TRINITY RIVER RESTORATION PROGRAM

A COLLABORATIVE APPROACH TO RIVER AND SALMONID RECOVERY

Trinity River Restoration Program

TRRP Partners and stakeholders work diligently, thoughtfully, and adaptively to recover dynamic river processes that will promote natural-origin salmonid populations.

THE TRINITY RIVER

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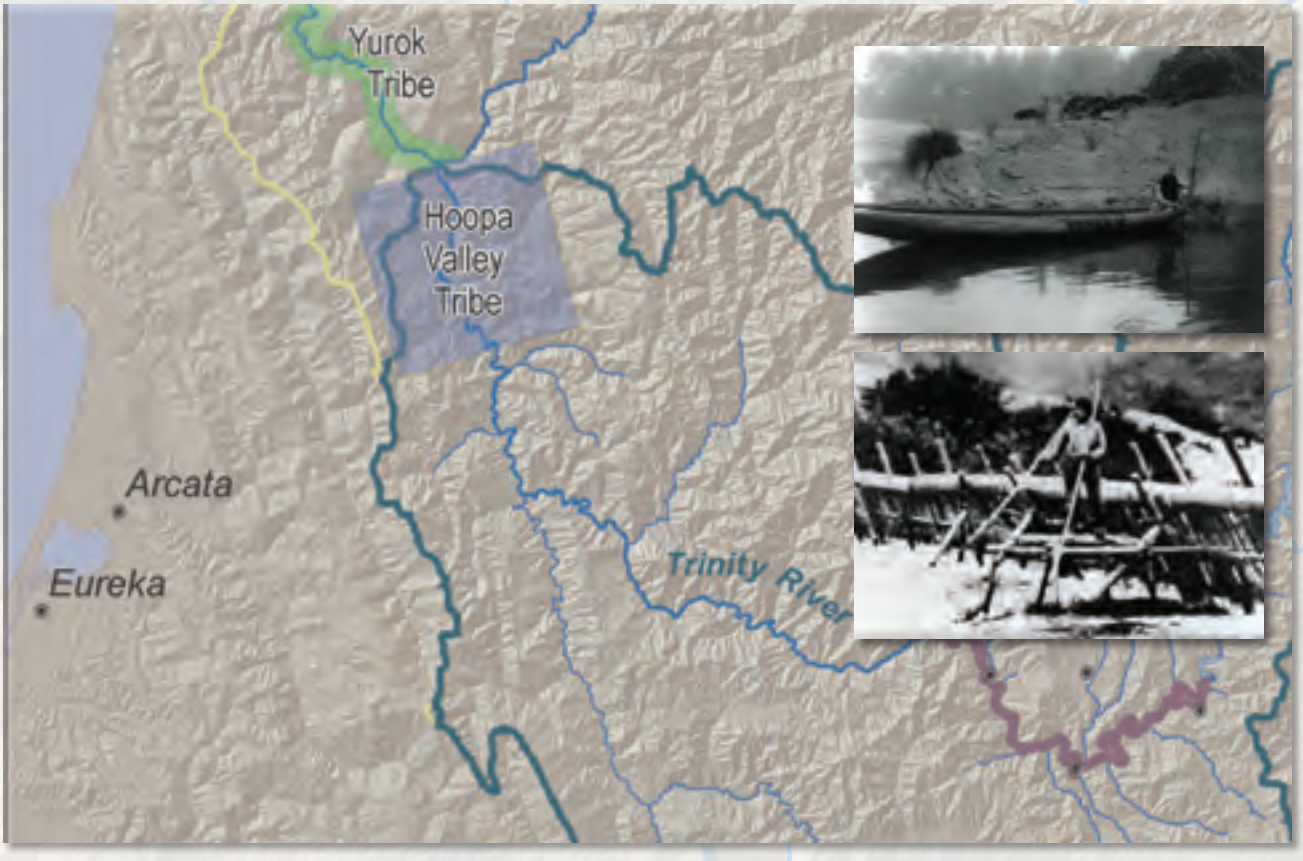
The Trinity River begins in the rugged mountains of the Klamath Region in northwestern California. On its journey to join the Klamath River at Weitchpec, the Trinity tumbles through steep canyons and meanders through broad valleys. This powerful river once supported large populations of Chinook salmon, as well as smaller runs of coho salmon and steelhead trout (collectively referred to as salmonids).

Trinity River salmonids evolved to live with the extreme seasonal changes that occurred most years on the river. Seasonal floods refreshed spawning gravels, scoured deep holes, and provided clear, cool water during spawning. Salmon were well adapted to these seasonal variations on the river.

For thousands of years, native tribes including the Hoopa Valley, Yurok, Wintu, Shasta, and Chimariko Tribes, were equally adapted to the river's fluctuations and used the fish, plants, and animals of the watershed for subsistence, cultural, ceremonial, and commercial purposes. The river is woven into their culture and livelihood.



HISTORICAL CHANGES

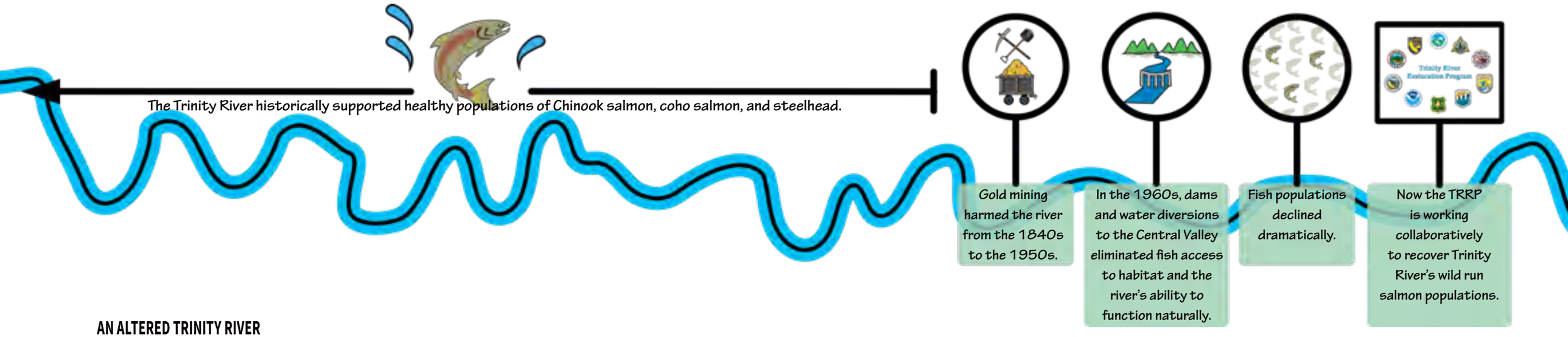
"Gold!" discovery in the late 1840s marked the start of severe changes to the Trinity River. Between the late 1800s and early 1900s, intensive hydraulic mining washed entire mountainsides into the river. A century of dredger mining followed, which turned the river inside out and upside down to sift for the gold not captured by hydraulic mining. The changes from mining are still evident throughout the basin. Some floodplains are covered in dredger tailings piles that rise 70 feet above the river.

In addition to gold mining, new arrivals logged Trinity County hillsides and valleys for lumber and firewood. In the 1950s, industrial logging began in earnest. Large volumes of sand washed into the river from vulnerable areas of the watershed where highly erodible granitic soils were left unprotected by logging. The accumulation of sand and other fine sediments further degraded the habitat for salmon and their insect food.

Despite these habitat damages, the Trinity River still had seasonally variable flows that sustained the river ecosystem, and salmon and steelhead continued to return in relatively large numbers.

Photos courtesy Trinity County Historical Society

In 1955 Congress authorized a plan to increase water supplies in California's Central Valley, in part by transferring water from the Trinity River into the Sacramento River. Completed in 1964, the Trinity River Division (TRD) of the Central Valley Project (CVP) began a decades-long era wherein up to 90% of the Trinity River's flow was diverted from the river each year. As a result, the resilience of the river's ecosystem began to decline.



