Feasibility of a Fish Production Facility in the Kilarc Canal

A Field Report

June 2008

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Introduction

This report was prepared to assess the reasonableness of an idea put forth by Davis Hydro at the Kilarc-Cow Creek hydroelectric site, and to address in a general way the potential viability of turning the Kilarc Canal into a Steelhead trout (Oncorhynchus mykiss) spawning and juvenile habitat area. I was asked to evaluate the idea with a prime focus on the technology of stream restoration discussed and taught by Dave Rosgen in Colorado[1]. The remarks below address not the detailed comparison of the production facility vs. returning the water to the Old Cow, for that will require a large detailed habitat study of both the Canal and the bypassed reach. I have visited two sections of the Old Cow and most of the habitat sections of the canal. The following is an assessment of the **possibility** that a re-engineered canal combined with the bypass reach can be developed into a more productive habitat than the Old Cow bypass by itself.

Habitat / Fish Populations

The Old Cow Creek provides large area of suitable spawning and rearing habitat for cold-water fish (cold flowing clear water throughout year with abundant cover) so that many fish are found in the area[2]. According to the Aquatic Habitat and Fisheries Resources Report[2] (AH) report, 90% of the sampled fish were rainbow trout and the rest were Riffle sculpin, brown trout, and Sacramento pikeminnow (sampled in the Kilarc bypass area of the creek during summer/fall samplings in 2003). The AH report mentions that because Whitmore falls (several miles downstream of Kilarc powerhouse; the most downstream migration barriers in Old Cow Creek) is reclassified by CDFG and NOAA Fisheries as a passable barrier for steelhead under certain high flow condition. The AH report not only focuses on the fish species presently existing in the area but also on possible steelhead restoration.

Because the intake at Kilarc Diversion dam is unscreened, and during much of the year, most of the flow goes into the canal, many fish are entrained into the Kilarc canal and the forebay, therefore the entrained fish spend their remaining lives within the canal/ forebay. Not all adult or juvenile fish that are swept into the canal at the diversion dam go into the

[1] Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colorado. 136p.
[2] Pacific Gas and Electric Company (PG&E). 2007. Kilarc-Cow Creek Project, FERC No. 606. Aquatic Habitat and Fisheries Resources Report. November 2007[2]

canal. There is a release-to-river outlet that releases in excess of 2 and 4 cfs. This probably carries some fish back into the Old Cow bypass reach[3].

"Although there were all size classes of rainbow trout and brown trout found through out the Old Cow Creek, the canal contained mostly small (less than 150mm) rainbow and brown trout. The forebay contained mostly (80%) brown trout of all sizes and some large size rainbow trout (stocked by CDFG; small portion appear to be wild origin), in addition to very few golden shiner"[2]. Further the AH report states that compared to the Old Cow Creek, the species and their size distributions were different in the canal/forebay area[2].

Effects of Kilarc Diversion on Fish

Considering the fact that "Sampling conducted in both July/August and September/ October 2003 indicates that populations within the bypass reach are generally similar to or higher than those in the reference sites (above and below the bypass reach[2])" the canal is likely to have had no negative effect on fish habitat in the bypass area. If the diversion canal had a negative effect, there would probably be less fish in the bypass area. This may be due to the narrow habitat observed and described[2] there.

The water in forebay stays cool all year from the high altitude, rapid water movement, shade, small forebay size and the constant water discharge to the powerhouse. Because of the relatively constant and limited discharge of water through the canal, there are only small fluctuation of water level, velocity, temperature in the canal and down to the powerhouse, which would result in minimal fish habitat disturbance. This is in contrast to the habitat below the diversion dam, which currently has reduced flow, increased temperatures, diversion altered streambeds, reduced cover, and altered channel configurations[4].

The bypass area, canal, and forebay fulfill the habitat requirement for cold-water fish[2], like salmon and trout, and the Kilarc current diversions are not likely to have significant negative effects on fish habitat in Old Cow Creek based on the observations above. In addition, by having the diversion canal with some modification, there could be an increase in the fish population in whole of Old Cow Creek including the bypass.

