2016 ANNUAL REPORT

TRINITY RIVER RESTORATION PROGRAM

Thank You to the Trinity River Restoration Program partners for their contributions to this report.

On the cover: *Aerial photography of the Trinity River taken downstream of Douglas City, California in July 2016.*

Contents

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Acronyms

AEAM	Adaptive Environmental Assessment and Management
BLM	Bureau of Land Management
CDFW	California Department of Fish and Wildlife
CDWR	California Department of Water Resources
CEQA	California Environmental Quality Act
CRS	channel rehabilitation site
DGC	Douglas City (rehabilitation site)
DOI	Department of the Interior
EA/IS	Environmental Assessment/ Initial Study
EIS	Environmental Impact Statement
EO	Executive Orders
ESA	Endangered Species Act
ESL	Environmental Study Limit
FEMA	Federal Emergency Management Administration
Flow Study	Trinity River Flow Evaluation Study
FNF	full natural flow
FY	fiscal year
GRTS	generalized random-tessellation stratified (sampling design)
HVT	Hoopa Valley Tribe
IDT	Interdisciplinary Design Team
LiDAR	light detection and ranging
LWS	Lewiston Gage
Master EIR	Master Environmental Impact Report for Channel Rehabilitation and Sediment Management for remaining Phase 2 Sites
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service (now NOAA Fisheries)
NRHP	National Register of Historical Places
NTU	nephelometric turbidity units
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries (formerly NMFS)
PA	programmatic agreement
Reclamation	Bureau of Reclamation
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
S3	Stream Salmonid Simulator
SWRCB	State Water Resources Control Board
TAMWG	Trinity Adaptive Management Working Group
TCRCD	Trinity County Resource Conservation District
TMC	Trinity Management Council
TREIS/EIR	Trinity River Environmental Impact Statement/Environmental Impact Report
TRRP	Trinity River Restoration Program
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WBR 2p	Wet-Biophysical-Riparian hydrograph
WY	water year (October through September)
YOY	young of year
YT	Yurok Tribe

Measurements

ºC	degrees Celsius
ºF	degrees Fahrenheit
af	acre feet
afa	acre feet annually
cfs	cubic feet per second
cm	centimeters
cms	cubic meters per second
km	kilometer
km^3	cubic kilometers
m^2	square meters
rkm	river kilometers
RM	river mile

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Introduction

Examining Bucktail Project site, April 2015.

The Trinity River Restoration Program (TRRP) is a partnership of Federal, State, Tribal, and Trinity County entities that share responsibility for restoring the Trinity River between Lewiston Dam and the confluence of the North Fork Trinity River, California. The TRRP is administered by two U.S. Department of the Interior (DOI) agencies: the Bureau of Reclamation (Reclamation) and the U.S. Fish and Wildlife Service (USFWS). Other partner agencies share in the decision-making process through their contributions to the Trinity Management Council (TMC). These partner agencies are:

- Hoopa Valley Tribe (HVT)
- Yurok Tribe (YT)
- Trinity County
- California Natural Resources Agency (which includes the State of California's Department of Water Resources [CDWR] and Department of Fish and Wildlife [CDFW])
- U.S. Forest Service (USFS)
- National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries)

This 2016 TRRP annual report provides concise summaries of major program activities with our partners, as well as citations, references, and contacts for more information. In addition to implementing restoration flows and the Bucktail mechanical rehabilitation project, the TRRP continued sediment management, monitoring, and assessments as well as environmental compliance activities in 2016. See the sections of this annual report dedicated to each of these topics.

Joe Polos, Supervisory Fisheries Biologist, U.S. Fish and Wildlife Service

Joe was born and raised in San Francisco. His interest in fish started at a young age when his grandmother bought him a fish bowl and goldfish for his fifth birthday. His interest increased as his father took Joe and his three brothers fishing for perch, kingfish, rockfish and sharks off of the piers in San Francisco (when they were old enough to hold a fishing rod and not fall in) . He moved to Arcata in 1980 where he attended Humboldt State University; receiving a B.S. in Fisheries (1985) and a M.S. in Natural Resources (1997).

Joe started his fishery biologist career as a volunteer with the USFWS on the adult Chinook salmon beach seining project in the Klamath River estuary in 1983. He has worked in the Klamath/Trinity Basin for 29 of his 32+ years as a USFWS employee. Joe's involvement with the TRRP began in 1988 when he helped establish the Trinity juvenile outmigrant monitoring project.

—continued in next sidebar

TRRP's Mission

TRRP's mission is to restore the fisheries and wildlife of the Trinity River between Lewiston Dam and the confluence of the North Fork Trinity River. The defined goal is to restore the Trinity River's fishery resources in a managed river that has the characteristics of a healthy alluvial river as set out in the legislation and Federal decision documents that were instrumental in creating the TRRP.

The TRRP was created by the Record of Decision (ROD) in 2000, which outlines the plan for restoring the Trinity River and its fish and wildlife populations (DOI 2000). It was the result of nearly 20 years of studies of the Trinity River and its fishery resources that culminated in the Trinity River Flow Evaluation Final Report (of the Trinity River Flow Evaluation Study) and the Trinity River Mainstem Fishery Restoration Environmental Impact Statement/Environmental Impact Report (TREIS/EIR), completed in 2000 (USFWS et al. 2000). The ROD is based on the TREIS/EIR, which is the environmental compliance document under the National Environmental Policy Act of 1969 (NEPA/California Environmental Quality Act of 1970 [CEQA]).

TRRP Background

As early as 1955, Congress passed legislation authorizing the Trinity River Division as an integral component of the Central Valley Project. The legislation directed the Secretary of the Interior to ensure the preservation and propagation of fish and wildlife in the Trinity Basin through adoption of appropriate measures.

Completion in 1964 of Trinity and Lewiston Dams restricted anadromous fish to habitat below Lewiston Dam. (See Important Terms on page 8.) The dams also inundated more than 20,000 acres of the former Trinity River Valley and eliminated the sediment supply below the dams from more than 700 square miles of the upper watershed.

Water diversions from Lewiston Reservoir to Whiskeytown reservoir via the Clear Creek tunnels and, ultimately, to the Sacramento River diminished the annual flows in the Trinity

—continued

—TRRP Background continued

River by up to 90 percent of the flows before construction of the two dams. The diminished flows resulted in encroachment of riparian (streamside) vegetation onto the former floodplain, establishment of riparian berms, and fossilization of point bars as far downstream as the North Fork Trinity River. The ages and species of riparian vegetation became less diverse and the floodplain was less frequently inundated, leading to reductions in both the quantity and quality of fish habitat.

In 1981, in response to the declines in the Trinity River's salmon and steelhead populations, the Secretary of the Interior directed the USFWS to begin a 12-year flow study to determine the effectiveness of flow restoration and other measures to mitigate for the impacts of the two dams. In 1984, Congress enacted the Trinity River Fish and Wildlife Program to further promote and support wildlife management and fishery restoration actions in the Trinity River basin. Under this program, nine pilot bank rehabilitation projects between Lewiston Dam and the North Fork Trinity River were implemented between 1991 and 1993.

In 1992, Congress enacted the Central Valley Project Improvement Act. One purpose of the act was to protect, restore, and enhance fish, wildlife, and associated habitats in the Trinity River basin. The act also directed the Secretary of the Interior to complete the 12-year Trinity River Flow Evaluation Study (Flow Study) and to develop recommendations "regarding permanent instream fishery flow requirements, Trinity River Division operating criteria, and procedures for the restoration and maintenance of the Trinity River fishery." The Trinity River Flow Evaluation Final Report (Flow Evaluation Report) was ultimately published in 1999, providing a framework for restoration activities below Lewiston Dam (USFWS and HVT 1999).

In 1994, the USFWS and Trinity County began the public process for developing the Trinity River Mainstem Fishery Restoration Environmental Impact Statement/Environmental Impact Report (TREIS/EIR). This process was completed with the signing of the Record of Decision (ROD) for the Final EIS/EIR in December 2000. The ROD directed DOI agencies to implement the Flow Evaluation Alternative and elements of the Mechanical Restoration Alternative (DOI 2000) analyzed in the TREIS/EIR. The ROD set forth Trinity River flows for five water-year types: extremely wet (815,200 acre-feet annually [afa]), wet (701,000 afa), normal (646,900 afa), dry (452,600 afa), and critically dry (368,600 afa).

—Joe Polos continued

In the mid-1990s, Joe was assigned the lead for the USFWS on the inter-agency team charged with completing the Trinity River Flow Evaluation Report and the accompanying TREIS/EIR. In his position as a Supervisory Fishery Biologist in Arcata, Joe has continued to be very involved in the Program, focusing efforts on habitat and fish populations monitoring projects as well as programmatic level coordination efforts.

Joe and his wife Janis have been married for 31 years. She is currently the Director of Nurses for the Open Door Community Health Centers, having worked as a nurse for over 30 years. They have two daughters who live in San Francisco: the oldest (29) pursuing a career in public health working at the University of California, San Francisco and the youngest (24) pursuing a graduate degree in history/ancient studies at San Francisco State. In his free time, Joe enjoys fishing, wood working, and hanging out at the beach or along the rivers.

Laws and Guiding Documents

1955. Congress authorized Trinity River Division of the Central Valley Project.

1963. Trinity and Lewiston Dams were completed.

1981. Interior Secretary increased flows to ~300 cfs (8.5 m^3/s) and initiated Flow Study.

1984. Congress enacted Trinity River Basin Fish and Wildlife Management Act to implement salmon restoration.

1992. Congress enacted Central Valley Project Improvement Act with 340,000 acre-feet (0.42 km^3) of water available to the Trinity River

1999. Flow Study completed and used as preferred alternative in TREIS/EIR.

2000. ROD signed, establishing modern TRRP with minimum water volume allocations determined annually by the water year type.

TRRP Restoration Strategy

This restoration strategy does not strive to recreate pre-dam conditions. Rather, the goal is to create a dynamic alluvial channel that exhibits all the characteristics of the pre-dam river but at a smaller scale. In accordance with the ROD, TRRP's restoration strategy consists of:

- *Flow management*—a variable flow regime based on five water year types to mimic natural flows.

—continued

—TRRP Restoration Strategy continued

- *Mechanical channel rehabilitation*—treatment of 44 channel rehabilitation sites and 3 side channel sites along the Trinity River to reshape the channel form to promote physical processes that will create and maintain riparian and fish habitat.

- *Sediment management*—augmentation of gravels below Lewiston Dam and reduction in fine sediments, which degrade fish habitats.

- *Watershed restoration*—a program to reduce fine sediment input to the Trinity River and to improve fish habitat connectivity within the tributaries and between the tributaries and the mainstem river.

- *Infrastructure improvements*—modification of structures in the floodplain to allow peak flows.

- *Adaptive environmental assessment and monitoring*—a rigorous program to monitor and improve restoration activities.

- *Environmental compliance and mitigation*—measures to minimize or eliminate short-term impacts.

Reclamation opened the TRRP Weaverville office in 2002 to guide implementation of the ROD based on the Flow Study and the TREIS/EIR. TRRP's focus encompasses seven activities outlined in the ROD: flow management, mechanical channel rehabilitation, sediment management, watershed restoration, infrastructure improvement, adaptive environmental assessment and monitoring, and environmental compliance and mitigation. Restoration flows in 2004 marked the beginning of active rehabilitation work for the program, followed by the first in-channel rehabilitation project in 2005.

Restoration activities in the past 11 years have focused on the first five management elements outlined in the ROD, supported by compliance and infrastructure work in the context of environmental mitigation and adaptive management. The five elements place a priority on physical restoration of the river to create the attributes of an alluvial river system that are known to enhance habitat for anadromous fish species. The ROD describes expected physical and biological outcomes from flow, channel rehabilitation, gravel, and watershed restoration activities. Monitoring and evaluation activities show progress toward these desired states.

Adaptive Management

The TRRP was established by the ROD as an adaptive management program. The Adaptive Environmental Assessment and Management (AEAM) component of the Program provides interdisciplinary information for developing and testing hypotheses regarding how the river is responding to TRRP's restoration work. Teams of scientists, managers, stakeholders, and policy makers use this information to update the restoration approach to best restore natural channel conditions and associated salmon populations. The adaptive management process (Figure 3) is systematically repeated through time as management actions are adjusted to benefit the Trinity River and its fishery resources.

2016 Highlights

Through 2016, the TRRP has conducted channel rehabilitation work at 33 of the 47 sites described in the Flow Evaluation Report within the TRRP Focal Reach (Figure 1). The TRRP substantially improved upon and enhanced previous efforts to lower floodplains and construct key habitat features around the Bucktail boat access site (Figure 2).

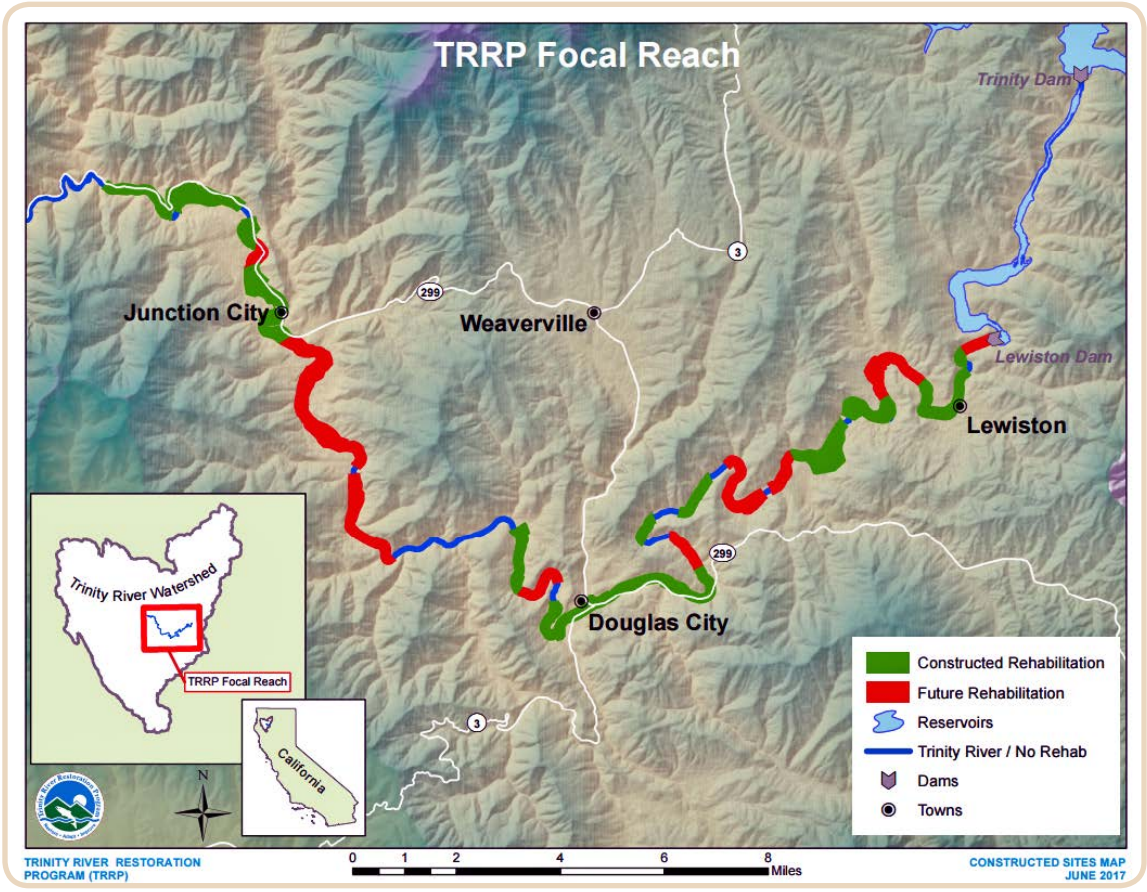


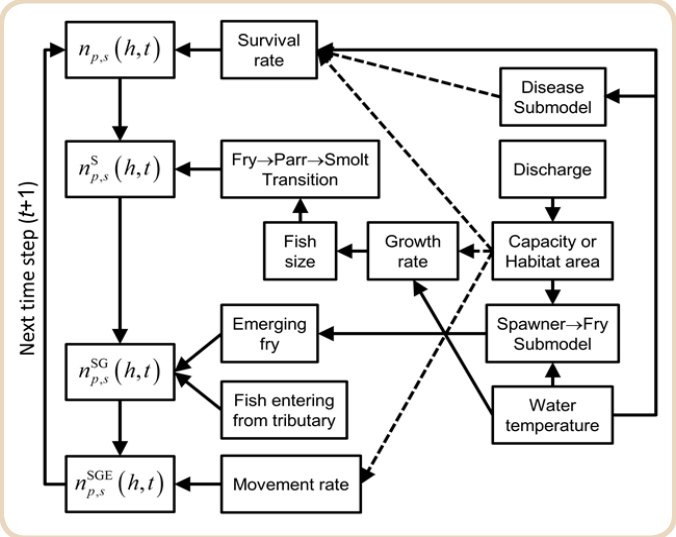
Figure 1. Map of the TRRP Focal Reach.

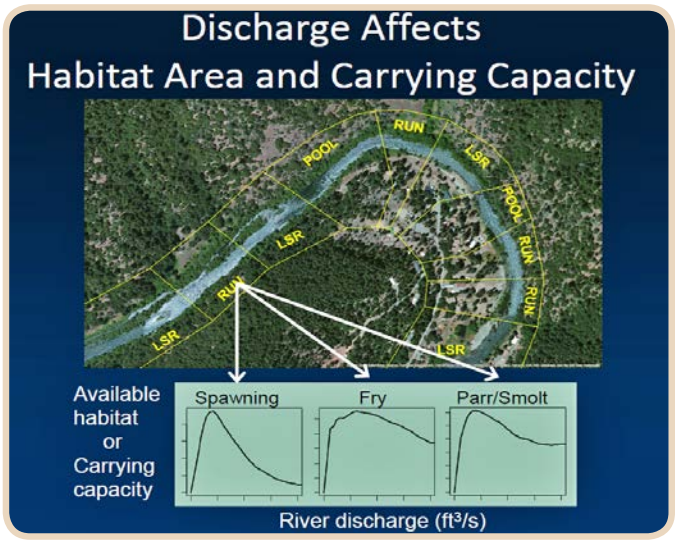
Figure 2. The Bucktail channel rehabilitation project was completed in 2016 and included the first beaver dam analog used at a channel rehabilitation site.

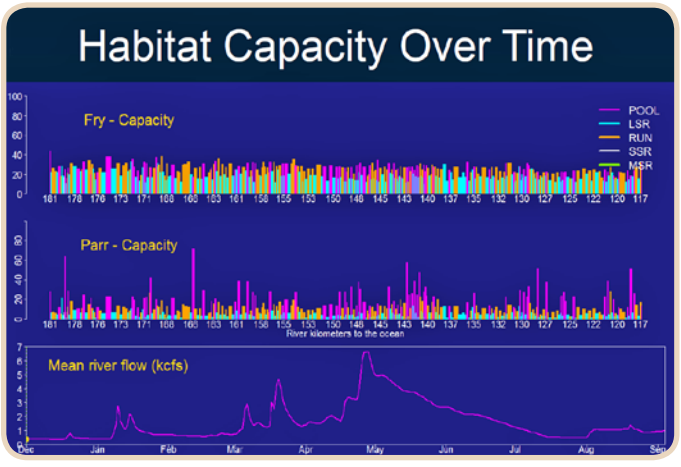
Program partners neared completion of a draft fish production model known as the Stream Salmonid Simulator (S3). The USFWS is developing the S3 model in collaboration with the U.S. Geological Survey (USGS) Columbia River Research Laboratory, Dr. Thomas Hardy from Watershed Systems Group, Inc., and Texas State University. The S3 model will enable evaluation of the effects of TRRP management actions and restoration scenarios on juvenile Chinook salmon (*Oncorhynchus tshawytscha*) production. The S3 model is composed of coordinated sub-models that reflect an array of physical and biological processes that affect the growth, movement, and survival of juvenile salmonids. The S3 model is constructed to:

1. Link habitat and flow to population dynamics
2. Operate on spatial scales that capture habitat quality gradients in the basin
3. Run on temporal scales that capture variability in river discharge that can result from flow management actions

The S3 model can update sub-models as new data and analyses become available. Sub-models currently being developed include a module to incorporate salmon-rearing conditions in the lower Klamath River and the Pacific Ocean and an upstream adult migration module that will enable the S3 model to function as a full life-cycle model. Future development of the S3 model will include predictions of fish dynamics for coho salmon (*O. kisutch*) and steelhead (*O. mykiss*), as requested by NOAA Fisheries and Reclamation, and modules for foothill yellow-legged frogs (*Rana Boylii*) and cottonwood recruitment.







