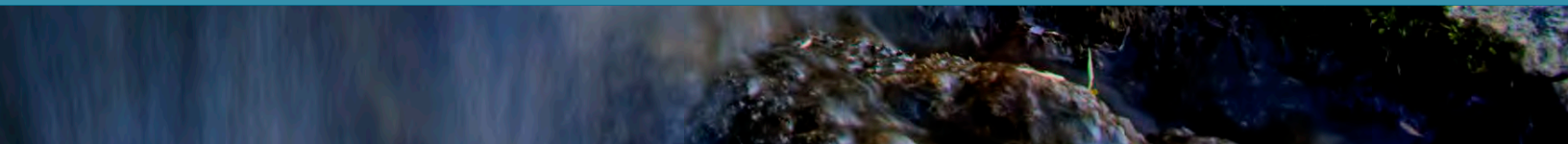
2019 ANNUAL REPORT

TRINITY RIVER RESTORATION PROGRAM



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 (BOR) 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 (USFW) 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.

On the cover: Photograph titled "Trinity Wild & Scenic River" from the 50th Anniversary of the National Wild and Scenic Rivers photo album by photographer Bob Wick, Bureau of Land Management.

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

Acknowledgements

Thank you to all partner agencies and entities 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.

Report Names

Flow 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. *Often referred to as the Trinity River Flow Evaluation Study.* http://www.trrp.net/library/document/?id=226.
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. http://www.trrp.net/library/document/?id=227.
TREIS/EIR	USFWS, Reclamation, HVT, and Trinity County. 2000. Trinity River Mainstem Fishery Restoration Final Environmental Impact Statement/Environmental Impact Statement. http://www.trrp.net/library/document/?id=1238.
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. http://www.trrp.net/library/document/?id=365.

Acronyms

2D	two dimensions
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 (now NOAA Fisheries)
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries (formerly NMFS)
NTU	nephelometric turbidity units
PT	Pear Tree Gulch rotary screw trap site
RAD	Restoration Action Database
Reclamation	Bureau of Reclamation
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 Establish 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
USFS	U.S. 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)
YT	Yurok Tribe
YTFP	Yurok Tribal Fisheries Program

Measurements

^{o}C	degree Celsius
^{o}F	degree Fahrenheit
af	acre foot
cfs	cubic feet per second
km^{3}	cubic kilometers
rkm	river kilometer
rm	river mile

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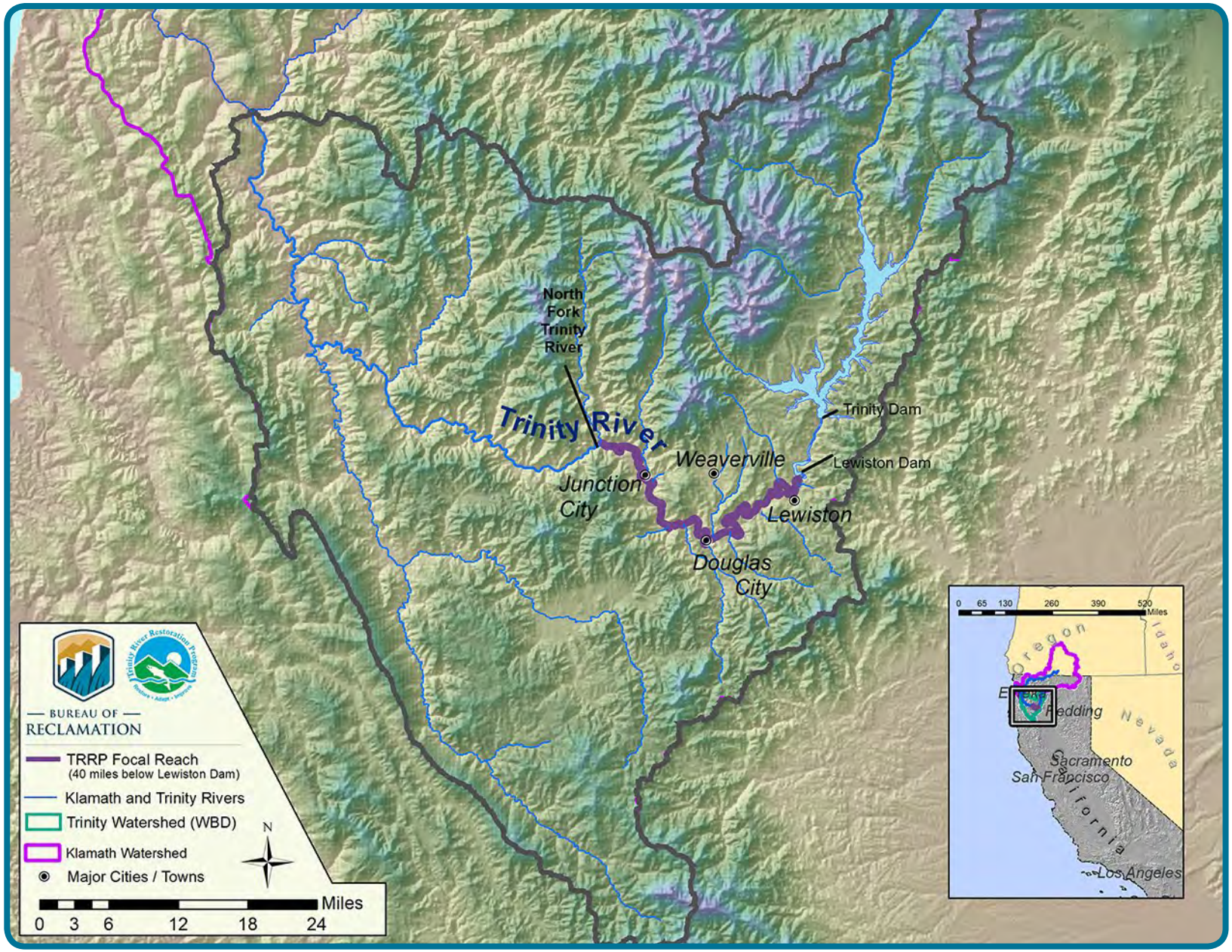

Figure 1. Map of Trinity River Restoration Program's reach.

Introduction

The Trinity River Restoration Program (TRRP) is a partnership comprised of Federal, State, Tribal, and Trinity County entities that collaborate to restore the Trinity River between Lewiston Dam and the confluence of the North Fork Trinity River, California (Figure 1). The partnership is administered by two U.S. Department of the Interior (DOI) agencies: the Bureau of Reclamation (Reclamation) and the U.S. Fish and Wildlife Service (USFWS). 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 Trinity Management Council include:

TMC partners work collaboratively with many other participants and stakeholders to recover a more productive naturally spawning fishery through a healthier Trinity River.

- 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)
- National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries)

This 2019 annual report highlights accomplishments achieved throughout the year as well as the extensive planning activities, environmental permitting, and monitoring efforts across disciplines, including upcoming synthesis reports. These comprehensive assessments on various performance measures have been underway for the past several years as part of TRRP's work to provide quality science and modelling that will better inform future actions. To learn more about the progress on Trinity River restoration and to review more detailed reports please visit TRRP.net.

Laws and Guiding Documents

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

1963. Trinity and Lewiston Dams were completed.

1981. Interior Secretary increased flows to ~300 cubic feet per second (cfs) (8.5 cubic meters per second [cms]) and initiated Flow Study.

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

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

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

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

2009. Master Environmental Impact Report (EIR)[4] provided all parts and appendices for the Draft and Final Master EIR in one document (North Coast Regional Water Quality Control Board [RWQCB] and Reclamation 2009).

2009. Integrated Assessment Plan identified the scope of research needed to evaluate restoration of the Trinity River and its fisheries.

2014. The Scientific Advisory Board conducted the Phase 1 Review of the Program's restoration actions through the Phase 1 channel rehabilitation sites.

TRRP's Goals

The TRRP 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 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.*

As outlined in the U.S. Department of Interior 2000 Record of Decision (ROD)[1], the TRRP works "to restore the Trinity River's anadromous fishery resources . . . [by] . . . rehabilitating the river itself."

The Trinity River ROD is based on the Trinity River Mainstem Fishery Restoration Environmental Impact Statement/ Environmental Impact Report (TREIS/EIR)[2], which is the environmental compliance document under the National Environmental Policy Act of 1969 (NEPA). The preferred alternative of the TREIS/EIR came from over 20 years of studies on the Trinity River and its anadromous fishery resources by various stakeholders that culminated in the Trinity River Flow Evaluation Study (Flow Study)[3].

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[1]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. www.trrp.net/library/document/?id=1238.

[2]TREIS/EIR. USFWS, Reclamation, Hoopa Valley Tribe, and Trinity County. 2000. Trinity River Mainstem Fishery Restoration Final Environmental Impact Statement/Environmental Impact Statement www.trrp.net/library/document/?id=1238.

[3]Flow Study. Often referred to as the Trinity River Flow Evaluation Study. USFWS (U.S. Fish and Wildlife Service) and HVT (Hoopa Valley Tribe). 1999. Trinity River flow evaluation final report. USFWS, Arcata, California and HVT, Hoopa, California. www.trrp.net/library/document/?id=226.

[4]Master EIR.North Coast RWQCB (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. www.trrp.net/library/document/?id=365.

TRRP Restoration Strategy

The TRRP's restoration strategy is to foster a more natural, dynamic river system that promotes all life-stages of salmonids through the following actions (Figure 2):

- *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 CDWR.
- *Mechanical channel rehabilitation.* Channel rehabilitation projects are designed to reshape the river channel to increase fish habitat across the range of allowable flows. The Flow Study identified 47 project sites along the river below Lewiston Dam.
- *Sediment management.* Coarse gravel is added to the river below Lewiston Dam to form gravel bars and other elements of habitat complexity to replenish the sediment supply from the headwaters which dams cut off.
- *Watershed restoration.* Restoration projects in tributaries reduce fine sediment input to the Trinity River and increase available salmon and steelhead habitat throughout the watershed.
- *Infrastructure improvements.* Modification of structures in the floodplain allow the peak restoration flows released from Lewiston Dam.

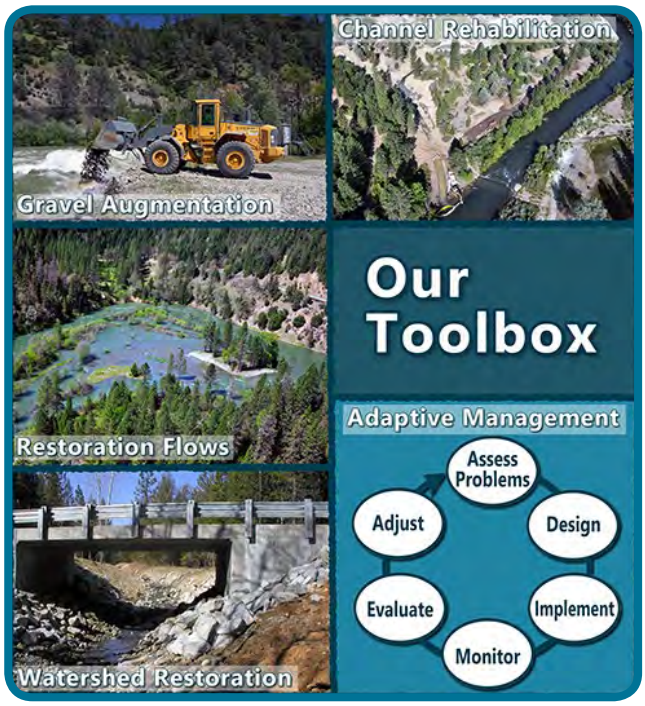


Figure 2. Using Adaptive Management, the TRRP implements four methods (channel rehabilitation, gravel augmentation, restoration flows, and watershed restoration) to allow the river to recover more natural processes that will support naturally spawning anadromous fish.

These actions are guided by an adaptive environmental assessment and management process (Adaptive Management)—a rigorous monitoring and analysis program to improve restoration activities. 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. Infrastructure improvements necessary to facilitate restoration flow releases were prioritized during the beginning of the Program and after early implementation of peak flow events (Figure 3). Since breaking ground on the first channel rehabilitation project in 2005, activities have focused on the first four management elements outlined in the ROD, within the context of environmental compliance and adaptive management.

Figure 3. Prior to implementing the peak restoration flow release of 11,000 cubic feet per second (cfs) from Lewiston Dam, infrastructure improvements and modifications were completed, including replacing five bridges (Reclamation).

The ROD includes an Adaptive Management program guided by the TMC, using sound scientific principles to ensure that "the restoration and maintenance of the Trinity River anadromous fishery continues based on available scientific information and analysis" (DOI 2000). Work Groups in the TRRP collaborate to conduct interdisciplinary analyses and support Adaptive Management efforts.

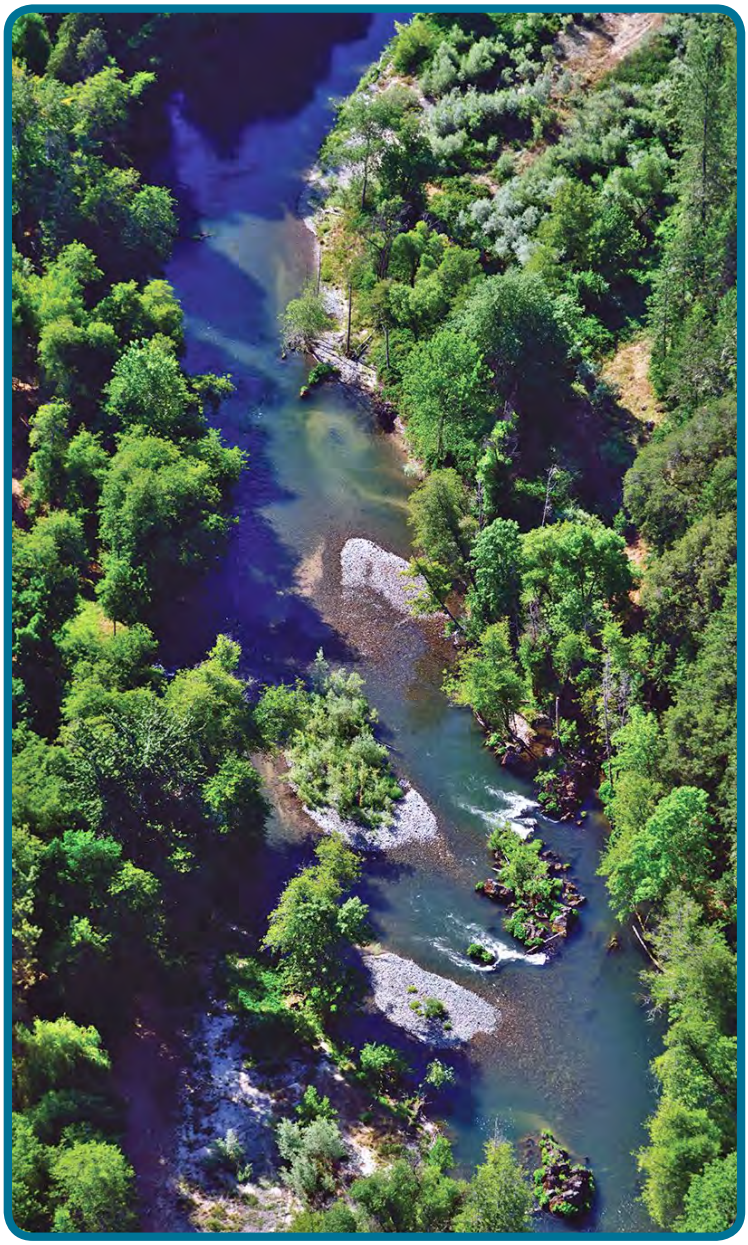


Figure 4. A complex of gravel bars and deep pools on the upper Trinity River contains the elements necessary for salmonid habitat. (Photo by Ken DeCamp).