With modifications, the diverted water could create a larger surface area of fish habitat (especially for juvenile fish) in the canal than that created by having the water in the bypass area. Because Old Cow Creek, including the bypass area, has significant areas of U shaped cross-section[2] (observed), addition of the diverted water would probably add only vertical habitat areas at many places. Although large fish would benefit having deeper vertical habitat, juvenile fish habitat would be only shifted to the higher water column near surface (For example, juvenile rainbow trout utilize shallow water[4]). More

[3] It may be possible that at some low flows, strong swimming fish like adult trout may swim up the canal and escape to the river through the same low orifice. This will be seriously attempted by studying reengineering the diversion structure and operations to allow episodic upstream passage.
[4] Peter B. Moyle, Inland Fishes of California (University of California press, Berkeley, 2002), p. 502.

juvenile rearing habitat areas could support more juvenile trout, which is important to create a large base number of trout population. Diverting a portion of the Creek water into the canal should help restore the trout population in the creek by benefiting the whole stream's juvenile trout population. Also, because the canal water is controlled at the diversion, there is no danger of flooding in the canal, fish eggs and juvenile fish could have opportunity to stay longer in the canal safely without washed away. Mortality of salmonid eggs and small juveniles were commonly found in floods (i.e. significant increase of mortality of alevin and early fry of Atlantic Salmon[5] and eggs of sea trout[6] in high flow).

Steelhead: The Primary Focus

I have been asked to focus here on restoration of rainbow trout (juvenile and adult), which can become steelhead. The Davis Hydro plan can provide more suitable trout habitat within the 3 mile-long canal and provide the fish a way to return to Old Cow Creek, before they enter the forebay. In this way, the canal could significantly contribute to the enhancement of the fish populations in Old Cow Creek.

There would not be needed major modifications to the current canal system. Kilarc diversion does not have a screen, and under the Davis Hydro Plan, no screen is proposed. Because the trout in the canal have already been reported seen spawning , what would be needed is to enhance some of the poorer rearing and spawning areas in the canal and make them more suitable ones. The Davis Hydro plan is to construct these habitat areas and multiple fish collecting and return paths to Old Cow Creek.

Small fish are more susceptible to entrainment from their poor swimming ability. "The usual solution to juvenile entrainment in diversions is to screen diversions, but can be expensive and often ineffective. Combining it with a reduction in diversions during periods of high out migration, this way is more effective.[4]" Instead of having a screen at the diversion, the Davis Hydro plan lets fish entrained and later release them through a downstream fishway(s). They also have suggested diminishing the flow during certain periods of upstream migration. Specifics were not provided.

Although there are some spawning beds within the canal, entrained pre-spawning fish will appear to have opportunities to pass upstream of the diversion dam and return to the upstream spawning grounds with physical and operation changes of the diversion according to Davis Hydro. Low flow opportunities (with suitable attraction flow) can be provided at the diversion dam during their migration periods. When a fish ladder (or

[5] Jensen, A.J. and B.O. Johnsen. (1999). The functional relationship between peak spring floods and survival and growth of juvenile Atlantic Salmon (Salmo salar) and Brown Trout (Salmo trutta). Functional Ecology. 13, 778-785.

[6] Ingendahl, D. and D. Neumann. (1997). Low spawning success for sea trout and reintroduced salmon in tributaries of the River Rhine – importance of flood events and heterotrophic processes. Ichthyoplankton Ecology. Pp. 22-23. 1997. (Abstract)

ladder like) structure needs to be made to support their migration, the operation at nighttime should be avoided. "Passage through fish ladders is relatively fast (in relation to total passage time). With the exception of sockeye, most species will not exit the fish ladder after dark. Longer ladder passage times are usually associated with holding in the ladder over night while waiting for daylight to exit."[7] Downstream moving juveniles and adults from above the diversion will be swept into the canal as they are now, but they can live and spawn in the canal and be carried down to the Old Cow in two different locations.

Description of the Canal

I have visited most sections of the canal and reviewed all the major trout habitat in the canal identified by Davis Hydro. The Kilarc canal is made of three types of structure. The first is steel flumes that can provide no habitat, and the flow may have to be slowed for upstream passage. The second is made of about 4ft(w) by 4ft(h) concrete canal. Both these types of canal sections also do not have any holding/hiding area and the water velocity is too high for smaller trout (rough surface measurement of >3ft/s). Typically, rainbow trout (possible steelhead) fry (<50mm SL) need shallow (<50cm) water along stream edges in low velocity area (1-25cm/sec). Juveniles (50-120 mm SL) are usually found among rocks or other cover in deeper (50-100 cm) and faster 10-30 cm/sec) water[4]. These concrete areas will be initially untouched in the Davis Hydro proposal. During periods of upstream migration for spawning, the velocities in these reaches would be dropped by releasing more water at the diversion dam, so that spawning adult fish can swim upstream easily past these areas[8].

