ATTACHMENT #2b.

Scope of Work and Evaluation Criteria for the Trinity River Restoration Program's Phase I Channel Rehabilitation Project Review

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BACKGROUND

The Trinity River Restoration Program (TRRP) aims to improve the Trinity River's salmonid fishery by using managed dam releases, sediment augmentation, channel rehabilitation, and temperature control. Details on the goals, objectives, and history are found in several foundational documents listed or summarized in the TRRP's Integrated Assessment Plan (IAP). The foundational strategy is summarized as follows from the Trinity River Flow Evaluation Report (TRFER, USFWS & Hoopa Valley Tribe, 1999; p. 230):

> *"A dynamic alluvial channel morphology cannot be accomplished solely by prescribing releases. Mechanically removing riparian berms, minimally reshaping the existing channel in selected reaches, introducing coarse bed material above Rush Creek, and reducing or preventing sand input from tributaries also will be necessary."*

> *"The riparian berm cannot be removed by TRD dam releases: therefore, habitat rehabilitation must be preceded by a one-time sequence of mechanical removal at strategic locations. Subsequent long-term habitat creation and maintenance must be accomplished by flow and sediment management prescriptions rather than mechanical means."*

Channel rehabilitation along the Trinity River has involved local reshaping of the channel boundary, floodplain, and terraces, as well as addition of gravel and large woody debris (LWD). Pre-TRRP channel rehabilitation began with the "feathered edge" projects of the early 1990's, which were evaluated by Gallagher (1995). Since establishing the TRRP in 2002, implementation has emphasized notably larger projects, and in total these constitute about half of the 44 planned projects proposed in the TRFER. The Science Advisory Board (SAB) has been charged with overseeing a comprehensive evaluation of the first half of these projects (Phase I). This document describes the review process and scope of work proposed by the SAB. Emphasis is to be placed on learning from past management actions, understanding ecosystem processes, development of guidance for hypothesis testing, and advancing adaptive management by TRRP.

REVIEW PROCESS

The review would involve four major components:

I. Compilation by TRRP of information and status for each of the rehabilitation projects completed during Phase I, as well as any system scale data. Compile a matrix of data collected for each project, including project objectives, as-built information, hypothesized channel/habitat response, pre- and post-project data collection and analyses, and critical evaluation of project outcome(s) relative to stated objectives, hypotheses, and TRRP mission.

II. Initial analysis of data provided by the TRRP to evaluate the efficacy of the channel rehabilitation projects on an individual and combined basis. Analysis will be performed by a support contractor (Anchor QEA) in conjunction with the SAB and in collaboration with the TRRP and partners.

An interim report will be prepared that outlines present understanding of fluvial processes, the linkages of these processes and flow parameters to critical attributes of fish habitat and ultimately fish population success. This report will identify available information, identify data gaps, and outline approaches for hypothesis testing and evaluation.

III. Appointment of an expert technical panel (the panel) to examine the information provided above and to provide comments relative to three ecosystem process themes described below. Emphasis will be on evaluating the stated hypotheses for each project design, predicted and documented channel response at each site, demonstrated influence on adjacent reaches, and demonstrated contribution to habitat improvement for the larger river system (upper 40^+ miles). Where no predictions or documented response have been made, the panel will be requested to describe the kinds of analyses that could have been done (using available information) for predicting and documenting channel response, with emphasis on the time frame for expected response and the uncertainty of future water year flow and sediment regimes. The panel recommendations will include descriptions for data collection, analyses, modeling and evaluation of response, assuming combinations of actions (e.g., mechanical alteration of the river, addition of coarse sediment, LWD, etc.). Given the panel's collective understanding of the present state of the river system, they will be requested to make recommendations for analyses that are appropriate for comparing alternative designs as part of Phase II. Consideration should be given to various combinations of channel shaping, berm removal, and sediment and LWD additions. Recommendations should consider basin history (e.g., mining, flooding, flow regulation), geomorphic context (e.g., process domains (Montgomery, 1999), confinement, alluvial versus bedrock-controlled reaches, tributary influence), and legal and permitting constraints.

IV. Following the expert panel recommendations, further analyses of Phase I activities may be conducted by the contractor in collaboration with the SAB. Analyses with recommendations would be delivered to TMC, TAMWG and TRRP partners. A final report with conclusions and recommendations from analyses of Phase I sites/data and specific recommendations, including an analytical framework for Phase II projects, emphasizing consideration of alternative designs, developing hypotheses, evaluation and testing. This should provide a sound scientific basis for adaptive management by TRRP.