An Alluvial River

These healthy river attributes in a natural river system are used to inform the design and implementation of TRRP restoration actions:

- Variable annual flows create and maintain channel complexity, which creates diverse aquatic habitat that benefits fish
- The river channel bed is frequently mobilized
- Alternating gravel/cobble bars are periodically scoured and redeposited
- Fine and coarse sediment supply from the watershed is balanced by river transport
- The mainstem channel periodically migrates across its floodplain
- Floodplains are created, frequently inundated, and areas where fine sediment deposits
- Infrequent, large floods move the mainstem channel and associated floodplains and side channels, as well as scour away riparian vegetation
- Riparian vegetation is spatially and structurally diverse and self-sustaining
- Groundwater beneath the floodplains is frequently recharged by high flows in the mainstem channel.

These attributes found in natural river systems create and maintain channel complexity, which creates habitat complexity, which benefits fish (Figure 4).

2019 Highlights

In 2019, the Program:

- Neared completion of the comprehensive effort to write and review synthesis reports on various monitoring efforts undertaken by TRRP's interdisciplinary work groups
- Constructed a 150-acre channel rehabilitation project to enhance in-channel and off-channel habitat by promoting natural river processes at the Chapman Ranch Phase A site (Figure 5)
- Coordinated and scheduled the release of 701,000 acre feet of water (af) from Lewiston Dam allowed under the ROD in a wet water year, with a peak release of approximately 10,800 cfs on April 29, 2019 (Figure 6)
- Designed a hydrograph with diurnal fluctuations to more closely resemble natural stream flow variation (Figure 7) and conducted studies to monitor the results of the release
- Combined gravel augmentation with multiple peak flow releases to efficiently transport the 3,500 cubic yards of gravel added at multiple locations
- Continued design, review, and environmental permitting to advance channel rehabilitation work at the remaining sites within the TRRP Focal Reach (on the Trinity River between Lewiston Dam and the confluence of the North Fork Trinity River) as described in the Flow Study

Figure 5. Aerial photography of the upstream end of the 2019 Chapman Ranch Phase A channel rehabilitation project, during the summer construction season. Photograph by Aaron Martin, Yurok Tribal Fisheries Program (YTFP).

Figure 6. A peak release of 11,000 cfs from Lewiston Dam (Reclamation).

Figure 7. Spring restoration flow release in 2019 had multiple peaks of 9,850, 10,800, and 9,000 cfs to more efficiently mobilize sediment and scour vegetation along the channel margin (Reclamation).

Interdisciplinary Team

The Interdisciplinary Team (IDT) coordinates the activities of TRRP technical work groups and integrates multi-disciplinary assessments into comprehensive management recommendations to the TMC. In 2019, the IDT consolidated and discussed an initiative to identify hypotheses and research questions related to adaptive management on restoration flows. The IDT continued coordination among work groups and TMC, reviewed proposed hydrographs and gravel augmentation, provided oversight and coordination for objectives and targets exercises, including cross-work group synthesis and annual updates.

Restoration Flows

As water year 2019 was forecast as a wet water year 2019, the TRRP coordinated and scheduled a peak release of 10,800 cfs from Lewiston Dam combined with gravel augmentation at multiple locations along the river. Three separate peaks were incorporated in the 2019 hydrograph to efficiently transport sediment and to enhance the ecological productivity of the release timing. Historically, precipitation-driven floods caused flows to vary over the winter and spring, while Chinook Salmon (*Oncorhynchus tshawytscha*) eggs were incubating and fry were growing. These floods inundated floodplains and allowed fry to access off-channel wetted areas where they could grow faster than they could in the main channel. TRRP releases restoration flows as early as legally possible to reap the benefits that winter and early-spring floods provide to salmonids.

A first peak release of 9,850 cfs on April 17, 2019, was the earliest peak implemented by the Program and was scheduled to better match local climate patterns and reduce scouring of Foothill Yellow-legged frog (*Rana boylii*)—a California Endangered Species Act candidate—and provide more habitat benefits to a larger portion of juvenile salmon.

Figure 8. Aerial photographs of the 2019 channel rehabilitation project before (left, July 25, 2018) and after construction (right, September 27, 2019). (Courtesy of McBain Associates, all rights reserved).

Chapman Ranch Phase A

The Chapman Ranch Phase A channel rehabilitation project was completed in 2019 with over 122,000 cubic yards of material excavated. This was one of the more complex single channel rehabilitations projects undertaken by the TRRP. Final construction was completed in October, and the site included three new mainstem meanders, extensive floodplain lowering, and large wood placement to enhance natural river processes (Figure 8).

Environmental Permitting and Design for Restoration Efforts

In addition to regulatory and environmental compliance permitting for upcoming channel rehabilitation projects, the TRRP continued developing site designs and reviewing environmental documents for sediment management and restoration flow releases.

- Environmental compliance, design review, and landowner coordination progressed on the Dutch Creek channel rehabilitation project in 2019. Construction on the project is anticipated to begin in the summer of 2020.

- Continued coordination with cooperating Federal and State agencies to initiate environmental documents for the proposed Chapman Ranch Phase B channel rehabilitation project.

- Advanced the design and coordination for proposed projects in the lower Junction City reach of the river, including the Oregon Gulch and Sky Ranch channel rehabilitation projects.

- Continued work on updating biological assessments for the Endangered Species Act (ESA) analyses of non-flow related restoration actions

Restoration Monitoring and Synthesis Reporting

Interdisciplinary TRRP work groups advanced the effort to refine objectives and targets to improve the means of measuring successes. Overall, the Program continues to explore opportunities to enhance flow variability and implement restoration flows earlier in the water year to promote fish and other wildlife productivity. The work groups continue their work on writing and reviewing the long-awaited synthesis reports on various topics that will support development of broader global objectives and targets.

Figure 9. Partners with the TRRP complete salmon redd and carcass surveys annually on the Trinity River.

Funding and Expenditures

Since the Program's inception, funding levels have varied from approximately $10 million to $16.66 million per year. In fiscal year (FY) 2019, the Program received a total of $14,160,392 million, as shown in Table 1.

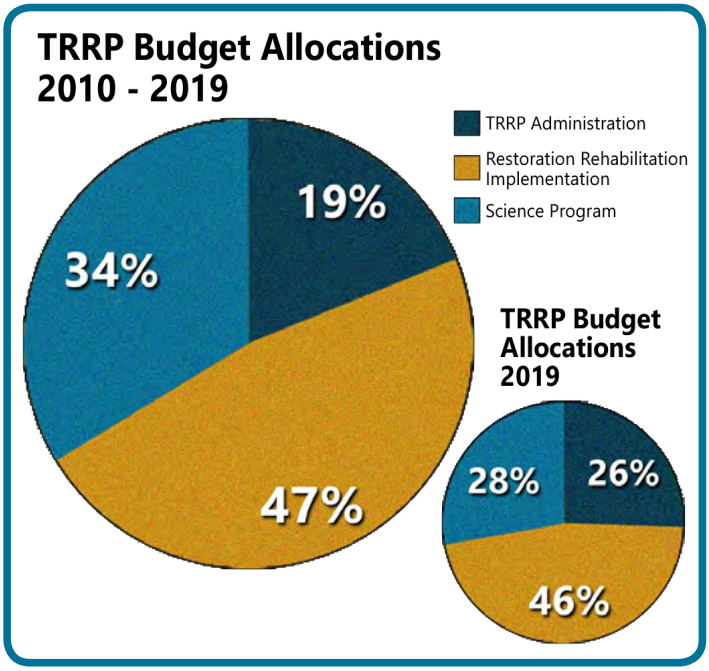
Table 1. Fiscal Year 2019 Funding

Water and Related Resources Account	$11,911,000
Central Valley Project Improvement Act Restoration Fund	$1,500,000
FY 2018 Funds provided to TRRP for use in FY 2019	$749,392

The FY 2019 budget allocations went to three primary areas as shown in Table 2.

Table 2. FY 2017 Budget Allocations

TRRP Administration	$3,671,536
Restoration Rehabilitation Implementation	$6,704,688
Science Program	$4,103,659



Most of the 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. Primary Program areas are consistent with funding levels in previous years. The funding for Program Administration in 2019 reflects staffing positions that were previously vacant and the 2019 Science budget prioritized on-going studies and the completion of work group synthesis reports (Figure 10).

Figure 10. This series of pie charts provides a breakdown of expenditures by category; TRRP Administration, Restoration Rehabilitation Implementation, and the Science Program.

Activities and Accomplishments

Flow Management

Restoration Releases

Each water year (WY), the TRRP's Flow Workgroup 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 for outmigrating smolts
- Managing riparian seed germination
- Reducing fine sediment storage in the channel
- 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 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 2019 was wet (CDWR, 2019). Based on the wet water year designation, the TMC recommended a restoration release of 701,000 af. Reclamation implemented a modified ROD hydrograph to meet programmatic objectives for the wet water year (Figure 11).

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Flow Work Group

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 Flow Work Group uses an ecosystem-based and multi-disciplinary approach in undertaking its activities.

Developing the spring 2019 hydrographs was the work group's primary effort. The work group also developed a summary paper on parameters for hydrograph development, including TREIS/EIR ramping rates, spring flow start dates, riparian ramping rates, peak discharges, and tracked Trinity River flows and temperatures to verify implementation of scheduled flows and monitored progress meeting in-river temperature targets.

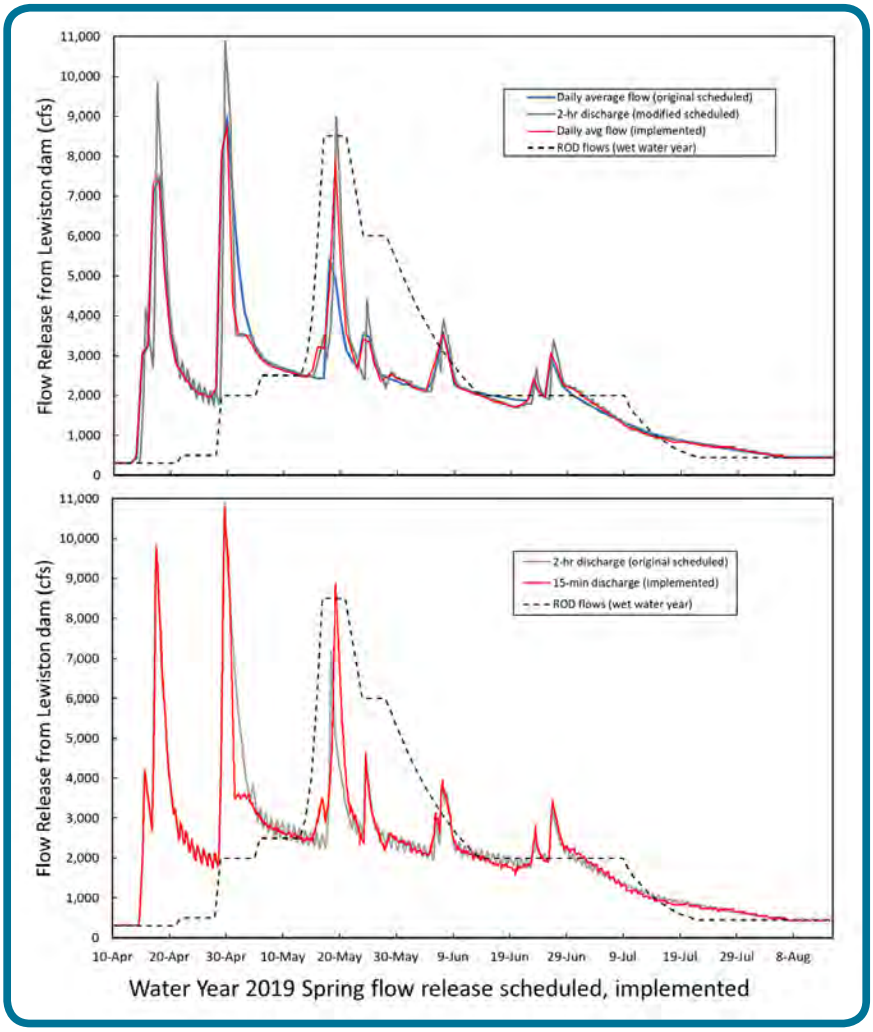

Figure 11. Daily average and sub-daily flows scheduled for the spring flow release period in WY2019. The modified flow schedule was implemented to enable repair of outlet works for Trinity and Lewiston Dams that were damaged during the peak flow release and is also shown along with implemented flows at the U.S. Geological Survey (USGS) gage at Lewiston (USGS #11525500) and the ROD wet hydrograph for comparison.

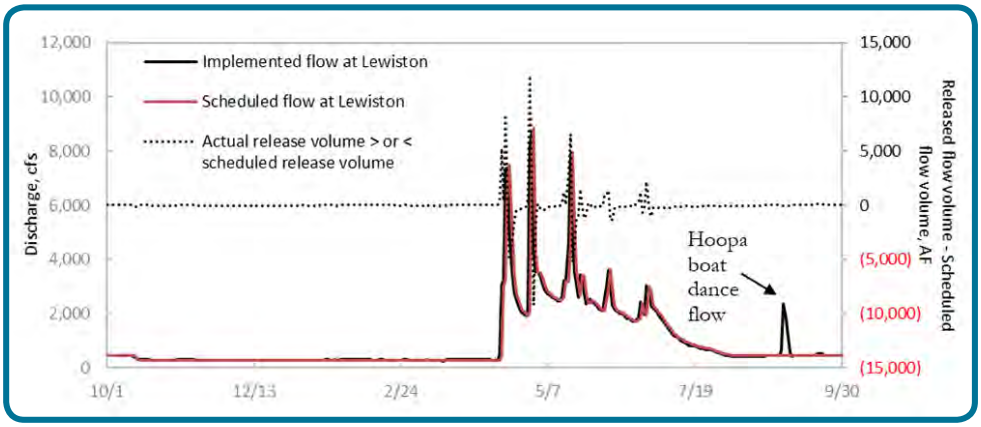

Figure 12. Plots of the TMC recommended flow release (red line) and the implemented flow (black line), which includes the Hoopa Boat Dance. The dotted line indicates how closely the implemented releases matched the schedule flow releases (i.e., the volume of water in acre-feet [af] that is released to the Trinity River in excess or above that targeted on a cumulative daily basis [values in parenthesis on right vertical axis]).

