

## **Trinity River Restoration Program Fiscal Year 2016 Preliminary Science Workplan Summary**

### **Program Overview**

The Trinity River Restoration Program (TRRP) is seeking to restore and sustain natural production of anadromous fish populations downstream of Lewiston Dam to pre-dam levels. The Secretary of the Interior signed a Record of Decision (ROD) for the Trinity River Fishery Restoration Final Environmental Impact Statement/Report on December 19, 2000. This decision adopted a strategy for restoration and maintenance of the Trinity River's fishery resources that requires rehabilitating the river channel and restoring dynamic alluvial processes that maintain aquatic habitats as well as managing flows to meet biological needs of anadromous salmonids. The primary components of the restoration strategy are: mechanical channel rehabilitation, gravel augmentation, a variable flow regime to meet fluvial geomorphic and biological objectives, and watershed restoration. These management actions, in combination, are expected to increase habitat availability for juvenile anadromous salmonids, resulting in increased natural anadromous salmonid production, increased adult recruitment, and increased harvest opportunity in dependent fisheries. The ROD also established an adaptive management program to guide implementation of the restoration strategy. To allow for adaptive management, the TRRP's Integrated Assessment Plan (IAP) (TRRP and ESSA Technologies Ltd. 2009) identifies key assessments to evaluate the river's response to management actions and ultimately the response of fish and wildlife populations that depend on the river. The IAP served as the foundation for the identification of Fiscal Year (FY) 2016 information needs.

### **Document Overview**

The intent of this document is to provide a concise description of what is being proposed for the FY 2016 science workplan to allow the Scientific Advisory Board (SAB) and Trinity Management Council (TMC) to evaluate the entire body of work. For each discipline, the proposed activities are briefly described. Additionally, we express how each proposed activity informs Decision Support System (DSS) development, channel rehabilitation design, flow management, and sediment management (see Tables 1-3). We also identify dependencies between proposed activities (see Tables 1-3). Finally, abstracts for proposed activities are included in Appendix A. Full investigation plans are also available for SAB and TMC review.

### **Workplan Development Process**

Two priorities were developed for FY 2014 and continued for FYs 2015-2016: (1) monitoring data collection and analysis and (2) DSS implementation. A ranked list of FY 2016 projects was developed based on these priorities, issues identified in the IAP, and recent learning. Following distribution of the FY 2016 solicitation in March 2015, investigation plans were submitted. All plans are currently undergoing administrative review. Selected investigation plans will also

undergo external scientific review. The SAB is now asked to evaluate the entire proposed body of work and to provide input to the TMC.

## **Fish Related Activities**

### Intent of the Proposed Body of Work

The Fish Workgroup (FWG) developed a prioritized list of fish monitoring and fish habitat assessment activities for the FY 2016 TRRP science workplan (Table A). These recommendations were considered by the TRRP managers and incorporated into the TRRP's FY 2016 Solicitation Package. Our primary recommendations addressed three general categories related to fishery resource assessments: (1) systemic and site specific habitat assessments, (2) juvenile salmonid assessments, and (3) adult Chinook salmon population assessment. The FWG believes these projects will contribute to advancement of the DSS, help inform the TRRP of progress towards achieving long term project goals and objectives; and will provide feedback to adaptive management actions (Table A).

The FWG has given high priority to projects that supported the SAB's recommendation to develop and implement a DSS. The FWG recognizes the potential applications of a DSS, particularly the fish production model (SSS) component. In accordance with the SAB's recommendation and TMC guidance, the first phase of the SSS has focused on the upper Trinity River from Lewiston Dam to the North Fork Trinity River confluence. With the expectation of the first phase of the SSS presented for review this fall (2015), the FWG proposed (but did not prioritize) the expansion of the spatial extent of the model to extend from the North Fork Trinity River confluence to the confluence with the Klamath River. If the spatial extent of the Trinity SSS is expanded to the Klamath River confluence, it will join with the Klamath fish production model which extends to the ocean. The Trinity SSS will focus on performance measures of Chinook salmon in relation to fish habitat and flow attributes before including production measures of other priority fish species.

The FWG does recommend adult assessments for other priority fish species, including coho salmon, and steelhead (as prioritized in the IAP), but these assessments were given a lower priority than habitat and fall Chinook assessments and were not selected as components of the FY 2016 science work plan. However, long-term run-size and escapement baseline data for these salmonids is enabled by operational efficiencies during adult Chinook monitoring. In addition, lower priorities such as assessments of Pacific lamprey habitat and juvenile and adult fish disease were also recommended.

The SAB and TRRP Adult Salmonid Monitoring Evaluation (Bradford and Hankin 2012) also recommend an analytical group be established to integrate and synthesize adult population information in order to evaluate TRRP hypotheses and IAP objectives and that emphasis should

first be placed on synthesis and analyses of fall Chinook salmon populations, due to the robust long-term monitoring data sets that are available. The FWG also recommends conducting project integration and data synthesis in the FY 2016 workplan as well as resuming the fall Chinook cohort reconstruction project. The intent of the fall Chinook salmon monitoring activities included in the FY 2016 workplan is to provide current population status updates and maintain the long-term data set, improve integrative analyses, and encourage evaluation of hypotheses.

#### Response to comments from past workplan reviews

Recommendations were incorporated into the FY 2016 workplan as follows:

- The need for a fish production model was recommended as a critical part of the adaptive management process and DSS to evaluate different management outcomes and then measure the response of juvenile salmonid production. The salmonid production model may not have the resolution to estimate changes due to actions at local scales, but will be useful for providing feedback at river reach and annual scales. The first version of the fish production model (SSS) is scheduled for delivery and review in the fall of 2015.
- The review noted that the need for a system wide habitat assessment to evaluate habitat availability over a range of flows. The investigation plan continues the annual systemic estimate of rearing habitat availability by sampling throughout the upper 40 miles of river as well as pre-construction/post-construction habitat assessments of select channel rehabilitation sites. The need for a system wide habitat model was addressed in FY 2014-15 by developing the 400-m 2D habitat models throughout the 40 mile upper river and integrating these models with the 40-mile physical model under development. For the FY 2016 workplan, we recommend to extend the 2D habitat model North Fork Trinity River confluence to the confluence with the Klamath River.
- The SAB noted that escapement estimates using mark-recapture methods and the Chinook salmon mainstem redd/carcass spawning survey projects are duplicative. However, the Chinook salmon run size estimation using mark-recapture methods produces estimates of all naturally-produced and hatchery produced salmonids for the entire Trinity River basin upstream of Willow Creek, and run-size of naturally and hatchery produced of Spring Chinook salmon above Junction City. Bio-sampling and fish health observations are also made. The Chinook salmon mainstem spawning survey provides spatially explicit estimates of the numbers of redds, density and distribution for the mainstem Trinity River that can be associated with restoration actions. The data collected from the redd/carcass surveys also provides information on pre-spawning mortality and the distribution of hatchery spawners throughout the mainstem Trinity River. The Fish Workgroup has initiated a review of adult run size estimates, and the differences between estimates made at the Willow Creek weir, and redd and carcass surveys in the upper Trinity River. We also recommend conducting a stock-recruitment and cohort reconstruction analysis by integrating comprehensive Chinook data collection.

Table A. Fish work group FY 2016 consensus priorities.