AN ALTERED TRINITY RIVER

A combination of historic land-use and current water management practices have brought the Trinity to where it is today, a river that may look beautiful but bears little resemblance to a naturally functioning river with an intact ecosystem. The distortions to the riverbanks left by mining might have been undone if the river had been left free-flowing. However, the construction and operations of Trinity and Lewiston Dams have an ongoing impact on the river ecosystem. Seasonal floods were blocked for decades and excessive fine sediment built up over time to form steep banks that channelized the river. This in turn affected how the river's flows distributed gravel, which is critical to the successful development of salmon and steelhead eggs.

In response to declining salmon returns, scientists, biologists, engineers, and ecologists from various entities began a decades-long study of the Trinity River and its fish populations. Following a cumulative report, the Secretary of the Interior, with concurrence from the Hoopa Valley Tribe, signed a 2000 Trinity River Record of Decision (ROD) which established a framework to recover natural-origin populations of anadromous fish to the Trinity River below Lewiston Dam, while retaining the diversion of water to the Central Valley.

Eight Partners form the Trinity River Restoration Program (TRRP) to collectively design, implement, and monitor actions to recover vital river processes that will revive natural-origin Chinook and coho salmon and steelhead populations in the Trinity River.

Trinity River Restoration Program

TRINITY RIVER ANADROMOUS SPECIES

Salmonid artwork by Paul Waters ~ Lamprey artwork by Rene Reyes

Chinook ("King") Salmon *(Oncorhynchus tshawytscha)*
Trinity River supports fall and spring-run Chinook salmon. These runs of salmon evolved to take advantage of different parts of the river. Spring Chinook arrive during spring snowmelt flows and hold through the summer in deep holes before accessing the upper river to svpawn, while fall Chinook make a quick run upstream to spawn in the lower and mid-river.

Coho ("Silver") Salmon (*Oncorhynchus kisutch*)
Trinity River coho salmon are part of the Southern Oregon/Northern California Coastal coho salmon population which is listed as threatened under the Endangered Species Act. Coho salmon prefer lower slope tributary streams which are susceptible to land use changes and water withdrawals, and much of their habitat in the Trinity River was locked away behind Lewiston Dam.

Steelhead *(Oncorhynchus mykiss)*
Steelhead that enter the river in an immature state and mature several months later are termed "stream-maturing;" these are the summer-run steelhead. "Ocean-maturing" steelhead enter the river system while sexually mature and spawn shortly thereafter; ocean-maturing steelhead are referred to as "winter-run" steelhead. Portions of both groups may enter freshwater in spring or fall and are then called "spring-" or "fall-run" steelhead.

Pacific Lamprey *(Entosphenus tridentatus)*
Pacific Lamprey are from an ancient lineage of fish that, like salmon, enter the river as adults to spawn. The juveniles spend several years as filter feeders, mostly buried in river sediments, before they leave for the ocean to mature. Returning adults are harvested by the Hupa, Karuk, and Yurok and remain an integral part of their culture today.

TRINITY RIVER RESTORATION PROGRAM

The TRRP uses a comprehensive approach to regain a portion of the river's previous form and ecological function to allow fish populations to recover. Just as the decline of the river's ecosystem stemmed from multiple factors, restoration doesn't rely on a single solution. Instead, restoration applies a broad set of actions based on decades of study and scientific modeling to drive river processes that will enhance and maintain habitat for fish and wildlife.

Restoration work outlined in the 2000 ROD began in-full in 2005. Since that time, Program biologists have tracked a substantial increase in the number of juvenile salmon out-migrating to sea. However, Pacific salmonids returning to western rivers have been trending downward and the Trinity is no exception. Scientists are working to determine why increased production of young fish has not translated into increased adults returning, and to find ways for young fish in the Trinity to be better prepared to survive the full migratory life-cycle.

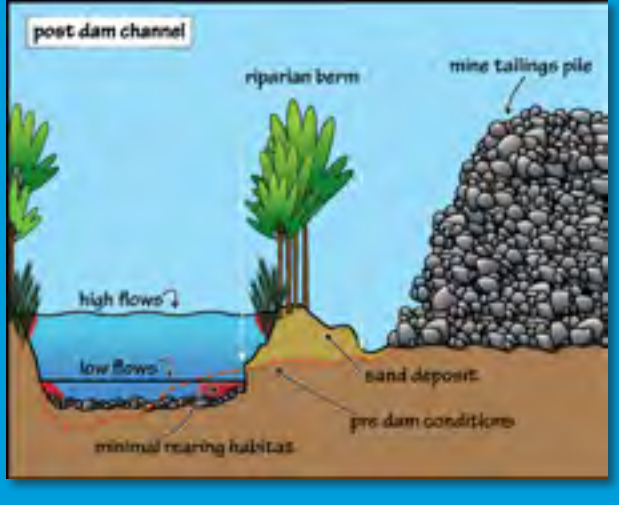
Salmon recovery efforts can provide immediate benefits, although it can take decades to fully realize restoration success for certain activities, such as establishing riparian habitat. A long-term investment in the health and function of the Trinity River and its ecosystem holds the greatest promise for meaningful, lasting change.

Photo by Aaron Martin, Yurok Tribal Fisheries Program

The Chapman Ranch Phase A channel rehabilitation site constructed in 2019.

Photo by Aaron Martin, Yurok Tribal Fisheries Program

Juvenile Chinook salmon at a channel rehabilitation site.

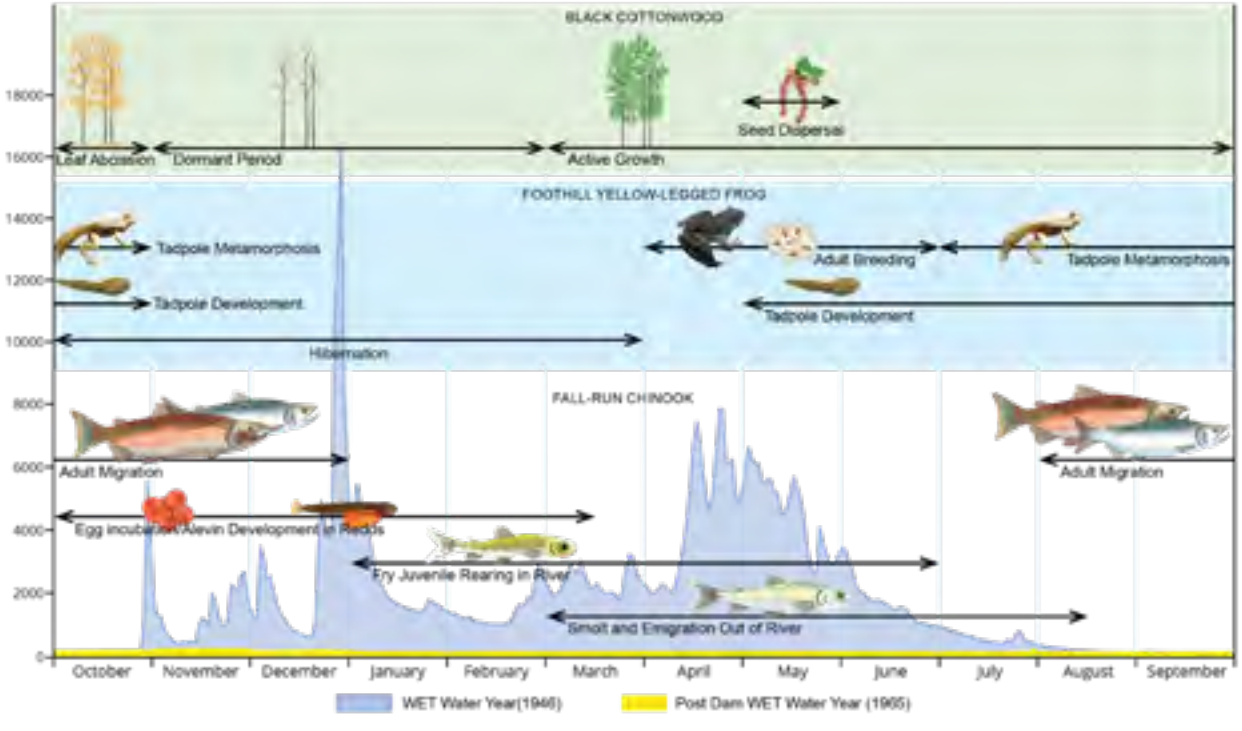


The most immediate and obvious change to the river post-dam involved riparian vegetation (the plants that live near the river) and the build-up of fine sediment. In the absence of high flows, riparian plants were able to sprout and establish along the river's edge. This unnaturally dense vegetation trapped sand and allowed confining riparian berms to form. The berms, some reaching up to 12 feet in height, separated the river from its gravel bars and floodplains, which are essential for salmon habitat.