—Restoration Releases continued

The approved daily average flow schedule for the wet WY was a modification of the wet water year hydrograph prescribed in the ROD (Figure 11). Changes from the ROD hydrograph were to:

- elevate flows at the beginning of the release to disperse steelhead (*O. mykiss*) smolts released from Trinity Hatchery in this period,
- provide variable flows that increase habitat diversity and benefit fish and other organisms in stream channels,
- maximize the variability in shear stress to increase sediment transport and bed scour,
- variably inundate floodplain areas to recruit nutrients to the channel, and
- slightly elevate flows in early June to disburse Chinook Salmon fingerlings that volitionally migrate from Trinity Hatchery in this period.

Flow Release Rates from Lewiston Dam

Figure 12 shows the daily average WY2019 flow releases from Lewiston Dam to the Trinity River, based on the Lewiston gage (USGS #11525500). In early September, Reclamation released flows above the baseline 450 cfs in summer to accommodate the Hoopa Boat Dance. Except for the Boat Dance flows, all other discharges were released for river restoration purposes (TMC recommended TRRP restoration flow release).

Restoration Flow Schedule

Outcome of Hydrograph Implementation

In addition to showing actual water releases, Figure 12 in the previous section compares the releases from Lewiston Dam to the TMC-specified release schedule, as measured by the Lewiston gage (USGS #11525500). Central Valley Project operations quite accurately implemented the allocated flow volume despite difficulties with Trinity and Lewiston Dams. Of the 701,000 af allocated for the wet water year, 703,093 af was released to the Trinity River for restoration purposes—an average of only +0.3%.

Temperature Targets and Compliance

Temperature targets are specified for three locations on the Trinity River to help ensure Lewiston Dam releases benefit—and do not detract from—the health of adult and juvenile salmonids. River temperature is measured at Douglas City and above the confluence with the North Fork Trinity River to meet regulatory compliance targets specified in State Water Resources Control Board (SWRCB) Order WR 90-5 (SWRCB 1990). The TREIS/EIR added targets for Douglas City and Weitchpec to aide juvenile salmonids in their downstream migration to the Klamath River (Table 3).

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Table 3. Trinity River Temperature Targets by Reach and Date

Source	Target Reach	Dates	Target
Basin Plan for the North Coast Region (North Coast RWQCB 2011)	Lewiston to Douglas City	July 1–September 14	≤60 °F (15.5 °C)
	Lewiston to Douglas City	September 15–30	≤56 °F (13.3 °C)
NMFS (2000) and WR 90-5 (SWRCB 1990)	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 & Wetter Water Years — Optimum**	
		Mid-April–mid-May	≤55.4 °F (12.8 °C)
		Late May–early June	≤59.0 °F (15.0 °C)
		Early June–early July	≤62.6 °F (17.0 °C)
		Dry & Critically Dry Water Years — Marginal	
		Mid-April–mid-May	≤59.0 °F (15.0 °C)
		Late May–early June	≤62.6 °F (17.0 °C)
		Early June–mid-June	≤68.0 °F (20.0 °C)

*2019 was a wet water year
NMFS = National Marine Fisheries Service (now NOAA Fisheries)
ºF = degree Fahrenheit
°C = degree Celsius

—Restoration Flow Schedule continued

The Weitchpec temperature target is designed to provide optimal temperatures in normal or wetter years and marginal temperatures in dryer years, based on fish studies. (Temperature targets are specified for three locations on the Trinity River to help ensure Lewiston Dam releases benefit—and do not detract from—the health of adult and juvenile salmonids. River temperature is measured at Douglas City and above the confluence with the North Fork Trinity River to meet regulatory compliance targets specified in State Water Resources Control Board (SWRCB) Order WR 90-5 (SWRCB 1990). The TREIS/EIR added targets for Douglas City and Weitchpec to aide juvenile salmonids in their downstream migration to the Klamath River

The Hoopa gage (USGS #11530000) is roughly 12 river miles (rm) (19.5 river kilometers [rkm]) upstream of Weitchpec. The Hoopa gage is used mostly in late summer when temperatures need to be monitored more closely. Figure 13 shows water temperatures and temperature targets at Weitchpec during the juvenile Chinook Salmon outmigration period (mid-April to early July) for the wet water year. Reclamation measures air temperatures and USGS measures water temperatures at Hoopa, and water temperatures at Weitchpec are measured by the USFWS, but these data are not available during the water year for monitoring temperature compliance in the lower river. Instead, compliance at Weitchpec is monitored with real-time data from the flow and water temperature monitoring station at Hoopa (USGS #11530000) after adjustment for heating that occurs between these stations. Due to a malfunction, temperatures were only measured at Hoopa from June 7 - September 30, which includes 33 days of the 79-day compliance period. Note that the temperature monitoring that occurs at the gage was only functioning for 33 days during the compliance period. The flow portion of the gage worked throughout during the compliance period. In the period that data were available, temperature criteria were met 50% of the time (16 of 33 days).

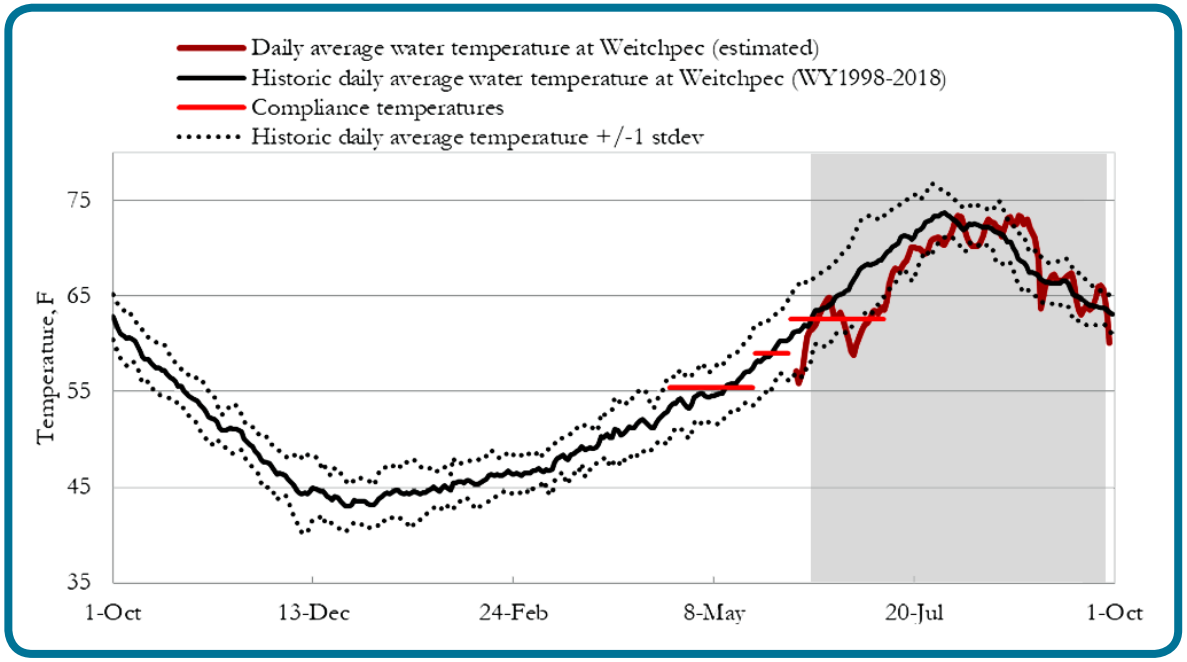

Figure 13. Daily average water temperatures for the Trinity River at Weitchpec and the historic daily average and range (+/- 1 standard deviation) of daily temperatures for the period of record (WY 1998-2018). Note that gray bar indicates when temperatures were only measured at Hoopa.

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.

In WY2019, water temperature targets at Douglas City were met for the entire period that data were available. However, gaps in data collection at Douglas City occurred July 30 through September 17, when some of the hottest air temperatures in summer occurred. Because of this, targets may have been exceeded in this period at this station, but it is unknown to what degree. Except for the period when data were not available, water temperatures remained below historic daily average values at this station after February 1 for the rest of the water year (Figure 14).

—continued

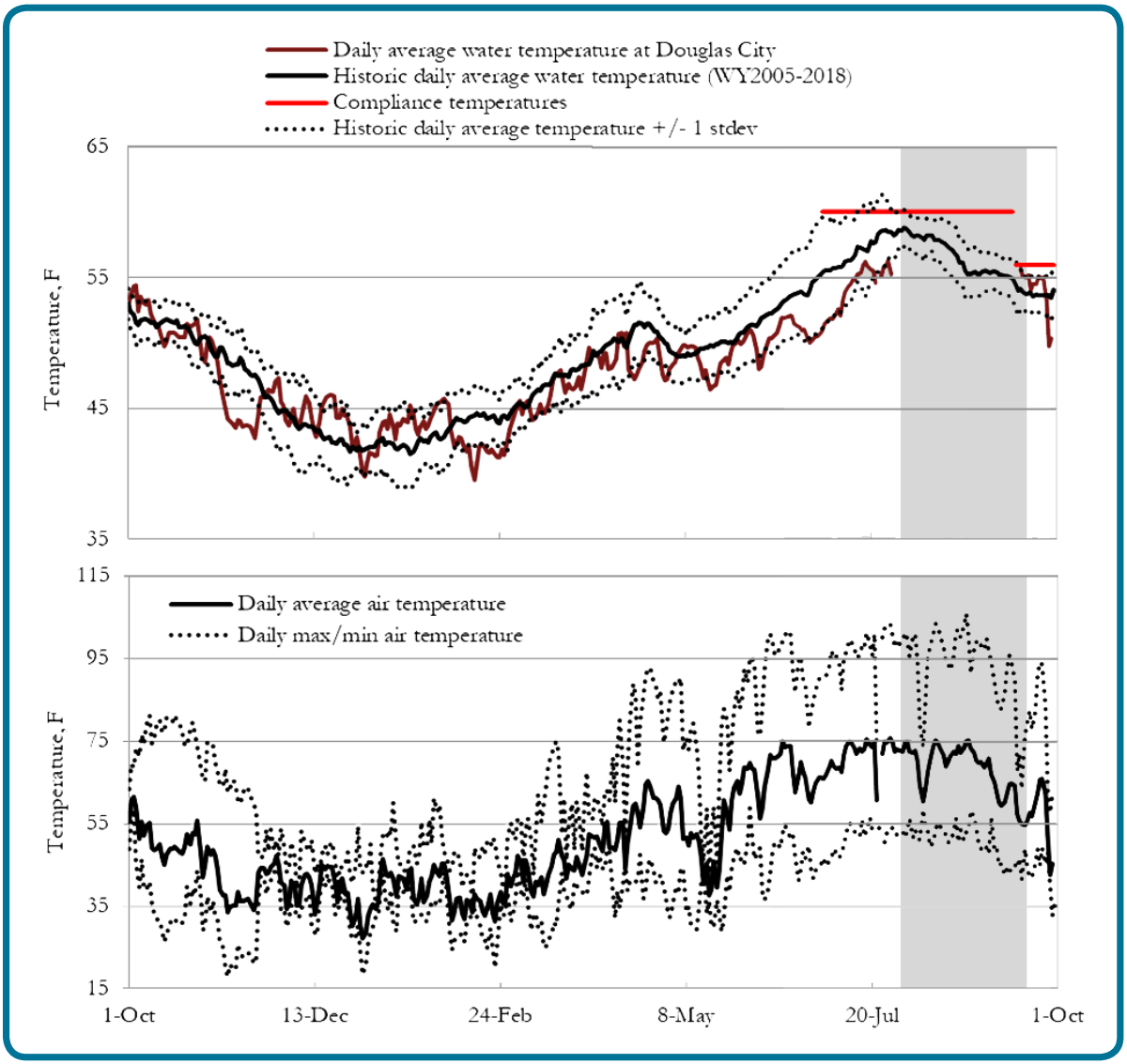

Figure 14. Daily average water and air temperature (top) at the Douglas City compliance point. Observed water temperatures are plotted with compliance targets and the average and range of daily temperatures for the period of record (WY 2005-2018). The daily average, maximum, and minimum air temperatures at Douglas City for WY 2019 are shown in the bottom panel.

—Restoration Flow Schedule continued

Water Volume Accounting

Table 4 lists flow releases in 2019. Implemented restoration volume (703,093 af) and the scheduled volume for river restoration (701,000 af) differed by 0.3%, which is less than the ±10% accuracy of the stream gage record. Therefore, the volume of the restoration flow releases was equivalent to the allocated volume when measurement error is considered.

Table 4. Flow Releases in WY2019

Flow release	Acre feet
The total volume of water released from Lewiston Dam to the Trinity River	711,483
Water released to the Trinity River for restoration purposes	703,093
Water released to the Trinity River for Hoopa Boat Dance	8,390
Water exported from the Trinity River basin via Clear Creek Tunnel	424,385

Reclamation exported 424,385 af of water from the Trinity River to the Sacramento River in WY2019 via the Judge Carr Power Plant. Exports in WY2019 to the Judge Carr Power Plant were approximately 60% of the volume of water released to the Trinity River for restoration purposes (Table 4). A summary of restoration releases and export volumes for WY2001 to 2019 is provided in Table 5, shown on next page.

The full natural flow (FNF) is the quantity of water that would have passed the gage at Lewiston if Trinity and Lewiston Dams and other diversions or impedances had not been in place. In WY 19, the FNF was 1,696,623 ac-ft, and Trinity Lake gained thousands of acre feet of storage.

Reservoir Conditions

Water year 2019 began October 1, 2018 with Trinity Reservoir holding 1,497,500 af (61% of capacity) and a water surface elevation of 2,303 feet above mean sea level (msl) (Figure 15). The water year ended September 30, 2019 with Trinity Reservoir holding 2,042,900 af (83% of capacity) at 2,344 feet mean sea level (msl). The total release from Trinity Reservoir in WY2019 was 1,135,868 af, which is 67% of the WY2019 full natural flow (FNF) at Lewiston (1,696,623 af). Total evaporation from Trinity and Lewiston Reservoirs was 49,216 af in WY2019.

Current elevations of the water reservoir at Trinity Lake are available on www.trrp.net/restoration/flows/lake-conditions/.

Table 5. Water Releases and Diversions as a Percent of Long-Term Average Inflow. Percentages above or below 100% are possible due to changes in reservoir storage across water years.

