TO: Steve Knell
CC: Peter Rietkerk and Jarom Zimmerman
FROM: Doug Demko and Andrea Fuller
DATE: July 10, 2020
SUBJECT: **Prioritization and selective reduction of fishery activities under constrained budget**

This memo is provided in response to your June 25 memo requesting an evaluation of the Districts fishery research and monitoring activities going forward in light of expected decreases in revenue from power generation. Two questions were posed:

1. What are the value added fishery activities the Districts can and should continue under a severely constrained budget and why?
2. What are your thoughts on why the Districts should continue with the Native Fish Plan as opposed to wrapping up the program this year?

As you noted, the biggest consumers of the current budget are Life-Cycle Monitoring at $550K and the Native Fish Plan at $1 million. Two additional budget items include Consulting and Publications. We have reviewed these four items with the goals of reducing the overall budget while maintaining critical program components that provide data to support the Districts in legal challenges and continue to demonstrate their commitment to science-driven management of the aquatic resources in the Stanislaus River. Below, we provide detailed answers to your questions, proposed short- and long-term annual budget modifications (Table 1), and justifications explaining these recommendations.

Table 1. Proposed revised budget for 2020 and recommended annual budgets through 2025.

	2020 Approved	2020 Revised	2021	2022	2023	2024	2025
Life-cycle monitoring	$550,000	$450,000	$200,000	$175,000	$175,000	$175,000	$175,000
Native Fish Plan	$1,000,000	$725,000	$500,000	$100,000	$100,000	$100,000	$100,000
Publications	$100,000	$150,000	$100,000	$100,000	TBD	TBD	TBD
Consulting	$100,000	$25,000	TBD	TBD	TBD	TBD	TBD
Total	$1,750,000	$1,350,000	$800,000	$375,000	$275,000	$275,000	$275,000

Life-Cycle Monitoring – The Life-Cycle Monitoring budget currently supports weir and RST monitoring, spawning surveys, and summer snorkel surveys to estimate *O. mykiss* abundance. RST and weir monitoring are the most essential activities as these provide the adult and juvenile abundance estimates required to monitor in-river productivity of salmon as it relates to managed conditions. As the Bureau of Reclamation intends to fund weir monitoring beginning in 2021 to fulfill requirements of the latest BiOp for steelhead, this will allow the critical monitoring to continue while reducing funding needed from the Districts at a cost savings of nearly 50% for the Life-Cycle Monitoring component. The budget may be further reduced by discontinuing spawning

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surveys in 2020. Given what we have learned from spawning surveys, publication of those results earlier this year, and no large-scale habitat restoration on the immediate horizon, continuing these surveys currently provides less value than other activities. At least one more year (2020) of summer snorkel surveys is recommended to inform hypotheses regarding *O. mykiss* carrying capacity. Overall, the changes proposed here would substantially reduce the life-cycle monitoring budget as reflected in Table 1. Details on each component of the Life-Cycle Monitoring program are provided below.

RST – The Stanislaus River rotary screw trap was installed by Tri-Dam in 1993. This is the second longest rotary screw trap monitoring dataset in the Central Valley, and the most thorough juvenile outmigrant dataset in all of California. This important program has provided annual estimates of juvenile abundance, gave us the first evidence of predation, and in concert with adult abundance estimates from the weir, allows us to determine instream productivity of Chinook salmon relative to environmental conditions and management actions. This is a key requirement of the stock-recruit framework to prescribe management actions and also to track responses to changes in management strategies. There is no substitute dataset or alternative means of obtaining this information, and we recommend that Tri-Dam continue this effort.