Schematic summary of the S3 model showing linkages between physical drivers, demographic processes, and changes in daily abundance. Dashed lines show submodels that that may be turned on or off to represent different dynamic processes in the S3 model. See forthcoming report, Model Structure of the Stream Salmonid Simulator (S3): A Dynamic Model for Simulating Growth, Movement, and Survival of Juvenile Salmonids, *by R.W. Perry, J.M. Plumb, E.C. Jones, N.A. Som, N.J. Hetrick, and T.B. Hardy.*

Important Terms

Anadromous Fish. Fish, such as salmon and steelhead that spawn in fresh water, migrate to the ocean to grow, and then return to fresh water to spawn.

Fossilization. The process of stabilization and "hardening" of gravel bars by rooted riparian vegetation, which also contributes to increased deposition of alluvial silts on the bars, promoting establishment of yet more vegetation and so on.

Geomorphology. The science of landforms, with an emphasis on their origin, evolution, form, and distribution across the physical landscape.

Hydraulic. Hydraulic action is the movement or wearing down of material by flowing water. In geographic processes, hydraulic action is also known as erosion.

Hydrograph. A chart that displays the change of a hydrologic variable over time. A discharge hydrograph, for example, shows the rate of flow (discharge) versus time past a specific point in a river.

Hyporheic zone. A region beneath and alongside a streambed where there is mixing of shallow groundwater and surface water.

LiDAR—light detection and ranging. An optical remote-sensing technique that uses laser light to densely sample the surface of the earth, producing highly accurate x,y,z measurements

Morphodynamic. The study of landscape changes due to erosion and sedimentation.

Point bars. Point bars are features of alluvial river channels formed by the deposition of sediment on the convex bank of a curve in the channel as erosion of the opposite concave bank occurs.

Point cloud. A set of three-dimensional point locations that provide a digital representation of an object or surface. Point clouds for natural resource sciences are typically derived from laser scanning methods, including aerial LiDAR and ground-based scanners, sonar methods for bathymetry (underwater topography), and recent methods for processing photographs with computer vision techniques. Point clouds often include thousands to millions of points.

Programmatic environmental document. A programmatic environmental impact statement evaluates the effects of broad proposals or planning-level decisions that may include any or all of the following: a wide range of individual projects; implementation over a long timeframe; and implementation across a large geographic area.

Record of Decision (ROD). A legally binding document that identifies a Federal agency's decision on how it will proceed with the proposed action identified in an environmental document prepared to comply with the National Environmental Policy Act (NEPA).

Restoration flow. All ROD-mandated flows, including summer and winter base flows and peak flows in the spring.

Riparian. Located on the bank of a river or other water body. The Riparian Zone is the area of direct two-way interactions between aquatic and terrestrial systems.

Funding and Expenditures

TRRP funding has varied between $10 and $16.66 million per year. In fiscal year (FY) 2016, the Program received a total of $15.14 million, as shown in Table 1.

Table 1. Fiscal Year 2016 Funding (in millions of dollars)

BUREAU OF RECLAMATION	
Water and Water-related Funds	$11.91
Central Valley Project Improvement Act Restoration Fund	$1.5
FISH AND WILDLIFE SERVICE	
FY 2016 Appropriations	$1.73
TOTAL	**$15.14**

Most of the funding supported physical modifications to the river and the associated watershed and monitoring of physical and biological responses. Other partner agencies contributed in-kind services to support Program activities.

The Program FY 2016 budget allocations for TRRP totaled $15.14 million with funding for three primary areas: Administration ($2.7 million), Restoration Rehabilitation Implementation ($7.44 million), and Science Program ($5 million) (Table 2).

Table 2. Fiscal Year 2016 TRRP Allocations (in millions of dollars)

Trinity River Restoration Program Budget Allocations	
TRRP Administration	$2.7
Restoration Rehabilitation Implementation	$7.44
Science Program	$5.0
TOTAL	**$15.14**

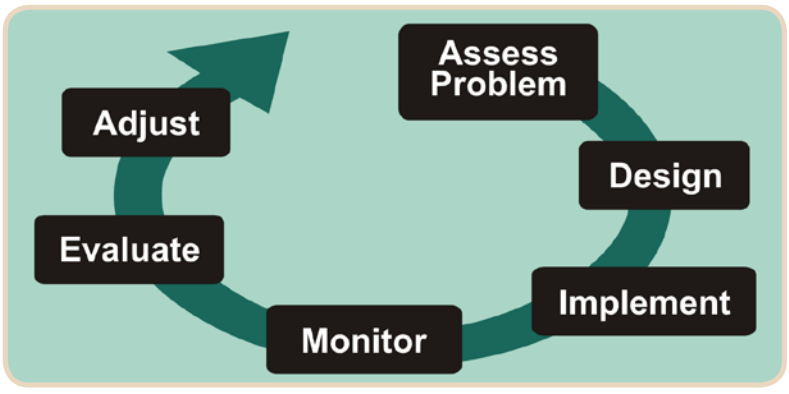


Figure 3. The adaptive management process.

Caryn Huntt DeCarlo, TRRP Executive Director

After serving temporarily in the position for 5 months in 2016, Caryn became the Executive Director of TRRP in January 2017. She has been working with river restoration projects for 14 years, formerly in the Desert Terminal Lakes Restoration Program in Nevada. Both her former and current work include coordinating collaboratively to achieve restoration goals with private landowners, Native American Tribes, Federal, State, and local agencies, universities, businesses, and national/local non-profits.

Caryn has a M.S. and B.S. in Natural Resource Management from the University of Nevada, Reno.

Caryn is honored to be part of the Trinity River Restoration Program and shares that she is inspired by the devoted TRRP Partner staff and stakeholders who care deeply about the ecological health and restoration of the Trinity River fisheries. She recognizes TRRP affects many stakeholders with a wide variety of interests important to each. She believes striving to balance the TRRP's Federal mandates and restoration goals with all the various stakeholder interests is critically important to TRRP's success.

Caryn is married to Ed, a retired forester, and they have two grown children, Emily and Paul and his wife Rachel, who live in Seattle.

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Activities and Accomplishments

Flow Management

Restoration Releases

Each year, the TRRP's Flow Workgroup, the Trinity Adaptive Management Working Group (TAMWG), and the Trinity Management Council (TMC) recommend a schedule for releasing restoration flows to Reclamation. The selection criteria used for determining each year's hydrograph include: providing suitable temperatures for all salmonid life stages, reducing the travel time for outmigrating smolts, managing riparian seed germination, reducing fine sediment storage, and providing monitoring opportunities to support learning and adaptive management strategies.

The water volume for restoration releases into the Trinity River below Lewiston Dam is based on the forecasted inflow to Trinity and Lewiston reservoirs, grouped into five water year types. Forecasts are used because the actual water year type is not known at the time that annual release schedules are developed. The forecasted water year type for 2016 was "Wet."

The 2016 water year (WY) began with Trinity Reservoir at 543,400 acre-feet (af) (0.670 cubic kilometers [km^3]), which is roughly 22.6 percent of capacity, and ended with Trinity Reservoir at 969,400 af (1.20 km^3), which is roughly 40.4 percent of capacity.

Because it was a Wet water year, the TMC recommended a restoration release of 701,000 acre-feet based on the B120 April 1, 2016, 50 percent inflow forecast from the California Department of Water Resources (CDWR) (CDWR 2017). Reclamation implemented a modified ROD hydrograph known as the Wet-Biophysical-Riparian (WBR 2p) to meet programmatic objectives for a Wet year, increase geomorphic work, and meet riparian objectives. Figure 4 shows the summer releases from Lewiston Dam.

Robert Franklin, Hydrologist for Hoopa Tribal Fisheries

Robert has been involved in Trinity River fisheries restoration since 1987. He left his native Pasadena, California, in the late 1970s, and attended Humboldt State University, gaining degrees in Fisheries Biology (B.S.) and Natural Resources (M.S.) before coming to Hoopa Tribal Fisheries in 1989. He led interdisciplinary studies focused on restoring the health of the Trinity River, which culminated with publication of the Trinity River Flow Evaluation Study in 1999—that study forms the basis of today's Trinity River Restoration Program.

Robert and his wife, Shelby, were married in Weaverville 21 years ago this month. They have three children ranging in age from 14 to 24 years. Fortunately, their youngest shares Robert's fascination with rivers and streams, providing a handy excuse to go fishing.

Seth Lawrence, Senior Engineer, California Department of Water Resources

Seth has been with DWR in the Northern Region Office for 17 years, splitting his time between groundwater and river restoration work. He has a B.S. from Humboldt State University in Environmental Resources Engineering and is a registered Professional Engineer. He is active in the TRRP, sits on the Flow Workgroup and the Interdisciplinary Design Team (IDT), and attends design team meetings. Seth currently supervises the Engineering Studies Section of the Northern Region Office which provides engineering and surveying support to the TRRP.

Currently Seth lives in Red Bluff California with his wife and three boys. He stays busy with kids sports, scouts, and running a family farm.

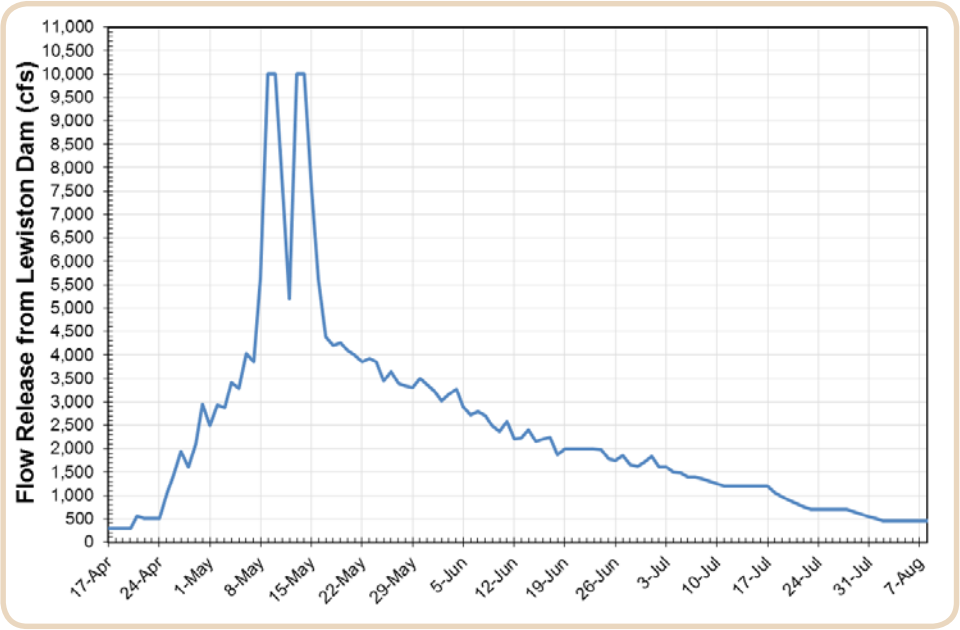

Figure 4. Summer releases from Lewiston Dam.

Flow Release Rates from Lewiston Dam

Figure 4 shows the actual WY2016 flow releases from Lewiston Dam to the Trinity River, based on the average daily stream flow record from the Lewiston gage (USGS #11525500). Reclamation released flows higher than 450 cubic feet per second (cfs) (12.7 cubic meters per second [cms]) in August and September 2016 to supplement flows in the lower Klamath River. All other flow releases were conducted for river restoration purposes (i.e., the TMC flow, which is the recommended TRRP restoration flow release). Figure 5 also shows the "full natural flow" (FNF) at Lewiston. The FNF is the quantity of water that would have passed the gage at Lewiston if Trinity and Lewiston Dams or other diversions or impedances had not been in place.

Implementation of Restoration Flow Schedule

Outcome of Hydrograph Implementation

In addition to showing actual water releases and the FNF, Figure 5 illustrates the releases from Lewiston Dam relative to the TMC-specified release schedule compared to the FNF, as measured by the Lewiston gage located below Lewiston Dam (USGS #11525500). Actual deviations were due to the operational constraints of the gates at Lewiston Reservoir and are within the measurement accuracy of the gage. Elevated flows in August and September were part of the Lower Klamath River late summer flow augmentation.

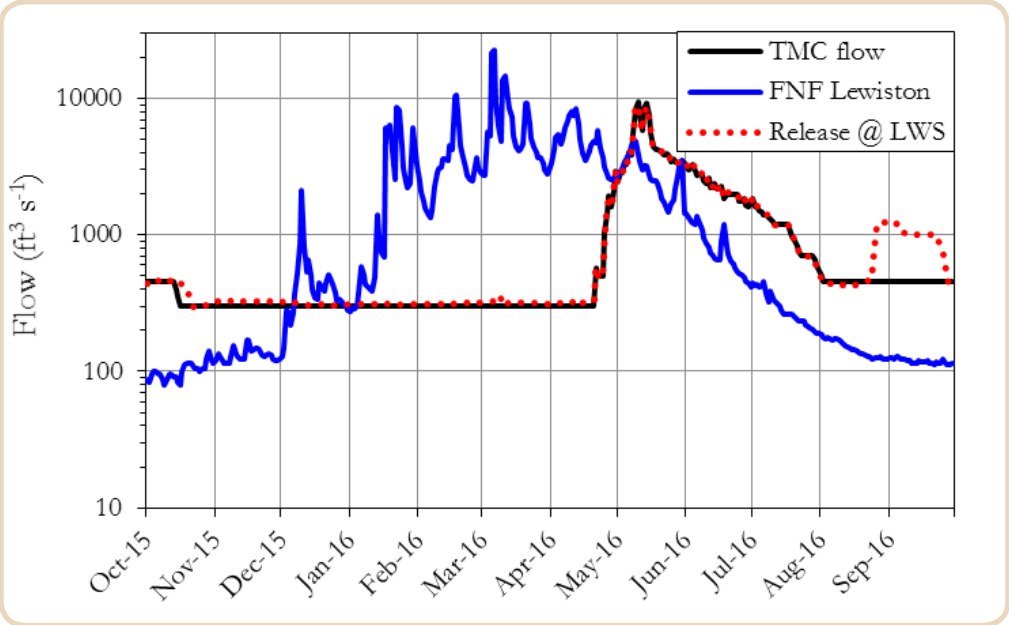

Figure 5. The "full natural flow" (FNF) at Lewiston (LWS; blue line), actual WY2016 flow release (redd dotted line), and flow release approved by the Trinity Management Council (TMC; black line).

Temperature Targets and Compliance

To protect all life stages of Trinity River salmonids, regulatory compliance mandates and scientifically based temperature targets have been established for multiple time periods at multiple locations along the Trinity River. River temperature is measured at Douglas City and above the confluence with the North Fork Trinity River to meet regulatory compliance targets specified in State Water Resources Control Board (SWRCB) Order WR 90-5 (SWRCB 1990). Additional targets for Douglas City and Weitchpec were added by the TREIS/EIR . Temperature targets (in degrees Fahrenheit [°F] and Celsius [°C]) and dates are shown in Table 3.

Table 3. Trinity River Temperature Targets by Reach and Date

Source	Target Reach	Dates	Target
		All Years	
Basin Plan for the North Coast Region (NCRWQCB 2011) NMFW (2000) and WR 90-5	*Lewiston to Douglas City*	*July 1–September 14*	*≤60 °F (15.5 °C)*
	Lewiston to Douglas City	*September 15–30*	*≤56 °F (13.3 °C)*
	Lewiston to North Fork	*October 1–December 31*	*≤56 °F (13.3 °C)*
Springtime Objectives of the Record of Decision for the Trinity River (USFWS et al. 2000)	*Lewiston to Weitchpec*	**Normal & Wetter Water Years — Optimum**	
		April 15–May 22	*≤55.4 °F (12.8 °C)*
		May 23–June 4	*≤59.0 °F (15.0 °C)*
		June 5–July 9	*≤62.6 °F (17.0 °C)*
		Dry & Critically Dry Water Years — Marginal	
		April 15–May 22	*≤59.0 °F (15.0 °C)*
		May 23–June 4	*≤62.6 °F (17.0 °C)*
		June 5–June 15	*≤68.0 °F (20.0 °C)*

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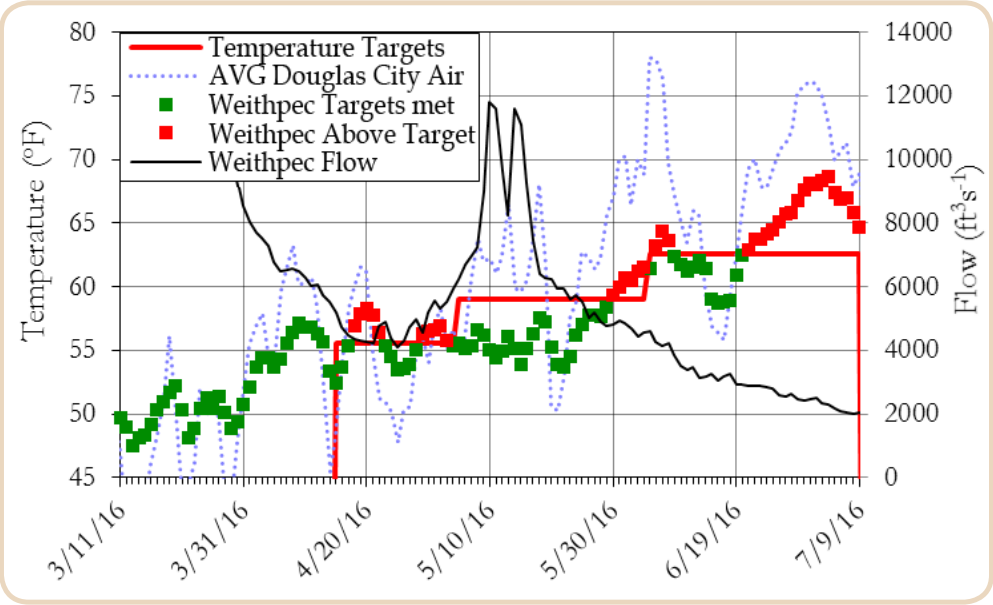

Figure 6. Trinity River spring and summer temperatures at Weitchpec. Temperature targets are shown as a solid red line indicating the highest temperatures for 'optimal' conditions.

— Temperature Targets and Compliance continued

The temperature target point recommended by the Flow Study at the confluence of the Trinity and Klamath Rivers (just upstream from Weitchpec on the Trinity River) is meant to ensure that temperature regimes are suitable for outmigrating salmonid smolts. The Weitchpec temperature target is designed to provide optimal temperatures in normal or wetter years, and marginal temperatures in dryer years, based on outmigrating fish studies (Table 3). The Hoopa gage (USGS #11530000) is roughly 12 river miles (19.5 river kilometers) upstream of Weitchpec.

Figure 6 shows water temperatures and temperature targets at Weitchpec and flows at Hoopa during the outmigration period. Mean daily temperatures exceeded the 'marginal' range starting in the end of April, and continued to periodically exceed the target through the remainder of the target period. Days with temperatures in exceedance of marginal targets are shown in red on Figure 6. Marginal temperature targets were met 48 days out of the 85 day target period, approximately 56% of the time. The average water temperature above the optimal target was 2.4 °F, with the peak exceedance of 6.0 °F occurring June 4, 2016.