Priority	Project/Activity	Comments	Year of Last Report, Year report covers
1.	Map and quantify the extent (area) of available fry/juvenile rearing habitat at rehab sites pre and post construction.	A second post construction revisit is desired after a geomorphic flow event.	various, sawmill done
2.	Map and quantify the extent (area) of available fry/juvenile rearing habitat throughout the mainstem (systemic-upper 40 miles).	Additional pannels should be added following geomorphic change.	draft 2014, 2012
TMC Request. Not Ranked	Expand flow-habitat relationship from NF Trinity to Weitchpec in support of the juvenile fish production model.	Recommend as a sub-task in another habitat project. This project would expand flow-habitat relationship from NF Trinity to Weitchpec.	new assessment
Not Ranked	Assess fish use of newly constructed habitat features. Quantify juvenile fish densities within different types of constructed features	Fish Work Group seeking clarification from Design team. FWG considering fish focused questions from Design team	TBD
3.	Chinook salmon spawner-recruit analysis	Project to synthesize RST and Weir data and possibly Redd data. Recruits expressed as outmigrants. Dataset could include an analysis of flows.	New Assessment
Not Ranked	Survival estimates for juveniles to Pear Tree	Pit tag detection pilot study	New Assessment
4.	Monitor redd distribution, abundance, and densities (includes carcass surveys)		2012, 2002-2012
5.	Monitor pre-spawning mortality to assess the number and proportion of un-spawned or partially spawned female Chinook and coho salmon	This activity gathers information supportive of redd distribution and abundance assessment	2012, 2002-2012
6.	Monitor smolt outmigrant numbers, Monitor smolt timing -		2014, 2013
7.	Monitor pre-smolt/smolt timing, size, condition and disease incidence at outmigration – Chinook.		2014, 2013
8.	Monitor the proportion of hatchery reared to natural Chinook smolt outmigrants		2014, 2013
9.	Monitor adult escapement of hatchery and naturally produced Fall Chinook.	Steve Cannata believes adult natural and TRH origin run-size should be ranked at number 5, above (or equal to redd distribution and abundance). Steve will support this work plan with that preference noted.	2104, 2013
10.	Monitor harvest (tribal, sport and commercial) of naturally produced fall Chinook		
11.	Conduct age -composition analysis for fall chinook.		2014, 2013
12.	Develop cohort reconstructions for fall Chinook and evaluate cohort performance or year class strength, and population growth rate		Draft 2014, 2013
13.	Monitor adult escapement of hatchery and naturally produced spring Chinook		2014, 2013
14.	Monitor harvest (tribal, sport and		2013, 2011-2012

	commercial) of naturally produced spring Chinook		
15.	Conduct age -composition analysis for spring chinook		HVT draft report available in 2015
16.	Monitor adult escapement of hatchery and naturally produced coho	This activity is an operational efficiency linked to fall Chinook monitoring	2014, 2013
17.	Monitor harvest (tribal, sport and commercial) of naturally produced coho		
18.	Develop cohort reconstructions for naturally produced coho and evaluate cohort performance or year class strength, and population growth rate		
19.	Monitor smolt outmigrant numbers - coho and steelhead		2014, 2013
20.	Monitor size (length/wt and condition of fry/smolts )-coho and steelhead		2014, 2013
21.	Monitor adult escapement of hatchery and naturally produced steelhead	This activity is an operational efficiency linked to fall Chinook monitoring	2014, 2013
22.	Monitor harvest (tribal, sport, commercial) of naturally produced steelhead		
23.	IAP. 2.1.5 Minimize physical impacts to lamprey habitat		

## Wildlife and Riparian Activities

### Intent of the proposed body of work

The intent of the proposed body of work is to monitor the interaction of flows, channel rehabilitation activities, and gravel augmentation, with riparian vegetation; and also monitor the populations of focal species of birds, reptiles, and amphibians that may be affected by these actions. TRRP uses this monitoring data to assess progress towards Programmatic objectives and to detect unanticipated effects of river restoration.

The wildlife and riparian portion of the science workplan has four components: 1) Riparian Vegetation Monitoring, 2) Avian Monitoring, 3) Herpetological Monitoring and 4) Riparian Vegetation Simulation using SRH-1D/2DV. Riparian Vegetation Monitoring, Avian Monitoring, and Herpetological Monitoring are similar to the work conducted in previous years, while the Riparian Vegetation Simulation modelling effort is new work.

Riparian Vegetation Monitoring involves a strategy that employs multi-disciplinary monitoring efforts to address cause-and-effect relationships between management actions, physical processes, and riparian vegetation response. Proposed tasks include:

- Evaluating riparian vegetation response to managed streamflows at a systemic scale,
- Evaluating the rate of change and transition state between different age classes of riparian vegetation,
- Evaluating large wood storage at GRTS segments,
- Mapping and quantifying vegetation area within constructed and proposed channel rehabilitation sites,

- Quantifying the particle size distribution and texture of in-channel and overbank deposits and constructed surfaces,
- Updating the hardwood phenology model: revise and apply the Trinity River date of seed dispersal,
- Estimating vegetation mapping accuracy

Results will be used to revise conceptual and quantitative models, link results to management actions, and make adjustments to future management actions.

The Avian Monitoring component includes monitoring temporal changes in riverine and riparian bird species performance metrics at the rehabilitation site, local reach, and restoration reach scales and determining restoration-associated mechanisms that explain variations in riparian bird performance metrics at the rehabilitation site scale. A new investigation plan was completed for Fiscal Years 2016-2020.

The Herpetological Monitoring component will implement the long-term monitoring protocols that are currently being developed under an agreement with the USGS. Monitoring focuses on two special-status aquatic species: western pond turtle and foothill yellow-legged frog. The protocols being developed are consistent with the assumptions required for occupancy modeling, in order to provide the TRRP with straightforward metrics for monitoring the status and trends of these populations.

The Riparian Vegetation Simulation work engages Reclamation's Technical Service Center staff modellers to update an existing vegetation model (the Vegetation module of Reclamations SRH-1D/2D model) for Trinity River conditions. This project was funded during FY 2015 and is included here because it was not scoped before the FY 2015 science workplan was finalized. A Project Management Plan has been prepared by the Technical Service Center with TRRP's input.

#### Response to comments from past workplan reviews

The SAB review of the FY 2014 preliminary workplan emphasized three questions important to designing a riparian-oriented science workplan for the TRRP. The questions are:

1. What are the relative rates of erosion and deposition?
2. What are the relative rates of fish habitat creation and loss?
3. What are the patch-wise transitions of the above transitions?

Now that there has been five years of data collection using a standardized, GRTS-based sampling routine, rates-of-change can be estimated. Riparian Task 2, "Evaluate riparian rate of change and transition state between age classes" augments this dataset and uses it to answer these three questions.

## **Physical Activities**

### Intent of the proposed body of work

The intent of the proposed body of work is to document and understand the channel response to management actions and inform future management actions. Specifically, 1) inform development of the peak magnitude and duration of the spring flow releases and 2) inform decisions on how much gravel augmentation is needed. The heart of the physical program of work for FY 2016 is two recurring projects: sediment monitoring and gravel implementation monitoring. Two additional projects including tributary delta monitoring and gravel implementation tracer experiment are designed to supplement the recurring projects.