The Habitat Canal Parts

The other parts of the canal are very much like narrow and deep natural streams (average about up to 10ft wide by 2-3ft deep). They have lower velocity (rough surface measurement of 0.5-3 ft/sec) and areas where consists of runs and riffle mostly and few small pools. Most trout found in Kilarc canal are less than 2 year old (based on the fish length measurement in the PG&E report[9]).

For the first year or two of life rainbow trout are found in cool, clear, fast-flowing permanent streams and rivers where riffles predominate over pools, where there is ample cover from riparian vegetation or undercut banks, and where invertebrate life is diverse and abundant[4]. With minor modifications, this area may serve well as spawning and rearing habitat. These are the areas Davis Hydro intends to improve the habitat by

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[7] Northwest Fisheries Science Center. (2000). White Paper. Passage of Juvenile and adult Salmonids Past Columbia and Snake River Dams. April 2000.

[8] Under the Davis Hydro plan this water will flow down the bypassed reach assisting in upward migration in this area also where not stopped by the reported barriers.

[9] California rainbow trout typically reach 75mm FL (1 year old) and 140mm FL (2 year old) Snider, W.M., and A. Linden. 1981. Trout growth in California streams. DCFG Inland Fish. Admin. Rpt. 81-1. 11 pp.

creating more riffles, elongated vegetated pools for macroinvertibrtes, and cover, and bringing in river gravel for spawning areas. Many areas of the natural-like canal fulfill the suitable trout habitat characteristics, but some areas do not at present only because of lack of cover and low velocity areas.

Adult Trout

As I walked along the canal, many juvenile trout were spotted but very few adult trout. The canal seems to be not suitable for supporting large trout because of the small stream size.[4] Migration of juvenile salmonids are caused by their environmental changes, habitat preference changes as they grow, and competition[10] These smaller trout eventually migrate downstream into the forebay or return back to Old Cow Creek (through fish collection systems and downstream fishway(s), discussed in later section).

Needed Canal Enhancements

Here we discuss the potential enhanced rearing habitat (and spawning habitat in later section) for smaller trout.

Velocities and Shape

Because the diversion canal is artificial, some areas of the canal are straight and therefore lacking natural low velocity hiding/holding areas, such as pools, undercut banks, tree roots, brush piles along the outside curves associating with a stream curvatures. Because juvenile rainbow trout prefer water where riffles predominate over pools with lower water velocity and enough cover, the way to convert the canal to their suitable habitat is to add artificial and/or natural cover such as over-hanging vegetation, logs, boulders and tree roots to the high velocity areas of the canal. This will provide them more areas with lower velocity to hold and hide. Also, small pools can be added at few areas where canal is straight to reduce overall water velocity of the areas.

According to the stream restoration guidelines by Dave Rosgen in Colorado[1], the closest stream type of the Kilarc diversion canal is E3 (moderate sinuosity, gentle to moderate steep channel gradients, and very low width/depth ratios). Because the Kilarc canal is controlled and does not flood, flood plain of E3 is ignored. This stream type has very stable channel materials, which resemble Kilarc canal's channel materials combined with the man-made bottom structure (hard clay). Fish habitat improvement structures, which the guideline recommend for E3 stream type, are bank placed boulder, submerged shelter, and bank placed rootwads.

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[10] Onset of juvenile salmonid migration is discussed in National Marine Fisheries Service *The Effects of Summer Dams on Salmon and Steelhead in California Coastal Watersheds and Recommendations for Mitigating Their Impacts*. July 23, 2001.

Cover & Variety

Cover (both above and in water) is also important to hide young trout from their predators (avian and fish). Small trout near surface/shallow water are attacked by avian predators such as, king fishers, mergansers herons, and in deeper waters by predatory fish such as pikeminnow and large trout[4]. Having variety of water depths, surface shapes, and covers not only benefits trout by providing feeding and resting habitat, but also by having variety of insects living in the various habitats. In some confined areas of the canal, water velocity are high and where both sides are concrete habitat will not be created. However Davis Hydro has shown me and I have reviewed about a mile of potentially good habitat assuming some engineering is done. From my observation:

Habitat Area 1 (see Davis Hydro map 1.a) had good juvenile trout habitat overall (approx. surface flow: 0.5-2 ft/s; canal depth: 2-3 ft) and only minor enhancement (addition of cover) is needed.

Habitat Area 2 includes good spawning beds (more discussion in next section), therefore juvenile trout habitat enhancement (addition of boulder, log, etc.) should be minimize in that area. However, toward downstream of this area was more favorable habitat for juvenile trout. This area had more shallow areas where juveniles can hide. Approximate surface flow of the area was 1-3 ft/s and the depth was about 2 ft.

