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Mr. Ben Swann, R. G., C. Hg.
Camp Dresser & McKee Inc.
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Sacramento, CA 95833

Ms. Tanya Sommer
Bureau of Reclamation
2800 Cottage Way, MP-152
Sacramento, CA 95825

Ms. Caitlin Bean
CA Department of Fish and Game
601 Locust Street
Redding, CA 96001

RE: Scoping input on the Klamath Settlement Environmental Impact Statement/Environmental Impact Report (EIR/EIS) Process

Dear Mr. Swann, Ms. Sommer and Ms. Bean:

I am a rancher and landowner in Siskiyou County and retired professor of agronomy and range science, University of California, Berkeley (1973-78) and Davis (1978-98). My Ph.D. is in Range Systems Ecology from Colorado State University (1970-73) and included study of dynamic simulation modeling, optimization modeling and statistical analysis methodologies. I taught systems modeling at UC Berkeley (1973-78), and built conifer forest succession/fire models and annual grassland ecosystem models through 1985. I taught quantitative ecology graduate courses at UC Davis with emphasis on vegetation sampling design and field methods, and a senior course in ranch resource planning using optimization modeling decision making applications.

I have been involved in various tasks related to the Klamath Basin Watershed including Coordinated Resource Management Planning (CRMP) beginning attendance in 1991, Intergovernmental Personnel Agreement (IPA) resource specialist with USDA Klamath National Forest (1992-1998), North Coast Regional Water Quality Control—Total Maximum Daily Load (TMDL)—Scott River Technical Advisory Committee (2.5 years), and Siskiyou County representative on Klamath Basin Fisheries Task Force—Technical Workgroup (1 year).

On or about August 25, 2009, in a conversation with California Department of Water Resources, I learned that flows in the Trinity River had been ramped up to over 2,200 cfs, and that the parties involved are likely to kill more salmon when the flow is ramped down. Historical summer and fall base flows prior to Trinity River dams construction was about 125 cfs. Since construction base flows have been maintained at approximately

450 cfs, so why does the Hoopa Boat Dance Event require over 2,000 cfs? Apparently boats hung up on rocks in the 2007 event, so flows in 2009 were ramped up over 2,000 cfs to alleviate problems during the event. I was told that ramping up brings salmon up the Klamath River prematurely and they 'keg-up' in the lower Shasta River. Then the River Keepers call the watermaster and attempt to get him to shut irrigation down in Shasta Valley before the normal end of irrigation season at the end of September. For the health of the salmon it is preferable for fish to delay migration until mid-October when water cools and algae concentration declines. This repeated request by environmentalists doesn't achieve any more water to increase flows, but a lot of negative spin about agriculture in the press is gained and agencies don't educate the public except to say the fish are not in any danger (which I don't agree).

Pulse flows in late August are a serious disturbance to Chinook salmon populations. Falsely triggering Chinook to migrate from the estuary in late August subjects them to abnormally warm environments. The flows in the Klamath River already allow salmon to migrate earlier than pre-dam construction since storage and power generation needs extend flows longer into summer. We don't need to further disturb them and put them at further risk of disease by triggering them to migrate even earlier in summer just so a bunch of environmentalists can harass law abiding agriculturalists and generate spin. As I have been researching a wide range of issues, mostly scientific in nature, I get offered other disturbing information such as methamphetamine dumping off a bridge in the lower Klamath River caused the catastrophic die-off of salmon in 2002, not lack of flow nor dissolved oxygen deficits.

Landowners in the Klamath River basin sense the agencies feel an underlying urgency to have a quick decision concerning dams' removal before the current Democratic administration leaves office, and even an executive order might be employed if necessary. The Cascade-Siskiyou National Monument immediately north of the Klamath River and east of Interstate 5 had livestock grazing eliminated through an executive order process, and there is a proposal to do the same for a second monument extending west of Interstate 5 down river as far as Happy Camp. Land use decisions in this part of California and southern Oregon have 'progressed' to the point that Presidential Executive Order pressure rather than reasoned science is the mode of operation. The KBRA and KHSA process is a means to the same end.

I have comments and suggestions related to scoping on the following topics:

Klamath River flows and flow modeling

Fish diseases—statistical analysis and presentation of findings

Water quality relationships and dam removal

Implications of past coho salmon management by California Department of Fish and Game

Klamath River flows and flow modeling

The National Research Council's (NRC 2008) review and recommendations are invaluable, especially the perceptions they provide on the management and land use conundrum landowners in the Klamath River basin face today. (see **National Research Council. 2008. Hydrology, Ecology, and Fishes of the Klamath River Basin, National Academic Press, Washington, D.C., 249 pp**. Critical limitations of the natural and instream flow and modeling studies due to the overly-long monthly time steps of the models (page 215-218), and non-biophysical nor process-based, mechanistic model structures show lack of preparedness to use those models in making decisions concerning dam removal, and I quote from NRC (2008) exactly:

> " • The products of the Natural Flow Study, flow values for the Klamath River at the Iron Gate Dam site, were calculated as monthly values. However, ecological applications of the model require daily values (as discussed in more detail below in the section on the Instream Flow Study). As a result, the output of the Natural Flow Study would not have satisfied its ultimate use requirements even if the study had been executed without other errors.
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> • The basic approach used by USBR researchers to estimate the flows of the river without the upstream influence of dams and withdrawals relied on a "black box" method of accounting for flow using a standard spreadsheet as the foundation. While such an approach allowed ready calculations and simplicity of output, the approach is not supported by a general understanding of physical processes that influence river flows...
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> • Calculations of the fate of water in the upper basin related to evapotranspiration were not done according to the best current methods...
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> • The USBR (2005) Natural Flow Study attempted to calculate flows at Iron Gate Dam without addressing several important controlling factors for those flows. Groundwater plays a critical role in the hydrologic cycle of the upper Klamath River basin...After the introduction of agriculture, groundwater pumping and marsh drainage for fields and pastures became common, so the entire groundwater-surface-water connection was altered. Present groundwater-surface-water interactions therefore are highly unlikely to be similar to the connections that previously influenced natural flows. The Natural Flow Study did not adequately take into account the role of groundwater in the system.
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> • More generally, the Natural Flow Study did not address the issue of changes in land use and land cover. While the study did account for marsh conversions to agriculture, there are other important land-use changes that the study did not assess. For example, the study did not assess logging for lumber and forest clearing for agriculture, but these

