Fiscal Year 2020 Supplemental Work Planning

The most recent fiscal year in which TRRP solicited Investigation Plans (IPs) was for FY2018. The workplan built from that solicitation has been forwarded to subsequent years (FY2019 and FY2020) by the TMC. Some additional funding that became available in FY2019 was applied to two new investigations. Preparation of appropriate IPs required updates to previously unfunded IPs, plus time consuming peer review of those plans.

This supplemental solicitation was intended to identify the currently unfunded needs of the Program and to become more prepared should funding become available, starting with a pre-proposal process.

Road Map:

Dec. 2018: TMC motion to "accept and allow the IDT to identify data gaps and solicit proposals to answer outstanding flow management questions. Such proposals would be solicited, reviewed, and shelved to be ready for implementation upon availability of funding."

Winter/Spring 2019: IDT coordinated with workgroups to develop a list of outstanding flow management questions.

June 2019: IDT prioritized questions.

Sept. 2019: Pre-proposal solicitation distributed.

November 2019: Pre-proposals received.

External peer reviews initiated.

December 2019: This presentation to TMC.

External peer reviews received.

Full IP development to be initiated?

January 2020? Full IPs to be received and reviewed?

? 2020 projects begin, if approved and funded by TMC.

Priorities for additional Investigation Plans were identified by TRRP's Interdisciplinary Team (IDT) in June, 2019, and focus on questions about flow management. The consensus priorities were:

1. Can variation in the timing of juvenile outmigration from the Trinity explain variation in survival and be influenced by water management? ***Tied with***
2. Can flow management tailored to meet temperature targets be an effective tool to reduce pre-spawn mortality and induce pool temperature stratification for adult salmon holding habitat?
3. How do flow and flood event timing and duration effect drift food availability and growth of juvenile salmonids?
4. Development of hydrophone method for monitoring sediment transport on the Trinity River at Douglas City, Limekiln Gulch and Lewiston.
5. Evaluate how the connectivity timing, controlled by flow management, of intermittently connected off-channel habitats impacts fish use and survival.
6. Apply the S3 model in conjunction with observed fish size data to evaluate assumptions regarding percent maximum consumption and food as a limiting factor for Chinook Salmon juveniles.
7. Evaluate the effects of flow event magnitude, duration, and recession on scour (bed, bar, redds), bank collapse, and channel meander.
8. Does flow management influence cottonwood cohort success on targeted floodplain surfaces and prevent willow establishment on channel margins? ***Tied with***
9. What are the impacts of a variable flow regime on reservoir levels and river recreational access?
10. Evaluate the impacts of higher discharge winter flows on intergravel water temperatures.
11. Evaluate the impacts of peak flow frequency and seasonal timing on turbidity.
12. How can flow releases be optimized for wood transport and deposition. (e.g. wood flux)
13. What is the minimum flow that is required to maintain suitable dissolved oxygen and temperature for juvenile salmonids in fish producing tributaries?

At a September IDT meeting to facilitate this process, a request was made to additionally consider a "Flow Synthesis Report" proposal and potentially additional flow questions. The IDT concurred that such proposals could be added at the end of the list above, to be prioritized later or by the TMC.

- Evaluate narrow leaf willow recruitment in the channel bed with unconstrained summer flow (min flow and temperature management).
- Evaluate Foothill Yellow Legged Frog recruitment with unconstrained summer flow
- Flow Synthesis Report

One-page summaries (adapted for brevity) of the pre-proposals received follow.

Priority 1: Can variation in the timing of juvenile outmigration from the Trinity explain variation in survival and be influenced by water management?

Influence of Water Management on Variation in Timing of Juvenile Salmonid Outmigration on the Trinity River

Partnership: USFWS, YTFP

The goals and objectives of this project are to:

1. Estimate the baseline disease risk, outmigration timing, and temperature related mortality of Trinity origin juvenile Chinook Salmon in the lower Klamath River.
2. Evaluate whether water management practices in the Trinity River have influenced observed variation in timing of outmigration and survival of juvenile Chinook Salmon from the Klamath-Trinity confluence to the ocean.
3. Assess how varying *flow scheduling* for each water year type affects outmigration timing and survival of juvenile Chinook Salmon in the Lower Klamath River.