EVALUATION CRITERIA

The panel will be thoroughly briefed and instructed to remain objectively focused on the process-based rehabilitation strategy described in the Department of Interior's Record of Decision (DOI ROD), the Trinity River Flow Evaluation Report (TRFER, USFWS and Hoopa Valley Tribe, 1999) and legal permitting constraints. With this context, the panel will be requested to evaluate data and analyses presented to them regarding project objectives and outcome(s). The following elements should be addressed by the panel in evaluating each project: (1) project design in relation to stated objectives and TRRP mission; (2) local channel response within the context of the geomorphic setting and basin history (flow and sediment transport events and other natural and anthropogenic disturbances); (3) influence on surrounding channel dynamics upstream and downstream of each project; (4) the contribution, if any, to increased salmonid spawning and rearing habitat complexity/suitability at the site and for the river system (upper 40^+ river miles).

Ideally, there would be few criteria for evaluation, but approaches for project design have varied over time. This evolution of the design process and implementation must be documented. For example, some approaches built smaller projects depending on high flows to create and maintain channel complexity and associated resource values such as rearing habitat. Other approaches built large projects that removed vegetation and lowered the floodplain in order to provide fish habitat over a range of flows in case river flows were not strong enough to create a complex channel. More recently the placement of LWD is included in project designs. These differences in design reflect not only the geomorphic setting but also the evolution of the thought process over time and differing views among project partners regarding design philosophy. Consequently, site-specific analyses and evaluation will be required. The influence of submerged vegetation on fish habitat has also been debated. Research along the Trinity River in the 1980's indicated that bare unvegetated banks were preferable, but recent TRRP observations of numerous young fish among submerged vegetation and LWD contradicts this. Actual fish use and annual production is the ultimate evaluation of efficacy, but this is complicated by spatial patterns of other variables such as temperature, the hatchery, and predation. Reasonable approximations may be made with modeling efforts recently developed in the northwestern U.S. (e.g., Blair et al., 2009) and can be presented in demonstration mode when significant gaps in information prevent detailed simulations. The support contract, Anchor QEA, has this capability and experience.

While each rehabilitation project may be unique in design and implementation, the compilation of information organized along the above themes will allow rapid assessment and choice of appropriate analyses associated with different implementation strategies and their implications for creating more complex fish habitat (e.g., Pitlick and Streeter, 1988; Pitlick et al., 1999).

An important aspect of this review is to provide a template for hypothesis testing and adaptive learning by providing examples, analytical approaches and tools for future use.

ECOSYSTEM PROCESS THEMES

Three themes, in the context of ecosystem processes, will be addressed in evaluating Phase I projects: fluvial response, fish habitat response, and riparian response, examined over time and space. Data and analyses relevant to each theme will be synthesized by the contractor in collaboration with the SAB and presented to partners, stakeholders, and the panel. Emphasis is to be placed on summarizing rehabilitation site objectives, designs, and assessments in terms of the physical setting of the site and the advancement of overall TRRP goals as stated in the DOI ROD and TRFER. Emphasis will be on stated hypotheses and evaluation of approaches used for hypothesis testing, predicting response, and assessing project outcome.

1. Fluvial response and processes contributing to channel complexity/dynamics at project sites and in adjacent upstream/downstream reaches: "*...dynamic changes can take place during individual flow events as the bed is scoured and re-deposited. Sediment transport at this scale is considered a critical part of disturbance and patch dynamics, and instrumental in habitat-conditioning processes like flushing fine sediment from spawning gravels.*" (Bencala et al., 2006).

   a) Geomorphic context: Determine the geomorphic setting of each site (i.e., local process domain (Montgomery, 1999), network structure and proximity to tributaries, etc.) and the presence/absence of confining features, including vegetated berms, terraces, and bedrock control.

   b) Basin history and anthropogenic constraints: Identify major natural and anthropogenic disturbances that influenced the site prior to rehabilitation (e.g., mining, wildfire, flow regulation), and identify current anthropogenic constraints (e.g., legal maximum water surface elevations, houses and other structures, landowner issues, maximum possible reservoir releases).

   c) Flow and sediment transport context:
      i) Determine the water year type and streamflow history experienced by each site during and since completion, using available gage data within the river and in neighboring basins (Sanborn and Bledsoe, 2006).
      ii) Estimate the bed load transport (total volume and size distribution) passing through a project reach over time and space as a function of flow history and gravel augmentation activities.

d) Evaluate the spatial and temporal changes in channel morphology (topography, grain size, channel units, reach type (Montgomery and Buffington, 1997)), wood loading, and the extent of alluvial features in light of the site's geomorphic setting and its history of flow and sediment transport (1a-c). How dynamic is the site and what physical processes dominate observed changes (project construction vs. post-construction flows and sediment transport)?

e) Using the above information, consider how each site functions individually and collectively as a system.

