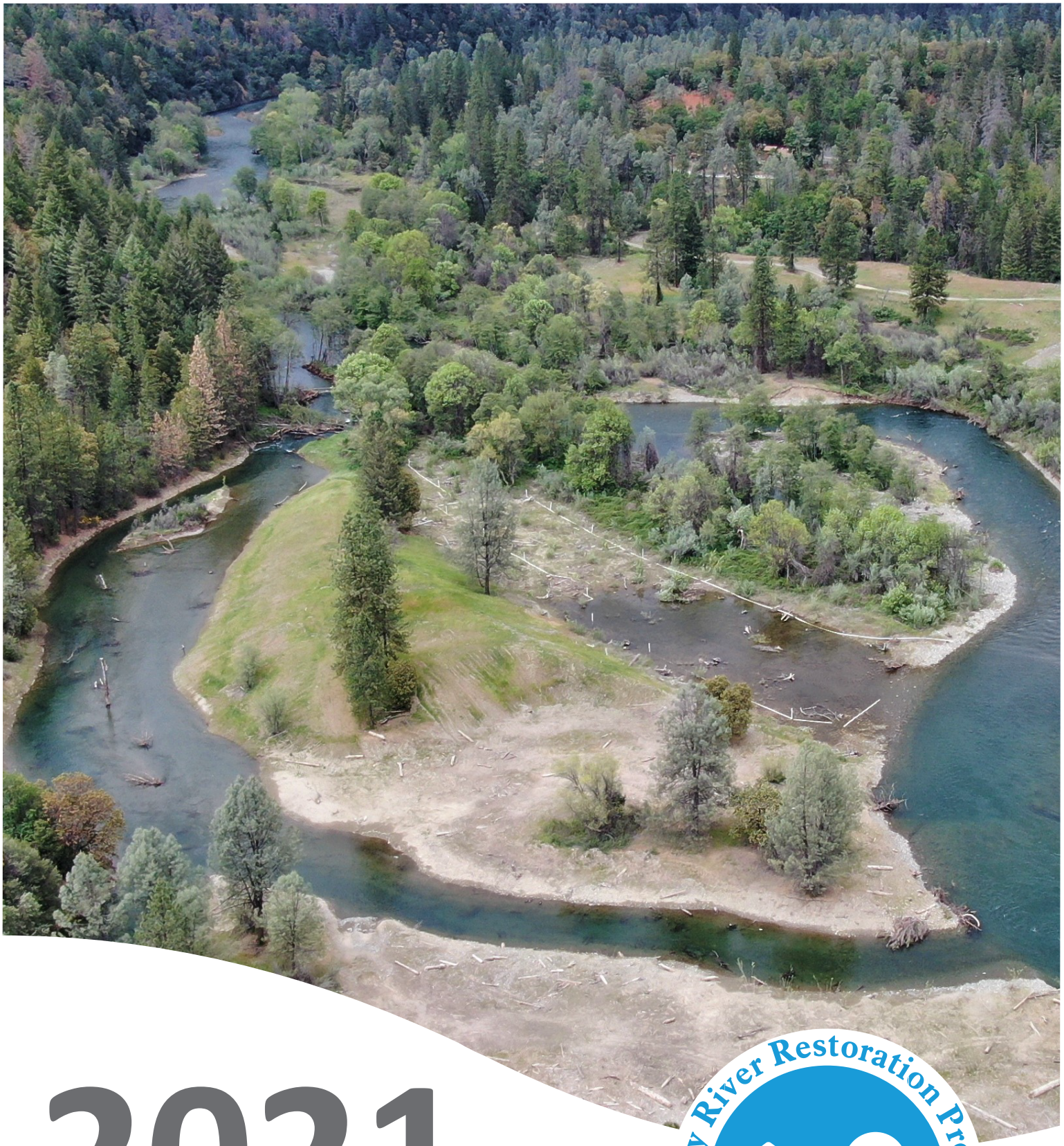


2021
Annual Report

Published: December 15, 2022

Trinity River Restoration Program

Restore • Adapt • Improve

Contents

On the Cover: An aerial shot at Chapman Ranch site, post rehabilitation.
(Aaron Martin, Yurok Tribal Fisheries Department)

Mission Statements

The **Department of the Interior** (DOI) conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

The mission of the **Bureau of Reclamation (Reclamation)** is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

The mission of the **U.S. Fish and Wildlife Service (USFWS)** is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.

The **Trinity River Restoration Program (TRRP)** implements the 2000 DOI Record of Decision, which directs DOI to restore the fisheries of the Trinity River impacted by dam construction and related diversions of the Trinity River Division of the Central Valley Project, California

Acknowledgements

Thank you to all partners and cooperating agencies for their contributions to this report. TRRP partners and stakeholders work diligently, thoughtfully, and effectively to meet the terms of 2000 Record of Decision and recover dynamic river processes that will promote natural-origin salmonid populations. Thank you to partners, stakeholders, and the public for continued involvement and interest in the restoration of the Trinity River. Photo credits are noted on photos, thanks to partners for their use. Note that all rights are reserved.

Acronyms

2D	two-dimensional
AEAM	Adaptive Environmental Assessment and Management process
BA	Biological Assessment
BiOp	Biological Opinion
BLM	Bureau of Land Management
CDFW	California Department of Fish and Wildlife
CDWR	California Department of Water Resources
CEQA	California Environmental Quality Act
CLOMR	Conditional Letter of Map Revision
DOI	Department of the Interior
ESA	Endangered Species Act
FEMA	Federal Emergency Management Administration
FIRM	Flood Insurance Rate Map
FNF	full natural flow
FONSI	Finding of No Significant Impact
FY	fiscal year
GPS	global positioning system
GRTS	Generalized Random Tessellation Stratified routine
HVT	Hoopa Valley Tribe
IDT	Interdisciplinary Team
KRTT	Klamath River Technical Team
LiDAR	light detection and ranging
LOC	Letter of Concurrence
LOMR	Letter of Map Revision
LW/rkm	large wood pieces per river kilometer
msl	mean sea level
NEPA	National Environmental Policy Act
NLAA	Not Likely to Adversely Affect
NMFS	National Marine Fisheries Service
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries
NTU	nephelometric turbidity units
PT	Pear Tree Gulch rotary screw trap site
Reclamation	Bureau of Reclamation
RAD	Restoration Action Database
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SRH-2D	Sediment River Hydraulics two-dimension
SWRCB	State Water Resources Control Board
TARGETS	Tool to Assess Riparian Germination and Establishment on Targeted Surfaces
TMC	Trinity Management Council
TREIS/EIR	Trinity River Mainstem Fishery Restoration Environmental Impact Statement/ Environmental Impact Report
TRRP	Trinity River Restoration Program (the Program)
USFS	U.S. Forest Service (Forest Service)
USFWS	U.S. Fish and Wildlife Service

USGS	U.S. Geological Survey
WCT	Willow Creek rotary screw trap site
WY	water year (October through September)
YOY	young-of-year
YT	Yurok Tribe
YTFP	Yurok Tribal Fisheries Program

Measurements

°C	degree Celsius
ºF	degree Fahrenheit
af	acre foot
cfs	cubic feet per second
rkm	river kilometer
rm	river mile

Report Names

Flow Study	Often referred to as the Trinity River Flow Evaluation Study. U.S. Fish and Wildlife Service (USFWS) and Hoopa Valley Tribe (HVT). 1999. Trinity River flow evaluation final report. USFWS, Arcata, California and HVT, Hoopa, California. Flow Study USFWS HVT 1999
ROD	U.S. Department of Interior (DOI). 2000. Record of Decision, Trinity River Mainstem Fishery Restoration Final Environmental Impact Statement/Environmental Impact Report. Decision by the U.S. Department of Interior, December 2000. DOI Record of Decision 2000
TREIS/EIR	USFWS, Bureau of Reclamation (Reclamation), HVT, and Trinity County. 2000. Trinity River Mainstem Fishery Restoration Final Environmental Impact Statement/Environmental Impact Statement. TREIS/EIR USFWS, Reclamation, HVY, Trinity County 2000
Master EIR	North Coast Regional Water Quality Control Board (North Coast RWQCB) and Reclamation. 2009. Channel Rehabilitation and Sediment Management for Remaining Phase 1 and Phase 2 Sites, Final Master Environmental Impact Report, Final Environmental Impact Report. Master EIR, 2009

Important Terms

Anadromous fish. Fish that spawn in fresh water, migrate to the ocean to grow, and then return to fresh water to spawn (e.g., salmon and steelhead).

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 action. Moving or wearing down of material by flowing water. In geologic 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) past a specific point in a river on the horizontal axis and the time on the vertical axis.

Hyporheic zone. A region beneath and alongside a streambed where shallow groundwater and surface water mix.

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 depth, width, and height measurements.

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

Point bars. 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 light detection, and ranging (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 assessment 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.

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

Riparian. On the bank of a river or other water body or the area of direct two-way interactions between aquatic and terrestrial systems.

Introduction

Trinity River Restoration Program (TRRP or Program) was established in 2000 by the U.S. Department of the Interior (DOI) Record of Decision. The long-term goals of the program are to restore the form and function of the Trinity River; restore and sustain natural production of anadromous fish populations in the Trinity River to pre-dam levels; and to facilitate full participation by dependent tribal, commercial and sport fisheries through enhanced harvest opportunities.

The Program is a partnership comprised of Federal, State, Tribal and Trinity County entities that collaborate to restore a 40-mile stretch of the Trinity River between Lewiston Dam and the confluence of the North Fork Trinity, California.

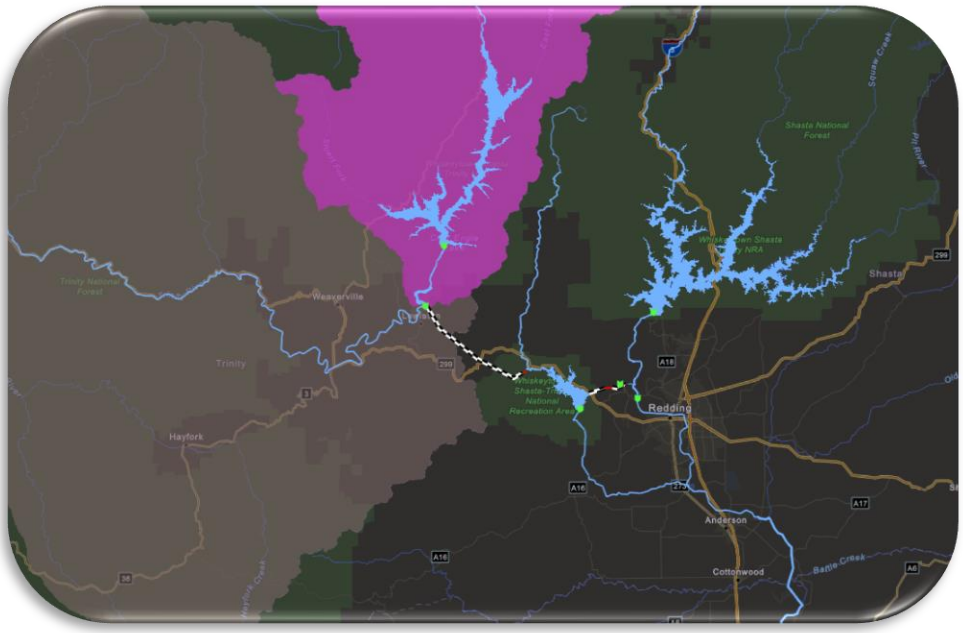


Figure 1. *The Trinity River watershed (fuchsia & opaque pink) and US Bureau of Reclamation Central Valley Project infrastructure (green chevron: dam/black and white lines: tunnel systems).*

The partnership is administered by two DOI agencies: the Bureau of Reclamation (Reclamation) and the U.S. Fish and Wildlife Service (USFWS). Partners share in the decision-making process through their participation on the Trinity Management Council (TMC). The TMC functions as a board of directors that sets priorities and schedules for strategic implementation by the Program's Executive Director.

Partners on the TMC include:

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

This annual report highlights accomplishments achieved throughout 2021 as well as the extensive planning activities, environmental permitting, and monitoring efforts across disciplines.

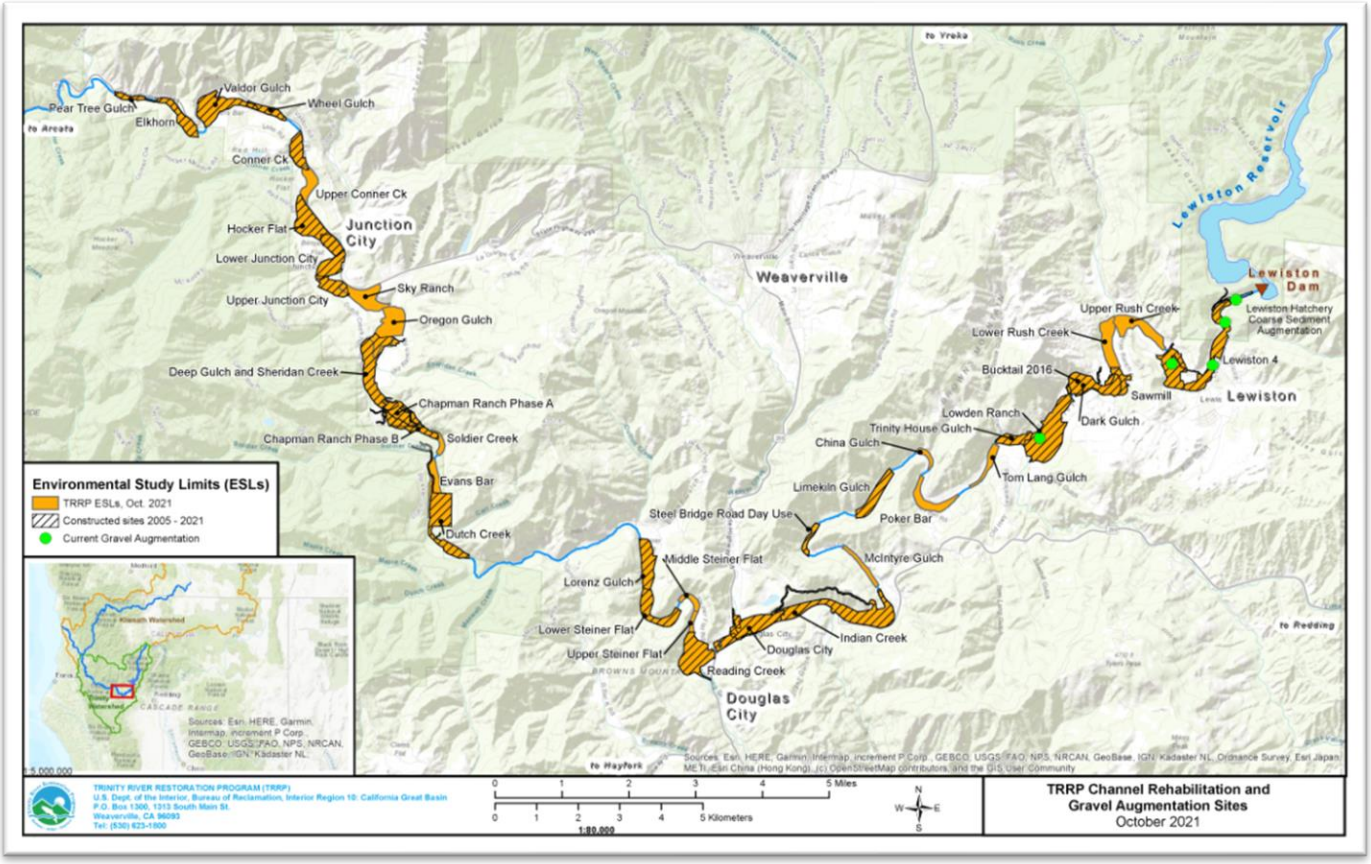


Figure 2. TRRP Channel Rehabilitation and Gravel Augmentation Sites: October 2021.