Habitat Area 3 is likely to need the most enhancement. There was less cover (both above and under water) and some side-walls are currently without vegetation and were eroding, and these areas need erosion control. The approximate surface flow speed of this area was 1-3 ft/s and the depth was 1-2 ft. This area had more shallow areas where juveniles can hide also with mixed gravel and hard bottom. No significant woody debris, cover, or boulders were present. All the three habitat areas are reported to be assessable by truck, but this was not verified.

Spawning Trout

Suitable rainbow trout (possible steelhead) spawning ground has coarse (1-13 cm diameter) gravel of the tail of a pool or in a riffle, typically 20-155 cm/sec, and depths are 10-150 cm[4] Habitat Area 2 had more gravels and less sand compared to other habitat areas. The canal was shallower (about 1 ft) and wider than other habitat areas. Approximate surface water velocity was 2-3 ft/s. The level of sand (which can suffocate eggs and susceptible to disease) seemed minimal in this area. No mud or silt was observed. More gravels in this area would help improve the spawning beds. Some areas do not have enough substrate so that the canal bottom surface (clay [I was told] bottom) was able to be seen in patches. There should be enough gravel for spawning trout to dig and cover deposited eggs, so the eggs have enough cover (from predators, from washed away). This could be increased in many areas to expand spawning grounds.

Fish return Passage

Because the canal and the forebay currently do not have any exit for fish, all entrained fish stay there for rest of their lives. By adding fish return passageways, entrained fish have the possibility to return to Old Cow Creek, and the Canal become potential habitat.

A key engineering study area is how to guide these fish into the return fishway. One of the most frequently used fish protection systems is surface bypasses associated with trashracks or angled bar racks with relatively close, particularly in the Northeast of the USA and in France.[9] Surface bypass fish collection/diversion channel combining with other devices (louvers or screens) would increase the system efficiency.[10] Above method also should work well for the case at the Kilarc project site. Because the canal water is controlled (i.e. depth, velocity), adjustment for the system could go smoothly. To minimize damages to the fish collecting system, a trash rack can be placed at the upstream. It would collect drifting debris as well as ice masses which could damage the system.

For the downward migrating fish, Davis Hydro utilizes a fish return pipe or ladder and the natural waterways (presently exist). The passageways should be designed carefully to support fish of any size, such as down migrating juvenile and adult trout, including possible down migrating post-spawn steelhead.

Because the penstock drop measures about 1,800 ft (elevation at the forebay about 3,800ft; elevation of the powerhouse about 2,000ft), the distance of a fish passage way would become a long one. Above the recreational fishing area (forebay), and the canal of the area is a planned location of a fish collection facility and a final return passage to the creek – primarily for juveniles.

However, despite the long distance, installation of a fish passageway is not difficult due to a natural stream originating at elevation of about 3,700 ft. near a small bridge on the possible pipeline/passageway route I visited. A fishladder or a fish return pipe can carry fish from the end of the screen near the forebay down to this small waterway. This waterway soon joins and adds steady flow to a small natural stream. This stream will then enter Old Cow Creek, about 1,500ft upstream of the powerhouse in what appears from the topo map to be the better habitat area of the bypass reach.

Research and Out-reach

Davis Hydro makes the point, with which I agree, that this area allows easy access of viewing wild living fish and can be used as a public outreach education. The fish collection facility can provide a great fish monitoring station and research facility as it is accessible about 8 months of the year. As the fish and the collection facility/fishway should be inspected daily, the facility can provide a great fish monitoring station and research facility. Comparing to upstream fish passage systems, downstream fish passage systems are much less advanced. This station could provide valuable data to the downstream fish passage research.

[9] Larinier, M. World Commission on Dams. Environmental Issues, Dams and Fish Migration. Final Draft, June 30, 2000.
[10] Adult and juvenile salmonid passage efficiency discussed in Therrien, J. and Bourgeois, G. (2000) Fish Passage at Small Hydro Sites. March, 2000

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April 29th, 2008

Richard Ely, Davis Hydro
27264 Meadowbrook Drive
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RE: Fishery evaluation for South, Old Cow Creek Hydroelectric Facilities

On January 29th, 2008 Cramer Fish Sciences biologists Joseph Merz and Bradley Cavallo visited various sites related to the Kilarc-Cow Creek Project, FERC Project No. 606 (Project). Pacific Gas and Electric (PG&E) began a FERC relicensing effort for the Project in 2002, but later decided to surrender and decommission the project. Ostensibly, PG&E and resource agency staff determined that benefits to aquatic ecosystems (particularly endangered anadromous fish) outweighed any societal benefits of continued Project operations.

