

# **The Davis Hydro Alternative I**

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An Alternative Proposal to Facilities Removal,  
Kilarc – South Cow Hydropower Project

A Document for Discussion

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## **Summary: The Davis Hydro Alternative I**

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The measures described in this Alternative are proposed as an alternative under the NEPA processes. They are designed to address the opportunities to save fish and generate renewable power that were raised in PG&E's plan to remove the hydropower facility called the Kilarc Cow-Creek Project. More importantly, they go beyond the bounds of current operation and PG&E's plan, to expand the amount of endangered fish and fishing that can be sustained in the area while still generating green power to save the environment beyond the Cow Creek watershed.

Alternative I is a combination of measures on the two diversions, to keep the hydropower going in some form. Reasonable measures can be taken to maintain and expand critical habitat under ESA. Specifically, we propose habitat enhancements divided into five zones. The proposed alternative includes building a diversion in the Kilarc and South Cow diversion canals close to the forebay ponds, and returning a fish bypass flow to the bypassed channels. These fish bypasses will enable the canals to be used as long spawning grounds for Steelhead and (in the South Cow) Steelhead and Salmon.

Further, the plan in the South Cow is to expand the tailrace and Hooten Gulch with engineering improvements, to create a long juvenile and spawning channel from near the powerhouse to well below the Abbott Ditch diversion.

If a fish bypass were constructed from the end of the Kilarc canal that would be screened from the forebay, a one mile fish bypass could safely conduct adult migrants and juvenile down to a feeder creek on the south side of the Old Cow, assuring the benefits of the whole Kilarc canal and a large, most useful part of the Old Cow bypass reach. This lower area would retain a reduced flow similar to its current state, with water coming in from numerous springs and North Canyon as well as the conduit water proposed.

Because the Kilarc canal is classified as critical habitat for steelhead trout due to its excellence as a potential spawning ground, it is going to be difficult to show that the vastly inferior habitat of the uncontrolled Old Cow will provide anything but a significant fish loss. The idea of using the canals as fish habitat is also applicable to the South Cow, where even more juvenile fish habitat can be created.

We welcome ideas on how to increase fish and fish habitat in these areas, and how to work with residents and ranchers to take care of our environment.

Davis Hydro,  
Davis California,  
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## **Davis Hydro Alternative I**

The ideas presented here derive from discussions with many different people. Our objective is to use the resources generated from small hydro to induce anadromy into a resident rainbow population, which is an unknown and so far unsuccessful art. Our ideas, and willingness to undertake this challenge, are presented here for discussion, and this document asks for your – the reader’s – ideas, criticism, and consideration. This description is available in the document section of [www.Kilarc.info](http://www.Kilarc.info) .

KC LLC proposes this alternative to increase fish habitat and fish anadromy in the Cow Creek area. It has evolved from the original KC alternative described in September 2007. This proposal also retains much of the existing hydroelectric generation. It will also meet all the recreation, water supply, and environmental objectives of all but a few directly interested parties. It may save PG&E (and thus all of us) a lot of money and is an environmentally responsible alternative.

Specifically, the Davis Hydro proposal is a fish enhancement engineering and operation program which has the following basic elements:

1. **The Kilarc Spawning Channel.** The Kilarc Diversion canal is full of fish of all types. It can be considered prime spawning fish habitat with some minor modifications for rainbow/steelhead.
2. **The South Cow Spawning Channel.** The South Cow Creek has a similar but smaller canal and by moving the diversion screen down to the forebay and installing a fish bypass, we can spawn, grow, and return all the juveniles and any migrating adults to the sea.
3. **The Abbott Ditch Spawning Channel and Management.** In the Abbott Ditch, if we can obtain cooperation of the ranchers, we intend to turn the first few hundred meters into a fish spawning area and return migrating adults and all juveniles to the Creek.
4. **The German Ditch Spawning Channel.** In the German Ditch, if we can obtain cooperation of the ditch water rights holders, we would likewise put a screen in the ditch and maintain approximately the first quarter mile as a fish hatchery.
5. **The Hooten Gulch Salmon and Steelhead Juvenile Habitat** New grading and habitat engineering in the South Cow tailrace and the Hooten Gulch down to where it joins the South Cow.

These physical and management improvements are intended to produce many thousands of salmon and rainbow more than what will occur naturally. They will be supported with oversight, financial support, and hands-on management from the hydropower operations as a condition of any future license.