Restoration Strategy

The TRRP's restoration strategy is to foster a natural, dynamic river system that promotes all life-stages of salmonids through the following actions.

Chinook at Blue Creek. (Ken DeCamp 2009)

Flow Management

Restoration flow releases are designed to help establish and maintain complex habitat features in the river. Flow management uses a variable flow regime based on five water year types designated by California Department of Water Resources (CDWR).

Rehabilitated floodplains doing their job at TRRP's Indian Creek site. Floodplains form productive fish habitats. (TRRP)

Mechanical Channel Rehabilitation

Channel rehabilitation projects are designed to reshape the river channel to increase fish habitat across a range of allowable flows. The Flow Study identified 47 project sites along the river below Lewiston Dam for channel rehabilitation.

Bucktail restoration site during mechanical channel rehabilitation in 2016. (TRRP)

Sediment Management

Coarse sediment (spawning-sized gravel) sourced from mine tailings are added back to the river downstream of Lewiston Dam. These sediments replenish gravel-starved reaches of the river and are vitally important for salmon to use in building their nests.

Gravel Augmentation at Lewiston Weir, 2017. (TRRP)

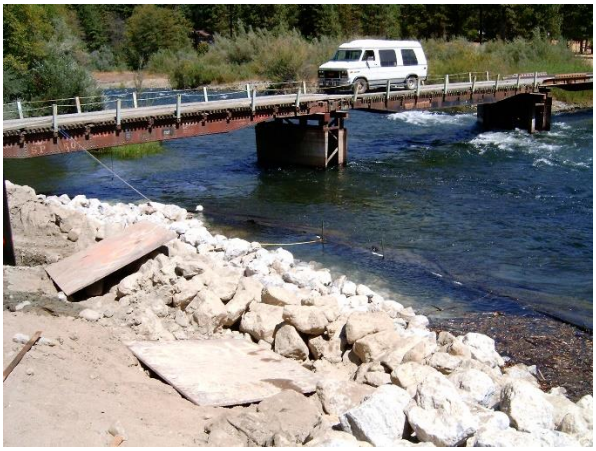
Watershed Restoration

Restoration projects in tributaries reduce fine sediment input to the Trinity River and increase available salmon and steelhead habitat throughout the watershed.

Watershed restoration on Little Browns Creek a tributary of the Trinity River, 2008. (TRRP)

Infrastructure Improvements

Modification of structures in the floodplain allow peak restoration flows released from Lewiston Dam.

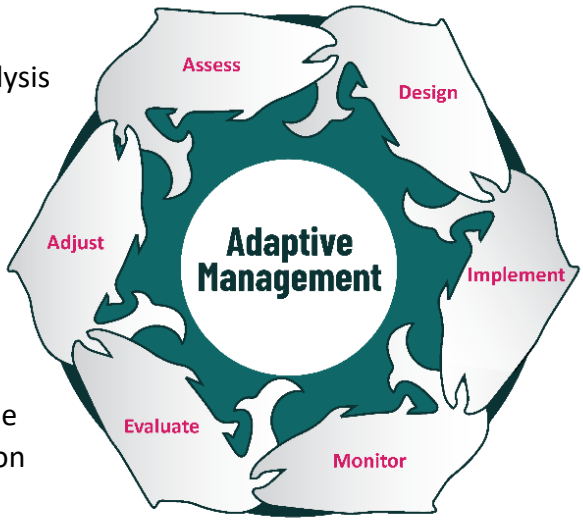


Salt Flat bridge before infrastructure improvement. (TRRP)

Salt Flat bridge after infrastructure improvement with a flow of 6000 cfs. The old bridge can be seen in the background to the right. (TRRP)

Adaptive Management

Adaptive Management is a rigorous monitoring and analysis program to improve restoration activities. The above actions are guided by an adaptive environmental assessment and management process. The first four elements place a priority on physical restoration of the river to create the attributes of an alluvial river system known to enhance habitat for anadromous fish species. Monitoring and evaluation under an adaptive management process show progress toward the expected physical and biological changes from restoration activities.



Executive Director Report

The Trinity River Restoration Program's 21st year was as fruitful and challenging as any we have previously experienced. Despite it being the second year of a global pandemic, and in the face of a crippling drought, we had many impressive accomplishments.

- Following on the recommendations of the 2018 TRRP Refinements Report, the Trinity Management Council and staff embarked on the creation of new foundational documents; one will summarize the program and its governance, and the other will describe how the TRRP can better incorporate science into our decision making through adaptive management.
- Public and agency feedback were solicited on an adaptive-management driven approach to use our restoration flow allocation across a wider portion of the year to better achieve physical and ecological objectives.
- Our spring restoration flow release targeted the objectives of a critically dry year.
- We entered into a new five-year agreement with the National Fish and Wildlife Foundation to administer watershed restoration grant funding, which we hope will attract a broader audience with new ideas.
- In response to declining spawning in the reach immediately below the dam, we executed our first gravel augmentation across from the Trinity River Hatchery since 2007 and saw immediate use by returning salmon.
- Our partnership completed its most ambitious mainstem restoration project to date, Phase B of the Chapman Ranch Restoration Project, which will dramatically increase the availability of juvenile fish habitat across a range of flows.

Funding and Expenditures

Funding levels have varied between $10 million and $16.66 million per year since the Program's inception. In fiscal year (FY) 2021, the Program received a total of $13.1 million, as shown in Figure 3.

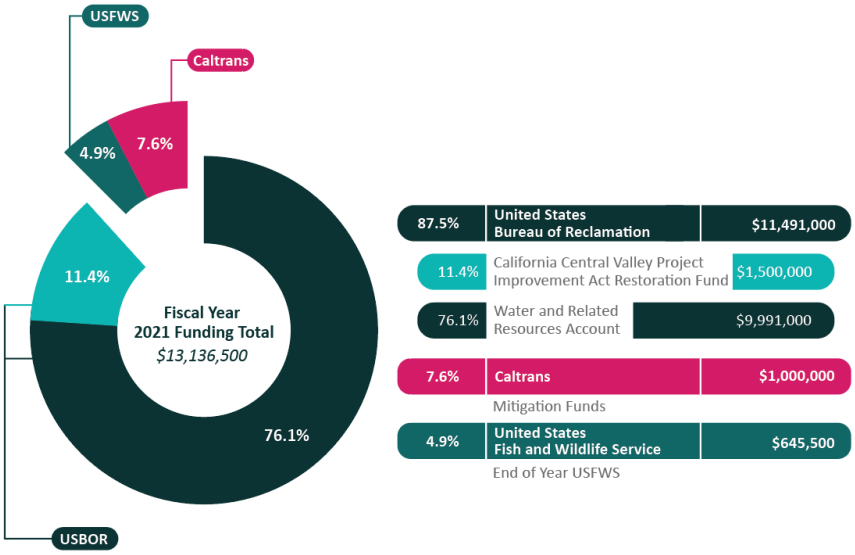


Figure 3. Funding for Trinity River Restoration Program for FY21.

Budget Allocations

The FY 2021 budget allocations went to three primary areas as shown in Figure 4.

Funding supported physical modifications to the river and the associated modeling, designing, permitting, and monitoring of physical and biological responses. Other partner agencies were funded and/or contributed in-kind services to support TRRP activities. It should be noted that staff positions and agency assistance funding can shift between categories so the level of funding in Administration, Implementation, and Science are not directly comparable between years. The 2021 Science budget prioritized a series of modeling and monitoring projects that targeted questions related to improving current models and reducing uncertainty in monitoring.

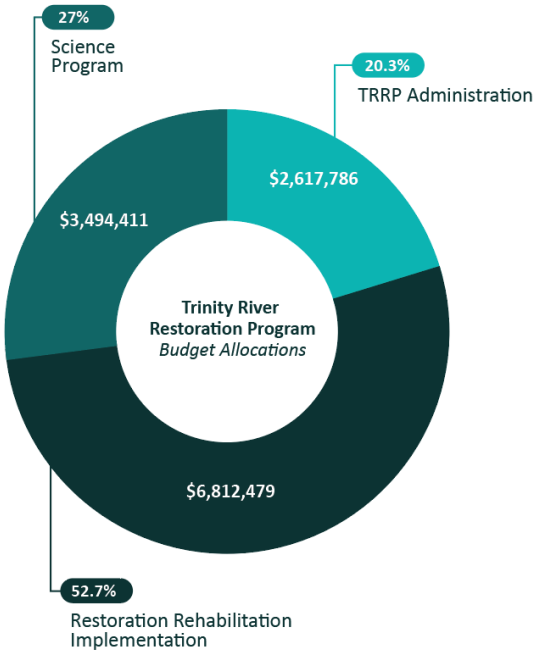
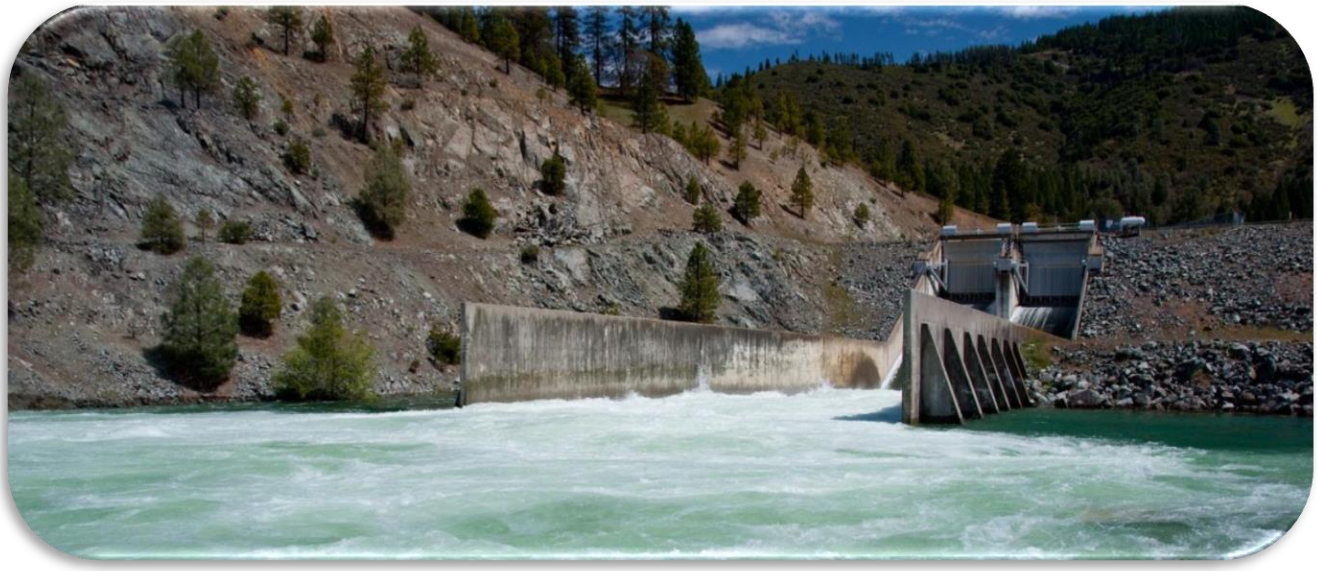


Figure 4. TRRP Budget Allocations for FY21.

I thank everyone from across the program, as well as our non-TRRP agency and nonprofit partners, for helping us accomplish so much this year. Looking ahead to what is planned for 2022, the future looks even more exciting.

Mike Dixon, *TRRP Executive Director*



Lewiston Dam. (Reclamation)

Flow Management

Restoration Releases

Each water year (WY), the TRRP's Flow Work Group and the TMC recommend a schedule for releasing restoration flows on the Trinity River. Selection criteria for determining the year's hydrograph include:

- Providing suitable temperatures for all salmonid life stages
- Reducing the travel time to the Klamath River for out-migrating smolts
- Managing riparian seed germination and plant growth
- Mobilizing sediment in the river and scouring pool depths; and
- Providing monitoring opportunities to support learning and adaptive management strategies

The water volume for the restoration flow release to the Trinity River below Lewiston Dam is based on the California Department of Water Resources (CDWR) April 1 forecast of the total annual inflow to Trinity and Lewiston Reservoirs, grouped into five water year types. Forecasts are used because the actual water year type is not known when the annual release schedules are developed. The CDWR forecasted that the water year type for 2021 was "Critically Dry". The approved daily average flow schedule for the Critically Dry WY was a modification of the hydrograph prescribed for this water year type in the ROD (Figure 5).

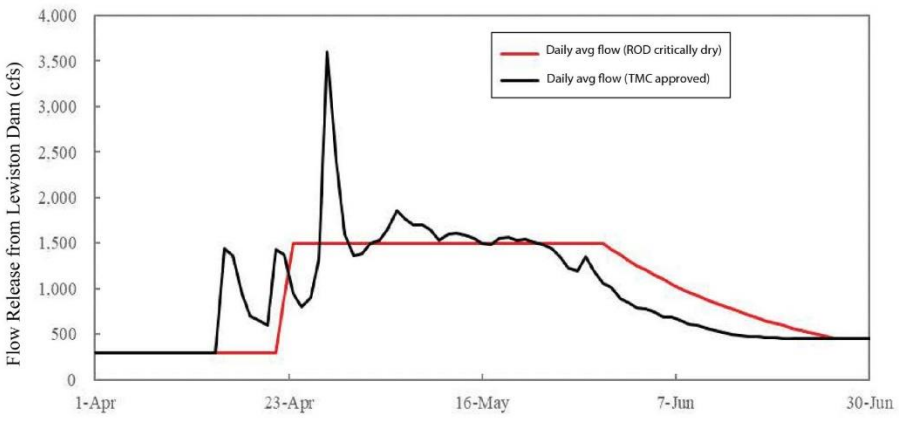


Figure 5. ROD Hydrograph change for WY 2021.

Changes from the ROD hydrograph were designed to:

- Elevate flows at the beginning of the hydrograph to disperse steelhead (*Oncorhynchus mykiss*) smolt released from Trinity Hatchery in this period
- Provide variable flows that increase habitat diversity and benefit fish and other organisms
- Maximize the variability in shear stress to increase sediment transport and riverbed scour
- Variably inundate floodplain areas to recruit nutrients to the channel

Flow Release Rates from Lewiston Dam

Daily average flows on the river closely followed the flows scheduled for release for WY21. There were two exceptions. The first was an emergency flow release made to lower river water temperatures at Hoopa in late July of 2021. The second was released during the Hoopa Boat Dance in mid-August early September (Figure 6).