Sediment monitoring consists of measuring bedload and suspended sediment transport rates at four locations along the river. These data are subsequently used by program scientists in a variety of analyses that track progress toward program objectives and inform management actions. Some of these analyses include: 1) compute sediment budgets needed to evaluate progress toward coarse and fine sediment storage objectives; 2) assess bed mobility and the effects of past gravel augmentation at the system scale; and 3) evaluate long-term gravel augmentation needs. The tributary delta monitoring consists of repeat topographic surveys of tributary deltas between Lewiston Dam and Limekiln. These surveys are designed to produce data and enable analysis to determine 1) tributary sediment delivery to the mainstem and reduce uncertainty in coarse sediment budget 2) evaluate the sinks and sources of sediment in the Rush Creek delta and determine sediment throughputs.

Gravel implementation monitoring consists primarily of topographic data collection and analysis that identifies and quantifies changes in channel morphology, such as bar formation and pool dynamics. The gravel implementation tracer experiment tracks individual gravel particles as they are transported downstream to investigate the transport characteristics of gravel that is injected into the channel during high flow events. These data and analyses provide a direct link between management actions and physical riverine conditions, and complement the sediment monitoring information by investigating the combined effects of gravel additions and flow managements at a more local scale.

### Response to comments from past workplan reviews

The FY 2013 workplan review (managed by Atkins with SAB oversight; Atkins 2012) identified updating the conceptual model for gravel routing and transport as one of the top three program priorities to be addressed. The updated conceptual model is needed to build a long-term operational plan for flow and gravel augmentation. The review stipulated the long-term plan must be built on more specific, testable estimates of how gravel moves through the system. To implement the recommendation, the Atkins review recommended that each component of the

physical program of work be revised and refocused into an integrated whole that directly supports the field monitoring and analytical work to update the conceptual model, build the long-term operational plan, and implement adaptive management.

Progress towards implementing the Atkins recommendations includes peer-reviewed gravel augmentation recommendations that were used to support renewal of the 5-year gravel augmentation permit. The tracer implementation experiment provides unambiguous information on how gravel is moving through the system which will facilitate updating the conceptual model of sediment transport. Recommendations from the Atkins review yet to be addressed include developing testable estimates of how the gravel is moving through the system. The gravel workgroup will continue to make progress towards addressing these recommendations in FY 2016.

### **Other activities**

In addition to the discipline specific activities listed in Tables 1-3, the FY 2016 preliminary science workplan also includes the following general activities: stream gage and temperature monitoring. It also include the assessment of channel rehabilitation activities and a restoration planning effort described below.

#### Channel rehabilitation assessment

Many of the monitoring activities included in the Science Workplan focus on the long-term and system-wide Program objectives. Though important, these studies are not well suited to provide the timely and site-specific feedback needed to improve ongoing project designs. Program scientists have identified a need for targeted studies that inform designers whether rehabilitation designs are meeting stated objectives for habitat improvement, fish utilization, and physical process after construction and interaction with high flows. The following process is proposed for identifying rehabilitation monitoring studies that will meet this need.

The Acting Implementation Branch Chief will distribute a notice to Design Team participants, inviting designers and team members to submit written suggestions for targeted studies that address uncertainties about specific rehabilitation designs or design features. The suggestions are to be forwarded to the Acting Implementation Branch Chief, the Acting Science Program Coordinator, and the Design Team Coordinator by July 24, 2015. The suggestions received will be discussed and prioritized at a subsequent Design Team meeting (late July or August). Prioritized monitoring activities will be eligible to receive funding that has been set aside for rehabilitation monitoring in 2016.

#### River corridor planning

The Gravel augmentation work group recently recommended the development of a river corridor map and associated approach to plan habitat rehabilitation strategies. A subgroup of TRRP



scientists were asked to undertake initial efforts to develop these management tools in late May, 2015. The work slated for FY 2015 includes two distinct components, the first of which is compilation of all available spatial data relevant to TRRP restoration activities. The second component involves data synthesis and analyses needed to identify local habitat and ecosystem deficiencies, objectives for local habitat improvement, and potential management strategies to alleviate those deficiencies. Management strategies to address issues at a range of time scales (immediate benefit to long-term evolution) will be considered, as well as all permutations of the three basic management tools (flow management, sediment management, and mechanical rehabilitation). These initial planning efforts will be restricted to five local reaches, which were selected to represent a range of circumstances encountered over the full TRRP project area.

### **Summary**

The suite of projects presented here meets the TRRP's priorities for restoring the Trinity River's fishery resources. Findings from these FY 2016 activities will be used to refine future study designs and restoration actions. We look forward to the SAB review and evaluation, and encourage their input.

### **References**

Atkins. 2012. Peer Review Report: Trinity River Restoration Program Preliminary Fiscal Year 2013 Science Workplan. Prepared for the TRRP – October 2012.

Bradford and Hankin. 2012. Trinity River Restoration Program Adult Salmonid Monitoring Evaluation. Prepared for the TRRP – March 26, 2012.

Scientific Advisory Board (SAB). 2013. Draft Appendix H Review of the Trinity River Restoration Program's Channel Rehabilitation Strategy, Phase 1: Decision Support System Framework. Draft March 22, 2013. Prepared by Anchor QEA, LLC for Trinity River Restoration Program's Scientific Advisory Board.

TRRP and ESSA Technologies Ltd. 2009. Trinity River Restoration Program: Integrated Assessment Plan. Version 1.0 – September 22, 2009.

Table B. Proposed fish activities for the FY 2016 preliminary science workplan. Activities are listed in order from highest to lowest priority.

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependences between projects within this discipline or with other disciplines
<b>Fish Population Dynamics Model</b>	Primary sub-model in proposed TRRP DSS structure.	If evaluating design alternatives.	Can be used to evaluate different flow releases.	Not as currently proposed. Another DSS component sediment model may feed into future fish prod model.	Yes - will be capable of modeling salmonid production with under varying restoration actions and relate these data to restoration goals.	Fish Habitat modeling, fry density monitoring, Chinook salmon outmigrant monitoring, Chinook salmon run-size estimation, redd and carcass surveys.
<b>Rearing Habitat Assessment</b>	(see tasks below)					
<i>Channel Rehabilitation Site Rearing Habitat Assessment</i>	Possibly - could be used in conjunction with 2D habitat modeling to improve the habitat submodels of the fish production model of DSS.	Assesses pre and post construction function and quantity of habitat change resulting from construction.	Documents physical change from flow releases.		Assesses changes in available fry/juvenile rearing habitat.	
<i>Systemic Habitat Estimate</i>	Possibly - could be used in conjunction with 2D habitat modeling to improve the habitat submodels of the fish production model of DSS.	Assesses systemic changes in quantity of habitat resulting from construction and flow management.	Documents physical change from flow releases.	Documents physical change from sediment management.	Assess changes in available fry/juvenile rearing habitat.	
<i>Support for Salmon Production model</i>	Needed as the habitat basis for the fish production model.		Model changes in available rearing habitat at various managed flows.			Fish production modeling is dependent on the habitat framework.