changes in the upper Klamath River basin are potentially important in influencing downstream flows. Such land-use and land-cover changes also are important along the main stem of the lower Klamath River on tributary streams, because logging activities on steep slopes of the region are likely to increase sediment inputs to the main stem. Remotely sensed data regarding land-use and land-cover change are available and can be analyzed using geographic information systems. Inclusion of land-use and land-cover analyses in the Natural Flow Study would have increased confidence in the resulting calculations, because, if such changes are important, they would reflect their influence in the model output. If the changes are unimportant, that outcome could be convincingly demonstrated.

- The Natural Flow Study failed to adequately model the connection between the Klamath River and Lower Klamath Lake. Under unregulated conditions, high flows in the Klamath River main-stem channel were able to overflow a shallow divide, and water coursed into the Lost River and to Lower Klamath Lake. During low-flow conditions in the Klamath River main-stem channel, flows in the main river were not deep enough to overflow the divide, and Lower Klamath Lake was essentially cut off from the main river channel. The availability of this "escape valve" probably was important in the pre-development river flow from Keno downstream. In the first decade of the twentieth century, the construction of a large levee to support a railroad effectively eliminated the original connection between the Klamath River and Lower Klamath Lake. Thereafter, high flows on the main stem of the Klamath River did not divert much water to the lake, leaving it in the main river. Even if all other things remained equal, the alteration of the Lower Klamath Lake connection would result in changed high flows at Keno and downstream. The hydrologic effects of this connection and its consequent elimination were poorly modeled with a regression function that mixed data from years before the disconnection and after it. Because those data were at monthly intervals, the model was further made unlikely to capture important dynamics of the hydrologic interaction. The inadequate and coarse-grained modeling of such potentially important interaction reduces the utility of the natural flows calculated by USBR (2005).

- The Natural Flow Study did not adhere closely enough to standard scientific and engineering practice in the areas of calibration, testing, quality assurance, and quality control. These activities are prerequisites for confidence in the model products by users, including decision makers and other modelers.

The committee concluded that the Natural Flow Study includes calculated flows that are at best first approximations to useful estimates of such flows. The present version of the Natural Flow Study is less than adequate for input to the Instream Flow Study and for day-to-day decision making regarding flows to benefit the listed and other anadromous fish species in the Klamath River downstream from Iron Gate Dam…"

One immediate concern that these critical review comments suggests is that due to the existing large levee and railroad structure between Dorris and Klamath Falls with no "escape valve", a rain-on-snow event today could result in an extreme flooding event downstream of Keno when no dams are present to ameliorate peak flood risk. With this levee and without dams, floods downstream will be more severe that during pre-settlement times when the divide could be breached. The weak modeling of flows, coupled with very poorly estimated groundwater dynamics, severely limit the applicability of the Natural Flow Study in general.

Next came the NRC Committee's review of the Instream Flow study and I, again, quote exactly from pages 218-222 in NRC (2008):

> "The Instream Flow Study (Hardy et al. 2006b) used products of the Natural Flow Study as inputs to a complex modeling project designed to connect river flows and channel characteristics with habitat suitability and fish populations…The application of two-dimensional approaches represented a willingness on the part of the investigators to engage in a highly complex and ambitious effort to deal with the hydraulic and hydrologic aspects of the problem of characterizing fish habitat…These analyses suggest some improvement in fish growth and production over current conditions, but they do not offer tools for evaluating tradeoffs between instream and out-of-stream uses of water…
>
> Despite these strengths, the committee found important shortcomings in the Instream Flow Study and its use of models and data. Two shortcomings—use of monthly data and lack of tributary analyses—are so severe that they should be addressed before decision makers use the outputs of the study. More fundamentally, the flow recommendations presented by the Instream Flow Study were not directly the result of physical-habitat modeling but rather reflect a sequence of estimations and comparisons among habitat values for various life stages derived from monthly flows and estimated monthly natural-flow values, interpolations, and a selection of the lower of either the natural monthly flow or a flow computed to provided the same amount of physical habitat as the natural flow. This series of adjustments led to flow recommendations that resembled the natural hydrograph in many aspects…
>
> The authors of the Instream Flow Study (Hardy et al. 2006a) were provided only with monthly flow values by the USBR in the Natural Flow Study, although daily flows were recognized to be more useful. Monthly flow values can be useful for general river-basin planning, but they are not adequate for ecological modeling for river habitats, because the monthly

average masks important values that may exist for only a few days or even less...The shorter-term variations in discharge can yield significant changes in stream hydraulics and temperature, both of which can have important ecological consequences. In either case, the very existence of critically important flow variations is masked by monthly averages, a fatal flaw. In short, planners may operate water systems on a monthly basis, but fish survive on a daily basis.

...Since only the main stem of the Klamath River was subject to analysis, stakeholders with interests in tributary locations would not have to deal directly with the study. However, the river is a highly integrated hydrologic and ecological system. Its tributaries give the river some of its essential characteristics and provide some of he most important habitats in the basin...The tributaries control the inflow of sediment and add important water to the main stem, they can provide important spawning and rearing habitats and serve as refuges for fish during some low-flow periods, and they influence water quality (sometimes positively, sometimes negatively). The Klamath River is not a confined gutter for rainwater, and therefore analyzing the river without considering its tributaries is akin to analyzing a tree by assessing only its trunk but not its branches. The previous NRC (2004a) report on the Klamath River basin also emphasized the importance of understanding the lower Klamath River tributaries and including them in restoration plans, especially for coho salmon.