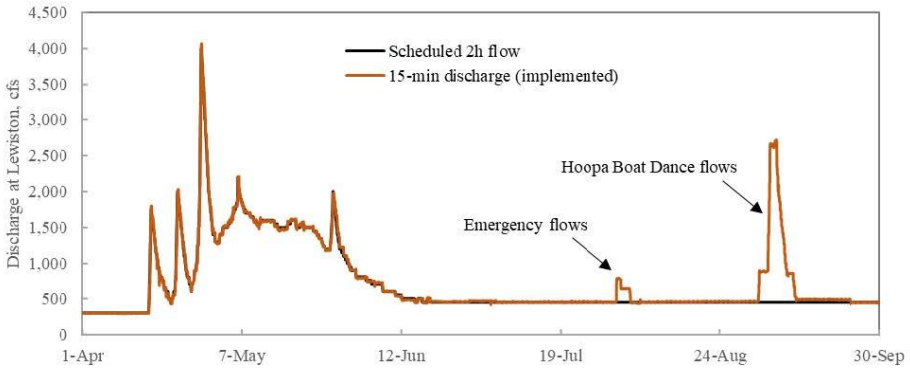


Figure 6. There were two exceptions to WY21 daily average flows.

The total volume of water released from Lewiston Dam to the Trinity River in WY 2021 was 389,683 acre feet (AF) according to the US Geological Service (USGS). According to US Bureau of Reclamation (Reclamation), water was released to the river via the power turbine (23,387 AF), fish hatchery and other outlets (120,034 AF), and radial gates at the dam (245,524 AF), for a total of 388,945 AF. The 0.2% discrepancy between the USGS volume (389,683 AF) and Reclamation volume (388,945 AF) reflects error in these respective measurements.

As mentioned above, an additional emergency release of 1,365 AF of water from Lewiston Reservoir was used to lower water temperatures at Hoopa in August. This water is separate from water released for restoration of the Trinity River as is water released for the Hoopa Boat Dance. The boat dance flow release involved 16,110 AF of water and commenced at 10:00 on September 2, 2021, reached a peak of 2,710 cfs at 05:15 on September 6, and returned to summer baseflow (450 cfs) at 23:15 on September 10.

Restoration Flow Schedule: Hydrograph Implementation

In addition to showing actual water releases, Figure 7 compares the releases from Lewiston Dam to the TMC-specified release schedule, as measured by the Lewiston gage (USGS #11525500). Central Valley Project operations implemented the allocated flow volume fairly accurately. The difference between the implemented restoration volume and the scheduled volume for restoration (369,000 AF) was

+3,208 AF, or +0.9%. The full water and temperature report is available by clicking this link: [2021 Water & Temperature Report](#).

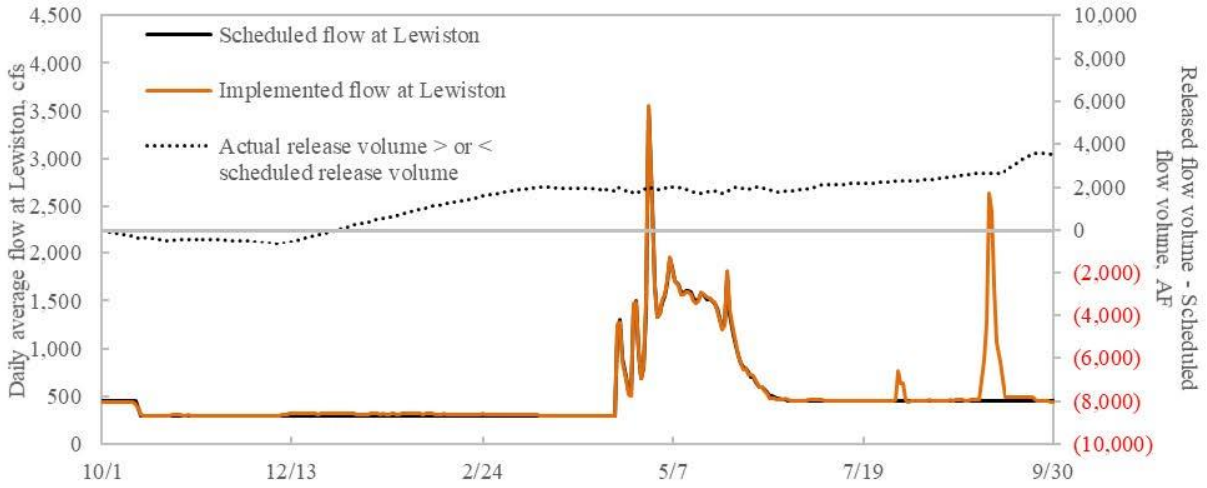


Figure 7. Daily average flows scheduled and implemented at Lewiston and the volume that implemented flows were above or below the ROD water volume allocated for a critically dry water year. The grey horizontal line indicates agreement between the scheduled and released water volume.

Water Exported from the Trinity River

Water exported from the Trinity River basin to the Central Valley via the Clear Creek tunnel totaled 604,290 AF in WY 2021, which is 155% more than the total volume of water released to the Trinity River (389,683 AF). An additional 32,632 AF and 2,432 AF of water evaporation was respectively estimated for Trinity and Lewiston reservoirs, making the volumetric expense of impounding Trinity River water 35,064 AF, or 11% of the full natural flow at Trinity Lake (330,139 AF) and 11% of the flow volume allocated for Trinity River restoration in WY 2021 (369,000 AF).

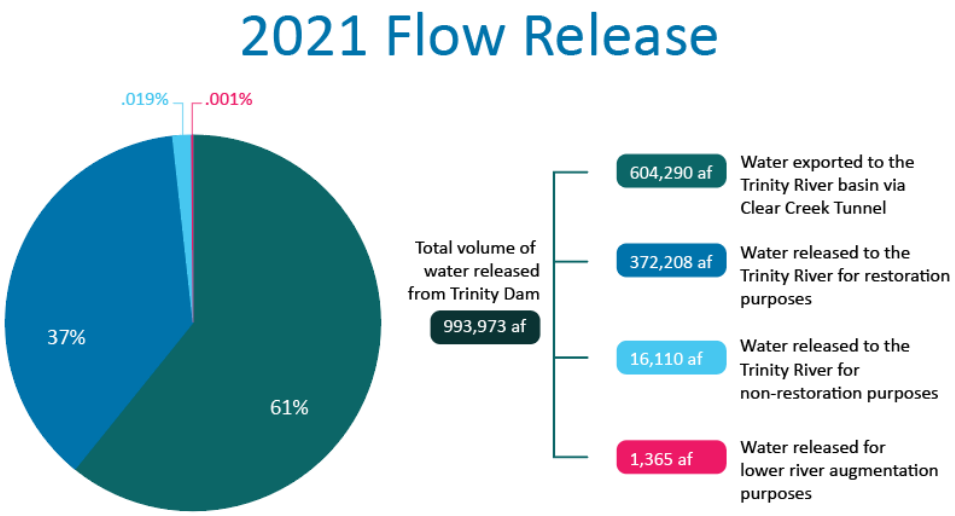


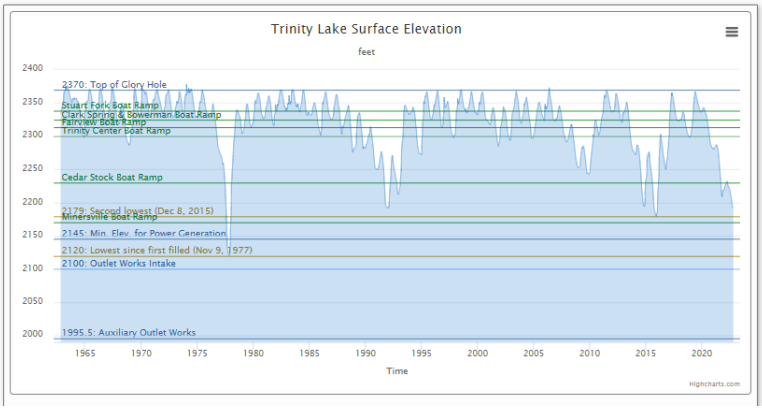
Figure 8. WY21 Flow Allocations in acre feet (af).

Trinity Reservoir Operations

The volume of water in Trinity reservoir decreased from 1,351,400 AF at the start of the water year (10/1/2020) to 710,400 AF at the end of the water year (9/30/2021). These volumes are respectively 55% and 29% of reservoir capacity (2,448,000 AF). The decrease in storage volume lowered the reservoir water surface 71.7 ft to 2218.7 ft above sea level and dewatered the Cedar Stock, Trinity Center, Fairview, Clark Spring, and Stuart Fork boat ramps.

Trinity Lake at Trinity Dam in April. (Kiana Abel, 2021)

Current elevations of the water reservoir at Trinity Lake are available on the [TRRP: DataPort].



Screenshot of current and past lake levels on our website: https://www.trrp.net/dataport/

Temperature Targets and Compliance

Water temperature targets are specified for two locations on the Trinity River to help provide adult salmon suitable conditions for upstream migration and holding in the mainstem channel. The compliance target locations are located at Douglas City and above the confluence with the North Fork (NF) Trinity River (SWRCB, 1990; NCWQCB, 1991). The temperature compliance targets are daily average values and vary with time of year and location on the river (Table 1). Success meeting the temperature targets and criteria in WY 2021 varied between stations as described below.

Source	Target Reach	Dates	Target
Basin Plan for the North Coast Region (North Coast RWQCB 2011) NMFS (2000) and WR 90-5 (SWRCB 1990)	Lewiston to Douglas City	July 1 - September 14	≤60 °F (15.5 °C)
		September 15 - 30	≤56 °F (13.3 °C)
	Lewiston to North Fork Trinity River	October 1 - December 31	≤56 °F (13.3 °C)
ROD Springtime Objectives for the Trinity River (TREIS/ EIR)	Lewiston to Weitchpec	**Normal and Wetter Water Years: Optimum**	
		April 22 - May 22	≤55.4 °F (13.0 °C)
		May 23 - June 4	≤59.0 °F (15.0 °C)
		June 5 - July 9	≤62.6 °F (17.0 °C)
		Dry and Critically Dry Water Years: Marginal	
		April 22 - May 22	≤59.0 °F (15.0 °C)
		May 23 - June 4	≤62.6 °F (17.0 °C)
		June 5 - July 9	≤68.0 °F (20.0 °C)

RWQCB = Regional Water Quality Control Board
NMFS = National Marine Fisheries Service (now NOAA Fisheries)
°F = degree Fahrenheit
°C = degree Celsius

Table 1. Trinity River Temperature Targets by Reach and Date.

The target to not exceed 60°F at Douglas City from July 1 to September 14 supports summer holding for spring run Chinook Salmon and for rearing juvenile Coho Salmon (*O. Kisutch*). The compliance mandate set forth by WR 90-5 (SWRCB 1990) from September 15 through September 30 (56°F) supports spawning Chinook Salmon and migrating adult Coho Salmon. River temperatures at Douglas City during the target period are influenced by the release temperatures at Lewiston Dam and local weather. Given the extremely hot summer that was experienced, water temperatures remained above the historic daily average values until fall. Water temperatures targets at Douglas City were met for 75 of the 92-day compliance period in WY 2021. The peak daily exceedance and total exceedance at this station was respectively 3°F and 34.4°F (Figure 9).

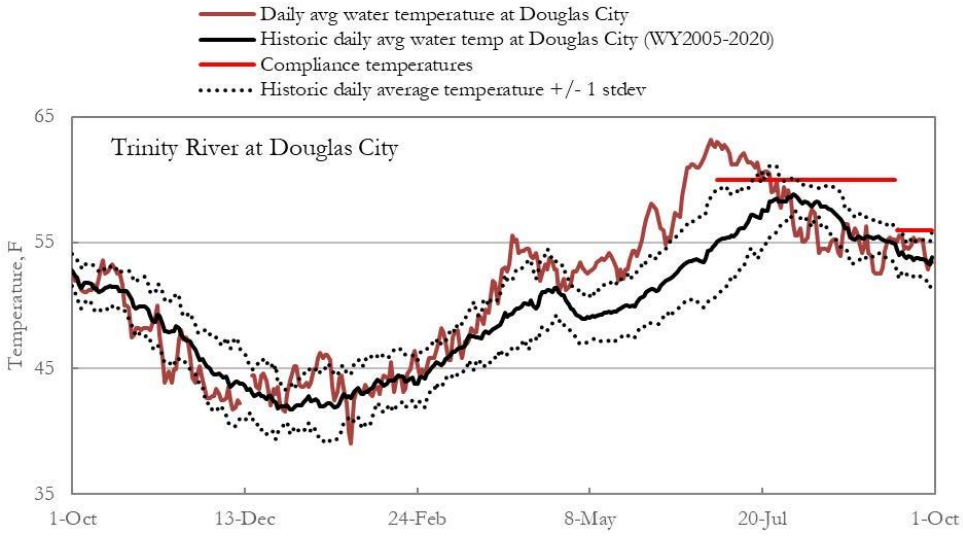


Figure 9. Daily average water temperatures at the Douglas City compliance point in WY 2021. Observed water temperatures are plotted with compliance targets and the average and range (+/- 1 standard deviation) of daily temperatures for the period of record (WY 2005-2020).

The target to not exceed 56°F on the Trinity River above the North Fork (NF) Trinity River from October 1 through December 31 supports spawning Chinook Salmon, Coho Salmon, and Steelhead. Water temperatures above the NF Trinity River were substantially below the targeted values and no exceedances occurred (Figure 10).

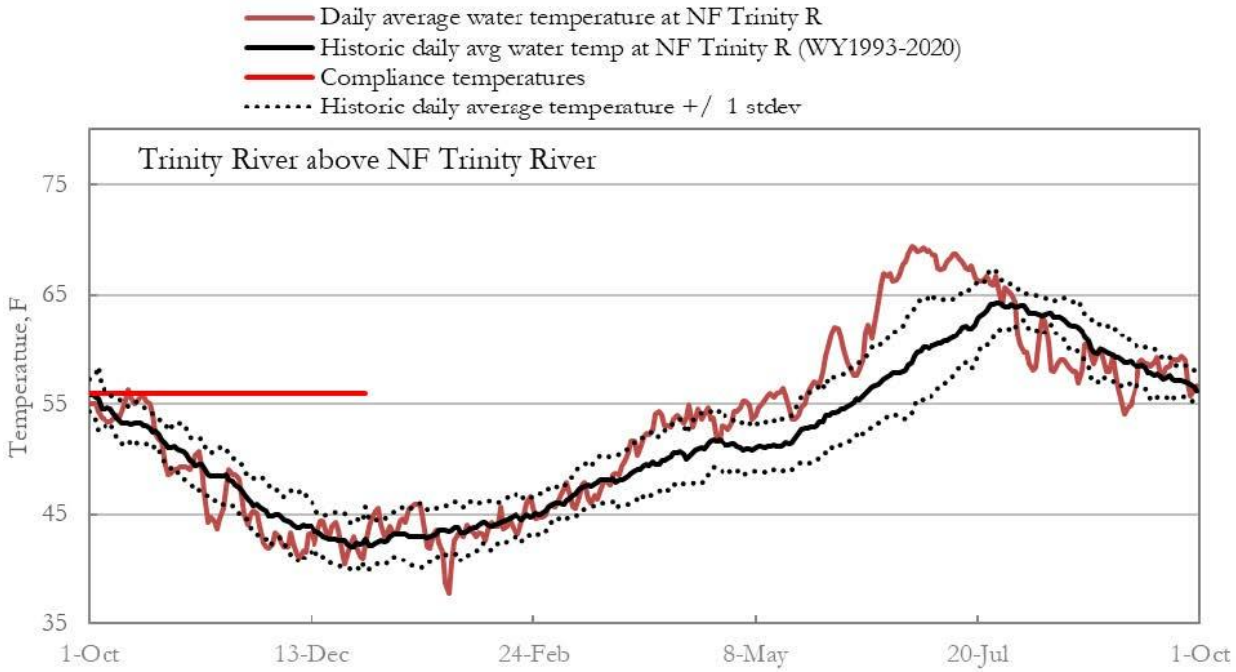


Figure 10. Daily average water temperatures for the Trinity River above NF Trinity River in WY 2021. Also shown are the historic daily average and range (+/- 1 standard deviation) of daily temperatures for the period of record (WY 1993-2020) at this station.