Methods (adapted for brevity):

Based on previously collected data for spore concentrations, Chinook outmigration, water temperature, and S3 modeled duration in the lower Klamath River.

- Using the juvenile movement, juvenile survival, and disease prevalence sub-models of the Klamath River S3 model and estimated size-based movement rates for duration of migration through the lower Klamath River, we will estimate baseline conditions for outmigration timing and survival of Trinity-origin juvenile Chinook Salmon in the lower Klamath River.
- Assess the relationship between any observed variation in survival and outmigration timing to historic water management practices in the Trinity River
- Evaluate the influence of varying water management on survival and outmigration timing. […] develop natural flow regimes for each water year type and determine changes in smolt size, outmigration timing, disease prevalence, and survival through the estuary.

Product Timeline:

Task	Months From Project Assignment															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Compile data	X	X	X													
S3 modeling				X	X											
Data analysis						X	X	X	X	X	X	X				
Final report													X	X	X	X

Peer Review (thus far):

- Well written and "should provide valuable information". Full proposal should give more context, but recommends "serious consideration".
- **"**The proposed work represents an excellent example of combining program data with projection models to generate quantitative evaluations of potential population limiting factors."

Priority 2: Can flow management tailored to meet temperature targets be an effective tool to reduce pre-spawn mortality and induce pool temperature stratification for adult salmon holding habitat?

Quantifying river flows that provide holding habitat in summer for adult spring Chinook and water temperatures that optimize juvenile salmonid growth

Partnership: TRRP/USBR, YTFP, CDFG, USFWS

The proposed work will evaluate summer flows that stratify pools and provide holding habitat for adult spring Chinook and water temperatures in the published range that maximizes juvenile salmonid growth. Flows that meet these aims will be used to derive a flow to holding habitat volume relationship for the restoration reach of the Trinity River. The curve could be used to adaptively manage summer baseflow releases from Lewiston Dam to better meet fisheries goals and provide water savings for addressing other restoration objectives.

Methods (adapted for brevity):

An inventory of pools in the Trinity River restoration reach will be made with the 2016 SRH-2D model of the restoration reach and associated lidar and bathymetry data. Pools will be described by their physical dimensions […] and configurations of flow entry and exit, among others. In the same manner, 8 to 10 pools will also be inventoried on the SFTR in Hyampom Valley, chosen for study by its proximity to the USGS stream gage, low summer flow conditions, and dimensional similarity to the Trinity River. Due to lack of modeling and bathymetry and lidar data for SFTR, pool inventories will be made with field surveys in the summer baseflow period (August - September).

Water temperatures will be measured in May through December (as flows allow) and used to define boundary conditions and calibrate models for pools in the SFTR. These data will also be used to assess the suitability of temperatures for juvenile rearing outside of each pool as stratification occurs.

Modeling results for the SFTR will be scaled to Trinity River pools to indicate the total volume of mainstem pools that meet Douglas City temperature targets as a function of discharge. This function will be used to estimate discharges that provide volumes of holding habitat required for numbers of adult spring Chinook that meet or exceed both natural escapement (≥6,000) and hatchery mitigation goals (3,000). Discharges that meet these goals will be used in the RBM-10 temperature model (Jones et al., 2016) to estimate percentages from maximum growth the flows provide juvenile salmonids at locations throughout the Trinity River restoration reach.

Timeline:

Activity		FY 2020				FY 2021			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 1	Equipment purchase and calibration		x						
Task 2	Field data collection			x	x	x			
Task 3	Data reduction and analyses				x	x	x		
Task 4	Draft and finalize report of findings						x	x	x

Peer Review (thus far):

- Well written and interesting topic; needs full development of methods.

Priority 4: Development of hydrophone method for monitoring sediment transport on the Trinity River at Douglas City, Limekiln Gulch and Lewiston.