Water Year and WY Designation	Restoration Releases to the Trinity River	Diversions to the Sacramento River	All Other Releases to the Trinity River[1]	Total Releases and Diversions
2001 – Dry	30.3%	53.4%	0.3%	84.0%
2002 – Normal	38.5%	50.2%	0.0%	88.7%
2003 – Wet	35.7%	68.4%	8.6%	112.7%
2004 – Wet	51.9%	78.7%	9.4%	140.0%
2005 – Normal	51.6%	37.2%	0.3%	89.1%
2006 – Extremely Wet	64.6%	107.7%	32.4%	204.7%
2007 – Dry	36.2%	49.0%	0.3%	85.5%
2008 – Normal	51.7%	44.3%	0.0%	96.0%
2009 – Dry	35.5%	43.0%	0.9%	79.4%
2010 – Normal	52.4%	21.9%	0.0%	74.3%
2011 – Wet	57.6%	37.7%	0.9%	96.1%
2012 – Normal	51.6%	56.6%	3.1%	111.3%
2013 – Dry	36.0%	68.0%	2.3%	106.3%
2014 – Critically Dry	29.5%	49.3%	5.2%	84.0%
2015 – Dry	35.9%	35.9%	4.6%	76.4%
2016 – Wet	56.5%	22.2%	3.1%	81.9%
2017 – Extremely Wet	55.0%	42.1%	3.0%	100.1%
2018 – Critically Dry	30.0%	31.1%	2.7%	63.9%
2019 – Wet	**41.4%**	**25.0%**	**0.49%**	**66.95%**
Average (2001 - 2019)	42.13%	48.51%	4.08%	96.91%
Five Year Average (2015 - 2019)	43.77%	31.26%	2.78%	77.85%

[1]Includes Trinity Reservoir storage management releases, supplemental flow releases for the lower Klamath River, and tribal ceremonial releases to the Trinity River.

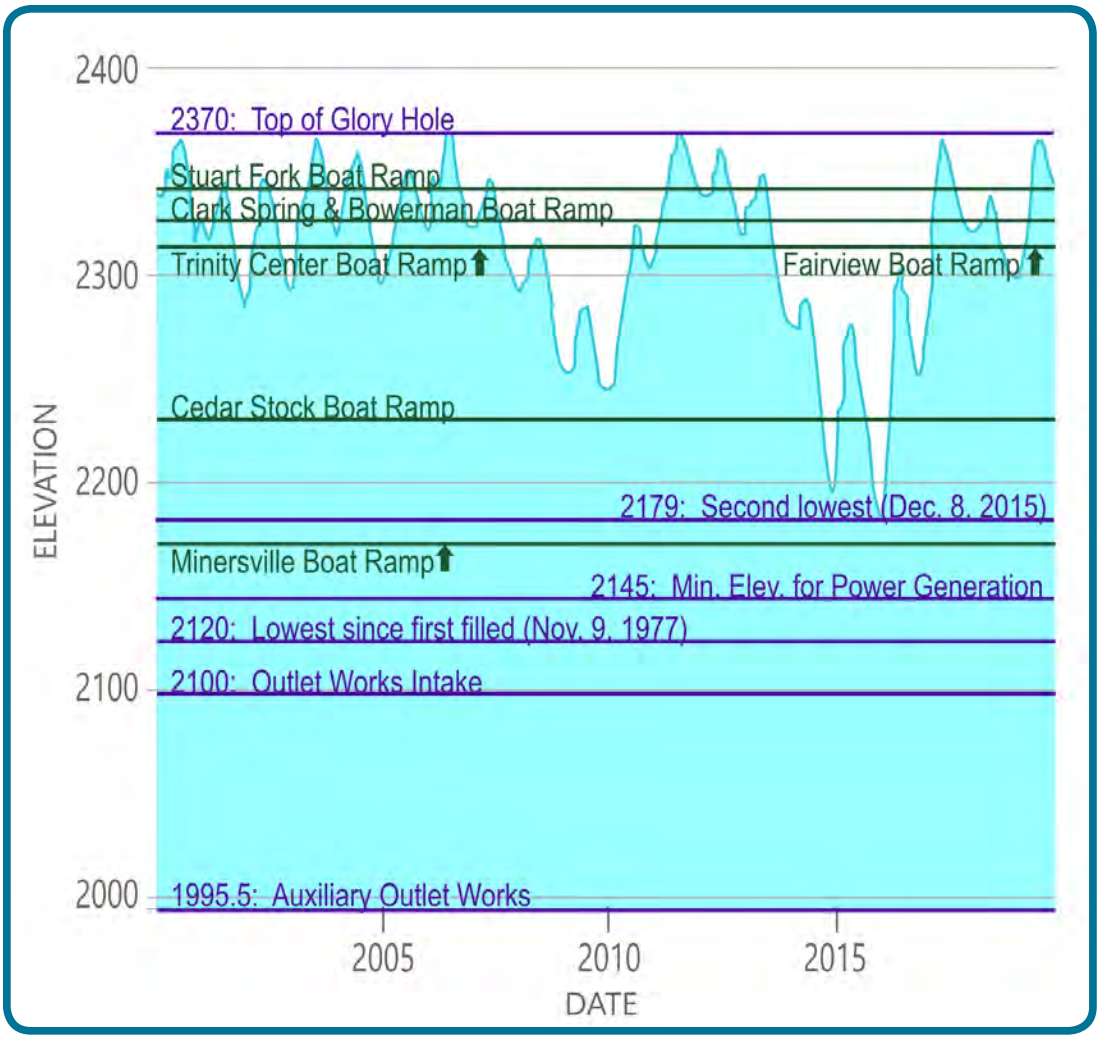

Figure 15. Elevation levels for Trinity Lake.

Design Work Group

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.

In 2019 the work group reviewed design reports for Dutch Creek (80%), Sky Ranch (60%), and Oregon Gulch (60%) and discussed existing conditions and ideas for upcoming projects. After heavy storms in 2019, work group members evaluated data collected within the Deep Gulch-Sheridan Creek project after restoration flows receded. These evaluations will inform subsequent designs and implementation actions.

The joint efforts by Yurok Tribe and Hoopa Valley Tribe provided invaluable support throughout the 2019 construction season.

Mechanical Channel Rehabilitation

Chapman Ranch Phase A Channel Rehabilitation

The Chapman Ranch Phase A project site was constructed in the summer and fall of 2019 to promote erosion, deposition, and seasonal floodplain inundation; increase channel complexity; and enhance riparian and wetland areas to expand habitat for salmon and steelhead (Figure 16 and Figure 17 on the next pages). The project was one of the more complex channel rehabilitation efforts undertaken by the Program, with over 122,000 cubic yards of material excavated. Three new mainstem river meanders were created in conjunction with extensive floodplain lowering and large wood placement to enhance in-channel and off-channel habitat and promote natural river processes.

The project included:

- Lowering areas of the floodplain to increase connection to the river at a greater range of flows to improve rearing habitat for young salmon
- Shifting the main channel into new meanders and constructed bar features to redistribute slope and raise channel complexity and salmon spawning habitat
- Constructing side-channels and off-channel habitat where young salmon have better cover and shallow water feeding habitat
- Installing large wood structures to increase juvenile fish-rearing areas, provide habitat variability, and enhance vegetation grown outside the banks of the river (Figure 18)
- Revegetating construction disturbed upland and riparian areas to create a healthy river ecosystem for fish and wildlife

Figure 18. Example of the dredge mine tailings piles in the upland areas of the Chapman Ranch site (Reclamation).

Reclamation and the Bureau of Land Management (BLM), Federal co-lead agencies on the project, and the North Coast Regional Water Quality Control Board (RWQCB), the state lead agency under the California Environmental Quality Act (CEQA), worked throughout 2017 and 2018 to permit the Chapman Ranch Phase A channel rehabilitation project for the 2019 construction season.

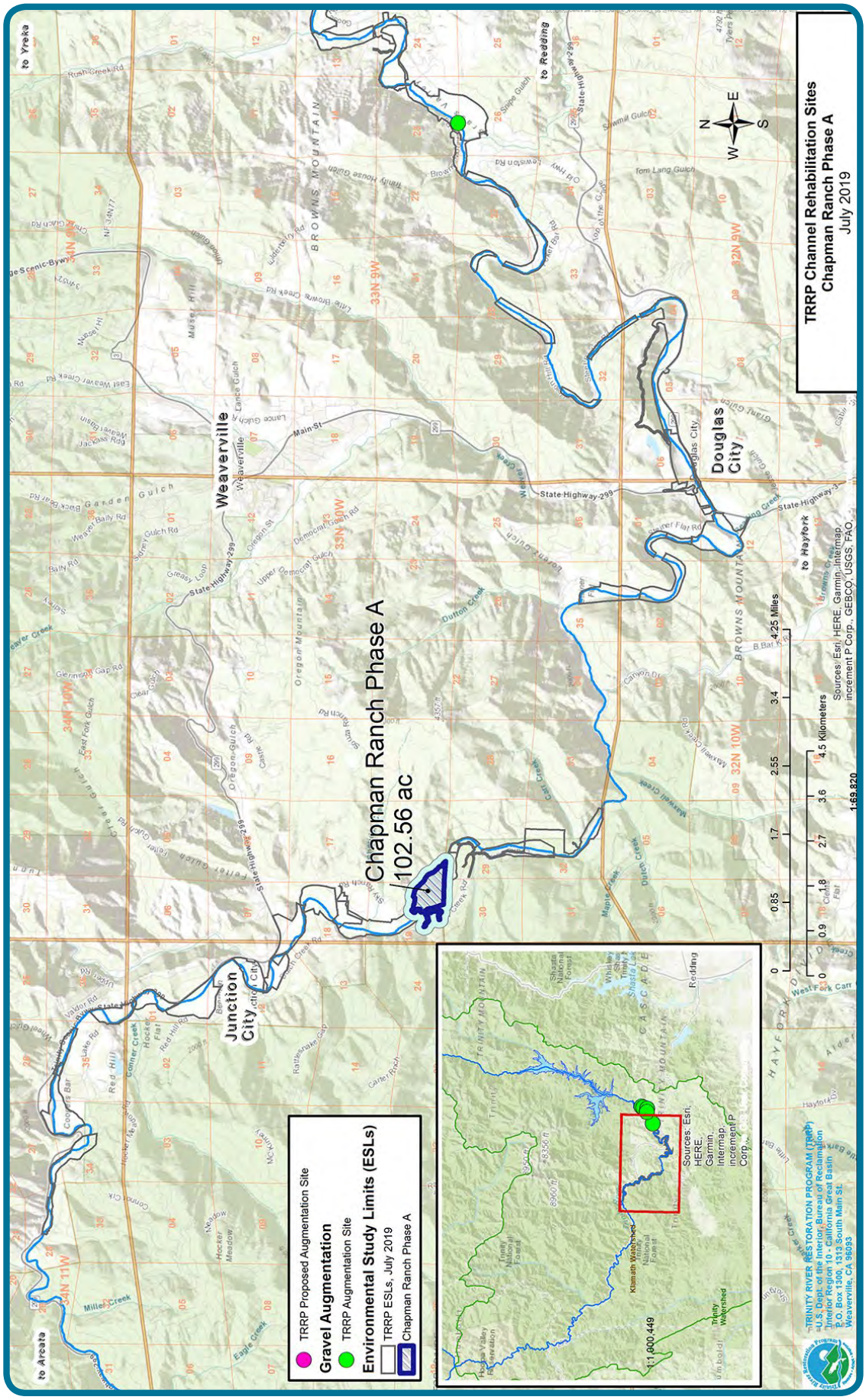

Figure 16. A pre-dam channel and a restored post dam channel Chapman Ranch Phase A. (Image provided by McBain Associates)

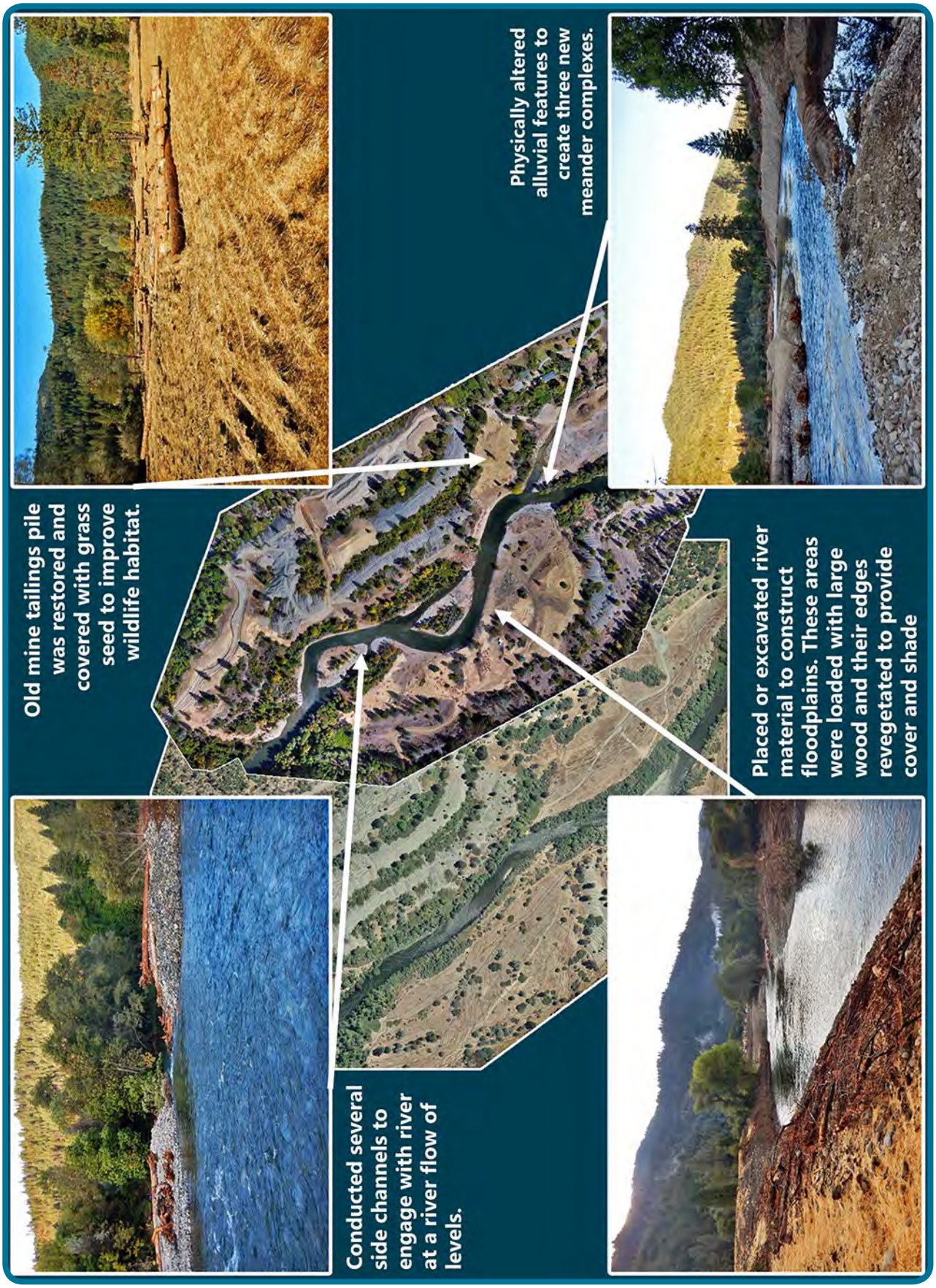

Figure 17. Large wood structures are designed using hydraulic modeling to promote natural river processes and field-fit at the construction site (Reclamation).