Salmon have adapted to the hydrology on the Trinity River. Fall and early-winter rainstorms (the peaks in October through December) allow salmon to move up the river; low flows between peaks allow for spawning; and the spring snowmelt (April through June) assists juvenile salmon in their journey to the ocean before the warm, low flows of summer.

Native plants along the river are similarly adapted; winter rainstorms and spring snowmelt floods scour away dormant seedlings and saplings growing too close to the river's edge; seeds released in the spring and early summer sprout higher up on the bank when the water level is high; and seedlings on these higher surfaces can grow during the slowly receding spring snowmelt, which has recharged the groundwater table.

Understanding these adaptations and monitoring the biological and physical response to previous flow releases allows the TRRP to assess critical relationships, such as the linkages between fish productivity and vegetation health, and to adjust management practices to better promote the linkages.



Plants and animals native to the Trinity River have different needs throughout the year and have adapted to seasonal changes in flow patterns and habitat conditions. In the above figure, the annual life cycles of fall-run Chinook salmon, foothill yellow-legged frog (*Rona boylii*), and the riparian black cottonwood (*Populus trichocarpa*) are overlaid on an example hydrograph. A hydrograph shows the average flow for each day, for every day of the year.

A MANAGED SYSTEM: WHAT IS THE TRINITY RIVER DIVISION?

The Trinity River Division (TRD) of the Central Valley Project is comprised of Trinity Dam, holding a large storage reservoir; Lewiston Dam, which stabilizes water for diversion; and Clear Creek Tunnel, which passes water from Lewiston Reservoir (photo below left) to Whiskeytown Lake (photo below right). Whiskeytown Lake is a stabilized pass-through reservoir with water released to Clear Creek or passed through to Spring Creek and Keswick Reservoir.

Photograph by Ken DeCamp

Photograph by Russell Smith

FLOWS ON THE RIVER

For decades, up to 90% of the Trinity River was diverted to the Sacramento River basin. In addition to water, large wood (logs and whole trees) and sediment (cobble, gravel, and sand) supplied from the upper watershed were blocked by the dams from continuing down the river. This dramatically altered the river's characteristics.

Interaction between river flows, sediment, and wood (fluvial processes) determine a river's size and shape (morphology). Before the dams were built, seasonal fluctuations in flow and gravel supply from the upper watershed constantly transformed the Trinity River, creating suitable conditions for salmon at all life stages.

The river's flows varied greatly within and between each year. In a given year, flows could be as low as 100 cubic feet per second (cfs) during the summer and reach over 100,000 cfs during rare flood events. Once the dams began operating, flows were held between 150 and 300 cfs year-round except for occasional "Safety of Dams" reservoir releases, the largest of which was 14,500 cfs in 1974.

IMPACTS TO SALMONIDS

When the TRD was completed, over one-hundred miles of salmon and steelhead habitat above the dams, nearly one-quarter of the watershed, was entirely lost. The remaining in-river habitat was degraded, especially from Lewiston Dam downstream to the North Fork Trinity River.

With floods reduced by the dams, deep pools used by adult salmon filled with sand, juvenile salmon and steelhead were no longer able to access critical floodplain habitats, and nest egg habitat in the spawning gravels was scoured away or choked with sand. These changes also degraded the food-web that salmonids depend on.

HOW MUCH HAVE THE TRINITY RIVER FISH STOCKS DECLINED?

After the construction of Trinity River dams, average fish returns declined by an estimated 80%. Coho salmon of Southern Oregon and Northern California ESU were listed under the Endangered Species Act in 1997. Although fish abundance estimates were not routinely monitored before Trinity and Lewiston Dams were constructed, the best available estimates suggest that fall-run Chinook salmon returns had averaged 45,700 upstream of the North Fork Trinity River.

RECOVERING SALMON AND STEELHEAD POPULATIONS

By 1970, less than 10 years after the dams were completed, the decline in salmon and steelhead populations became obvious.

Intent on reversing the decline, the U.S. Fish and Wildlife Service, the Hoopa Valley Tribe, and other stakeholders began two decades of studies on the river that culminated in the Trinity River Flow Evaluation Study completed in 1999. The decades-long study is the foundation of the restoration strategy to promote natural river processes that will help recover natural-origin salmon and steelhead populations.

The restoration strategy is intended to:

1. re-establish the natural physical processes that create and maintain high-quality aquatic habitat, and
2. create spawning and rearing conditions downstream of Lewiston Dam that best compensate for lost habitat upstream.

This strategy is not intended to return the river to its pre-dam condition. Rather, the goal is to create a dynamic river channel that exhibits the characteristics of the pre-dam river at a smaller scale. It is carried out to achieve the fishery restoration goals while maintaining the purpose of the existing water infrastructure to hold and divert water to the Central Valley.

The Trinity River Restoration Program's goals have remained unchanged since its inception, but the Trinity Management Council adopted a new, concise goal statement in 2019:

> *The long-term goals of the TRRP are to restore the form and function of the Trinity River; restore and sustain the natural production of anadromous fish populations in the Trinity River to pre-dam levels; and facilitate full participation by dependent tribal, commercial, and sport fisheries through enhanced harvest opportunities.*

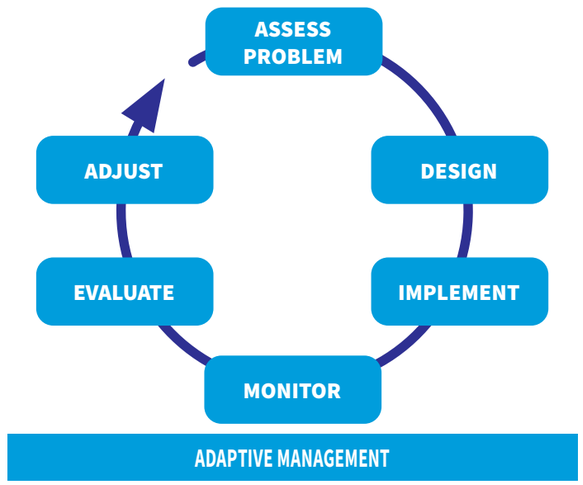
As outlined in the U.S. Department of Interior 2000 Record of Decision (ROD), the TRRP works *"to restore the Trinity River's anadromous fishery resources…[by]…rehabilitating the river itself."*

Geographic setting of the TRRP focal reach on the Trinity River

TRRP STRATEGY

The strategy consists of the following actions:

- **Flow Management:** A variable flow regime based on five water year types (as determined by California Department of Water Resources), ranging from critically dry to extremely wet, is intended to mimic natural flows (on a reduced scale);
- **Mechanical Channel Rehabilitation:** Numerous sites along the river were identified for projects meant to reshape the channel form to re-establish the physical processes that create and maintain diverse fish and wildlife habitat with the available restoration flows;
- **Sediment Management:** Gravel augmentation below Lewiston Dam to provide the cobble and gravel necessary to form gravel bars and other elements of habitat complexity;
- **Watershed Restoration:** A strategy to reduce fine sediment input to the Trinity River and improve tributary habitat for salmon and steelhead;
- **Adaptive Management:** A rigorous science-based monitoring and analysis program to improve restoration activities and incorporate public input.



VARIABLE RESTORATION FLOWS

Variable restoration flows provide critical ecological functions. Flows of sufficient size scour sand from spawning gravels and adult holding pools, build and maintain gravel bars, prevent vegetation from establishing on riverbanks, and provide adequate temperature and habitat conditions for fish and wildlife at different life stages.