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependences between projects within this discipline or with other disciplines
<b>Mainstem Chinook Spawning Survey</b>	Provides model inputs: spawner abundance, distribution, timing, and pre-spawn mortality, sex ratios.	Provides data that can be overlaid with restoration site habitat data to evaluate changes in spawning areas and used to evaluate specific areas where spawning habitat is prioritized (i.e. hatchery reach).	Documents redd desiccation issues.	Can be used to evaluate coarse and fine sediment management effects on spawner distribution.	Redd data used to estimate total inriver spawning escapement in conjunction with weir generated data.	CWT recovery/tag recovery for separating hatchery/natural and spring and fall Chinook salmon spawning in the river, and spawning habitat assessment.
<b>Trinity River Juvenile Salmonid Outmigration Monitoring Program</b>			Relates outmigrant timing to flow management.		Assesses changes in juvenile Chinook salmon in relation to channel rehabilitation and flow management.	Dependent on Chinook CWT at TRH.
<b>Chinook Run-size Estimation Using Mark-recapture Methods in the Trinity River basin</b>					Provides estimates of hatchery and naturally produced adult Chinook and coho salmon and steelhead run-size and escapement to inform TRRP programmatic goals.	TRH Chinook CWT tagging, Klam-Trin fall-run scale age analysis, sport and tribal harvest monitoring.
<i>Trinity River Hatchery Chinook Coded Wire Tagging</i>					Tagging data necessary to separate hatchery and naturally produced fish.	Chinook run-size estimates, outmigration monitoring, Klam-Trin fall-run scale age analysis, cohort analysis, sport and tribal harvest monitoring.

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependences between projects within this discipline or with other disciplines
<i>Klamath-Trinity River Fall Run Scale Age Analysis</i>					Age composition data allows for separation of run into age classes to allow for cohort analysis.	Contributes to sport and tribal harvest management, cohort reconstruction analyses, dependent on scale collections at TRH, weirs and carcass surveys.
<b>Monitor Harvest of Chinook</b>	(See tasks below)					
<i>Yurok Tribal Fisheries Monitoring</i>					Assesses Program goal to "to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities".	Contributes to CWT recovery, fall Chinook salmon age composition analysis, and cohort reconstruction analyses.
<i>Hoopa Tribal Harvest Survey of Trinity River Fall Chinook</i>					Assesses Program goal to "to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities."	Contributes to CWT recovery, fall Chinook salmon age composition analysis, and cohort reconstruction analyses.
<i>Lower Trinity River Sport Harvest Survey</i>					Assesses Program goal to "to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities".	Contributes to CWT recovery, fall Chinook salmon age composition analysis, and cohort reconstruction analyses.

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependences between projects within this discipline or with other disciplines
Conduct Chinook Cohort reconstruction analyses					Assesses Program goal to "to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities".	Contributes to Chinook run-size, Adult Harvest, Integrated analyses and project synthesis. Dependent on Chinook CWT at TRH.
Lower Klamath Creel Census					Assesses Program goal to "to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities".	contributes to CWT recovery, fall Chinook salmon age composition analysis, and cohort reconstruction analyses.

Table C. Proposed wildlife and riparian activities for the FY 2016 preliminary science workplan. Activities are listed in order from highest to lowest priority.

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependences between projects within this discipline or with other disciplines
<b>Map and Quantify Riparian Vegetation</b>	(see tasks below)					
<i>Evaluate systemic Riparian Vegetation Response to Managed Streamflows (Task 1)</i>	Informs models and flow scheduling.	Constructed floodplains were intended to support the natural establishment of vegetation.	Depending on water year, flows may be intended to scour vegetation or promote establishment at various bank positions.	Rates of berm formation; checks sediment augmentation and fine sediment reduction.	Measures progress towards vegetation scour and establishment objectives.	Geomorphic monitoring and assessment of bed scour and mobility; Potential to further integrate flow and sediment modeling to predict planform dynamics.
<i>Evaluate riparian rate of change and transition state between age classes (Task 2)</i>	Informs models	Streampower, and therefore the transition, is affected by changes in confinement after construction.	Can refine the "three dry years in a row = encroached bank" hypothesis		Measures progress towards vegetation scour and establishment objectives.	Past mapping work, particularly 2014 and 2015. Map and quantify vegetation area within constructed and proposed channel rehabilitaiton stie ESLs
<i>Evaluate large wood storage at GRTS segments (Task 3)</i>	Potentially can be used to develop a large wood budget for the Trinity River, and to assess past and current conditions relative to targeted large wood loads.	The Program places large amounts of wood on channel rehab sites.			Measures whether placed large wood is moving, remaining in place, or racking additional wood.	Systemic Riparian Vegetation Response to Managed Streamflows.
<i>Map and quantify vegetation area within constructed and proposed channel rehabilitaiton stie ESLs (Task 4)</i>	Informs models (e.g., SRH2DV).	Informs constructed floodplain and disturbance feature designs.Helps determine quantity needed to plant (1:1 replacement of riparian vegetation).			Measures progress towards environmental compliance objectives (1:1 replacement of impacted riparian vegetation).	Evaluate systemic Riparian Vegetation Response to Managed Streamflows, Estimate vegetation mapping accuracy.

<i>Quantify particle size distribution and texture of inchannel and overbank deposits and constructed surfaces (Task 5)</i>	Informs models and flow scheduling.	Channel rehab reforms surfaces; substrate texture can control vegetation distribution.	Flows deposit sediment, and substrate texture can control vegetation distribution.	Checks degree of fine sediment reduction.	Two objectives are to flush fine sediment from the channel, and to deposit fine sediment on flood plain surfaces.	Flow modeling, Evaluate systemic Riparian Vegetation Response to Managed Streamflows, Map and quantify vegetation area within constructed and proposed channel rehabilitaiton stie ESL
<i>Update hardwood phenology: revise and apply the Trinity River date of seed dispersal model (Task 6)</i>	To promote riparian establishment, peak must recede peak of seed dispersal. Seed dispersal timing is thought to vary from year to year,depending on weather.		To promote riparian establishment, peak must recede peak of seed dispersal. Seed dispersal timing is thought to vary from year to year,depending on weather.		Spring release is intended to be synchronized with black cottonwood seed dispersal.	
<i>Estimate vegetation mapping accuracy (Task 7)</i>						Map and quantify vegetation area within constructed and proposed channel rehabilitaiton stie ESLs.
<b>Avian Monitoring</b>	High-level indicators of ecosystem health.	Avian habitat use influences revegetation designs.			Measures progress towards wildlife objectives.	Evaluates use of vegetation placed or impacted during channel rehabilitation.
<b>Herpetological Monitoring</b>	Long-term indicators of ecosystem health; used in flow scheduling.	FYLF and WPT occupancy influences design feature placement.	FYLF breeding chronology indicates degree of synchronicity between tributaries and mainstem; flow scheduling intends to avoid scour of FYLF egg masses.	FYLF require bars for breeding; informs sediment augmentation.	Measures progress towards wildlife objectives.	
<b>Riaprian VegetationSimulation using SRH-1D/2DV</b>	Riparian vegetation model is a component of the DSS	Should provide resolution on surface lowering and confinement needed to meet scour and establishment objectives.	Would allow simulation of different flow releases and how they affect riparian vegetation.			Evaluate systemic Riparian Vegetation Response to Managed Streamflows, Evaluate riparian rate of change and transition state between age classes, Map & quantify vegetation area w/in constructed and proposed channel rehabilitaiton stie ESLs, Quantify particle size distribution and texture of inchannel and overbank

						deposits and constructed surfaces
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Table D. Proposed physical activities for the FY 2016 preliminary science workplan. Activities are listed in order from highest to lowest priority.