Aerial view of Chapman Ranch site after construction (Aaron Martin, Yurok Tribal Fisheries Department)

Mechanical Channel Rehabilitation

Chapman Ranch Phase B Rehabilitation Project

The second phase of the Trinity River Chapman Ranch Rehabilitation Site (Phase B) was constructed in 2021 and included an additional meander complex in the existing mainstem and creation of a side channel complex and lowered floodplains mostly on the left bank that ensure advantageous interplay between the Phase A and Phase B areas. Promotion of dynamic river processes, preservation of the alluvial potential of reach, and increasing the lateral and longitudinal connectivity of fry/juvenile salmonid rearing habitat were some of the physical and biological objectives of the project. Additionally, by revegetating the constructed floodplains and terraces with native woody riparian, conifer, and understory species, Phase B increased wetland and riparian plant species diversity.

Located approximately 3.2 miles upstream of the Dutch Creek Road Bridge in Junction City, CA, the site spans approximately 1 mile river section that was impaired by a legacy of dredger mining and water diversions, which had degenerated the river into a straight, narrow, and simplified channel with minimal habitat value for juvenile salmonids. The entire Trinity River Chapman Ranch project (Phases A and B) encompassed roughly 100 acres, including 48 acres of National Forest System land, 32 acres of managed by Bureau of Land Management (BLM), and 12 acres of private land.

This project set a milestone by becoming the first TRRP channel rehabilitation project constructed partially on National Forest System (NFS) lands and is a testament to years of close cooperation with the Shasta-Trinity National Forest (USFS), the BLM-Redding Field Office and other stakeholders.

The design, led by the Hoopa Valley design group, sustained years of review from the Design Team, as well from public stakeholders. The project was jointly constructed through a partnership between the Yurok Tribe (YT) and the Hoopa Valley Tribe (HVT) and funded by the Trinity River Restoration Program (TRRP) through the Department of Interior Bureau of Reclamation (USBR).

Noteworthy components of the Chapman Ranch Phase B project included wide floodplain lowering and multiple, structured large wood installations that were constructed using locally harvested trees from around the project site that were strategically positioned to force the river's flow through a new meander-pool-bar complex and into an extensive side channel and pond complex that includes three entrances to capture flow.

High-oblique aerial photograph looking downstream at the Chapman Ranch project site in 2015. The barren land terraced above the river on the right side of the photo supported predominantly non-native grasses and is largely disconnected from the river. (Aaron Martin, Yurok Tribal Fisheries Department.)

Channel Rehabilitation Design Objectives

Overall, the Trinity River Restoration Program (TRRP) design objectives are separated into three categories: physical, biological, and riparian. Although the primary focus is on increasing salmonid rearing habitat availability at flows between 300 and 2000 cubic feet per second (cfs), the means objectives include habitat for all life stages. The Chapman Ranch Phase B design also considered bank full flows for fluvial geomorphological processes and site evolution.

Physical (Geomorphic/Flow)

The design consisted of a new channel alignment that will increase channel sinuosity and length, increase channel complexity, and promote entrainment of spawning gravel from bankside dredge tailings. These features were designed and built to promote fine sediment deposition on floodplain and lowbench surfaces and help to create multi-threaded, chute, and side channels where geomorphic conditions are appropriate for a multi-channel morphology. The river will now inundate multiple floodplain areas across the project with mainstem flows ranging between 350 and 17,000 cfs. Clean spawning gravels sourced and mechanically processed during excavation were deposited into the river. These spawning gravels, combined with the large wood installations, will result in hydraulic

interactions to re-direct the river's flow into the new features and provide dynamic river processes that will create fish habitat.

Biological

The Chapman Ranch project areas have increased and will sustain fry rearing habitat area across a range of flows during the January 1–April 30 period. Also increased is the lateral and longitudinal connectivity of fry/juvenile rearing habitat (January 1–April 30) and pre-smolt/smolt habitat (April 1–June 30). This project expanded areas of vegetated surfaces experiencing continuous inundation duration of ≥ 14 days during Normal and wetter years for fry/juvenile rearing (January 1–April 30) and enhanced existing good amphibian habitat (facilitate local warming in channel margin habitats to improve existing populations and breeding use).

Riparian

The TRRP's goal for revegetation of the Chapman Ranch rehabilitation site is to preserve patchy existing multi-story riparian vegetation and cottonwoods. Increase surfaces providing > 21 days of moist soils within 0.85 ft of the ground surface during seed dispersal (April 1–June 30) in Normal and wetter years will provide suitable surfaces for natural riparian regeneration, especially near local cottonwood seed sources. The surfaces meeting the flow duration criteria would inundate at approximately 2,200 cfs.

Site Characteristics

Existing conditions at the Phase B site have been influenced by historic mining, and subsequent reductions in flood flow on the Trinity River. The large volume of dredge tailing deposits essentially channelized this reach of the Trinity River and simplified the available habitat for aquatic, riparian, and upland species. In addition to the enormous influx of mining debris associated with upslope hydraulic mining, the entire valley floor was dredged, obliterating all traces of a fluvially-formed channel. The approximate planform of the modern channel through Chapman Ranch was established by 1960, most likely during the 1955 flood, and remained relatively unchanged until the implementation of Chapman Ranch Phase A in 2019, which reset the channel to a planform orientation more closely resembling pre-dam conditions.

The existing Trinity River channel through Chapman Ranch was deeply incised into the mining debris and for much of its length, the channel is bound on one bank by tailings piles or flattened tailings terraces as much as 20 ft higher than the stream bed. On the opposite bank, the channel is confined by large, heavily vegetated berms that developed along the pre-dam channel margin in the latter half of the 20th century. These berms reach heights of up to 15 ft above the stream bed, restricting the channel to an average width of approx. 100 ft (this equates to flow confinement ranging between 493–7,155 cfs). In Phase A project areas, these berms were removed as a part of floodplain lowering activity, increasing the potential for lateral migration. Since implementation in 2019, Phase A meander bends have begun to migrate into the tailings terraces adjacent to the channel as intended, eroding the coarse sediment, and recruiting it into the geomorphic system. Sediment transport is an integral function of sustainable systems.

Initial Concept

Positioned at the top end of a valley reach, the site offered an opportunity to significantly lower floodplain elevations and force the river into a new meander with a structured logjam and gravel bars. The terraced floodplain on the right bank provided a chance to re-connect a large portion of the

reach to the river across a broad range of flow conditions. Extensive floodplain lowering allowed for fine sediment deposition to enhance soil composition and encourage riparian vegetation growth thus increasing the biological complexity of the reach in both the near-term and long-term.

Positioned at the top end of a valley reach where the wide valley width and minimal infrastructure presented a unique opportunity to take a relatively aggressive restoration approach, Chapman Ranch allowed for reshaping the channel geometry, increasing floodplain connectivity, adding large wood pieces, and creating an abundance of habitat features. The design incorporated input from two independent value engineering studies and numerous consultations with the Program and other members of the Program's Design Team. The design allowed for immediate and notable improvements in salmonid habitat for all life stages by creating large areas with suitable flow depth, velocity, and cover. Improvements in riparian ecosystem health and floodplain connectivity are addressed throughout the project site.

Rehabilitation Design Process

From 2016 to 2020, the Hoopa Tribal Fisheries design group, working with McBain Associates, used a multi-disciplinary and multi-organizational approach that focused on including stakeholder input early in the design phase. This structured design process helped to foster better communication and transparency—and created a collaborative environment that allowed for innovated ideas and important recommendations.

Design Features and Implementation

The features of the Chapman Ranch Phase B channel rehabilitation project are shown in Figure 11. A new forced meander, point bar, pool feature and a medial bar that blocks the existing mainstem increases low-water channel length, sinuosity, and complexity. By decreasing meander wavelength and radius of bend curvature the features provide the physical template for future channel migration and

Figure 6. Chapman Ranch Phase B features during construction. (TRRP)

entrainment of coarse alluvium from the channel bank. Low flow and high flow side channels and three constructed ponds will be predominantly wetted year-round, providing habitat for a variety of aquatic and terrestrial species, with a maximum depth of over 6 ft during typical summer baseflows. Feature construction included abundant wood placements and provided low-velocity refugia for salmonids of all life stages. Several rehabilitation activities at the site were completed, including:

- Lowered floodplain elevations to provide opportunities for establishment of native vegetation and improve channel–floodplain hydraulic connectivity.
- Create changes in channel planform to increase dynamism, consistent with Program objectives.
- Reduced depth to groundwater to increase riparian planting success and provide winter refuge for juvenile salmonid rearing.
- Provided the physical templates to maintain riffle–pool–riffle sequence near the upstream end and increased sinuosity and bank erosion further downstream.
- Maintain suitable spawning area as the new channel morphology becomes established.
- Constructed large wood hydraulic structures at strategic locations to engage with the river at a range of water surface elevations

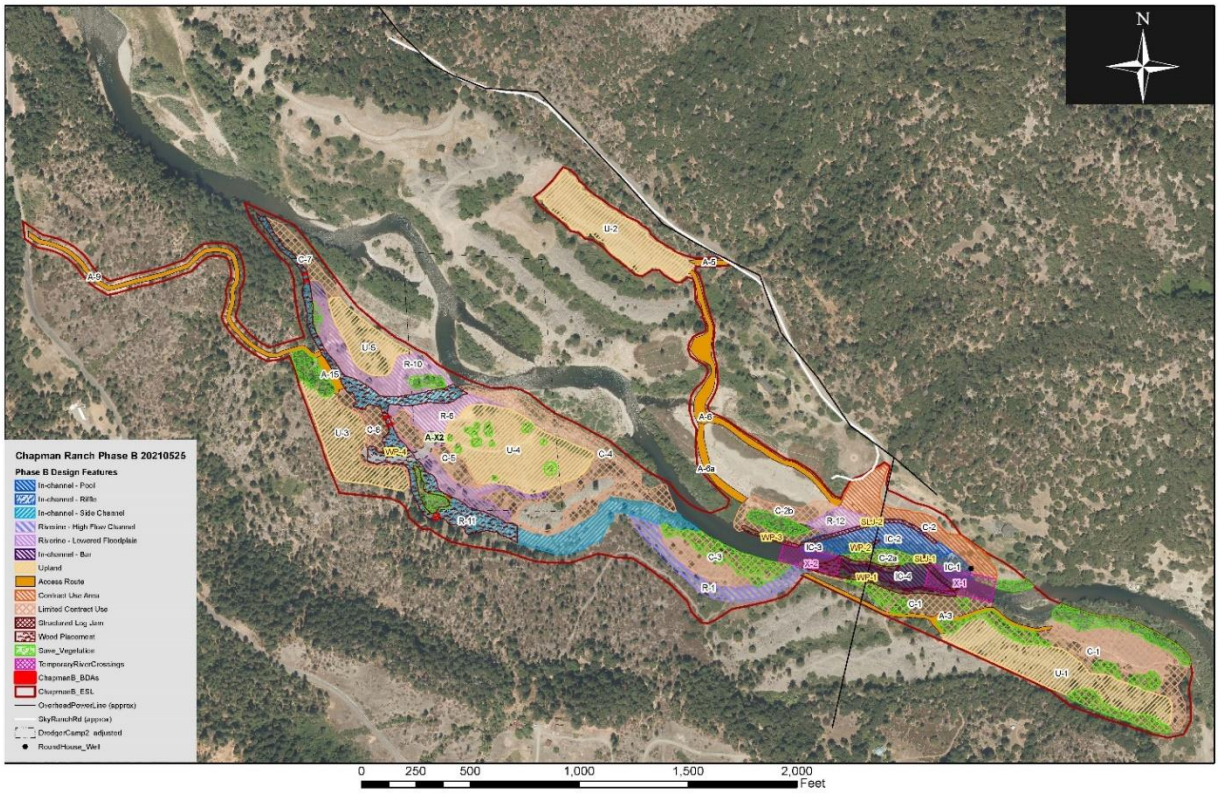


Figure 7. Labeled Design Features map for Chapman Ranch Phase B.

The 2021 construction season posed a unique set of challenges with COVID-19 and USFS closures due to extreme fire behavior. Civil construction work was largely completed by the beginning of October 2021 with revegetation work and mitigation measures extending into late October.

A previously straight and nearly featureless section of the river now has a new meander bend, structured logjams, side channels, ponds and lowered floodplains that will connect with the river at much lower flows. These new features will provide immediate and long-term habitat for salmon and

steelhead. Following project implementation, the river will continue to evolve the site and create a more productive section of river for salmon and steelhead.

A TRRP staff member watches as placed sediment washes downriver during a high flow event. (TRRP)

Sediment Management

Trinity and Lewiston Dams not only trap water but also the supply of sediment from areas upstream of Lewiston Dam. To mitigate for this, gravel additions are made to the channel to increase the availability and quality of bar features that provide physical habitat in the river. As with flow management, optimizing the gravel management strategy through applied science is an ongoing priority.

Water year 2021 was a “critically dry” year in which the annual spring high flow release from Lewiston Dam peaked at 3,550 cfs from Lewiston Dam. This flow is too low to mobilize coarse sediment, so sediment transport was not monitored, and coarse sediment was not added to the channel during the spring flow release in water year 2021. However, gravel was added to the channel during summer baseflow. The addition totaled 5,600 cubic yards and was made in July 2021 in the reach that is adjacent to the Trinity River Fish Hatchery. The reason for the gravel placement was to provide spawning habitat for Chinook Salmon and Steelhead. This goal was verifiably met, as several hundred spawning salmon were observed utilizing the gravels for redd construction within three months of its placement.

Juvenile Chinook near Lewiston. (Nathan McCanne)

Physical and Biological Responses to Restoration Flows

Riparian Species Monitoring and the Riparian and Aquatic Ecology

Much of TRRP's actions for wildlife are guided by the 1984 Trinity River Basin Fish and Wildlife Management Act (Public Law 98-541) that acknowledged the loss of habitat for deer and other wildlife species caused by inundating riparian and upland areas behind Lewiston and Trinity Dams.

Western Pond Turtle (Actinemys marmorata) designated by CAL- Fish and Game as a "species of special concern". (Jamie Bettaso, USFWS)

Conventional TRRP monitoring for wildlife and riparian vegetation paused in 2021, while researchers took time to assess data in several finalized synthesis reports. The riparian encroachment synthesis report and the cottonwood seed dispersal synthesis report have been finalized (Bair et al. 2020, HVT and McBain Associates 2021) and are part of a programmatic effort to use long-term data sets to answer long-standing questions.

Flow Scheduling for Riparian Vegetation

Riparian vegetation is an important component of the Program's strategy to restore natural processes. In addition to providing numerous benefits to fish as a source of cover, shade and food for insects, riparian vegetation also provides habitat elements for songbirds and other wildlife species.