This plan will include elements to induce the rainbow to migrate downstream. In both Creeks, spawning and separate juvenile habitat will be created. Predators will be attacked, and ranching practices will be changed. Fish habitat will be created in ditches and diversions and toxic run-off will be reduced. These actions will be institutionalized under a FERC license and provide many hundreds or thousands of fish with full sea access. This alternative also provides for a working arrangement wherein revenue from the hydropower will be used to help maintain these facilities.

This is a different type of small hydro – one where some of the benefits from the hydro are used to improve to habitat, fish behavior, and fish populations far beyond what is possible with natural flows and channels.

## **Background and Discussion**

The following discussion addresses some details of Alternative I. This is considered a study document, and Alternative I should be considered as a work-in-progress. The individual ideas proposed here are not new, but their use and arrangement in this facility is novel. Likewise, the idea of an active management of the facility by the hydro operators is not new, but the creation of a widespread partnership between hydro operators and ranchers, and physically creating an extensive fish environment, may be unprecedented for small hydro.

The noted and details discussed below are taken in the same order as the elements listed in the summary.

### **1. *The Kilarc Spawning Channel***

It is proposed that the Kilarc Spawning Channel be comprised of the existing canal between the diversion and the forebay, with a new structure that allows fish to return to suitable habitat areas in the bypassed reach. An additional benefit of maintaining flows in the existing canal is the lower downstream temperature effect in the main channel below the powerhouse.

### **Current Canal Habitat**

The Kilarc Canal is a near perfect Steelhead spawning channel. It has a flow of between 2 and 4 feet per second, of varying width but with large sections typically between 8-10 feet. A forest covers over much of the reach, and there is cold water all year. Total flow is typically between 15 and 40 cubic feet per second. Significant reaches form a near perfect spawning bed with water depths about 1-3 feet and water flowing between 1 and 3 feet per second. Storm floods do not disrupt this flow. The bottom varies but has large stretches of sand with minor amounts of lateral gravel. There is a forest cover over the prime spawning areas and the entire length on private property. To be perfect, there needs to be only some gravel augmentation and occasional boulders where the channel sides will permit. The great thing about this augmented is that it can be controlled, raked, graded, and not blown out by floods.

This description fits major portions of the first half of the Kilarc canal. Parts of the remaining parts of the canal have similar long areas that are near perfect spawning beds but with less tree cover. Narrower open flumes interrupt these spawning areas with little or no cover from predation and usually little bottom habitat. The lower half of the canal has less tree cover and generally easier human access.

### **The Bypassed Reach**

The bypassed reach also has a mix of fish spawning habitat with parts of it in broad deep pools with juvenile and spawning grounds, and steep fish barriers. In many areas, the sides of the channel are steep and increases in flows would have a mixed effect on spawning. The cathartic effect of the floods in this area has multiple positive and negative effects – first to sweep adults and juveniles alike downstream and second to rearrange, refresh, and to some extent sanitize the habitat. At the same time, these floods bury reeds, and destroy large areas of gravel beds.

Whatever the analysis will show, the bypass reach may be found to sustain an average fish population well under a thousand fish per mile, with the hydropower flows returned to the bypassed reach and new habitat created with those flows. The comparison between over possibly a thousand fish per mile in the Kilarc canal and a fraction of that in a reconstructed bypass is not possible now for a very simple reason: almost all fish in the canal are caught by fishermen or are destroyed going through the turbines.

This “problem” is also the opportunity. If a return fish bypass were put near the end of the canal, for example near the existing trash rack, and the forebay screened off, all fish moving downstream, juveniles and adults alike could be returned to the Old Cow via the bypass. Conceptually this bypass would go from the end of the screen for about a mile, to one of the small tributaries to the Old Cow. It would come into the Old Cow above the primary juvenile habitat areas which are fed by springs from the North slope and from the North Canyon, below the upper cascade (~2 miles up from the powerhouse) which blocks upward migration of steelhead except in the most exceptional of circumstances.

### **Observed Fish Populations**

Observations in November 2007 revealed numerous fish spawning in the Kilarc canal. A visiting fisheries biologist considered large parts of the canal “a blue ribbon trout stream” with a habitat that might support multiple thousand fish per mile. PG&E’s biological assessment documents that the whole area has populations of rainbow/steel head present.

These features have suggested opportunities that were not obvious a few months ago. Currently, more fish studies are underway to see what specifically can be said about the rainbow/steelhead population.

### **Engineering the Canal**

In many hydro facilities, fish bypasses are required to bypass fish around the entrance to hydropower turbines. In this case, a long screen can be put in the end of the canal near the current trash rack where it is easy to maintain by hydro staff. Along with gravel addition, some boulder insertions in the Canal will produce about 2 miles of prime fish

spawning habitat. This is simple engineering. The flow in the canal is fairly steady with no floods and occasional slack water during outages. The flow in the Old Cow is very flashy, so it is difficult to make a reasonable diversion screen in the channel. However, is simple to make a screen in the quiet water of the Kilarc canal and return any fish heading down stream.