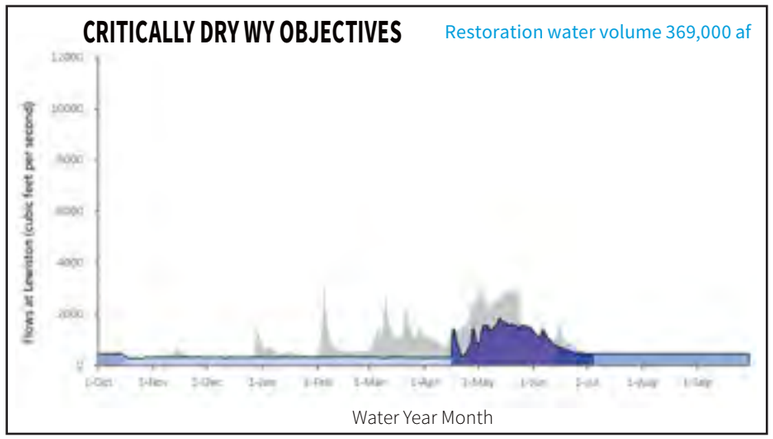
To recreate flow variability, the 2000 Record of Decision defined five water year types with a minimum volume of water to be released into the Trinity River for each water year type. The water volumes are measured in acre-feet (af), which is the amount of water needed to cover an acre of land one foot deep. Stored water not allocated to the river is available for export to the Central Valley.

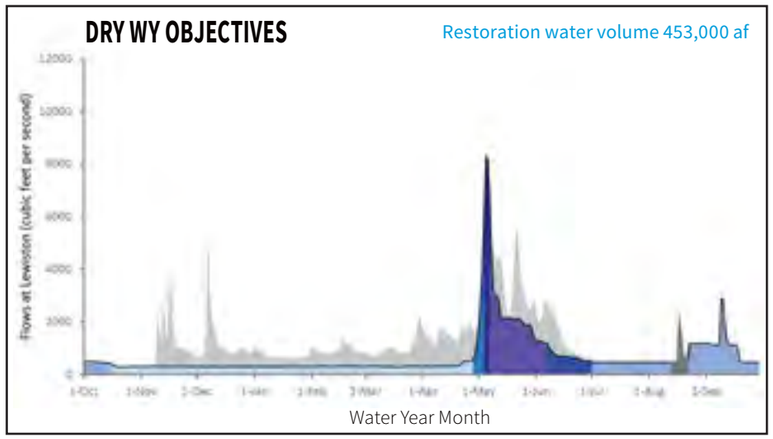
Annual flow variability is incorporated into the elements of the hydrograph schedule to meet specific restoration objectives. The hydrographs on the following pages show examples of the flow releases for each water year type (October 1 through September 30), ranging from extremely wet to critically dry. The hydrograph components are designed to achieve various objectives outlined on the bottom of the following page. Variable restoration flow releases range from 300 to 11,000 cfs.

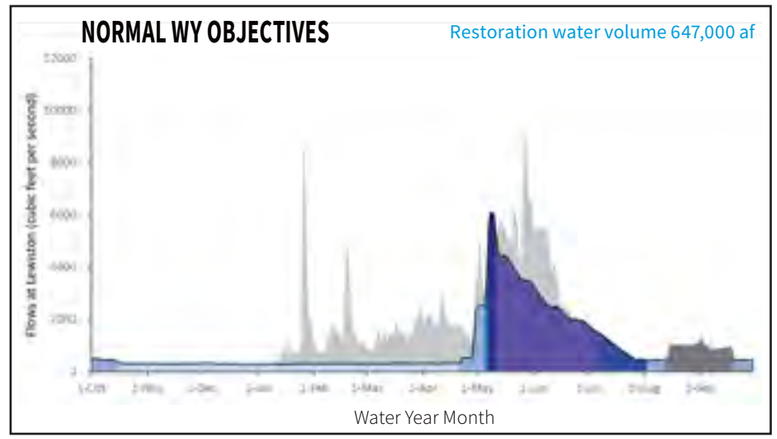
Infrastructure improvements necessary for peak restoration flows outlined in the 2000 ROD were largely completed in the early 2000s.

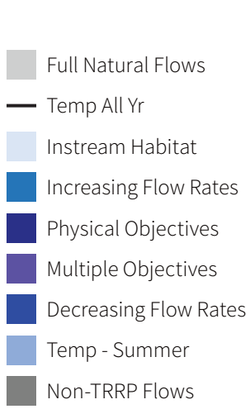
FLOW MANAGEMENT FOR GEOMORPHIC AND RIPARIAN PROCESSES

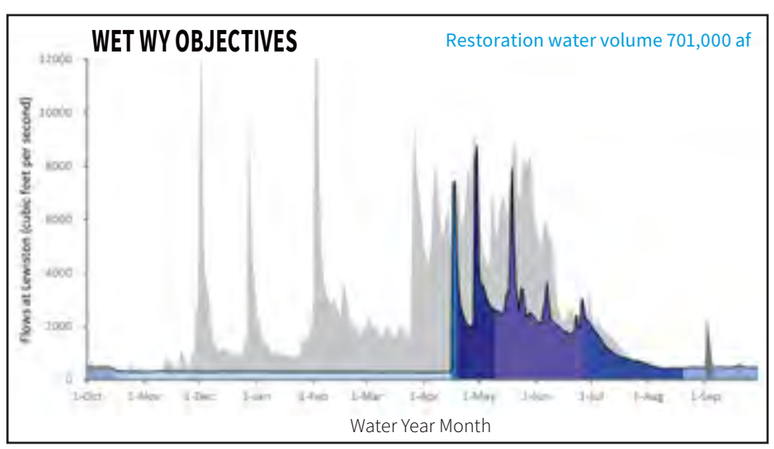
Variable restoration flows are designed to provide distinct geomorphic or ecological purposes on a managed river system. This approach provides a basis for estimating how much water is needed for the environment and then target key components of the natural flow regime to achieve desired outcomes. Variable flows help support the physical and ecological processes that create and maintain habitat and enable native species to reproduce, thrive, and migrate.