Quantifying entrainment thresholds and bed load transport on the Trinity River with paired measurements of bed load and the acoustic noise of mobile sediment

Partnership: TRRP/USBR, USGS

Monitoring bed load at Douglas City enables gravel augmentation design and bed load monitoring at Limekiln Gulch and Lewiston track progress restoring sediment loads in these areas of the river. Without this information, data to design gravel augmentations and track restoration of sediment transport rates on the Trinity River will be unavailable. Past bed load transport monitoring has been expensive, but recent advances have made passive techniques for estimating bed load affordable. The affordability results from relatively few physical samples needed to obtain an accurate load estimate from the acoustic signal.

The proposed work will enable evaluation of the effects of management actions on bed load entrainment thresholds and loads and to provide information needed to design annual gravel augmentations. The latter is applied adaptive management that is needed to restore the sediment transport characteristics of a healthy alluvial river, scaled to the post-TRD hydrology.

Methods (adapted for brevity):

Two hydrophones will be deployed at each sediment transport monitoring station at Lewiston, Limekiln Gulch, and Douglas City. The equipment will continuously record acoustic signals beginning with the start of the spring flow release and lasting until bed load transport ceases in the declining limb of the hydrograph. The amplitude of the acoustic signal scales with transport rate, so higher amplitudes (i.e., more noise) indicate higher sediment loads. The scaling requires calibration, which we will accomplish by sampling bed load at each station when the channel bed is mobile. Calibrated signals will then be used to produce continuous estimates of coarse bed load transport for the release events.

Coarse bed loads will be scaled by the observed ratio of coarse to fine bed loads and summed provide a total load estimate. Sampled sediments will be sieved to determine size distributions, and water surface slopes through each monitoring site will be measured. The measurements are needed to estimate entrainment thresholds for the total load and fractional loads for comparison to threshold estimates provided by the acoustic method.

Timeline:

Activity		FY 2020			FY 2021	
		Q2	Q3	Q4	Q1	Q2
Task 1	Equipment purchase and installation	x				
Task 2	Field data collection	x	x			
Task 3	Data reduction and analyses			x	x	
Task 4	Gravel augmentation design and presentation				x	
Task 5	Draft and finalize report of findings				x	x

This proposal only requests first year funding. A smaller effort of calibration will also be needed in a subsequent year.

Peer Review (thus far):

- “Important modernization” and deserves “serious consideration”. Concern raised on startup costs (first 2 years) and possible continuation of need for calibration (physical samples).

Priority 5: Evaluate how the connectivity timing, controlled by flow management, of intermittently connected off-channel habitats impacts fish use and survival.

Monitoring intermittently connected off-channel features for growth and use by juvenile salmonids on the Trinity River, CA.

Partnership: CDFW, USFWS, YTFP

The proximate goal of this study is to improve our understanding of potential differences in short-term and seasonal growth patterns of fish using intermittently connected off-channel features in comparison to fish using the mainstem river, with an ultimate goal of informing adaptive management of flow releases from […] currently prescribed baseflows during the critical rearing period (February to April) that would allow fish access to constructed and natural off-channel features.

Methods (adapted for brevity):

A paired caged fish study between the mainstem Trinity River and intermittently connected off-channel features. Off-channel features used for the caged fish study will be selected using the 2016 SRH-2D model of the restoration reach and additional models of sites constructed since this time. All off-channel sites will be disconnected from the mainstem river via surface flow at 2500 cfs or less but connected at flows between 2500-5000 cfs. A total of six intermittently connected off-channel features will be selected; three sites in the Lewiston area and three in the Junction City area.

Describe the seasonal growth trajectories of juvenile Chinook Salmon residing in off-channel features for several months by estimating daily growth rates from otoliths. During the last sample period in October at each off-channel feature up to 15 captured juvenile Chinook Salmon will be sacrificed for later extraction of otoliths. Comparison of daily growth rates between off-channel residents and mainstem fish will describe potential differences in seasonal growth trajectories and be used to infer whether off-channel features provide better growing conditions than mainstem rearing.