Channel Rehabilitation Design Objectives

TRRP design objectives are separated into three categories: physical, biological, and riparian.

Physical (Geomorphic/Flow)

Figure 19. Example of the dredge mine tailings piles in the upland areas of the Chapman Ranch site (Reclamation).

- Promote dynamic river processes (scour/deposition, width changes, lateral migration, sinuosity, etc.)
- Reduce mine dredge tailings piles on the floodplain by sorting and using the materials for the gravel bar construction (Figure 19)
- Promote fine sediment deposition on floodplain and low bench surfaces
- Create multi-threaded, chute, and side channels where geomorphic conditions are appropriate for a multi-channel morphology
- Use mainstem, tributary, valley wall water sources, and perched groundwater to reduce excavation to develop functional floodplains capable of natural riparian recruitment, as well as benefit natural and constructed off-channel habitats
- Create annual or seasonal surface water connection to existing water features
- Reduce mainstem wood storage deficit (dynamic wood structures and standing inventory)
- Inundate the floodplain at multiple elevations across the project with mainstem flows ranging between 1,500 and 7,155 cfs

Biological

- Increase and sustain fry rearing habitat area across a range of flows (January 1 through April 30)
- Increase lateral and longitudinal connectivity of fry/juvenile rearing habitat (January 1 through April 30) and pre-smolt/smolt habitat (April 1 through June 30)
- Increase area of vegetated surfaces experiencing 14 consecutive days or more of continuous inundation during normal and wet years for fry/juvenile rearing (January 1 through April 30)
- Increase area of vegetated surfaces experiencing continuous inundation for a duration of 14 days or more during normal and wetter years for pre-smolt and smolt rearing (April 1 through May 31)
- Enhance existing amphibian habitat (facilitate local warming in channel margin habitats to improve existing populations and breeding use)

Riparian

- Preserve patchy existing multi-story riparian vegetation and cottonwoods
- Increase surfaces providing more days of moist soils within one foot of the ground surface during seed dispersal (April 1 through June 30) in normal and wetter years for natural riparian regeneration, especially near local cottonwood seed sources
- Revegetate constructed floodplains and benches with native woody riparian, conifers, and understory species

Site Characteristics

The Chapman Ranch Phase A channel rehabilitation project site begins approximately three miles upstream of Dutch Creek Road bridge in Junction City (Figure 16). The project area encompasses 103 acres of land: 81 acres is managed by BLM and 22 acres is privately owned.

Salmonid habitat and other aquatic and riparian habitat for other species was impaired throughout the reach by a legacy of hydraulic mining, dredger mining, and past flow regulation (Figure 19).

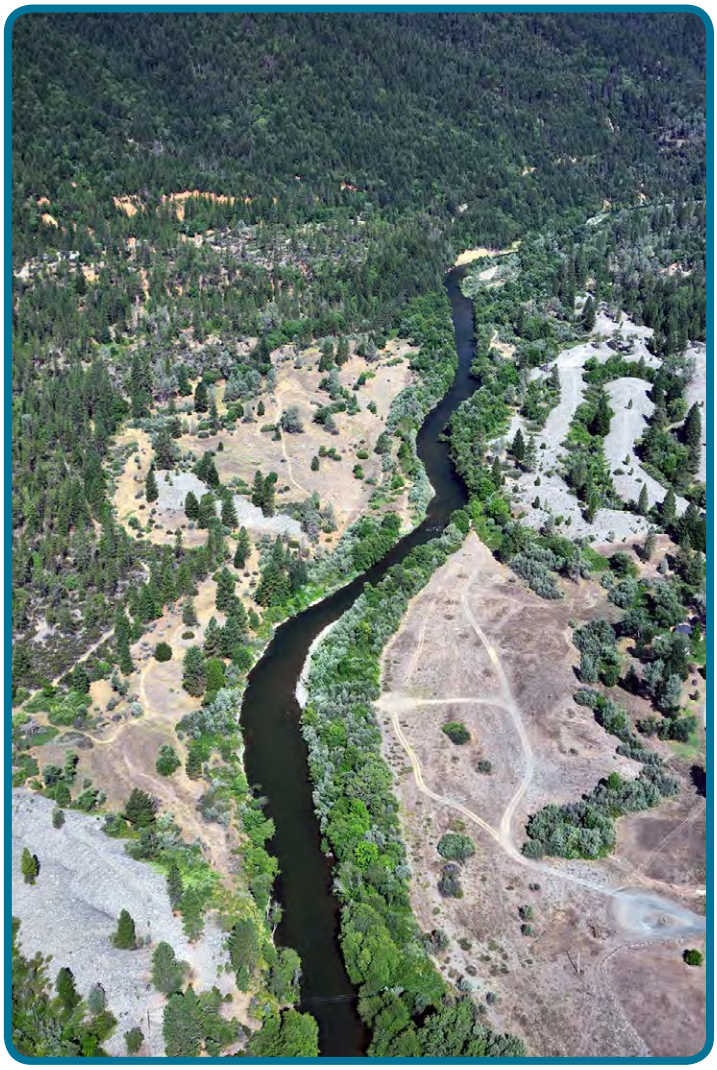

Figure 20. Historic mine dredge tailings and hydraulic mine scars are visible at the Chapman Ranch Phase A channel rehabilitation project area photographed in August 2016. (Photo by Ken DeCamp for Reclamation)

Initial Concept

The wide valley width and minimal infrastructure within the project reach presented a unique opportunity to take a relatively aggressive restoration approach (Figure 20). The project was designed to create salmonid habitat while also ensuring that habitat quantity and complexity increase as the alluvial processes of the Trinity River are enhanced.

The design struck a balance between hard and soft methods for restoring aquatic and riparian habitat and provided the river opportunities to express dynamic processes that existed before Lewiston Dam was completed, while on a smaller scale than pre-dam conditions. This strategy allowed for immediate and dramatic improvements in salmonid habitat for all life stages by creating large areas with suitable flow depth, velocity, and cover. Additionally, riparian ecosystem health and floodplain connectivity was improved by increasing the frequency and duration of inundation in critical areas.

Figure 21. Members from various partner and cooperating agencies visit the Chapman Ranch Phase A project site during construction in 2019 (Reclamation).

Figure 22. The revegetation work at Chapman Ranch Phase A site will continue for several years and is implemented and monitored by the Hoopa Valley Tribe.

Rehabilitation Design Process

From 2011 to 2018, 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. The TRRP and the design group reached out to local landowners and the riverine community during the planning process to discuss and evaluate design elements and measures that best met the project goals and objectives. This structured design process helped to foster better communication and transparency—and created an environment that allowed for new ideas and recommendations (Figure 21).

Rehabilitation Activities

The activity areas for the Chapman Ranch Phase A channel rehabilitation are described in detail in the Final Environmental Assessment/Initial Study (EA/IS) for the site (North Coast RWQCB et al. 2017). The 2019 rehabilitation project was designed to increase channel length, sinuosity, and complexity from the existing conditions to enhance juvenile and adult salmon habitat. A newly constructed meander complex created opportunities for future actions to add spawning gravel, encourage channel migration, and rework old dredge tailings to increase the hydraulic complexity of the reach in both the near-term and long-term. The project also constructed large wood hydraulic and habitat structures and removed or replaced riparian and upland vegetation at strategic locations.

Civil construction work was largely completed in October 2019, and revegetation efforts continued at the site into the winter, with potential maintenance for several more years to come (Figure 22). The original Chapman Ranch project was split into two distinct phases to be able to implement each phase within a single year. The two phases were designed to function independently so that Phase A would still substantially improve habitat even if Phase B is not constructed. Phase B is comprised of additional meander sequences, floodplain lowering, and side-channels to be built in coming years (Figure 23).

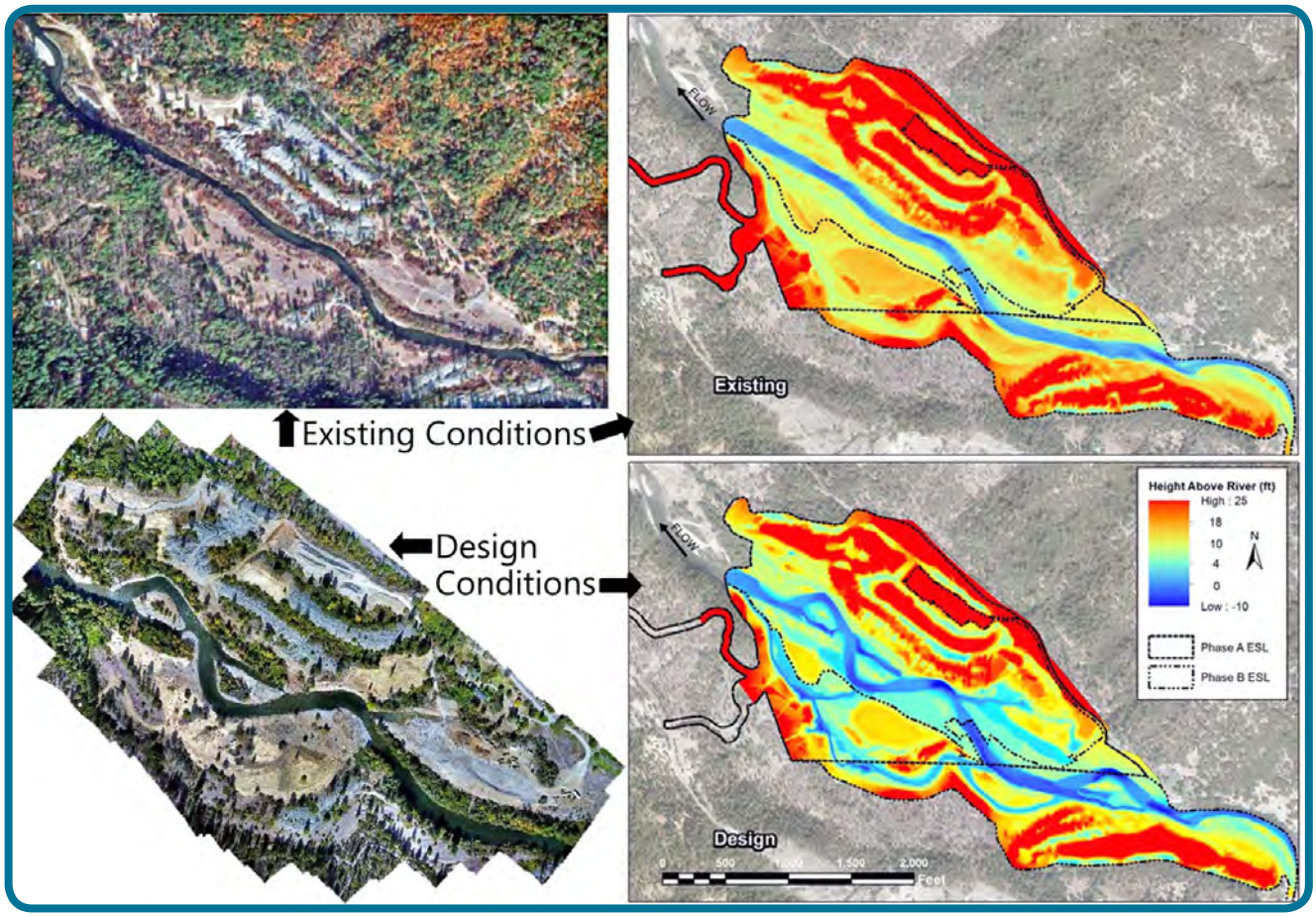

Figure 23. The 2019 project increased river complexity as seen through the model for changed river elevations in the upper portion pre-design and lower portion with design conditions. The lower right portion includes Phase B design plans (delineated by dashed black line) of the Chapman Ranch project.

Completing this phase of construction at the Chapman Ranch site provides significant opportunity for the river to reoccupy floodplain area from which it has long since been isolated. It also represents a significant milestone for our tribal partners in their effort to gain capacity to lead restoration construction efforts through the basin. This year was the first TRRP project in which nearly all the equipment operators and laborers were enrolled tribal members (Figure 24).

Figure 24. The Chapman Ranch Phase A construction crew had daily safety meetings before beginning work each day at the site. (Photo by Aaron Martin, Yurok Tribal Fisheries Program [YTFP]).

Physical Work Group

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.

In 2019, the group developed a strategy for modifying the planning and implementation of gravel augmentation projects and developed gravel augmentation and monitoring recommendations for the Spring 2019 flows. In the coming year, the work group expects to receive several synthesis reports (coarse sediment, fine sediment, channel complexity) that will support development of broader, global objectives and targets.

Coarse Sediment Management

Trinity and Lewiston Dams not only trap water but also the supply of sediment from areas upstream of Lewiston Dam. To replace the coarse sediment trapped behind the dams and to balance sediment supply and transport rates, the ROD directs a coarse sediment (gravel) augmentation program below Lewiston Dam. High-flow releases are used together with gravel augmentations to increase the availability and quality of physical habitat in the river channel by promoting scour and fill processes that maintain bars, pools, juvenile rearing habitat, spawning beds, and other elements of channel complexity. As with flow management, optimizing the gravel management strategy through applied science is an ongoing priority.

A total of 3,500 cubic yards of coarse sediment at two locations on the upper river was introduced into the river channel on three separate dates before the peak releases (daily mean discharges of 9,850 cfs on April 17; 10,800 cfs on April 29; and 9,000 cfs on May 19). Approximately 60% of the sediment was placed in the river at the Sawmill gravel injection site on BLM-managed land about three miles downstream from Lewiston Dam on April 11-12, April 25-26, and May 17 (Figure 25). The remainder of the sediment volume was placed in the channel at Lowden Ranch about six miles downstream from the dam on April 11-12 and on April 24-25. At both locations, the peak flows that followed gravel placement redistributed the sediment throughout the stream reach.

Figure 25. Gravel augmentation at the Sawmill gravel injection site on April 25, 2019 before the peak release on April 29.

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. Congress directed the Secretary of the Interior to take appropriate actions to maintain and propagate such wildlife.

Conventional TRRP monitoring for wildlife and riparian vegetation paused during 2019, while researchers took time to assess data in several draft synthesis reports as part of a programmatic effort to use long-term data sets to answer long-standing questions. The riparian encroachment synthesis report has been peer-reviewed and is forthcoming (HVT and McBain Associates 2020, in prep). The cottonwood seed dispersal synthesis report has been peer-reviewed and finalized (Bair et al. 2020).