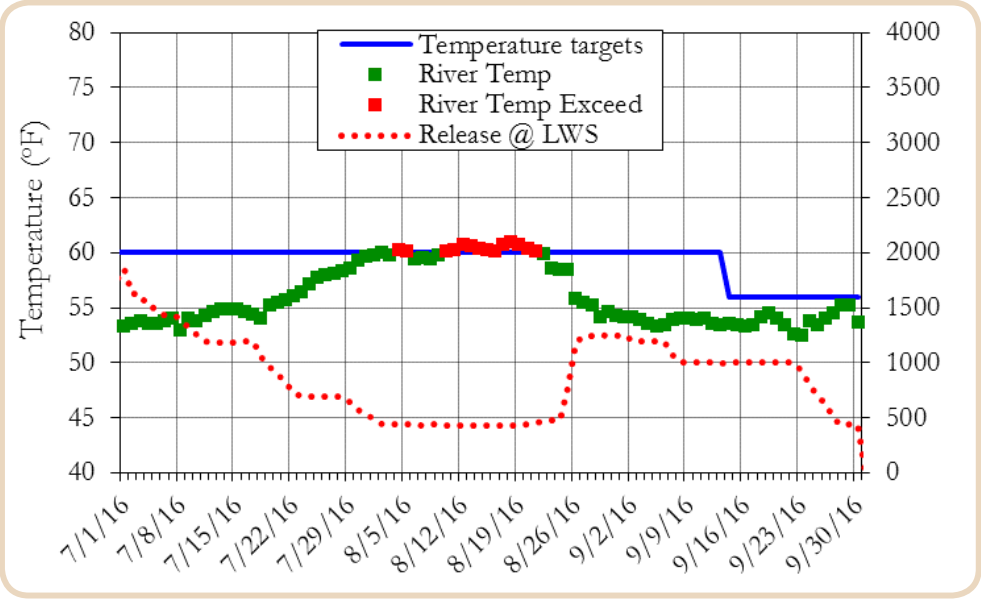

Figure 7. Trinity River summer and fall temperatures at Douglas City (DGC). Solid blue line shows temperature compliance target at Douglas City. The dotted red line shows discharge at the Lewiston Gage (LWS) (USGS#11525500).

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— Temperature Targets and Compliance continued

The target not to exceed 60 °F at Douglas City from July 1 to September 14 is to ensure appropriate temperature regimes for summer holding spring run Chinook and rearing juvenile coho salmon. The compliance mandate set forth in WR 90-5 (SWRCB 1990) from September 15 through September 30 at 56 °F is to ensure appropriate temperature regimes for spawning Chinook salmon and migrating adult coho salmon. River temperatures at Douglas City during the target period are influenced by release temperatures at Lewiston Dam and local weather.

In WY2016, the Trinity River temperatures at Douglas City remained near the temperature target during the summer holding period while flows remained at baseflow. Figure 7 shows water temperature, targets, and mandates for Douglas City along with the flow rate released from Lewiston Dam. Discharges above baseflow (450 cfs) were released for lower Klamath River fish health concerns, which caused a sharp decline in water temperatures on August 26, 2016 (Figure 7). In WY2016, the Trinity River water temperatures at Douglas City remained near the target for the summer holding period when discharge was at baseflow. During the compliance period, targets were met for 62 out of 76 days, with exceedances limited to August during the middle of the summer holding target period. The average exceedance above summer holding targets was 0.44 °F with maximum of 1.0 °F on August 1, 2016. The compliance mandates (September 15 –September 30) were satisfied for all of the days (16 of 16) during the spawning period.

Water Volume Accounting

The total volume of water released from Lewiston Dam to the Trinity River in WY2016 was 748,100 af. Of that total, restoration releases accounted for 708,800 af. The difference between the restoration water volume (701,000 af) and measured restoration releases (708,800 af) is roughly 1.1%, and is less than the ±10% accuracy of the stream gage record. Therefore, the water volume of the restoration releases equals the volume recommended when measurement error is accounted for. Additional releases to address lower Klamath River fish health concerns accounted for 39,200 af.

Bill Brock, Fish Program Manager, Shasta-Trinity National Forest

Bill was born on the island of American Samoa and spent the first few years of his life there before moving to California to live in the Bay Area, Morro Bay, and Santa Barbara, then in Humboldt, Trinity, and Shasta Counties. He attended University of California at Santa Barbara and Humboldt State University to get a B.S. in fisheries and an M.S. in Watershed Management. His involvement with the Trinity River began in 1981 when he was the first person hired to launch the Hoopa Tribal Fisheries Department. Seven years with the Tribe was followed by seven years with the Fish and Wildlife Service working for the Trinity River Restoration Program in Weaverville. He then worked four years with the Bureau of Reclamation at Shasta Dam before joining the U.S. Forest Service.

Bill lives in Redding and has been married to his wife Sheila for 25 years. They have a 22-year-old son, Benjamin, and a 20-year-old daughter, Bridget. Bill now spends much of his free time riding his human-powered racer bike.

Basin Export Volume

Reclamation exported a total of 278,900 af of water from the Trinity River to the Sacramento River in WY2016, as reported by the California Data Exchange Center for the Judge Carr Power Plant. Table 4 lists the history of the in-basin releases and basin exports, and includes the balance in terms of the average annual basin inflow since inception of the ROD. Exports in WY2016 to the Carr Power Plant were approximately 36% of the long-term average annual inflow to Trinity Reservoir.

Table 4. Water Releases and Diversions as Percent Long-term Average Inflow

Water Year	Restoration Releases to the Trinity River	Diversions to the Sacramento River	All Other Releases	Total Releases and Diversions
	30.3%	53.4%	0.3%	84.0%
2002	38.5%	50.2%	0.0%	88.7%
2003	35.7%	68.4%	8.6%	112.7%
2004	51.9%	78.7%	9.4%	140.0%
2005	51.6%	37.2%	0.3%	89.1%
2006	64.6%	107.7%	32.4%	204.7%
2007	36.2%	49.0%	0.3%	85.5%
2008	51.7%	44.3%	0.0%	96.0%
2009	35.5%	43.0%	0.9%	79.4%
2010	52.4%	21.9%	0.0%	74.3%
2011	57.6%	37.7%	0.9%	96.1%
2012	51.6%	56.6%	3.1%	111.3%
2013	36.0%	68.0%	2.3%	106.3%
2014	29.5%	49.3%	5.2%	84.0%
2015	35.9%	35.9%	4.6%	76.4%
2016	56.5%	22.2%	3.1%	81.9%
Average (2001 - 2015)	44.7%	51.5%	4.5%	100.7%
Five Year Average (2011 - 2015)	41.9%	46.4%	3.6%	92.0%

The long-term average annual water inflow for Trinity Reservoir is 1,254,000 af per year, as reported by Reclamation for the period 1911-2007. Percentages above or below 100% are possible due to changes in reservoir storage across water years.

Reservoir Conditions

The 2016 water year began October 1, 2015 with Trinity Reservoir holding a total volume of 543,400 af, roughly 24.7% capacity (Figure 8). The water year ended on September 30, 2016 with Trinity Reservoir holding a total volume of 969,400 af, roughly 39.6% capacity. The total release from Trinity Reservoir in WY 2016 amounted to 1,027,000 af. Releases totaled 81.9% of the long-term average annual inflow to Trinity Reservoir, or approximately 70% of WY 2016 FNF. Total evaporation from the Trinity and Lewiston Reservoirs was 33,800 af in WY2016.

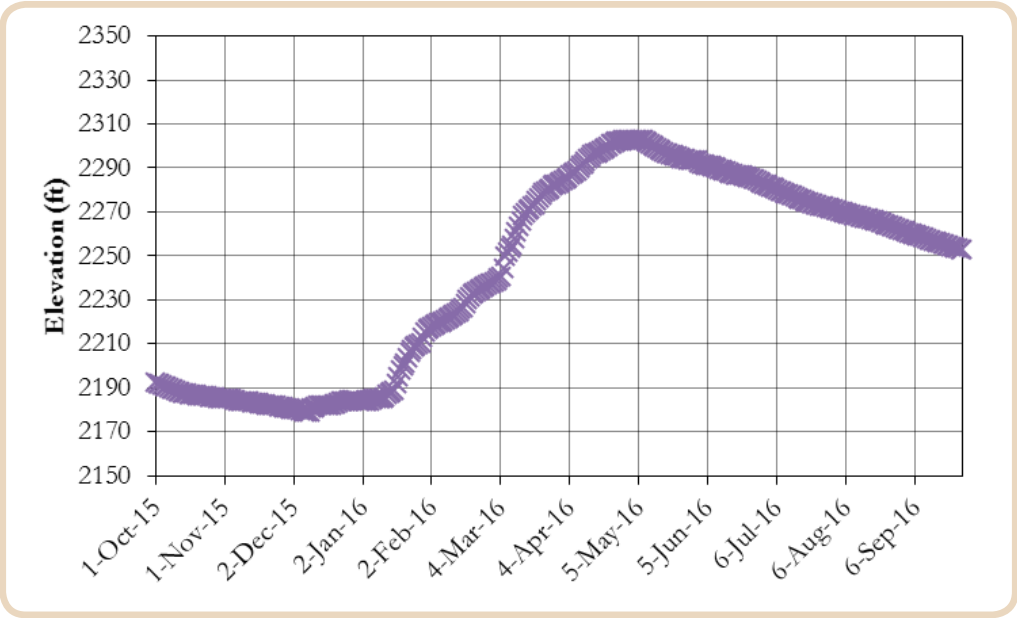

Figure 8. WY2016 Reservoir elevations for Trinity Lake.

Mechanical Channel Rehabilitation

Bucktail Channel Rehabilitation

Channel rehabilitation work was conducted at the Bucktail site to further improve habitat conditions at previously constructed TRRP sites as covered in the Master EIR (USFWS and HVT 1999). The Bucktail site is immediately upstream of Trinity County's Bucktail Bridge, comprising 110.4 acres, the site includes a Bureau of Land Management (BLM) managed boat launch and comfort area (see Figure 9). The site spans approximately 1.5 miles of the Trinity River from River Mile (RM) 105.5 to RM 107.0. More than 60 percent of the site is privately owned, but the site also includes BLM-managed land.

Site Characteristics

The Bucktail rehabilitation site was first designed in 2007 and constructed in the summer and fall of 2008. The Bucktail rehabilitation site encompasses a stretch of river that includes several sharp bends, bounded by steep valley walls on the inside of the bends. Evidence of historic dredge activities is visible at several locations throughout the site. Although some mature riparian vegetation occurs on alluvial features, upland vegetation adjacent to the project area is characterized as scattered stands of mixed conifer/hardwood forest with an understory of shrubs and grasses.

The 2016 Bucktail channel rehabilitation project included:

- Constructing two side channels
- Lowering part of a barren floodplain and stocking it with woody material
- Installing wood jams ballasted with boulders
- Slowing an existing side channel with gravel and a wood grade-control structure
- Developing a flow-through wetland with a beaver dam analog used as a water control structure

Post-construction riparian improvement included revegetating wetland, upland, and riparian areas. A variety of native sedges, rushes, and willows were planted in the wetland/slope areas after the construction was completed.

Initial Design and Redesign

After the Dark Gulch rehabilitation site construction was originally completed in 2008, several factors led the TRRP to initiate a new rehabilitation site. As with previous channel rehabilitation projects on the Trinity River, the Bucktail channel rehabilitation project was designed to increase aquatic habitat for salmonids over a range of flow conditions by creating hydraulic and ecological complexity in the form of in-channel and riverine elements. Work included activities at the downstream end of the Dark Gulch rehabilitation site and the upstream end of the Lowden Ranch rehabilitation site (originally completed in 2010).

The Bucktail channel rehabilitation site was designed to build and sustain dynamic mainstem bar (point, medial) and riffle morphology, and off-channel rearing areas intended to increase and sustain the availability, quantity, and quality of anadromous fish habitat between 300 cfs and 2,000 cfs for all life stages. The design elements for the Bucktail channel rehabilitation included mid-channel islands, split flows, side channels, off-channel ponds, alcoves, floodplain, large wood/boulder habitat structures, and riparian revegetation. Site-specific design features are intended to evolve over time under the congressionally mandated flow releases described in the ROD.

Rehabilitation Design

Figure 10 shows an example of conditions at the site in 2014 before rehabilitation. From 2014 to 2016, the Hoopa Valley Tribe Design Group designed the rehabilitation work at the Bucktail site using a multi-disciplinary and multi-organizational approach that focused on including stakeholder input early in the design phase. The Design Team reached out to local landowners and the riverine community during the planning process to discuss and evaluate design elements and measures that best met the project goals and objectives. Through this collaborative process, several alternatives were formally evaluated using objective and quantitative metrics before an agreement was reached on the best alternative to implement. This more structured design process helped to foster better communication and transparency and created an environment that allowed for new ideas and recommendations.

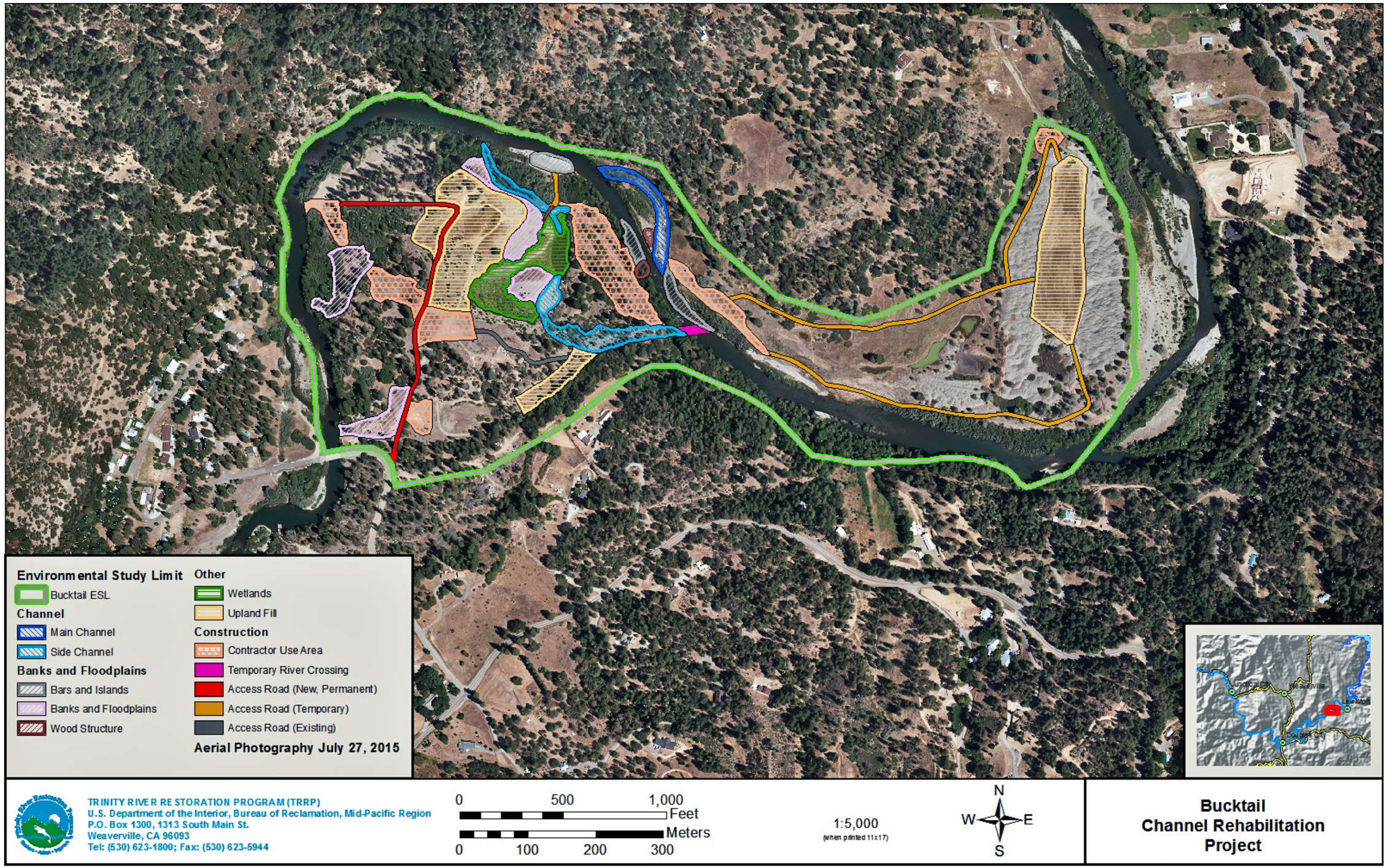

Figure 9. Map of Bucktail site with original features and new activity areas from the 2014-2016 rehabilitation work.

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Rehabilitation Activities

The activity areas for the 2016 Bucktail channel rehabilitation are shown in Figure 9. A description of the activity areas is described in detail in the Final Environmental Assessment/Initial Study (EA/IS) for the Bucktail site (North Coast RWQCB et al. 2016).

The ground surface in select locations was modified to reduce riparian encroachment and minimize the risk of stranding juvenile salmonids. To reconnect the Trinity River with its floodplain at targeted flows, lowered floodplain surfaces were constructed and associated alcoves were excavated to remain inundated to provide year-round juvenile fish habitat (Figure 11).

Figure 10. Conditions at Bucktail in 2014. Note the gravel bar in the forefront.

A structure like a beaver dam, consisting of buried posts, provided a framework of willow cuttings to raise groundwater elevations at various flows. Side channels above and below this structure were constructed to provide surface flows to enhance the existing seasonal wetland. A combination of excavation, coarse sediment, riparian plantings, and engineered log jams were used to redirect most of the mainstem flow into a new channel alignment, with an alcove in the previous natural channel. The forced meander was constructed to allow a limited amount of surface flow into the new alcove, allowing it to provide habitat for juvenile Chinook salmon with stream-type life histories.

Figure 11. Split flow side channel constructed at the Bucktail channel rehabilitation project. The temporary gravel dam at the entrance to the side channel was removed after construction was complete.

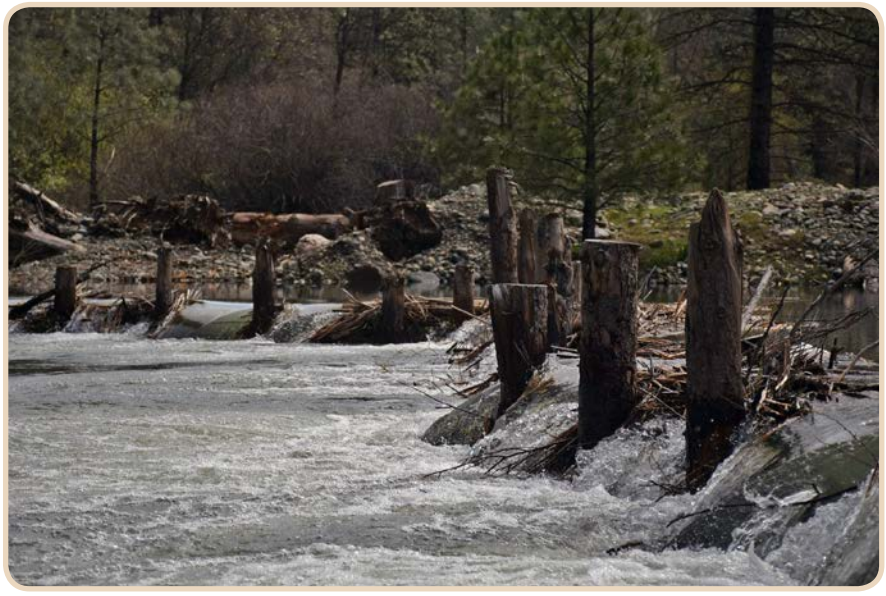
Features constructed at the Bucktail site included:

- Constructing low flow side channels and split flow structures to provide juvenile salmon rearing habitat

- Connecting an existing seasonal wetland to surface and subsurface flows to provide juvenile salmon rearing and foraging habitat

- Shifting the main channel into a new meander to decrease slope and increase spawning area

- Lowering areas of the floodplain to increase connection to the river at a greater range of flows, increasing shallow rearing habitat



- Installing engineered log jams and beaver dam analogs to provide cover for fish and to increase channel complexity and groundwater retention

- Revegetating construction-disturbed upland and riparian areas

Coarse Sediment Management

Trinity and Lewiston Dams trap the supply of coarse sediment (gravel and small cobble) above Lewiston Dam (Figure 12). To replace the coarse sediment trapped behind the dams and to balance the coarse sediment transported during high-flow release, the ROD directs a coarse sediment augmentation program below Lewiston Dam. The combination of the high-flow releases and coarse sediment augmentation is intended to increase the availability and quality of physical habitat by promoting the processes of scour and fill that maintain bars, pools, juvenile rearing habitat, spawning beds, and other elements of channel complexity. Progress toward these goals is assessed by measuring coarse sediment transport, estimating sediment fluxes, and tracking changes in channel topography.