The Instream Flow Study also exhibits modeling shortcomings. First, **the study did not include important water-quality attributes, such as dissolved oxygen levels, nutrient loadings, contaminants, and sediment concentrations, each of which has important implications for the vitality of the fish populations of the Klamath River basin**...(bolded for emphasis)

Second, high flows are especially important to the physical and biological processes of the Klamath River, and further analysis of their frequency, duration, and timing is essential in understanding the dynamics of the river's hydrologic, geomorphic, and ecological processes...Reliance on monthly flow data, as noted above, made analysis of high flows impossible in the scope of the study.

Third, there was a lack of a thorough assessment of the relationship between flow-data time series and the behavior of different species and life stages and the population dynamics of coho and Chinook salmon. Such an analysis for both natural (historical) and existing flows would provide valuable insights into changes in the natural regime that have been brought about by human activities. It also would point the way toward evaluating alternative management scenarios capable of creating more natural river conditions that might lead to recovery of fish populations.

Fourth, the claim that the model outcomes are accurate, as assessed by some empirical tests of fish distributions and by use of bioenergetic and the SALMOD models, impairs the utility of the Instream Flow Study's prescriptions as representing the best alternative...they do not substitute for a rigorous statistical test of model predictions against observed distributions of fish and sensitivity analysis of changes in fish growth and population productivity related to changes in flow regime.

Finally there are three shortcomings...First, the study makes the implicit assumption that the primary limiting factor for recovery of salmon is physical habitat, directly related to instream flows, but **the study does not demonstrate when or even if physical habitat is a limiting factor** in any of the life stages of the fishes of concern. The precise nature of any flow-related "bottlenecks" in the population dynamics of the salmon is not demonstrated, **so it is possible that temperature, dissolved oxygen, water quality, connectivity, disease, competition, or other factors are more critical to fish persistence than the hydraulic aspects of habitat are. In other words, suitable hydraulic-habitat conditions may be necessary but are not by themselves sufficient for fish persistence.** (bolded again for emphasis)

Second, the study used several relatively short reaches of the Klamath River for detailed analysis and testing of model output because it was impossible to map and analyze in detail the entire length of the river from Iron Gate Dam to the sea. The selection of representative reaches seems reasonable, but the study does not justify the selection of the reaches used in the study and does not indicate how representative they are of the unstudied reaches...

Third, application of the Periodic Autoregressive Moving Average (PARMA) to analyze the calculated set of flows is problematic because the data were not normalized and spatial cross-correlations were not considered...By missing these attributes, the Instream Flow Study is seriously impaired."

The NRC (2008) critique of the Instream Flow Study is the first thorough assessment of the federal government's and cooperative NGO's research on flows in the Klamath River Basin watershed. California Department of Fish and Game, through its Watershed-Wide Permitting Programs in the Shasta and Scott River sub-basins has jumped to similar conclusions that taking water from agriculture is the prime solution to producing more salmon for instream and ocean harvest.

The North Coast Regional Water Quality Control Board's TMDL studies of the Scott River, Shasta River, and Klamath River as a whole, have been relied upon for water quality assessment in the Klamath River Basin watershed. Having served for 2.5 years on the Scott River TMDL Advisory Committee, I can state first-hand that these staffs are way out of their league for doing such studies—they proposed growing 90-foot cottonwood trees along the Scott River to cool summer-time river temperatures, at the same time not accounting for increased transpirational demand. They also, similarly to the NRC (2008) account of beneficial effects of agricultural water use in the Upper Basin, covered-up their modeled findings that diversion along the Scott River at Young's dam reduced water temperatures in late summer all the way to the mouth of the river. They hid the finding that cold water accretion from tributaries to the Scott River is overwhelmed by warm main-stem Scott River flows in summer thereby reducing cold water refugia without diversion. We severely need an independent science review and management mechanism as NRC (2008) proposes (item #2 below) of water quality, sediment toxicity and sediment chemical activity prior to Secretarial Determination for dam removal.

The last two pages of NRC (2008; pages 224-225) are enlightening, and I quote exactly,

> "CONNECTING SCIENCE WITH DECISION MAKING
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> Connecting effective science with successful decision making for delivering water to users, sustaining downstream fisheries, and protecting the populations of protected species have been problematic in the Klamath River basin. The Natural Flow Study (USBR 2005) and the Instream Flow Study (Hardy et al. 2006a) are not likely to contribute effectively to sound decision making until political and scientific arrangements in the Klamath River basin that permit more cooperative and functional decision making can be developed. The employment of sound science will require the following elements:
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> 1. A formal science plan for the Klamath River basin that defines research activities and the interconnections among them, along with how they relate to management and policy.
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> 2. An independent science review and management mechanism that is isolated from direct political and economic influence and that includes a lead scientist or senior scientist position occupied by an authoritative voice for research.
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> 3. A whole-basin viewpoint that includes both the upper and lower Klamath River basins with their tributary streams.
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> 4. A data and analysis process that is transparent and that provides all parties with complete and equal access to information, perhaps through an independent science advisory group.

5. An adaptive management approach whereby decisions are played in water management with modeling efforts capable of evaluating alternative flow-management schemes and with monitoring and constant assessment, including assessment of any management actions taken and with occasional informed adjustments in management strategies.

The committee recommends that the researchers, decision makers, and stakeholders in the Klamath River basin evaluate the DOI-approved implementation plan for the Trinity River Implementation Program and emulate their counterparts in the Trinity River basin in attempting to connect scientific efforts and decision making and that the two units coordinate their research and management for the greater good of the entire river system."