To take advantage of this extensive stable habitat, a screen is needed near the forebay end of the canal and a long fish return bypass pipe to the Old Cow to pass juveniles and fish migrating to the sea. The downstream end of this screen can direct into a fish bypass pipe that would lead fish down to the Old Cow about 1.5 miles upstream from the Powerhouse. This is simple engineering.

### **Engineering the Diversion**

Currently, for most of the year the majority of the water and downstream-moving fish are swept into the Kilarc diversion canal. The juveniles cannot escape from this canal, but a few adults can escape by working upstream and going down a release gate. There is no reason under our new developments to screen this area. It can be left open as it is now.

The Kilarc facility does not need to have an upstream screen to the diversion, because there are no salmon at this elevation and steelhead passage that far up is considered to be hardly possible due to various steep gradients, with the ultimate one located approximately one mile below the diversion dam. Fish that are swept into the canal will be screened out at the end and returned gently down Old Cow where there is significant steady water from springs in the area.

This Old Cow area is, or could be, an emitter of steelhead and rainbow juveniles. Currently, there are no records of any juvenile rainbow going downstream. There are strong reports from local anglers that upstream migration is unknown. While upstream passage past the Whitmore Falls and other barriers may be possible in some years, in some flows, for some steelhead, the upper barrier appears to be impassable under all but abnormal water. Thus, this area at best can be an emitter of juveniles from a resident rainbow population. There may be some reverse migration into the lower bypass reach when the conditions at Whitmore falls permit, but this will be uncommon. Those that can make it will enhance the genetic content of the bypass area. Here the flushing in floods will, to some extent, depending on timing, augment seaward migration, as opposed to the destruction of reeds that would occur if spawning occurred in this bypass reach.

### **Temperature Effects**

The current operation of the Kilarc delivers cold water to the downstream end of the project. The water is cold relative to what it would be in the natural flow, because the water is delivered very quickly from the diversion to the forebay via a shaded conduit, then quickly to the powerhouse. The hydropower turbines extract energy, also cooling the water slightly. The net effect is a cooler water stream out of the powerhouse with the hydropower in operation than without it. This cooler water passes downstream enhancing habitat for not only steelhead but for various species of endangered salmon. This effect may be small but it is real and constitutes a fish enhancement.

## ***2. The South Cow Spawning Channel***

The South Cow Creek diversion canal can be used also as a fish-spawning channel. If the screening structure at the diversion dam were removed, fish will come down the creek and be diverted into the existing diversion. At the other end of the diversion canal will be a screen that will return juveniles and downward adult migrants to the new Hooten Gulch juvenile habitat area (see below) that flows into the South Cow. The bypass pipe to Hooten Gulch will inject water and fish along with tailrace water from the turbines, and any coming down Hooten Gulch at the head of a new juvenile habitat area that is discussed below.

An alternative design would lead the fish bypass pipe back down to the South Cow rather down to Hooten Gulch. If the return pipe were to lead directly into the South Cow, the length of the pipe will be shorter, and more water would be in the bypassed reach, but less assured water supply would be available for the habitat area in the Hooten Gulch.

The South Cow Spawning Channel provides a similar spawning ground to the Kilarc Canal facility with the following differences noted:

- First this canal is low enough in altitude to also have two endangered species in it: fall run salmon and rainbow/steelhead.
- Second, the bed area is shorter with less good habitat areas, and less forest cover.
- Third and most importantly, there are instances of salmon and steelhead up above the Diversion dam and unlike Kilarc, it is quite possible for steelhead to migrate past the diversion dam up to extensive habitat areas above the diversion dam. This means there will be every incentive to keep water in the Diversion area and more water in the bypass region than in the Old Cow.

## ***3. The Abbott Ditch Spawning Channel and Management***

A two-pronged approach is proposed for enhancing fish habitat with the cooperation of the ranchers.

### **The New Spawning Channel**

In the Abbott Ditch, if we can obtain cooperation of the ranchers, we intend to use the first few hundred meters as a fish spawning area. There would be a screen in the canal at the end of the habitat area and a return to the river so that no fish are lost by entering the diversion. This would become the Abbott Ditch fish hatchery – maintained by under the direction of the ranchers by the hydro staff. It turns the canal into something the ranchers can be proud of rather than burdened with. Upstream migration would be augmented with some increased flows from the diversion into the bypassed reach. There would be no screen at the river diversion. The screening function is implemented a few hundred meters down the ditch where it is well out of any high storm flows in the creek. The new spawning beds will allow most debris to settle out before the screens. This makes the screening facility easy to maintain by the hydropower staff.