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependences between projects within this discipline or with other disciplines (list item #)
<b>Gravel Implementation Monitoring</b>		Evaluates past augmentation and Informs future augmentation.		Evaluates past augmentation and Informs future augmentation.		This project is not dependent on other activities.
<b>Sediment Monitoring</b>	Informs models (transport / morph dynamics) and sediment budget.		Transport rates and dynamics inform high flow releases.	Transport rates inform sediment budget and gravel augmentation requirements.	Transport rates inform sediment budget i.e. quantifies sediment storage goals.	This project is not dependent on other activities.
<b>Gravel Implementation Tracer Experiment</b>	Informs conceptual and numerical models (transport / morph dynamics).	Evaluates past augmentation and Informs future augmentation.	Depositional patterns are dependent on flow rate.	Informs conceptual/ numerical models of sediment transport.	Evaluates the fate of augmented material to evaluate the effects of gravel additions to reach target/risk areas.	This project is not dependent on other activities. However more fruitful results are expected when combined with Gravel Implementation Monitoring.
<b>Delta Monitoring</b>			Evaluates the effectiveness of restoration flows to mobilize delta sediments.	Constrains estimates on sediment budget.	Sediment loadings inform sediment budget i.e. sediment storage goals. Tracks flows ability to mobilize delta sediments.	This project is not dependent on other activities. However its usefulness for systematic sediment budget calculations becomes questionable in the absence of Sediment Monitoring.



**APPENDIX A**

**TRINITY RIVER RESTORATION PROGRAM  
FISCAL YEAR 2016 INVESTIGATION PLAN ABSTRACTS**

**TRINITY RIVER RESTORATION PROGRAM  
FISCAL YEAR 2016 INVESTIGATION PLAN ABSTRACTS**

**FY16-01: Fish population dynamics model development (North Fork to Klamath)**

**Title:** Trinity River Stream Salmonid Simulator Development: Physical and Biological Data Between the Confluences of the North Fork Trinity and the Klamath Rivers

**Authors:** Nicholas A. Som, Damon Goodman, Thomas Hardy, Sean Ledwin, Aaron Martin, Russell Perry, Joe Polos

**Abstract:** The Stream Salmonid Simulator (SSS) is currently being constructed for the mainstem Trinity River between Lewiston Dam and the North Fork Trinity River (hereafter: upper river). This effort will continue in FY2016, with plans to release an initial version of SSS during the first-half of that fiscal year. The SSS model will contribute significantly to the Trinity River Restoration Program's (TRRP) Decision Support System (DSS), which is an adaptive management effectiveness monitoring and planning tool. The TRRP has requested a FY2016 proposal be submitted outlining initial data collection needs in order begin construction of SSS downriver of the Trinity's confluence with the North Fork Trinity. The proposal describes 4 tasks associated with this effort deemed necessary to begin SSS development downstream of the upper river (hereafter: lower river). The lower river SSS model will be completed in future fiscal years.

Task 1: Collection and processing of physical data necessary to build a 2-dimensional hydrodynamic model (hereafter: 2D model) at two sites in the lower river. Data collected for this task will serve two purposes. First, after the 2D models have been built, calibrated, and validated, the outputs from these models will form the basis of assessment for the methods developed in Task 2. Additionally, should the need arise, the data collected in FY2016 under this task can drive the development of 2D models that inform flow-to-habitat relationships in the lower river necessary to implement SSS.

Task 2: Development of methods to predict the joint depth-velocity frequency distribution in meso-habitats according to channel, bedform, and gradient parameters, and assessment of applications of this method to the lower river. Three sub-tasks will be required to complete Task 2, and they are 1) quantification of meso-habitat characteristics in the upper river; 2) delineation of meso-habitats in the lower river; and 3) development of hydraulic prediction equations for the joint frequency distribution of depths and velocities at the meso-habitat scale.

Task 3: Assess the characteristics of habitats utilized by Chinook Salmon smolts in the lower river, with a focus on comparisons to upper river fish-utilization and physical characteristics not found in the upper river. In this task, we will evaluate the physical characteristics of habitats utilized by Chinook Salmon smolts with a focus on 1) comparing observed use with predictions generated via the model estimated using upper river data; and 2) isolating physical variable ranges not existing or sampled in the upper river.

Task 4: SSS architecture development for the lower river. Given the meso-habitat template derived from Task 2, this task will involve stitching the habitat template from the lower river with those from the upper river and the Klamath SSS template to facilitate a basin-wide implementation of SSS.

### **FY16-02: Vegetation dynamics model development SRH 1/2 DV**

Title: Riparian Vegetation Simulation using SRH-1D/2DV

Authors: James Lee, John Bair, Robert Franklin, George Kautsky

Abstract: Note: Blair Greimann at Reclamation's Technical Service Center (Denver, CO) is updating this Project Management Plan (PMP) to reflect timeline and budget changes negotiated with TRRP. The original PMP (submitted in entirety in the "Background/Problem Statement" section) date of completion is December 30, 2015 and the budget is \$68,900 (\$57,200 for FY 2015). The next version will have a later date of completion and a smaller budget. Pending receipt of the updated PMP, \$57,200 is used for the FY 2016 budget in this IP submittal.

### **FY16-03: Rearing habitat assessment**

Title: Habitat assessment 2016

Authors: Damon Goodman, Justin Alvarez, George Kautsky, Aaron Martin

Abstract: The Trinity River is the focus of a restoration effort designed to improve riverine function as a means for increasing anadromous fish populations. Anadromous salmonid populations are limited by habitat area which is the primary focus of the restoration effort. This project focuses on evaluating changes in habitat availability due to restoration actions in the Trinity River. These observations are then leveraged to develop tools for decision makers to improve the impact restoration actions on increasing freshwater habitat quantity and quality. The primary components of this proposal include (1) before and after comparisons of channel rehabilitation actions across a range of streamflows, and (2) an assessment of status and trends in habitat quantity and quality throughout the restoration reach.

### **FY16-04: Monitor redd distribution, abundance, and densities (includes carcass surveys)**

Title: Mainstem Chinook Salmon Spawning Survey

Authors: Steve Gough, Nicolas Davids, Phil Fishella, Andrew Hill, George Kautsky

Abstract: This study targets spring and fall Chinook Salmon spawning in the mainstem Trinity River. Trinity River Chinook Salmon spawning begins in early September and continues through mid-December. Monitoring salmon redd and carcass abundance and distribution will inform estimates of total natural mainstem spawning escapement, and reveal temporal and spatial response of mainstem spawning to restoration through time. We postulate that the spatial distribution of returning spawners (hatchery fish excluded) is influenced not only by the spatial distribution of spawning habitat, but by the distribution of habitats that specific to other life history stages that facilitate successful emergence, rearing, and recruitment to adulthood. The mainstem spawning distribution of natural origin Trinity River Chinook Salmon upstream of the Burnt Ranch Gorge is currently skewed toward Lewiston Dam; the distribution of hatchery origin fish much more so (Sinnen 2004, Knechtle and Sinnen 2006, Hill 2009, Chamberlain et al. 2012). As the success of fish born from gravels in the mainstem increases in response to improved rearing habitat conditions, we expect spawning distribution to be driven increasingly by distribution of habitat, rather than proximity to the hatchery.