Weir – The Districts proposed the weir to count adult Chinook salmon 20 years ago, and following a collaborative pilot study with the USFWS, Tri-Dam has continued to fund annual operation since. It has probably provided one of the most important data sets on adult Chinook migration characteristics in California. The weir provides real-time information on the abundance of Chinook salmon each year, and perhaps more importantly, how fish respond to environmental conditions which could not be evaluated using carcass surveys conducted by CDFW. Further, operation of the weir has shown abundance estimates from carcass surveys to be highly inaccurate, and those surveys provide no information regarding steelhead. We believe weir monitoring will continue to provide insight into Chinook escapement and migration behavior and should be continued. The US Bureau of Reclamation recently solicited quotes to operate the weir annually between August and May to collect information on steelhead. We expect this will begin in August 2021 so there is a remaining need for the allocation already approved by Tri-Dam for fall 2020. Our budget recommendations also reflect some effort extending into early 2021 to remove the weir, and to complete data review and reporting.

RBT – The Districts began estimating the annual abundance of rainbow trout in the Stanislaus River in 2009 in response to the NMFS Biological Opinion the same year, which lacked any data regarding the population yet called for substantially higher flows to protect the species. This dataset tracked response through the drought and recent wet conditions, including the unprecedented high flows of 2017. Key findings thus far include greater than 80% reduction in the population in response to the drawdown of New Melones and the depletion of the coldwater pool. Data also demonstrate that the population was quick to rebound, since the population returned to pre-drawdown levels within a few years. We recommend continuing this survey in 2020 to test our hypothesis that there is a carrying capacity of approximately 17,000 rainbow trout regardless of flow conditions. Abundance this year reflects wet, higher flow conditions since 2017. After 2020, the need for this work should be considered on an annual basis depending on environmental conditions. Our recommended budget in Table 1 does not include this effort beginning in 2021.

Spawning Surveys – Spawning surveys have been conducted since 2007 to document the timing and geographic distribution of spawning relative to instream conditions. Prior to this work, no detailed information on spawning distribution of Chinook salmon existed in the Stanislaus River, and redd superimposition due to lack of spawning habitat was believed to be a significant limiting factor to juvenile salmon production (as evidence by abundance in the Oakdale RST). This work determined redd superimposition is occurring even under relatively low spawner abundances, and that despite widely varying flow and temperature conditions across years, the timing and distribution of spawning remained relatively constant. Findings from this research were published in a peer-reviewed journal earlier this year. Given the findings of the research and with no largescale habitat restoration efforts on the immediate horizon, continuing this work in the near term would not be expected to provide significant new findings.

Stanislaus Native Fish Plan – The Native Fish Plan study began in 2017 following the passage of the WIIN Act. Despite support from NMFS, opposition from CDFW posed a major hurdle which consumed substantial resources to obtain permits and also delayed data collection. CDFW fought hard to block the study because they know the evidence of predation impacts would be damming to their position that more flow is the one and only solution to increasing salmon abundance. The fight to block the study is a testament to their desire to protect sport fisheries of non-native predator species at the expense of native salmon and steelhead. We're finding that the problem is likely greater than we thought in the Stanislaus and the issue is attracting more attention from NMFS. Key findings thus far include: (1) the documentation of a substantial population of black bass throughout the lower Stanislaus River, which make up approximately 50% of the predator population on average, (2) a low but consistent consumption rate of juvenile Chinook salmon overwhelmingly by striped bass and black bass, and (3) consumption at a variety of flow levels, suggesting that predation occurs more frequently than expected and that simply increasing flows may not yield substantial benefits as intended by the resource agencies.

We recommend that the Districts follow through with the final year of the study in 2021. There are four major reasons for this recommendation. First, we have been able to conduct the field sampling at a lower cost than expected, and combined with modifications to the study scope, we propose a reduced budget in 2021. One example of reduced scope is dropping some elements of the study that were required by CDFW to obtain the permits. Second, the significant investment to date is expected to generate the most robust data in 2021 with more tagged fish available in the system after three seasons of tagging providing for more recaptures. Recapture of tagged fish provides better estimates of predator abundance, survival and movement, and abundance estimates are integral to calculating the number of salmon that could be consumed by predators. Third, the cumulative impacts of predation by nonnative fishes will likely remain a key limiting factor for native species recovery and sustainability into the future, therefore, we recommend the Districts consider funding to continue predation investigations at a substantially reduced scope and budget beyond 2021. To accomplish this, fewer sites and/or few sampling events could be conducted annually to estimate abundance and salmon consumption rates relative to the intensive study proposed to end next year. Obtaining this data over several years of varying environmental conditions provides information to evaluate whether there are correlations between predator abundance and river conditions or if the predator populations and predation risk are relatively

consistent regardless of water year type. Lastly, given the amount of information collected from the program, many important questions could be answered regarding predator populations in the Stanislaus River and their impacts to juvenile Chinook salmon (and other native fishes) in the form of peer-reviewed journal articles. We recommend a series of publications (described below) after the field implementation of the core project concludes.