Using part of an agricultural irrigation ditch as a fish enhancement facility is an experiment, and if successful may be applicable to many other places around the state.

What we know is that the Abbott ditch is full of fish that seem to be thriving in the shallow slow waters of the ditch. It seems an ideal opportunity to turn the problem of unscreened and unmanaged diversions into an asset for all concerned.

The amount of water that can be diverted out of the stream under existing water rights is often a very large percentage of the flow in the stream. Occasionally the amount of water that can legally be diverted will exceed the amount of water in the stream. This looks like a complete disaster for fish in the South Cow, as there would be no water in the Creek at all. Efforts in this area will include reengineering part of the ditch to actually provide needed habitat for the fish, and work to minimize leakage losses where field irrigation water is not needed, such as the first 100 meters of the ditch.

### **Enhanced Environmental Ditch Management**

If the ranchers are willing, the habitat creation would be coupled with an expanded environmental management service for the ditch so as to minimize water waste. This will have several goals:

- all the ranchers will get just the water they need without waste,
- there will be more water left for the fish, and
- there would be little or no field run-off during dry weather.

These measures would save nutrients for the field and improve water quality for the fish. The ditch management service would also provide a service to the ranchers, both in terms of monitoring and impartially assuring that each rancher gets his/her fair share of the water.

### ***4. The German Ditch Spawning Channel***

Similar to the Kilarc Canal, if we can obtain cooperation of the ditch water rights holders, the German Ditch provides opportunities to enhance water delivery and fish protection. In cooperation with the Ditch Association, we propose to put a screen in the ditch about a half-mile downstream from the diversion and maintain the first section as a fish spawning ground. Having a fish screen in a quiet part of the ditch rather than the river will greatly simplify the screen. It will facilitate maintenance and make it more reliable, and having the screen in the ditch rather than in the natural stream bed means that it is out of the way of floods and debris, and can be maintained from the safety and convenience of a road-side access rather than an in-river engineering access.

To increase the water below the German Ditch, we would work with ditch water rights holders to line portions of the ditch to reduce waste. Water saved through these conservation measures would be returned to the stream for the fish.

Benefits to the German Ditch Association Members:

The coming requirement for screening is solved

Water is conserved

Fish in the creeks are increased

## **5. The Hooten Gulch Salmon and Steelhead Juvenile Habitat**

The Hooten Gulch is a long, sinuous riverbed that has limited storm flooding and plays a role as the tailrace from the South Cow powerhouse. If it is filled with diverted water from the South Cow Creek in addition to what comes through the powerhouse, the Hooten Gulch Salmon and Steelhead Juvenile Habitat (HGH) will make an ideal juvenile salmon and rainbow trout habitat. As revenues permit over the first few years, we will modify the bed to produce a large steelhead and salmon spawning and juvenile habitat area, nestled in newly planted cottonwood trees and fenced off from cattle.

The creation of the HGH will require cooperation and collaboration with the local land owners and ranchers, and the revenue from the hydropower. As the cooperation of the ranchers is obtained we will plant more cover trees, place large anchored stumps for pool creation in the bed, fence off the cattle, and provide a cold water flow from the hydropower diversion and from the outflow from the South Cow Diversion canal spawning facility. The Tetrick ranch encompasses significant parts of the Hooten Gulch, the diversion, the forebay, powerhouse, and the Abbott Ditch diversion. This project is enabled because the major landowner of the HGH will be the hydro owner/operator of the site.

Finally, under this Alternative element is the presence of an active effort to trap and remove otters from the area. While human interference in the ecosystem is a major concern, the natural salmon predators cannot be ignored. The otter pests in the South Cow are a significant problem, and if we are going to great lengths to create fish habitat, part of our job as stewards is to protect the fish. Management of these pests will be attempted to the extent permitted as they directly interfere with resident and spawning anadromous fish.

### **Benefits to the Community:**

- Fish in the rivers are enhanced
- Green hydropower is saved
- Money is provided for maintenance from the hydropower

In summary, these features of this alternative greatly increase the fertility of the area for fish. The facilities provide extensive spawning and juvenile habitat creation, and increase flow in the bypass of the South Cow for in-stream migrants. More importantly, with the FERC-supervised mandate the hydropower becomes a source of permanent funding and manpower to manage these facilities. With the close cooperation of the community and the Ditch users/water rights holders this alterative has the possibility of increasing the fish production in the area far beyond what is otherwise possible.