process so that the City of Lincoln can obtain the necessary permits for the bridge project, AAR is assisting with fisheries issues. To that end, AAR is providing the following: (1) Attended Kick-Off meeting; (2) Conducted a Renaissance-Level Fish Habitat Survey; (3) Collection of relevant information; (4) Wrote a Fisheries Resources Biological Assessment (BA); (5) Assistance with Section 7 Consultations with NOAA Fisheries and assistance with the California Department of Fish and Wildlife concerns.

THERMAL IMPACTS OF REDUCED FLOWS ON CHINOOK SALMON AND STEELHEAD IN THE YUBA RIVER (California Department of Fish and Game, Sacramento, CA)

AAR assisted the California Department of Fish and Game (CFG) with the analysis of a water diversion and the potential thermal impacts on the Chinook salmon and steelhead. As a fish physiologist specializing in thermal impacts on fishes, Dr. Alice Rich assisted CFG with their preparation for the State Water Resources Control Board Hearings and was an expert witness on CFG's behalf.

THERMAL CONDITIONS IN THE SAN JOAQUIN RIVER SYSTEM ON CHINOOK SALMON AND STEELHEAD (California Department of Fish and Game, Fresno, CA)

The San Joaquin and its tributary rivers are listed as impaired by high water temperatures, under the State's Clean Water Act Section 303 (d). Dr. Alice Rich provided the California Department of Fish and Game with testimony on the existing thermal conditions within the San Joaquin River and its tributary rivers. The testimony included: (1) Analyzing the physiological effects of water temperatures on the various life stages of fall-run Chinook salmon and steelhead; and, (2) Analyzing the effects of water temperature-related mortality (both sublethal and lethal) on populations of fall-run Chinook salmon and steelhead in the San Joaquin River System.

THERMAL IMPACTS OF DELTA WETLANDS PROJECT ON SALMONIDS IN THE SAN JOAQUIN DELTA (California Department of Fish and Game, Sacramento, CA)

AAR assisted the California Department of Fish and Game (CFG) with the analyses for a project in the Sacramento-San Joaquin Delta in which water would be stored for later discharge. One of the key issues for this project was the potential thermal impacts on Chinook salmon. As a fish physiologist specializing in thermal impacts on fishes, Dr. Alice Rich assisted CFG in their preparation for the State Water Resources Control Board Hearings and was an expert witness on CFG's behalf.

STUDIES ON INSTREAM FLOWS, WATER TEMPERATURES, AND GROWTH OF ANADROMOUS FISHES IN THE LOWER AMERICAN RIVER (County of Sacramento, CA)

Dr. Alice Rich designed and conducted laboratory and field physiology studies to determine the relationship between instream flows, water temperature, and the growth of Chinook salmon, rainbow and steelhead trout, and American shad in the lower American River. At issue were the effects of the potential diversion of water from the American River by the East Bay Municipal Utility District for domestic uses. The results of the studies were presented by Dr. Alice Rich to the State Water Resources Control Board.

A REVIEW OF STUDIES ON EXISTING FISHERY RESOURCES IN THE AMERICAN RIVER (County of Sacramento, CA)

AAR reviewed existing information on the status of the fishery resources of the lower American River between Discovery Park and Nimbus Dam. At issue were the effects of the potential diversion of water from the American River by the East Bay Municipal Utility District for domestic uses. Tasks included: (1) Analysis of 40 years of historical data on Chinook salmon spawning escapement; (2) Review of existing data to assess optimal water temperature ranges for fishes; and, (3) Presentation of results by Dr. Alice Rich to the State Water Resources Control Board Hearings.

THERMAL EFFECTS OF P G & E'S DE SABLA-CENTERVILLE PROJECT ON SPRING-RUN CHINOOK SALMON IN THE BUTTE CREEK AND WEST BRANCH FEATHER RIVER SYSTEMS (California Sportfishing Protection Alliance Berkeley, CA)

PG&E operates its 26.6 megawatt DeSabla-Centerville Project within the Butte Creek and West Branch Feather River watersheds. The existing PG&E license for the project is due to expire in 2009 and the Federal Energy Regulatory Commission may issue a license to operate the project for a term of up to 50 years. Butte Creek provides one of the last viable remaining habitats for Spring-run Chinook salmon and Central Valley steelhead. Dr. Rich provided testimony on the existing thermal conditions within the Project Area. The testimony included: (1) Analyzing the physiological effects of water temperatures on the various life stages of spring-run Chinook salmon; and, (2) Analyzing the effects of water temperature-related mortality (both sublethal and lethal) on the population of Spring-run Chinook salmon in the Butte Creek Watershed.

LEWISTON DAM POWER PLANT REPLACEMENT PROJECT (Trinity County Public Utility District, Weaverville, CA)

AAR worked with the Trinity County Public Utility District on the replacement of the Lewiston Dam Power Plant. *AAR* address potential fishery resources impacts of the proposed project. Fish species of management interest included the spring- and fall-run Chinook salmon, coho salmon, and steelhead. Issues of concern include river flows and water temperature. *AAR* provided the Biological Assessment for the fishery resources component to this project.

IMPACTS OF DREDGING ON STRIPED BASS IN CLIFTON COURT FOREBAY IN THE SACRAMENTO-SAN JOAQUIN DELTA (Department of Water Resources, Sacramento, CA)

AAR assessed the potential impacts of different concentrations of suspended sediment on striped bass, as a result of dredging in Clifton Court Forebay in the San Joaquin Delta.

U.S. BUREAU OF RECLAMATION PROGRAMMATIC EIS FOR THE CENTRAL VALLEY IMPROVEMENT ACT (Montgomery Watson, Sacramento, CA)

As part of the Bureau's Programmatic EIS for the Central Valley Improvement Act ***AAR*** reviewed and analyzed past, present, and proposed anadromous fish restoration projects for the entire Central Valley. This review of restoration projects included both state- and Federal-funded projects on Chinook salmon, steelhead trout, striped bass, American shad, and white sturgeon. Riverine systems included both the mainstem and tributaries of the San Joaquin and Sacramento rivers, and the Sacramento-San Joaquin Delta.

EIR AND MASTER PLAN FOR WASTEWATER TREATMENT EXPANSION IN ROSEVILLE (City of Roseville, CA)

As part of the EIR and Master Plan for the wastewater treatment expansion in Roseville, potential impacts on fishery resources had to be addressed. To that end, ***AAR*** conducted fishery resources assessments of Dry Creek, Pleasant Grove Creek, and Auburn Ravine Creek. Issues of concern were the potential water temperature and water quality problems associated with sewage effluent into streams containing salmonids. ***AAR's*** Tasks included: (1) Stream habitat (Habitat Typing) surveys; (2) Fish population surveys (electrofish, seine); (3) Review of relevant data; (4) Analysis, report of results and recommendations; and, (5) Integration of fishery resources issues into the Master Plan.

IMPACTS OF TRANS-SIERRA TRANSMISSION LINE INTERTIE (ESA, San Francisco, CA)

In connection with the EIR for the Trans-Sierra Transmission Line Intertie, ***AAR*** conducted a fishery resources assessment of over 400 square miles of streams along proposed alternate routes. Riverine systems included the American, Bear, Truckee, Carson, and Yuba rivers; Prosser, Dry, Wolf, Auburn Ravine, Weber, and Alder creeks; and, Dutch Flat, Rollins and, Camp Far West reservoirs. ***AAR's*** Tasks included: (1) Developing criteria for assessing the fishery resources values of each water course; (2) Assessing the effects of erosion and sedimentation on fishery resources; and, (3) Providing mitigation measures for fishery resources.

CHINOOK SALMON SMOLT QUALITY IN THE SAN JOAQUIN RIVER WATERSHED (California Department of Fish and Game, Fresno, CA)

Dr. Alice Rich designed and supervised a Chinook salmon smolt quality study in the San Joaquin, Merced, and Tuolumne rivers. Physiological smolt and stress indicators were monitored in emigrating fish during the parr-smolt transformation. The data were then used to assess smolt quality at different sites (the rivers, the State Pumping Facility, fish trucked to Antioch) as the fish emigrated from the system. Smolt quality was correlated to survival, using tag return data.

IMPACTS OF AGUAS FRIAS ROAD BRIDGE CONSTRUCTION ON FISHES IN BUTTE CREEK (Eco-Analysts, Chico, CA)

AAR assessed the potential impacts of bridge construction on threatened/endangered fish species, including the spring-run Chinook salmon, Central Valley steelhead, and the Sacramento splittail. *AAR* undertook the following fishery resources Tasks: (1) Literature review of relevant studies and information on fishery resources; (2) Consultations with state and federal agencies; (3) Assessment of general fishery resources habitat conditions; (4) Determination of potential impacts of the project on fishery resources; and, (5) Identification of measures to mitigate for potential impacts of the project.

CHINOOK SALMON AND STEELHEAD SNORKELING SURVEYS IN DRY CREEK, BEALE AIR FORCE BASE, CALIFORNIA (U. S. Department of Defense, Beale Air Force Base, CA)

As part of updating the Beale Air Force Base Integrated Natural Resources Management Plan, *AAR* is conducting field surveys (snorkeling) to determine the presence/absence of the fall-run Chinook salmon and Central Valley steelhead in Dry Creek within the Beale Air Force Base.

WATER TEMPERATURE, WATER QUALITY, STREAMFLOWS, AND FISH PHYSIOLOGY PROJECTS

- Adaptive Management Plans
- Age and Growth Studies
- Agriculture
- Biological Assessments and Monitoring
- CEQA and NEPA Permitting Processes
- Dams and Diversions
- De-Watering, Fish Salvage and Relocation
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- Endangered Fish Species Section 7 Consultations
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Dr. Alice Rich designed and conducted laboratory and field physiology studies to determine the relationship between instream flows, water temperature, and the growth of Chinook salmon, rainbow and steelhead trout, and American shad in the lower American River. At issue were the effects of the potential diversion of water from the American River by the East Bay Municipal Utility District for domestic uses. The results of the studies were presented by Dr. Alice Rich to the State Water Resources Control Board.

A REVIEW OF STUDIES ON EXISTING FISHERY RESOURCES IN THE AMERICAN RIVER (County of Sacramento, CA)

AAR reviewed existing information on the status of the fishery resources of the lower American River between Discovery Park and Nimbus Dam. At issue were the effects of the potential diversion of water from the American River by the East Bay Municipal Utility District for domestic uses. Tasks included: (1) Analysis of 40 years of historical data on Chinook salmon spawning escapement; (2) Review of existing data to assess optimal water temperature ranges for fishes; and, (3) Presentation of results by Dr. Alice Rich to the State Water Resources Control Board.

LEWISTON DAM POWER PLANT REPLACEMENT PROJECT (Trinity Public Utility District, Weaverville, CA)

AAR is working with the Trinity Public Utility District on the replacement of the Lewiston Dam Power Plant. *AAR* is addressing potential fishery resources impacts of the proposed project. Fish species of management interest include the spring- and fall-run Chinook salmon, coho salmon, and steelhead. Issues of concern include construction-related activities, river flows and water temperature. *AAR* is writing the Biological Assessment for the fishery resources component to this project.

CHINOOK SALMON SMOLT QUALITY IN THE SAN JOAQUIN RIVER WATERSHED (California Department of Fish and Game, Fresno, CA)

Dr. Alice Rich designed and supervised a Chinook salmon smolt quality study in the San Joaquin, Merced, and Tuolumne rivers. Physiological smolt and stress indicators were monitored in emigrating fish during the parr-smolt transformation. The data were then used to assess smolt quality at different sites (the rivers, the State Pumping Facility, fish trucked to Antioch) as the fish emigrated from the system. Smolt quality was correlated to survival, using tag return data.

IMPACTS OF CHEVRON'S VALERO PIPELINE PROJECT ON FEDERAL-LISTED FISH SPECIES (Adams Broadwell Joseph & Cardozo, Attorneys, South San Francisco, CA).

Dr. Alice A. Rich provided assistance on the: (1) Potential impacts of Chevron's Valero Pipeline on threatened and endangered fish species and Essential Fish Habitat, in particular those in Carquinez Strait; and, (2) Mitigation measures to minimize impacts. Issues of concerned included sampling stress on fish during fish collections and sampling during the parr-smolt transformation of anadromous salmonids.

IMPACT OF PROPYLENE GLYCOL SPILL ON BENTHIC HABITAT IN SEWARD CREEK, MENDOCINO COUNTY (Fetzer Vineyards, Hopland, CA)

As a result of a potentially toxic spill at Fetzer Vineyards in Hopland, California, the winery was required to assess the potential damage to Seward Creek. Fetzer Vineyards contracted with ***AAR*** to undertake the following Tasks: (1) Habitat characterization; (2) Macro-invertebrate sampling; and, (3) Water quality analysis based on macro-invertebrates as an indicator species.

IMPACTS OF A SEASONAL GRAVEL DAM ON AQUATIC RESOURCES IN LAGUNITAS CREEK AND TOMALES BAY IN MARIN COUNTY (North Marin Water District and Giacomini and Sons, Marin County, CA)

As part of the California State Water Board Hearings, regarding raising Kent Lake, ***AAR*** assisted both the North Marin Water District and the Giacomini Dairy Cattle Ranch, with regard to fishery resources issues. ***AAR's*** Tasks included: (1) Studies on salmonid smolt trapping; (2) Water temperature monitoring and analysis; (3) *Neomysis* (opossum) shrimp studies; (4) Salmonid predation studies; (5) Analysis of the potential impacts of the summer dam on salmonids, sturgeon, tidewater goby, and opossum shrimp; and, (6) Expert Witness Testimony by Dr. Alice Rich at the State Water Resources Control Board Hearings for the raising of Kent Lake.

TIRE TOXICITY STUDY IN PHOENIX LAKE, MARIN COUNTY (Marin Municipal Water District, Corte Madera, CA)

AAR assessed the impacts of rubber tires, placed in Phoenix Lake in Marin County for bass habitat, on the fishery resources of the Lake. Tasks included assessing the content of rubber tires and the potential impacts of the decay of the tires on largemouth bass.