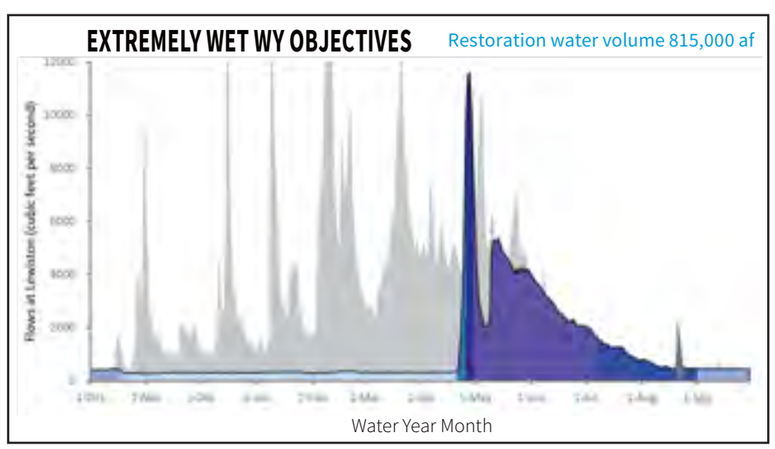






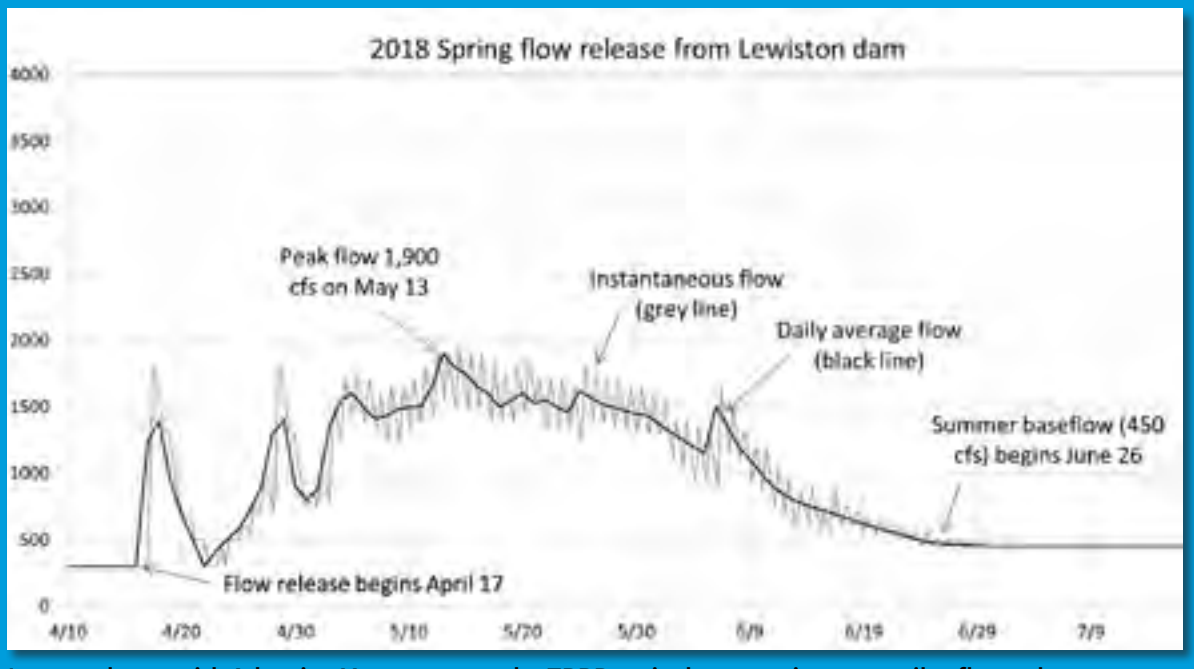




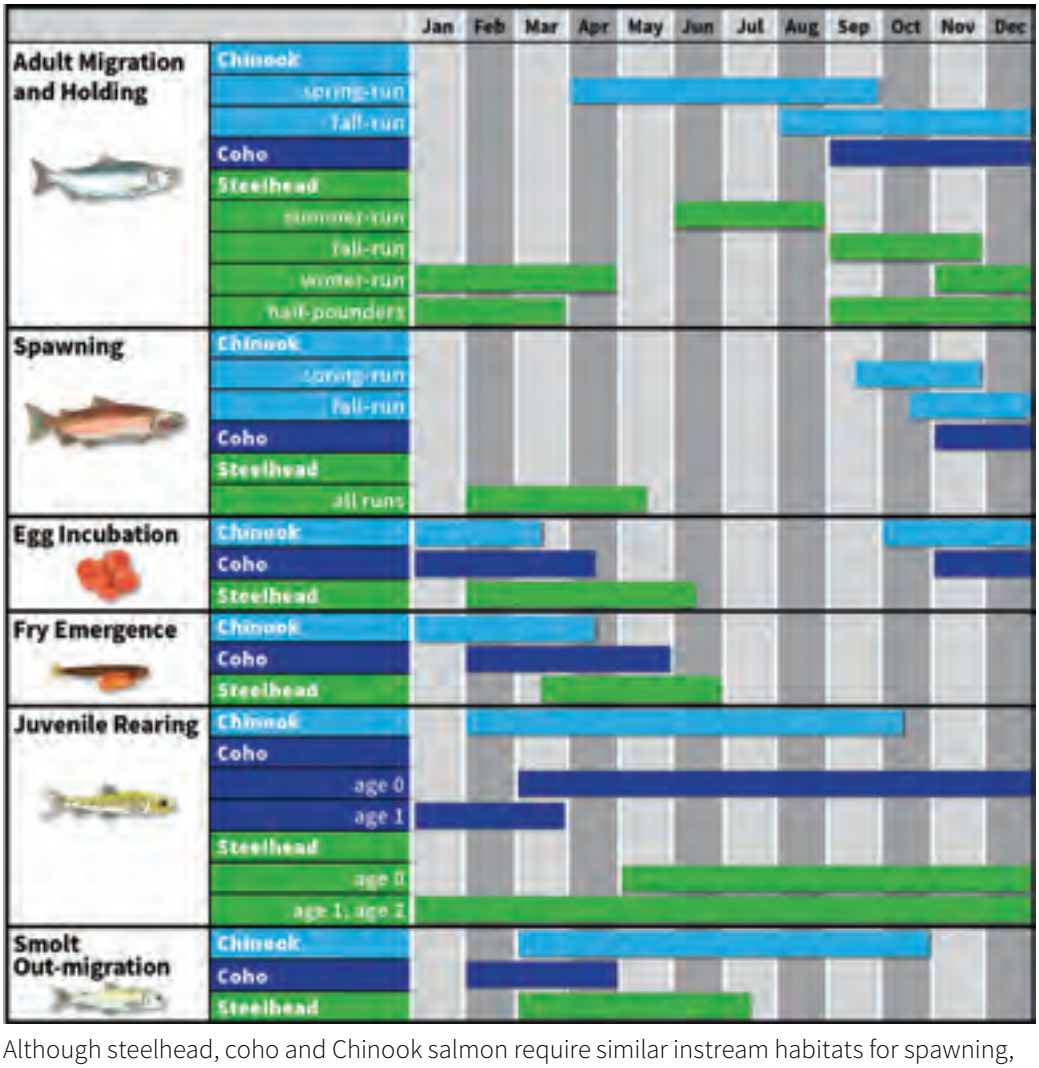


LEGEND

- Full Natural Flows at Lewiston: Representative hydrographs for the Trinity River at Lewiston for each water year type showing the flow rates without dams
- Temperature All Year: Provide optimal holding / spawning temperatures for spring-run Chinook adults; reduce pre-spawn mortality and increase egg viability
- Instream Habitat: Provide best balance of spawning and rearing habitats for salmon and steelhead in the existing channel; increase salmon and steelhead spawning and rearing habitat while minimizing dewatering of redds
- Increasing Flow Rates: Increase flows to peak volumes and reduce travel time of out-migrating steelhead smolts
- Physical Objectives: Create and maintain mobile gravel bars; create floodplains and fine sediment deposition; encourage riparian vegetation; scour bars and riparian seedlings along channel margins
- Multiple Objectives: Reduce fine sediment storage in channel bed surface; maintain seasonal variation of water surface levels in off channel habitats; improve salmon and steelhead smolt production by providing temperatures necessary for survival of steelhead, coho, and Chinook smolts; provide outmigration cues for Chinook smolts
- Decreasing Flow Rates: Minimize stranding of salmon and steelhead fry behind berms; increase survival of steelhead fry; provide outmigration cues for Chinook smolts and support cottonwood growth
- Late Summer Temperatures: Provide optimal temperatures for high survival of smolts
- Non-TRRP Related Flows (e.g. Lower Klamath Temperature Augmentation flows)



In accordance with Adaptive Management, the TRRP actively uses science to tailor flow releases to more effectively emulate natural variability. The 2018 hydrograph (above) contained diurnal flow fluctuations to better match the flow changes between night and day on unimpaired rivers.



Although steelhead, coho and Chinook salmon require similar instream habitats for spawning, egg incubation, and rearing, the timing of their life history events varies.

TRIBUTARIES AND MANAGED FLOWS

The effects of the TRD would have been considerably more severe if not for the tributaries downstream of Lewiston Dam. By the time water reaches the North Fork Trinity River (40 miles downstream from Lewiston Dam) the river regains much of its pre-dam nature because of the flows and sediment added by tributaries between the dam and the North Fork.

In many years before the dams, winter floods generated by rainstorms and rain-on-snow events were followed by spring snowmelt floods. These two different types of floods come from distinct areas in the watershed: Trinity River tributaries lower in the watershed are typically lower elevation rainfall-dominated streams, while tributaries entering above the dams are higher elevation snowmelt-dominated streams. The restoration flow releases are typically timed to restore the annual spring snowmelt component necessary for migrating smolts, riparian vegetation, and sediment transport. These releases combined with the inflow from downstream tributaries create a more natural hydrograph.

FLOWS FOR INSTREAM HABITAT

The salmon lifecycle evolved with the seasonal changes in river levels; spawning during low flows allows for productive egg development so that the juvenile fish emerge in time to take advantage of the higher flows that provide access to rearing habitat and cues for migration. In general, lower flows result in shallower water depths, lower velocities, and higher water temperatures, whereas higher flows have the opposite effect. The quantity and quality of spawning and rearing habitat for salmon and steelhead varies depending on the amount of water in the river. After the river became channelized as a result of water diversions, juvenile rearing habitat was reduced, especially during higher flows.

Field studies and monitoring inform TRRP's understanding of the relationship between stream flow and habitat. These data are used to recommend (within allowable bounds) flow releases for fresh-water life stages of Chinook and coho salmon and steelhead.