The purpose of our visit was to: 1) examine probable fishery effects of the Project (whether decommissioned or left operational) and 2) evaluate potential for Project related waters to provide suitable habitat for fish, particularly endangered anadromous salmonids (steelhead trout *Oncorynchus mykiss* and Chinook salmon *Oncorhynchus tshawytscha*).

The Project encompasses separate but adjacent hydroelectric facilities in Old Cow Creek and South Cow Creek basins. The summary of our observations and recommendations which follow is not intended to provide a complete description of the project area or its resources (readers are directed to PG&E 2007 for a detailed background).

SOUTH COW CREEK

South Cow Canal diverts a maximum of 55 cfs at the upstream end of Wagoner Canyon. South Cow Canal water is discharged (after passing through Cow Creek Forebay, penstocks and Cow Creek Powerhouse) into Hooten Gulch. The Tetrick Ranch Powerhouse diverts water from Hooten Gulch downstream of the Cow Creek Powerhouse for generation of power. The water is returned to Hooten Gulch a short distance (~1/2 mile) downstream until it reaches a second diversion dam that diverts a maximum of 13.4 cfs (which services a significant local agricultural canal, Abbott Ditch), and then rejoins the South Cow Creek.

<u>Observations</u>

- Our assessment of fish habitat below Hooten Gulch is consistent with fishery studies indicating that fall-run Chinook salmon spawning occurs almost exclusively in this reach. However, removal of South Cow Creek hydroelectric project would likely not provide sufficient supplemental flows to improve fall spawning habitat quality or accessibility.
- Several fisheries studies (e.g. Moock and Steitz 1984) indicate that anadromous *O. mykiss* populations in South Cow Creek are well documented. However, these studies

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seemed to be based solely on observations of redds or of larger adult *O. mykiss.* In light of recent investigations demonstrating that anadromous forms of rainbow trout can only be definitely identified (and distinguished from resident forms) by otolith chemical analysis (e.g. Zimmerman 2008), previous observational studies should be viewed with some skepticism. If the South Cow Creek truly supports an anadromous *O. mykiss* population, this should be definitely documented so that the stream can be appropriately managed.

- Given andromous *O. mykiss* are adapted to migrating upstream during winter high flow events, removal of the South Cow Creek hydroelectric project would likely have negligible benefits for the migratory adult life stage.
- Supplemental flows provided by removal of the South Cow Creek hydroelectric project may improve summer suitable rearing habitat and water temperatures within the bypass reach. However, it appears that no studies have been conducted to document and quantify potential benefits.
- The presence of an *O. mykiss* population within the South Cow Creek bypass reach suggests that with-Project conditions are at least suitable (though perhaps not ideal) for species of interest.
- Diversion of South Cow Creek waters may act to conserve cold temperatures, such that when waters return to Hooten Gulch they may provide suitable habitat where it might not exist in absence of the Project.
- The Hooten Gulch diversion dam appears impassible but could be easily modified to facilitate fish passage. Improved fish passage at Hooten Gulch, screening at Abbot Ditch canal, and some physical habitat improvements could make the Hooten Gulch reach a potentially productive spawning and rearing habitat for salmnoids.
- Abbott Ditch canal appears to have very limited potential (even with direct physical enhancement) as rearing or spawning habitat for salmonid species.
- Though we were unable to visit the South Cow Canal, we speculate (based on visits to similar canals in the area) that parts of it could probably be modified to provide rearing habitat for *O. mykiss*. However, such habitat improvements would best be viewed as incremental rather than a significant increase in carrying capacity for *O. mykiss* populations.
- Flood irrigation and poor grazing practices in South Cow Creek (downstream of Hooten Gulch) could be ameliorated by improved management practices and better canal flow management.
- Removal of the South Cow Creek hydroelectric project would eliminate source water for the Hooten Gulch canal. Consequently, a new diversion dam and canal would be required on the South Cow Creek mainstem as a condition of Project decommissioning. Depending on its placement and design, this new diversion structure would inhibit passage and reduce supplemental instream flows gained by Project decommissioning. Purchasing water rights or providing off-channel water sources might also be options.