CALTRANS BRIDGE PROJECT, BLYTHE, CALIFORNIA (California Department of Transportation, Riverside, CA)

This CalTrans project consisted of removing the Palo Verde Drain Bridge near Blythe, California, and constructing a new wider bridge at the same site. This project was funded by the American Recovery and Reinvestment Act of 2009 (ARRA). Because the federally-listed (as endangered) razorback sucker inhabits the Palo Verde Drain, CalTrans required that the area be monitored during construction activities. A. A. Rich and Associates (***AAR***) provided the following biologically-related tasks required by CalTrans: (1) Installed fish exclusion fencing upstream and downstream of the project area before the water diversion pipe was installed and water was diverted; (2) Performed a survey of the construction site for razorback sucker after the fish exclusion netting was installed; (3) Collected and removed fishes within the area to be de-watered; (6) on-sight during de-watering operations; (4) Prepared a training manual titled, "Working around endangered species"; (5) Inspected the site, cleaned and repaired the nets and removed any fish that were trapped in the nets at least once per week; (6) Monitored compliance of the construction company with avoidance and protective measures; (7) If construction company was not in compliance, halted work and took corrective action; (8) Reported to the Caltrans engineer all activities that were non-compliant with the specifications; (9) Present during final walk through inspection; (10) Provided monthly logs of site inspections, including photos; and, (11) Reviewed all contract change orders that arise during construction activities

CALTRANS FREEWAY PROJECT, SOUTH SAN FRANCISCO BAY, CALIFORNIA - PERMIT COMPLIANCE MONITORING FOR CONSTRUCTION OF NEW FREEWAYS (H. T Harvey and Associates, Alviso, CA)

As part of a CalTrans project to expand the highway system, ***AAR*** monitored the progress of the construction, with regard to the biological effects on creeks. ***AAR's*** Tasks included: (1) Monitoring construction for compliance with all permits related to riparian habitat and wetlands; and (2) Monitoring re-vegetation of Calabazas and San Tomas Aquino creeks, and the Guadalupe River mitigation sites.

HERITAGE RANCH COMMUNITY SERVICES DISTRICT GALLERY WELLS EMERGENCY REPAIR PROJECT, SAN LUIS OBISPO COUNTY, CALIFORNIA (Heritage Ranch Community Services District, Paso Robles, CA)

In March 2011, a higher than expected release of water from the Nacimiento Reservoir occurred, resulting in an increased river flow rate and damage to the Heritage Ranch Community Services District's (HRCSD) gallery wells through scouring of the river bottom and removal of river bed material. To repair the gallery wells, the HRCSD had to uncover the wells. As federally designated critical habitat for steelhead existed on-site, all fish had to be collected and relocated prior to diverting the Nacimiento River. ***AAR*** contracted to collect and relocate all fishes in the approximately 1200-foot long area of the project. One of the issues was potential impacts of sediment to the steelhead during collection and relocation of fishes. Dr. Rich provide direction, with regard to minimizing stress on fishes during the relocation process. Dr. Rich provided a report of the methods and results of these activities to NOAA Fisheries.

CALTRANS BRIDGE PROJECT, MARYSVILLE, CALIFORNIA (California Department of Transportation, Marysville, CA)

This CalTrans project consisted of repairing and replacing a bridge over the Feather River in downtown Marysville. Because the federally-listed Chinook salmon, steelhead, and North American green sturgeon inhabit the Feather River, fishes had to be collected and relocated prior to construction, and construction activities had to be monitored by fisheries biologists. A. A. Rich and Associates (***AAR***) provided the following biologically-related tasks required by CalTrans: (1) Installed fish exclusion fencing upstream and downstream of the project area before the water diversion pipe was installed and water was diverted; (2) Performed a survey of the construction site for razorback sucker after the fish exclusion netting was installed; (3) Collected and removed fishes within the area to be de-watered; (6) on-sight during de-watering operations; (4) Prepared a training manual titled, "Working around endangered species"; (5) Inspected the site, cleaned and repaired the nets and removed any fish that were trapped in the nets at least once per week; (6) Monitored compliance of the construction company with avoidance and protective measures; (7) If construction company was not in compliance, halted work and took corrective action; (8) Reported to the Caltrans engineer all activities that were non-compliant with the specifications; (9) Present during final walk through inspection; (10) Provided monthly logs of site inspections, including photos; and, (11) Reviewed all contract change orders that arise during construction activities.

LAGOON BREACHING (DREDGING) IMPACTS AT THE MOUTH OF THE CARMEL RIVER (Carmel Point and Lagoon Preservation Association, Carmel, CA)

Mechanically breaching (dredging) the Carmel River Lagoon is eroding a road on Carmel River Point. ***AAR*** assisted the Carmel Point and Lagoon Preservation Association (Association) to determine the best breaching methodology for steelhead while protecting the road and homeowners' property. Project Tasks included: (1) Analyzing existing biological and chemical data for adult or juvenile steelhead inhabiting the lagoon or passing through it; (2) Working with the Federal, state, and local agencies to identify solutions; (3) Providing written reports and oral and written testimony on behalf of the Association; and, (4) Oral expert witness testimony provided by Dr. Alice Rich.

IMPACTS OF DREDGING ON THE FISHERY RESOURCES OF THE PETALUMA RIVER RELATED TO THE BAHIA PROJECTS, NOVATO, CALIFORNIA (Bahia Homeowners Association, Novato, CA)

AAR assisted the Bahia Homeowners Association with the fishery resources issues connected with their dredging project. Tasks included: (1) Section 7 Consultation with the Federal agencies to assess the potential impacts of the project on Chinook salmon, steelhead, delta smelt, and Sacramento splittail; (2) Consultation with the California Department of Fish and Game, the Regional Water Quality Control Board to identify their concerns; (3) Preparation of an Environmental Assessment, regarding the Federally-listed fish species; and, (4) Design of post-project monitoring.

CALTRANS BRIDGE PROJECT, OAKLAND, CALIFORNIA (California Department of Transportation, Oakland, CA)

AAR is working on a 3-year CalTrans project in Oakland, California. The project is a seismic retrofit of portions of the Highway 880 freeway in Oakland, Alameda County, California. A part of this project involves retrofitting the highway over the Lake Merritt Channel. Because there are a number of Federally-listed fishes (i.e., Central Valley steelhead, Spring-run Chinook salmon, Winter-run Chinook salmon, North American green sturgeon) in the vicinity of the project area that could be affected by the construction activities, CalTrans is requiring that the area be monitored during construction activities. AAR is providing the following biologically-related tasks required by CalTrans: (1) Providing biological monitors at the site during pile driving activities; (2) Providing biological monitors at the site during any construction activities that are over or in the Lake Merritt Channel; (3) Removing and relocating any aquatic life during dewatering process prior to pile driving activities; (4) Providing weekly logs of activities, including photos, to CalTrans; (5) Monitoring compliance of the construction company with avoidance and protective measures; (6) When the construction company is not in compliance, halting work until the problem is remedied; (7) Reporting to the Caltrans engineer all activities that are in noncompliance with the specifications; and, (8) Reviewing all contract change orders that arise during construction activities.

SOUTHERN STEELHEAD MIGRATION PASSAGE PROJECT, SANTA YNEZ RIVER SYSTEM, SANTA BARBARA COUNTY (Morrison & Foerster representing the San Lucas Ranch, Santa Ynez, CA)

AAR spent over three years assisting a private landowner in the Santa Ynez River System in Santa Barbara County, with her dispute against the Cachuma Operation and Maintenance Board (COMB) who planned to alter Hilton Creek, a tributary of the Santa Ynez River. At issue was COMB's plan to alter existing conditions in Hilton Creek to facilitate the upstream movement of the endangered Southern steelhead so that the fish could access the upper reaches of the watershed, all land within the active San Lucas Cattle Ranch. Steelhead had never inhabited Hilton Creek upstream of the migration barriers, including an ten-foot waterfall. In addition to the watershed being on private property, the problem with COMB's plan was that the actions would result in harm to the Southern steelhead. If the endangered Southern steelhead were allowed to spawn within Hilton Creek on the San Lucas Ranch property, their progeny would die, due to the lack of water in the creek throughout the spring and summer months; the creek within the San Lucas Cattle Ranch is dry most of the year. To assist their Client, *AAR* performed the following Tasks: (1) Conducted extensive physical habitat (availability of rearing and spawning habitat) surveys throughout Hilton Creek and the Santa Ynez River; (2) Conducted water quality and water temperature monitoring of Hilton Creek for three years; (3) Designed and produced a video of Hilton Creek habitat conditions that was provided to both the Client and the surrounding landowners; and, (4) Provided an analysis of existing conditions and testified as to the negative impact of COMB's plan to the endangered Southern steelhead. Dr. Alice Rich also provided expert witness testimony on behalf of *AAR's* client.

P G & E's MOKELUMNE HYDROELECTRIC PROJECT – COLE CREEK GRIZZLY RACK RESTORATION WATER QUALITY MONITORING (P G & E, San Ramon, CA)

To repair the grizzly rack of the Cole Creek Diversion, PG&E constructed a cofferdam and diverted instream flow around the project area. In accordance with the water quality certification from the California Regional Water Quality Control Board, a water quality program was required. ***AAR*** provided assistance to PG&E by monitoring turbidity, water temperature, conductivity, settleable solids, and other water quality parameters using a HydroLab Quanta water quality analyzer. Sample sites were located upstream and downstream of the dam repair area.

SMALL HYDROELECTRIC PROJECT IN CANYON CREEK, EL DORADO COUNTY, CALIFORNIA (Eagle Hydro Partners, Millbrae, CA)

In connection with a small hydroelectric project, ***AAR*** evaluated the water availability and potential conflicts that streamflow withdrawals would have on existing salmonids. The project included: (1) Field habitat studies; (2) Flow duration analysis; and, (3) Analysis, report of results, and recommendations.

SALMONID REHABILITATION FEASIBILITY PROJECT IN PILARCITAS CREEK, HALF MOON BAY (San Francisco Water Department, CA)

To determine whether or not flow releases would enhance trout habitat in Pilarcitos Creek, ***AAR*** conducted a salmonid rehabilitation feasibility study for the San Francisco Water Department. Tasks included: (1) Identification of habitat (Habitat Typing) and water quality requirements for rainbow and anadromous steelhead trout; (2) Analysis of stream flow releases that would provide suitable habitat conditions; and, (3) Recommendations of possible stream rehabilitation measures that could be implemented to enhance rainbow and steelhead trout conditions.

CITY OF SANTA ROSA MASTER AGREEMENT FOR PROFESSIONAL CONSULTING SERVICES (CITY OF SANTA ROSA, CA

The City of Santa Rosa has awarded ***AAR*** a multi-year Master Services Agreement for professional services. Services include fisheries habitat and population surveys, fish habitat restoration and mitigation, collection and relocation of fishes, including T &E fish species, water quality and water temperature monitoring, and fisheries technical reports.

WATER STORAGE-WATER RECLAMATION PROJECT IN THE NOYO RIVER WATERSHED, MENDOCINO COUNTY (City of Fort Bragg, CA)

AAR conducted a seven-year assessment of fishery resources for a proposed water supply expansion for the City of Fort Bragg. Of concern were the impacts on coho salmon and steelhead trout populations in the Noyo River. ***AAR's*** Tasks included: (1) Summer salmonid rearing habitat and population surveys; (2) Salmonid spawning surveys; (3) Salmonid critical riffle surveys; (4) Estuary water in connection with a quality and fish sampling; (5) Data analysis and assessment of the project on fishery resources; and, (6) Annual reports on results, conclusions, recommendations, and mitigation measures.

FISH KILL IN BEAR GULCH CREEK AS A RESULT OF BROKEN MAIN WATER PIPE BY CALTRANS IN WOODSIDE, SAN MATEO COUNTY (Tetra Tech, Oakland, California)

Dr. Alice A. Rich provided expert opinion on the cause of steelhead mortalities in Bear Gulch Creek as a result of a broken main water pipe caused by a CalTrans crew during guard rail replacement in Woodside, California. As a result of the pipe break, 11,000 gallons of chlorinated water flowed into Bear Gulch Creek and killed about 20 endangered Central Coast steelhead (*Oncorhynchus mykiss*).

NAPA COUNTY GENERAL PLAN AND EIR-IMPACTS ON FISHERY RESOURCES FROM VINEYARD CONVERSIONS (Napa County, Napa, CA)

AAR assisted Napa County with the fishery resource issues that needed to be addressed for an update of the Napa County General Plan and EIR. *AAR* submitted a Fishery Resources Technical Report that included: (1) Distribution of Federal- and state-listed fishes, and other sensitive fish species; (2) Importance of Indicator Species, such as salmonids (salmon and trout), in determining a watershed's ecological health; (3) Importance of identifying habitat requirements and limiting factors for sensitive fish species; (4) Life history stages and requirements for the Federal- and state-listed fishes; (5) Fishery resources habitat conditions, including water temperature, water quality, and physical habitat; (6) Factors that limited salmonid production in the Napa County Watershed; (7) General impacts of vineyard conversions and other development on fishery resources; and, (8) Recommendations for integrating the requirements of the fishery resources with those of future development in Napa County, including Best Management Practices (BMP's), and maintenance channel dredging and clearing.

FISHERY RESOURCES SURVEYS IN WILDCAT CANYON, MONTEREY COUNTY (Hoge, Fenton, Jones & Appel, Attorneys, Monterey, CA)

AAR conducted fishery resources surveys related to erosion problems connected with road construction. Of particular concern was the problem of hillside and bank erosion on salmonids in the creek. The project included: (1) McNeil spawning gravel sampling; (2) Electrofishing surveys; (3) Analysis of salmonid habitat; and, (4) Expert witness testimony by Dr. Alice Rich.

AGGREGATE RESOURCES MANAGEMENT PLAN FOR THE UPPER RUSSIAN RIVER (Mendocino County Planning Dept, Ukiah, CA)

As part of the Aggregate Resources Management Plan for the Upper Russian River, *AAR* evaluated the impacts of past, present, and future gravel mining on fishery resources, particularly steelhead trout, including: (1) Documenting the status of fishery resources conditions; (2) Identifying appropriate gravel extraction sites; (3) Identifying appropriate extraction methods; (4) Developing a Fishery Resources Monitoring Plan; and, (5) Integrating fishery resources needs into the Aggregate Resources Management Plan.

GRAVEL EXTRACTION MINING IN THE EEL RIVER, HUMBOLDT COUNTY (Mercer Fraser Company, Eureka, CA)

Mercer Fraser Company was required by NOAA Fisheries to prepare a document that analyzed the existing fishery resources conditions for each of Mercer Fraser's gravel mining bars in the Eel River. To that end, ***AAR*** assisted Granite with fishery resources issues. ***AAR's*** Tasks included: ((1) Section 7 Consultation with the federal agencies; (2) writing a Fishery Resources Technical Report that included: (a) Assessing past and present fishery resources conditions; (b) Identifying appropriate extraction methods; (c) Providing an Adaptive Management Plan that incorporated long-term cause-and-effect monitoring (e.g., fish populations and fish use, fish habitat, water temperature, water quality); and, (3) Facilitating meetings.

GRAVEL EXTRACTION MINING IN THE MAD RIVER, HUMBOLDT COUNTY (Granite Construction Company, Ukiah, CA)

Granite Construction Company (Granite) was required by NOAA Fisheries to prepare a document that analyzed the existing fishery resources conditions for each of Granite's gravel mining bars in the Mad River. To that end, ***AAR*** assisted Granite with fishery resources issues. ***AAR's*** Tasks included: ((1) Section 7 Consultation with the Federal agencies; (2) Writing a Fishery Resources Technical Report that included: (a) Assessing past and present fishery resources conditions; (b) Identifying appropriate extraction methods; (c) Providing an Adaptive Management Plan that incorporated long-term cause-and- effect monitoring (e.g., fish populations and fish use, fish habitat, water temperature, water quality); and, (3) Facilitating meetings.