Consulting – Expenditures from the consulting budget vary depending on real-time needs of the Districts during a given year and have included development of information in support of operating plans, responses to agency filings, field research, and participating in the Stanislaus River Forum. Consulting activities this year have been few, and less than 1% of the allocated budget has been spent through June. Given the unpredictable need for these activities, we recommend continuing to allocate funding for this task based annually on the Districts' expected need, recognizing that it would not be used if activities are not needed.

Publications – We recommend that a portion of the budget continue to be allocated for publishing results in peer-reviewed scientific journals to leverage the long-term investments made by Districts. The Districts have funded some of the longest-running monitoring programs (RST, weir, and snorkel surveys), as well as supported the Native Fish Plan, which is one of the more comprehensive studies of native and nonnative predators and their impacts to native fishes in the Central Valley. The continued pursuit of publications will be important for ongoing and future legal challenges, contribution to the knowledge base of fisheries in the Central Valley, and will demonstrate the Districts' commitment to using a scientifically based approach to improve management of the Stanislaus River.

Over the past few years, we have published multiple papers using long-term datasets funded by the Districts and have made significant progress in developing many others. Below, we provide a series of publications that are in development (nearly ready to be submitted) or are proposed. We highlight one key publication under development focusing on a stock-recruit assessment of Chinook salmon in the Stanislaus River, tentatively titled '*Use of stock-recruit relationships in management of fall-run Chinook salmon (Oncorhynchus tshawytscha) in the Stanislaus River.'* The approach was recently recommended by the Independent Scientific Advisory Panel of the Delta Stewardship Council to the State Water Resources Control Board (SWRCB) as an appropriate analytical framework to assess how recruitment is affected by various management actions and represents a more holistic approach than just a flow-based management scheme focused on a single period. The analyses use data collected by the Districts since the mid-1990s combined with a focus on environmental conditions during specific life stages of Chinook salmon (i.e., egg incubation, fry rearing) to assess how environmental conditions and management actions in the Stanislaus River affect the productivity and capacity (i.e., recruitment) of fall-run Chinook salmon using stock-recruitment models. Some preliminary work was conducted by Dr. Josh Korman and included as an example in the peer review panel's report that was submitted to the SWRCB. Given Dr. Korman's experience, recognition as an outside expert, and investment in the Stanislaus analysis to date, we recommend investing in his involvement to complete and publish this analysis. To support this and the completion of three other publications (see list of titles and descriptions below) in progress by the end of this year, we propose increasing the publications budget to $150,000 (Table 1).

We also recommend that some funding be allocated to publications in 2021-2022 to publish the findings of the Native Fish Plan. Proposed publications to be developed during 2021 and 2022 are primarily focused on presenting key findings from the intensive research conducted under the Native Fish Plan since 2018 (see list below).

Steelhead life history considerations to guide river monitoring in California's Central Valley: A new framework to inform monitoring, management, and recovery of steelhead in California's Central Valley (to be submitted late 2020)

The recent Biological Opinion calls for increased steelhead research and monitoring in the San Joaquin River basin, with particular focus on the Stanislaus River. This publication describes what is currently known about biotic and abiotic factors resulting in residency and anadromy in California steelhead populations and presents a detailed *O. mykiss* life history model to inform monitoring and management. In a case study, Stanislaus River *O. mykiss* data is used to illustrate the difficulties in monitoring the resident and anadromous forms of *O. mykiss* and highlight that proposed management actions by the agencies may ultimately yield little benefit to the steelhead population in the Stanislaus River.