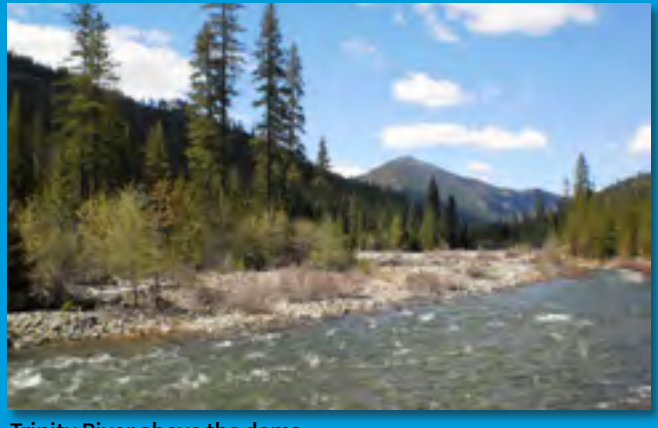
FLOWS FOR WATER TEMPERATURE

Water temperature affects salmon and steelhead in many ways, including egg incubation, juvenile growth rates, the timing of migration and spawning, and resistance to disease.

Flow releases during spring and summer are developed to meet Chinook smolt out-migration objectives and adult holding and spawning temperature objectives developed by the California State Water Resources Control Board at specific locations on the river (Douglas City and Willow Creek).

Recent restoration flow releases incorporated multiple peaks to improve sediment movement, groundwater recharge, and floodplain access for juvenile salmonids.

Confluence of the Trinity River and the North Fork Trinity River.



Trinity River above the dams.

The Trinity River has the characteristics of a mountain stream, as opposed to a low-land, slow-flowing river, such as those in the San Joaquin Valley. The watershed typically receives heavy rainfall from October to February - the rainy season - when up to eighty inches of rain can fall in some areas. This rain can cause a rapid rise in river levels when it accelerates snow melt run-off from the higher elevations.

SEDIMENT MANAGEMENT

Gravel and cobble (coarse sediments), and silt and sand (fine sediments), are essential components of healthy salmon habitat. The dams have trapped all sediment that was normally delivered to the lower river from the upper watershed. Additionally, the reduced flows from previous decades allowed sediment supplied from the tributaries in the first 17 miles below the dam to build-up in tributary deltas rather than be transported and distributed downstream. To restore river processes and improve spawning and rearing habitat, the Program adds spawning gravel to the river, develops hydrographs to efficiently mobilize sediment, and funds projects that reduce fine sediment input from tributaries.

Through careful monitoring and analysis, the TRRP has achieved a better understanding of gravel movement during restoration flows and subsequently reduced gravel augmentation volumes since 2000.

COARSE SEDIMENT

The overall restoration strategy for managing coarse sediment in the Trinity River is to increase coarse sediment storage in the river (gravel bars), improve coarse sediment transport (distribute gravel downstream), and restore a balance between coarse sediment supply by adding gravel to the river and coarse sediment transport using high flows. This gravel is often sourced from nearby mine tailing piles that were created from gravels removed from the riverbed during dredger mining. As with flow management, optimizing gravel management actions through applied science is an ongoing priority.

FINE SEDIMENT

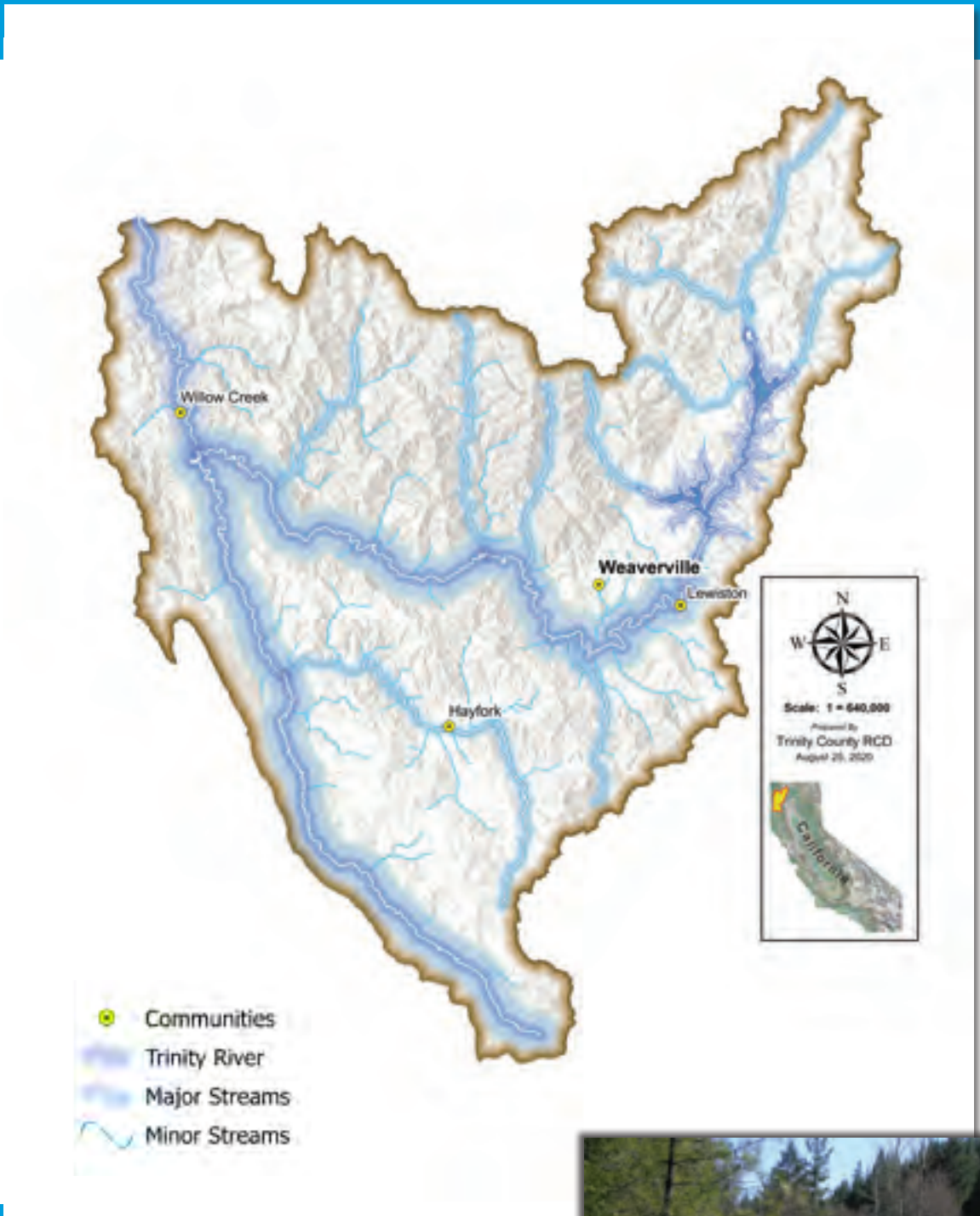
Restoration actions include the following:

- Continue watershed rehabilitation work to reduce fine sediment supply in key tributaries including the South Fork Trinity River;
- Continue implementing high flow releases to transport fine sediment through the river;
- Remove sand-laden riparian berms during channel rehabilitation.

Like coarse sediment, fine sediment is an essential component of a healthy river channel. Improved land-use practices, enhanced stream crossings, and the removal of unused logging roads combined with restoration flows have helped restore the balance between fine sediment inputs and river flows.

WHAT DOES WATERSHED LAND USE HAVE TO DO WITH SALMON AND STEELHEAD?

Changes in land use, such as road building and logging, increased the amount of fine sediment delivered to the Trinity River from tributaries. When the dams were constructed and water diversions began, the mainstem flows lacked the power to scour the additional fine sediment. Excessive fine sediment in a river system can pose a threat to the survival and development of salmon and steelhead eggs. Yet some amount of fine sediment is needed in the river to help mobilize gravels (much like ball-bearings in machinery movements) and to provide habitat for various organisms including juvenile lamprey.



Based on monitoring and stakeholder input, TRRP has placed greater emphasis on watershed restoration that improves tributary habitats.