PHOSPHATE MINE EXPANSION EVALUATION IN DRY VALLEY CREEK, IDAHO (FMC Corporation, Soda Springs, ID)

AAR assisted with fishery resources issues, regarding, a phosphate mine expansion project in Dry Valley Creek (part of the Blackfoot River Watershed) in Southeastern Idaho. The main issue of concern that ***AAR*** was responsible was the potential impact of the project on the Yellowstone cutthroat trout. Tasks performed by AAR included: (1) Fish habitat and population surveys; (2) Heavy metal analysis; (3)) Macro-invertebrate sampling and analysis; (4) Food-growth relationships; (5) Sediment impacts; and, (6) Heavy metal impacts, including bioaccumulation of heavy metals by fishes.

GOLD MINE EXPANSION EVALUATION OF THE EAST FORK OF THE SOUTH FORK OF THE SALMON RIVER, PAYETTE NATIONAL FOREST, IDAHO (Maxim Technologies, Boise, ID)

AAR provided a fishery resource analysis for an EIS being prepared for a gold mine expansion on a tributary of the Salmon River in the Payette National Forest, Idaho. Of particular concern were the potential toxic impacts on the threatened spring-run Chinook salmon, proposed federally-threatened steelhead, bull trout, and westslope cutthroat trout. Issues of concern included food-growth relationships, sedimentation, heavy metal, and macro-invertebrate impacts, and risk analysis of potential chemical spills.

ECOLOGICAL RISK EVALUATION OF GOLD MINE FAILURE IN THE MIDDLE FORK BOISE RIVER WATERSHED, IDAHO (Monarch Greenback, Boise, ID)

In connection with a catastrophic failure of a gold mine tailings impoundment, ***AAR*** designed a ***Fishery Resources Risk Evaluation***. Of particular concern were the potential toxic impacts on the Federally-listed threatened bull trout and other sensitive salmonid fishes. Issues of concern included toxicological impacts, food-growth relationships, sedimentation impacts, and macro-invertebrate impacts.

GOLD MINE EXPANSION EVALUATION STUDIES IN THE HUMBOLDT RIVER WATERSHED, NEVADA (Maxim Technologies, Helena, MT)

AAR completed the fishery resources portion of the EIS for the expansion of a gold mine in the Humboldt River in Nevada, including: (1) Reviewing information on the water quality and thermal impacts of the expansion of the gold mine on fishery resources; (2) Identifying thermal requirements of each life stage of the key fish species; (3) Evaluating the potential impacts of heavy metals and other potentially polluting agents to the fishes; and, (4) Identifying the cumulative impacts of this and other mining activities (past, present and proposed) on fishery resources.

LEEVILLE GOLD MINE EIS, HUMBOLDT RIVER WATERSHED, CARLIN, NEVADA (Maxim Technologies, Helena, MT)

Future operations of the Leeville Gold Mine involved cooling water from the mining operations discharged into the Humboldt River in Nevada. ***AAR*** was responsible for addressing potential impacts on fishery resources, including: (1) Identifying life stage requirements of key fish species affected by the project; (2) Evaluating the potential impacts of heavy metals and other pollutants to the fishes; (3) Evaluating the potential impacts of de-watering on the fishery resources and riparian habitat; and, (4) Identifying the cumulative impacts of this and other mining activities (past, present and proposed) on fishery resources.

PHYSIOLOGICAL STRESS INDICATORS TO MONITOR FISH HEALTH AT THE MILFORD HYDROELECTRIC FACILITY ON THE PENOBSCOT RIVER (Lakeside Engineering, NH)

AAR provided technical expertise on the physiological impacts of fishways on alewives and Atlantic salmon in the Penobscot River in Maine. Included in this project was the use of physiological indicators to assess the stressful impacts of fishways and design methods to alleviate stress on the fish.

SALMONID FRY STRANDING STUDY IN THE SKAGIT RIVER, WASHINGTON (R.W. Beck and Associates, Seattle, WA)

As part of a Seattle City Light project to assess the significance of salmonid fry stranding as a result of pothole formation, ***AAR*** conducted studies to identify which physiological indicators of smoltification (e.g., lunar cycle, photoperiod) could be used to predict the severity of fry stranding.

WATER QUALITY EVALUATION FOR USE IN THE DESIGN OF A SALMONID HATCHERY WATER TREATMENT FACILITY IN WHATCOM CREEK, BELLINGHAM, WASHINGTON (Callen Construction Company, Bellingham, WA)

AAR evaluated existing water quality conditions for use in the design of a water treatment facility for a salmonid hatchery. *AAR's* Tasks included: (1) Assessment of water quality requirements for rainbow and steelhead trout; (2) Assessment of existing water quality conditions; and, (3) Analysis, report of results, and recommendations.

AGE AND GROWTH STUDIES OF MARINE AND FRESHWATER FISH IN BRITISH COLUMBIA AND THE YUKON TERRITORY (Dames and Moore, Vancouver, British Columbia, Canada)

AAR determined the age composition for populations of a number of different fish species (e.g., starry flounder, Arctic grayling, prickly sculpin, mountain whitefish, etc.) collected in the Kitimat River Estuary in northern British Columbia and in several lakes and creeks in the Yukon Territory. To determine age, otolith and scale analysis were used, together with data on lengths and weights of the fishes.

ATLANTIC SALMON DELAYED MORTALITY ASSOCIATED WITH CATCH-AND-RELEASE FISHING IN THE PENOBSCOT RIVER, MAINE (Bangor Hydro-Electric Company, Bangor, ME)

AAR conducted a study on the delayed mortality associated with the catch-and-release of emigrating Atlantic salmon smolts and returning adults in the Penobscot River in Maine. To assess the potential physiological stress associated with catch-and-release fishing *AAR* used physiological indices. This information was then to be correlated with tag-return data in an effort to increase adult returns.

DREDGING AND MINING PROJECTS

- Adaptive Management Plans
- Age and Growth Studies
- Lagoons
- Biological Assessments and Monitoring
- CEQA and NEPA Permitting
- Dams and Diversions
- De-Watering, Fish Salvage and Relocation
- Endangered Species Section 7 Consultations
- Endangered Fish Species Surveys
- Expert Witness Testimony
- Fish Habitat and Fish Population Studies
- Bioaccumulation of Heavy Metals
- Macro-invertebrate Studies
- Mitigation Plans
- Rehabilitation Plans
- Risk Evaluations
- Stream Flows
- Stress Physiology
- Water Quality and Water Temperature Studies

EFFECTS OF RE-SUSPENDED SEDIMENTS DUE TO DREDGING AND DREDGED MATERIAL PLACEMENT ON SENSITIVE FISH SPECIES IN THE SAN FRANCISCO BAY ESTUARY (U. S. Army Corps of Engineers, San Francisco, CA)

Concern has been raised over the level of suspended sediments caused by dredging and dredging operations on fishes in the San Francisco Bay Estuary. The potential impacts of suspended sediment caused by dredging activities in the San Francisco Bay Estuary are compounded by the fact that there is a high degree of uncertainty associated with the distribution of many fish species, both spatially and temporally. The Corps has contracted with ***AAR*** to conduct an analysis of the effects of dredge-related suspended sediments on the sensitive fishes in the Bay. The information will be used to design specific research to address the issue.

TOOLS FOR ASSESSING AND MONITORING FISH BEHAVIOR IN RELATION TO DREDGING ACTIVITIES IN THE SAN FRANCISCO BAY ESTUARY (U. S. Army Corps of Engineers, San Francisco, CA)

The potential behavioral effects of dredging and dredging material placement on fishes in the San Francisco Bay Estuary have been a source of environmental concern for decades. Exposure of fishes to dredging operations may result in detrimental effects that are often mediated by behavioral responses. The San Francisco Bay Long-term Management Strategy (LTMS) members are interested in better understanding the behavioral responses of fishes to environmental effects of dredging operations. The Corps has contracted with ***AAR*** to conduct an analysis of the methods used to assess behavioral effects of dredging activities on fishes. The overall goal is to provide the Corps and the San Francisco Bay LTMS agencies with a firm technical basis upon which to design and implement studies on the behavioral effects of dredging activities on sensitive fish.

SACRAMENTO YACHT CLUB MAINTENANCE DREDGING PROJECTS – IMPACTS ON THE NORTH AMERICAN GREEN STURGEON AND DELTA SMELT (Sacramento Yacht Club, Sacramento, CA)

AAR assisted the Sacramento Yacht Club with their Maintenance Dredging Permit Application. Tasks include assessing the impacts of the project on the North American green sturgeon and its critical habitat and delta smelt.

IMPACTS OF DREDGING ON STRIPED BASS IN CLIFTON COURT FOREBAY IN THE SACRAMENTO-SAN JOAQUIN DELTA (Department of Water Resources, Sacramento, CA)

AAR assessed the potential impacts of different concentrations of suspended sediment on striped bass, as a result of dredging in Clifton Court Forebay in the San Joaquin River Delta.

AGGREGATE RESOURCES MANAGEMENT PLAN FOR THE UPPER RUSSIAN RIVER (Mendocino Co Planning Dept, Ukiah, CA)

As part of the Aggregate Resources Management Plan for the Upper Russian River, ***AAR*** evaluated the impacts of past, present, and future gravel mining on fishery resources, particularly steelhead trout, including: (1) Documenting the status of fishery resources conditions; (2) Identifying appropriate gravel extraction sites; (3) Identifying appropriate extraction methods; (4) Developing a Fishery Resources Monitoring Plan; and, (5) Integrating fishery resources needs into the Aggregate Resources Management Plan.

GRAVEL EXTRACTION MINING IN THE MAD RIVER, HUMBOLDT COUNTY (Granite Construction Company, Ukiah, CA)

Granite Construction Company (Granite) was required by NOAA Fisheries to prepare a document that analyzed the existing fishery resources conditions for each of Granite's gravel mining bars in the Mad River. To that end, ***AAR*** assisted Granite with fishery resources issues. ***AAR's*** Tasks included: ((1) Section 7 Consultation with the Federal agencies; (2) Writing a Fishery Resources Technical Report that included: (a) Assessing past and present fishery resources conditions; (b) Identifying appropriate extraction methods; (c) Providing an Adaptive Management Plan that incorporated long-term cause-and- effect monitoring (e.g., fish populations and fish use, fish habitat, water temperature, water quality); and, (3) Facilitating meetings between agency biologists and Granite.

GRAVEL EXTRACTION MINING IN THE EEL RIVER, HUMBOLDT COUNTY (Mercer Fraser Company, Eureka, CA)

Mercer Fraser Company was required by NOAA Fisheries to prepare a document that analyzed the existing fishery resources conditions for each of Mercer Fraser's gravel mining bars in the Eel River. To that end, ***AAR*** assisted Granite with fishery resources issues. ***AAR's*** Tasks included: (1) Section 7 Consultation with the federal agencies; (2) writing a Fishery Resources Technical Report that included: (a) Assessing past and present fishery resources conditions; (b) Identifying appropriate extraction methods; (c) Providing an Adaptive Management Plan that incorporated long-term cause-and-effect monitoring (e.g., fish populations and fish use, fish habitat, water temperature, water quality); and, (3) Facilitating meetings.

MONITORING OF HANSON PERMANENTE CEMENT COMPANY'S QUARRY OPERATIONS, WITH REGARD TO POTENTIAL IMPACTS ON STEELHEAD (Hanson Permanente Cement Company, Cupertino, CA)

According to the terms of a lawsuit filed against Hanson Permanente Cement Company (Hanson) by the California Sportfishing Protection Alliance (CSPA), ***AAR*** was selected by CSPA to monitor and report on Hanson's quarry operations for a year. At issue were the potential impacts of the quarry operations on the steelhead in Permanente Creek in Cupertino, south of San Francisco.

RECLAIMING THE SIERRA-GOLD COUNTRY COMMUNITY SUMMIT ON MINING IMPACTS, NEVADA CITY, CALIFORNIA (Sierra Fund, Nevada City, CA)

Dr. Alice A. Rich facilitated a discussion on Best Management Practices and stimulating new technologies for mining clean-up and reclamation at the first conference on Reclaiming the Sierra-Gold Country Community Summit on Mining Impacts in November 2011. Discussions included: (1) Fate and transport of contaminants in a watershed with abandoned mines and their potential impacts on the aquatic and terrestrial ecosystem; (2) New technology for removal of mercury from sediment in Nevada Irrigation Districts' Combie Reservoir; and, (3) The Regional Water Quality Control Board's responsibility to protect and preserve water quality in watersheds with abandoned mines, as well as challenges and needs.

PHOSPHATE MINE EXPANSION EVALUATION IN DRY VALLEY CREEK, IDAHO (FMC Corporation, Soda Springs, ID)

AAR was involved in a phosphate mine expansion project in Dry Valley Creek (part of the Blackfoot River Watershed) in Southeastern Idaho. The main issue of concern that *AAR* was responsible was the potential impact of the project on the Yellowstone cutthroat trout. Tasks performed by *AAR* included: (1) Fish habitat and population surveys; (2) Heavy metal impact analysis, including bioaccumulation of heavy metals by fishes; (3) Macro-invertebrate sampling and analysis; (4) Food-growth relationships; and, (5) Sediment impacts.

GOLD MINE EXPANSION EVALUATION OF THE EAST FORK OF THE SOUTH FORK OF THE SALMON RIVER, PAYETTE NATIONAL FOREST, IDAHO (Maxim Technologies, Boise, ID)

AAR was responsible for conducting the fishery resources analysis for an EIS being prepared for a gold mine expansion on a tributary to the Salmon River in the Payette National Forest, Idaho. Of particular concern were the potential toxic impacts of the project on the threatened spring-run Chinook salmon, proposed Federally-threatened steelhead trout, bull trout, and westslope cutthroat trout. Issues of concern included food-growth relationship, sedimentation impacts, heavy metal impacts, macro-invertebrate impacts, and a risk analysis of potential fuel and chemical spills.

ECOLOGICAL RISK EVALUATION OF GOLD MINE FAILURE IN THE MIDDLE FORK BOISE RIVER WATERSHED, IDAHO (Monarch Greenback, Boise, ID)

In connection with a catastrophic failure of a gold mine tailings impoundment, AAR designed a Fishery Resources Risk Evaluation. Of particular concern were the potential toxic impacts on the Federally-listed threatened bull trout and other sensitive salmonid fishes. Issues of concern included toxicological impacts, food-growth relationships, sedimentation impacts, and macro-invertebrate impacts.

GOLD MINE EXPANSION EVALUATION STUDIES IN THE HUMBOLDT RIVER WATERSHED, NEVADA (Maxim Technologies, Helena, MT)

AAR completed the fishery resources portion of the EIS for the expansion of a gold mine in the Humboldt River Basin in Nevada. Tasks included: (1) Reviewing information on the water quality and thermal impacts of the expansion of the gold mine on fishery resources; (2) Identifying thermal requirements of each life stage of the key fish species; (3) Evaluating the potential impacts of heavy metals and other potentially polluting agents to the fishes; and, (4) Identifying the cumulative impacts of this and other mining activities (past, present, and proposed) on fishery resources.