Early-season reproductive failure of Chinook salmon: limited behavioral plasticity in warming rivers? (to be submitted late 2020)

Data collected during weir monitoring and redd surveys during the drought (2012-2016) showed only minor migration and spawning delays for returning adult Chinook salmon to the Stanislaus River but may have led to decreased juvenile production due to poor survival during egg incubation. This paper investigates the long-term patterns in relative survival of eggs relative to water temperature conditions using a degree-day model and assesses the likelihood of a shortened migration window during the spring due to increasingly warmer ambient temperatures during spring. The study highlights the need for refined management of cold-water storage in New Melones Reservoir to improve survival of eggs during drought periods.

Fish community responses on the Stanislaus River before, during, and after California's most recent drought: a glimpse into the future? (to be submitted early 2021)

This publication highlights the biological responses of native and nonnative fish in the Stanislaus River using long-term monitoring data collected from the weir and during snorkel surveys. Most notably, we observed increases in the prevalence of nonnative fish (i.e., black bass and striped bass) during the drought and no substantial decline in prevalence after the drought. This is in contrast to *O. mykiss,* which declined severely during the drought but have largely recovered to pre-drought abundance and density levels. Combined, the differential response between the groups suggests that the total overlap between the groups increased throughout the study period leading to the potential for increased negative interactions between native and nonnative fishes in the Stanislaus River.

Mortality explained? Repeated, consistent collections of diet from nonnative fishes yields widespread, sustained, and unrecognized predation impacts on juvenile Chinook salmon in the Stanislaus River (to be submitted mid-2021)

This publication will use diet data collected from predatory fishes on the Stanislaus River beginning in 2018 to estimate the spatial and temporal scope that predation is occurring on. As part of the paper, we will review existing studies to better understand how the predation studies conducted on the Stanislaus River yield new, previously unrecognized aspects of predation. Most importantly, the study will serve as a foundation for the series of other proposed publications from the Stanislaus Native Fish Plan (see below for details).

Survival, distribution, and movement patterns of predatory fishes in the Stanislaus River (to be submitted late 2021)

This paper will estimate survival rates and assess distribution and migration patterns of predatory fish that have been PIT tagged and subsequently recaptured over the course of the study. Little information currently exists on survival and movement patterns in the Stanislaus River and the study will help to inform and understand the reliability of abundance estimates made during the study. Understanding movement and survival patterns of predatory fishes may improve removal or suppression strategies to benefit juvenile Chinook salmon.

Abundance of predatory fishes in the Stanislaus River (to be submitted late 2021)

This publication will be focused on the within and between season abundance of predatory fishes in the Stanislaus River and will use previous reports and technical memorandums as a foundation. Currently, no abundance data is available on many predatory fishes around the Central Valley and this information will be invaluable to estimating total seasonal consumption estimates of juvenile Chinook salmon. Abundance data from the study can be used to inform or improve predatory fish removal or suppression strategies.

Impact of nonnative predatory fishes on native fishes in the Stanislaus River (to be submitted mid 2022)

This paper will serve as the culmination of all the previous NFP-related publications in that it will provide estimates of the impact of nonnative predatory fishes on the juvenile Chinook salmon population in the Stanislaus River. The data will provide important information on the impact of predatory fish relative to other factors (discharge, flow, and habitat). Combined with insights from the other NFP-related publications, the study may inform larger-scale management strategies that may be feasible in a variety of settings.

Efficacy of repeated, localized removals of nonnative predatory fishes to improve survival of juvenile Chinook salmon in the Stanislaus River (to be submitted mid 2022)

*(*assumes that removals and assessment conducted in 2021)*

Based on data collected in 2021, this study will summarize and analyze data from repeated and localized removals to understand how effective removals of nonnative predatory fishes might be to improve juvenile Chinook salmon survival. Studies with limited scope have shown some positive responses, however, the responses may be more pronounced if removal or suppression activities were sustained. This paper will focus on this question as it is the first study that has the proper study design to fully answer it.