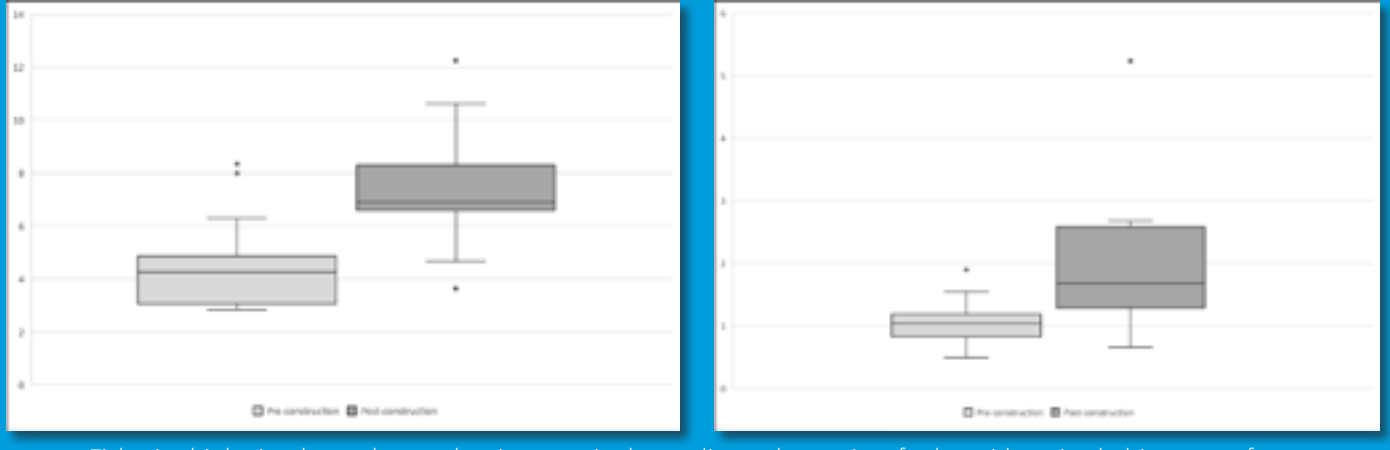
CHANNEL REHABILITATION

TRRP channel rehabilitation site designs evolve as TRRP monitoring and understanding of river science progresses. The recognition of the deficit of wood in the river and development of methods to add wood during channel rehabilitation is one example of design evolution.

Just as it took an enormous amount of effort spanning a century of drastic change to reduce salmonid habitat, it will require concentrated effort and time to make the river productive again for salmon. To achieve this, large-scale construction projects are carried out to transform the terrain to better match the reduced flows available from the dams.

Studies from the 1990s found that flows exceeding 24,000 cfs would be necessary to recreate habitat and remove the riparian berms and mine waste deposits that channelized the river. Trinity Dam, however, is only capable of a maximum controlled release of 13,750 cfs. Additionally, roads and houses built on floodplains since the dams were constructed have restricted restoration releases to just 11,000 cfs. Therefore, 47 sites were identified for mechanical channel rehabilitation to provide river function that creates salmon and steelhead habitat with constrained flows. These sites were selected based on a variety of factors, including land management, ease of access, and where the greatest increase of habitat can be obtained efficiently.

In addition to immediate habitat benefits, such as side channels, these sites change overtime as they interact with restoration flows. The series of photos above are of the Lowden Ranch site constructed in 2010.



Fisheries biologists have observed an increase in the quality and quantity of salmonid rearing habitat area after channel rehabilitation at 12 of 13 sites surveyed from 2005 to 2015 (Boyce et al., 2018).

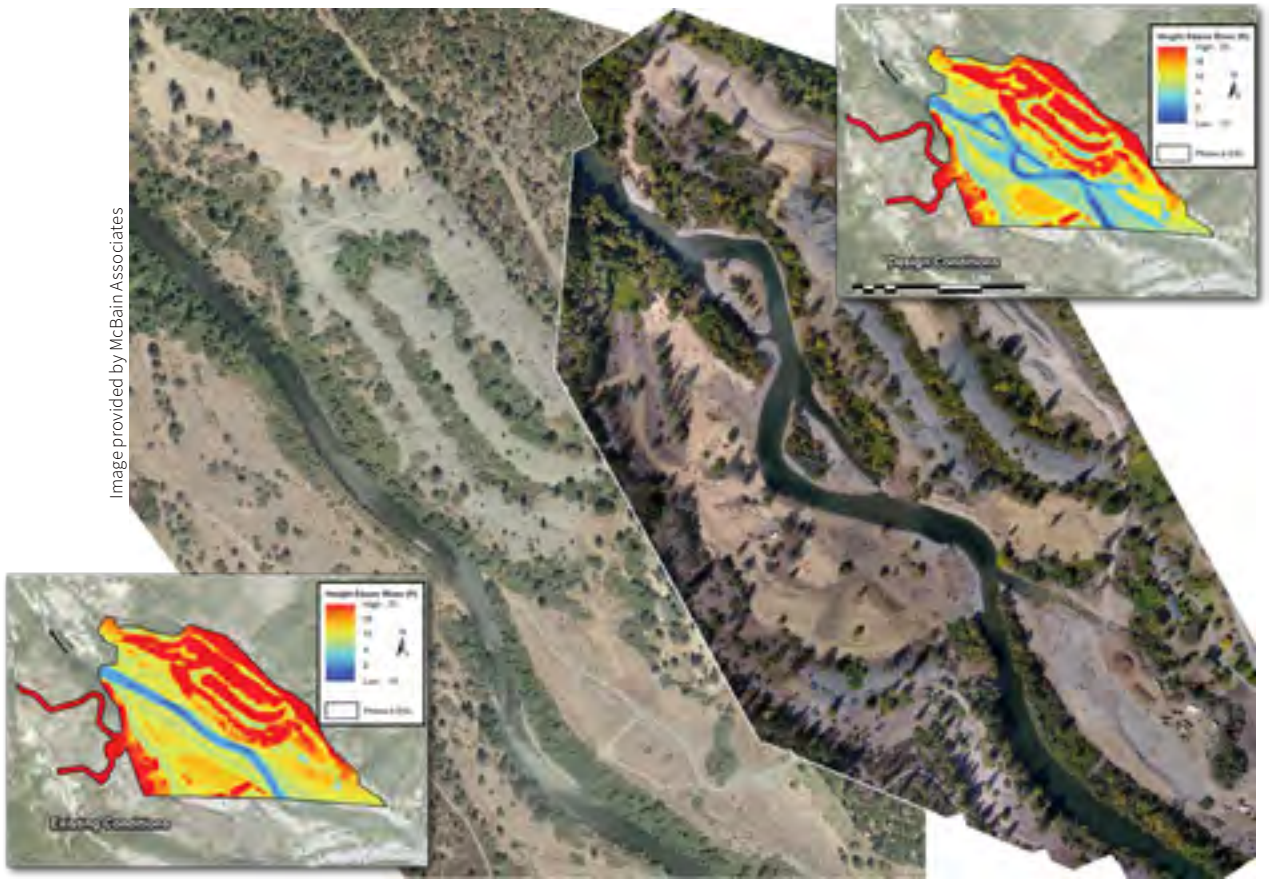


Image provided by McBain Associates

Sites are designed to increase river complexity. The image above shows a site before and after construction. The graphics in the bottom-left (pre-construction) and top-right (post-construction), show modeled river elevations. Projects undergo an iterative design process including hydraulic and fish capacity modeling and alternative analyses based on public input.

DESIGN STRATEGY

Channel rehabilitation sites are designed to enhance the quality of both terrestrial and aquatic habitat. In-river work increases river complexity to create and maintain long-term habitat. Immediate habitat is provided through the construction of off-channel refuge areas, such as side channels and alcoves. Channel confining riparian berms and piles of mine waste are removed to reconnect the river and the floodplain at a greater range of flows. Large wood is added to the river to create habitat and to change the direction and speed of flows. Coarse sediment is added to the river as gravel bars to increase gravel storage, improve channel dynamics, and increase salmon spawning and rearing habitat. And riparian vegetation is planted on restored floodplains to provide fish and wildlife habitat.

Channel rehabilitation sites are designed to enhance habitat for fish and wildlife, including foothill yellow-legged frogs, turtles, and birds.