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OLD COW CREEK

Observations

- A very significant natural barrier to upstream fish passage, Whitmore Falls is present downstream of the reach affected by Project operations. Steelhead generally require a 1.25:1 pool-to-jump ratio in order to jump a barrier; with sufficient pool depth, an adult steelhead can jump up six to nine feet (Gunther et al. 2000). We viewed the falls during our site visit and judged that it was most-likely impassable at this flow and probably is similarly impassable at significantly higher flows.
- We concur with NOAA and CDFG biologists assessment that Whitmore Falls probably does become passable for migratory salmonids during extremely high flow events. The management significance of this observation is questionable however (see recommendations section).
- However, even if Whitmore Falls were fully passable, given andromous *O. mykiss* penchant for migrating upstream during winter high flow events (which overwhelm the relatively small amount of water diverted to Kilarc Canal), it is unclear how removal of the Old Cow Creek hydroelectric project would significantly improve upstream migratory fish passage.
- Supplemental flows provided by removal of the Old Cow Creek hydroelectric project may improve suitable rearing habitat and water temperatures within the bypass reach. However, it appears that no studies have been conducted to document and quantify potential benefits.
- The presence of a strong *O. mykiss* population with the Old Cow Creek bypass reach suggests that with-Project conditions are at least suitable (though perhaps not ideal) for *O. mykiss*.
- Diversion of Old Cow Creek waters may act to conserve cold temperatures, such that when waters return downstream of Kilarc Powerhouse they may provide suitable habitat where it might not exist in absence of the Project.
- We walked approximately ½ mile of the Kilarc Canal and observed several dozen trout between 6 and 12 inches total length. Habitat could be further improved by addition of in-stream objects (boulders, woody debris) and overhead cover (riparian vegetation). These enhancements would primarily provide additional rearing habitat for *O. mykiss* (and other trout species). From our cursory inspection, we foresee extensive physical modifications would be required to even develop potential *O. mykiss* spawning habitat within the Kilarc Canal.
- Kilarc Forebay and Kilarc Canal provide a significant recreational and informal handicapped angling resource to the area. Current decommissioning plans for the Project would eliminate these well-known and accessible fishery resources. Improvements to Old Cow Creek fisheries resulting from Project removal might offset these losses, but apparently not studies have evaluated

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Recommendations

Based on our findings, as well as concerns raised previously by other stakeholders, we strongly recommend that PG&E and fishery resource agency staff carefully and objectively review and reconsider current plans to decommission the Project.

During this review, a number of key points and informational deficiencies should be addressed.

- While "natural conditions" generally are best for fish, this is a case where the benefits of Project removal may be small relative to the loss of existing fish habitats (Kilarc Forebay, Kilarc Canal, South Cow Canal, South Cow Forebay, Hooten Gulch), loss of a significant green energy source, loss of existing diversion waters and structure (Abbot Ditch canal and diversion dam) and the related need to construct replacement diversion structures elsewhere on South Cow Creek. Available information suggests that these factors have not been given due consideration.
- Studies should be conducted to determine water temperature effects of Project operations (or Project removal).
- Studies should be conducted to quantify and contrast bypass reach fish habitats under with-Project and without-Project conditions or suggested modifications – such as canal screening and fish return bypasses. These studies could be based on PHABSIM methodology, or more economically by a mesohabitat based model assessment.
- Provide review and consideration of scientific literature related to influence of habitat condition on relative residency and anadromy among *O. mykiss* populations. If the goal of Project decommissioning is to improve anadromous *O. mykiss* populations, then management decisions must reflect and be grounded in a thorough understanding of latest relevant scientific findings.
- Conduct a thorough analysis of fish passage at Whitmore Falls. If possible, document by direct observation (e.g. video monitoring), conditions under which Whitmore Falls are passable for anadromous fishes. Determine the frequency with which fish passage will occur under with-Project and without-Project conditions.
- *O. mykiss* anadromy in Project waters should be determined more definitively by sampling and analyzing *O. mykiss* otoliths.
- Evaluation of the Project should include alternatives other than complete decommissioning. For example, studies may suggest that a 25% reduction in South Cow Creek diversions during July and August may be sufficient to support significant additional *O. mykiss* rearing habitat.
- Evaluation of the Project should include consideration for beneficial actions, improvements, or new project features and operations which could be funded and supported and maintained as conditions of a new Project license (i.e. regulatory authorities including Federal Power Act (FPA) section 18, FPA section 10(j), FPA section (10a) and ESA reasonable and prudent measures). If the Project is decommissioned, then there will be no obligation or funding source for fishery, wildlife, recreational, or water quality enhancement and management actions.