### **FY16-05: Outmigrant monitoring**

**Title:** Trinity River Juvenile Salmonid Outmigrant Monitoring Program

**Authors:** Bill Pinnix, Nate Harris, Tim Hayden, Sean Ledwin, Paul Petros

**Abstract:** The partners propose to continue juvenile salmonid emigration monitoring data on the mainstem Trinity River, California in 2016 at Pear Tree Bar (PTRST; rkm 118) and Willow Creek (WCRST; rkm 34). Monitoring at PTRST is conducted to estimate juvenile salmonid population size passing PTRST during the sampling season. Monitoring at WCRST is conducted to estimate juvenile salmonid population size and emigration timing during the monitoring period. The goal of this project is to assess juvenile salmonid abundance, run timing, condition and health; the primary population of interest is juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in the mainstem Trinity River.

Age of salmonid outmigrants, length frequency distributions, migration rates, and hatchery contributions will be estimated. Catch data will be used to calculate flow based abundance indices for juvenile Chinook salmon, coho salmon (*O. kisutch*), and steelhead (*O. mykiss*). Catch data of other fishes will also be presented.

Weekly stratified mark-recapture population estimates of emigrating age-0 Chinook salmon will be calculated for both naturally and hatchery-produced sub-populations.

Juvenile salmonid emigration target dates were developed as part of the flow recommendations contained in the Trinity River Flow Evaluation (USFWS and Hoopa Valley Tribe 1999, Figure 5.46) to assess at what date 80% of the juvenile salmonid population had left the Trinity River, and provides information for managing water temperatures in the mainstem Trinity River. The date at which 80% of the population passed the WCRST site will be calculated for age-0 Chinook salmon, age-1 steelhead, and sge-1 coho salmon.

In addition to quantifying salmonid outmigrant production and timing, fish condition and hatchery/natural composition of outmigrants will be presented in a data series report to provide timely dissemination of data to local managers and for inclusion in agency databases. A technical report synthesizing multi-year datasets developed by this project will be periodically published to evaluate trends in outmigrant salmonid production, outmigrant timing, hatchery/natural contribution and condition/health. Monitoring emigrating juvenile salmonid populations in conjunction with habitat availability and suitability studies is expected to provide a direct evaluation of restoration efforts because these studies focus on the early freshwater life-history phase which is directly affected by instream conditions and management actions.

### **FY16-06: Monitor adult escapement of hatchery and naturally produced fall Chinook**

**Title:** Chinook salmon run-size estimation using mark-recapture methods in the Trinity River basin.

**Authors:** Mary Claire Kier, Steve Cannata, George Kautsky, Bill Matilton

**Abstract:** The purpose of this study is to produce run-size and spawner escapement estimates on the Trinity River primarily for naturally-produced Chinook salmon (Chinook). Run-size and spawner escapement estimates for naturally- and hatchery-produced coho, and adult fall-run steelhead will be produced as well. The run-size and escapement estimates aid in the status and trend monitoring needed to evaluate short- and long-term progress toward achieving Trinity River Restoration Program's (TRRP) fundamental goals and objectives. The current goal for Trinity River naturally-produced fall-run

Chinook salmon is 62,000 adults; 6,000 naturally-produced spring Chinook; 1,400 naturally-produced coho; and 40,000 naturally-produced steelhead. Additionally, the harvest estimate component of this study addresses the stated goal in the Record of Decision (ROD 2000) of increasing harvest opportunity for dependent fisheries. Run-size estimates and associated 95% CI will be estimated using Chapman's version of the Peterson single census mark-recapture method (as modified by Ricker, 1975).

#### **FY16-06a: Coded wire tagging (fall Chinook)**

Title: Trinity River Hatchery Chinook Coded Wire Tagging

Authors: George Kautsky, Bill Matilton

Abstract: The project objective is to apply a 25% constant fractional mark (CFM) of all Chinook production at Trinity River Hatchery (TRH) using Coded Wire Tags (CWT). This project applies CWTs and Ad fin clips to spring- and fall-run Chinook salmon reared at TRH. Twenty-five percent of each race (spring/fall) and each release strategy within race (smolt or yearling) are to be marked. An automated tagging trailer constructed by Northwest Marine Technology will be used for in 2016 to tag brood year 2015 Chinook. Representative marking will be ensured by the automated tagging trailer as well ensuring that 25 percent Ad CWT is assigned to each rearing pond sub-population. The marks subsequently recovered in juvenile and adult monitoring projects in river are used to estimate contributions of hatchery and natural populations in mixed stock marine and river fisheries and adult spawning escapements. Population estimates are used to assess juvenile and adult production by brood year, run, and rearing type. Brood tables constructed for hatchery and wild fish, based on Ad CWT results, may be used to model performance of hatchery and naturally spawned fish.

#### **FY16-07a: Yurok tribal fisheries monitoring**

Title: Yurok Tribal Fisheries Monitoring 2016

Authors: Desma Williams, Arnold Nova, Robert Ray

Abstract: The goal of this project is to gather information from the Yurok Tribal fall fishery to assess the harvest of Klamath/Trinity fish stocks by the Yurok Tribe. This information is critical to determine the abundance of particular broods of fall-run Chinook from the Klamath and Trinity Basins, as well as their hatchery or natural origin. The companion age composition project then allows this information to be apportioned to each brood. The Tribal harvest numbers, and inriver run data from other areas/fisheries combined with the age composition, and coded wire tag recoveries, can be used to develop a cohort reconstruction for ocean escapement of Trinity River fall Chinook; both hatchery and natural origin fish. This project will not conduct this cohort reconstruction analysis, but will provide information from the Yurok harvest that is necessary to conduct this analysis.

The cohort reconstruction modeling will provide the number of ocean recruits (pre-harvest adult fish) per brood, which can then allow for an evaluation of brood year success relative to environmental factors (such as flow regimes), as well as an evaluation of the success of the Trinity River Restoration Program (TRRP). The Tribe's harvest information is also used for the management of Klamath/Trinity fall Chinook fisheries.

This project also allows the tracking of progress toward meeting long-term TRRP goals as identified in the IAP, such as restoring and sustaining natural production of anadromous fish populations downstream of Lewiston Dam to pre-dam levels to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities.

#### **FY16-07b: Hoopa tribal harvest survey**

Title: Hoopa Tribal harvest survey of Trinity River fall Chinook

Authors: George Kautsky, Bill Matilton

Abstract: The primary goal of this study is to provide a total estimate of Hoopa Tribal harvest of fall Chinook. CWT recovery and analysis is necessary to determine the contribution of Trinity Hatchery fish to the over-all harvest. CWT data are also useful for correcting bias in the estimates of scale-based age structures for fall Chinook (KRTT 2015). Further, hatchery/natural composition for fall Chinook is estimated through expansion of CWTs recovered in this fishery. This provides the Program with a tool to assess the potential confounding influence of hatchery stock on the naturally produced fall Chinook target.