I request that the team preparing the Klamath Settlement Environmental Impact Statement/Environmental Impact Report (EIR/EIS) complete the task of getting the work done as outlined by NRC (2008) as stated above prior to trying to meet NEPA/CEQA requirements. Doing this NEPA/CEQA document at this time is clearly premature since the models concerning flows and nutrient dynamics are largely insufficient or absent and unavailable.

Our newly formed 501, c4, Siskiyou County Water Users Association has prepared to file suit because of lack of transparency in the analysis process (item 4 above). A subset of agriculturalists in the Upper Klamath Basin was part of the Klamath Basin Restoration Agreement (KBRA), and many today are not pleased with the follow-up treatment they are receiving—very limited water and unacceptable trends in governmental regulatory behavior. Exceedingly low power rates and water enticed them to agree, and the rest of us using PacifiCorp power are paying higher rates to account for the lower rates for agriculturalists in the KBRA. We are also paying an additional monthly fee to develop a dam removal fund. Scott and Shasta Valley tributary agriculturalists were so suspicious of the process early on that they elected to not be a part of the process.

One can easily see now that Shasta and Scott River tributary water will be sought in the future to augment low summer and fall flows once the PacifiCorp' dams are removed and storage flexibility is gone without dams. The Federal regulatory agencies were so constraining on PacifiCorp operations during the FERC re-licensing process that taking the dams out appeared to them to be the only option—therefore they agreed with the Klamath Hydroelectric Settlement Agreement (KHSA). The ultimate problem with dam removal for agriculture in Siskiyou County is that power rates will increase significantly, making hay production uneconomical. There is also a matter of a 60,000 acre-foot water right held by Siskiyou County. Hay and cattle production are the primary, by far, elements of the economy of Siskiyou County now that timber management has all but been shut down. The NGO's feel the primary economy of the future is government funded restoration of the Klamath River, and the KBRA is the outlined arrangement for payments.

On a related and current issue, the California Department of Fish and Game has instituted the Scott and Shasta Rivers Watershed-Wide Permitting Programs in conjunction with Resource Conservation districts in the Shasta and Scott River valleys. Likewise, the regulatory controls these programs are trying to institute are unprecedented. The Scott Valley, Protect our Water (POW) chapter of the newly formed Siskiyou County Water Users Association and others are resisting through civil disobedience. Much detail on these matters can be viewed at a website: pienpolitics.com. Landowners are getting organized, albeit belatedly!

From an academic perspective, the situation Siskiyou County and neighboring counties in California and Oregon are facing, along with the insights in **National Research Council. 2008. Hydrology, Ecology, and Fishes of the Klamath River Basin, National Academic Press, Washington, D.C., 249 pp.**, provide an outstanding case study in government-mandated land use planning. Sadly, broke state and federal governments may be the only salvation! An unbiased water quality and related fish disease study would go a long way to getting at likely limiting factors to greater Klamath River Basin ecosystem health.

Fish diseases—statistical analysis and presentation of findings

After analyzing the growing fish parasite disease situation from below Iron Gate Dam to above the Scott River confluence, it appears to some of us that phosphorus pollution from Upper Klamath Lake and downstream including fine particulate phosphorus held behind dams continues to promote colonization of single-celled though rooted-aquatic-plant-life forms and habitat for polychaete worm vectors for fish parasites. The Klamath River biota appear able to scrub the phosphorus loads such that worm colonization does not exist downstream from the Scott River. The primary nitrogen source for these aquatic plants during summer comes from blue green algae nitrogen fixation coupled with ammonia input from the Upper Basin. Without the dilution benefit of reservoirs, highly concentrated phosphorus and ammonia-N will progress much further down river especially if the high-phosphorus laden sediments behind the dams are flushed down river. There has been no proposal to remove the 21 million cubic yards of sediment behind the dams from the river during dam removal, just flushing the material downstream—this is idiotic without sufficient prior analysis. There is a large study proceeding concerning these sediments according to research leader Dr. Dennis Lynch (USGS), but it would sure make many of us more comfortable if the National Research Council were involved in this work as well. Circulation of the study topics and investigators names and credentials would go a long way to heading off last minute problems later in the process.

In addition to the points raised in a previous paper I prepared for the Siskiyou County Board of Supervisor (see somewhat revised version in next section), I have been suspicious that wetland development on the California Department of Fish and Game's Shasta Valley Wildlife Area may be a more local and recent source of nutrient pollution to the Shasta River and Klamath River downstream. Beginning in the early 1990's a large ranch was purchased by CDFG and the manager has gone about developing and actively managing 300-acres of shallow wetlands and lakes on formerly irrigated pastureland. The parent material in this area is very likely similar to the phosphorus laden organic-rich soils of the Upper Klamath Basin. The shallow lake bottoms are disked every three-to-four years, raising a grain crop to maximize wetland values for waterfowl. If necessary the lakes are drained in spring to allow grain production for waterfowl. Drainage water is made available to neighboring ranchers or re-stored in other Wildlife Area reservoirs. Tail water from these wetlands/ephemeral lakes is used by neighboring ranchers for irrigation, formerly without sufficient tail-water control best management practices. This may have been a new source of fine particulate phosphorus in the Klamath River downstream from the confluence with the Shasta River where the highest incidence of escaping salmonids indicate infection (65-100%) by parasites, ich, swelled bellies, and impaired swimming ability. Flood conditions in 1997, 2003 and 2006 could have flushed large quantities of organic phosphorus into the Little Shasta River which feeds the Shasta River to the Klamath River. The timing of the precipitous decline in steelhead returns to Iron Gate Hatchery is since this wetland development and management program began on the Shasta Valley Wildlife Area.