Figure 12. Distribution of suitably sized cobbles and gravel are necessary to create habitat for fish spawning.

Water year 2016 was a Wet year, and flow releases from Lewiston Dam attained two separate peaks with daily mean discharges of 8,870 cfs on May 10 and 8,710 cfs on May 14. These relatively large peak flow events made it possible to introduce a total of 3,600 cubic yards of coarse sediment into the river channel. A little more than half of that total (55%) was introduced into the flow about a mile from Lewiston Dam, and the remainder was introduced at a second location about 6 miles downstream from the dam. The quantity of coarse sediment added to the river in 2016 was determined using methods described by Gaeuman (2014). Subsequent sediment monitoring shows that the augmentation provided about two-thirds as much coarse sediment as was transported in more downstream reaches of the river where natural sediment supplies are abundant.

Sediment Transport Monitoring

TRRP monitors sediment transport rates during annual spring flow releases at four locations downstream from Lewiston Dam. This monitoring is intended to assess gravel augmentation needs and to determine whether management objectives to increase coarse sediment transport rates and coarse sediment storage are being met. Figure 13 shows that as intended, the 2016 gravel injection and restoration flow releases increased topographic diversity with scour and deposition.

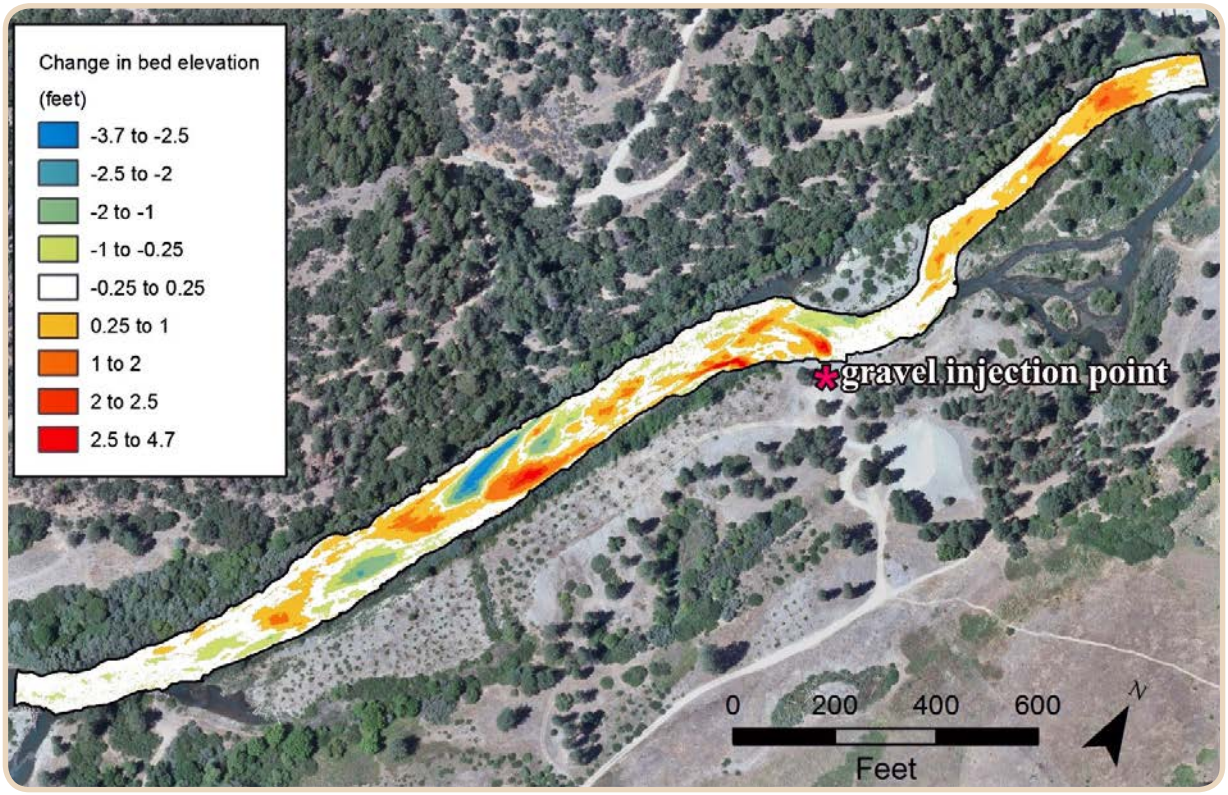


Figure 13. Observed changes in bed elevations at the Lowden Ranch channel rehabilitation site after the 2016 gravel injections and restoration flow releases.

In addition to collecting physical samples of suspended and bedload sediment discharge, investigations into alternative technologies for assessing sediment transport rates continued in 2016. TRRP scientists collaborated with USGS researchers to refine the use of hydrophones to detect acoustic vibrations that provide a continuous record of coarse sediment transport rates throughout the flow release (Marineau et al. 2016). This type of acoustic monitoring can generate useful estimates of bedload transport rates at a lower cost than traditional sediment sampling. Water year 2016 also saw continued collaboration with University of New Mexico researchers, who deployed an array of seismometers at one sediment monitoring location to detect ground vibrations generated by sediment transport. Prior seismic monitoring in 2015 showed that this research tool can provide new insights into the temporal and spatial variability of gravel transport characteristics (Gaeuman et al. 2017 and Schmandt et al. 2017).

Physical and Biological Responses to Restoration Flows

Riparian Monitoring

The TRRP intends to indirectly restore the Trinity River fishery by restoring natural processes. An important suite of natural processes includes riparian vegetation establishment, growth, and mortality.

Riparian vegetation provides numerous benefits to fish as a source of cover and shade and a source of food for the insects that fish eat; it also provides a source of large woody debris around which the river can scour or deposit sediment. Riparian vegetation also provides habitat elements for songbirds and other species.

Spring releases from Lewiston Dam are timed to promote the natural recruitment of important riparian species, such as black cottonwoods (Figure 14). For successful recruitment, the flood peak needs to occur before the seed dispersal period, the seeds need to fall on suitable surfaces, and the water surface needs to recede slowly enough that the seedling roots can track the water table as it sinks to its late-summer level. In addition, the flows need to interact with the right surfaces for riparian vegetation to become established. The TRRP creates those surfaces by moving sediment around with excavators, bulldozers, and dump trucks during channel rehabilitation projects.

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Figure 14. Jeannie Mcsloy, TRRP natural resource scientist, records cottonwood seed dispersal along the Trinity River.

— Riparian Monitoring continued

TRRP has been investigating how to synchronize the spring releases with the cottonwood seed rain. To answer this question, TRRP biologists monitored seed dispersal by visiting specific female cottonwood trees weekly during the spring. By monitoring when the peak of seed dispersal occurs, TRRP can schedule flow releases so that the water reaches floodplains and the floodplains stay wet when the peak of the seed dispersal period occurs. The data collected in WY2016 is summarized in Figure 15.

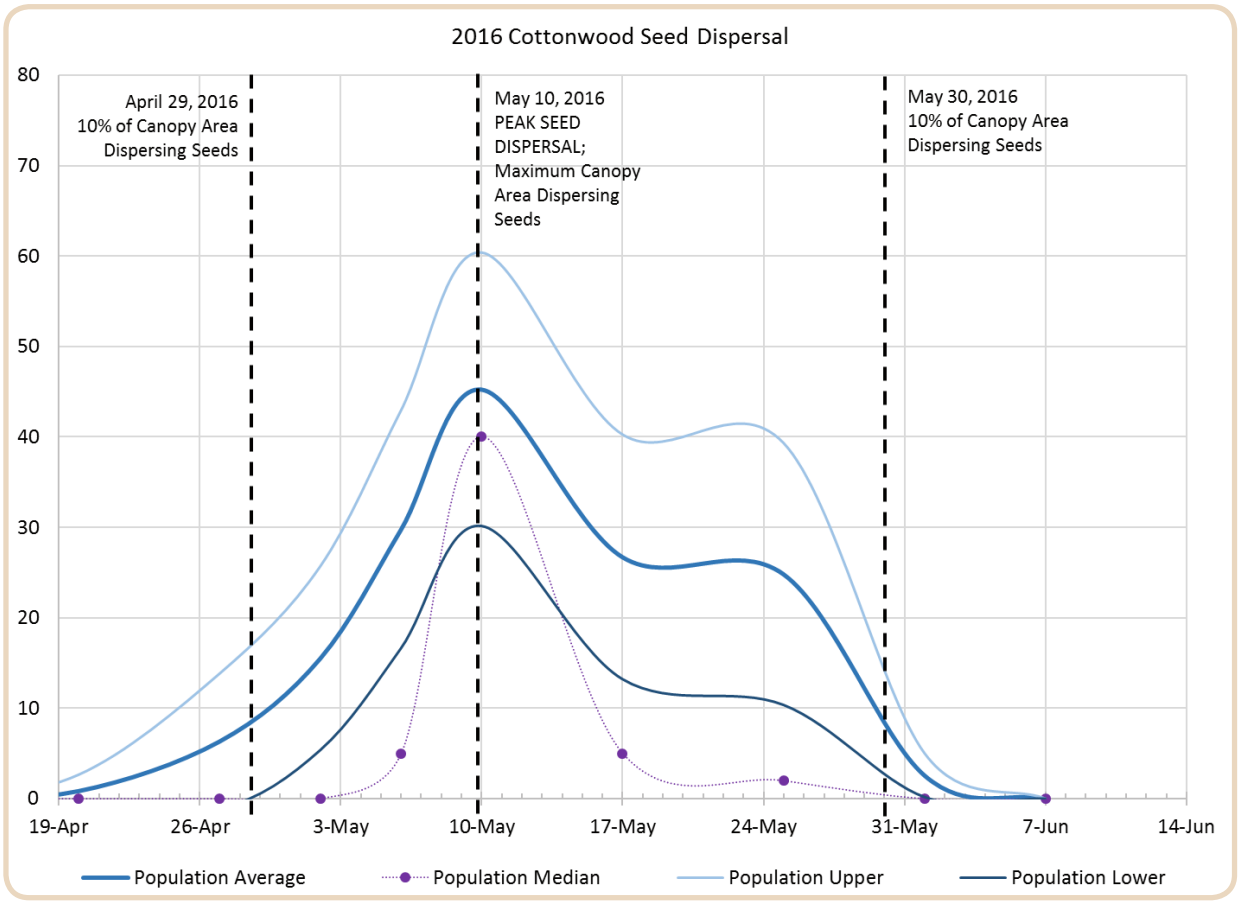

Figure 15. Seed dispersal period for black cottonwood monitored in WY 2016.

TRRP uses flows to promote establishing vegetation on floodplain and to scour the willow seedlings that sprout along the summer baseflow channel margin. Before restoration flows were implemented, dense stands of willows grew along the riverbank, which trapped sediment during floods and built berms which confined the river and prevented the gradually-sloping banks from forming, which juvenile salmonids use to feed in and to avoid larger fish. The high-flow releases help keep the dense willow thickets from forming along the river's edge. Monitoring in the fall of 2016 confirmed that the high flows scoured nearly all the willow seedlings that recruited on gravel bars and banks near the river's edge in the preceding two years (Table 5).

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Table 5. Assigned and actual water year peak magnitudes, cohort mortality objectives associated with each flow (from the Trinity River Flow Evaluation Final Report [TRFER] Chapter 8, USFWS and HVT 1999), and actual cohort mortality monitored since 2005.

Water Year	Assigned Water Year Class	ROD Assigned Magnitude	Actual Daily Average Lewiston Release	Actual Magnitude ROD WY Class equivalent	Scour Objective	Actual Cohorts Scoured
2005	WET	240.7 cms	6,970 cfs*	NORMAL	1 yr-old and YOY	2004 cohort
2006	EXT WET	311.5 cms	286.0 cms	EXT WET(ish)_	3 yr-old and younger	2003, 2004, and 2005 cohorts
2007	DRY	127.4 cms	134.5 cms	DRY	No scour mortality	
2008	NORMAL	169.9 cms	183.2 cms	NORMAL	1 yr-old and YOY	2007 cohort
2009	DRY	127.4 cms	124.9 cms	DRY	No scour mortality	
2010	NORMAL	169.9 cms	193.7 cms	NORMAL	1 yr-old and YOY	2009 cohort
2011	WET	240.7 cms	328.5 cms	EXT WET	3 yr-old and younger	2008, 2009, and 2010 cohorts
2012	NORMAL	169.9 cms	172.1 cms	NORMAL	1 yr-old and YOY	2011 cohort
2013	DRY	127.4 cms	125.1 cms	DRY	No scour mortality	
2014	CRIT DRY	42.5 cms	42.2 cms	CRIT DRY	No scour mortality	
2015	DRY	127.4 cms	235.3 cms	WET	2 yr-old and younger	2013 and 2014 cohorts
2016	WET	240.7 cms	268.1 cms	WET	2 yr-old and younger	2014 and 2015 cohorts

*Note that the releases in 2005 are measured in cubic feet per second (cfs) rather than cubic meters per second (cms)
Assigned and actual water year peak magnitudes, cohort mortality objectives associated with each flow
YOY = Young of year
EXT DRY = Extreme Dry
CRIT DRY = Critical Dry

Figure 16. Elton Baldy, of the Hoopa Valley Tribe, monitors the revegetation work at the Upper Douglas City rehabilitation site constructed in 2015.

— Riparian Monitoring continued

TRRP also investigates the changes in overall vegetated areas along the river from growing vegetation with properly timed flows, from scouring plants with floods, and from the excavation and planting that is done at channel rehabilitation sites. Every year, TRRP maps vegetation magnitude and the emerging pattern is that losses and gains in vegetation are balanced (Table 6).

Native vegetation provides many resources to the river (Figure 16). One of the most important resources is large wood, which not only provides cover for fish, but also increases the complexity of the channel from interaction with high flows (Figure 17). Large wood pieces were counted at channel rehabilitation sites in 2016 and the number was

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— Riparian Monitoring continued

Table 6. Hectares of Riparian Vegetation Mapped in Fall 2016 at 28 Channel Rehabilitation Sites (CRS).

	Preproject Riparian Vegetation		Estimated Riparian Vegetation Impact		Riparian Vegetation Impact 1yr post construction		Non-Construction Riparian Vegetation Reductions (pre/post project)		Riparian Vegetation in ESL Needed to Compensate Impact	Riparian Vegetation in ESL 2015	Riparian Vegetation in ESL 2016	Difference (2015-Compensation)	Difference (2016-Compensation)
Project	**Year**	**Area**	**Year Constructed**	**Area**	**Year**	**Area**	**Year**	**Area**	**Area**	**Area**	**Area**	**Area**	**Area**
Peartree Gulch	2005	2.9	2006	0.3	2007	0.7	2008-2010	0.1	2.8	2.8	2.8	0.0	0.0
Elk Horn	2005	5.5	2006	0.8	2007	1.9	2009	0.0	5.5	5.1	5.1	-0.4	-0.3
Valdor Gulch	2005	11.5	2006	2.6	2007	4.5			11.5	12.3	12.3	0.8	0.8
Wheel Gulch	2008	5.6	2011	1.5	N/A	N/A	2007-10	0.2	5.4	6.2	6.2	0.8	0.8
Connor Creek	2005	7.1	2006	1.3	2007	2.5			7.1	7.2	7.1	0.1	0.1
Hocker Flat	2003	12.3	2005	3.4	2006	8.0			12.3	10.7	10.6	-1.6	-1.6
Lower Junction City	2014	9.1	2015	7.7					9.1	7.7	8.6	-1.4	-0.5
Upper Junction City	2008	3.9	2012	-	N/A	N/A	2008-2009	0.2	3.7	4.0	4.1	0.3	0.4
Sheridan Creek	2016	13.6	TBD	-					13.6	13.6	14.9	0.0	1.4
Deep Gulch	2016	12.3	TBD	-					12.3	12.3	12.3	0.0	0.0
Chapman Ranch	2016	15.5	TBD	-					15.5	15.5	15.6	0.0	0.0
Evans Bar	2016	9.3	TBD	-					9.3	9.3	12.3	0.0	3.0
Lower Dutch Creek	2016	3.6	TBD	-					3.6	3.6	3.6	0.0	0.0
Upper Dutch Creek	2016	8.9	TBD	-					8.9		8.9		0.0
Lorenz Gulch	2010	7.3	2013	6.9	2014	16.9			7.3	6.7	6.8	-0.7	-0.5
Lower Steiner Flat	2008	7.7	2012	-	N/A	N/A	2008	0.3	7.4	9.3	9.4	1.9	2.1
Reading Creek	2008	13.3	2010	4.9	2011	2.4	2008	1.0	12.3	13.1	13.3	0.8	1.0
Lower Douglas City	2010	3.8	2013	0.4	2014	-0.3			3.8	3.3	3.4	-0.4	-0.4
Douglas City	2014	14.2	2015	0.0					14.2		15.1		0.9
Douglas City within 2003	2014	11.1	2015	0.0					11.1		12.0		0.9
Indian Creek	2006	33.9	2007	6.5	2008	10.9	2009	1.7	32.2	31.5	31.8	-0.7	-0.4
Limekiln Gulch	2015	6.6	2015	6.6					6.6	6.6	6.4	0.0	-0.2
Trinity House Gulch	2008	5.3	2010	1.1	2011	1.5			5.3	4.6	4.8	-0.7	-0.5
Lowden Meadows	2009	21.5	2010	10.5	2011	8.8	2006-2010	0.4	21.0	22.0	22.1	0.9	1.0
Bucktail 2015	2016	9.6	2016	-					9.6	9.6	7.9	0.0	-1.7
Dark Gulch	2006	14.4	2008	2.9	2009	3.1			14.4	14.6	13.1	0.2	-1.4
Sawmill	2008	12.2	2009	4.7	2009	6.2			12.2	11.2	11.4	-1.0	-0.8
Lewiston Four	2006	15.6	2008	3.5	2008	5.2			15.6	14.6	14.6	-1.0	-1.0
Lewiston Hatchery CSA	2003	0.0	2006	0.4	2007	1.1			0.0	0.0	0.8	0.0	0.8
Hatchery											6.1		6.1

Hectors of riparian vegetation mapped in fall of 2016 at 28 CRS. Sites with N/A have not been constructed yet.
ESL = Environmental Study Limit

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— Riparian Monitoring continued

roughly the same as in 2011 (Figure 18). The density of large wood pieces counted was approximately one-tenth of what some experts have suggested is a decent target for wood loading.

Although the average number of large wood pieces mapped per km was 51.6 in 2011, 42.8 in 2015, and 48.1 in 2016, the total number of large wood pieces greater than 20 centimeters (cm) in diameter was not significantly different between years (Figure 19) at the 95% confidence level (p=.78, α=0.10).