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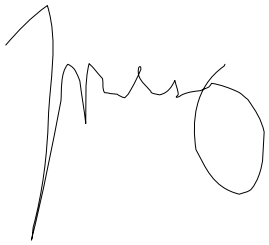
Signed respectively,



Joeseph E. Merz, PhD

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April 4, 2008

Richard Ely, Ph.D.
Kelly Stackheim
Davis Hydro LLC
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Dear Dick and Kelly:

This letter serves as a summary of the observations made during our April 2, 2008 site visit to the South Cow Creek (Tetrick Ranch) and Old Cow Creek (Kilarc) project areas.

Our understanding of the Davis Hydro objectives includes continuation of the hydro power generation and enhancement of the fishery productivity of the existing facilities. This enhancement is proposed to be accomplished by alterations to the existing facilities to improve spawning production, provide return passage to the main channel for juvenile fish, and perhaps even create connectivity for upstream and downstream migration of spawning adult trout.

The purpose of the field visit was to discuss the feasibility of this concept and provide input from past habitat enhancement projects conducted by StreamWise. The enhancement activities are proposed by Davis Hydro as a viable alternative to the current PG&E proposal to remove all hydro facilities and diversions and return full flows to the main channel of South Cow and Old Cow Creeks. StreamWise did not conduct a detailed assessment of the two proposals, and cannot, therefore, offer any insight as to the relative benefits of one alternative over the other. StreamWise can, however, offer some comment on the Davis Hydro proposal to enhance existing conditions to improve productivity of the native trout fishery.

The first site we will consider is the Tetrick Ranch project on South Cow Creek. Due to the age of the hydro diversion channels, their appearance closely mimics a natural stream channel in many areas. Trout habitat includes cobble and gravel substrate, healthy riparian vegetation, and sufficient volume of cool, clean water to provide excellent holding and some spawning habitat. Spawning habitat is somewhat impacted by a lack of adequate gravel bedload supply that would replenish substrate for spawning redds. In the present condition, there is no connectivity of the diversion channel to the main channel, as the diversion dam at Tetrick Ranch effectively prevents upstream migration.

StreamWise Tetrick Ranch Observations:

1. Fishery habitat within the open diversion channels, including Hooten Gulch and Abbott Ditch, could be enhanced with gravel augmentation at intervals along the channels. As the current flow regime is controlled by hydro operations, these gravel sites would require periodic maintenance and replenishment to insure spawning viability.

2. The large diversion structure below the small power house at Tetrick Ranch headquarters could be redesigned to allow for fish passage at most flows while still supplying enough grade control to operate diversion to Abbott Ditch. This could be accomplished with a series of boulder weir structures to create a step-pool system passable to adult trout in both directions.
3. A return flow or fish bypass system would be required to allow for escape of juvenile trout. The proposed bypass route was not evaluated in great detail, but may be feasible.
4. The habitat and spawning potential for the former main channel flow in South Cow Creek was not assessed.

The second project site took us to the Kilarc Reservoir to visit the Old Cow Creek project site. We toured the reservoir itself and diversion canal leading to the pond.

Kilarc Reservoir is used for recreational fishing, swimming and boating by local residents and other visitors. It is easily accessible, even for handicapped visitors. It apparently is an excellent source of water for fire protection in the Whitmore community and surrounding landscape.

The diversion system leading to Kilarc is approximately three miles long and travels along the contour of the hillslope, and in several locations, through rocky cliffs along the hillslope. The diversion is engineered along an even gradient with alternate segments of ditch excavated along the hill, u-shaped concrete aqueducts, and suspended metal aqueducts at periodic side-canyon crossings. A gentle trail leads alongside the waterway for the entire length, except at the tunnel, where the trail passes over the hill above. The diversion was created to pass flows evenly along an even base elevation.

StreamWise Kilarc Project Observations:

1. Due to the age of the diversion channel, the portions of the channel that have been excavated into native material have stabilized and provide reasonably good fish habitat, as was evidenced by the numerous trout seen along the channel.
2. Spawning areas are limited due to the lack of periodic influx of spawning gravel and the lack of pool-riffle sequence within the diversion.
3. Opportunities for enhancement of spawning productivity are available along approximately one mile of the diversion canal, in the reaches of natural hillslope.
4. Small rock cross-vanes and supplemental gravel segments could be placed at intervals along the diversion to greatly enhance spawning activity.
5. Concrete aqueduct reaches could be baffled in certain areas to offer increased fish passage potential.
6. It is possible to supply a fish bypass channel at one or two locations. A pipe near the lower end has been proposed by Davis Hydro, but open channels were also discussed as a possible alternative. The feasibility and location of such bypass systems were not evaluated during this visit.