Screw trap monitoring and fish disease incidence information has been gathered for many years, yet the reports are obtuse and too diffuse to reach any conclusions of use to management decision making. I suggest as a major scoping recommendation, that all the federal, state and NGO-collected fish disease incidence data be collated, analyzed statistically and a concise report be prepared using the following standard sections for the paper (abstract of 1-3 paragraphs), introduction citing all relevant and related published studies, methods, results, discussion, implications, literature cited—limit paper to 7 tables and 7 figures total) with the caveat that statistics be used as they were designed to be used—reduce the data into measures of central tendency (means, medians or modes as appropriate) with confidence intervals (standard deviations or standard errors) and testing of stated hypotheses where appropriate.

Water quality relationships and dams' removal

Hetrick et al. (2010) prepared an outstanding report on the benefits of dam removal from many perspectives. But they did not evaluate the most critical factor of all—millions of years accumulation of naturally occurring organic phosphorus and nitrogen. The phosphorus and nitrogen dynamics in the Klamath River Watershed pose a high risk to successful restoration of the Klamath River. Now that I have looked into the matter in some detail including the Klamath River status prior to 1918, I think the use of the word restoration of the Klamath River Watershed is a misnomer. For millennia nature produced high phosphorus and nitrogen sediments and water in the Klamath River. Early farming practices exacerbated the situation. The Klamath Project fixed some of the problems and made others worse. Yes, organic wetland soil disturbance during the Klamath Project further mobilized fine phosphorus sediments, the mobilization of fine sediments continues today, millions of cubic yards of these materials exist today behind the hydro dams on the Klamath River, and man will live with the consequences forever. Things can be done to reduce drainage pollution from agriculture in the Tulelake

Irrigation District as discussed by Danosky and Kaffka (2002), but the relative magnitude of this phosphorus and nitrogen source is miniscule in comparison to the larger upper Klamath Basin source.

From January 1999 to October 2001, Danosky and Kaffka (2002) collected and analyzed subsurface tile drain and surface water quality samples throughout the Tulelake Irrigation District and surrounding locations in California and Oregon within the Klamath Project area. Their report summarized earlier studies documenting the biogeochemistry of the Upper Klamath Basin. Organic soils developed over geologic time beneath the region's shallow wetlands under anaerobic conditions. Wetland-adapted plants with their ability to transport oxygen to their roots below the water line, coupled with high nutrient levels in water and soil promoted exceedingly high biomass productivity and high organic matter development in soils. It is the anaerobic condition that allowed exceptionally high quantities of organic deposits to develop because oxygen was largely unavailable under water and therefore natural decomposition rates for belowground roots and dead plant shoots under water were exceedingly slow for millions of years. Parent material in the area is naturally high in apatite minerals containing phosphorus which promoted high productivity in natural wetlands and soils for millennia. Post-settlement drainage and cultivation released large amounts of organically bound nutrients as fine sediments when first exposed to air through decomposition processes, enriching sediments in the region's lakes and streams as well as behind hydropower dams and below (Snyder and Morace 1997).

Professor Hans Jenny at UC Berkeley developed the 'state-factor' equation to explain contributing factors to soil formation:

Soil = *function* (climate, organisms, relief, parent material, and time)

In the Upper Klamath Basin, Meiss Lake area of Butte Valley, and sub-basin areas of Shasta Valley, dry semi-desert climates, anaerobic bacteria and waterfowl, basin relief with restricted drainage if drained at all, high phosphorus-laden parent materials, and time, respectively, over millions of years have developed rich wetland soils loaded with organic phosphorus and organic nitrogen in huge quantities per acre over very large areas of these landscapes. Cultivation exposed these organic materials to the air leading to decomposition and mobilization of fine particulate, highly chemically active phosphorus and nitrogen. These two elements are the prime driving forces for all plant growth on earth, from single celled algae, to aquatic multi-celled higher plants, to all terrestrial plants. Waterfowl enhancement efforts by fish and wildlife agencies have worked hard to enhance bird populations throughout America, but unfortunately in these three areas of the Klamath River Watershed, waterfowl enhancement has contributed to the phosphorus and nitrogen problems in the watershed as a whole.

Waterfowl transport large quantities of phosphorus and nitrogen from the surrounding irrigated and wet meadow landscapes while they feed daily on these lands and then fly and land on Klamath River Watershed wetlands (Klamath Basin refuges, Meiss Lake, and Shasta Valley Wildlife Area) and defecate very mobile phosphorus and nitrogen laden waste (Manny et al. 1994, Olson et al. 2005, Portnoy 1990, Post et al. 1998, Scherer et al. 1995). Unlike mammals, birds defecate their urea (nitrogen) and solid waste (phosphorus) in a mixed-slurry which provides plants with the optimum, 'hot' fertilizer, in a single package. This mixture maximizes the 'fertilizer effect' response in plants because both nutrients are delivered together in available forms so uptake is optimized for plant growth. Water quality in waterfowl habitat where lakes or reservoirs are used is exceptionally polluted with phosphorus and nitrogen, with residency times for phosphorus approaching 10 years.

This is a spreading problem today in my judgment as fine sediments are disturbed and mobilized then deposited downstream. Fine sediments have high surface area and high chemical activity which continually releases phosphorus within lakes and streams. Stream flow from Upper Klamath Lake, drainage water from the Klamath Project, pumped water from Meiss Lake following wet winters, and stream flow leaving Shasta Valley Wildlife Area, continually add solution and fine sediment phosphorus and nitrogen to the Klamath River. The solution component supports abundant populations of blue-green algae which fixes nitrogen from the air causing a positive-feedback-loop, i.e., more nitrogen leads to more blue-green algae which leads to more nitrogen fixation, etc., etc. Other aquatic plant species with rooted growth habit have and are presently spreading populations of colonizing-gravel-bed-aquatic plants which serve as hosts to polychaete worms that serve as intermediate hosts to two or more parasite species causing salmon and steelhead mortality (see above section on fish diseases).