Flow Scheduling for Riparian Vegetation

Riparian vegetation, such as black cottonwood (*Populus trichocarpa*), provides numerous benefits to fish as a source of cover, shade, and food for the insects that fish eat, as well as an important source of large woody debris for the river to scour or deposit sediment around. Riparian vegetation also provides habitat elements for songbirds and other wildlife species and is an important component of the Program's strategy to restore natural processes (Figure 26).

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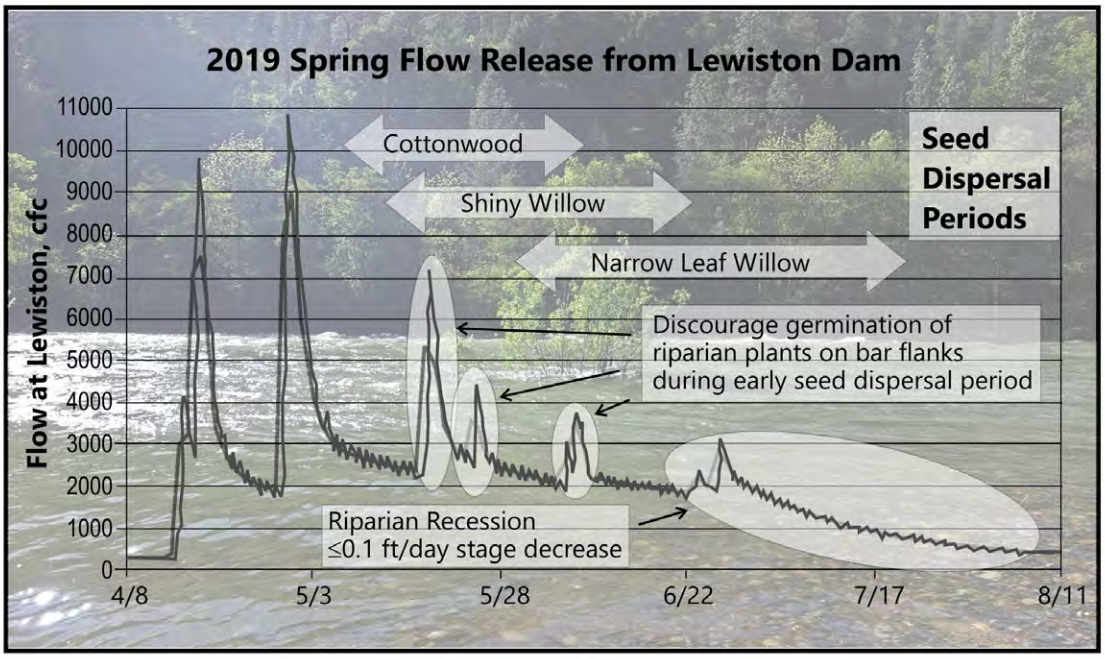

Figure 26. The Flow Work Group uses the TARGETS model to design hydrographs that will promote TRRP's vegetation objectives.

—Flow Scheduling for Riparian Vegetation continued

Planting cottonwoods, willows, and other species at individual channel rehabilitation sites is a very visible method of promoting vegetation. In addition to revegetation methods at channel rehabilitation sites, the TRRP also uses managed 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 (Figure 27). This model, first created in the early 2000s, was updated in 2018 and applied during flow scheduling in 2019.

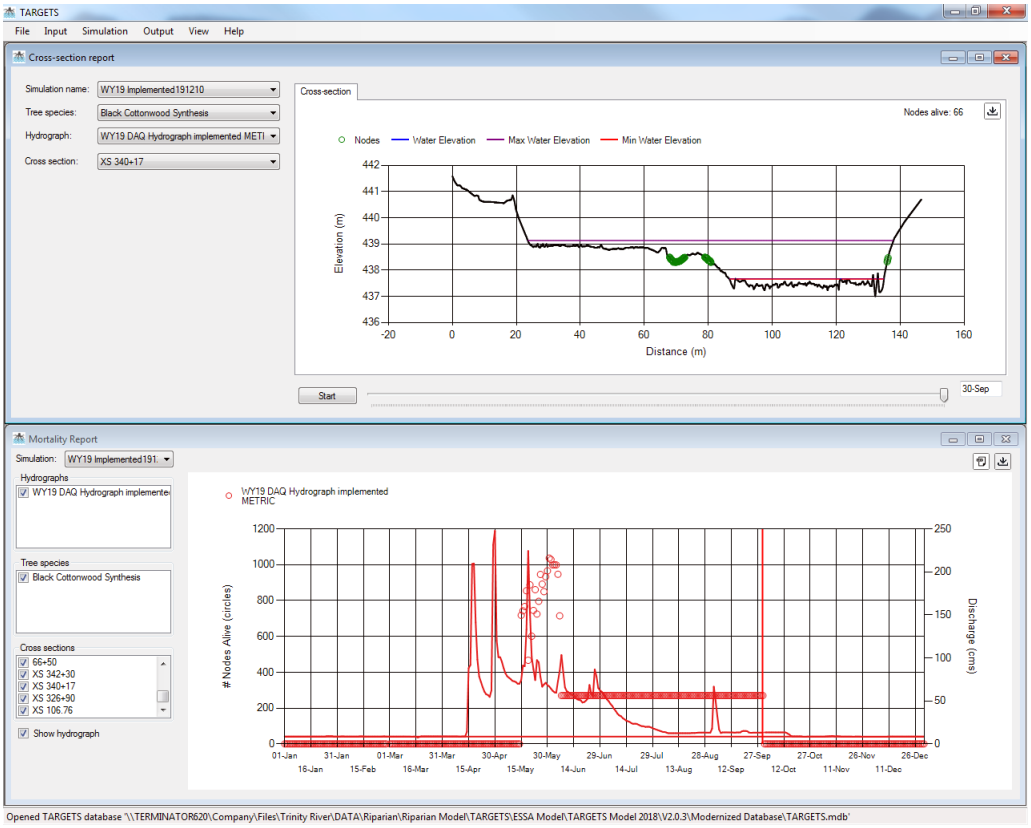

Figure 27. Example of output from TARGETS used to evaluate the potential of flow release schedules to allow black cottonwood seedlings to become established. The green circles represent locations on the selected cross section where establishment is predicted by the TARGETS model.

Black Cottonwood Seed Dispersal Period

For successful black cottonwood recruitment, the flow peak needs to occur before the seed dispersal period, the seeds need to fall on suitable surfaces, and the water surface needs to recede slowly enough that the seedling roots can track the water table as it sinks to its late-summer level. In addition, the flows need to interact with appropriate surfaces for riparian vegetation to become established. The TRRP sets the timing of spring floods and creates suitable riparian nursery sites by moving sediment with heavy equipment during channel rehabilitation projects to promote the natural recruitment of black cottonwoods.

Black cottonwood seed dispersal periods have been monitored to synchronize the timing of spring ROD releases to the dispersal period to enhance germination. To facilitate black cottonwood recruitment through peak release timing, TRRP researchers synthesized seed dispersal data from the years monitored (i.e., WY2004, WY2015, WY2016, WY2017, and WY2018) to identify a targeted seed dispersal period that could be used annually, regardless of water year type (Bair et al. 2020). Seed dispersal occurred between April 19 and July 3 during five years of monitoring (Figure 28). Sometimes seed dispersal occurred earlier within this broad window (in 2004, 2015, and 2016), and sometimes later (in 2017 and 2018). Therefore, further analyses were conducted to refine the broad seed dispersal window into a target seed dispersal period for annual flow release planning. Survey weeks 10 and 11 (May 15 to May 28) had the highest median seed dispersal, and seed dispersal for all trees always occurred during these two weeks (Figure 29). Therefore, these two weeks May 15 to May 28 were recommended as the black cottonwood target seed dispersal period for annual flow release planning. The target seed dispersal period corresponded well to TMC-approved hydrographs for WY 2015 through WY 2018 (Figure 30 on the next page).

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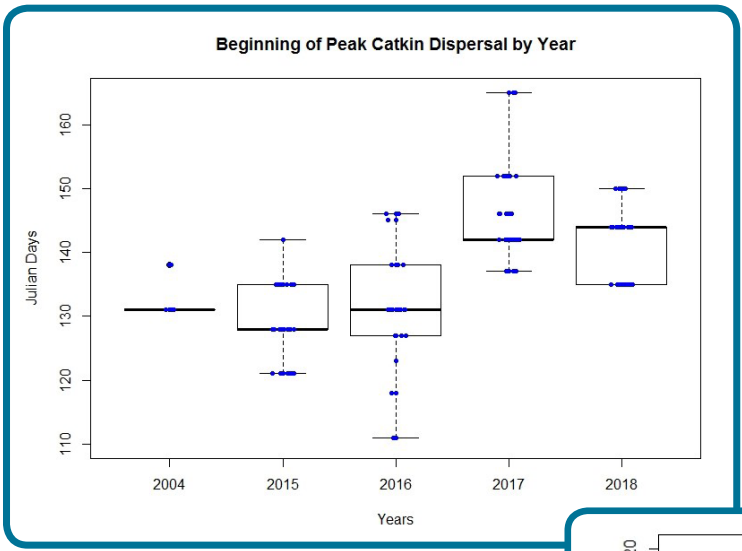

Figure 28. Box plots of Julian date when peak seed dispersal occurred during each year surveyed. Junction City was the only site monitored in 2004. Blue dots are the peak dispersal Julian date for an individual tree. The upper and lower limits of the box are the first and third quartiles (25th and 75th percentiles, respectively). The dark lines represent the median of peak seed dispersal timing, the whiskers are the bounds of the minimum and maximum values. Julian day 110=April 19, 120=April 29, 130=May 9, 140=May 19, 150=May 29, 160=June 8, during a non-leap year.

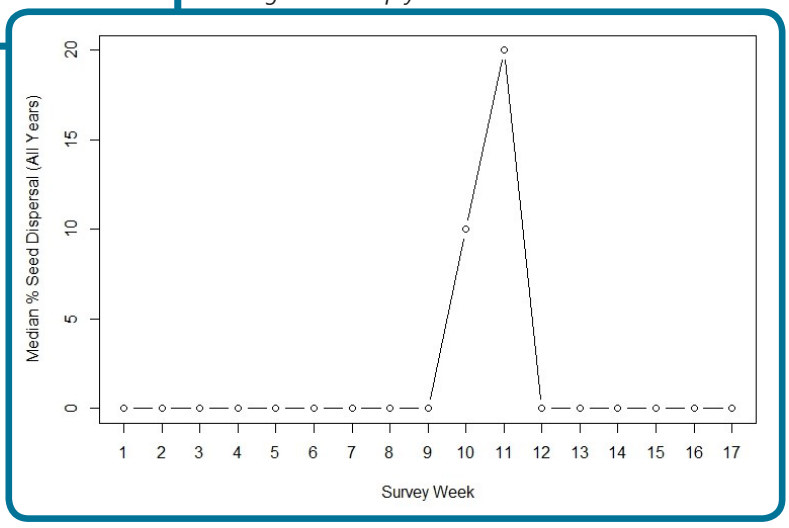

Figure 29. The median percent dispersal of each week for all years combined plotted against survey week. Survey weeks 10 and 11 corresponded to May 15-28 and were used to define the target black cottonwood seed dispersal period for annual flow release planning.

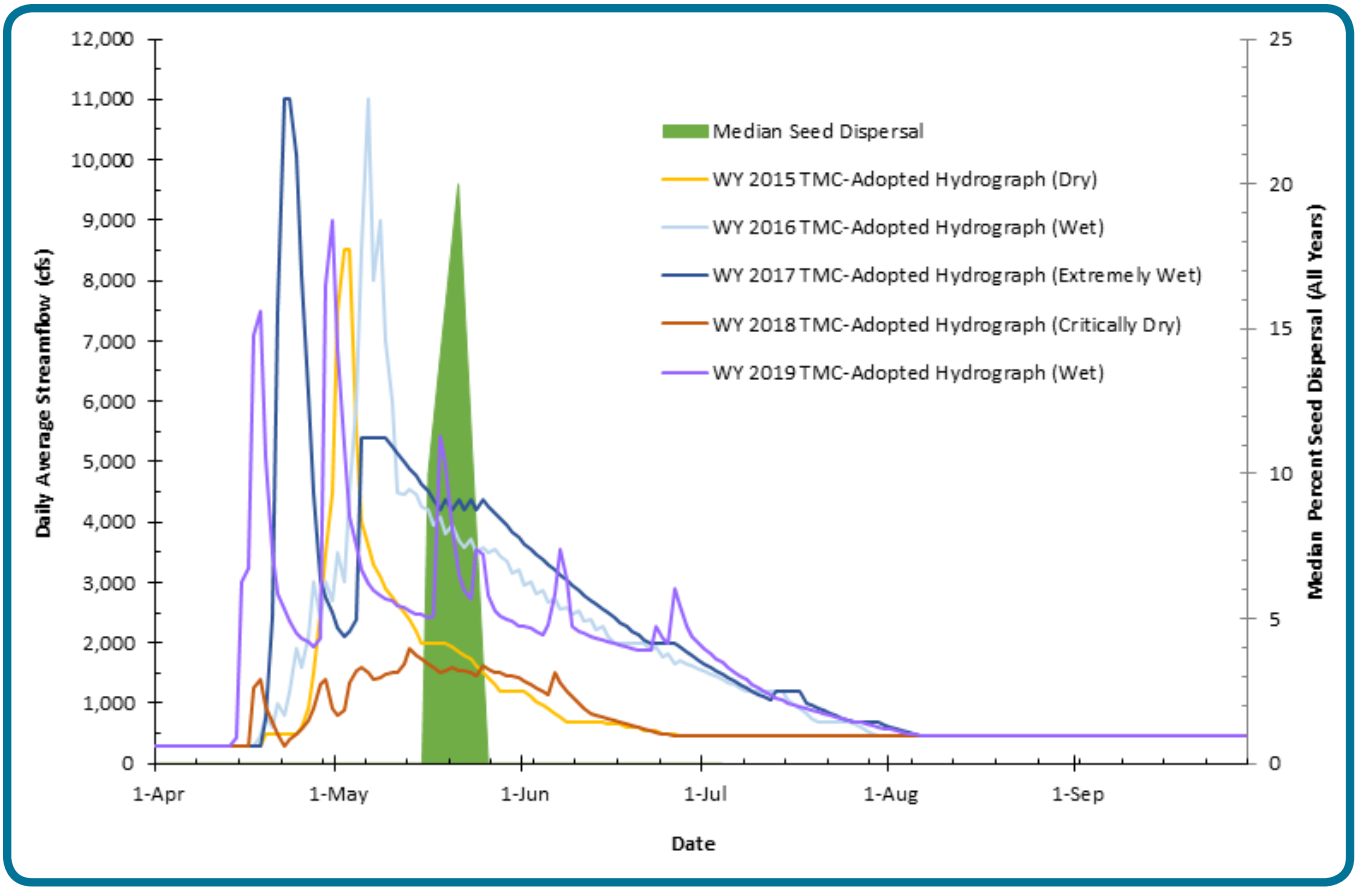

Figure 30. Median seed dispersal period for all years combined overlaid onto the TMC approved hydrographs for WY 2015 through WY 2019. Flow levels are scheduled to be high enough to wet areas for cottonwood seedlings.