A small field effort to determine the feasibility of conducting a mark-recapture survival study in off-channel features. Juvenile Chinook Salmon obtained from the Trinity River Hatchery will be measured, weighed, individually identified by surgical implantation of a Passive Integrated Transponder (PIT) tag, and placed in cages located in selected off-channel features and paired mainstem locations.

Temperature will be monitored continuously throughout the study at all locations.

Timeline:

Activity		FY 2020				FY 2021			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 1	Build cages and calibrate equipment	x							
Task 2	Obtain and prepare test fish		x						
Task 3	Deploy cages, test fish, and loggers		x						
Task 4	Revisit cages for monitoring		x	x					
Task 5	Mark-recapture feasibility					x	x		
Task 6	Otolith collection and processing					x	x	x	
Task 7	Data organization and analysis				x			x	

Peer Review (thus far):

- "nicely designed study". Full proposal should give more context for significance of off-channel habitats for Program goals.
- A critical step forward to managing flows that can leverage these habitats. Raised question about value of PIT tags for short term study.

Priority 6: Apply the S3 model in conjunction with observed fish size data to evaluate assumptions regarding percent maximum consumption and food as a limiting factor for Chinook Salmon juveniles.

Estimation of Consumption by Juvenile Salmon in the Trinity River Using the S3 Model

Partnership: USGS, USFWS

Evaluate the consumptive behavior of juvenile Chinook salmon within the Trinity River, CA, using the Stream Salmonid Simulator (S3) model. In particular, resource managers want to know how different flow regimes during Dry, Normal, and Wet water years that might affect fish consumption and growth.

Methods (adapted for brevity):

In consultation with USFWS, USGS will use the S3 model to estimate fish movement, survival, and consumption using data from 2006 to 2017, providing wide range from Dry to Wet water years to compare parameter values and simulation output.

The S3 model will be fit to the abundances and sizes of fish at the Pear Tree trap site located near the downstream end of the 40-mile restoration reach. The Pear Tree trap site will be used for fitting because the habitat changes as function of river flow is best quantified within the restoration reach. USGS will fit the model to the weekly trap abundances and mean fish sizes at the trap during 2006 – 2017. Fitting the S3 model to the weekly abundances at the Pear Tree trap site will enable the estimation of fish survival (daily survival rate) and movement (daily probability of moving downstream) during each migration year. Further, fitting the model to the weekly mean sizes of fish sampled at the trap will enable the estimation of the fish's average proportion of maximum consumption during each migration year.

Once the S3 model has been fit to all years of data from the fish traps, the predicted weekly abundances and fish sizes will be compared to the observed abundances and sizes measured at the Pear Tree trap site. The parameter values for fish survival, movement, and consumption estimated for each year will also be compared among the years and grouped by Dry, Normal, and Wet year types, providing resource managers with an objective assessment of the expected effect of different water years on fish survival, movement, and consumption (and in turn growth).

Timeline: deliverables by August 31, 2020.

Peer Review (thus far):

- Reviewer felt this was far enough from their expertise that they had rather limited comments; asked if back-calculating consumption through model assesses if food is limiting.
- "an excellent example of combining program data with projection models to generate quantitative evaluations". Raised some questions on analytical methods.

Priority 7: Evaluate the effects of flow event magnitude, duration, and recession on scour (bed, bar, redds), bank collapse, and channel meander.

Modeling the potential for scour of Chinook Salmon Redds and unspawned Streambeds in the Trinity River, CA.

Partnership: YTFD, TRRP/USBR

We propose to describe the relationship of flow magnitude to shields stress, which can be used to predict both redd scour and stream bed disturbance in the restoration reach of the Trinity River, through the use of existing models and data. Information available will be used to estimate the proportion of redds and stream bed that are scoured by a range of flows. We hypothesize that salmonids place redds in areas that are not prone to scour over a large range of flows, and that scouring flows affecting significant portions of the stream bed, altering invertebrate communities, can be achieved during the incubation period without posing significant risk to a substantial proportion of redds constructed in a given spawning year.