LEEVILLE GOLD MINE EIS, HUMBOLDT RIVER WATERSHED, CARLIN, NEVADA (Maxim Technologies, Helena, MT)

The Leeville Gold Mine EIR that involved cooling water from the mining operations discharged into the Humboldt River in Nevada. *AAR* was responsible for addressing potential impacts on fishery resources, including: (1) Identifying life stage requirements of key fish species affected by the project; (2) Evaluating the potential impacts of heavy metals and other pollutants to the fishes; (3) Evaluating the potential impacts of de-watering on the fishery resources and riparian habitat; and, (4) Identifying the cumulative impacts of this and other mining activities (past, present and proposed) on fishery resources.

PERMITTING ASSISTANCE AND FISHERY RESOURCES ISSUES FOR A VARIETY OF RIVER AND STREAM CHANNEL PROJECTS IN THE SAN FRANCISCO BAY AND SACRAMENTO-SAN JOAQUIN RIVER SYSTEMS INVOLVING FEDERAL, STATE, AND LOCAL AGENCIES

AAR has been involved in over 20 river and stream projects in the Sacramento-San Joaquin River System and in the Bay Area (including estuarine systems) involving maintenance dredging, bank stabilization, de-watering of channels, collecting and relocating fishes, and streamside house and deck repairs. With each of these projects, *AAR* has been responsible for assisting clients with the permitting process for threatened and endangered fish species with the Federal (U.S. Army Corps of Engineers, NOAA Fisheries and U.S. Fish and Wildlife Service) and state agencies (California Department of Fish and Wildlife, Regional Water Quality Control Boards, etc.), local agencies, writing Biological Assessments, and salvaging and relocating fishes.

IMPACTS OF DREDGING ON THE FISHERY RESOURCES OF THE PETALUMA RIVER RELATED TO THE BAHIA PROJECTS, NOVATO, CALIFORNIA (Bahia Homeowners Association, Novato, CA)

AAR assisted the Bahia Homeowners Association with the fishery resources issues connected with their dredging project. Tasks included: (1) Section 7 Consultations with the Federal agencies to assess the potential impacts of the project on Chinook salmon, steelhead, delta smelt, and Sacramento splittail; (2) Consultation with the California Department of Fish and Game the Regional Water Quality Control Board to identify their concerns; (3) Preparation of an Environmental Assessment, regarding the Federally-listed fish species; and, (4) Design of post-project monitoring.

LAGOON BREACHING (DREDGING) IMPACTS AT THE MOUTH OF THE CARMEL RIVER (Carmel Point and Lagoon Preservation Association, Carmel, CA)

Mechanically breaching (dredging) the Carmel River Lagoon is eroding a road on Carmel River Point. *AAR* assisted the Carmel Point and Lagoon Preservation Association (Association) to determine the best breaching methodology for steelhead while protecting the road and homeowners' property. Project Tasks included: (1) Analyzing existing biological and chemical data for adult or juvenile steelhead inhabiting the lagoon or passing through it; (2) Working with the Federal, state, and local agencies to identify solutions; and, (3) Providing written reports and oral and written testimony on behalf of the Association by Dr. Alice Rich.

IMPACTS OF A SEASONAL GRAVEL DAM ON AQUATIC RESOURCES IN LAGUNITAS CREEK AND TOMALES BAY IN MARIN COUNTY (North Marin Water District and Giacomini and Sons, Marin County, CA)

As part of the California State Water Board Hearings for raising Kent Lake, *AAR* assisted both the North Marin Water District and the Giacomini Dairy Cattle Ranch with regard to fishery resources issues. *AAR's* Tasks included: (1) Studies on salmonid smolt trapping; (2) Water temperature monitoring and analysis; (3) *Neomysis* (opossum) shrimp studies; (4) Salmonid predation studies; (5) Analysis of the potential impacts of the summer dam on salmonids, sturgeon, tidewater goby, and opossum shrimp; and, (6) Expert Witness Testimony by Dr. Alice Rich at the State Water Resources Control Board Hearings for the raising of Kent Lake.

IMPACTS OF A DREDGE DISPOSAL SITE ON FISHERY RESOURCES, GRAYS HARBOR, WASHINGTON (U.S. Army Corps of Engineers, Portland, OR)

AAR collected and analyzed data on fishery resources and fishery resource user activities in the vicinity of potential U. S. Army Corps of Engineers dredge disposal sites near Grays Harbor, Washington. Data were obtained from trawling and creel census surveys, personal interviews with local fishermen, and reports from state and Federal agencies. The data were used in the evaluation and selection of disposal sites.

IMPACTS OF A DREDGE DISPOSAL SITE ON FISHERY RESOURCES, WILLAPA BAY, WASHINGTON (U.S. Army Corps of Engineers, Portland, OR)

AAR documented existing information on fishery resources and fishery resource user activities in the vicinity of Willapa Bay, Washington. These data were used, in conjunction with other biological and physical data, to evaluate the suitability of the site for continued use as a dredge disposal site by the U.S. Army Corps of Engineers.

NAVIGATION PROJECT IN EVERETT HARBOR, PUGET SOUND, AND SNOHOMISH RIVER, WASHINGTON (U. S. Army corps of Engineers, Portland, Oregon)

In connection with a U.S. Army Corps of Engineers Navigation Project, a fishery resources analysis was required. *AAR* documented and analyzed existing fishery resources data including: (1) Description of existing conditions; (2) Identification of the impacts of regular disposal of dredged material at an open water site; (3) Assessment of the impacts of continued disposal at an island (formed from past dredged material) that had recently been recognized as an important wildlife habitat area; and, (4) Analysis, report of results, and recommendations.

FISHERY RESOURCES REHABILITATION PROJECTS

- Adaptive Management Plans
- Biological Assessments and Monitoring
- De-Watering, Fish Salvage and Relocation
- Endangered Fish Species Section 7 Consultations
- Endangered Fish Species Surveys
- Fish Habitat and Fish Population Studies
- Lagoons
- Mitigation Plans
- Rehabilitation Plans
- Water Quality and Water Temperature Studies

STEELHEAD RESTORATION IN PERMANENTE CREEK, SANTA CLARA COUNTY, CALIFORNIA (American Rivers, Santa Clara, CA)

AAR assisted American Rivers on a project to determine the feasibility of restoring steelhead to the Permanente Creek Watershed. Tasks include: (1) identifying factors required to determine steelhead habitat; (2) identifying factors that would limit steelhead production; and, (3) designing a study to determine feasibility of re-introducing a steelhead fishery to the Permanente Creek Watershed.

REDWOOD LODGE STEELHEAD PASSAGE PROJECT, MILL VALLEY, MARIN COUNTY, CALIFORNIA (Peter Buckley, Mill Valley, California)

As part of a bank/house repair project for a historical lodge along Arroyo Corte Madera del Presidio Creek in Mill Valley, California, Dr. Alice Rich assisted ***AAR's*** client with the permitting and facilitating of a steelhead passage structure To complete the project, Dr. Rich worked with NOAA Fisheries, California Department of Fish and Wildlife, San Francisco Regional Water Quality Control Board, and the U.S. Army Corps of Engineers on the project. Tasks included: (1) Section 7 Consultation; (2) Pre-project fish population surveys; (3) Pre-project fish relocation; (4) Biological Monitoring during construction activities; and, (5) Final inspection and reporting to the agencies.

SALMONID REHABILITATION IN ARROYO CORTE MADERA DEL PRESIDIO IN MILL VALLEY, MARIN COUNTY

To assess the feasibility of restoring salmonids to the creeks in Mill Valley, ***AAR*** undertook studies that included: (1) Fish habitat (Habitat Typing) and population assessments; and; (2) A Salmonid Restoration Plan that included (a) Fish rehabilitation measures and implementation; (b) Monitoring the success of the project; and, (c) Public involvement to assist with the rehabilitation efforts.

GREEN GULCH BANK REPAIR PROJECT, MUIR BEACH, MARIN COUNTY, CALIFORNIA (San Francisco Zen Center, San Francisco, California)

As part of a bank repair project needed to prevent a road from collapsing at Green Gulch near Muir Beach, Dr. Alice Rich assisted ***AAR's*** client with the permitting and facilitating of a steelhead passage structure To complete the project, Dr. Rich worked with the California Department of Fish and Wildlife, San Francisco Regional Water Quality Control Board, and the U.S. Army Corps of Engineers on the project. Tasks included: (1) Obtaining permits from state and federal agencies; (2) Biological Monitoring during construction activities; and, (3) Final inspection and reporting to the agencies.

STEELHEAD TROUT RESTORATION PLAN FOR THE CORTE MADERA CREEK WATERSHED IN MARIN COUNTY (Friends of Corte Madera Creek, Larkspur, CA)

As part of a project to rehabilitate the Corte Madera Creek Watershed, *AAR* conducted watershed-based fishery resource studies, including: (1) Fish habitat (habitat typing) and population surveys; and, (2) Water temperature monitoring. Based on the results of the analyses, Dr. Alice Rich prepared a Fishery Resources Technical Report that included a Steelhead Trout Restoration Plan for the Watershed. *AAR* provided assistance with permitting and Section 7 Consultations for ongoing salmonid restoration projects.

FISHERY RESOURCES SURVEYS WITHIN THE TOWN OF FAIRFAX, MARIN COUNTY (Town of Fairfax, CA)

Following the December 2005 flooding of the Town of Fairfax, there was a need to determine fishery resources conditions in the watershed. As a result, the Town of Fairfax contracted with AAR to conduct watershed-based studies that included: (1) Fish habitat (Habitat Typing) and population surveys; (2) Water quality monitoring; (3) Water temperature monitoring; (4) Data analyses; and, (5) A Fishery Resources Technical Report that included descriptions of protective measures for steelhead in the watershed.

STREAM REHABILITATION IN EASKOOT CREEK, STINSON BEACH, WEST MARIN COUNTY
(Environmental Action Committee of West Marin, Point Reyes Station, CA)

To determine whether or not steelhead conditions in Easkoot Creek in Stinson Beach, California, could be improved, the Environmental Action Committee of West Marin was interested in determining the fishery resources conditions of Easkoot Creek. To that end ***AAR*** performed the following Tasks: (1) Conducted fish habitat (Habitat Typing) and population surveys; (2) Reported the results of the study; and, (3) Designed curricula for school children (fourth and eighth grades) interested in knowing more about their creeks.

SALMONID REHABILITATION IN WALKER CREEK, MARIN COUNTY (Marin Municipal Water District, Marin Rod and Gun Club, County of Marin, California State Coastal Conservancy)

AAR designed and undertook a salmonid restoration project on Walker Creek, a creek that flows into Tomales Bay. Tasks included: (1) Stream habitat (Habitat Typing) and population assessments; and, (2) Steelhead Rehabilitation Plan.

ALHAMBRA CREEK WATERSHED (CONTRA COSTA COUNTY) STEELHEAD RESTORATION PROJECT (Urban Creeks Council, Berkeley, CA)

Although local citizens have studied the biology of the Alhambra Creek Watershed for many years, no comprehensive professional studies on the fishery resources have been undertaken. To address fishery resources conditions, ***AA R*** performed the following Tasks: (1) Conducted habitat (Habitat Typing) and population surveys to determine the existing fishery resources habitat and population conditions; and, (2) Provided recommendations for the rehabilitation of the fishery resources in the creek, specifically the anadromous steelhead.

SAND CREEK FISH RELOCATION, ANTIOCH, CA (Contra Costa County Flood Control and Water Conservation District, Martinez, CA).

The Contra Costa County Flood Control and Water Conservation District (District) plans to expand the existing Upper Sand Creek flood control basin. The purpose of the expansion is to attenuate flows from the upper Marsh Creek watershed to provide improved flood protection for downstream communities in the lower Marsh Creek watershed. The expansion will impact natural communities including Sand Creek. To avoid or minimize adverse impacts to fishes in Sand Creek, The District will and wetlands onsite. Pror to expanding the flood control basin, ***AAR*** was contracted to rescue and relocate all aquatic life/fishery resources in Sand Creek.

FISH REHABILITATION OF SALMONIDS IN CODORNICES CREEK, ALAMEDA COUNTY (Urban Creeks Council, Berkeley, CA)

The Urban Creek Council (UCC) has long been interested in Codornices Creek. Recently, juvenile rainbow/steelhead were collected in a downstream pool associated with a CalTrans Project. As a result, the UCC wanted to know how viable the creek was for steelhead and contracted ***AAR*** to assess fishery resources conditions. ***AAR*** provided the following: (1) Fish habitat survey (Habitat Typing); (2) Water temperatures monitoring (3) Urban Creeks Steelhead Guide; (4) Creek Monitoring Plan for Codornices Creek; (5) The design of a GIS database for the UCC; and, (6) Steelhead collection and relocation for a steelhead migration passage improvement project.

SALMONID FEASIBILITY STUDY IN CODORNICES CREEK, ALAMEDA COUNTY (Department of Water Resources, Sacramento, CA)

In the early 1990's, in response to local interest in whether or not Codornices Creek had viable steelhead habitat, ***AAR*** performed the following Tasks: (1) Stream habitat survey (Habitat Typing) to determine the existing fishery resources conditions; (2) Bank erosion surveys; and, (3) Recommendations for the rehabilitation of the fishery resources in the creek.

ANADROMOUS SALMONID CULVERT ANALLYSIS I-80 EXPRESS LANES PROJECT, SOLANO COUNTY (Solano County, Fairfield, CA)

The Solano County Transportation Authority and the Metropolitan Transportation Commission, in cooperation with the California Department of Transportation and Federal Highway Administration propose express lanes in both westbound and eastbound direction on Interstate 80 from west of red Top Road to east of Interstate 505 within Solano County. ***AAR*** assisted with fisheries issues. More specifically, ***AAR's*** task was to determine which aquatic habitat sites (including water crossings and other aquatic habitats), depicted on aerial maps, met the California Department of Fish and Wildlife and NOAA Fisheries requirements for passage of anadromous salmonids (salmon and trout). All creeks in Solano County were analyzed (habitat and culvert barrier assessments).

LITTLE HASTINGS ISLAND CONSERVATION BANK, SOLANO COUNTY, IDENTIFICATION AND EVALUATION OF RESTORATION MEASURES FOR THREATENED AND ENDANGERED FISH SPECIES (Wildlands, Inc., Rocklin, CA)

The purpose of the Little Hastings Island Conservation Bank is to provide regional compensation for impacts to federal- and/or state-listed fish species, and/or species of concern (Central Valley steelhead, delta smelt, winter-run Chinook salmon, spring-run Chinook salmon, Central Valley fall and late-fall runs Chinook salmon, North American green sturgeon, longfin smelt, Sacramento splittail, white sturgeon, and river lamprey). ***AAR*** is evaluating the habitat to determine whether or not there are on-site restoration measures that would provide additional habitat for these species of fishes.