A Sediment retention pond on Grass Valley Creek provides nourishing habitat for young fish and other wildlife. (TRRP)

Healthy riparian vegetation allows protected species such as foothill yellow-legged frogs to thrive. These frogs are unique in that they breed in rivers and streams versus still waters. (Jamie Bettaso, USFWS)

TRRP scientist finds a nest in the riparian vegetation. (James Lee, TRRP)

Planting cottonwoods, willows, and other species at individual channel rehabilitation sites is one method to promote successful revegetation. In addition to revegetation methods at channel rehabilitation sites, the TRRP also relies on flow releases from Lewiston Dam to manage vegetation. The TRRP models the vegetation responses to proposed flow schedules using the computer model, Tool to Assess Riparian Germination and Establishment on Targeted Surfaces (TARGETS). TARGETS models the bank location where cottonwoods and willows are likely to grow along different cross-sections of river channel, based on the flow patterns of a proposed dam release schedule. This model, first created in the early 2000s, was updated in 2018; the updated model has been applied during flow scheduling since 2019.

Native plants ready for revegetation at the Chapman restoration site, 2021. (TRRP)

Riparian Encroachment

Native vegetation provides many resources to the river. However, in regulated rivers such as the Trinity River below Lewiston Dam, the loss of large floods, coupled with stable summer flows, can result in continuous bands of unnaturally dense vegetation along the summer water line (Figure 13). This vegetation shapes bars and banks into areas that are unfavorable for rearing salmonids and can hasten the development of steep berms along the banks. Using managed flows to discourage woody plant encroachment is a primary objective identified in the Trinity River Flow Evaluation Report (TRFE) (USFWS HVT 1999) and is a long-standing TRRP goal. Vegetation monitoring has indicated that managed flow releases have discouraged woody plant encroachment as described in a riparian encroachment synthesis report (HVT and McBain Associates 2021).

Figure 13. An example unnaturally dense vegetation and the use of high flows to discourage willow growth along the summer water line. (Reclamation)

The WY21 hydrograph (Figure 14) was reflective of a critically dry year. No woody plant recruitment or seedling scour objectives are associated with a Critically Dry Year (USDI 2000). Past results of annual riparian band transect, and exposed bar monitoring showed that, in most years, riparian hardwoods will be scoured from the low water edge by winter storms (tributary-generated floods) and spring ROD releases (Table 2).

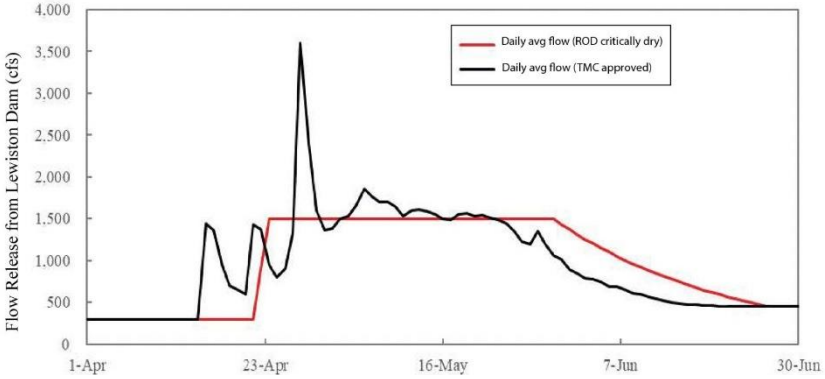


Figure 14. WY hydrograph was reflective of a critically dry year.

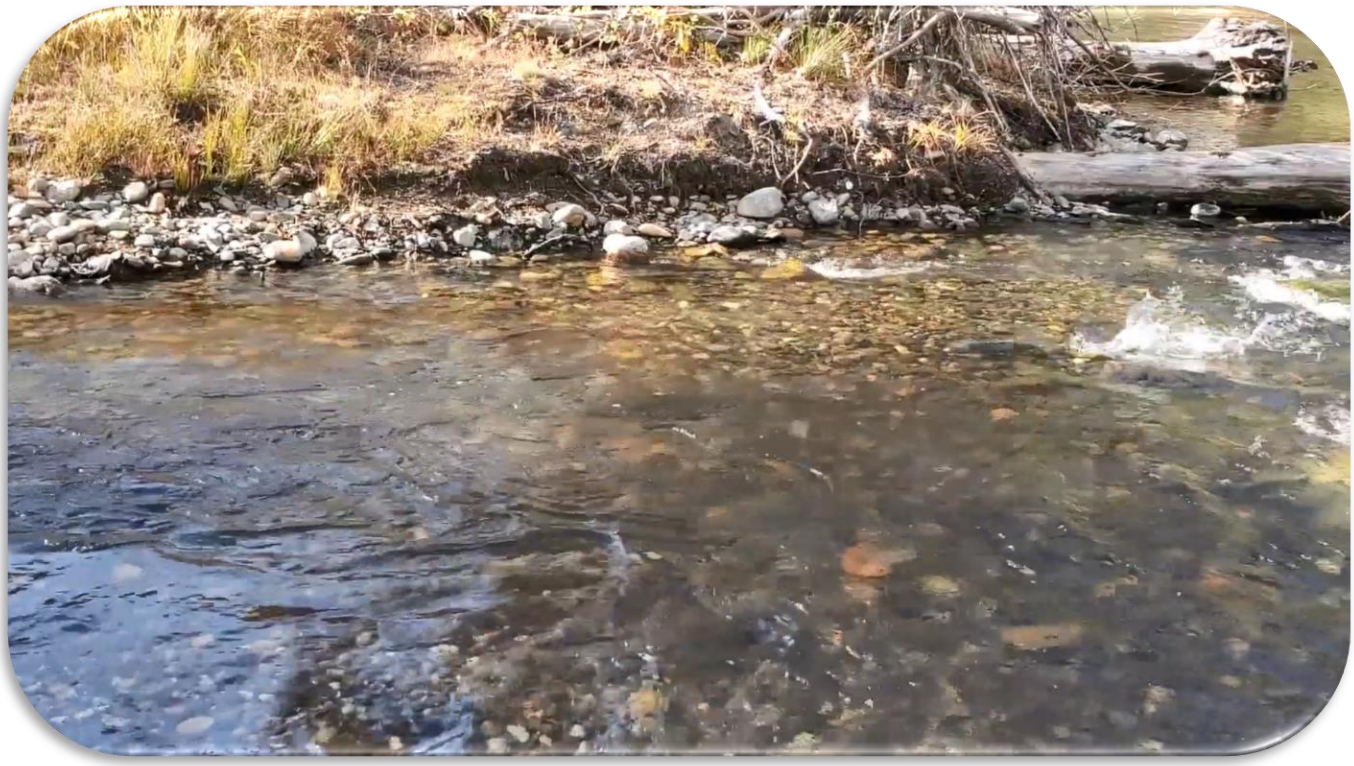
Water Year	Instantaneous Maximum Lewiston Discharge (cfs)	Cohorts Scoured	Surviving Cohorts	Established Cohorts
2005	7,640	2004 cohort	None	1993, 1998, 2000, and 2002 cohorts
2006	10,400	2003, 2004, and 2005 cohorts		1993, 1998, 2000, and 2002 cohorts
2007	4,810	None	2006 cohort	1993, 1998, 2000, 2002, and 2006 cohorts
2008	6,890	2007 cohort	2006 cohort	1993, 1998, 2000, 2002, and 2006 cohorts
2009	4,630	None	2006 and 2008 cohorts	1993, 1998, 2000, 2002, 2006, and 2008 cohorts
2010	7,480	2009 cohort	2006 and 2008 cohorts	1993, 1998, 2000, 2002, 2006, and 2008 cohorts
2011	12,300	2008, 2009, and 2010 cohorts	2006 cohorts	1993, 1998, 2000, 2002, and 2006 cohorts
2012	6,180	2011 cohort	2006 cohorts	1993, 1998, 2000, 2002, and 2006 cohorts
2013	4,590	None	2006 and 2012 cohorts	1993, 1998, 2000, 2002, 2006, and 2012 cohort
2014	3,460+	None	2006, 2012, and 2013 cohorts	1993, 1998, 2000, 2002, 2006, 2012, and 2013 cohorts
2015	8,830	2013 and 2014 cohorts	2006 and 2012 cohorts	1993, 1998, 2000, 2002, 2006, and 2012 cohorts
2016	9,600	2014 and 2015 cohorts	2006	1993, 1998, 2000, 2002, and 2006 cohorts
2017*	12,000	2015 and 2016 cohorts	2006 cohort	1993, 1998, 2000, 2002, and 2006 cohorts
2018*	2,040	None	2006 cohort and 2017 cohorts	1993, 1998, 2000, 2002, 2006, and 2017 cohorts
2019*	10,800	2017 and 2018 cohorts	2006 cohort	1993, 1998, 2000, 2002, and 2006 cohorts
2020*	3,970	None	2006 and 2019 cohorts	1993, 1998, 2000, 2002, 2006, and 2019 cohorts
2021*	4,070	None	2006, 2019 and 2020 cohorts	1993, 1998, 2000, 2002, 2006, and 2019, 2020 cohorts

+The peak discharge of 2014 was not associated with spring ROD flows, rather it occurred on September 22, 2013, and was associated with Lower Klamath temperature and health flows.

Table 2. Peak Flow Magnitudes Related Riparian Seedling Scour. Cohort survival and mortality are estimated in years with an asterisk (*). + The peak discharge of 2014 was not associated with spring ROD flows; it occurred on September 22, 2013 and was associated with Lower Klamath temperature/health flows.

Seedlings become established after four growing seasons, after which their root systems are too extensive to be scoured by ROD flow releases alone. Since 2000 at least one cohort (WY 2006) has been documented to have survived to establishment, and is, therefore, beyond the ability of ROD releases to remove via scour. Allowing 2 out of every 13 cohorts to survive to establishment could rapidly lead to further encroachment along the low water channel, especially at newly created habitat within rehabilitation sites.

Survival and mortality patterns have been estimated since 2017. Estimates are based on relationships between flood peak magnitude and seedling scour and have not been verified through field sampling.

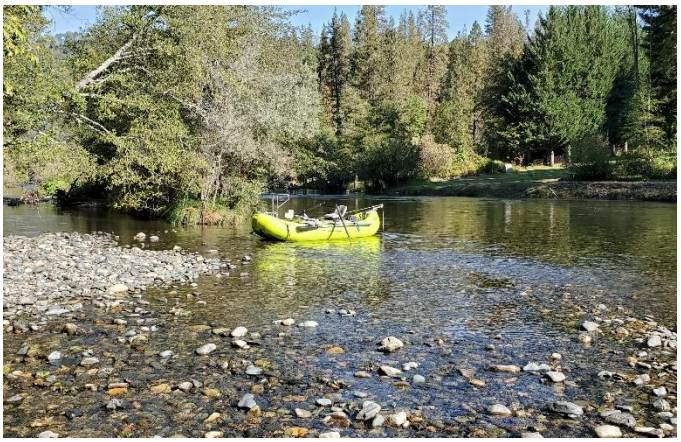


Salmon spawning in the Trinity River. (Yurok Tribal Fisheries Department)

Fisheries Monitoring

Juvenile Salmon Habitat Assessment

The Habitat Assessment Team collaborates with the Science Program and the Implementation Branch Team to monitor the effectiveness of channel rehabilitation for increasing juvenile habitat availability. Goals in 2021 included completing a survey of most recent cover habitat and catalog large wood installations at rehabilitation sites.



A research raft is moored while scientists gather spawning data on the Trinity River. (Yurok Tribal Fisheries Department)

Surveying Cover Habitat and Large Wood

In 2021, the habitat team surveyed instream cover habitat for the recurring (~ 5-year interval) update to TRRP's hydraulic model of the 40-mile restoration reach. Sites were selected based on when they

were last surveyed with preference to sites that had not been surveyed since 2014. This information is a critical component to updating the SRH2D 40-mile hydraulic model, which is used by most TRRP practitioners. For example, spatial distribution of cover habitat is an important variable for biological models estimating rearing habitat capacity for endangered Coho Salmon at the fry life stage *(Som et al. 2018, Beechie et al. 2005, Beecher et al. 2002)*. The final cover habitat spatial layer representing cover habitat of the entire restoration reach was finalized and is available for distribution.

A large wood instillation at Dutch Creek Restoration Site completed in 2020. (TRRP)

Large wood (LW) surveys were conducted in 2021 at Bucktail, Dutch Creek, Lowden Ranch, and Sawmill rehabilitation sites contributing to a long-term dataset monitoring trends in LW across the restoration reach.

Habitat Monitoring Synthesis Reports

A report describing trends in LW installations at all rehabilitation sites over the course of 15 years was initiated based upon the long-term dataset in which field activities contributed. Figure 15 depicts an example of the types of trends the report will document. Analysis is ongoing and will develop in

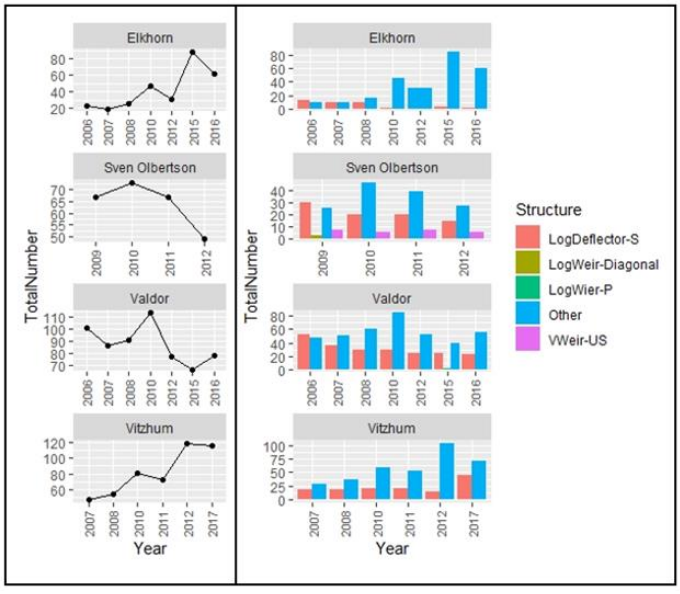


Figure 15. Analysis of LW trends over time at a select group of rehabilitation sites using a long term LW dataset produced by the habitat assessment team.

A scientist observes wildlife at a large wood jam built in 2017 in off channel ponds at the Sheridan Creek Rehabilitation Site. (Mike Dixon, TRRP)

conjunction with other large wood research conducted by TRRP collaborators.

The habitat team contributed to the completion of a synthesis report on estimates of habitat capacity in 2021. This report describes trends in habitat capacity between constructed and non-constructed areas of the restoration reach at a range of stream flows using hydraulic model outputs of depth, velocity, and distance to cover. It is available on the TRRP DataPort (Boyce et al).

Monitoring of Juvenile Chinook Salmon

Monitoring of juvenile Chinook Salmon on the Trinity River was conducted by the Hoopa Valley Tribal Fisheries Department at the Pear Tree Gulch Monitoring Site, and Yurok Tribal Fisheries Program at the Willow Creek Monitoring Site. Monitoring at the Pear Tree Site began January 1, 2021, and ended in August 2021, several weeks prior to the anticipated end date due to the Monument Fire.