Returns of steelhead to Iron Gate Hatchery in 2009-10 have been meager at best which certainly is due to spreading disease exposure below Iron Gate Dam caused by very high residualization behavior (Wright 2009) of steelhead (delayed migration to the ocean until age three). Coho are next most affected, likely because of their life cycle of living in freshwater for a year longer than Chinook. Additionally, the Iron Gate Hatchery goal of raising abnormally older-age Chinook and steelhead further exposes them to disease prior to release.

Systems ecology theory states that 'lag-effects' often lead to instability of ecosystems. This may be a classic lag-effect of post-gold rush farming practices mobilizing nutrient-rich sediments in such large quantities and of such high mobility that it has taken until 2009-10 to cause steelhead to become threatened (hatchery-mitigation-program-limited) below Iron Gate Dam. The presence of hydro and diversion dams below the Upper Klamath Basin has certainly trapped and reduced downstream impacts of fine particulate sediments. Recent droughts certainly have a role as well since the flushing benefits of higher flows below Iron Gate Dam have not occurred in recent years. So, as fine particulate phosphorus sediments move downstream, further disease exposure will occur as more polychaete worm habitat develops. Record steelhead and high coho salmon runs today on the Trinity River with its clean mountain watershed serves as a local stark comparison of steelhead and coho salmon population dynamics returning to Iron Gate Hatchery. Shasta Valley soils and wetlands share many of the conditions as in the Upper Basin and therefore coho salmon populations in Shasta Valley are more limited than those in tributaries without high phosphorus soils and organic rich wetlands such as Scott Valley.

Danosky and Kaffka (2002) paint a bleak picture as far as a solution is concerned. While lower phosphorus containing fertilizer should be used in potato and onion production in the Tulelake Irrigation District, irrigation water coming into the District contains 5-25 times more phosphorus than is considered a problem in freshwater systems (Grobbelaar and House 1995; Correll 1998). Input surface waters, fine particulate-high phosphorus sediments, and phosphorus-rich soils are the most important sources of phosphorus in the Klamath Basin. Amounts of phosphorus and nitrogen are not likely to change, even if farming activities are modified or curtailed in the Klamath Basin (Danosky and Kaffka 2002).

Prescribed farming/ranching practices in the Klamath River Watershed to maximize export of phosphorus in grains (naturally high in phosphorus) could be used to lower the content of phosphorus over time on sites with phosphorus rich soils. Likewise, grazing of steers and heifers on irrigated pastures where appropriate would export phosphorus in bone as these animals grow from 450 lbs to 800 lbs over summer taking with them phosphorus out of the watershed. Drain water recycling and use by irrigated agriculture according to Danosky and Kaffka (2002) make more sense to solving the problem than a TMDL approach where irrational, unachievable loads are set which have no chance of ever being met. Phosphorus and nitrogen containing drainage water is a resource which agriculture can use in crop production. A tail water ordinance could be used to assure that drainage water gets used rather than drained into the Klamath River.

In all three locations, Upper Basin, Butte Valley, and Shasta Valley, clean water sources exist at headwater locations, however, at the lower end of each basin or along the conduit water course, the contamination problem discussed above taints the out-flowing water severely. There is no general solution to any of these problems. Solutions have been tried in all three areas from the massive long-term Bureau of Reclamation's Klamath Project, to Meiss Lake's relatively small-scale pumping plant development to flush nutrient-rich water and sediments into the Klamath River, to recent efforts to take away private water rights for the Little Shasta River and wash out tainted sediments forever from the Shasta Valley Wildlife Area. This would further impair both the lower Shasta River but also the Klamath River itself by providing a nearer source of fine phosphorus sediment causing deposition even further down river below the Shasta River confluence than at present.

The massive acreage of phosphorus laden organic soils in the Upper Basin, Butte Valley, and Shasta Valley is a severe geographic (size/area) limitation, and nature will cause continual drainage and fine sediment transport forever. Naïve regulators have imposed irrational TMDL standards (Danosky and Kaffka 2002), fish biologists are seeking to take away irrigation water to increase flows through the Shasta Valley Wildlife Area, with little or no positive results expected due to nature's volcanic deposits of parent material in these basin-and-range landscapes of the Upper Klamath Basin, Butte Valley and Shasta Valley. It is the nature of basins to accumulate salts and organic phosphorus and nitrogen on certain volcanic parent materials that are periodically wetted. Since these areas are true basins and they occur in locations with periodic, relative high precipitation or incur periodic runoff events, they have supported exceptionally high productivity wetlands—and it is these wetlands and their productivity of nutrient-rich organic deposits and soils that are the basis of the 'problem at hand'. It is not a problem from nature's perspective—it is natural and historical records tell us that. The Klamath River below Keno was a cesspool many summers and falls prior to dam construction along the Klamath River. Older folks living along the Klamath River prior to dam construction know of the poor conditions which existed prior to dam construction. There is nothing different to be expected now if the dams are removed.

Narrow analysis of the problem is unacceptable. Ignoring history is inexcusable!

Hopefully the USGS assessment led by Dr. Lynch will include soil science and nutrient cycling expertise before making a critically flawed recommendation to remove the Klamath River dams. Area soil scientist Jim Komar, NRCS Red Bluff, recommended to me many months ago to forgo this research effort of mine, since according to Jim "the dams are going and soil science is out of vogue". I don't know whether Jim Komar as well as Jim Patterson (NRCS District Conservationist, Yreka) have been given marching orders from Secretary of Agriculture Tom Vilsack or not, but I would not be surprised these days.