Additional project analyses (as appropriate) may be conducted by contract personnel in collaboration with the SAB following expert panel recommendations (see Task 7, below).

2. Evolution of fish habitat quantity and quality available during critical fish life stage events: *"Mechanistic models can be used in stream and fishery communities....By linking flow to the specific behaviors, physiology, or growth of fish, the impact of the physical habitat on fish will come more directly from the fish's perspective, rather than just modifying flow and habitat and assuming that fish populations will respond in a direct and positive manner."* (Bencala et al., 2006.

   a) Estimate the amount of pre-rehabilitation rearing habitat and any increases in quality and quantity estimated to have resulted from the project actions and evolution over time, using available habitat data (e.g., habitat mapping and biomonitoring, 2D hydraulics, etc.), modeling combinations of habitat features, hydraulics (depths and velocities), water temperatures at various index flows using the channel structure, cover, hydraulics, water temperature and time series simulation concepts of IFIM (Bovee et al.,1998). Include all important habitat characteristics, such as boulders, undercut banks, large woody debris, aquatic plants and terrestrial plants submerged at low to high flows. Examine habitat metrics and performance indices for simulation of fish use and production over space and time. Examine time series simulations of water temperatures from construction to present time period, with emphasis on the timing of spawning and rearing life stages of the salmonid fishes.

   b) Identify any overriding events (extreme temperatures, extensive scour or deposition of the bed, extended unsuitable hydraulic conditions (e.g., extreme velocities, extended drought draw-downs, etc.) that may have influenced the habitat quality during important fish life stages over the time series examined. Particular attention should be directed to the role of annual hatchery introductions and the Program goal of increasing natural production of salmonid species.

   c) Using the best available information, make recommendations and provide example analyses for linking biological response to river processes. For example appropriate aspects from, fish habitat-related life history models (e.g. EDT, RIPPLE, SALMOD) could be used for developing simulations and estimates for system level annual production of selected salmonid species (see Bartholow and Henriksen, 2007; Blair et al., 2009; Knudsen and Michael, 2009). The intent is to further develop and demonstrate a set of analytical tools that could be used use by TRRP in the future.

Riparian vegetation response:

a) Describe any vegetation- related channel narrowing as defined by the lowest (streamward) extent of woody riparian vegetation at convenient time intervals (say 3 years) since project completion.

b) Estimate expected equilibrium channel widths based on 1) hydraulics and sediment transport associated with expected flow regimes and sediment supplies, and 2) the change in channel narrowing rate as defined by vegetation (e.g., willow) establishment since construction.

c) Quantify the survivorship of planted and seed-origin woody riparian plants on channel rehabilitation sites and present costs in terms of labor, material, and the water allocated from dam releases, where appropriate.

d) Describe any large wood recruitment associated with rehabilitation site actions.

The above themes provide a framework to produce a data matrix and catalog of information about the rehabilitation projects, identify missing data, and suggest various types of analyses that might be used for more efficient design, implementation, and evaluation of Phase 2 rehabilitation projects. Due to expected gaps in information, some of these analyses and simulations may only consist of demonstrations useful for future evaluations. This information will be compared across rehabilitation sites to evaluate site-specific performance of different project designs and to develop an understanding of the cumulative function and effect of the projects on the Trinity River. The evaluations are specifically aimed toward assessment of the efficacy of the approaches used for past projects along with specific recommendations for improved approaches for modeling and directing fluvial processes. Analyses will emphasize prediction and evaluation of channel response and increase of suitable quantity and quality of fish habitats throughout the system during Phase II.

TASKS

The review process is further detailed below through a series of tasks. Elaboration of tasks will reflect modifications and approval of the initial thematic and analytical approaches outlined above, as well as partner input during the review process. Data availability and the time line imposed for conducting this review will limit the analyses and tasks that can be accomplished. Hence, we envision first-order (i.e., basic) analyses and assessments, rather than detailed evaluations that would require more time and effort than has been allotted.

Task 1. An initial call has already requested that Anchor QEA thoroughly review appropriate background documents: Subtask A. Foundational Document Review; Subtask B. Review of SAB scoping document; Subtask C. Review of USGS project on geomorphic change; and Subtask D. Review of the Value Engineering Study by CH2M Hill.

Task 2. Summary documentation of Phase I designs and identification of all subsequent assessments, field measures, and available data. It is anticipated that data compilation and summarization would be thorough and would reflect process linkages similar to that done for the Sacramento River (Stillwater Sciences, 2007). Anchor QEA will also identify forthcoming data and suggest a timeline and method for interfacing with the ongoing USGS study of geomorphic change.

Task 3. After review by TMC, TRRP, partners and stakeholders, the summary document will incorporate any additional information. Based on the summary and available data, Anchor QEA will suggest specific analyses that could be done to better understand site and system level responses. Recommended analyses will focus on the three themes and linkages among them.