Despite the abrupt end to trap operation, it was a successful season that will allow for season-wide and weekly population estimates to be calculated. Monitoring at the Willow Creek Site began March 6, 2021, after spring high flows receded and continued through July 23, 2021. Trapping operations at the Willow Creek site were suspended when water temperature surpassed 24 degrees Celsius at USGS gaging station 11530000 in Hoopa to protect fish health and limit handling stress. The 2021 estimates of naturally produced juvenile Chinook Salmon are expected to be released in 2022.

A Yurok Tribal Fisheries Department fish screw trap station. (Yurok Tribal Fisheries Department)

Salmon Redd Distribution and Abundance

Since 2002 the USFWS, USFS, CDFW, HVT, and YTFP have conducted annual salmon spawning surveys on the mainstem Trinity River to evaluate the distribution and abundance of Chinook Salmon spawning activity.

A Coho Salmon carcass caught during the spawning surveys in 2021. (Yurok Tribal Fisheries Department)

Surveyors located 1,991 salmon redds and examined 1,102 fresh salmon carcasses during the 2021 survey season. Of the fresh carcasses, 1,084 were Chinook Salmon and 18 were Coho Salmon. Counting redds in the uppermost reach (TRH to Old Lewiston Bridge) ceased after the eighth of thirteen survey weeks when redds built on an area of recently augmented gravel in this reach became indistinguishable. Three hundred fifty-two redds had been counted in Reach 1 before surveys there ceased. Natural-origin Chinook Salmon built an estimated 1,340 redds,

hatchery-origin Chinook Salmon built 596 redds, and Coho Salmon built the remaining 55 redds (Table 3).

Species	Origin	2021
Chinook Salmon	All	1,936[b]
	Natural	1,340[b] (1,191 - 1,511)
	Hatchery	596 (426 - 746)
Coho[a] Salmon	All	55[b]
	Natural	NA[c]
	Hatchery	NA[c]

Bootstrap-generated 95% confidence intervals are in parentheses.

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

[b] Confidence intervals are generated with both Chinook and Coho salmon data. Not enough female Coho Salmon carcasses were found in 2021 to calculate a confidence interval.

[c] Not enough fresh female Coho Salmon carcasses were found in 2021 to calculate separate estimates for natural and hatchery-origin Coho Salmon redds.

Table 3. Estimated numbers of Chinook and Coho salmon redds observed in the mainstem Trinity River in 2021. Note: Redds between TRH and the Old Lewiston Bridge were only counted during the first 8 of 13 total survey weeks.

The number of Chinook Salmon redds observed in 2021 was the fourth lowest since the survey, in its current iteration, was initiated in 2002 (Figure 16).

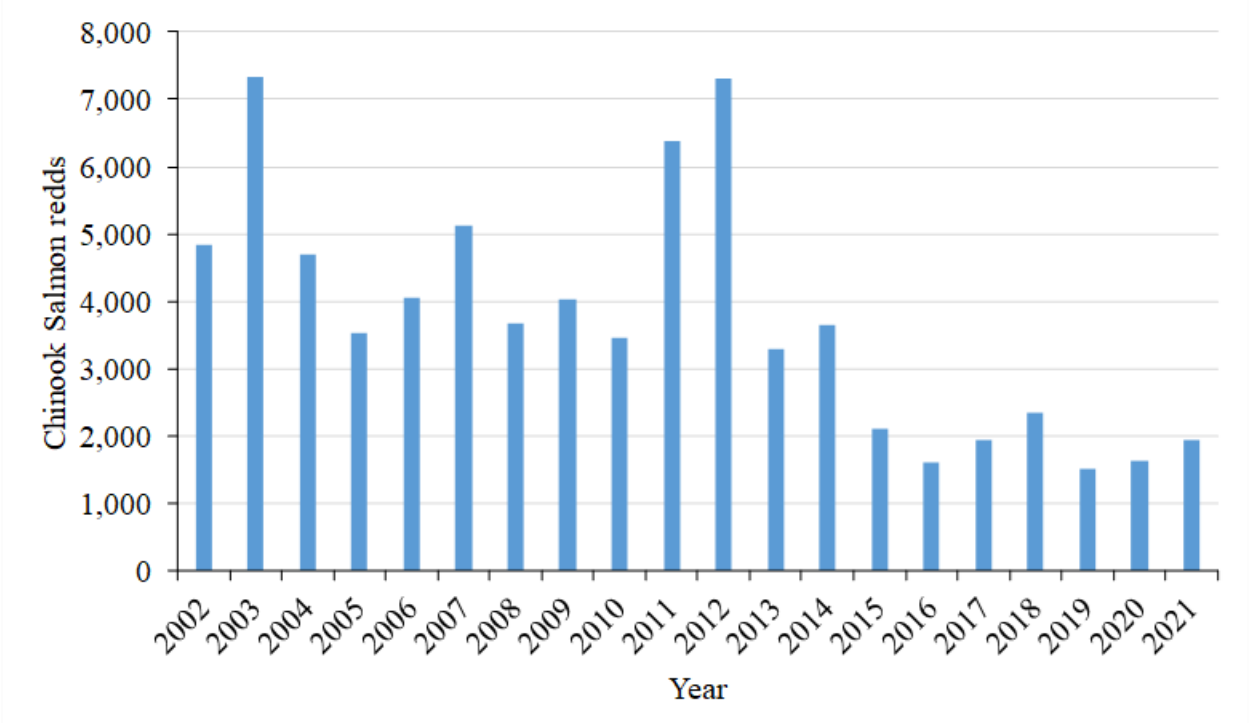


Figure 16. Estimated numbers of Chinook Salmon redds in the mainstem Trinity River, California, from 2002 to 2021. Note: Redds between TRH and the Old Lewiston Bridge were only counted during the first 8 of 13 total survey weeks.

Hatchery-origin Chinook Salmon tended to spawn relatively close to the Trinity River Hatchery located at the base of Lewiston Dam. A large proportion of natural-origin Chinook Salmon spawned in the area

just below the dam as well; however, their redds were more distributed downstream, mainly throughout the restoration reach (Figure 17).

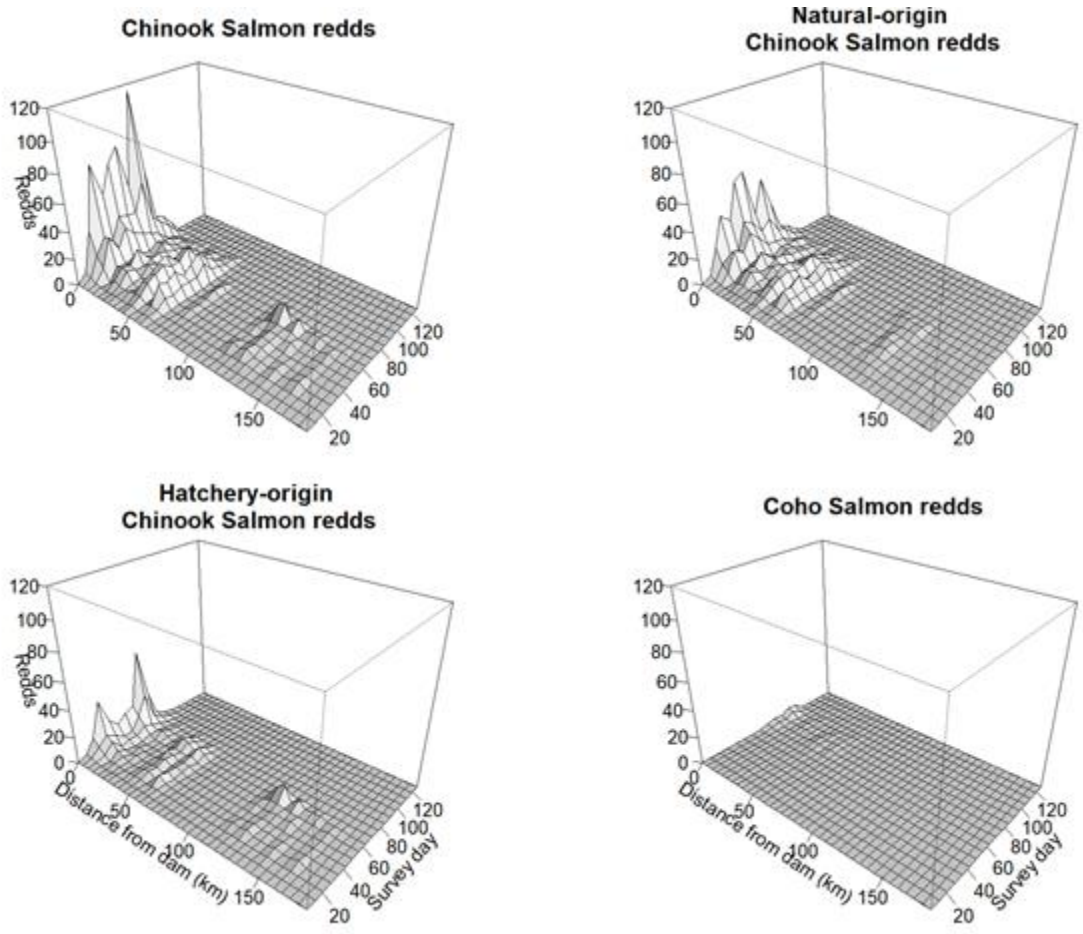


Figure 17. Spatiotemporal distribution of salmon redds observed in the mainstem Trinity River, California, in 2021. Pigeon Point and Burnt Ranch whitewater reaches were not surveyed. Survey Day l = September 1. Note: Redds between TRH and the Old Lewiston Bridge.

Salmonid Spawning Escapement and Harvest

TRRP supports monitoring for run-size, escapement, and harvest of natural-origin and Trinity River Hatchery-produced spring and fall run Chinook and Coho Salmon, as well as adult fall steelhead.

Species	Natural-origin escapement		Hatchery-origin escapement	
	2021	Program Goal	2021	Program Goal
Spring Chinook Salmon	669	6,000	3,956	3,000
Fall Chinook Salmon	5,496	62,000	13,137	9,000
Coho Salmon	214	1,400	3,611	2,100
Fall steelhead	3,088	4,000	3,751	10,000

Table 4. 2021 adult escapement estimates for Trinity River salmonids upstream of Willow Creek Weir or Junction City Weir (spring Chinook Salmon only) including natural area and hatchery returns. (Kier et al. 2022).

The estimated escapement of adult fall Chinook Salmon to natural spawning grounds in the Trinity River basin (above Willow Creek Weir) in 2021 was 12,768 (adults + jacks) fish, with an additional 324 spawning in the mainstem river and tributaries downstream of Willow Creek Weir (Kier

et al. 2022, KRTT 2022). Estimates for 2021 indicate that 8,434 natural-origin fall Chinook Salmon and 14,189 hatchery-origin fall Chinook Salmon returned to natural river areas or the Trinity River Hatchery (including age-2 jacks). Details on the 2021 escapement monitoring for Trinity River salmonids are provided in Table 4 and a recent perspective of adult natural origin fall Chinook Salmon escapement is presented in Figure 18.

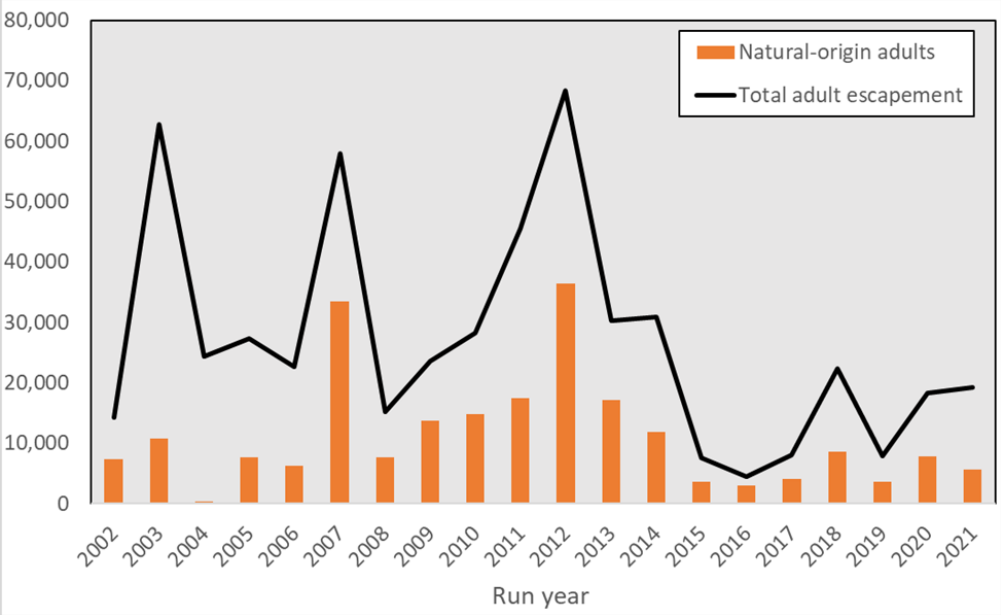


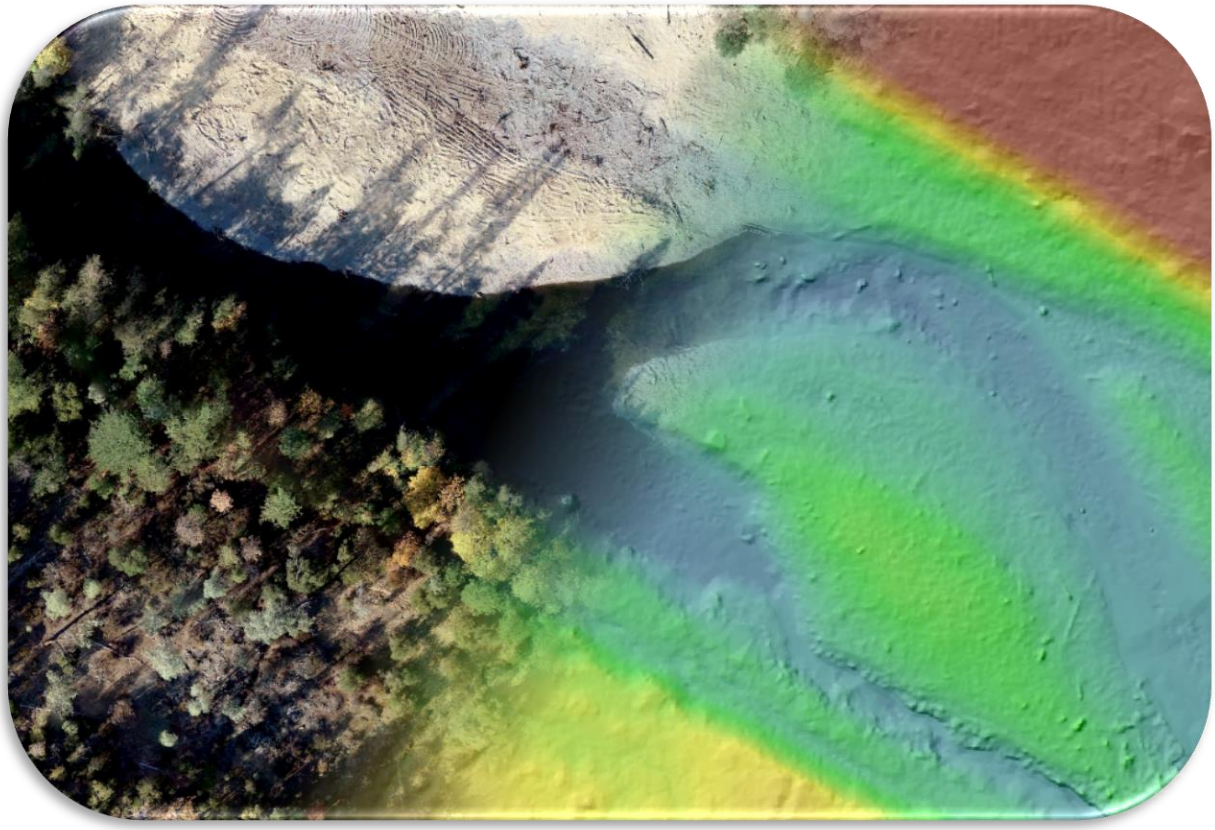
Figure 8. Natural-origin and total adult fall Chinook Salmon escapement upstream of Willow Creek Weir, 2002 - 2021 (includes returns to natural spawning areas and Trinity River Hatchery).