Part of this process includes changes to the revegetation composition and planting techniques at channel rehabilitation sites.

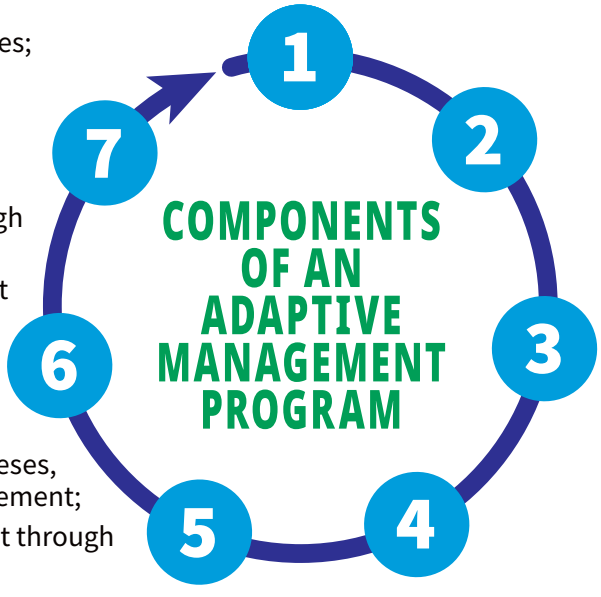
A strategy using a combination of native riparian planting and natural regeneration can quickly revegetate floodplains at rehabilitation sites. Improved floodplains are one of the most productive habitats and are a critical element to juvenile fish rearing and other wildlife. A 2015 report shows that many of the bird and vegetation metrics are meeting habitat restoration goals.

ADAPTIVE MANAGEMENT AND MONITORING

A key component of the Program is implementing a process that continuously monitors results to improve future actions, commonly referred to as Adaptive Management. This is a systematic and rigorous process of learning from the outcomes of management actions, accommodating change, and improving decisions.

Given that varying levels of scientific uncertainty exist in complex systems, such as rivers, the Program is continually improving its understanding of the Trinity River ecosystem. The Adaptive Management program promotes responsible, science-based progress in the face of this uncertainty, with a decision-making process structured on evidence. The process facilitates cooperative integration of water operations, resource management, scientific monitoring and research, and stakeholder input.

1. Define measurable goals and objectives;
2. Document and evaluate existing conditions with respect to goals and objectives;
3. Develop testable hypotheses of how to achieve goals and objectives through management actions;
4. Predict river response to management actions before implementing management actions;
5. Implement, monitor, and evaluate management actions;
6. Re-evaluate objectives, refine hypotheses, improve models, and improve management;
7. Examine the science and management through external peer review.



MONITORING & TARGETED STUDIES

Long-term monitoring is at the foundation of Adaptive Management. It measures progress towards achieving restoration objectives and improves understanding of river response to management actions (e.g., flow releases, gravel introduction, etc.).

Short-term targeted studies are often required to confirm or refute hypotheses that emerge from long-term monitoring. These might examine how the insects that provide food for juvenile salmonids respond to changes in river flows or other specific questions. These studies are vital to evaluate and improve management actions and close information gaps.

Monitoring and targeted studies are guided by the scientific branch of the program. Proposals that address specific issues are done by public, private, and academic scientists and are carefully reviewed to improve the quality and efficiency of studies conducted on the river.

Current investigations look into how the unnatural water temperatures below the dams affect fish development, how flows affect food production, and how access to productive floodplains at various stages of fish development could be shifted within allowable restoration flow limits. These investigations will facilitate an improved understanding of how the increase in surviving juvenile salmonids can be translated into an increase of returning adults.

TRRP MANAGEMENT ACTIONS

A brief chronology.

2002 2002: TRRP Weaverville office opened.

2003 2003: First gravel augmentation in Lewiston.

2005 2005: Trinity River bridges project completed. First unconstrained restoration flow from Lewiston Dam. First channel rehabilitation project at Hocker Flat.

2006 2006: Canyon Creek projects constructed. Continued infrastructure improvements below the dam to allow for higher flow releases.

2007 2007: Indian Creek project constructed - first side channel built

2008 2008: Lewiston-Dark Gulch project constructed - aggressive wood integration begins.

2009 2009: Master EIR-EA/EIR completed for remaining rehabilitation and sediment management. Sawmill project constructed; first meander and large-wood structure built.

2010 2010: Reading Creek, Lowden Ranch, & Trinity House Gulch projects constructed - first off-channel habitats built.

2011 2011: Wheel Gulch project constructed. First maximum peak release of 11,000 cfs implemented in the wet water year.

2012 2012: Lower Steiner Flat & Upper Junction City projects constructed.

2013 2013: Lower Douglas City & Lorenz Gulch projects constructed.

2014 2014: Phase I review complete with recommendations. Lower Junction City project constructed

2015 2015: Limekiln Gulch & Upper Douglas City projects constructed.

2016 2016: Bucktail project constructed. Science Symposium on Decision Support System.

2017 2017: Deep Gulch & Sheridan Creek projects constructed. 11,000 cfs peak release implemented in the extremely wet water year.

2019 2019: Chapman Ranch Phase A project constructed.

Trinity River Restoration Program

Through the Adaptive Management process, the TRRP has adjusted restoration methods and continues to work toward further improvements. Since the first project was completed in 2005, channel rehabilitation designs have evolved in response to monitoring and advanced modeling. Lowered floodplains, gravel bars, meanders, and large-wood structures have been incorporated into projects to create and sustain long-term fish and wildlife habitats. In key places, these are coupled with features that create immediate habitat such as alcoves, low- and high-flow side channels, and wetlands.

TRRP WORK GROUP STRUCTURE FOR ADAPTIVE MANAGEMENT

- **The Interdisciplinary Team (IDT)** coordinates the activities of TRRP technical work groups and integrates multi-disciplinary assessments into comprehensive management recommendations to the TMC.

- **The Flow Work Group** focuses on all technical aspects of restoration flow releases from Lewiston Dam to the Trinity River, including but not limited to scheduling flow releases, evaluating the flow releases in meeting restoration goals and objectives on an annual and multi-annual basis, and considering alternatives to the current flow scheduling methodology and temperature targets on the Trinity River.

- **The Design Work Group** provides comprehensive and implementable designs for TRRP's identified channel rehabilitation project sites within the 40-mile restoration reach. Within the work group there are individual partner teams represented by various entities, including the Federal Design Team with representatives from Reclamation, NOAA Fisheries, USFWS, and USFS; the State Design Team (CDFW, CDWR); Hoopa Design Team, and the Yurok Design Team.

- **The Physical Work Group** makes recommendations for data collection and analysis of physical processes in the Trinity River and its tributaries. The group uses this information to guide channel rehabilitation designs, flow management, sediment management, and Adaptive Management to better achieve TRRP goals.

- **The Riparian and Aquatic Ecology Work Group** focuses on Program science and management issues related to aquatic and riparian ecology. The work group guides monitoring and data collection, and analyzes and interprets information that will inform channel rehabilitation designs and flow management for riparian and aquatic species.

- **The Fish Work Group** provides technical support and guidance to the TRRP concerning fish population and fish habitat monitoring, assessment and analysis to inform decision-making, and management to help successfully fulfill the goals of the Program.

- **The Watershed Work Group** identifies restoration activities as described in the Trinity River ROD. The group pursues high priority watershed restoration activities in coordination with other organizations in the basin.

TRD AND RIVER RESTORATION

The TRRP is legally mandated to restore the fishery of the Trinity River. Beneficiaries of a restored fishery and restoration program include the sport, tribal, and commercial fishing communities that depend on a healthy fishery; local contractors and tribal staff hired to implement and monitor restoration actions; and the tourist and recreation industries along the Trinity River.

The TRRP attempts to restore a reasonable balance by developing an approach that has a high likelihood of achieving the legally mandated restoration objectives while allowing for continued benefits to water and power users.

Photograph by Ken DeCamp

Photograph by CDFW

Trinity River Restoration Program

Thank you to all partners and stakeholders for continued involvement and interest in restoring the Trinity River.

For more detailed and current TRRP information, including reports and datasets, please visit our website.

www.trrp.net

Trinity River Restoration Program

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