As a major scoping recommendation, I recommend that a scientifically-rigorous GIS-referenced, area-based assessment be made of the soils/wetlands in the three areas: Upper Klamath Basin, Meiss Lake area of Butte Valley, Shasta Valley Wildlife Area (and add to that the Grenada area with similar soil types as that for Shasta Valley Wildlife Area), using a water and nutrient mass balance approach, modeling wet, average and dry year scenarios to determine phosphorus and nitrogen content of outflows expected from all three basins including fine-sediment deposition impact analysis.

Very detailed assessment must be accomplished on sediment deposits behind the dams prior to making a determination concerning dam removal. The volume of deposits of fine phosphorus sediments behind the Klamath River dams could put the fine fisheries of Scott River, Salmon River and Trinity River at risk from colonizing polychaete worms all the way to the mouth of the Klamath River. I for one would not like to give up outstanding steelhead fishing from Johnson's Bar to Bluff Creek, today one of the blue-ribbon steelhead fisheries of the world!

Having served for years on the Klamath Bird Observatory, Board of Directors, and visited Upper Klamath Lake with Executive Director John Alexander and Research Director Dr. C.J. Ralph at his cabin on the lake, I understand the value of the created wetlands around Upper Klamath Lake for bird habitat. However, in this setting the attraction of large populations of waterfowl to this landscape is, in part, its undoing. I suspect that the Fish and Wildlife Service, Yreka Office personnel have not analyzed the problems caused by landscape nutrient transfers to the Klamath Basin wetlands by resident and migratory waterfowl. The published literature on this subject is voluminous and enlightening. The short-nosed sucker fish biological opinion was used as an excuse to keep the Link Dam in place and maintain water levels where artificial wetlands were planted in the past. The attracted waterfowl now contribute to the phosphorus pollution problem in the area.

The relative isolation of the Klamath River Watershed allows regulators nearly *carte blanche* influence to filter the information used to justify a program they already have decided is a good thing. This is unprofessionalism at its highest and will be very disappointing to the public and Native Americans in the future when a cesspool river situation occurs much of the time following dam removal.

Retired Iron Gate Dam hatchery employees who can speak openly worry as I do that without the dams, a four-year drought could essentially wipe out the salmonid genetics in the upper Klamath River below Iron Gate Dam and above. The study by Danosky and Kaffka (2002) and their nutrient/water balance calculations indicate the concentrations of nitrogen and phosphorus from mobilized fine sediments and natural drainage in dry years, coupled with lack of adequate dilution effects during low summer and fall flows without the dams, will lead to a worse cesspool condition than the historians wrote about prior to the first dam construction in 1918.

Phosphorus Submodel flow diagram (see explanation below)

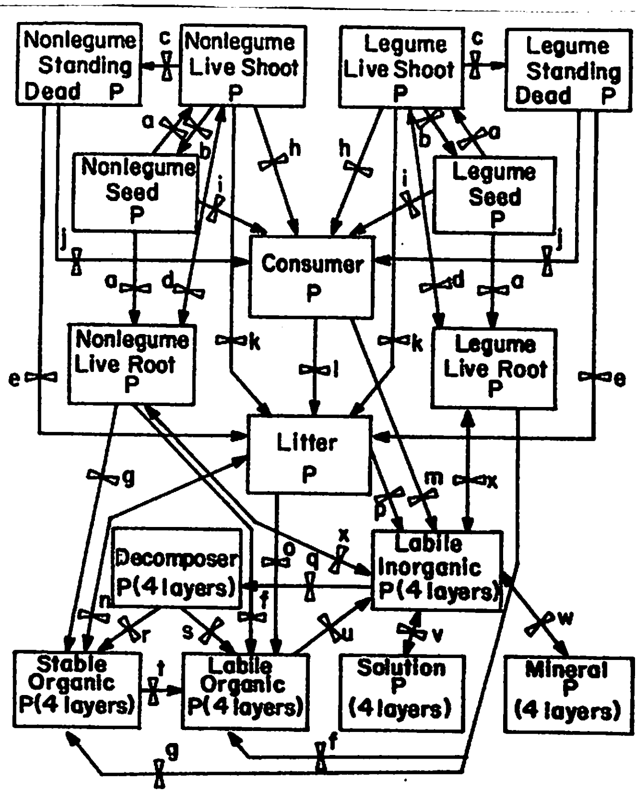

Fig. 9. Flow diagram of phosphorus flows in the phosphorus submodel (modified from Cole, Innis, and Stewart, 1977).

Footnote concerning integration of flow and nutrient modeling: (see phosphorus model above) I second the NRC (2008) criticism of the monthly time step limitations of both the Natural Flow Study and Instream Flow Study models being used by the federal regulatory agencies involved in the Klamath River Basin. Time step must be appropriate to the modeling task.

As a follow-up to the daily-time-step short-grass prairie model developed during the US/IBP Grassland Biome Program (Innis 1978) at Fort Collins while I was a student there in the early 1970's, we developed the Annual Grassland Ecosystem Model for California annual grasslands (Pendleton et al. 1983). C. Vern Cole's expertise in phosphorus dynamics (Cole et al. 1977; Cole and Olsen 1959a, 1959b) was critical in our modeling of nonlegume and legume live shoot and standing dead P, seed P, and live root P, consumer P, litter P, and 4-layer decomposer P, soil labile inorganic P, stable organic P, labile organic P, solution-P, and mineral-P.

A problem arose in our effort to describe the rapid transformation of some forms of phosphorus given the daily time step of our model. The solution pool is replenished from the labile pool many times daily. Daily root uptake from solution under optimal conditions may be 50 times the amount of phosphorus in solution in grassland soils. The problem was dealt with in the model by allowing uptake by plant roots and decomposers to come directly from the pool of labile inorganic phosphorus—a similar technique could be used in the Klamath River situation. Flow rates per unit weight of root or decomposer biomass are a function of solution phosphorus concentration, labile inorganic phosphorus, and effect of soil temperature and water (Cole et al. 1977).