USACE WALL RE-CONSTRUCTION IN NAPA CREEK - FISH COLLECTION AND RELOCATION (U.S. ARMY CORPS OF ENGINEERS, NAPA, CA)

In connection with the reconstruction of a wall along Napa Creek and the Napa River in downtown Napa, ***AAR*** provided the following services: (1) Wrote a Biological Assessment that included mitigation measures to protect any T & E fish species (e.g., steelhead, delta smelt, Chinook salmon) that would be affected by the project; (2) Provided assistance with permitting and Section 7 Consultations with federal agencies; (3) Collected and relocated fish, including the federal- and state-listed fish species, during the de-watering operations in the channel; and, (3) Prepared a Final Report summarizing the results of the fish collection and relocation effort.

CITY OF SANTA ROSA MASTER AGREEMENT FOR PROFESSIONAL CONSULTING SERVICES (CITY OF SANTA ROSA, CA

The City of Santa Rosa has awarded ***AAR*** a multi-year Master Agreement for professional services. Services include fisheries habitat and population surveys, fish habitat restoration and mitigation, collection and relocation of fishes, including T &E fish species, water quality and water temperature monitoring, and fisheries technical reports.

SALMONID REHABILITATION FEASIBILITY PROJECT IN PILARCITAS CREEK, HALF MOON BAY (San Francisco Water Department, CA)

To determine whether or not flow releases would enhance trout habitat in Pilarcitos Creek, ***AAR*** conducted a salmonid rehabilitation feasibility study for the San Francisco Water Department. Tasks included: (1) Identification of habitat (Habitat Typing) and water quality requirements for rainbow and anadromous steelhead trout; (2) Analysis of stream flow releases that would provide suitable habitat conditions; and, (3) Recommendations of possible stream rehabilitation measures that could be implemented to enhance rainbow and steelhead trout conditions.

POTENTIAL IMPACTS OF THE CASA DE FRUTA EXPANSION ON THE STEELHEAD IN PACHECO CREEK, HOLLISTER, SANTA CLARA COUNTY, CALIFORNIA (San Francisco Water Department, CA)

To determine the potential impacts of the expansion of the Casa de Fruta project on steelhead in Pacheco Creek, ***AAR***: (1) Conducted fishery resources habitat surveys; (2) Identified steelhead and rainbow trout requirements; (3) Analyzed potential impacts of the proposed project; and, (4) Provided a report detailing the fishery resources conditions, potential impacts, and recommended measures to mitigate potential impacts of the project on steelhead.

FISHERY RESOURCES SURVEYS IN SONOMA COUNTY CREEKS (Circuit Rider Productions, Windsor, CA)

In connection with an erosion control project for the State Coastal Conservancy, ***AAR*** conducted a fishery resources habitat (Habitat Typing) assessment of a number of Sonoma County coastal creeks.

STEELHEAD REHABILITATION PROJECT IN SUSCOL CREEK, TRIBUTARY TO THE NAPA RIVER (Friends of the Napa River, Napa, CA)

AAR designed and managed a steelhead restoration project in Suscol Creek, a tributary to the Napa River. The project included: (1) Stream habitat (Habitat Typing) and population assessments; (2) Water temperature (thermographs) monitoring; and, (3) Steelhead Rehabilitation Plan, including monitoring the success of any rehabilitation measures undertaken.

SALMONID MONITORING IN THE GARCIA RIVER, MENDOCINO COUNTY (Rawles, Hinkle, Carter, Behnke, and Oglesby, Attorneys, Ukiah, CA)

In response to illegally re-routing the Garcia River with the objective of reducing flood-related problems, landowners received a "cease and desist" order from the California Water Quality Control Board. In response to this action, the California Department of Fish and Game and other agencies directed the landowners to assess the potential damage of their actions on the salmonids in the Garcia River. To that end, ***AAR*** was hired to address the fishery resources issues. ***AAR's*** Tasks included: (1) Designing and implementing a salmonid monitoring plan; (2) Identifying salmonid rearing habitat; (3) Conducting fishery resources population surveys; (4) Monitoring water temperatures; (5) Conducting salmonid immigration and spawning use surveys; (6) Developing a riparian vegetation plan; and, (7) Analyzing data and writing annual reports.

FISHERY RESOURCES REHABILITATION PROJECT IN THE PIETA CREEK WATERSHED, MENDOCINO COUNTY (Mendocino County RCD, Ukiah, CA)

In an effort to improve steelhead conditions in the Pieta Creek Watershed, the Mendocino County Resource Conservation District contracted with *AAR* to conduct a two-year fisheries rehabilitation project. The project included: (1) Fish habitat (Habitat Typing) and population surveys; (2) Water quality monitoring; (3) Erosion surveys and erosion control measures; and, (4) Analysis, reports of results, and recommendations.

U.S. BUREAU OF RECLAMATION PROGRAMMATIC EIS FOR THE CENTRAL VALLEY IMPROVEMENT ACT (Montgomery Watson, Sacramento, CA)

As part of the Bureau's Programmatic EIS for the Central Valley Improvement Act, *AAR* reviewed and analyzed past, present, and proposed anadromous fish restoration projects for the entire Central Valley. This review of restoration projects included both state- and Federal-funded projects on Chinook salmon, delta smelt, steelhead trout, striped bass, American shad, and white sturgeon. Riverine systems included both the mainstem and tributaries of the San Joaquin and Sacramento rivers, and the Sacramento-San Joaquin Delta.

FISHERY RESOURCES OF THE PAHRANGAT NATIONAL WILDLIFE, NEVADA (Harris Environmental, Tucson, AZ)

AAR is evaluating the fishery resources of the Pahrangat National Wildlife Refuge in Nevada, including an analysis of the endangered Pahranagat roundtail chub. Tasks include: (1) Fish population and habitat surveys; (2) Identification of significant native fishery resources and their habitats; (3) Develop habitat protection strategies for the native fishes of the refuge and the Pahranagat Valley; (4) Develop an invasive/exotic aquatic species control strategy; (5) Monitoring fishery resources; (6) Develop a Long-Term Recreational Fishery Resources Plan; (8) Provide fishery resources technical reports; and, (9) Assist the Pahranagat National Wildlife Refuge with fishery resources-related issues.

ESTUARINE AND MARINE FISHERY RESOURCES PROJECTS

- Age and Growth Studies
- Biological Assessments and Monitoring
- De-Watering, Fish Salvage and Relocation
- Dredging and Pile Driving
- Endangered Species Act Section 7 Consultations
- Endangered Fish Species Surveys
- Expert Witness Testimony
- Fish Habitat and Fish Population Studies
- Fishing - Bycatch Analyses
- Herring Mapping and Analyses
- Lagoons
- Marinas, Boat Activity, and Piers
- Marine Protection Areas (MPA's)
- Mitigation Plans
- Oil Rig Platforms
- Rehabilitation Plans
- Water Quality and Water Temperature Studies

SACRAMENTO YACHT CLUB MAINTENANCE DREDGING PROJECTS – IMPACTS ON THE NORTH AMERICAN GREEN STURGEON AND DELTA SMELT (Sacramento Yacht Club, Sacramento, CA)

AAR assisted the Sacramento Yacht Club with their Maintenance Dredging Permit Application. Tasks include assessing the impacts of the project on the North American green sturgeon and its critical habitat and delta smelt.

EFFECTS OF RE-SUSPENDED SEDIMENTS DUE TO DREDGING AND DREDGED MATERIAL PLACEMENT ON SENSITIVE FISH SPECIES IN THE SAN FRANCISCO BAY ESTUARY (U. S. Army Corps of Engineers, San Francisco, CA)

Concern has been raised over the level of suspended sediments caused by dredging and dredging operations on fishes in the San Francisco Bay Estuary. The potential impacts of suspended sediment caused by dredging activities in the San Francisco Bay Estuary are compounded by the fact that there is a high degree of uncertainty associated with the distribution of many fish species, both spatially and temporally. The Corps has contracted with *AAR* to conduct an analysis of the effects of dredge-related suspended sediments on the sensitive fishes in the Bay. The information will be used to design specific research to address the issue.

TOOLS FOR ASSESSING AND MONITORING FISH BEHAVIOR IN RELATION TO DREDGING ACTIVITIES IN THE SAN FRANCISCO BAY ESTUARY (U. S. Army Corps of Engineers, San Francisco, CA)

The potential behavioral effects of dredging and dredging material placement on fishes in the San Francisco Bay Estuary have been a source of environmental concern for decades. Exposure of fishes to dredging operations may result in detrimental effects that are often mediated by behavioral responses. The San Francisco Bay Long-term Management Strategy (LTMS) members are interested in better understanding the behavioral responses of fishes to environmental effects of dredging operations. The Corps has contracted with *AAR* to conduct an analysis of the methods used to assess behavioral effects of dredging activities on fishes. The overall goal is to provide the Corps and the San Francisco Bay LTMS agencies with a firm technical basis upon which to design and implement studies on the behavioral effects of dredging activities on sensitive fish species in the Bay.

DREDGING AND CONSTRUCTION PROJECTS IN SAN FRANCISCO BAY (Port of San Francisco, CA)

As part of an on-call contract with the Port of San Francisco, *AAR* provided services related to aquatic resources, including: (1) Fishery resources evaluations including impacts of polluted sediments on fishery resources; (2) Eelgrass surveys; and, (3) Assistance with permit applications.

IMPACTS OF DREDGING ON THE FISHERY RESOURCES IN THE PETALUMA RIVER (Bahia Homeowners Association, Novato, CA)

As part of the environmental assessment for the dredging out of the Bahia Lagoon, a fishery resources analysis was required. *AAR* conducted a fishery resources assessment that included: (1) Section 7 Consultation with the agencies to assess the potential impacts of the project on Chinook salmon, steelhead, delta smelt, and Sacramento splittail; (2) Consultation with the CFG and the Regional Water Quality Control Board to identify their concerns; and, (3) Preparation of an Environmental Assessment, regarding the federal-listed fish species, including the design of pre- and post-project monitoring.

PIER 39 AQUARIUM EIR, SAN FRANCISCO (EIP Associates, San Francisco, CA)

As part of a general environmental assessment for the Pier 39 Aquarium in San Francisco, ***AAR*** provided the following: (1) Assessed the potential impacts of the Aquarium discharge on the marine organisms in the area; and, (2) Provided mitigation measures to offset negative impacts.

IMPACTS OF LAGOON BREACHING ON STEELHEAD IN CARMEL LAGOON (Carmel Point and Lagoon Preservation Association, Carmel, CA)

The mechanical breaching of the Carmel River Lagoon is eroding a road on Carmel River Point. ***AAR*** assisted the Carmel Point and Lagoon Preservation Association (Association) to determine the best breaching methodology for steelhead while protecting the road and homeowners' property. Project Tasks included: (1) Analyzing existing biological and chemical data for adult or juvenile steelhead inhabiting the lagoon or passing through; (2) Working with the Federal, state, and local agencies to identify solutions; and, (3) Providing written reports and oral and written testimony on behalf of the Association.

VALLEJO FISHING PIER REPLACEMENT (Greater Vallejo Recreation District, Vallejo, CA)

In response to a Negative Declaration for the reconstruction of the Vallejo fishing pier, ***AAR*** completed the following tasks: (1) Assessment of existing fishery resources conditions, particularly with regard to winter-run chinook salmon; (2) Assessment of the potential impacts, particularly with regard to pile driving, of the proposed project on the fishery resources in the area; and, (3) Responded to agency concerns.

RICHARDSON BAY FISHERY RESOURCES SURVEY (Martin Jarvis, Attorney, San Francisco, CA)

In response to issues connected with the "Anchor Out" houseboats off of Sausalito, AAR was contracted to conduct fishery resources surveys. Specific Tasks included: (1) Assessment of existing fishery resources conditions, particularly with regard to herring and herring spawning areas, and juvenile salmon and steelhead; (2) Assessment of the potential impacts of the "anchor out" houseboats on the fishery resources in the area; and, (3) Dr. Rich provided expert witness on behalf of the "Anchor Outs", with regard to the beneficial impact of the houseboats, which provided habitat on which herring spawned.

FISHERIES ISSUES WITHIN MARINE PROTECTED AREAS IN THE CHANNEL ISLANDS NATIONAL MARINE SANCTUARY, SANTA BARBARA, CALIFORNIA (Ilson W. New, Attorney, San Francisco, CA)

In connection with a case involving fishing in the Santa Barbara Channel, ***AAR*** assisted the fishermen, with regard to the interpretation of scientific studies of the fisheries in the area. Tasks undertaken by ***AAR*** included:(1) reviewing and analyzing scientific studies demonstrating the need for MPA's; (2) reviewing and analyzing scientific studies demonstrating the effects of Marine Protected Areas (MPA) on abundance, size, biomass, and diversity of fishes; (3) analyzing information on fishing pressure in the area; and, (4) reviewing the pros and cons of MPA's, with regard to the fishing needs of the community.

TOMALES BAY DOCK AND BOAT HOUSE REPLACEMENT (The Draper Family, Inverness, CA)

AAR assisted owners with the repair of a boat dock and boat house in Tomales Bay. The project included repair and replacement of the existing boat dock and boat house. As part of the project a biological resources assessment was required. *AAR* conducted a fishery resources assessment that included: (1) Assessment of existing biological resources conditions in the vicinity of the dock and boat house; (2) Writing a Biological Resources Assessment of existing biological conditions, potential impacts, and mitigation for the project; and, (3) Assisting the owners with the necessary permits from the Federal, state, and local agencies.

MARSH RESTORATION/FISH MONITORING PROJECT IN COYOTE CREEK IN SOUTH SAN FRANCISCO BAN (Zentner & Zentner, San Francisco, CA)

To determine the extent to which larval and juvenile fishes and other aquatic organisms were using a recently-constructed tidal embayment, *AAR* conducted herring and *Neomysis* shrimp surveys.

A VARIETY OF RIVER AND ESTUARY PROJECTS INVOLVING DREDGING, PERMITTING FOR THREATENED AND ENDANGERED FISH SPECIES, FISH COLLECTION, AND RELOCATION OF FISHES

AAR has been involved in over numerous Bay Area Estuary projects involving maintenance dredging, bank stabilization, and house and deck repairs. With each of these projects, *AAR* has been responsible for assisting clients with the permitting process for threatened and endangered fish species with the Federal (including the Corps of Engineers) and state agencies, writing Biological Assessments, and salvaging and relocating fishes.

SPOT PRAWN BYCATCH ANALYSIS, CALIFORNIA COAST (Commercial Spot Prawn Fishermen, Santa Barbara, CA)

In connection with a case involving the bycatch of fishes as a result of spot prawn fishing along the California coast, AAR assisted the fishermen, with regard to scientific studies of the fisheries in the area. Tasks undertaken by AAR included: (1) Analysis of reports and raw data; and, (2) Expert witness testimony provided by Dr. Alice Rich at the California Fish and Game Commission Hearings.

QUANTITATIVE MAPPING OF HERRING SPAWN, PUGET SOUND, WASHINGTON (Kiewit Construction Company, Bellingham, WA)

In connection with a proposed oil rig platform construction site, *AAR* provided a quantitative assessment of the relative abundance of herring spawn along nine miles of shoreline in northern Puget Sound. This information was then used to determine the impacts of the proposed oil rig platform on the herring fishery in the area.