Methods (adapted for brevity):

We propose to evaluate the potential for deep (>12 in) stream bed scour during flood events to disturb salmon redds by comparing the spatial distribution of redds mapped in the Trinity River in 2012 and 2014 with modeled shear stresses (τ) during a range of flood events. Redds constructed in 2012 and 2014 were chosen for this analysis because those are years in which redd numbers were among the largest (in 2012) and smallest (in 2014) in recent years. The 2012 40-mile Trinity River SRH-2d hydraulic model, developed and calibrated by Reclamation’s Technical Services Center (TSC), will be used to assess shear stresses.

Timeline:

Activity		FY 2021			
		Q1	Q2	Q3	Q4
Task 1	Obtain data and model/model output	x			
Task 2	Develop D_{50} substrate map	x			
Task 3	GIS analyses and curve development	x	x		
Task 4	Interpretation, synthesis		x	x	
Task 5	Prepare draft report			x	
Task 6	Finalize report				x

Peer Review (thus far):

- “Worthwhile” proposal that leverages existing data but needs refinement regarding methods. Recommends consideration of a full proposal. Notes that it does not address all questions within priority item.

***Added** Flow Synthesis Report Proposal*

Flow Synthesis Report

Partnership: HVTFD, YTFP, NMFS

In the 19 years since the ROD was signed, a substantial body of scientific information has emerged regarding environmental flows in general, and Trinity River flow needs in specific. For example, information pertaining to springtime flow recession rates to support healthy riparian vegetation has been used in recent years to improve annual flow releases during wetter water years, which is one of many examples of the TRRP using emerging science to adjust and improve flow releases to better achieve the management objectives (as required by the ROD and TRFEFR). […] Unfortunately, a synthesis of ROD flow release management outcomes was omitted in the 2018 synthesis reports. After 16 years of full ROD flow release implementation, a comprehensive review of what we have learned, identification of future flow flexibility needs, and recommended flow refinements is clearly needed.

Methods:

The Flow Synthesis will consider the various studies described in the Problem Description above to identify how the existing ROD flow hydrographs can be refined to improve fishery and ecological benefits – aiming to attain additional goals and better meet objectives identified in the ROD, while adhering to the annual ROD flow volumes and AEAM process required by the ROD.

Outline addresses all components of annual hydrographs including baseflows.

Timeline:

Action	FY 2020		FY 2021	
	2nd Q	3rd Q	2nd Q	3rd Q
Technical Review Phase	X			
Technical Analysis		X		
Draft Synthesis Report			X	
Final Synthesis Report				X

Peer Review (thus far): *all reviews pending*

Priority Questions Not Addressed

3: How do flow and flood event timing and duration effect drift food availability and growth of juvenile salmonids?

---*Already covered by other activities (Current MacroInvertebrate Project)*

8: Does flow management influence cottonwood cohort success on targeted floodplain surfaces and prevent willow establishment on channel margins?

---*Already covered by other activities (Riparian Monitoring Report in review)*

9: What are the impacts of a variable flow regime on reservoir levels and river recreational access?

---*Should not address at this time; likely an EIS evaluation*

10: Evaluate the impacts of higher discharge winter flows on intergravel water temperatures.

---*Already covered by other activities (2017 USFWS Report)*

11: Evaluate the impacts of peak flow frequency and seasonal timing on turbidity.

---*Already covered by other activities (Fine Sediment Synthesis Report)*

12: How can flow releases be optimized for wood transport and deposition.(e.g. wood flux)

---*Already covered by other activities, at least in part (Large Wood Synthesis Report)*

13: What is the minimum flow that is required to maintain suitable dissolved oxygen and temperature for juvenile salmonids in fish producing tributaries?

---*Aligned with work Trush is doing elsewhere – no new work proposed at present*

Added: Evaluate narrow leaf willow recruitment in the channel bed with unconstrained summer flow (min flow and temperature management).

---*future proposal?*

Added: Evaluate Foothill Yellow Legged Frog recruitment with unconstrained summer flow

---*future proposal?*