Figure 17. Large wood placed at the Sawmill channel rehabilitation site constructed in 2009.

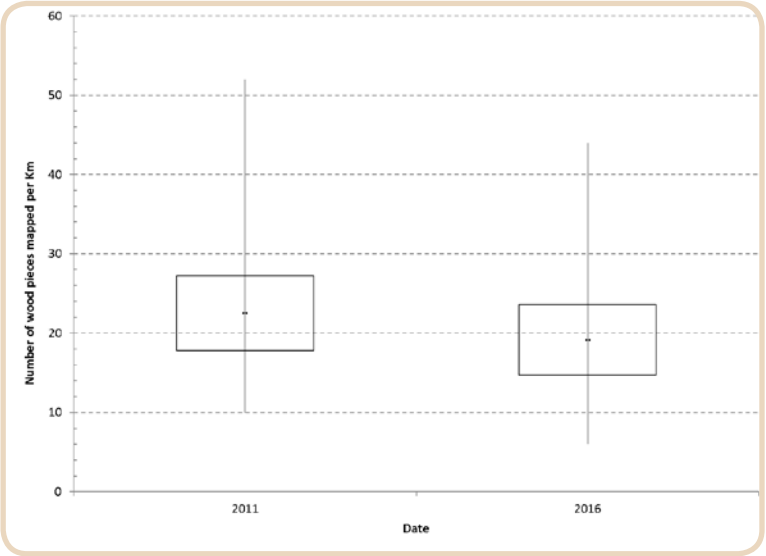


Figure 18. Total number of large wood pieces mapped per kilometer (km) at eight GRTS Panel 3 and eight GRTS Panel 4 sites between 2011 and 2016. The difference in the average number of wood pieces (-) was not statistically significant between years at α=0.10.

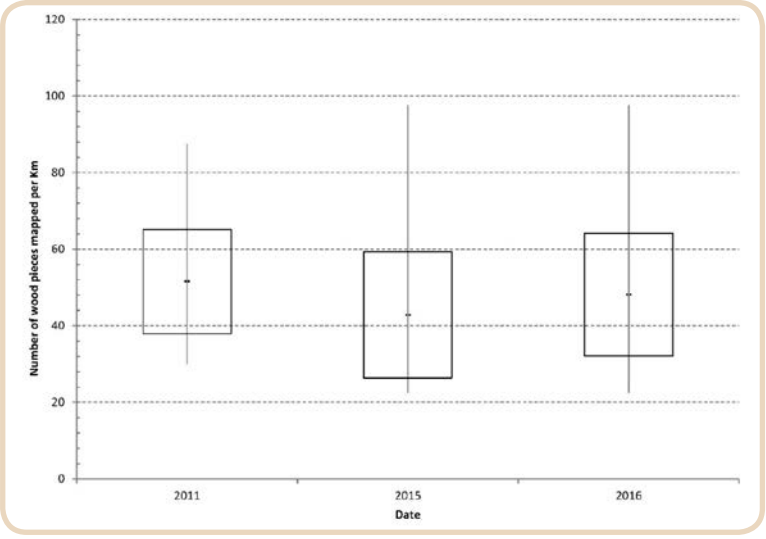


Figure 19. Total number of large wood pieces mapped per km at eight GTRS[1] Panel 3 sites between 2011, 2015, and 2016. The difference in the average number of wood pieces (-) was not statistically significant between years at α=0.10.

[1]GRTS = generalized random-tessellation stratified (a term in sampling design).

Figure 20. Vegetation coverage and shallow, slow flowing water are a few of the elements that create juvenile salmonid rearing habitat.

Fisheries Monitoring

Juvenile Salmon Habitat Assessment

Restoration Reach Evaluation

The combination of TRRP restoration efforts (including gravel augmentation, watershed restoration, flow management, and mechanical channel rehabilitation) are designed to catalyze fluvial processes that create juvenile salmonid rearing habitat within rehabilitation sites and throughout portions of the restoration reach that have not been directly manipulated with heavy equipment (Figures 20 and 21).

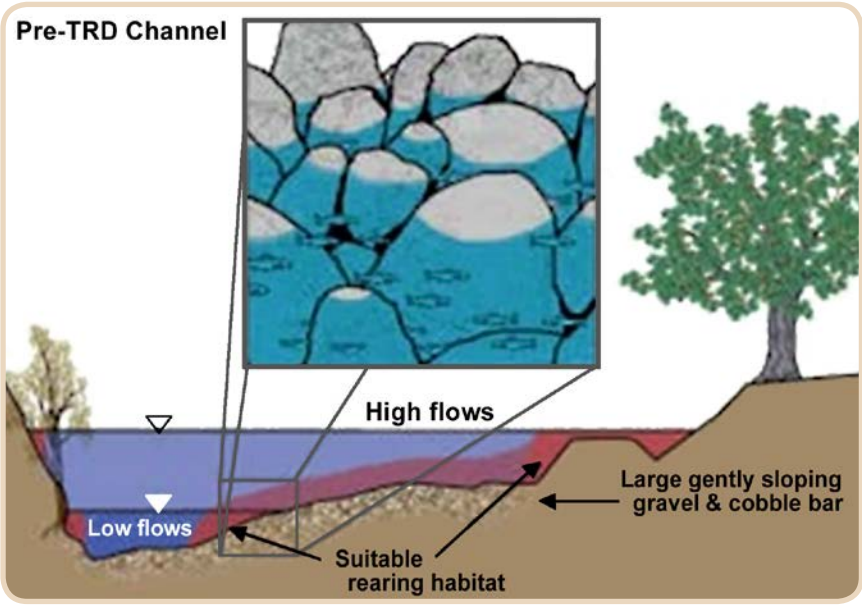


Figure 21. Suitable juvenile salmonid rearing habitat.

Juvenile Salmon Habitat in the Restoration Reach of the Trinity River

The TRRP has conducted annual studies since 2009 to evaluate changes in rearing habitat for juvenile salmonids at 12.7 cms summer baseflow within the 64-km restoration reach of the Trinity River downstream of Lewiston Dam. Rearing habitat was mapped at 16 randomly selected, 400 meter river segments in 2011, and these segments were revisited in 2016 (Figure 22). The sample overlapped several rehabilitation sites, with some surveyed before and after construction and some surveyed only after construction (for sites constructed prior to 2011). Eleven of the sixteen surveyed segments were in sections without rehabilitation construction portions of the restoration reach, eight of which showed higher habitat values in the 2016 survey than the 2011 survey. Two rehabilitation sites constructed after the 2011 survey also showed improvements in habitat availability. Rearing habitat increased at two of the three sites constructed before 2011 (Figure 23). Between 2011 and 2016, the restoration reach experienced six high streamflow releases from Lewiston Dam, peaking at 350 cms. Overall, the median total pre-smolt habitat area increased from 2,576 square meters (m^2) to 3,020 m^2.

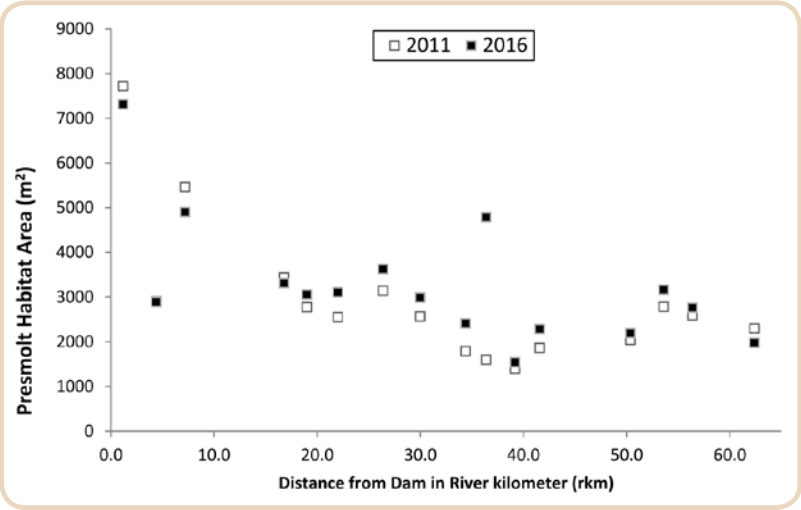


Figure 22. Presmolt habitat area measured at 16 randomly selected 400 m river segments in the restoration reach of the Trinity River in 2011 and 2016. Note there was no change at the river segment located at river kilometers (rkm) 5.

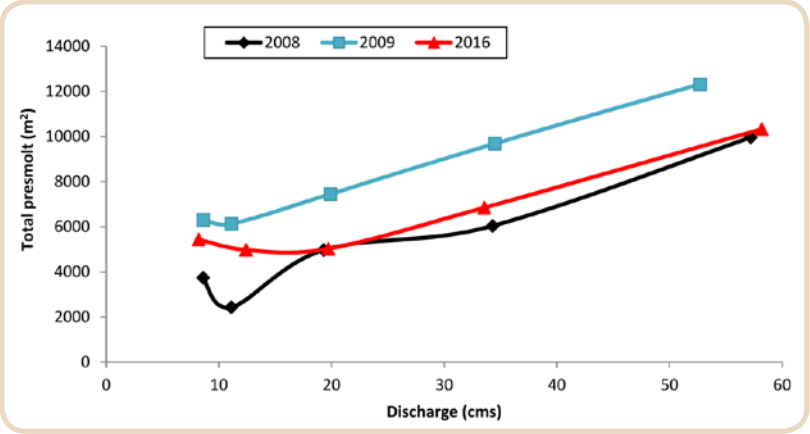
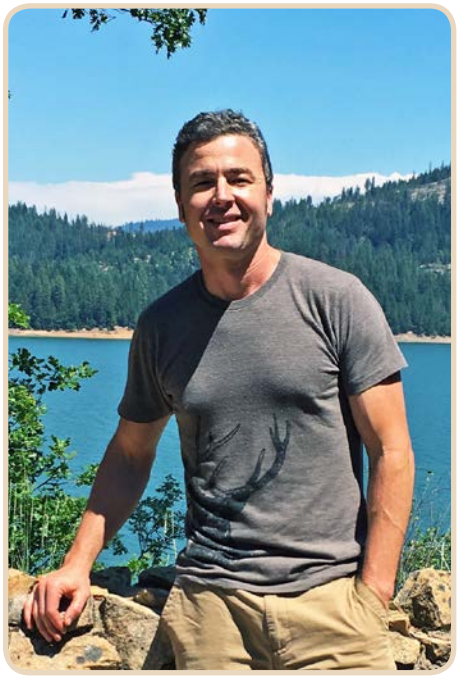


Figure 23. Total pre-smolt habitat area at Lewiston Cableway by survey year. Symbols indicate measured habitat areas.

Rehabilitation Site Assessments

The Lewiston Cableway channel rehabilitation site was constructed in 2008. Three years of assessments at this site evaluated the effect of TRRP construction and other restoration actions (such as flow management) on trends in rearing habitat availability. Rearing habitat was measured at five streamflows between 8.5 cms and 56.6 cms before construction in 2008, after construction in 2009, and eight years after construction in 2016 (Figure 23). Total pre-smolt rearing habitat increased 24% to 165% across the five streamflows the first year after construction. Eight years later, rearing habitat decreased 13% to 33%, with the largest decrease occurring at a flow of 19.7 cms. Despite these habitat losses, construction-related changes to the discharge to habitat relationship persisted in eliminating the sharp decrease in habitat relationships persisted in eliminating the sharp decrease in habitat area at 12.7 cms that was documented in 2008. Additionally, prior to rehabilitation in 2008, surface flow in the existing side channel at this site (constructed before the TRRP) was not observed until releases from Lewiston Dam reached 19.3 cms. After reconfiguring this side channel in 2008, it had surface connection at 8.5 cms. However, the revisit survey in 2016 documented a 33% decrease in the discharge in the side channel at winter base flow: from 1.33 to 0.89 cms.



Seth Naman, Fisheries Biologist, NOAA Fisheries

Seth Naman has worked on the Trinity River since 2003. He earned a B.S. from Oregon State University and an M.S. in Fisheries Biology from Humboldt State University. Seth worked as a fisheries biologist for the Yurok Tribal Fisheries Program for five years before taking his current position with NOAA Fisheries, where he has worked for the last ten years. Seth's focus areas include hatchery management, fisheries management, and hydrology. When not working, Seth enjoys hunting, fishing, kayaking, and spending time with his two sons.

Synthesis Reporting

Adaptive management requires syntheses of information on river restoration activities, which are then interpreted by scientists, managers, and policy makers to help inform subsequent restoration actions. In 2016, the TRRP completed a systemic estimate of rearing habitat availability throughout the restoration reach at the summer baseflow of 12.7 cms from 2009-2013 (Goodman et al. 2016). A complementary reporting effort that assessed long-term (2005-2015) changes to rearing habitat availability at rehabilitation sites at 12.7 cms discharge is currently under review. The assessment of Lewiston Cableway described above is one component of a third, long-term (2008 - 2016) analysis planned for fiscal year 2018 to establish the relationship between multiple discharges from 8.5 to 56.6 cms and rearing habitat availability at rehabilitation sites. These analyses, which look at different aspects of rearing habitat availability over relatively long time scales, provide the TRRP with a valuable opportunity to revisit the design objectives for rehabilitation sites and to evaluate TRRP progress in general. These evaluations could consider the geomorphic context and environmental fluctuations at particular rehabilitation sites during the appropriate time period to inform current and future management actions. For example, this adaptive process could focus on the influence of peak streamflows on fluvial processes related to sediment load and/or large wood dynamics throughout the restoration reach in addition to finer scale assessments such as constructed feature-specific trends in rearing habitat.

Salmon Redd Distribution and Abundance

To evaluate the distribution and abundance of Chinook salmon spawning activity, the USFWS, USFS, CDFW, the Hoopa Valley Tribe, and the Yurok Tribal Fisheries Program conduct salmon spawning surveys annually on the mainstem Trinity River.

During the 2016 surveys, 1,671 salmon redds were located, and 616 salmon carcasses were examined. Natural-origin Chinook salmon built an estimated 1,607 redds, hatchery-origin Chinook salmon built roughly 91, and Coho salmon built the remaining 64 (Table 7). The number of redds observed in 2016 was the lowest since the survey, in its current iteration, was initiated in 2002 (Figure 24).

—continued

— Salmon Redd Distribution continued

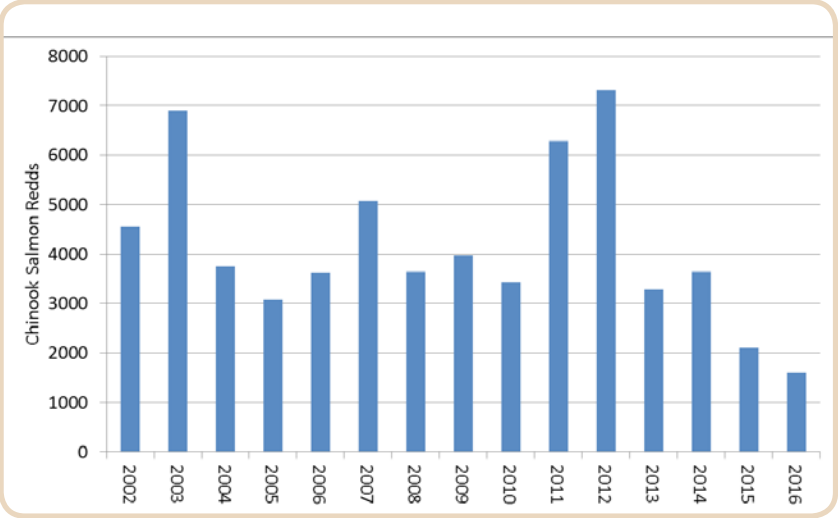


Figure 24. Estimated numbers of Chinook salmon redds from mainstem Trinity River surveys, 2002–2016.

Table 7. Estimated numbers of Chinook and Coho salmon redds observed in the mainstem Trinity River in 2016. Bootstrap-generated 95% confidence intervals are in parentheses.

Species	Origin	2016
Chinook Salmon	All	1,607[b]
	Natural	1,516 (1,453–1,580)
	Hatchery	91 (27–154)
Coho Salmon[a]	All	64[b]
	Natural	NA
	Hatchery	NA

[a]Our survey season only partially covers the Coho Salmon spawning period

[b]Confidence intervals are generated with both Chinook and Coho salmon data. Not enough Coho Salmon female carcasses were found in 2016 to calculate a confidence interval here.

Hatchery-origin Chinook salmon tended to spawn relatively closely to Lewiston Dam, the location of the Trinity River Hatchery, while natural-origin Chinook Salmon spawned throughout the mainstem, with particularly high numbers spawning within the restoration reach itself (Figures 25 through 28).

Ken Lindke, Environmental Scientist, California Department of Fish and Wildlife

Ken, a Humboldt County native, began his career in natural resources in 2005 working on the Lower Klamath River with the Yurok Tribe and the AmeriCorps Watershed Stewards Program. After a few years of field work in the rivers of Northern California, he enrolled as a graduate student at Humboldt State University, earning his M.S in Fisheries Biology in 2014. His thesis evaluated marine survival of Chinook salmon from Klamath and Trinity River hatcheries. He worked as a quantitative ecologist for a small consulting firm from 2014 to 2016, and was excited to accept a job with the California Department of Fish and Wildlife dedicated to the restoration of the Trinity River in January 2017.

Ken married his wife Melissa on the Trinity River in 2015—only a stone's throw from the Willow Creek Weir, a place his wife worked as a fish biologist, and Ken now shares responsibility for its operation. In his spare time, Ken gets on and in the river as much as possible and conducts volunteer research on glaciers, plants, and amphibians in the Trinity Alps with a group of fellow rogue scientists.

Ken Lindke, Environmental Scientist, California Department of Fish and Wildlife, with his wife Melissa Reneski.

— Salmon Redd Distribution continued

Kyle De Juilio, Senior Fisheries Biologist for Yurok Tribal Fisheries

Kyle has worked on the Trinity River since 2007. After growing up landlocked in central Illinois, Kyle found his way to the coast of Northern California where he attended Humboldt State University, receiving a B.S. in Marine Biology with a minor in scientific SCUBA diving. He moved to Weaverville with his soon-to-be wife, Carla, in 2007 and they were married in 2010 in Coffee Creek. Kyle started his work on the Trinity River with the State of California and began working for the Yurok Tribe in 2008. Kyle and Carla are lucky enough to both live and work with natural resources in Weaverville, California. They spend as much time as they can on the river, in the mountains, and on the ocean. Fishing, diving, hunting, rafting, gardening, and backpacking are some of their favorite hobbies. They enjoy sharing both the experience and the food that these hobbies provide with friends and family.

Carla and Kyle DeJuilio fishing off California's north coast.