Adult Fall Run Chinook Salmon Harvest

TRRP supports dependent ocean fisheries, as well as in-river recreational and tribal fisheries as part of the goal to restore anadromous fish populations. Natural and hatchery-origin fall Chinook Salmon from the Trinity River support the recreational fishery and the Hoopa Valley Tribal fishery on the Trinity River and contribute to the recreational fishery and the Yurok Tribal fishery in the lower Klamath River below its confluence with the Trinity River.

In 2021, an estimated 537 adult fall Chinook Salmon were harvested in the recreational fishery on the Trinity River and 1,149 were harvested on the lower Klamath River (river mouth to Weitchpec). The estimated tribal harvest of adult fall Chinook Salmon was 2,626 fish by the Hoopa Valley Tribal fishery and 5,440 fish by the Yurok fishery (KRTT 2022). These estimates include both natural origin and hatchery origin fish.

The mouth of the Klamath River in Klamath, CA. (Mike Dixon, TRRP)



LiDAR photography shown overlaying aerial photography. LiDAR technology help scientists detect depth along restoration reaches.

Data Management

DataPort

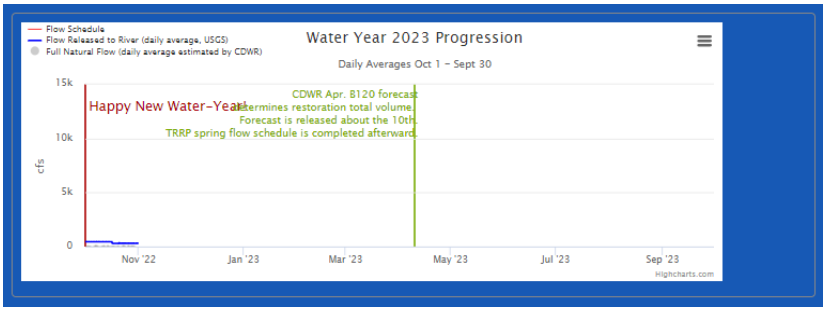
Data forms the basis for assessing restoration performance, measuring progress towards goals and objectives, and designing channel rehabilitation projects and hydrographs. Effective data management ensures that TRRP has the resources needed to analyze past actions and plan for future actions, yielding better adaptive management and decision support.

Data stewardship practices encompass quality assurance and quality control, information security, public and partner accessibility, and usable documentation to preserve data's value through time. The Program's primary outlet for data is our DataPort, which fosters the usability of data and information across the partnership by making it accessible to restoration professionals and to the public.

Over 1,600 reports and other documents, and over 120 data packages, including reports and documents dating back to 1900, are searched and downloaded from the TRRP: DataPort library.

Data Resources

A growing number of data resources are managed through the DataPort, many of which are integrated into other portions of the website. For example, the TRRP.net home page itself has a table of current river flows and multiple graphs that are resourced from the DataPort.



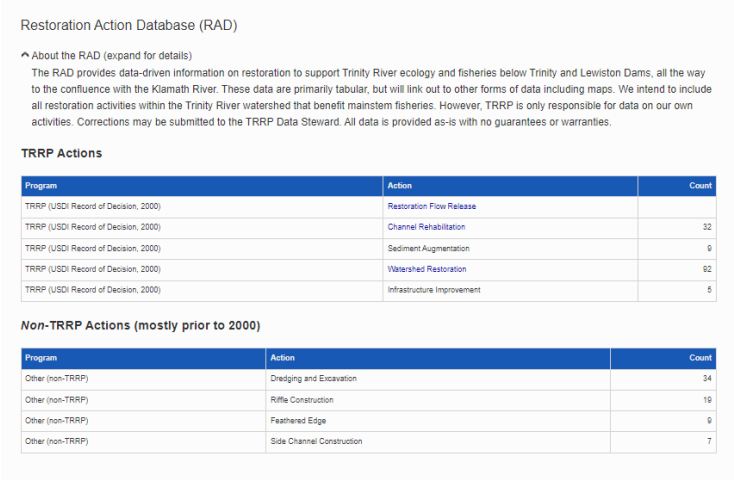
Current river flows can be found on the TRRP homepage.

[TRRP: Current River Flows]

The Restoration Action Database

The Restoration Action Database (RAD) is comprised of a collection of tabular data on completed projects within the TRRP focal reach and includes watershed improvement projects and previous non-TRRP efforts.

[TRRP: Restoration Action Database]


Restoration Action Database (RAD)

About the RAD (expand for details)

The RAD provides data-driven information on restoration to support Trinity River ecology and fisheries below Trinity and Lewiston Dams, all the way to the confluence with the Klamath River. These data are primarily tabular, but will link out to other forms of data including maps. We intend to include all restoration activities within the Trinity River watershed that benefit mainstem fisheries. However, TRRP is only responsible for data on our own activities. Corrections may be submitted to the TRRP Data Steward. All data is provided as-is with no guarantees or warranties.

TRRP Actions

Program	Action	Count
TRRP (USDI Record of Decision, 2000)	Restoration Flow Release	
TRRP (USDI Record of Decision, 2000)	Channel Rehabilitation	32
TRRP (USDI Record of Decision, 2000)	Sediment Augmentation	9
TRRP (USDI Record of Decision, 2000)	Watershed Restoration	92
TRRP (USDI Record of Decision, 2000)	Infrastructure Improvement	5

***Non*-TRRP Actions (mostly prior to 2000)**

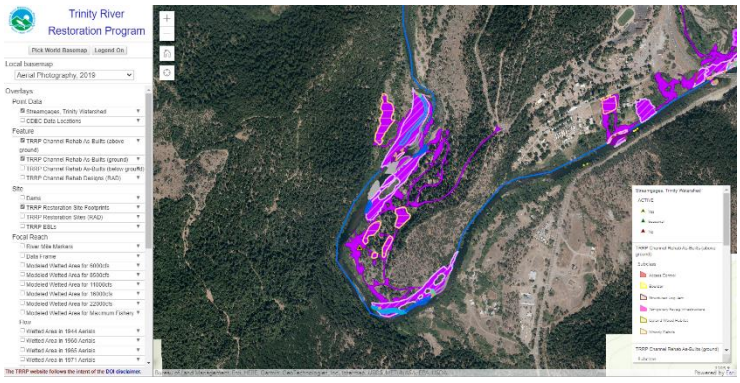
Program	Action	Count
Other (non-TRRP)	Dredging and Excavation	34
Other (non-TRRP)	Riffle Construction	19
Other (non-TRRP)	Feathered Edge	9
Other (non-TRRP)	Side Channel Construction	7

A screenshot of the TRRP Restoration Action Database (RAD)

Mapping Applications

A mapping application provides access to aerial photography, restoration designs and as-builts, modeled flow extents, and a variety of other geospatial data.

[TRRP: Mapping Application]



A screenshot of the TRRP mapping application.

Riverview Application

The RiverView application provides an oblique point-of-view for the restoration reach and can provide the public with a virtual float down the river.

[TRRP: RiverView Application]

A screenshot of the TRRP RiverView application.

Aerial Photography

High-resolution aerial photography may be TRRP's most widely used type of data since it provides the context for documenting changes in the river channel, designing restoration actions, planning scientific investigations, and communicating both within the TRRP and with the public. Aerial photography data sets going as far back as 1944 allow the public and TRRP partners to view changes on the river over time and are available in [TRRP DataPort maps:]

Chapman Ranch area aerial imagery collected by the U.S. Department of Defense, 1944. Before Lewiston and Trinity Dams.

Aerial imagery collected by the U.S. Bureau of Land Management of the Chapman Ranch area in 1980. After construction of Trinity and Lewiston Dams which led to channel simplification.

Aerial imagery collected by TRRP if the Chapman Ranch area in 2021. Photo taken during restoration which aimed to achieve a more complex channel and better salmonid habitats (some shadows caused by clouds).

Unmanned Aerial Systems

Other localized aerial photography and topography data collections are performed by TRRP tribal partners using UAS (unmanned aerial systems, or "drones"). UAS activities for TRRP are reported on our website.

[TRRP UAS Reporting Page]

Dates	Pilot Agency or Company	Location	Purpose of flights
10/5/2017	GMA Hydrology, Inc.	Near the Trinity Dam Blvd bridge ("New Bridge") in Lewiston	Gravel Implementation Monitoring, under contract to U.S. Bureau of Reclamation
2/1-2/2018	GMA Hydrology, Inc.	Near Sky Ranch Road area of Junction City	As-built conditions for Deep Gulch and Sheridan Creek Channel Rehabilitation sites, under contract to U.S. Bureau of Reclamation
7/5/2018	GMA Hydrology, Inc.	Rush Creek Confluence	Under contract to U.S. Bureau of Reclamation in support of delta sediment inputs, TRRP synthesis reporting
7/6/2018	GMA Hydrology, Inc.	Indian Creek Confluence	Under contract to U.S. Bureau of Reclamation in support of delta sediment inputs, TRRP synthesis reporting
7/11/2018	Yurok Tribe	South Fork (near Butter Creek)	South Fork Wood Project (Watershed Restoration)
7/12/2018	GMA Hydrology, Inc.	Buckhorn Reservoir	Under contract to U.S. Bureau of Reclamation in support of fine sediment inputs, TRRP synthesis reporting
7/15/2018	Yurok Tribe	Indian Creek (Watershed Restoration site)	Indian Creek Connectivity (pre-restoration conditions)
9/19-20/2018	Yurok Tribe	South Fork (near Butter Creek)	South Fork Wood Project (Watershed Restoration)
10/9-30/2018	Yurok Tribe	South Fork (near Butter Creek)	South Fork Wood Project (Watershed Restoration)
12/28/2018	Yurok Tribe	Indian Creek (Watershed Restoration site)	Indian Creek Connectivity (pre-restoration conditions)
various 2019	Yurok Tribe	Chapman Ranch area	Channel rehabilitation "Chapman Ranch Phase A" project.
11/20-21			
Summer, Fall 2020	Valley Tribe	Trinity River	
Late 2020	Yurok Tribe	near confluence of Dutch Creek and Trinity River	As-built conditions for Dutch Creek Channel Rehabilitation site, under contract to U.S. Bureau of Reclamation
February, 2021	Yurok Tribe	Lewiston	Mapping current conditions of Sawmill gravel storage area and Cemetery Side Channel.

A screenshot of UAS activities reported on the TRRP website.

Aerial Photography in 2021

Aerial photography for the restoration reach was collected July 29 and 30, 2021. In addition to aerial photographs, detailed topographic models from data collected by aerial LiDAR (light detection and ranging), photogrammetry from unmanned aerial systems (UAS, a.k.a. “drones”), and boat-based bathymetric sonar are often completed to document changes at rehabilitation sites or other locations along the river. Reach-wide data collection occurs less frequently due to the cost of data collection. That expansive data collection had been scheduled for 2021 but was delayed by the Critically Dry water year type due to the need for particular flows for sonar data collection.

Fiscal Year 2021 included completion of the as-built topographic data and orthophotography for our 2020 Channel Rehabilitation at Dutch Creek.

Dutch Creek As-Built Survey Technical Report

Trinity River in late fall 2021. (Kiana Abel, TRRP)

Environmental Compliance and Mitigation

NEPA, CEQA, and Other Mandates

A multitude of statutes, Acts, and Executive Orders, in addition to NEPA and CEQA, provide regulatory guidance and broadly define the type and intensity of actions that the TRRP may perform to benefit the health of the Trinity River fishery. The Regulatory Framework is broadly described in Section 3 of the 2009 Master Environmental Impact Report (2009 Regional Water Board and Reclamation: Document Details Page – TRRP).

Interagency site tour of tailing piles a product of historic dredge mining at Oregon Gulch. (TRRP)

The TRRP works with numerous partners, collaborators, and public and private stakeholders to meet legal requirements and inform decision

making. As part of this effort, Reclamation staff work with Federal land managers (e.g., BLM and USFS) and the North Coast Regional Water Quality Control Board (the Regional Water Board), as our CEQA Lead Agency, to meet environmental and regulatory requirements for implementation activities. Together the TRRP works with our permitting agencies (the Army Corps of Engineers, Trinity County, etc.) to facilitate implementation and monitoring of restoration projects so that our projects may be evaluated and adapted to quickly support beneficial uses in the watershed. In 2021, TRRP office staff worked with federal partner agencies, the U.S. Fish and Wildlife Service and the NMFS (who administer the Endangered Species Act for wildlife and ocean fisheries) to develop programmatic coverage for potential project implementation impacts to federally threatened and endangered species. The resulting Biological Assessment (BA), Biological Opinion (BiOp), and Letter of Concurrence (LOC), are beginning to simplify permitting of restoration-based projects within the Trinity River watershed as described below.

Oregon Gulch NEPA/CEQA

The Oregon Gulch channel rehabilitation project (permitted in 2021 & construction expected in 2022) is like other TRRP funded projects, however there are some marked differences.

Birds eye view of the Oregon Gulch restoration site prior to rehabilitation. (Aaron Martin, Yurok Tribal Fisheries Department)

First, the Oregon Gulch project is intended to move tailings and old mining waste to Eagle Rock Inc., a local company within 4 miles of Oregon Gulch that will process Oregon Gulch material into useable road products and potentially restoration rocks. Reuse by Eagle Rock removes the need to place excavated material in local upland areas as many past TRRP projects have done. By moving this material offsite, the TRRP opens the Trinity River Valley to create juvenile rearing habitat which will allow the river to move more naturally than it has since the bucket line dredge boats last mined the area in the 1930s and 1940s.

"Dredging Scene." Near Weaverville, Calif. J.H. Eastman

The Project is also different from other TRRP efforts because of its sheer magnitude. At Oregon Gulch, the TRRP proposes to move around 500,000 cubic yards of floodplain material and old tailings out of the river so that more area is available for habitat and riverine processes. Specifically, the Oregon Gulch project proposes to create up to 1,000

times the amount of juvenile rearing habitat for small salmon at the site than presently exist. This largescale increase in juvenile habitat is needed as nursery habitat to increase the size and number of young salmon and steelhead that leave Trinity River on their way to the ocean.

Out of concern for traffic that would result from trucking up to 29,0000 trucks from Oregon Gulch to Eagle Rock, the Project was introduced to the public via the TRRP's scoping process in October 2020. Though there were concerns about the traffic and roadway impacts, the public generally supported the short-term impacts based on the expected large-scale benefits in riverine habitat and function which the TRRP expected would result from implementation. Reclamation, BLM, and the California North Coast Regional Water Board completed the Oregon Gulch Project public Draft EA/IS in February 2021 and NEPA/CEQA requirements were completed in May 2021.