OIL RIG PLATFORM CONSTRUCTION SITE EIS, BELLINGHAM, WASHINGTON (Kiewit Construction Company, Bellingham, WA)

In connection with the construction of a proposed oil rig platform in northern Puget Sound, ***AAR*** collected and analyzed fishery resources data including the following: (1) Assessing existing conditions, with regard to herring and salmon; (2) Assessing impacts of the proposed project, including those related to oil spills; (3) Mitigating for loss of habitat that would result from the proposed project; and, 4) Incorporating the results of the fishery resources analysis into an EIS for the project.

IMPACTS OF A DREDGE DISPOSAL SITE ON FISHERY RESOURCES, GRAYS HARBOR, WASHINGTON (U.S. Army Corps of Engineers, Portland, OR)

AAR collected and analyzed data on fishery resources and fishery resource user activities in the vicinity of potential U. S. Army Corps of Engineers dredge disposal sites near Grays Harbor, Washington. Data were obtained from trawling and creel census surveys, personal interviews with local fishermen, and reports from state and federal agencies. The data were used in the evaluation and selection of disposal sites.

IMPACTS OF A DREDGE DISPOSAL SITE ON FISHERY RESOURCES, WILLAPA BAY, WASHINGTON (U.S. Army Corps of Engineers, Portland, OR)

AAR documented existing information on fishery resources and fishery resource user activities in the vicinity of Willapa Bay, Washington. These data were used, in conjunction with other biological and physical data, to evaluate the suitability of the site for continued use as a dredge disposal site by the U.S. Army Corps of Engineers.

NAVIGATION PROJECT IN EVERETT HARBOR, PUGET SOUND, AND SNOHOMISH RIVER, WASHINGTON (U. S. Army corps of Engineers, Portland, OR)

In connection with a U.S. Army Corps of Engineers Navigation Project, a fishery resources analysis was required. *AAR* documented and analyzed existing fishery resources data including: (1) Description of existing conditions; (2) Identification of the impacts of regular disposal of dredged material at an open water site; (3) Assessment of the impacts of continued disposal at an island (formed from past dredged material) that has recently been recognized as an important wildlife habitat area; and, (4) Analysis, report of results, and recommendations.

EAGLE HARBOR MARINA EIS, CYPRESS ISLAND, PUGET SOUND, WASHINGTON (Shapiro and Associates, Seattle, WA)

As part of the environmental analysis for an EIS for a Marina in Puget Sound, a fishery resources analysis was required. *AAR* collected and analyzed marine fishery resources data including: (1) Assessment of existing conditions; (2) Assessment of impacts of the proposed project; and, (3) Mitigation measures for loss of habitat resulting from the proposed project. The results of the analysis were included as a Technical Appendix to the EIS.

TIMBER HARVEST FISHERY RESOURCES PROJECTS

- Adaptive Management Plans
- Biological Assessments and Monitoring
- CESA and CEQA Permitting
- De-Watering, Fish Salvage, and Relocation
- Endangered Fish Species Surveys
- Endangered Species Section 7 Consultation
- Expert Witness Testimony
- Fish Habitat and Fish Population Studies
- Macro-invertebrate Studies
- McNeil Substrate Sampling Surveys
- Mitigation Plans
- Rehabilitation Plans
- Water Quality and Water Temperature

WATERSHED PROTECTION AND RESTORATION COUNCIL (WPRC) SCIENCE PANEL (The Resources Agency and National Marine Fisheries Services, CA)

Dr Alice Rich was appointed to the Science Panel of the Watershed Protection and Restoration Council (WPRC). To establish a program to protect and enhance steelhead and coho salmon populations in northern California, the National Marine Fisheries Service signed a Memorandum of Understanding (MOU) with the State Resources Agency and the California Department of Fish and Game. A key element of the MOU was the creation of an Independent Science Panel who would review the California Forest Practices Rules to determine the adequacy for the protection of salmonid species. The Science Panel completed a report so that any potential rule changes could be considered and implemented. Tasks for the Science Panel included: (1) Reviewing the Forest Practices Rules; (2) Reviewing Timber Harvest Plan review and approval processes; and, (3) Interviewing over 25 panels representing government agencies, landowners, and other resources professionals.

IMPACTS OF TIMBER HARVEST ON FISHERY RESOURCES, MENDOCINO COUNTY (Louisiana-Pacific Corporation, Samoa, CA)

AAR conducted a three-year study to assess the impacts of Louisiana-Pacific's (LP's) timber harvest practices on the fishery resources of the Navarro River Watershed. The project included: (1) Fishery resources population surveys; (2) Fishery resources habitat (Habitat Typing) surveys; (3) Salmonid spawning population surveys; (4) Salmonid spawning gravel sampling (McNeil sampling); (5) Water temperature modeling and monitoring; (6) Macro-invertebrate sampling and analysis; (7) Participation by Dr. Alice A. Rich at public meetings; and, (8) Annual reports prepared to assist LP with timber harvesting.

IMPACTS OF TIMBER HARVEST ON FISHERY RESOURCES IN THE MATTOLE RIVER WATERSHED, HUMBOLDT COUNTY (Washburn, Briscoe & McCarthy, Attorneys, San Francisco, CA)

AAR worked on a timber harvesting project in Humboldt County, California. Tasks included: (1) Determining the impacts of timber harvest practices on coho and Chinook salmon, steelhead and sea-run cutthroat trout; and, (2) Designing and supervising long-range monitoring studies, including water temperature monitoring, food, habitat and population studies.

IMPACTS OF TIMBER HARVEST ON FISHERY RESOURCES, HUMBOLDT COUNTY (Barnum Timber Company, Eureka, CA)

AAR assisted Barnum Timber Company (BTC) with timber harvest/fishery resources issues in the headwater streams of the Mattole River Watershed in Humboldt County, California. The project consisted of assessing salmonid habitat, using Habitat Typing, and Spawning Gravel Sampling (McNeil sampling). The results of the surveys were analyzed and a report prepared to assist BTC with timber harvest plans. In addition, *AAR* collaborated with the California Department of Fish and Game in the preparation of salmonid mitigation measures for timber harvesting in Baker Creek, a tributary of the Mattole River.

IMPACTS OF TIMBER HARVEST ON FISHERY RESOURCES IN THE EEL RIVER, HUMBOLDT COUNTY (Barnum Timber Company, Eureka, CA)

AAR provided assistance, with regard to fishery resources issues, to Barnum Timber Company on the South Fork Eel River in Humboldt County. Tasks included: (1) Fishery resources population surveys; (2) Fishery resources habitat (Habitat Typing) surveys in Sproul Creek, a tributary to the South Fork Eel River; and. (3) Collaborated with the California Department of Fish and Game in the preparation of salmonid mitigation measures for timber harvest.

IMPACTS OF TIMBER HARVEST PRACTICES ON FISHERY RESOURCES IN THE MOKELUMNE RIVER WATERSHED, AMADOR COUNTY (East Bay Municipal Utility District, Oakland, CA)

AAR conducted studies to assess the impacts of Georgia Pacific's timber harvest practices on the fishery resources in the upper Mokelumne River Watershed. The project included: (1) Fishery resources population surveys; (2) Fishery resources Habitat (Habitat Typing) Surveys; (3) Trout spawning gravel (McNeil sampling) surveys; (4) Analysis of the results of the field studies; and (5) Expert witness testimony by Dr. Alice A. Rich.

POSSIBILITY THAT COHO SALMON WERE NOT NATIVE TO THE CREEKS AND RIVERS SOUTH OF SAN FRANCISCO, SANTA CRUZ COUNTY (Big Creek Lumber Company, Davenport, CA)

AAR contracted with Big Creek Lumber Company to review, analyze and comment on the scientific evidence of whether or not coho salmon were native to the creeks and rivers south of San Francisco. The results of the analysis were ambivalent. While coho salmon that originated from other areas of California had been planted extensively in the creeks and rivers south of San Francisco during the 19th and 20th centuries, there was no scientific proof that there had never been a remnant coho salmon population and, hence, there was no scientific proof that coho salmon were not native south of San Francisco.

IMPACTS OF TIMBER HARVEST PRACTICES ON STEELHEAD AND COHO SALMON IN WADDELL CREEK, SANTA CRUZ COUNTY (Big Creek Lumber Company, Davenport, CA)

AAR assisted Big Creek Lumber with salmonid issues in connection with a lawsuit regarding potential impacts of timber harvest practices. ***AAR's*** Tasks included: (1) Salmonid habitat analysis in logged and non-logged areas; (2) Review and analysis of other scientists' data and reports; and, (3) Expert witness testimony by Dr. Alice A. Rich.

SIERRA NEVADA AND LAKE TAHOE FISHERY RESOURCES PROJECTS

- Biological Assessments
- Dewatering, Fish Salvage, and Relocation
- Endangered Species Section 7 Consultations
- Endangered Fish Species Surveys
- Fish Habitat and Fish Population Studies
- Macro-invertebrate Studies
- Mitigation Plans
- Rehabilitation Plans
- SCUBA and Snorkeling Surveys
- Water Quality and Water Temperature Studies
- Marinas, Boat Activity, and Pier

LAHONTAN CUTTHROAT TROUT SALVAGE AND RELOCATION IN DONNER CREEK (TRUCKEE RIVER TRIBUTARY), TRUCKEE, CALIFORNIA (Kinder Morgan, Orange, California)

SFPP, L.P., operating partnership for Kinder Morgan Energy Partners, L.P., maintains a pipeline that transports petroleum products from Colfax to Woodchopper, California. During a re-analysis of the pipeline, an anomaly was found that required inspection and repair within the stream channel of Donner Creek, a tributary to the Truckee River. The federally-threatened Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) was known to occur within the stream channel. As part of the California Department of Fish and Game's Stream Alteration Agreement, and the U.S. Fish and Wildlife Service's Avoidance/Mitigation Measures for this project, ***AAR*** collected and relocated fishes and amphibians within the project area prior to the de-watering of the channel. Following the field work, Dr. Alice Rich submitted a biological report to the client.

BIOLOGICAL ASSESSMENT FOR A BREAKWATER ON FISHES AND FISH HABITAT (D. G. Menchetti, Ltd., Attorney, Incline Village, Lake Tahoe, NV)

AAR analyzed the fishery resources and fish habitat in connection with a breakwater which was installed by a landowner in Incline Village, Lake Tahoe. The project included: (1) Habitat (SCUBA and snorkeling) surveys to determine existing substrate conditions; (2) Monitoring of thermal conditions; (3) Monitoring of water quality conditions; (4) Assessing whether or not the breakwater was impacting fishery resources; and, (5) Expert testimony provided by Dr. Alice A. Rich.

BIOLOGICAL ASSESSMENT FOR THE CONVERSION OF BOAT RAMP TO PIER, (Chaplinsky Family, Incline Village, NV)

AAR assisted a homeowner with the conversion of a boat ramp to a Pier in Lake Tahoe. Tasks included: (1) Habitat surveys to determine existing environmental conditions; (2) An assessment of the potential impacts of the proposed project; (3) Analysis, report of results, mitigation measures; (4) Fish habitat restoration plan for the project; and, (5) Biological Assessment for the Project.

FISHING ACCESS BOAT RAMP IMPROVEMENT MASTER PLAN REVIEW (Tahoe City Public Utility District, Tahoe City, CA)

AAR provided fisheries resources services for the Tahoe City Public Utility District (TCPUD) for a Master Plan developed by the TCPUD. Under the California Environmental Quality Act, TCPUD must certify an environmental document which discloses the environmental consequences of the Master Plan improvements. As part of this environmental process, ***AAR*** conducted a fishery resources assessment, that included: (1) Habitat surveys to determine existing environmental conditions; (2) An assessment of the potential impacts of the project; (3) Analysis, report of results and, mitigation measures for the project; and, (4) Biological Assessment for the Project.

ENVIRONMENTAL ASSESSMENT OF FISHERY RESOURCES AND WILDLIFE STUDIES FOR PIER EXTENSION (Croom Family, Crystal Bay, Lake Tahoe, NV)

AAR assisted a homeowner with a pier extension at Crystal Bay in Lake Tahoe. Tasks included: (1) SCUBA and habitat surveys to determine existing environmental conditions; (2) An assessment of the potential impacts of the proposed project; and, (3) Biological Assessment for the Project including, analysis, report of results, and mitigation measures.

FISHERY RESOURCES AND WILDLIFE STUDIES FOR PIER CONSTRICTION (McClean Family, Meeks Bay, Lake Tahoe, CA)

AAR assisted a homeowner with a pier construction project in Meeks Bay, Lake Tahoe, California. Tasks included: (1) SCUBA and habitat surveys to determine existing environmental conditions; (2) An assessment of the potential impacts of the proposed project; and, (3) Biological Assessment, including analysis, report of results, and mitigation measures for the project.

FISHERY RESOURCES HABITAT CONDITIONS FOR BOAT DOCK (Jerome Emerson, Incline Village, NV)

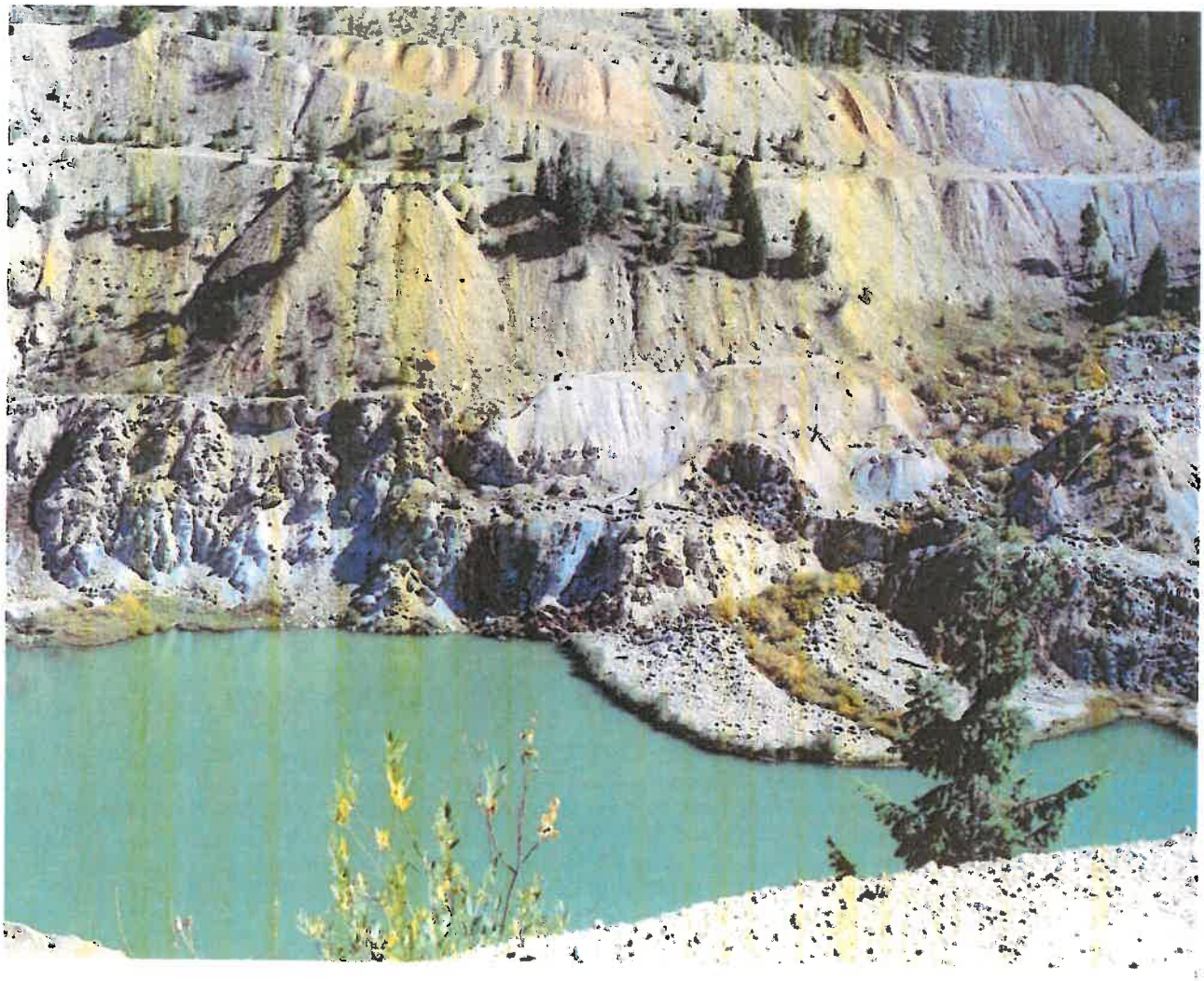
AAR assisted a homeowner with a boat dock project in Incline Village, Lake Tahoe. Tasks included: (1) Habitat surveys to determine existing environmental conditions; (2) An assessment of the potential impacts of the project; (3) Analysis, report of results and, mitigation measures for the project; and, (4) Rehabilitation measures.