Existing monthly-time-step water flow models will never be adaptable to modeling phosphorus dynamics in the Klamath River Basin watershed since the water chemistry involved is a faster dynamic, therefore shorter time-step models will be necessary for scientists to make sound recommendations to decision makers concerning dam removal, flow management, agricultural land use, etc. in order to reduce nutrient inputs to the Klamath River. Klamath River single-to-multi-celled floating algae, algal scums and crustal algal forms, nitrogen-fixing blue-green algae, floating and anchored macrophytes, and other plants scrub solution phosphorus as it travels downstream. Controlling inputs is critical to managing phosphorus in the biota of the Klamath River Basin since nature built unlimited stores of phosphorus in the Upper Klamath Basin, Butte Valley and Shasta Valley—this situation presents tremendous challenges of very high phosphorus parent materials that likely cannot be overcome. Underestimating the problem followed by dam removal could lead to tremendous damage to a relatively healthy lower Klamath River ecosystem. The decision to remove dams without sound scientific analysis could be catastrophic to the fisheries of the Klamath River. Dynamic simulation modeling is the only tool available to integrate the complexity necessary to explain the dynamics involved. Those models have not yet been built, and those that have are insufficient since water is the medium of transfer and therefore modeling flows on a shorter time step is crucial (NRC 2008).

Implications of past coho salmon management by California Department of Fish and Game

From 1962-2003 all coho salmon entering Iron Gate Hatchery were harvested, some for their eggs or sperm, some for charity. With the listing under the Endangered Species Act in 1997 and through 2003, California Department of Fish and Game ignored the Federal listing and continued with policy as usual, harvesting of all wild reared unmarked coho salmon entering Iron Gate Hatchery as well as all returning reared coho. Having watched the coho listing process develop from 1991 to date, I as a citizen and scientist resent this practice of our Fish and Game agency, not disclosing the work of Ogawa and Therry (2006) to us as affected landowners in Siskiyou County even during the final listing process in 2005 and since that time. Following the Ogawa and Therry (2006) study in fall 2004 at least they changed policy and only harvested 5 male and 5 female wild reared unmarked coho each year since 2004.

Having been threatened with jail time and fines this spring if we did not sign up for the CDFG Incidental Take Permitting Program, and learning that we already have ITP coverage by the Legislative, the lack of disclosure of the law or actions by California Department of Fish and Game continues.

Following the field research by Ogawa and Therry (2006) in the fall of 2004, the results of movement and spawning activity were not disclosed or used in the state listing process under the California Endangered Species Act in 2005.

Table 1 shows the projected distribution of coho salmon returns to tributaries forgone due to harvest of wild reared unmarked coho from 1997-2003.

I request that the results of Ogawa and Therry (2006) be used to model projected additional coho salmon tributary and main stem Klamath River population returns we would have expected from 2004 through 2010 had California Department of Fish and Game followed the law of the Federal Government of the United States of America and released all wild reared unmarked coho salmon from 1997 through 2003. I would like all parameters of the model fully described with confidence intervals on parameters and sensitivity analysis of the modeled results to each parameter. The relative importance of reproductive rates, limiting factors including differential disease incidence by main stem or tributary, spawning habitat limitations, ocean, Native American , and sport-fishing harvest rate parameters, juvenile predation, predation rates by marine mammals, etc. must be included with best estimates where little or no data exist. I request that the data used to estimate reproduction rates, escapement rates, ocean survival rates, harvest rates, etc. be summarized with literature citations for all related studies used to parameterize and test the model.

Once the model is developed I would like to see a comparison of modeled populations of coho compared to actual returns by tributary and to Iron Gate Hatchery. This exercise will allow use of all the past monitoring data gathered by fish management agencies and the development of a dynamic simulation model to fully describe agency best estimates on limiting factors to coho salmon population dynamics with explanatory variables to illustrate for the first time the best estimates of causal mechanisms affecting coho salmon abundance in the Klamath River Watershed.

Table 1. Relocation distribution of unmarked coho salmon released back in the Klamath River at Iron Gate Hatchery and tracked from October 28 through December 22, 2004 (from Ogawa and Therry 2006).

Sex	Mainstem	Bogus Creek	Cottonwood Creek	Shasta River	Beaver Creek	Horse Creek	Scott River	Total
Male	6	6	0	3	1	1	2	19
Female	11	2	3	1	2	1	1	21
Totals	17	8	3	4	3	2	3	40
		Summary: 23 out of 40, 10 females and 13 males, or 58% of 40 fish released back to the Klamath River went up tributaries						

Projected Number of Mainstem Klamath River and Tributary Unmarked Coho Salmon Returns Foregone due to Iron Gate Hatchery Harvest Policy

Return Year	Total # Unmarked	Mainstem	Bogus Creek	Cottonwood Creek	Shasta River	Beaver Creek	Horse Creek	Scott River
1997	**165**	**70**	**33**	**12**	**17**	**12**	**8**	**12**
1998	**289**	**123**	**58**	**22**	**29**	**22**	**14**	**22**
1999	**15**	**6**	**3**	**1**	**2**	**1**	**1**	**1**
2000	**262**	**111**	**52**	**20**	**26**	**20**	**13**	**20**
2001	**246**	**105**	**49**	**18**	**25**	**18**	**12**	**18**
2002	**225**	**96**	**45**	**17**	**23**	**17**	**11**	**17**
2003	**589**	**250**	**118**	**44**	**59**	**44**	**29**	**44**
Total	**1791**	**761**	**358**	**134**	**179**	**134**	**90**	**134**
2004*	424	176	83	31	41	31	21	31

* All but 10 of these unmarked coho salmon were returned to the Klamath River, 40 of them were fitted with telemetry devices and tracked as shown above. Ten were harvested for propagation at Iron Gate Hatchery.

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Sincerely,

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Rancher and Professor--retired