Net harvest sampling methods include field acquisition of catch and biological data and samples in a two-stage sampling schedule. Net harvest analyses include two-stage calculations of harvest estimates for sampling stata and season totals, calculations of statistical confidence intervals, proportions of hatchery and natural -origin fish of each species. Reporting metrics include timely generation of catch estimates, and magnitudes of statistical uncertainty.

For tribal hook and line fishing, sampling is carried out in week-day and week-end strata. Types of biological data acquired are similar to those from net harvest sampling. Estimation of total harvest involves sample data for total anglers, angler fishing hours, and catch per hour fished on sampled days within strata. Stratum estimates are summed to week estimates. Development of methods to calculate measures of uncertainty of estimates are in progress.

#### **FY16-07c: Lower Trinity sport harvest survey**

Title: Lower Trinity River Sport Harvest Survey

Authors: George Kautsky, Bill Matilton

Abstract: The overall project goal is to estimate total angler harvest of Chinook and steelhead from Willow Creek Weir (WCW) downstream to the confluence of Trinity River with Klamath River. This project evaluates the hypothesis that by restoring natural production of the Trinity River, dependent fisheries will be restored. The project monitors harvest by non-tribal fishers participating in annual recreational harvest of fish produced in the Trinity River. Complementary investigations assessing contribution of naturally produced Trinity River origin fish are also conducted within the Tribal harvest sector. Analysis comprises mathematical expansion of sample data values to generate estimates of total harvest within sample strata, and summing to season totals. A useful metric will be calculated estimates of uncertainty, or confidence intervals, for stratum and season total estimates. Developing methods for estimating uncertainty in results of the Lower Trinity River Sport Harvest Survey is a work-in-progress.

### **FY16-07d: Lower Klamath creel**

Title: 2016 Lower Klamath Creel Census

Authors: Sara Borok, Steve Cannata

Abstract: The California Department of Fish and Wildlife proposes to continue creel census data collections to monitor the number of Chinook salmon (*Oncorhynchus tshawytscha*) harvested by sport anglers in the lower Klamath River. The main objectives of the creel census are to estimate the sport harvest and sport angling effort, estimate the harvest of naturally produced and estimate the contribution from TRH and Iron Gate hatchery stocks to the Chinook salmon harvests. Access point creel census design and analysis are used to develop quantitative data to describe the lower Klamath River Chinook salmon sport fishery. The sport harvest data are used to inform the Trinity River Restoration Program (TRRP) of status of the fishery and the contribution of Trinity River salmon towards fulfilling a fundamental objective of the TRRP; to facilitate and expand salmonid harvest opportunities. We will use trend analysis techniques to determine if harvest are changing over time. In addition, scales collected from all fish and coded-wire-tag data collected from hatchery fish during creel census are integrated into cohort reconstruction efforts needed to estimate the harvest of naturally produced Trinity River Chinook salmon from the lower Klamath River. The budget for this Investigation Plan is for support of field crew activities. A California Department of Fish and Wildlife funded Biologist is the project manager not funded by this IP or by TRRP.

### **FY16-08: Conduct age -composition analysis for fall Chinook**

Title: Klamath-Trinity River fall run Chinook scale age analysis

Authors: George Kautsky, Eric Logan, Bill Matilton, Desma Williams

Abstract: This project is dependent upon partnering with fishery managers responsible for monitoring the harvest and escapement of fall Chinook within the Klamath-Trinity Basin. Scales collected from these field efforts are catalogued, cleaned, impressed on acetate slides, and aged by the proposers. Age structure data complements general totals estimated for the Klamath Basin fall run Chinook stratified by recovery sector (e.g. fishery, hatchery, or natural spawning areas). This project contributes invaluable information to related efforts such as the annual Chinook harvest management process of the PFMC and the development of cohort reconstructions to assess performance of subsequent broods of Klamath-Trinity Chinook. This project evaluates long-term progress toward achieving TRRP goals and objectives. An Adult Fish PITA in the IAP summarizes: “What is the effect of TRRP habitat improvements on recruits per spawner and harvest, after removing effects of ocean conditions, temperatures, in-river flows, etc.?” One method for probing this question is the completion of cohort analyses based upon age-structured assessments of river returns by run and their specific contributions to fisheries. Cohort reconstructions are dependent upon age-structured run and fishery recovery data that are developed by the activity proposed herein.

### **FY16-09: Gravel implementation monitoring**

Title: Gravel Implementation Monitoring

Authors: David Gaeuman, Andreas Krause, Robert Stewart

**Abstract:** This proposal integrates monitoring activities needed to evaluate the transport and deposition of gravel introduced into the channel via high-flow injection or low-flow placement, and to support the planning and design of future gravel augmentation activities. These monitoring activities will also help to evaluate the performance of individual rehabilitation design elements and rehabilitation strategies. The proposed monitoring builds upon similar activities initiated in FY2011 and continued in FY2013. In FY2013, the work focused on assessing how gravel additions and channel rehabilitation actions have affected pool depths at both the local and system-wide scales in response to questions regarding the potential filling of adult holding habitat raised by certain stakeholder groups. No gravel implementation monitoring was conducted in 2014 because no high flows capable of entraining gravel occurred due to the ongoing drought. Although the tracking of pool depth changes remains an important component of this monitoring effort, it is proposed that the scope of the FY2014 work will be expanded to address a wider range of questions regarding the fate of augmented gravel and how it interacts with other management actions to alter geomorphic complexity at the reach scale.

#### **FY16-10: Riparian vegetation monitoring**

**Title:** Riparian Vegetation Monitoring

**Authors:** James Lee, John Bair, Robert Franklin, George Kautsky

**Abstract:** This riparian investigation plan (IP) proposes assessments to evaluate riparian related program hypotheses and objectives (TRRP 2005, TRRP and ESSA 2009). The riparian monitoring strategy employs multi-disciplinary monitoring efforts, where appropriate and possible, to address cause-and-effect relationships between management actions, physical processes, and riparian vegetation response. Riparian vegetation response to 2016 spring managed streamflows will be predicted using a model that is compatible with the Trinity River Restoration Program's Decision Support System. Riparian vegetation response prediction will be evaluated along the mainstem Trinity River at sites selected using a Generalized Random Tesselation Stratified (GRTS) survey design. Additional sites will be selected for evaluating large wood storage and characterizing vegetation structure utilizing the systemic GRTS 400 m segment based sub-sampling strategy that was developed and used in WY 2010-2013 (Goodman et al 2012). The evaluation of large wood and the characterization of riparian vegetation structure will be co-located with the fish habitat assessment sample sites. Many of the methods, analyses, and metrics proposed in this IP have been previously used in Trinity River geomorphic and riparian monitoring (McBain and Trush 2004, McBain and Trush 2006, McBain and Trush 2007). Based on the Science Advisory Board review of 2013 science work plans, a less intensive sampling method will be used to reduce the effort of evaluating seedling establishment along the summer baseflow water edge (Atkins 2012). Monitoring will document changes in woody plant demographics resulting from managed streamflows. Vegetation will be mapped at channel rehabilitation sites to document riparian vegetation recruitment, recovery, and revegetation response. Riparian vegetation recruitment and revegetation response will be related to inundation frequency and duration, groundwater proximity where feasible, and soil texture. The predictive model for cottonwood seed release timing will be revised and applied using 2015 phenology data. Monitoring results will be used to revise conceptual models, provide empirical soil texture data to the SRH 1D/V based Riparian Vegetation DSS model, link results to management actions, and potentially recommend adjustments to current riparian vegetation management strategies



### **FY16-11: Sediment monitoring**

Title: Sediment monitoring

Authors: Eric Peterson

Abstract: Investigation plans for on-going contracts (e.g. sediment transport monitoring) are not required in FY16. This abstract simply provides a high level overview of sediment transport monitoring to indicate it is part of the overall program of work. Sediment transport data provides the basis to quantify the track the sediment budget for the Trinity River. Sediment transport and sediment budget information is used to assess whether we are meeting stated sediment management objectives and to guide high flow releases and gravel augmentation management actions. Mainstem sediment transport monitoring has been conducted at 4 locations since 2004 in dry and wetter water years. The standard protocols for monitoring and analyses set forth by the US Geological Survey are used to determine suspended sediment and bedload transport rates, develop sediment transport curves, and determine total sediment loads by size fraction that represent the entire flood hydrograph. This information is provided to the Restoration Program in the form of a final report from the sediment monitoring contractor. Computation of the sediment budget is a separate task performed by program staff.