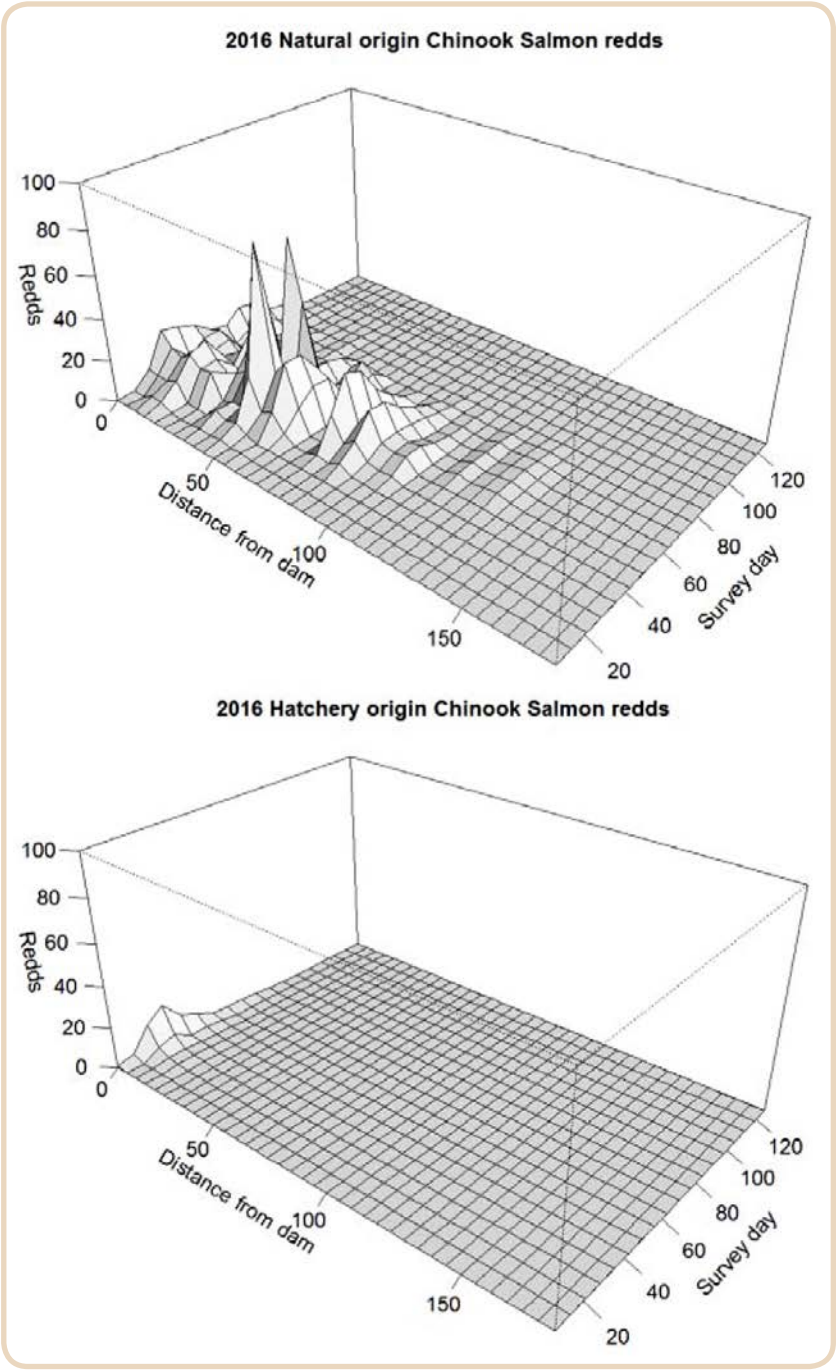


Figure 25. Spatiotemporal distribution of mainstem Trinity River natural-origin and hatchery-origin Chinook salmon redds observed in 2016. Pigeon Point and Burnt Ranch whitewater reaches were not surveyed. Survey Day 1 = September 1 and Survey Day 120 = December 29. Distance from Lewiston Dam is in kilometers.

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— Salmon Redd Distribution continued

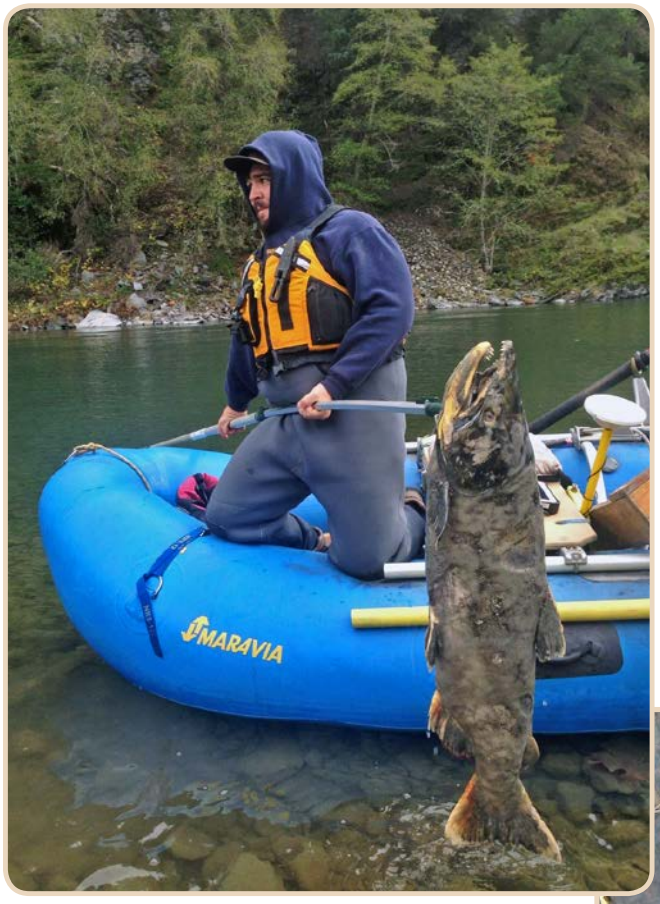


Figure 26. Fisheries technician Adam Carbone of the Hoopa Valley Tribe shows off a 100 cm (40 inch) male Chinook salmon carcass found in the Trinity River near Willow Creek, California.

Figure 27. Spawned female Chinook salmon carcass in the Trinity River near Junction City, California.

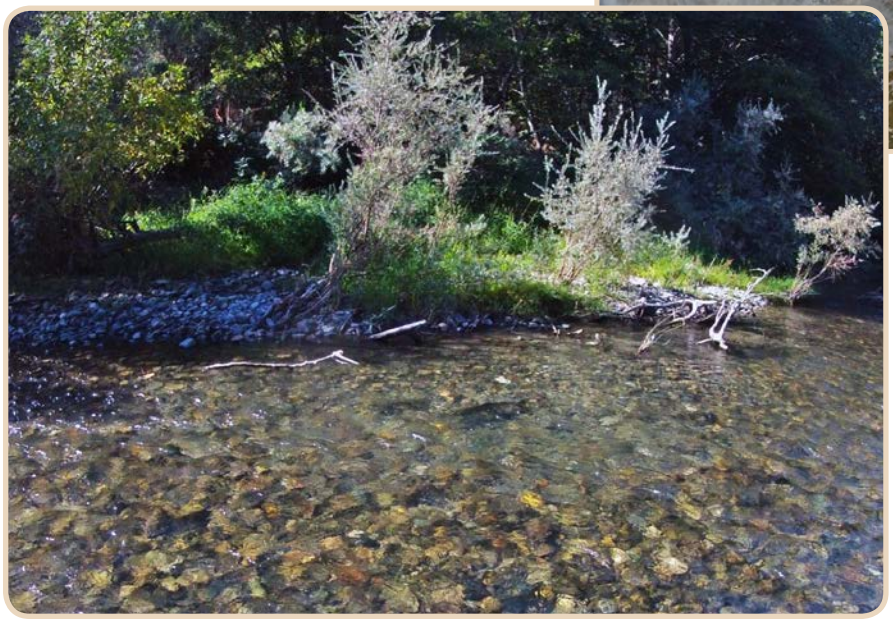


Figure 28. Two Chinook salmon swimming over a recently excavated redd in the Trinity River.

Eric Peterson, Ph.D., TRRP Natural Resource Specialist Data Steward

Eric grew up in Weaverville, hiking in the Trinity Alps or exploring East Weaver Creek as often as possible. A natural biologist from an early age, he completed a B.S. in biology and botany at Humboldt State in 1995, then a Ph.D. in plant ecology with a focus on lichens and forestry at Oregon State in 2000. Eric worked as the vegetation ecologist for State of Nevada' Natural Heritage Program for about 8 years, covering all corners of the state and developing techniques for mapping invasive annual grasses with satellite imagery.

As they became parents, Eric and his wife Adriane decided to raise their kids (Juniper, now starting 9th grade and Lilly, 5th grade) in Weaverville. Eric joined TRRP in 2009 to manage Trinity River data and coordinate its use across the many offices of our partnership. Eric also maintains his interest in lichens on the side as a Research Associate of the California Academy of Sciences, and he chairs the California Lichen Society's conservation committee.

Riparian Species Monitoring

Continued fish and wildlife monitoring in 2016 helped to assess the overall effectiveness of the Program in meeting its goals and objectives. Monitoring also provides reliable data on longer term trends which informs adaptive management decisions on the overall effectiveness of the Program (TRRP and ESSA 2009). Much of TRRP's wildlife and management is guided by a 1984 act (Public Law 98-541) that acknowledged the loss of habitat for deer and other wildlife species caused by the inundation of riparian and upland areas behind Lewiston and Trinity dams. Congress directed the Secretary of the Interior to take appropriate actions to maintain and propagate such wildlife.

Additionally, the TRRP's monitoring of species listed under the Federal and California Endangered Species Acts (ESA) and other sensitive species helps to ensure that their conservation and restoration needs are met. Two additional documents, Conceptual Models and Hypotheses for the Trinity River Restoration Program (TRRP 2009) and Integrated Assessment Plan (IAP), Version 1.0 (TRRP and ESSA Technologies 2009), provide further clarification and guidance on the development of fish and wildlife monitoring for the Program.

The purpose of the conceptual models is to clearly illustrate the physical-biological linkages by which the TRRP expects management actions to achieve the stated goals for valued ecosystem components, thus providing a foundation for developing detailed monitoring plans both to assess overall impacts and to resolve key questions affecting management decisions.

Data Management

The ultimate products of the TRRP will be twofold: a more functional river and the information we gather about it. The Program's online data portal (DataPort) at www.trrp.net/dataport is a key resource for managing TRRP information and coordinating data across the partnership. Data stewardship encompasses this information throughout the data life cycle to ensure that data are developed appropriately, accessible for efficient use, properly analyzed, and maintained or archived with sufficient documentation to enable future use. Thus data stewardship improves the efficiency and rigor of data use both short-term and long-term, providing a solid foundation for adaptive management. The DataPort is a data storage and access system that provides

—continued

—Data Management continued

equal access to Program information to partners, stakeholders, and the public. The DataPort includes millions of data points on stream flow, water temperature, and reservoir operations, plus online maps at www.trrp.net/dataport/map with convenient and intuitive access to a growing number of overlays and aerial photography datasets dating as far back as 1944. The DataPort library at www.trrp.net/library provides convenient access to over 1,400 reports and other documents and 79 data packages. Many of the reports and documents are scanned items dating as far back as 1900. Using web services to automatically provide up-to-date information on data and document holdings, the DataPort interacts with other parts of the Program's general website at www.trrp.net.

Remote Sensing

Historic aerial photography datasets going as far back as 1944 provide context for current river conditions. High-resolution aerial photography may be the most widely used type of data by the Program partnership since it provides the context for documenting changes in the river channel, designing restoration actions, planning scientific investigations, and communicating both within the Program and with the public.

Detailed topographic models have similarly widespread utility and the data can be collected over large areas by aerial LiDAR (light detection and ranging) and boat-based bathymetric sonar. Because LiDAR and sonar costs are significantly greater than for aerial photography, data collection is limited to documentation of the rehabilitation sites completed each year while reach-wide collection occurs less frequently.

After restoration flows with peaks designed for geomorphic change in both 2015 and 2016 (and without the fore-knowledge that 2017 would turn out to be extremely wet), the program decided to collect data for a new reach-wide topography model (see Figure 29 through Figure 32 for examples). Bathymetric data collection began as the 2016 restoration flow subsided, as sonar data collection is optimal between 2,000 and 4,000 cfs on the Trinity River. Recent advances in sonar

—continued

Trinity River Restoration Program DataPort

The TRRP's online DataPort is a repository of information for the Trinity River watershed. Use this portal to:

- Search for documents—meetings, reports, and more.
- Get data—analyze flows by time series, probability, box whiskers, and more.
- View maps—see aerial photographs, stream gages, study limits, rehabilitation designs, and more.

Screenshot from the DataPort Map.

—Remote Sensing continued

technologies allowed collection of wide swaths of data using multibeam sonar, which also increased data collection efficiency and reduced overall costs for bathymetry (Figure 29). For dry-land topography, reach-wide LiDAR was collected in November of 2016 (Figure 30). While sonar and LiDAR data were collected for the vast majority of the river corridor, a number of data gaps remained in important areas. These gaps were addressed by more traditional survey methods such as Real-Time Kinematic GPS and "total station" surveys. Additionally, banks of two side channels were surveyed using Structure-from-Motion Photogrammetry (Figure 32).

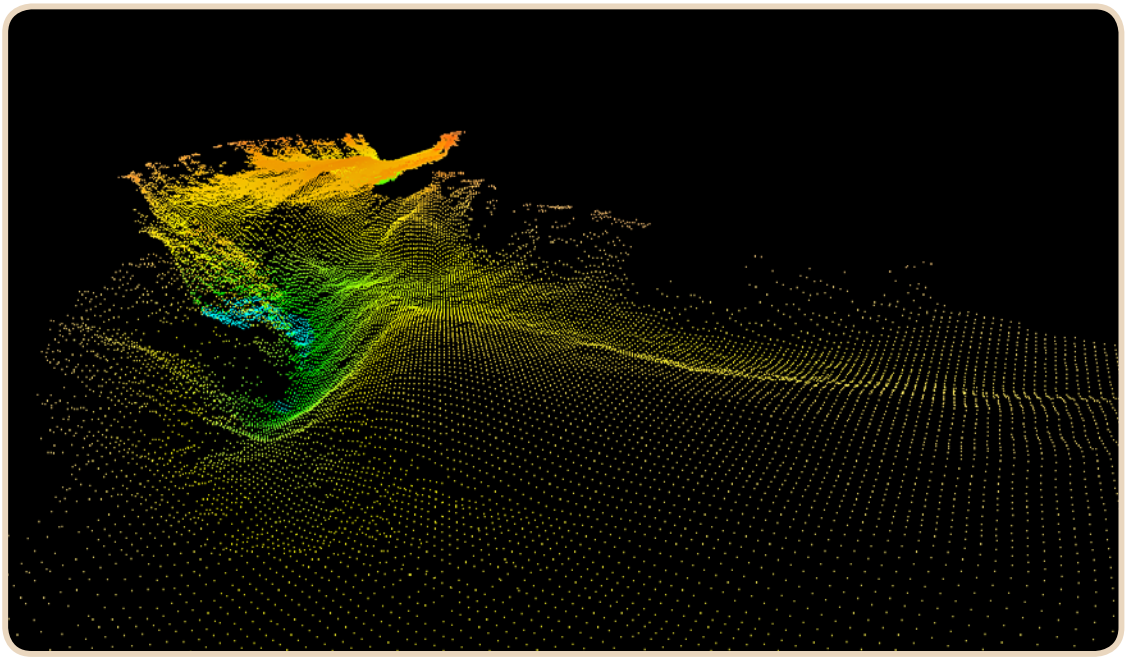


Figure 29. Detailed multibeam sonar bathymetry collected for the 2016 topography model in the river channel near the Bucktail boat ramp.

Figure 30. LiDAR data collected for the 2016 topography model. View shown looking toward the Trinity River from the parking lot to the Bucktail boat ramp.

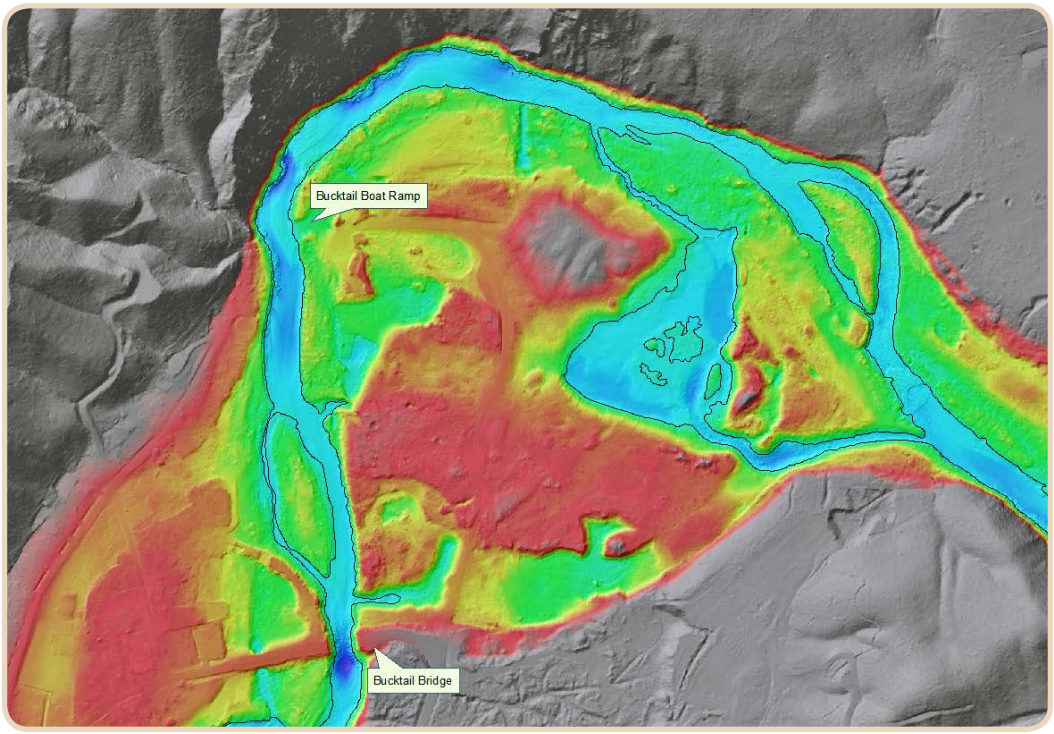


Figure 31. Topography model for 2016 showing the Bucktail boat ramp area. Colors indicate elevation relative to the water surface with cool colors in-channel and warm colors above. The black line represents the water's edge during the November 2016 LiDAR data collection.

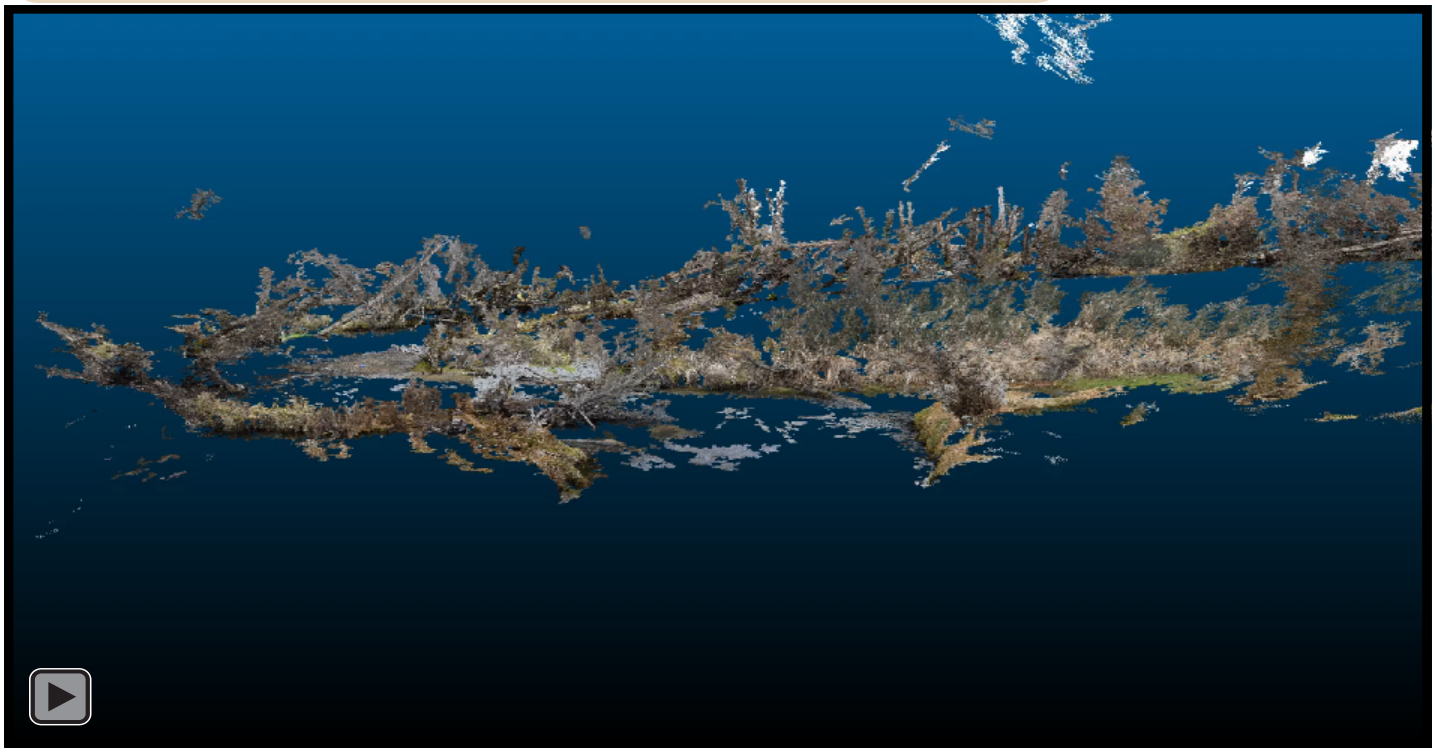
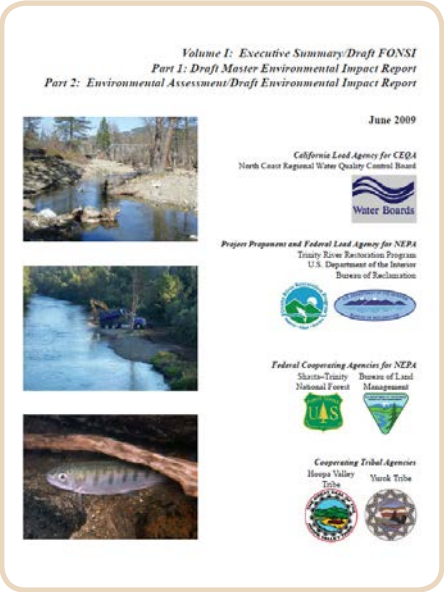


Figure 32. Structure-from-Motion photogrammetry collected for the 2016 topography model at the Sawmill side channel. This video begins at the lower end of the side channel then 'flies' up the channel to the primary public access point. The raw data are shown here; both vegetation and reflections from the water surface were removed from data used in the topography model.