IMPACTS OF TRANS-SIERRA TRANSMISSION LINE INTERTIE (ESA, San Francisco, CA)

In connection with the EIR for the Trans-Sierra Transmission Line Intertie, *AAR* conducted a fishery resources assessment of over 400 square miles of streams along proposed alternate routes. Riverine systems included the American, Bear, Truckee, Carson, and Yuba rivers; Prosser, Dry, Wolf, Auburn Ravine, Weber, and Alder creeks; and, Dutch Flat, Rollins and, Camp Far West reservoirs. ***AAR's*** Tasks included: (1) Developing criteria for assessing the fishery resources values of each water course; (2) Assessing the effects of erosion and sedimentation on fishery resources; and, (3) Providing mitigation measures for fishery resources.

ASSESSMENT OF FISHERY RESOURCES CONDITIONS IN PINE AND MILL CREEKS, INYO COUNTY (Pacifica Development Inc., Bishop, CA)

AAR completed the fishery resources section for an EIR for a housing development project near Bishop, California. The project involved the Pine and Mill Creek watersheds. The fish species of special concern included Owens pupfish, speckled dace, Owens tui club, and Owens sucker. Project Tasks included: (1) Fishery resources habitat surveys; (2) Fishery resources population surveys; and, (3) Analysis of data and submission of report describing existing conditions, potential impacts of the proposed project, and measures to mitigate potential impacts.



PACIFIC NORTHWEST FISHERY RESOURCES PROJECTS

- Age and Growth Analyses
- Biological Assessments and Monitoring
- Dredging and Mining
- Endangered Species Surveys
- Expert Witness Testimony
- Fish Habitat and Fish Population Studies
- Herring Mapping and Analyses
- Instream Flows
- Mitigation Plans
- Oil Rig Platforms
- Use of Physiological Salmonid Smolt Indicators
- Water Quality and Water Temperature Studies

SALMONID FRY STRANDING STUDY IN THE SKAGIT RIVER, WASHINGTON (R.W. Beck and Associates, Seattle, WA)

As part of a Seattle City Light project to assess the significance of salmonid fry stranding as a result of pothole formation, ***AAR*** conducted studies to identify which physiological indicators of smoltification (e.g., lunar cycle, photoperiod) could be used to predict the severity of fry stranding.

SALMONID REHABILITATION PROJECT IN BIG SOOS CREEK, KING COUNTY, WASHINGTON (Richard Carothers Associates, Seattle, WA)

As part of the King County Park Master Plan, ***AAR*** assisted a landscape architecture firm with an analysis of the fishery resources in an urban creek near Seattle, Washington. ***AAR's*** Tasks included: (1) Habitat assessment for coho salmon and cutthroat trout; and, (2) Analysis, report of results, and recommendations for restoration to be used in conjunction with the construction of the park.

AGE AND GROWTH STUDIES OF MARINE AND FRESHWATER FISH IN BRITISH COLUMBIA AND THE YUKON TERRITORY (Dames and Moore, Vancouver, British Columbia, Canada)

AAR determined the age composition for populations of a number of different fish species (e.g., starry flounder, Arctic grayling, prickly sculpin, mountain whitefish, etc.) collected in the Kitimat River Estuary in northern British Columbia and in several lakes and creeks in the Yukon Territory. To determine age, otolith and scale analysis were used, together with data on lengths and weights of the fishes.

WATER QUALITY EVALUATION FOR USE IN THE DESIGN OF A SALMONID HATCHERY WATER TREATMENT FACILITY IN WHATCOM CREEK, BELLINGHAM, WASHINGTON (Callen Construction Company, Bellingham, WA)

AAR evaluated existing water quality conditions for use in the design of a water treatment facility for a salmonid hatchery in Bellingham, Washington. ***AAR's*** Tasks included: (1) Assessment of water quality requirements for steelhead and rainbow trout; (2) Assessment of existing water quality conditions; and, (3) Analysis, report of results, and recommendations.

IMPACTS OF A DREDGE DISPOSAL SITE ON FISHERY RESOURCES, GRAYS HARBOR, WASHINGTON (U.S. Army Corps of Engineers, Portland)

AAR collected and analyzed fishery resources data on fishery resources and fishery resource user activities in the vicinity of potential U. S. Army Corps of Engineers dredge disposal sites near Grays Harbor, Washington. Data were obtained from trawling and creel census surveys, personal interviews with local fishermen, and reports from state and federal agencies. The data were used in the evaluation and selection of disposal sites.

IMPACTS OF A DREDGE DISPOSAL SITE ON FISHERY RESOURCES, WILLAPA BAY, WASHINGTON (U.S. Army Corps of Engineers, Portland, OR)

AAR documented existing information on fishery resources and fishery resource user activities in the vicinity of Willapa Bay, Washington. These data were used, in conjunction with other biological and physical data, to evaluate the suitability of the site for continued use as a dredge disposal site by the U.S. Army Corps of Engineers.

NAVIGATION PROJECT IN EVERETT HARBOR, PUGET SOUND, AND SNOHOMISH RIVER, WASHINGTON (U. S. Army corps of Engineers, Portland, Oregon)

In connection with a U.S. Army Corps of Engineers Navigation Project, a fishery resources analysis was required. *AAR* documented and analyzed existing fishery resources data including: (1) Description of existing conditions; (2) Identification of the impacts of regular disposal of dredged material at an open water site; (3) Assessment of the impacts of continued disposal at an island (formed from past dredged material) that had recently been recognized as an important wildlife habitat area; and, (4) Analysis, report of results, and recommendations.

OIL RIG PLATFORM CONSTRUCTION SITE EIS, BELLINGHAM, WASHINGTON (Kiewit Construction Company, Bellingham, WA)

In connection with the construction of a proposed oil rig platform in Northern Puget Sound, *AAR* collected and analyzed fishery resources data. Tasks included: (1) Assessment of existing conditions, particularly with regard to herring and salmon; (2) Assessment of impacts of the proposed project, including those related to oil spills; (3) Mitigation for loss of habitat that would result from the proposed project; and, (4) Incorporating the results of the fishery resources analysis into an EIS for the project.

QUANTITATIVE MAPPING OF HERRING SPAWN, PUGET SOUND, WASHINGTON (Kiewit Construction Company, Bellingham, WA)

In connection with a proposed oil rig platform construction site, *AAR* provided a quantitative assessment of the relative abundance of herring spawn along nine miles of shoreline in northern Puget Sound. This information was then used to determine the impacts of the proposed oil rig platform on the herring fishery in the area.

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As part of the environmental analysis for an EIS for a Marina in Puget Sound, a fishery resources analysis was required. *AAR* collected and analyzed marine fishery resources data including: (1) Assessment of existing conditions; (2) Assessment of impacts of the proposed project; and, (3) Mitigation measures for loss of habitat resulting from the proposed project. The results of the analysis were included as a Technical Appendix to the EIS.

CLIENTS

FEDERAL, STATE, AND LOCAL AGENCIES

Alameda County, Hayward, California
Butte County, Chico, California
California Coastal Conservancy, Oakland, California
California Department of Fish and Game, Sacramento, California
California Department of Fish and Game, Fresno, California
California Department of Transportation, Oakland, California
California Department of Transportation, San Jose, California
California Department of Water Resources, Sacramento, California
California State Coastal Conservancy, Oakland, California
Central Delta Water Agency, Stockton, California
City of Fort Bragg, California, California
City of Mill Valley, California, California
City of Petaluma, California
City of Roseville, California
City and County of San Francisco, California
City of Sutter Creek, California
County of Marin, California
County of Sacramento, California
East Bay Municipal Water District, Oakland, California
El Dorado Irrigation District, Placerville, California
Greater Vallejo Recreation District, Vallejo, California
Heritage Ranch Community Services District, San Luis Obispo, California
Inyo County, Bishop, California
King County, Seattle, Washington
Las Gallinas Valley Sanitary District, San Rafael, California
Marin County Resource Conservation District, Point Reyes Station, California
Marin Municipal Water District, Corte Madera, California
Mendocino County Planning Department, Ukiah, California
Mendocino County Resource Conservation District, Ukiah, California
Mendocino County Water Agency, Ukiah, California
Napa County, Napa, California
National Marine Fisheries Service, Santa Rosa, California
North Marin Water District, Novato, California
Pacific Gas and Electric Company, San Ramon, California
Plumas County, Chester, California
Port of San Francisco, California
Sacramento Municipal Utility District, California
San Francisco Water Department, Millbrae, California
San Joaquin County Council of Governments, Stockton, California
Seattle City Light, Seattle, Washington
Solano Transportation Authority, Fairfield, California
Tahoe City Public Utility District, Tahoe City, California
Town of Fairfax, California
Trinity Public Utility District, Weaverville, California
U.S. Army Corps of Engineers, Portland, Oregon

CLIENTS *(Cont.)*

FEDERAL, STATE, AND LOCAL AGENCIES (cont.)

U.S. Army Corps of Engineers, San Francisco, California
U.S. Army Corps of Engineers, Seattle, Washington
U.S. Bureau of Land Management, Pocatello, Idaho
U.S. Bureau of Reclamation, Denver, Colorado
U.S. Bureau of Reclamation, Sacramento, California
U.S. Department of Defense, Beale Air Force Base, California
U.S. Forest Service, Seattle, Washington
U.S. Forest Service, McCall, Idaho
Yolo County Parks and Resources Department, Woodland, California

ENVIRONMENTAL GROUPS

BayKeeper, San Francisco, California
California Fisheries Coalition, Sacramento, California
California Sportfishing Protection Alliance, Berkeley, California
Carmel Point and Lagoon Preservation Association, Carmel, California
Center for Ecoliteracy, Berkeley, California
DeltaKeeper, Stockton, California
Environmental Action Committee of West Marin, Point Reyes Station, California
Friends of the Corte Madera Creek Watershed, Larkspur, California
Friends of the Napa River, Napa, California
Friends of West Union Creek, Woodside, California
Marin Rod and Gun Club, San Rafael, California
Urban Creeks Council, Berkeley, California

PRIVATE COMPANIES

Alaska Airlines, Seattle, Washington
Allied Waste Corporation, Manteca, California
Ardea, Woodland, California
Bahia Homeowners Association, Novato, California
Bangor Hydro-Electric Company, Bangor, Maine
Barnum Timber Company, Eureka, California
Big Creek Lumber, Davenport, California
Califia Development Group, Lathrop, California
California Forestry Association, Sacramento, California
Callen Construction Company, Bellingham, Washington
Cascade Properties, Boulder, Colorado
Casa De Fruta, Hollister, California
Chico Scrap Metal, Inc., Chico, California
Circuit Rider Productions, Windsor, California
Clearwater Hydrology, Berkeley, California
CSW/Stuber-Stroeh, Novato, California
Dames and Moore, British Columbia, Canada
David Powers & Associates
Eagle Hydro Partners, Burlingame, California
Eco-Analysts, Chico, California

CLIENTS *(Cont.)*

PRIVATE COMPANIES (Cont.)

Eel River Saw Mills, Eureka, California
EIP Associates, San Francisco, California
ESA. San Francisco, California
Fetzer Vineyards, Hopland, California
FMC Corporation, Soda Springs, Idaho
Forward, Inc., Monteca, California
Granite Construction Company, Ukiah, California
Granite Construction Company, Santa Barbara, California
Grupe Communities, Stockton, California
Hanson Permanente Cement, Cupertino, California
Harland Bartholomew and Associates, Sacramento, California
H. T. Harvey and Associates, San Jose, California
Inwood Corporation, Woodside, California
Jonathan Parker, Real Estate, San Rafael, California
Jones & Stokes, Sacramento, California
Kiewit Construction Company, Bellingham, Washington
Lakeside Engineering, New Hampshire
Lone Tree Mine, Valmy, Nevada
Louisiana-Pacific Corporation
Mangi Environmental, Virginia
Maxim Technologies, Boise, Idaho
Maxim Technologies, Helena, Montana
McEvoy Olive Ranch, Petaluma, California
MCM Construction, Oakland, California
MHA Environmental Consulting, San Mateo, California
Millsap Degnan Associates, San Rafael, California
Monarch Greenback, Boise, Idaho
Montgomery Watson, Sacramento, California
Newmont Gold Company, Carlin, Nevada
Norecol Dames and Moore, British Columbia, Canada
Pacifica Development, Bishop, California
Pacific Municipal Consultants, Sacramento, California
Philip Williams & Associates, San Francisco, California
Quad-Knopf Consultants, Roseville, California
Questa, Point Richmond, California
Richard Carothers Associates, Seattle, Washington
Roma, San Francisco, California
RBF Consulting, A Baker Company, Sacramento, California
Roseville, City of, California
R. W. Beck and Associates, Seattle, Washington
Sacramento Yacht Club, Sacramento, California
Santa Fe Pacific Gold Corporation, Valmy, Nevada
Shapiro and Associates, Seattle, Washington
Sunrise Engineering, Draper, Utah
SWCA, Half Moon Bay, California
SWCA, San Luis Obispo, California
Sycamore Environmental Consultants, Sacramento, California

CLIENTS *(Cont.)*

PRIVATE COMPANIES (Cont.)