### **FY16-12: Gravel implementation tracer experiment**

Title: Gravel Implementation RFID Tracer Experiment

Authors: David Gaeuman, Aaron Martin, Shane Quinn, Robert Stewart

Abstract: The proposed project will use passive integrated transducer (PIT) tags to track individual gravel particles as they are transported downstream to investigate the transport characteristics of gravel that is injected into the channel during high flow events. In particular, particle tracking is intended to quantify how far gravel moves over a range of times scales (single flow releases to multiple years) and to examine how channel morphology influences and responds to gravel dispersion, accumulation, and propagation. The proposed work will complement a related investigation into the behavior of gravel additions and their effects on the river system (Gravel Implementation Monitoring). While Implementation Monitoring focusses on the effects of gravel augmentation on channel geometry and substrate texture, this particle tracking experiment addressed gravel mobility and transport directly. Tracking individual particles from their point of insertion into the river to their ultimate resting locations downstream provides unambiguous information about how far gravel particles move and the frequency distribution of different travel distances. Such information is critical for planning gravel management strategies for improving aquatic habitats in reaches that are far downstream from locations where direct gravel augmentation is feasible.

### **FY16-13: Delta Monitoring**

Title: Delta Monitoring

Authors: Robert Stewart

Abstract: The proposed project will use a combination of airborne, terrestrial, and boat-based survey techniques to monitor tributary deltas to quantify coarse sediment delivered to the Trinity River above Limekiln. Sequential delta surveys will be used to create digital terrain models pre- and post-hydrologic

events. Differencing sequential digital terrain models will be used to quantify the volume of sediment delivered to the Trinity River and develop sediment rating curves where sufficient hydrologic data is available. The development of rating curves will be used to estimate sediment delivered when delta monitoring surveys are not possible either due to high flows or logistical constraints. Quantifying tributary sediment inputs to the Trinity River is necessary to constrain estimates of the sediment budget. The sediment budget quantifies the relative abundance of sediment and provides a means to assess the response of mainstem sediment transport and river morphology to sediment inputs and river hydrology. The proposed work will serve the secondary purpose to quantify sediment sources and sinks in the Rush Creek delta to test hypothesis originating from the Trinity River Flow Evaluation Study. The information gained by the proposed study is critical for planning coarse sediment management and scheduling restoration release flows necessary for improving aquatic habitats.

#### **FY16-14: Avian Monitoring**

Title: Avian Monitoring

Authors: James Lee, Jaime Stephens, Sarah Rockwell

Abstract: Restoration-associated changes in fish abundance and riparian habitat complexity are expected to affect riparian and riverine bird communities on the Trinity River. From 2012-2015, KBO created and carried out a multi-scale, multiple-methodology monitoring program designed to meet and assess compliance requirements and inform the adaptive management process by tracking avian response to restoration actions. We have (1) monitored temporal changes in riparian and riverine bird abundance and composition, (2) used spot-map surveys to estimate territory density, size, and configuration for target riparian bird species, (3) completed intensive vegetation sampling to track restoration-associated changes in microhabitat complexity and habitat selection of riparian birds, and (4) conducted nest-monitoring to link variation in demographic parameters (i.e., nest survival and productivity) and nest site selection to restoration-associated changes in vegetation structure at a subset of sites. Point count survey data from the last 12 years have been used to calculate relative abundance, diversity, and associated temporal trends for the riparian bird community at the scale of the rehab site, river reach, and 40-mile program area. Estimates of relative abundance and long-term trends for target riverine bird species were derived from float survey data at the scale of the river reach and 40-mile program area. For 2016-2020, we propose to continue annual intensive monitoring (spot-mapping, vegetation surveys, and nest-searching) on two of our existing reference sites and two newly rehabilitated sites, ideally sites that KBO has an important role in designing. We will also continue to spot-map at each of our existing six rehab sites on a rotating basis to continue to monitor changes in bird performance and vegetation structure as restored areas continue to revegetate. Avian predator and brood parasite surveys will be added to spot-mapping protocols, to estimate relative abundance of potential nest predators at rehabilitated vs. control sites. We also propose to target-net and color-band individuals of one or more of our study species so that we can examine return and/or survival rates, body condition, and age ratios (of adults to second-year birds) at different sites as additional metrics of bird performance. Survival data will permit us to determine whether rehabilitation sites or the Program Area as a whole function as source or sink habitats. Point count and float surveys will continue as before to monitor long-term trends at a larger spatial scale, while also surveying additional point count locations in the new rehabilitation sites.

## **FY16-15: Herpetological Monitoring**

Title: Herpetological Monitoring

Authors: James Lee, Melissa Snover, Mike Adams, Ernie Clarke

Abstract: Although the primary goal of the Trinity River Restoration Program (TRRP) is to rehabilitate the fisheries on the dam-controlled main Trinity River, maintaining and enhancing other wildlife populations through the restoration initiatives is a key objective. For herpetological species, the foothill yellow-legged frog and western pond turtle have been identified as important species on which to focus monitoring efforts due to their status as California state-listed Species of Concern. As a result, considerable prior effort has focused on understanding the distribution and demography of these species, both on the main Trinity River and on the South Fork Trinity River as a comparison population (potentially representing pre-dam population status). These studies have highlighted differences in life-history traits of each species between the two rivers that may be due to conditions of the main Trinity River. For western pond turtle these traits include slow growth rates, smaller adult sizes, lower annual fecundity, and later age at maturity in comparison to South Fork Trinity River and other western pond turtles in the region. For foothill yellow-legged frogs, densities of egg masses are an order of magnitude lower on the main Trinity River in comparison to the South Fork Trinity River. Egg masses on the main Trinity River are also vulnerable to scour depending on the timing and volume of water released from the dam. TRRP is working to address these issues by including consideration of the impacts of water management decisions on these species, as well as taking habitat requirements into account in their channel rehabilitation work that is geared towards improving salmonid rearing habitat. The purpose of the current study is to develop robust, long-term monitoring protocols for both species, where the data collected will be consistent with the assumptions required for occupancy modeling, to provide TRRP with straightforward metrics for monitoring the status and trends of these populations. Concurrently, population models will be developed based on historic data collection efforts complimented with new data that can be used to inform management decisions regarding impacts on these populations.