The first phase of the Oregon Gulch Project, rock processing and the movement of material to Eagle Rock, Inc. is expected to start in the summer of 2022. Constructing the in-river potion of the Oregon Gulch project, where floodplain habitat is constructed, backwaters created, and wood structures constructed, is expected in summer 2023.

Chapman Ranch Rehabilitation Project: Phase B

The Chapman Ranch Phase B project completed NEPA/CEQA requirements in October 2020. The project was planned for construction on private, BLM, and USFS managed lands and separate decision memorandums were signed by the Forest Service, within the Department of Agriculture, and Reclamation/BLM within the Department of Interior. In February 2021 trees and shrubs were removed prior to the migratory bird nesting period (March 15-August 30) and equipment was mobilized to the site in Late June 2021 to commence channel rehabilitation. Despite a month of work stoppage during the 200,000 acre Monument Fire, the Chapman Ranch Phase B project construction was completed in October 2021. The project enhanced salmonid habitat by increasing channel complexity and floodplain inundation and supports vegetation within the riparian corridor.

Poor air quality captured in August of 2021 at the Chapman rehabilitation site. Work stopped for about one month while the Monument Fire burned significant acreage nearby. (TRRP)

Heavy machinery creates Beaver Dam Analogues (BDAs) to increase wetted areas and provide juvenile fish rearing habitat within the river reach at Chapman Ranch restoration site, 2021. (TRRP)

Noteworthy components of the Chapman Ranch Phase B project included construction of a new river meander, an extensive low flow side channel, and the use of Beaver Dam Analogs (BDAs) to increase wetted areas and provide juvenile fish rearing habitat within the river reach.

Gravel Augmentation

Dams are a physical barrier for course sediment that typically flow from upper watershed areas and distribute downstream with seasonal rain and snow melt events. Distribution of such sediments are important for the formation of rearing habitat for salmonid species. To reduce the barrier impact, gravel additions are permitted by the Regional Water Board and Army Corps at five locations on the Trinity River upstream of Rush Creek, including in the vicinity of the Trinity Hatchery (the "Hatchery Reach"). Prior to 2017, the last gravel placements occurred in 2007 and have long since washed away.

A chinook salmon rests over spawning gravel. (Thomas Dunklin)

In summer 2021, the TRRP returned to the Hatchery Reach to place gravel. Our objectives were to:

- Reverse the deficit of streambed gravels between Lewiston Dam and Weir Hole, located 1 river mile downstream;
- Provide salmonid spawning habitat in the vicinity of Trinity River Hatchery where adult salmon congregate; and
- Place gravel in this largely featureless reach to provide hydraulic diversity in support of juvenile salmonid rearing.

To complete the work, the Program used locally processed gravel, that ranged from 0.5 to about 4 inch diameter, and would mobilize at flows of around 2,500 cfs. The Program stored the processed gravel on site, upslope of the river and spread the gravel in-channel during permitted in-river work period after July 15 (Figure 1) and before the 2021 Hoopa Valley Tribe Boat Dance flows. By completing the in-channel placement of gravel before the Boat Dance flows, the placed gravel was conditioned and sorted by dam releases prior to the 2021 salmon return and spawning.

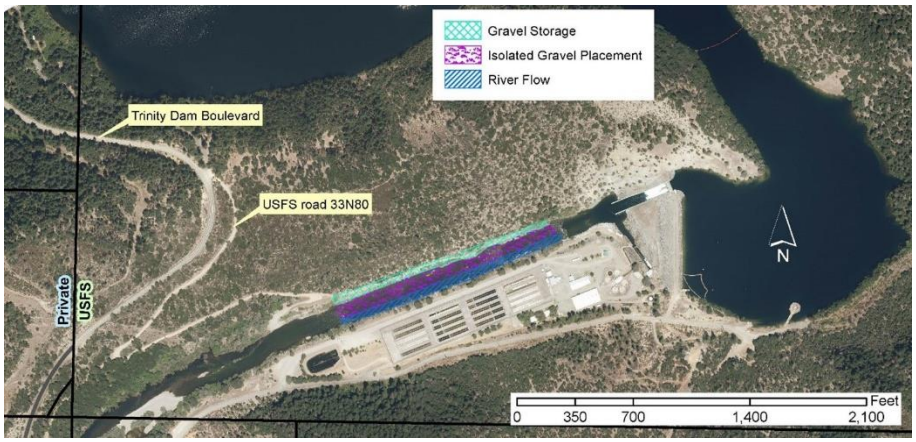


Diagram of the hatchery gravel addition area.

In fall 2021, the refurbished habitat was heavily used by returning steelhead and salmon for spawning. It is expected that the new gravel will provide quality nursery habitat for juvenile salmon and steelhead that have recently emerged from their redds. However, because the river does not naturally replenish gravel at this location due to the dam, maintenance of the spawning area will need to occur again in the future once flows push 2021 gravel additions downstream.

Before gravel placement, downriver of Lewiston Dam. (TRRP)

After gravel placement, downriver of Lewiston Dam. (TRRP)

Biological Assessments

2020 Biological Opinion

Indian Creek Fall 2020, post restoration meant to increase ground and surface water elevations. (Yurok Tribe).

Since the signing of the ROD and implementation of the TRRP, new information has been evaluated and initial approaches to restoration refined, so that the TRRP is better able to implement the ROD. The TRRP's Programmatic Biological Assessment (BA) was provided to the NMFS in December 2020 and analyzes the effects of TRRP activities associated with physical channel rehabilitation, sediment management, watershed restoration activities, infrastructure improvements or modifications, and the Adaptive Environmental Assessment and Management (AEAM) process, specifically fish monitoring and handling activities (collectively, the action).

The first project to utilize the TRRP's 2020 Biological Opinion (BiOp) was partially funded by the TRRP and implemented by the Yurok Tribe at Indian Creek along Reading Creek Road in Trinity County during fall 2020. The Yurok tribe's Indian Creek Stage 0 project is meant to increase ground and surface water elevations in this previously mined area so that a natural vegetated flowing stream may eventually develop where Indian creek usually dries up in summer.

In the future, the BiOp will also be used to facilitate watershed restoration for ESA listed species in the TRRP's developing Programmatic Watershed Restoration Environmental Assessment TRRP: Trinity River Watershed Restoration Project – Programmatic Environmental Assessment (PEA).

Watershed Workgroup

The Watershed Workgroup did not release a Request for Proposals (RFP) for funding in 2021. Instead, the focus was to improve the grant process and provide a larger amount of available funding for 2022. The primary issues the program identified in wanting to improve the watershed grant process were:

1.) making funds available earlier in the year so projects could be implemented the same year funding is received;
2.) having greater flexibility to "hold back funds" in years when not enough quality proposals are received;
3.) ensure environmental compliance and permitting are addressed for all on-the-ground projects prior to implementation;
4.) advertise the RFP throughout the region to bring in new proposals from first time applicants; and
5.) address perceived issues with conflict of interest during proposal review.

To address the above issues, TRRP solicited for a third-party administrator (i.e., an external organization) to oversee the grant program. After an open competition, the National Fish and Wildlife Federation (NFWF) was selected to be that external partner helping to manage the grant process for the next 5 years.

Environmental Mitigation

A revegetated side channel on the Trinity River. (TRRP)

To ensure that functioning wetland and riparian habitats are maintained after TRRP's mainstem channel rehabilitation projects are constructed, the TRRP avoids, minimizes, and mitigates native vegetation impacts. However, this can be challenging when our projects require large-scale floodplain lowering (excavation of the earth) on river edge where plants live. Through vegetation monitoring, we have learned much of what is needed to initiate self-sustaining native vegetation and have increased plant colonization and survival on our newly constructed surfaces. New techniques have improved the success of both planted and naturally regenerated growth at restoration sites and will hopefully allow vegetative self-maintenance in the future. TRRP permits require 1:1 replacement of riparian habitat and wetlands within 5 years of construction and revegetation. In 2021, the TRRP completed Army Corps restoration permit monitoring for our channel rehabilitation projects that enumerated our impacts on wetlands and "Waters of the U.S." (e.g., ephemeral streams, perennial streams, and seasonal wetlands) through the 2016 Bucktail Project. Though the definition of "Waters of the U.S." has been argued over in the courts, these waters include both perennial and ephemeral areas that may provide chemical, physical,

or biological benefits to adjacent areas. Accounting through the 2016 Bucktail project, TRRP reports a cumulative total increase in “Waters of the U.S.” at our channel rehabilitation sites of 87.7 acres. Though we predicted that “Waters” would increase with implementation of the ROD, this reporting points out specific locations where “waters” have increased at our constructed projects. In some cases, the Trinity River channel has scoured and increased in size, in others, wetlands and side channels have developed in the floodplain and resulted in the increase in “waters.” What is more, when more variable winter flows inundate riverine floodplains in the future, the wetland vegetation is expected to benefit from increased inundation.

Native species ready for planting at Chapman Ranch. (TRRP)

A teacher and student sift river water, looking for aquatic organisms in Swift Creek at the annual River Day event in Trinity Center in 2021. (TRRP)

Public Outreach

Enrichment Activities

COVID restrictions at both the state and federal level prevented TRRP from doing in-person events in 2021, except a brief window in June and July when new cases remained low in Trinity County. Fortunately, that window allowed the program to hold several events across the County.

TRRP and Trinity County Resource Conservation District (TCRCD) hosted their annual River Day event with Trinity Center School at Swift Creek on June 4. The kids did several water-focused activities, including macroinvertebrate collection and identification, an interactive

A lucky student from Trinity Center Elementary finds a newt during an outreach event in 2021. (TRRP)

animal/habitat game, and making fish prints on t-shirts.

TRRP helped to fund a few other visits to area schools in 2021. One of those was an outreach event focusing on salmon education. Maya Williams of TCRCD dissected salmon for Lewiston Elementary School kids. The team also set up a mock predator game to further explain the lifecycle of a salmonid.

Lewiston School kids play a salmon predator game set up by TCRCD. (TCRCD)

Maya Williams from TCRCD dissects salmon for Lewiston School kids. (TCRCD)

2021 brought back the Weaverville Summer Day Camp. Weaverville Summer Day Camp gives children in Trinity County the opportunity to spend three weeks outside learning about nature, art, food, farming, and cultural history in and around Weaverville. TRRP is a funding partner for the camp which is put on by Trinity Resource Conservation District and hosted at the Young Family Ranch in Weaverville. 60 kids participated in Weaverville Summer Day Camp in 2021! Campers learned about salmon, prescribed fire, gardening, composting, shelter building, Nor Rel Muk-Wintu culture, wildlife, community and more! Older campers had the opportunity to explore Canyon Creek, the Weaverville Community Forest, and took a rafting trip down the Trinity River.

Kids touch and hold earthworms at Weaverville Summer Day Camp, 2021. (TCRCD)

Public Float

On July 29, several TRRP staff floated with local residents on rafts in the annual TRRP and TCRCD sponsored event. This year, the float started from the put-in at Evans Bar and took out at the Junction City campground. The group was able to float by the Chapman B restoration site and see the action with restoration activities going on in full gear. Next, they stopped at the recently completed Deep Gulch and Sheridan Creek restoration sites to discuss site design and the importance of lowered floodplains and backwater areas.

The rafting group got to chat with TRRP staff and got a river view the Chapman restoration site during construction. (TRRP)

A group of rafters caught on camera during the 2021 Public Float. (TRRP)

Rafters take a break to learn about river ecology from TRRP staff during the July 2021 public float. (TRRP)

Science Symposium

COVID didn't stop science and learning, but it did force us to change some of our venues. The program had planned for an in-person Science Symposium in 2021 to share recent research findings and newly completed synthesis reports. When it became apparent that COVID restrictions wouldn't let the symposium happen as planned, he Program took it virtual. For five weeks in November and December, TRRP held 2-hour "brownbag sessions" and had 17 presentations to highlight important research on the Trinity River. The presentations and recordings can be found by clicking: Science Symposium Presentations.

Public Notices

TRRP also continued to reach out to the public about our restoration efforts. Prior to beginning construction at Chapman Ranch Phase B, we sent invites to everyone on Sky Ranch and Dutch Creek Roads in Junction City and held an outside, evening event by the river. The event offered effected residents an opportunity to express their concerns about the project and to hear the ways TRRP planned to address them. We also shared contact information and discussed the project timeline.

Science on Tap at the Trinity County Brewery in October 2022. (Andy Johnson)

A Look Ahead: 2022 Program Activities

In 2022, the Program will continue to execute the restoration strategy based on its foundational documents while pursuing ways to evolve through adaptive management as new information is collected and evaluated. Actions planned for 2022 include:

- Provide flow schedule modeling, planning and implementation
- Continue supporting efforts to identify priority watershed improvement projects
- Develop recommendations for coarse sediment augmentation locations and amounts, depending on the water year type and how much water is available to mobilize it, and explore possible alternative gravel augmentation sites
- Examine the influence of naturally variable winter and summer flows on Trinity River fisheries health and production
- Finalize and integrate the synthesis reporting work to plan the future restoration monitoring activities

Environmental and Other Compliance

Spawning riffles are critical to salmonoid reproduction on river systems. (TRRP)

Gravel Augmentation Environmental Assessment

In 2022, TRRP will scope a draft Environmental Assessment (EA) for gravel augmentation including removal and placement of materials on permitted areas. The EA assesses impacts of 9 proposed sites along the Trinity River near Lewiston and Douglas City.

Trinity River Watershed Restoration Project Programmatic Environmental Assessment

The TRRP in collaboration with the BLM, Forest Service and the Bureau of Reclamation initiate the Trinity River Watershed Restoration Project Programmatic Environmental Assessment (PEA). The purpose of the project is to lay a foundation with vested agencies for future restoration actions by completing a PEA for targeted restoration within the Trinity River Watershed. Future Trinity River watershed restoration activities that target improvement of the quality and quantity of cold-water habitats for aquatic species will tier off the finalized PEA.

Channel Rehabilitation

Drone footage captures an aerial view of the 2022 augmentation site, Oregon Gulch. (Aaron Martin, YTFD)

Oregon Gulch Channel Rehab: Phase 1

TRRP with the Yurok Construction Company (YCC) begin phase 1 activities at the Oregon Gulch Channel Rehab site in July of 2021. Phase 1 activities include rock hauling and sorting of tailing piles deposited from historic hydraulic mining activities. By removing rock piles from the floodplain, the land will be lowered and accessible to waters during high flow events allowing vegetation, fish, and wildlife back into key rearing habitat.

Stakeholder Involvement

A volunteer pulls scotch broom as a TRRP employee assists at an event in 2022. (Trinity County Resource Conservation District)

TRRP's outreach and other stakeholder involvement were set into high gear as the threat of COVID exposures minimized in 2022. The Program and its partners held several community events with excellent turnout due in large part to the organization and dedication of our outreach partner Trinity Resource Conservation District (TRCD) . Additionally, our 2022 outreach and stakeholder involvement continue through:

- Updating and adding new features to the TRRP website to share program information in easily accessible platforms
- Working with river front property owners and private landowners on rehabilitation projects in the Junction City and Lewiston areas
- Working with our partners to produce educational events for community members that benefit the Trinity River.