Toyon Environmental Consultants, Kentfield, California
Trinity County Public Utility District, Weaverville, California
URS, Oakland, California
Wildlands, Rocklin, California

LAW FIRMS

Adams, Broadwell, Joseph & Cardozo, South San Francisco, California
Alston & Bird, LLP, Sacramento, California
Bradley & Gmelich, Glendale, California
Cannata, Ching, & O'Toole, San Francisco, California
Carter, Behnke, Oglesby and Bacik, Ukiah, California
Dan Muller, Attorney, Walnut Creek, California
Dana Parry, Walnut Creek, California
D. G. Menchetti, Ltd., Incline Village, Nevada
Diepenbrock and Harrison Law Firm, Sacramento, California
Hoge, Fenton, James and Appel, Monterey, California
Lozeau:Drury, Alameda, California
John Dante Nomellini, Stockton, California
Morrison & Foerster, Walnut Creek, California
Morrison & Foerster, Sacramento, California
Morrison & Foerster, San Francisco, California
Pillsbury, Winthrop, Shaw, Pittman, Sacramento, California
Preti, Flaherty, Beliveau & Pachios, Augusta, Maine
Rawles, Hinkle, Carter, Behnke, and Oglesby, Ukiah, California
Stoel Rives, LLP, San Francisco, California
Technical Advisory Services for Attorneys (TASA), Blue Bell, Pennsylvania
Washburn, Briscoe, and McCarthy, San Francisco, California
Weinberg, Roger & Rosenfeld, Alameda, California

RÉSUMÉS

Historical Distribution and Current Status of Steelhead/Rainbow Trout *(Oncorhynchus mykiss)* in Streams of the San Francisco Estuary, California

Robert A. Leidy, Environmental Protection Agency, San Francisco, CA
Gordon S. Becker, Center for Ecosystem Management and Restoration, Oakland, CA
Brett N. Harvey, John Muir Institute of the Environment, University of California, Davis, CA

This report should be cited as:

Leidy, R.A., G.S. Becker, B.N. Harvey. 2005. Historical distribution and current status of steelhead/rainbow trout *(Oncorhynchus mykiss)* in streams of the San Francisco Estuary, California. Center for Ecosystem Management and Restoration, Oakland, CA.

Center for Ecosystem Management and Restoration

SOLANO COUNTY

Unnamed Creek to Cordelia Slough Watershed

This creek drains the area between American and Jameson Canyons. It flows generally east to enter Cordelia Slough about one-half mile south of the town of Cordelia.

Unnamed Creek to Cordelia Slough

In July 1996, Leidy sampled the unnamed creek where it flowed through Ridgeview Park in the Oakbrook Drive development south of Cordelia and west of Interstate 680. He sampled the creek again in October, about 650 feet further upstream. *Oncorhynchus mykiss* was not found during either sampling effort (Leidy 2002).

In July 2003, *O. mykiss* were noted in an unnamed tributary to Cordelia Slough. Two *O. mykiss* (~175-200 mm) were seen in a pool east of Interstate 80, approximately 200 yards upstream of the Pacific Gas and Electric tower where a two-foot diameter pipe crossed the stream (Field biologist pers. comm.). Subsequent surveys found juvenile *O. mykiss.*

Green Valley Creek Watershed

Green Valley Creek is an intermittent to perennial stream that runs southeast where it is joined by Cook Canyon Creek, and then by Wild Horse Creek before entering the Green Valley. Green Valley Creek runs approximately 4.7 miles to Cordelia Slough.

Green Valley Creek

In 1958, DFG staff described the reach immediately above Highway 40 as having negligible function for fisheries (Elwell 1958). In a 1962 report, Skinner indicated that Green Valley Creek was an historical migration route and habitat for steelhead (Skinner 1962).

In October 1974, DFG surveyed Green Valley Creek in relation to the Via Palo Linda Bridge project. The survey report noted several juvenile steelhead observed upstream from the site (Week 1975).

In January 1975, DFG sampled four sites on Green Valley Creek by electrofishing. The sites were pairs of 30-meter reaches in downstream and upstream locations. *Oncorhynchus mykiss* occurred in each of the sites as follows: 1,500 feet downstream of the project site, 15 steelhead; 200 feet downstream, four steelhead; 300 feet upstream, 39 steelhead; and 1,750 feet upstream, 96 steelhead (Week 1975). Based on these results, DFG calculated the average *O. mykiss* density for undisturbed sections of the creek to be about 68 fish per 30 meters (Week 1975).

In June 1976, more than 50 YOY steelhead were reported in an unnamed tributary of Green Valley Creek flowing through the Green Valley Country Club. Thirty YOY steelhead were electroshocked, collected, and moved to the Napa River (Pinkham and Johnson 1976). The incident report noted some suitable spawning and rearing habitat areas in upstream portions of this creek,

as well as YOY present in these reaches (Pinkham and Johnson 1976). One *O. mykiss* measuring 73.5 mm SL was collected from Green Valley Creek near Lake Frey in January 1979 (Courtois 1979).

According to residents living upstream of the Via Palo Alto Bridge, a steelhead run persisted in Green Valley Creek until approximately 1986 (Gray 1990). The Department of Fish and Game sampled this area by electrofishing in September 1990 and found one *O. mykiss* measuring 222 mm FL (Gray 1990).

Leidy sampled Green Valley Creek at two locations in 1994 and one location in 1996, all downstream of Interstate 80, and did not collect *O. mykiss* (Leidy 2002). However, in January 1997 he caught one *O. mykiss* (102 mm FL) approximately one mile upstream of Interstate 80 at Pavallion Court and another individual (100 mm) at a site about two miles upstream from Interstate 80 (Leidy 2002). The second site also contained one dead *O. mykiss* (~150 mm). Near Country Club Drive in Green Valley, Leidy caught one adult steelhead (480 mm) and two juveniles (92 mm, 92 mm) (Leidy 2002).

Wild Horse Valley Creek

Lake Frey and Lake Madigan were created on Wild Horse Valley Creek by construction of dams in 1894 and 1908, respectively. Fishways were not included in the dams. In 1940, DFG reported that the local warden considered both lakes to be "fine" trout lakes, but that steelhead stocking would be necessary for a continued fishery. Shapovalov cited absent or extremely limited spawning areas upstream of Lake Frey as precluding a self-sustaining steelhead population (Shapovalov 1940).

Assessment: *Oncorhynchus mykiss* has been collected in the Green Valley Creek drainage from the 1950s to the present. While the watershed is relatively small, its position adjacent to the Suisun Creek drainage provides habitat opportunities to salmonids migrating upstream from the Suisun and Cordelia Slough area.

Suisun Creek Watershed

Suisun Creek drains a 52 square mile drainage on the west side of the Vaca Mountains. The creek flows south where it is joined by Wooden Valley, Gordon Valley and Green Valley creeks. Suisun Creek enters Grizzly Bay in the northern part of the San Francisco Estuary via Cordelia Slough.

Suisun Creek

Lake Curry was formed by the construction of Gordon Valley Dam on Suisun Creek in 1926. No fishway was built as part of this project (Shapovalov 1940). In a 1940 report, DFG cited the reservoir caretaker as seeing "sea-run" steelhead running up Suisun Creek to the dam spillway.

A May 1956 DFG survey found steelhead fingerlings "abundant" in the upper portions of Suisun Creek and its tributaries, particularly in and just below the confluence of Wooden Valley Creek (Westgate 1956). Steelhead also were present, although in smaller numbers, downstream to the mouth. The survey report stated DFG's opinion that the Suisun Creek system could not support a substantial trout fishery due to over-appropriation of water (Westgate 1956).

In a 1962 report, Skinner indicated that Suisun Creek was an historical migration route and habitat for steelhead (Skinner 1962). At that time, the creek was said to be "lightly used" as steelhead habitat (Skinner 1962).

In April 1964, DFG sampled Suisun Creek at the upper end of Suisun Valley near Mankas Corner. Several *O. mykiss* (~150 mm) were observed, and the survey report noted some spawning gravels present in the vicinity of the site (Gerstung 1964).

A 1969 DFG memorandum noted an estimated run of less than 50 steelhead in the Suisun Creek watershed (Greenwald 1969). The Department of Fish and Game stated that juvenile steelhead were observed throughout the watershed and further noted a lack of nursery habitat as the population's limiting factor (Greenwald 1969).

In February 1975, DFG electrofished 30-meter reaches near the Rockville Road bridge construction site. Thirty-nine steelhead were found in the reach immediately upstream and 96 in the reach immediately downstream of the site (Rugg 1975). Rockville Road crosses Suisun Creek immediately upstream of Interstate 80.

In July 1980, DFG visually surveyed and electrofished Suisun Creek between the Southern Pacific Railroad Bridge, downstream of Interstate 80, and the Wooden Valley Creek confluence. No *O. mykiss* were found, but the survey report stated that the creek sustained a winter steelhead run (Cox 1980). The report noted anglers taking steelhead in the summer of 1979, as well as local residents' claims that runs had decreased in recent years (Cox 1980). The Department of Fish and Game recommended management for steelhead by removing barriers, improving agricultural practices, and preventing dumping.

Three Suisun Creek sites downstream of Lake Curry were sampled in October 1981 as part of a fish distribution study. No *O. mykiss* were found (Leidy 1984). In a 1984 report, DFG noted that Suisun Creek had a self-sustaining, natural steelhead population (Meyer 1984).

Between March and July 2001, *O. mykiss* were observed in Suisun Creek by people performing habitat mapping and monitoring activities. In March, an adult female steelhead (673 mm FL) was found approximately 0.25 miles downstream of the Wooden Valley Creek confluence (Hanson Environmental 2001). In June and early July, three additional adult steelhead (530 to approximately 640 mm) were observed in the creek between approximately six and 11 miles downstream of Lake Curry. Juvenile *O. mykiss* also were observed downstream of the dam. These fish typically ranged from 160-170 mm in length (Hanson Environmental 2001).

Wooden Valley Creek

The Department of Fish and Game reported in 1940 that the caretaker of Lake Curry (on Suisun Creek) observed steelhead runs in Wooden Valley Creek (Shapovalov 1940). In May 1956, DFG sampled throughout the Suisun Creek drainage, and stated in a report that steelhead in the Suisun Creek system were most abundant in Wooden Valley Creek downstream from Wooden Valley (Westgate 1956).

A 1959 DFG correspondence cited Mr. Bolten Hall, the local game warden, as saying that Wooden Valley Creek supported a small run of steelhead trout every year (Jones 1959). The letter stated DFG position that Wooden Valley Creek provided a steelhead trout fishery that was worth preserving through insurance of adequate flows (Jones 1959).

In April 1964, DFG surveyed Wooden Valley Creek in the canyon downstream of Wooden Valley. Two to eight *O. mykiss* juveniles were noted in deeper pools in the reach (Gerstung 1964). Numerous *O. mykiss* juveniles to 150 mm in length were observed in the canyon below Wooden Valley. The survey report noted patches of "excellent" spawning gravels (Gerstung 1964).

A 1965 DFG letter regarding a box culvert on Wooden Valley Creek noted that the stream was important to salmonid populations. The letter contained recommendations for providing fish passage at the project (Jones 1965). A 1969 DFG memorandum identified the greatest concentrations of steelhead juveniles in the Suisun Creek system to be in Wooden Valley Creek (Greenwald 1969). A 1980 DFG stream survey report for Suisun Creek noted that juvenile *O. mykiss* were seen in surveys of Wooden Valley Creek that year (Cox 1980).

Wooden Valley Creek was sampled in October 1981 as part of a fish distribution study. No *O. mykiss* were collected in a 15-meter reach along Wooden Valley Road (Leidy 1984). An undated draft letter from DFG to the City of Vallejo Water Superintendent identified the lack of surface flows below Lake Curry as the principal element limiting the productivity of steelhead in Suisun Creek (Hunter *n.d.*).

In December 2001, a pair of spawning "salmon" were observed constructing a redd in the lower reach of Wooden Valley Creek near Wooden Valley Road (Blizard 2001). A pair of spawned out carcasses (1 male, 1 female) and possibly another male salmon also were observed (Blizard 2001).

In June 2002, a survey of Wooden Valley Creek between the mouth and the White Creek confluence was conducted. Juvenile *O. mykiss* were observed near the headwaters and at various other locations throughout the length of the survey area (L. Marcus pers. comm.). Residents in the vicinity reported adult *O. mykiss* had been present in the creek in recent years.

White Creek

White Creek is a tributary of Wooden Valley Creek and flows through the property of Wild Horse Valley Ranch. In 1980 Professor John Hopkirk of Sonoma State University identified White Creek as one of the last remaining spawning streams for steelhead trout within the Suisun Creek system (Hopkirk 1980).

Assessment: The Suisun Creek watershed formerly supported steelhead runs, although the *O. mykiss* population likely was substantially affected by the construction of Gordon Valley Dam (Lake Curry) in 1926 and subsequent water developments. *Oncorhynchus mykiss* persists in the drainage, although recent surveys have not included estimates of density. Adult *O. mykiss* believed to be wild have been noted in main stem Suisun Creek and in its major tributary, Wooden Valley Creek (L. Marcus pers. comm.). Restoration planning is now being developed for the watershed, with likely recommendations to include habitat improvements such as invasive species control and instream flow modifications to improve over-summering habitat conditions (J. Beuttlier pers. comm.).

Table X-1. Distribution status of O. mykiss in San Francisco Estuary streams of Solano County, California[a]

Watershed	Stream/ Tributary	Yrs. Surveyed/ Quant. Data	Max. Period of Record	Data Type	Life Hist. Stage/ No. Yrs. Data	Anad. Life-Cycle Possible	O. mykiss		Evidence of Pop. Decline	Current Pop. Status	References (Pers. Comm.)
							Hist.	Current			
Unnamed creek to Cordelia Slough	Unnamed to Cordelia Slough	3/0	2003	1, 2	J/1	Y	PB	DF	-	1, 2, 3	14 (2)
Green Valley Creek	Green Valley	9/4	1962-97	0, 1, 2, 3	J/3; R/1; M/2	Y	DF	DF	Y	1, 2, 3	2, 4, 6, 14, 16, 19, 20
	Wild Horse Valley	1/0	1940	0, 1	-	UNK	DF	PS	-	0	18
Suisun Creek	Suisun	10/3	1940-2001	0, 1	J/4; M/4	Y	DF	DF	Y	1, 2, 3	3, 5, 7, 8, 13, 15, 17-19, 21 (1)
	Wooden Valley	7/1	1940-2002	0, 1	J/4; M/3	Y	DF	DF	Y	1, 2, 3	1, 3, 5, 7, 10-13, 18, 21 (3)
	White	1/0	1980	0	-	UNK	DF	UNK	Y	0	9

[a] Table headings and codes are defined in the Methods section of this report.

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SOLANO COUNTY MAPS

Historical status of *Oncorhynchus mykiss* in streams of Solano County, Caliornia.

Current status of *Oncorhynchus mykiss* in streams of Solano County, Caliornia.