—Black Cottonwood Seed Dispersal Period continued

Black cottonwood phenology monitoring (i.e., timing of leaf-out, flowering, capsule formation, and seed dispersal) was continued in 2019. New dispersal data will be incorporated into existing analyses to develop and improve our predictive ability to use seed dispersal timing for annual flow planning.

System-wide response of black cottonwoods to improved riparian streamflows and habitat conditions has been lower than expected. This result could be from a combination of factors, including large-scale mining activities, which reduced the area available for potential cottonwood seed germination as the seedlings need a fairly shallow water table to become established. Dredger mining turned over floodplain soils and washed much of the very fine sediment fraction from the soil in much of the Trinity River valley bottom, which reduced the ability of the soil to hold moisture in many places, which in turn compounded the impact from the hydraulic mining.

Riparian Hardwood Recruitment Monitoring

As stated in the previous section, annual flow release planning described in the Flow Study includes specific measures to promote riparian hardwood establishment on upper bars and floodplains during normal and wetter years. Recent flows were designed to promote moist soils at the ground surface on natural and constructed floodplains (e.g., WY 2016, WY 2017, and WY2019). The WY 2017 release was the largest release from Lewiston Dam since implementing the ROD, which provided conditions most closely resembling the natural large floods that would typically result in widespread episodic recruitment of cottonwoods. The WY 2016, WY 2017, and WY 2019 hydrographs were expected to regenerate cottonwoods, red willows, and shiny willows to establish a richer species assemblage of deciduous hardwoods growing on natural and constructed floodplains. While narrowleaf willows will also regenerate every year, they are not a target species on upper bars and floodplains. The outcome of these hydrographs are measurable areas associated with black cottonwood, red willow, and shiny willow cohorts from 2016, 2017, and 2019.

System-wide monitoring of riparian hardwood recruitment was conducted in fall 2019. Locations for recruitment sampling were selected using a combination of the Generalized Random Tessellation Stratified (GRTS) routine, the 2015 Sediment River Hydraulics two-dimension (SRH-2D) hydraulic model for the 40-mile project reach (Bradley 2016), and the draft 2019 systemic riparian vegetation map (HVT and McBain Associates 2020, in prep). Hardwood seedling occurrences were estimated using abundance classes -visual estimates to characterize seedling prevalence in each polygon (Figure 30). A total of 212 polygons were sampled in four inundation bins (450-1,500 cfs; 1,500 cfs-4,000 cfs; 4,000-5,000 cfs; and 5,000-6,000 cfs), which were defined based on the SRH-2D model.

Preliminary analyses show that eleven species were sampled as seedlings or saplings 4-years and younger (Table 6). Water Year 2018, a critically dry water year, initiated the highest species diversity of any other cohort (n=11 species), with WY 2017 initiating the second highest number of species (n=10 species). Black cottonwood was sampled as young-of-year (YOY), 1-year, 2-year, and 3-year old seedlings, with the highest percent frequency of cottonwood seedlings occurring in WY 2017 (Table 6). Seedling numbers at sample locations were generally low, with 71% of the sampled locations hosting less than 1,000 seedlings (Figure 31 on the next page). Of all species sampled, narrowleaf willow and dusky willow were most frequent, followed by black cottonwood and red willow (Table 6).

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Riparian and Aquatic Ecology Work Group

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, analyze and interpret information that will inform channel rehabilitation designs and flow management for riparian and aquatic species. The work group focused on refining their associated objectives and targets, developed the riparian encroachment synthesis report, and assisted with revegetation design and planning for the Chapman Ranch Phase A project. Work group members also prepared a manuscript for publication that describes a method for developing revegetation designs based on ground height above the water table.

—Riparian Hardwood Recruitment Monitoring continued

Table 6. Percent Frequency of Each Age Class of Each Species Sampled During the Fall 2019 Riparian Hardwood Recruitment Monitoring

Species	2015 DRY	2016 WET	2017 EXT WET	2018 CRIT DRY	2019 WET	Percent of Total Sample
White alder	0%	3%	3%	5%	10%	6%
Oregon ash	0%	3%	6%	4%	8%	6%
Ponderosa pine	100%	0%	0%	2%	0%	1%
Grey pine	0%	0%	0%	1%	0%	0%
Fremont cottonwood	0%	0%	5%	6%	4%	4%
Black cottonwood	0%	15%	18%	13%	10%	13%
Narrowleaf willow	0%	43%	35%	31%	28%	32%
Red willow	0%	13%	10%	13%	8%	10%
Shiny willow	0%	0%	1%	2%	0%	1%
Arroyo willow	0%	8%	7%	3%	5%	5%
Dusky willow	0%	18%	15%	22%	28%	22%

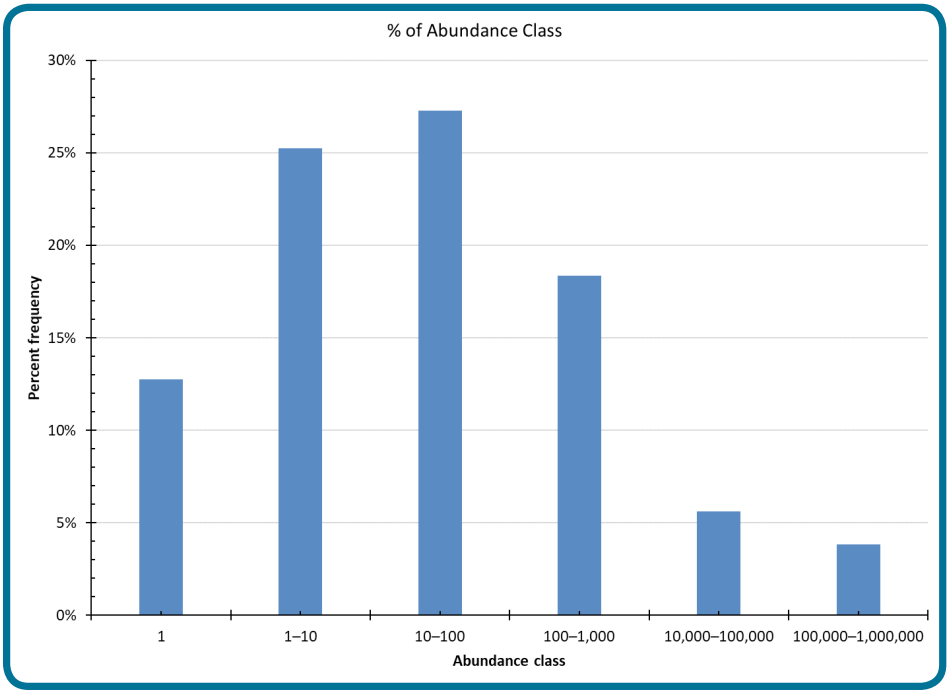

Figure 31. Percent frequency of each abundance class sampled in fall 2019.

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. 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 flows to discourage these vegetation patterns from forming is a long-standing TRRP goal. Vegetation monitoring in recent years indicates that TRRP has discouraged some unnatural vegetation patterns and riparian berm formations, as summarized in a riparian encroachment synthesis report (HVT and McBain Associates 2020, in prep).

The WY19 hydrograph (Figure 26) was designed using riparian modeling data to efficiently scour willows along the channel margins (Reclamation).

Past results of annual riparian band transect and exposed bar monitoring showed that, in most years, riparian hardwoods were scoured from the low water edge by winter storms (tributary-generated floods) and spring ROD releases (Table 7). Every year, high densities of seedlings initiated—regardless of streamflows and substrate availability. However, successful establishment mostly depended on avoiding channel bed scour the winter after the first growth season. Seedlings become established after four growing seasons, after which their root systems are too extensive to be scoured by ROD flow releases alone.

—continued

Table 7. Peak Flow Magnitudes Related to Riparian Seedling Scour

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 and 2012 cohorts	1993, 1998, 2000, 2002, 2006, and 2012 cohorts
2017	12,000	2015 and 2016 cohorts	2006 and 2012 cohorts	1993, 1998, 2000, 2002, 2006, and 2012 cohorts
2018	2,040	None	2006, 2012, and 2017 cohorts	1993, 1998, 2000, 2002, 2006, 2012, and 2017 cohorts
2019	10,800	2017 and 2018 cohorts	2006 and 2012 cohorts	1993, 1998, 2000, 2002, 2006, and 2012 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.

—Riparian Encroachment continued

At least two cohorts (WY 2006 and WY 2012) were documented to have survived to establishment, and are, therefore, beyond the ability of ROD releases to remove via scour. Although the density of mature plants that established across each site is unknown, willows are highly clonal species that can reproduce vegetatively (i.e., new plants can grow from pieces of stems or roots as shown in Figure 32). 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.

Figure 32. Willow growth along the Trinity River (Reclamation).

Encroachment is a natural process on many rivers and is not always detrimental. When encroachment is dense, continuous, and mature enough to be unaffected by ROD flow releases—and it initiates channel simplification, it becomes detrimental. Differences of opinion exist regarding whether encroachment on the Trinity River is detrimental or not—existing monitoring data are not sufficient to allow an objective, rigorous evaluation to be made. Despite that fact, results continue to suggest that the TREIS/EIR-prescribed flow thresholds intended to induce narrowleaf willow mortality are capable of maintaining a variable low water fringe if seedlings are scoured within the window of opportunity to inhibit the establishment of 3-year old and older woody plants. If the seedling management window is surpassed, as it was for the 2006 and 2012 cohorts, then TREIS/EIR-prescribed streamflow peaks alone are unlikely to inhibit encroachment.

Fisheries Monitoring

Juvenile Salmon Habitat Assessment

The TRRP uses two-dimensional (2D) hydrodynamic models to estimate aquatic habitat benefits for alternative channel rehabilitation projects during the channel rehabilitation design process. By integrating hydrodynamic modeling into its channel rehabilitation effectiveness monitoring, the habitat assessment team is able to show trends in habitat availability based on channel restoration and fluvial processes modeling (Figure 33). This development facilitates closer collaboration between the Habitat Monitoring Group, the Science Program, and the Rehabilitation Site Design Team.

Data Collection

In 2019, habitat data collection took 16 days. The habitat assessment team developed hydraulic models of 2019 conditions at three previously constructed rehabilitation sites, Upper and Lower Junction City (constructed 2012 and 2014) and Dark Gulch (constructed 2008), to compare changes in habitat availability to conditions modeled in 2016 (after previous construction work and annual flow releases). The team measured water surface elevation, area of inundation, and depth averaged velocities at four streamflows ranging from 450 cfs to 11,000 cfs. Bathymetric and substrate/cover data were also collected to create a terrain model and roughness estimate, respectively. These modeling data will be shared with Reclamation's Technical Service Center in a collaborative effort to complete the hydraulic and habitat-modeling portion of this project. A presentation and report evaluating these changes will be provided to the TRRP in fall 2020.

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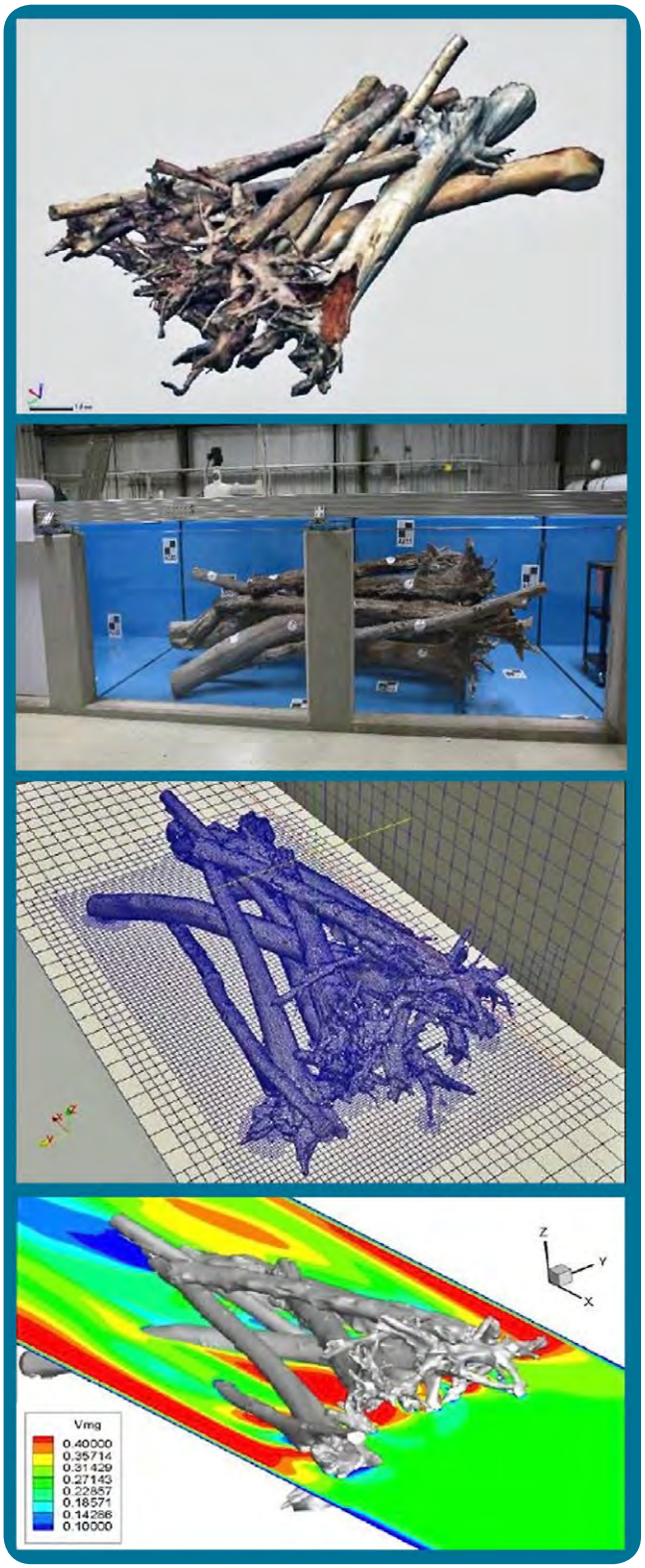

Figure 33. 3D Hydraulic modeling of large wood structures.