In summary, the Davis Hydro proposal to continue power production and enhance the productivity of the existing facility seems feasible. Further investigation is needed to determine the cost and specifications of this concept. If it is determined that the fishery could potentially benefit more from enhancement of existing facilities than from a complete removal of the hydro

system, then that alternative should be investigated into greater detail and given due consideration in the FERC relicensing process.

StreamWise is pleased to participate in the discussion of alternative actions for the Kilarc / Cow Creek hydro project and looks forward to further discourse with those interested in addressing the resource concerns associated with all project alternatives.

Thank you,

Rick Poore, StreamWise

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April 14, 2007

Richard Ely, Ph.D.
Kelly Sackheim
Davis Hydro LLC
27264 Meadowbrook Dr.
Davis, CA 95618

Dear Dick and Kelly:

This letter provides a summary of observations made on 2 April 2008, at the Kilarc project area. These observations were made by Todd Sloat of Todd Sloat Biological Consulting, Inc. (Sloat Consulting) during a site visit with Rick Poore (Stream Wise), Richard Ely and Kelly Sackheim (Davis Hydro LLC) at the Kilarc Hydro Power Plant facility between the hours of 1100-1615.

Sloat Consulting evaluated the existing facilities including diversion, raceway, forebay (Kilarc Reservoir), and power plant. The evaluation consisted of documenting biological use of the facilities as they currently function. The evaluation was conducted by walking the entire length of the raceway and around the forebay and diversion. Notes were recorded regarding habitat present on-site, species occurrences and potential for species use of habitat associated with the existing facilities. Because of the timing of the site visit (early spring), several wildlife species are still migrating from wintering areas to breeding areas and therefore would not be present on-site during this survey. Repeated visits to the site would confirm some assumptions regarding species use of the facilities presented below.

Kilarc Reservoir, or the forebay, is an "island" of wetland habitat within a forested landscape. Therefore, the reservoir serves as a unique habitat type in the region. Although it is relatively small (4 acres) in size, the reservoir likely provides habitat for several biological species that would not normally occur in the area or use the area for resting or foraging. These species would primarily include birds, such as waterfowl, shorebirds, wading birds, and herons/egrets. For example, during a 30-minute visit at the reservoir, two waterfowl species were observed, the Canada goose and common goldeneye. Other waterfowl species likely use the reservoir during brief time periods in small groups (2-15) during spring, fall, and winter. Other species that would likely use the site include killdeer, great blue heron, and greater yellowlegs. The wetland habitat of the reservoir also produces some insect species that fly, and aerial foraging birds would prey on them. Aerial foraging birds would likely include species such as tree swallow, northern rough-winged swallow, black phoebe, and yellow-rumped warbler. The emergent wetland plants (cattail, rushes, sedges) that currently grow at the margins of the shallow water

habitat would likely provide foraging habitat for other bird species including song sparrow, marsh wrens, common yellow-throat, and blackbirds. Finally, the site may be used on occasion by birds that prey upon fish such as osprey, bald eagle, and belted kingfisher.

The raceway between the diversion at Cow Creek and Kilarc Reservoir traverses a forested landscape for approximately three miles. The raceway primarily provides freshwater habitat for fish species and to a lesser extent, a small number of wildlife species. Several fish were observed (presumably rainbow trout) during a walk along the raceway. In general, more fish were observed within the raceway where in-stream habitat diversity was greater (e.g. pools). This in-stream habitat was the result of physical structures within the stream (e.g. roots of trees) or a change in channel morphology (e.g. a narrowing of the channel size). Although no trout were observed spawning, there appeared to be several redds (est. 15) where fish had either spawned or "dug" within the gravel in an attempt to spawn.

Few wildlife species were observed along the raceway, but several would be expected to use the water as a drinking source (e.g. deer, birds). Also, part of the raceway (estimated 1000 feet) travels within a tunnel built from wood, and the tunnel may provide habitat for nesting and/or roosting bats.

Sloat Consulting did not walk along the stretch of Cow Creek between the diversion and power plant. However, habitat at the diversion and power plant were observed and provide some information as to their habitat value for biological resources. In general, the creek and associated habitat appear to be in stable condition and would provide many benefits to fish and wildlife species. If the Kilarc power plant were to be dismantled, these values would likely improve. However, documenting the specific biological improvements was not part of this evaluation.

In summary, Kilarc Reservoir and the raceway appears to provide some unique biological values in the region, and if the hydro plant was dismantled, these values would be lost.

Sincerely,

Todd Sloat