Environmental Compliance and Mitigation

NEPA, CEQA, and Other Mandates


Volume I: Executive Summary/Draft FONSI
Part 1: Draft Master Environmental Impact Report
Part 2: Environmental Assessment/Draft Environmental Impact Report

June 2009

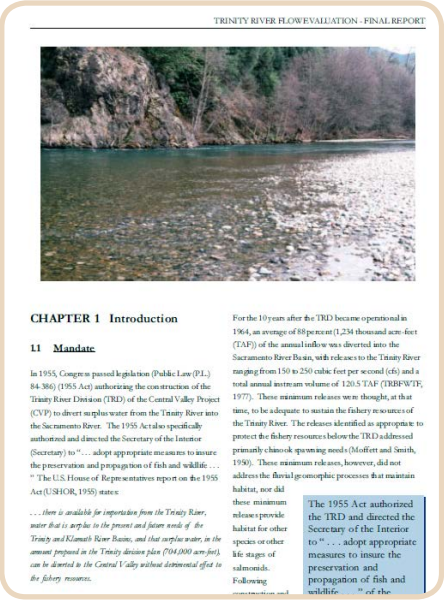
California Lead Agency for CEQA
North Coast Regional Water Quality Control Board

Water Boards

Project Proponent and Federal Lead Agency for NEPA
Trinity River Restoration Program
U.S. Department of the Interior
Bureau of Reclamation

Federal Cooperating Agencies for NEPA
Shasta-Trinity National Forest
Bureau of Land Management

Cooperating Tribal Agencies
Hoopa Valley Tribe
Yurok Tribe


TRINITY RIVER FLOW EVALUATION - FINAL REPORT

CHAPTER 1 Introduction

1.1 Mandate

In 1955, Congress passed legislation (Public Law (P.L.) 84-386) (1955 Act) authorizing the construction of the Trinity River Division (TRD) of the Central Valley Project (CVP) to divert surplus water from the Trinity River into the Sacramento River. The 1955 Act also specifically authorized and directed the Secretary of the Interior (Secretary) to "... adopt appropriate measures to insure the preservation and propagation of fish and wildlife ... " The U.S. House of Representatives report on the 1955 Act (USHOR, 1955) states:

... there is available for importation from the Trinity River, water that is surplus to the present and future needs of the Trinity and Klamath River Basins, and that surplus water, in the amount proposed in the Trinity division plan (704,000 acre-feet), can be diverted to the Central Valley without detrimental effect to the fishery resources.

For the 10 years after the TRD became operational in 1964, an average of 88 percent (1,234 thousand acre-feet (TAF)) of the annual inflow was diverted into the Sacramento River Basin, with releases to the Trinity River ranging from 150 to 250 cubic feet per second (cfs) and a total annual instream volume of 120.5 TAF (TRFWTF, 1977). These minimum releases were thought, at that time, to be adequate to sustain the fishery resources of the Trinity River. The releases identified as appropriate to protect the fishery resources below the TRD addressed primarily chinook spawning needs (Moffett and Smith, 1950). These minimum releases, however, did not address the fluvial geomorphic processes that maintain habitat, nor did these minimum releases provide habitat for other species or other life stages of salmonids. Following

The 1955 Act authorized the TRD and directed the Secretary of the Interior to "... adopt appropriate measures to insure the preservation and propagation of fish and wildlife ... " of the

The National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) compel Federal, State, and local agencies to analyze and disclose to the public the potential environmental effects of their proposed actions. NEPA applies specifically to actions proposed by Federal agencies, and CEQA applies to actions proposed by California State agencies and local governments. CEQA requires that, to the extent feasible, the effects of the proposed actions be mitigated to minimize significant adverse environmental effects.

To meet NEPA and CEQA requirements, the TRRP continues its efforts to inform the northern California community, including partners, collaborators, and public and private stakeholders, about its proposals. Public meetings are held during the early stages of project site design and gravel augmentation planning. Subsequent meetings also help keep the public informed about any modifications made to the designs based on public or agency input and associated monitoring and evaluation before, during, and after in-channel project construction and revegetation. (See the Public Outreach section.)

The Trinity River Mainstem Fishery Restoration Final Environmental Impact Statement (USFWS et al. 2000) serves as the programmatic document under NEPA, and the Master Environmental Impact Report for Channel Rehabilitation and Sediment Management for remaining Phase 2 Sites (Master EIR) (NCRWQCB and TRRP 2009) serves as the programmatic document under CEQA. Each year, the TRRP completes site-specific environmental assessments and initial studies to determine if the impacts are the same as described in the programmatic document and to identify and decide on specific environmental commitments that might reduce construction impacts. In 2015, Reclamation and BLM were the Federal co-leads, and with the Regional Water Board as the State co-lead, wrote the Bucktail Project Environmental Assessment/Initial Study (EA/IS) and held public meetings. Responses to comments were developed and the Bucktail Project EA/IS was finalized in 2016 prior to construction (North Coast RWQCB et al. 2014).

—continued

—NEPA, CEQA, And Other Mandates continued

In addition to NEPA and CEQA, the following statutes, Acts, and Executive Orders (EO) provide regulatory guidance and are programmatically discussed in the Master EIR. These guidelines broadly define the type and intensity of actions that the TRRP may perform to benefit the health of the Trinity River fishery:

- Endangered Species Act (ESA) of 1973
- Clean Water Act
- Wild and Scenic Rivers Act
- National Historic Preservation Act of 1966
- Archaeological Resources Protection Act of 1979
- Executive Order (EO) 11988 for Floodplain Management
- EO 11990 for the Protection of Wetlands
- EO 13112 for Invasive Species
- EO 12898 for Environmental Justice

Bucktail channel rehabilitation 2016. Photo by Kenneth DeCamp.

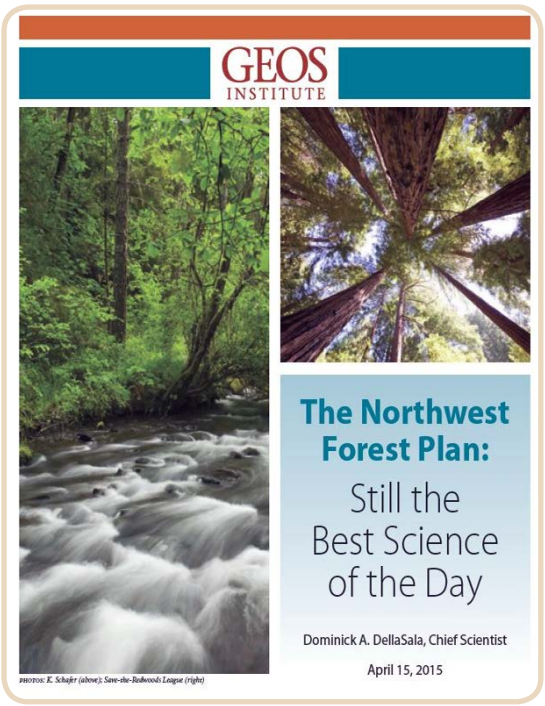
Channel Rehabilitation Compliance

Channel rehabilitation projects are designed to reestablish the physical and hydrological attributes that existed before the dams were built more than 50 years ago.

Activities associated with channel rehabilitation projects have the potential to result in short- and long-term impacts on protected Trinity River resources. Monitoring and mitigation help ensure long-term beneficial results.

Other Compliance Activities

The TRRP is preparing Biological Assessments to address potential new effects of Program activities on species listed as threatened or endangered under the Federal ESA since the 2000 Biological Opinions were issued (NMFS[2] 2000, USFWS 2000). As a result of the TRRP's evolving restoration techniques, and the desire to develop programmatic coverage for ESA listed species in the watershed, Reclamation is working with TMC member agencies and Federal land managers (e.g., BLM and USFS) to update their impact analyses. Because the agencies that administer the ESA (USFWS and NOAA Fisheries) work as members of the TMC and provide guidance in the adaptive management program, the developing biological assessments are expected to include process based sections where expert review of proposed actions may facilitate work when site-specific evaluations are not realistic due to financial or logistic limitations. It is anticipated that the Biological Assessments will be completed in 2018.



The Northwest Forest Plan: Still the Best Science of the Day, April 2015.

Projects performed on public lands that USFS or BLM manage must also meet the guidelines of the Northwest Forest Plan and the related Aquatic Conservation Strategy. In the same way that TRRP works with private landowners to implement mutually beneficial projects on their lands, the TRRP works with Federal partners to ensure that their environmental compliance needs are met for each project.

Environmental Mitigation

To support the goal of long-term benefits to the Trinity River fishery and associated habitats, specific measures are required to avoid, minimize, and mitigate for short-term adverse effects, such as removing riparian and wetland vegetation. Environmental permits require no net loss of riparian lands and wetlands and the TRRP uses performance monitoring to determine the success of mitigation efforts during and after construction. Contractors provide healthy, native container stock or dormant cuttings; perform weeding, mulching, fertilizing, and irrigating; and install browse protection. Monitoring includes pre-and post-project vegetation surveys and data collection as well as obtaining aerial imagery and GIS documentation, and detailed reporting. This monitoring has been key to learning why vegetation has failed and developing methods to increase vegetation survival (e.g., irrigation, soil amendments, and overall decreases in floodplain elevations to allow more frequent access to groundwater).

—continued

[2]National Marine Fisheries Service, now known as NOAA Fisheries.

—Environmental Mitigation continued

Other important work involves removing invasive species such as Dyer's woad (*Isatis tinctoria*), star-thistle (*Centaurea solstitialis*), and tree-of-heaven (*Ailanthus altissima*) which can out-compete native vegetation. Since using herbicides is discouraged in Trinity County, invasive species have been manually removed, a labor-intensive process. After removal, re-infestation must be prevented until native species can become established. The TRRP contracts with local agencies to maintain revegetated sites, but success is hard-won. Drought and high temperatures can substantially reduce the survival rate of native plants, which means that crews must return to the project sites to monitor and counter vegetation losses as needed to keep survival at or above replacement requirements.

Dyer's woad (Isatis tinctoria).

Cultural Resources

To ensure the preservation of historic and cultural resources in the restoration reach, a programmatic agreement (PA) between the BLM and several TMC participating Federal agencies (NOAA Fisheries, Reclamation), and the Hoopa Valley Tribe, and California State Historic Preservation Office was developed. In addition to the PA requirements, the TRRP works with BLM, Reclamation and USFS archaeologists to evaluate the status of cultural resources, such as old homesteads, apple orchards, mining remnants, at proposed channel rehabilitation sites. The archaeologists also evaluate whether these resources might make a significant contribution to our understanding of history and might be eligible for inclusion in the National Register of Historic Places (NRHP). In addition, when working on federally managed lands adjacent to the Trinity River, Reclamation works with BLM and USFS managers to meet guidelines of the Archaeological Resources Protection Act of 1979.

As implementation of the ROD was considered, the potential impact to cultural resources in the restoration reach was recognized.

Much of the Program's work is confined to the floodplain, where historic resources have lost much of

—continued

Star-thistle (Centaurea solstitialis).

Tree-of-heaven (Ailanthus altissima).

—Cultural Resources continued

The other California gold: Trinity County placer mining, 1848-1962. (Bailey 2008).

their integrity during flood events. However, the large scope of the channel rehabilitation projects and the interrelatedness of the remaining historic sites along the river (e.g., Trinity Historical Mining District) have highlighted the need for a comprehensive analysis of historic resources throughout the restoration reach—as these may be sequentially impacted by restoration activities. Prior to 2013, cultural resources studies have included archaeological surveys within the project areas and evaluations of any identified cultural resources for inclusion in the NRHP.

In 2013, the Program developed a map-based historic context report to determine which areas within the proposed project sites might be eligible for NRHP listing (AECOM 2013). The historic context is now used to facilitate site-specific surveys as each new site is evaluated. Pre-project surveys at Bucktail did not raise concerns about cultural resources but early surveys there, and at other up-coming channel rehabilitation sites, have enabled restoration staff to design around areas that might be of historic interest.

Turbidity

Background

Turbidity is a measure of water clarity measured in nephelometric turbidity units (NTU). Turbidity is typically low in the Trinity River during summer (Figure 33). Turbidity in the Trinity River, like in most rivers, occurs naturally during storms or other runoff events but may also be caused by construction or other human activities in the river. The permits needed for restoration projects such as gravel augmentation or mechanical channel rehabilitation require that TRRP construction contractors ensure that Trinity River water does not become excessively turbid.

As the CEQA lead agency for the 2009 Master EIR, the North Coast Regional Water Quality Control Board (RWQCB) worked with the TRRP to develop water quality mitigation measures for TRRP activities. These measures were also

—continued

—Turbidity Background continued

included in the initial (2010) 5-year water quality certifications (permits) for channel rehabilitation, fine sediment reduction, and coarse sediment management activities. Because of the nature of the proposed restoration activities and the clarity of the Trinity River during low flow conditions, the North Coast RWQCB determined that an allowable zone of turbidity dilution is appropriate and necessary for Trinity River restoration activities to be accomplished in a meaningful, timely, and cost-effective manner that fully protects beneficial uses without resulting in a violation of the North Coast RWQCB Region's water quality control plan (the Basin Plan) objective for turbidity.

Figure 33. Five and fifty-five NTUs.

The TRRP long-term (5 year) water quality certification language states that "turbidity levels downstream of the 500 linear foot zone of dilution shall not be increased to greater than 20 NTUs or 20% above background, whichever is greater." This permitting detail ensures that the TRRP actions are consistent with the permit conditions, protective of the river, and allow for lawful restoration activities.

Turbidity Monitoring at 2016 Bucktail Channel Rehabilitation Construction Sites

During 2016, a combined Hoopa Valley and Yurok Tribal team constructed the Bucktail channel rehabilitation project. This team successfully employed best management practices (e.g., isolated work areas, pumped turbid water into upslope sediment ponds, and slowed work during periods of increased turbidity) to ensure that turbidity consistently stayed within permit levels (<20 NTUs 500 feet downstream of work areas). During base flow conditions, the tribal contractors were generally able to control turbidity so that within minutes of exceeding the 20-NTU limit, the situation was resolved. In general, construction was slowed or halted when turbidity levels rose above 20 NTUs, and appropriate measures were taken to ensure that turbidity returned to within limits before construction activities continued (Figure 34).

Figure 34. Mitigation measures are used to control turbidity during construction at Bucktail.

However, on August 25, turbidity control was lost as Lewiston Dam flows were increased from a base flow of 450 cfs to 1,250 cfs to enhance water quality conditions for salmon in the lower Klamath River. During this time, Trinity River flows routed through a newly constructed meander (IC-4) and enhanced wetland complex (W-1) at Bucktail. Water during this initial peak of emergency flows scoured newly exposed soils and resulted in the highest measured NTUs

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—Turbidity Monitoring continued

(approximately 90 NTUs) during Bucktail Project construction. On-site work was halted during the emergency flows until August 29th when work resumed.

While the contractor's attention to detail allowed the TRRP to minimize 2016 construction-related turbidity impacts, late summer flow releases from Lewiston dam, caused short-term turbidity impacts that were measurable at the North Fork Trinity River monitoring site. Given the extra costs to protect floodplain areas from increased flows, it is expected that late summer flows will always negatively impact the TRRP's ability to control turbidity and to meet permit conditions. Figure 35 shows the effects of increasing flows on turbidity control at the Bucktail channel rehabilitation site.

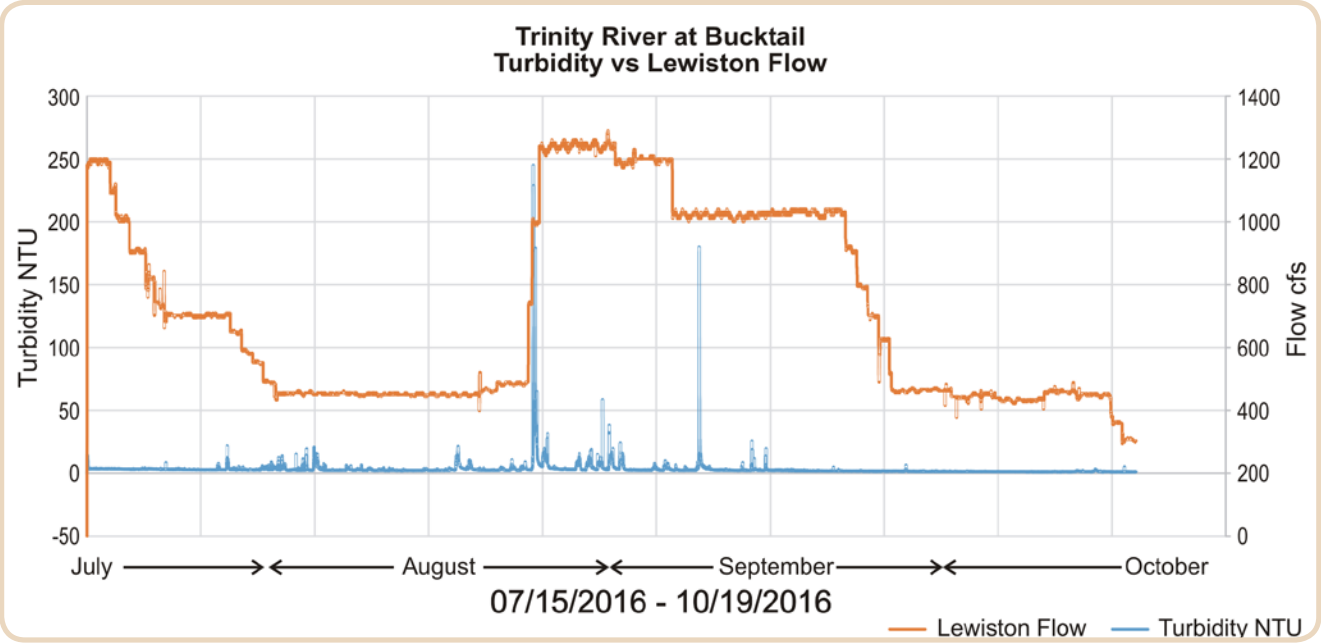

Figure 35. Turbidity compared to flow at the Bucktail channel rehabilitation site.