Task 4. A final scope of work and timeline will be delivered to TMC, TRRP, partners and stakeholders for approval.

Task 5. In collaboration with the SAB, Anchor QEA will conduct additional analyses and prepare an interim report. The interim report will summarize existing information, compare and contrast various site design approaches, include appropriate analyses of site and system evolution and suggest a framework for Phase II implementation, including evaluation of alternative site designs, formulation of hypotheses, and assessment of response over time and space. This could involve additional work at Phase I sites if appropriate. The suggested framework would include examples demonstrating specific analytical procedures, tools, and models as appropriate.

Task 6. Following review and modification, Anchor QEA and the SAB will complete the interim report for delivery to an outside panel of experts for review, comment and suggestions.

Task 7. A panel of technical experts will be identified and provided the interim report from Task 6. Interaction among SAB, Anchor QEA and the expert panel may be iterative. This will depend on the panel's initial suggestions and comments on applicable analyses and/or demonstrations of additional analyses that they would like to see conducted.

Task 8. A final review including recommendations will be presented by the panel. Recommendations regarding maintenance of existing features or needed modifications to better achieve project goals and additional potential benefits at each site, and suggested approaches for comparing alternative project designs, hypothesis development, and evaluation during Phase II should be included.

Task 9. Building upon the panel suggestions, the SAB and Anchor QEA will prepare a draft final report, including review of Phase I activities, conclusions and a template for conducting sound scientific designs, hypotheses, predictions and evaluations for Phase II implementation. This report will be distributed to TMC, TRRP, partners and stakeholders for comment. The final report will include recommendations for TMC adoption.

REFERENCES

Bartholow, J. M and J.A. Henriksen. 2006. Assessment of Factors Limiting Klamath River Fall Chinook Salmon Production Potential Using Historical Flows and Temperatures. USGS, Open File Report 2006-1240. 111p.

Bencala, K.E., D.B. Hamilton, and J.H. Petersen. 2006. Science for Managing Riverine Ecosystems: Actions for the USGS Identified in the Workshop "Analysis of Flow and Habitat for Instream Aquatic Communities". USGS, Open File Report 2006-1256.

Blair, G, L. Lestelle and L. Mobrand.2009. The Ecosystem Diagnosis and Treatment Model: A tool for evaluating habitat potential for salmonids. Pp. 289-310. *in* Eric Knudsen, Hal Michael, editors. Pacific Salmon Environment and Life History Models: Advancing Science for Sustainable Salmon in the Future. American Fisheries Society. Symposium 71, Bethesda, Md.

Bovee, K.D., B.L. Lamb, J.M. Bartholow, C.B. Stalnaker, J. Taylor and J. Henriksen. 1998. Stream Habitat Analyses Using the Instream Flow Incremental Methodology. Information and Technology Report. USGS/BRD/ITR—1998-0004

Gallagher, S. P. 1995. Evaluation of the feathered edge restoration projects on the Trinity River: fish use and physical habitat. U. S. Fish and Wildlife Service. Division of Ecological Services, Sacramento, California. 28 p.

Knudsen, E.E, and J.H. Michael. 2009. Pacific Salmon Environmental and Life History Models: Advancing Science for Sustainable Salmon in the Future. American Fisheries Society Press. Bethesda, MD.

Montgomery, D. R. (1999), Process domains and the river continuum, Journal of the American Water Resources Association, 35(2), 397-410.

Montgomery, D. R., and J. M. Buffington (1997), Channel-reach morphology in mountain drainage basins, Geological Society of America Bulletin, 109(5), 596-611.

Pitlick, J. and M.M.Van Streeter. 1988.Geomorphology and endangered fish habitats of the upper Colorado River 2. Linking sediment transport in habitat maintenance. Water Resources Research, vol 34, p. 303-316.

Pitlick, J., M.M. Van Streeter, B. Baskett. 1999. Geomorphology and Hydrology of the Colorado and Gunnison River and Implications for Habitats Used by Endangered Fishes. Report prepared for U.S. Fish and Wildlife Service, Dept. Geography, Univ. Colorado, Boulder, CO. Available online:www.colorado.edu/gepgraphy/geomprph.usfws.html.

Sanborn, S.C. and B.P. Bledsoe. 2006. Predicting streamflow regime metrics for ungauged streams in Colorado, Washington, and Oregon. J. Hydrology 325:241-261.

Stillwater Sciences. 2007. Linking Biological Responses to River Processes: Implications for Conservation and Management of the Sacramento River.

U.S. Fish and Wildlife Service and Hoopa Valley Tribe. 1999. Trinity River Flow Evaluation Final Report. June 1999, 513pp.