Public Outreach in 2016

The TRRP is committed to engaging with the community through education opportunities, public meetings, and informational meetings to provide accurate, consistent, and timely information on restoration activities.

Public Events

The TRRP held public events in 2016, including inviting the pubic to join TRRP staff for a raft trip through a restoration reach on the Trinity on July 7, 2016 (Figure 36). The public float provided an opportunity for TRRP stakeholders, rehabilitation project site landowners, community members, and people interested in learning more about Trinity River and to see the river from a unique perspective. The event allowed TRRP staff to interact with

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—Public Events continued

the public while floating the river and discuss restoration objectives and strategy while viewing previous project sites from the river. It was also a chance for the public to see how the river functions as TRRP partners talked about different river features. The float began at the Steel Bridge boat launch near Lewiston, California and continued downstream through several channel rehabilitation sites near Douglas City and took out at the Lorenz Gulch rehabilitation site.

Figure 36. The TRRP held a public rafting trip down the Trinity River restoration reach on July 7, 2016.

In March of 2016, TRRP hosted a science symposium on the implementation of the Decision Support System (Figure 37). Partners across TRRP participated in the two-day event that was held in Weaverville, California from March 28-29, 2016.

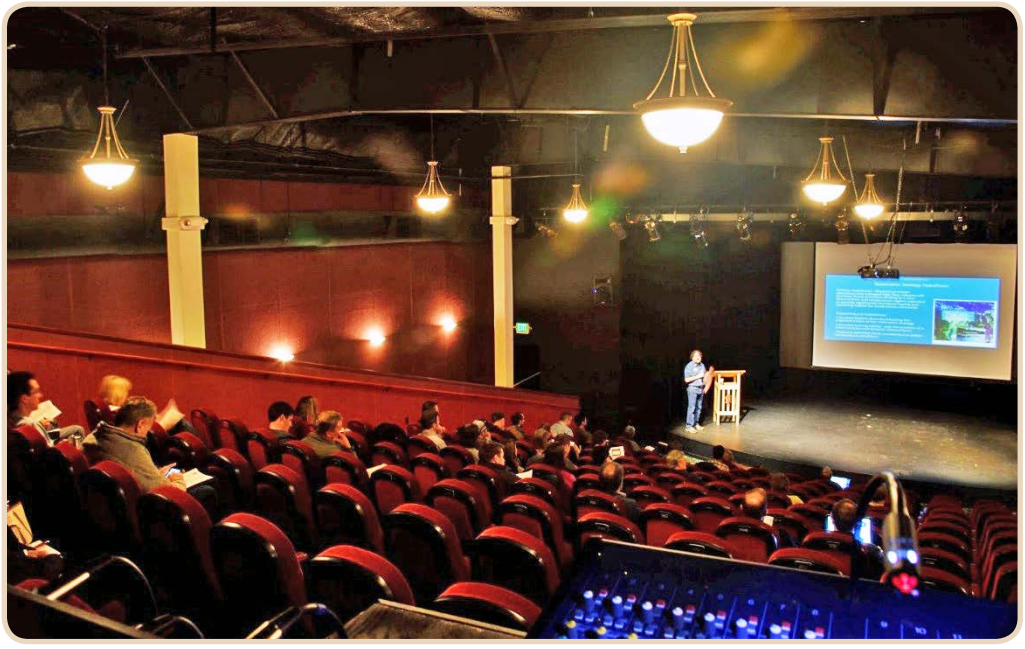

Figure 37. Decision Support System Science Symposium hosted by TRRP in March 2016.

Public Meetings and Workshops

A primary objective of the TRRP's public meetings, whether formal or informal, is to increase public knowledge and understanding of program activities. Several formal and informal meetings were held in 2016 to describe projects proposed for implementation in 2016 and to provide information to the public on restoration objectives.

Formal public meetings were held to describe the proposed 2016 Bucktail channel rehabilitation project and to inform the public of TRRPS intentions as recommended under NEPA and CEQA guidelines.

A Flow and Gravel Recommendation informational meeting was held on April 14, 2016 to provide a forum for local residents to learn about the 2016 flow release schedule based on the forecasted "Wet" year designation and the associated gravel augmentation recommendations. These meetings provide an important venue for the community to ask questions on restoration activities and become better informed.

In addition to formal meetings to describe proposed projects and their potential environmental impacts, a meeting was held with the landowners and residents of the Bucktail subdivision in Lewiston to provide information on the construction schedule and to answer questions about the channel rehabilitation project in the area.

Community Events

TRRP continued to provide financial support to the Trinity County Resource Conservation District (TCRCD) for the Trinity River Salmon Festival, Trinity County Fair, Day the Wetlands, River Days, Student monitoring of Foothill yellow-legged frogs, Weaverville Summer Day Camp, and sixth grade Environmental Camp (Figure 38). The support of interactive learning opportunities designed to connect community youth with the species, natural cycles and cultural importance of the Trinity River inspires the next generation of river stewards. Technical staff from TRRP volunteered as science instructors for Day at the Wetlands and Environmental Camp for local school students. Over 250 students received environmental education through these TRRP efforts.

The TRRP also continued its educational outreach at the Trinity River Salmon Festival, the Trinity County Fair and other community events with displays of live salmon and interactive salmon games.

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Figure 38. Riparian ecologist, James Lee, teaches elementary students about wetland habitats.

—Community Events continued

At the Trinity County Fair from August 12 to August 14, 2016, the TCRCD gave a quiz about the history and current restoration activities of the Trinity River to voluntary participants. The TCRCD learned insightful information from the responses, which has informed further activities and publications.

At the annual Trinity River Salmon Festival on October 18, 2016, TRRP partnered with the Turtle Bay Exploration Park Live Animal Show to appeal to new audiences (Figure 39).

In early October, the Program hosted a Day at the Hatchery, where the public was invited to stop by the Lewiston Hatchery and ask questions about the Program and Trinity River fish.

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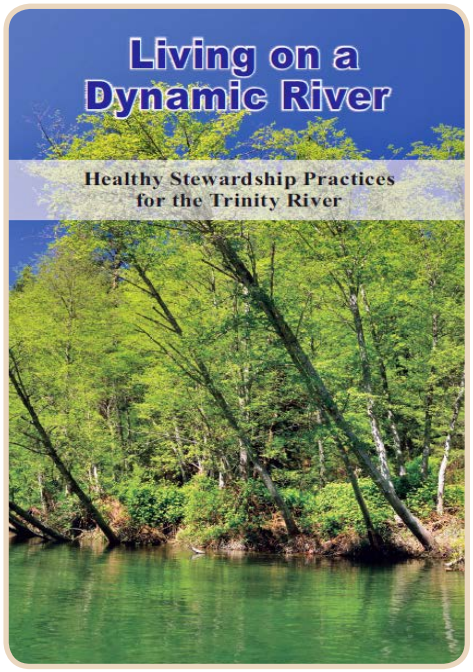
Figure 39. TRRP supports the annual Trinity River Salmon Festival in Weaverville, CA. The event celebrates the return of the salmon and the Trinity River.

—Community Events continued



In 2016, TRRP funded the publishing and distribution of the Trinity County Resource Conservation District's newsletter, the Conservation Almanac. The almanac featured articles on the environmental responses to the Upper Douglas City rehabilitation project completed in 2015 and on the importance of woody debris in rivers to provide habitat and ecological function. The almanac reaches over 300 people every quarter.

A new brochure "Living on a Dynamic River" was created and printed for distribution to property owners in need of advice on Best Management Practices in taking care of their property and the river. Three prior brochures were also reprinted and distributed throughout the watershed.

The hand-illustrated panoramic map "Trinity River California: A Wild and Scenic River" was completed and printed. Over 500 maps have been distributed to businesses, restaurants, schools, the Lewiston Fish Hatchery and members of the public (Figure 40).

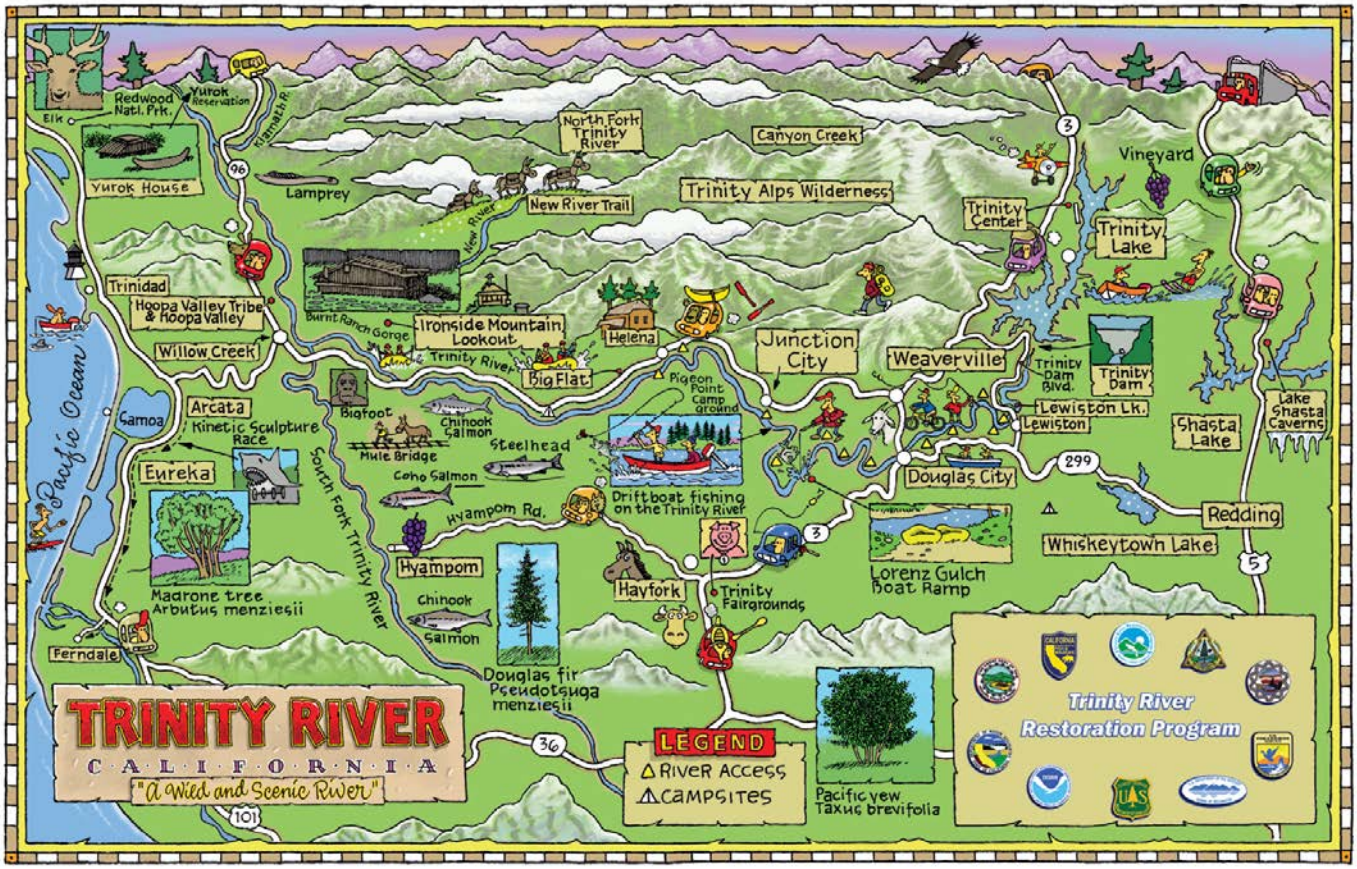


Figure 40. This popular Trinity River cartoon map was developed by local artists through the Trinity County Resource Conservation District with TRRP support.

In-Person Contact and Response

The program continued to engage with and create conversation with community members by welcoming walk-ins, answering telephone calls, and responding to email messages. Topics of special interest included: restoration flow release schedules, duration, ramping rates, and maximum peaks. To update river users about coming changes in the river flows with accurate and timely information, TRRP volunteers and staff continued to post the approved restoration hydrographs for about 40 sites along the river.

One-On-One Meetings

Individual meetings with private landowners were held on their properties to arrange for rights of entry for upcoming projects and monitoring revegetation at previous project sites.

Internet and Media Presence

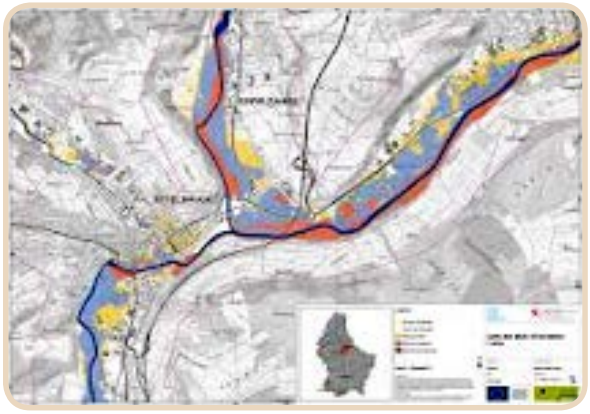
TRRP's official website, www.trrp.net, is used to post announcements, scientific data, technical papers, and other information on the website. In 2016, the Program continued to review, improve, and update website content to provide pertinent, useful, and accessible information for the public.

A number of articles regarding TRRP's 2016 activities appeared in various regional media. TRRP also funds the outreach website, www.trinityriver.org.

Looking Ahead: 2017 Program Activities

In 2017, the TRRP is continuing to execute the restoration strategy based on the ROD (DOI 2000), the TREIS/EIR (USFWS et al. 2000), and the Trinity River Flow Evaluation Final Report (USFWS and HVT 1999). Activities proposed for the year include:

- Constructing a channel rehabilitation project at the combined Deep Gulch-Sheridan Creek site
- Completing Design and initiating compliance for Dutch Creek channel rehabilitation project
- Providing WY2017 flow schedule planning and implementation
- Completing identified priority watershed projects
- Processing gravel at Sawmill site (near Cemetery Hole) to sort gravel into appropriate sizes for movement by river flows for fish spawning
- Adding coarse sediment (gravel) based on how much water is available to mobilize gravel downstream
- Continuing monitoring and assessment projects



FEMA floodplain map.

Flow Management

Preliminary modeling of the ecosystem response to Lewiston Dam releases indicates that flow management strategies should move toward a hydrology that more closely mimics that of regional streams by providing higher flow rates in the winter—higher and potentially more variable than a flat 300 cfs base—and earlier in the spring. A simple goal for TRRP scientists might be to increase juvenile salmonid capacity during peak densities. TRRP scientists continue to develop methodologies consistent with the ROD to provide winter flows for the benefit of anadromous fisheries and to promote a healthy river.

Environmental Compliance

TRRP's restoration activities continue to evolve as new information is collected and evaluated. This focus on adaptive management enables the TRRP to better achieve the goals set forth in the ROD.

Since the ROD and the associated Biological Opinions (NMFS 2000 and USFWS 2000) were issued, the status of several species, or their designated critical habitats, in the Trinity River watershed has been under review or changed. Some species that are now listed or proposed for listing under the ESA and/or their designated critical habitats were not listed or designated when the TREIS/EIR, the ROD, and the 2000 Biological Opinions were prepared and were therefore not analyzed in these documents. New restoration techniques were also not analyzed. Because of these changes, we have reinitiated consultation with NMFS and the USFWS under Section 7 of the ESA. As part of these consultations, Program partners are working to broaden the area of analysis so that the TRRP Biological Assessments might be used to support restoration activities on federally managed lands throughout the Trinity River watershed.

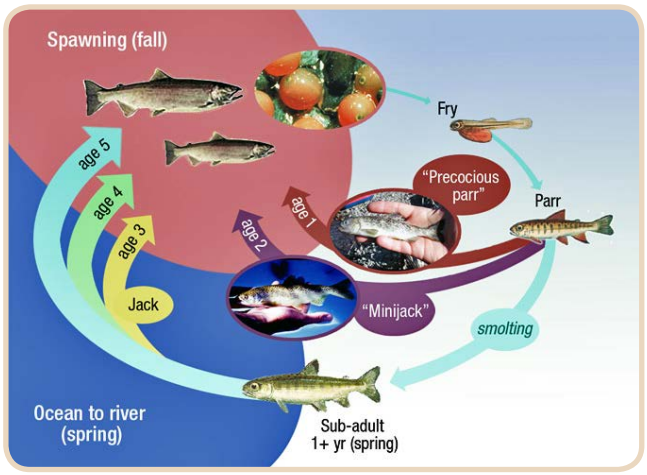
FEMA Floodplain Mapping and County Floodplain Development Compliance

New Federal Emergency Management Agency (FEMA) Flood Hazard Zone maps became effective on July 20, 2016. TRRP staff are working with Reclamation, FEMA, CDWR, and Trinity County to update floodplain maps to include changes due to recent projects and to ensure that new project designs minimize changes to the 100-year base flood hazard zone. Because the effective maps now have a regulated floodway, our new designs need to ensure that flood elevation changes are minimized around structures. Revisions or amendments to the effective FEMA maps are required when projects are completed and, conditionally, when designs are being drawn.

Fish Production Model

We are continuing to develop a salmonid production model for the Trinity River that will link to a Klamath River model. The model will be a component of the TRRP Decision Support System that can be used to evaluate:

1. The response of fish production to different flow management alternatives
2. The response of fish production to different proposed channel rehabilitation project designs
3. Fish growth and resulting production in response to water temperature
4. The growth/size and survival of fish in response to different flow/temperature alternatives.



Salmonid life cycle.

Stakeholder Involvement

Outreach and other forms of stakeholder involvement continue through:

- Outreach materials
- Updates to the TRRP website www.trrp.net
- Public meetings and seminars
- At least one public float per year
- Work with private landowners on rehabilitation projects
- Educational outreach to students through field days
- Informational booths at fairs and festivals such as the Trinity County Fair, the Trinity River Salmon Festival in Weaverville, and the Return of the Salmon Festival in Anderson

The Trinity Adaptive Management Working Group (TAMWG) continues to provide an opportunity for stakeholders to give policy and management advice about restoration efforts.

Implementation Monitoring

TRRP and its partners will continuing and/or expanding upon approaches to monitor gravel movement, physical habitat attributes, and juvenile rearing to track the effectiveness of sediment management and channel rehabilitation projects.

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— Stakeholder Involvement continued

Channel Rehabilitation

In 2017, we intend to initiate construction of the Deep Gulch-Sheridan channel rehabilitation project, which will likely span into 2018. As part of this project, we will:

- Construct surface and subsurface flow-connected wetlands to provide juvenile salmon rearing and foraging habitat
- Shift the main channel into two new meanders to decrease slope and increase channel complexity and spawning area
- Lower areas of the floodplain to increase connection to the river at a greater range of flows, thereby increasing shallow rearing habitat
- Install engineered log jams and a beaver dam analog to increase juvenile fish-rearing area, provide habitat variability, and enhance groundwater retention and riparian condition
- Revegetate construction-disturbed upland and riparian areas

Engineered log-jam at the Sawmill channel rehabilitation constructed in 2009.

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On the back cover: *Captions from left to right (clockwise): Aerial photography from 2016 of the Sawmill channel rehabilitation site constructed in 2009. As part of ongoing gravel augmentation efforts, coarse material is added to the river during high flows. In addition to creating salmon habitat, woody debris helps to restore fluvial processes to the river. Staff from TRRP tour the Lorenz Gulch channel rehabilitation site, which was constructed in 2013.*


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