—Juvenile Salmon Habitat Assessment continued

Fish Work Group

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 primary focus for the work group is refining TARGETS, developing synthesis reports, and providing guidance on the impacts to Coho Salmon and lamprey from sediment management practices at Hamilton Ponds. The work group developed a list of examples of changes to management in response to learning that occurred since implementation of the ROD, which is intended to inform future development of an adaptive management plan.

Habitat Monitoring Synthesis Reports

Prior to primarily using 2D modeling, the habitat monitoring team measured physical habitat area with mapping grade global positioning systems (GPS) to create geo-referenced and spatially explicit representations of rearing habitat areas. These methods were used to assess the effects of channel rehabilitation on construction related increases and longer-term trends in rearing habitat availability at:

- Summer base streamflow throughout the restoration reach between 2009 and 2013 (Goodman et al. 2016)
- Rehabilitation sites between 2005 and 2015 (Boyce and Goodman 2018)

Three additional reports will be delivered to the TRRP in 2020. Two reports will summarize mapping efforts: one assessing habitat availability at summer base streamflow throughout the restoration reach (2009-2017) and another summarizing streamflow to habitat relationships at six rehabilitation sites between 2008 and 2017. The third report estimates habitat capacity in constructed and non-constructed areas of the restoration reach at a range of stream flows using hydrodynamic model outputs of depth, velocity, and distance to cover generated from a TRRP-sponsored restoration reach-wide modeling effort in 2016.

Large Wood Monitoring for Juvenile Salmonid Rearing Habitat

The TRRP places large wood at channel rehabilitation sites to interact with streamflow to enhance natural river processes and provide juvenile salmonid rearing habitat (Figure 33). In 2019, the habitat team documented large wood placement at the Deep Gulch Sheridan Creek site constructed in 2017 and re-surveyed three other previously constructed sites (Connor Creek, Lorenz Gulch, and Upper Junction City). Figure 34, shown on the next page, shows all large wood placement at rehabilitation sites immediately after construction between 2005 and 2017. The habitat monitoring group will leverage the entire large wood database (2005-present), including site re-visits to assess inter-annual large wood dynamics and longevity of wood installations to inform future augmentation efforts.

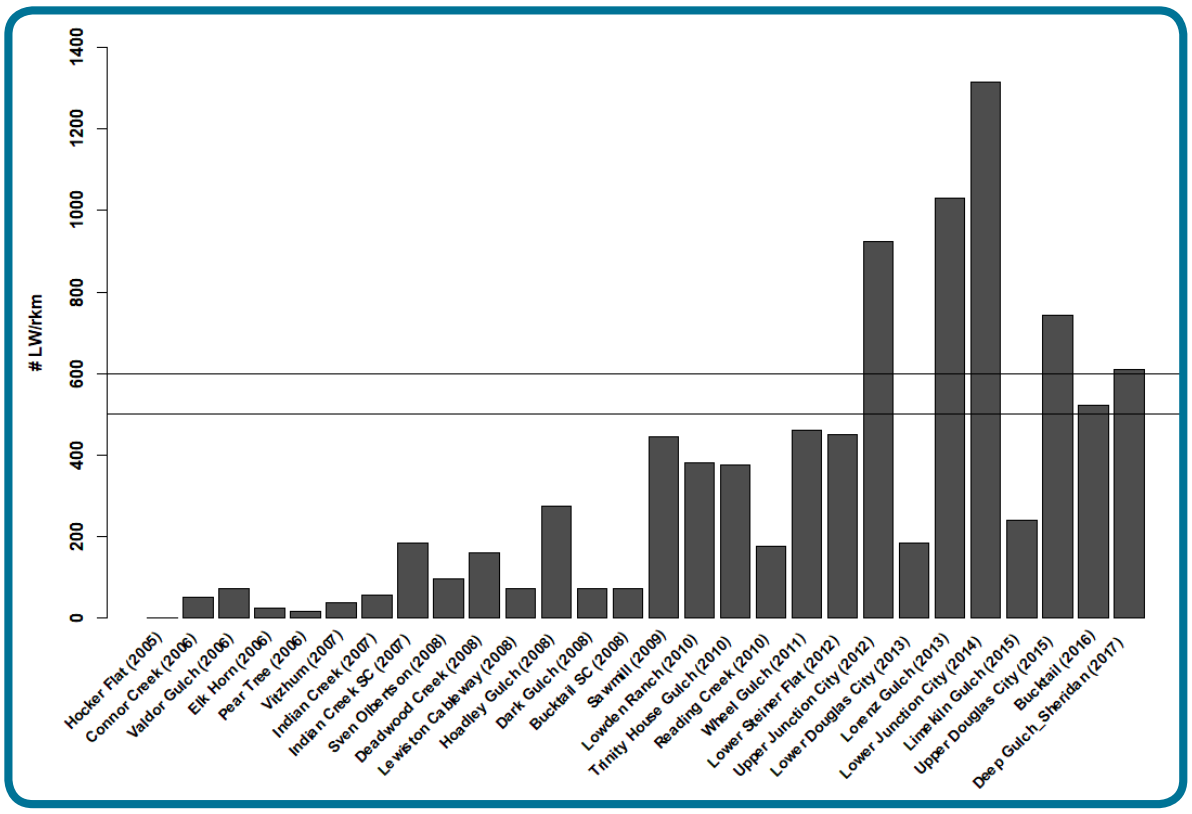

Figure 34. The total number of installed large wood pieces per river kilometer (LW/rkm) for each rehabilitation site after construction. The lines indicate the range of Trinity River-specific recommendations for large wood loading (Cardno Entrix and CH2MHill 2011). Sites are ordered chronologically.

Juvenile Chinook Salmon Abundance

Juvenile salmonid outmigrant monitoring occurred at two sampling sites along the Trinity River, at the Willow Creek rotary screw trap site (WCT) on the lower Trinity River and at the Pear Tree Gulch rotary screw trap site (PT) immediately above the confluence with the North Fork Trinity River (Figure 35 on next page). Sampling at WCT typically occurs from March through August and at PT from January through August, capturing the bulk of the emigrating naturally produced juvenile Chinook Salmon. It is important to note a portion of the population is not sampled (i.e., September through December). In addition, WCT captures juvenile salmon that originate from the entire basin above the trap site, while PT captures juvenile salmon that originate from the restoration reach of the Trinity River.

Annual population estimates of naturally produced juvenile Chinook Salmon (spring- and fall-run combined) for 2007-2018 at WCT and PT are presented in Figure 36 on the next page. The lower estimates of juvenile production in 2016-2018 likely reflect the low spawning population sizes in the preceding years. It is natural for salmon populations to vary dramatically from year to year—reflecting variation in freshwater and marine conditions, and level of harvest of adults. Initial analyses indicate that although numbers of juveniles produced were low in the past few years, the number of juveniles produced per adult seems to be improving in recent years, possibly reflecting a density dependent effect (fewer fish lead to lower competition for space and resources and higher relative survival).

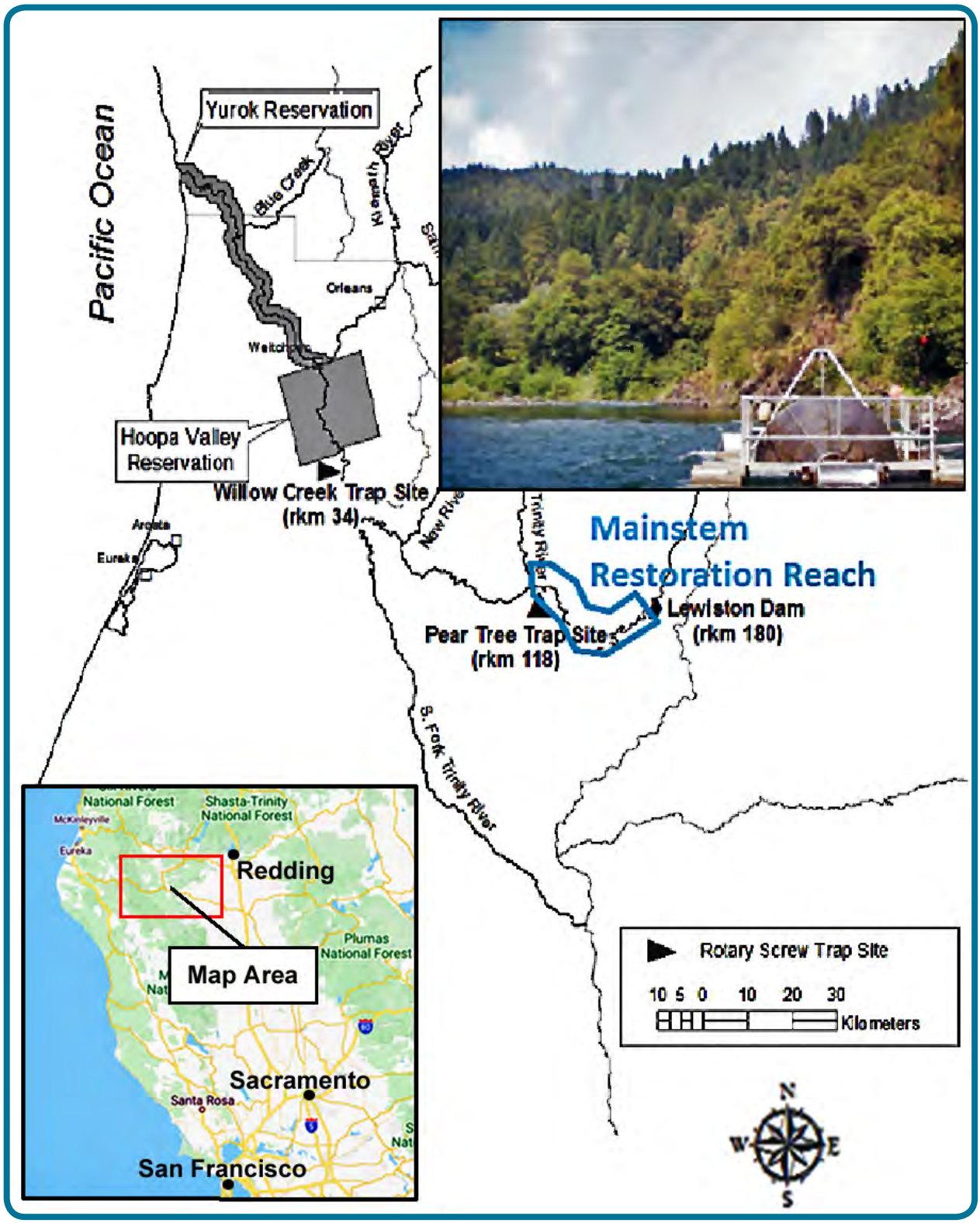

Figure 35. Map of the screw trap sites in 2019 with screw trap inset. The Pear Tree rotary screw trap site captures juvenile salmon that originated from the watershed within the Trinity River restoration reach between Lewiston Dam and the North Fork Trinity River.

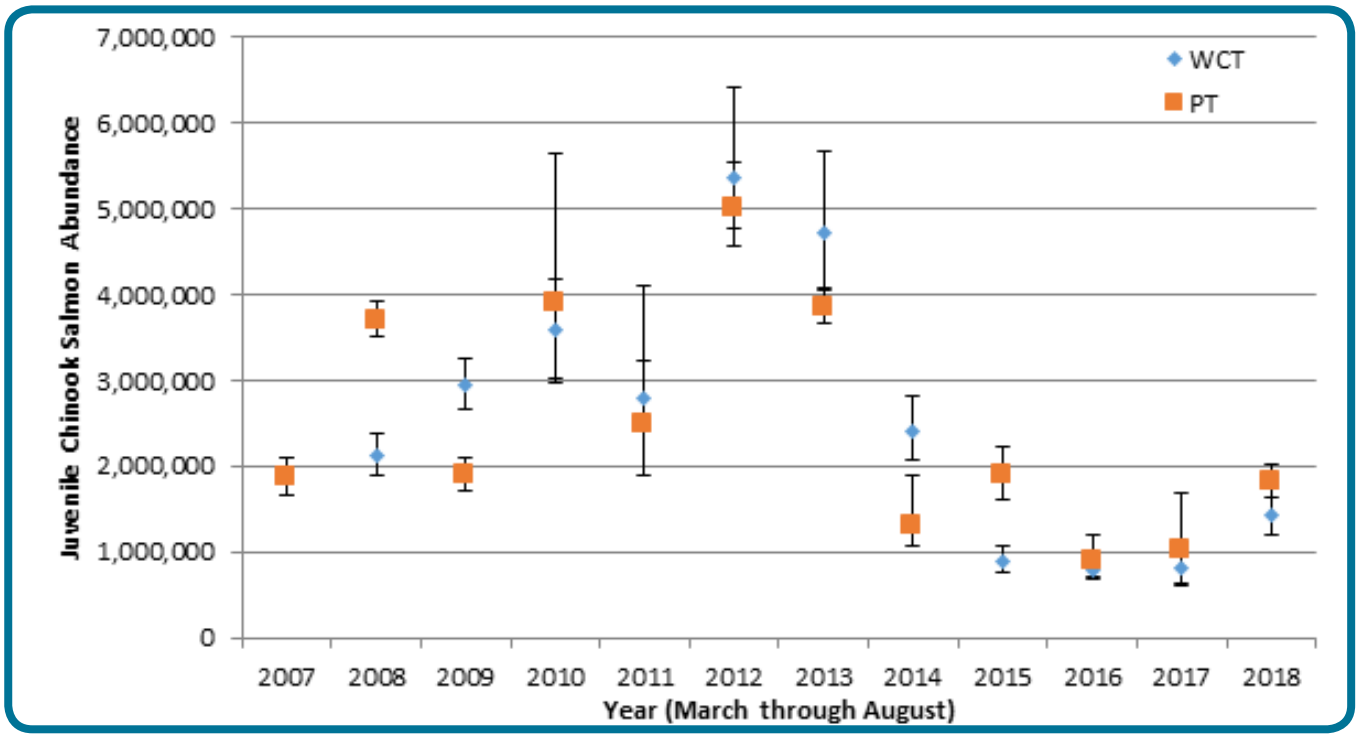

Figure 36. Abundance of naturally produced juvenile Chinook Salmon at the WCT and PT trap sites, 2007-2018. Error bars represent 95% credible limits for the annual estimates.

Salmon Redd Distribution and Abundance

To evaluate the distribution and abundance of Chinook Salmon spawning activity, the USFWS, USFS, CDFW, the HVT, and the YTFP conduct salmon spawning surveys annually on the mainstem Trinity River (Figure 37).

During the 2019 surveys, 1,549 salmon redds were located and 2,053 salmon carcasses were examined. Of these carcasses, 541 were fresh Chinook Salmon (Figure 38) and one was a fresh Coho Salmon. Natural-origin Chinook Salmon built an estimated 1,117 redds, hatchery-origin Chinook Salmon built 405 redds, and Coho Salmon built the remaining 27 redds (Table 8). The number of redds observed in 2019 was the lowest number recorded since the survey, in its current iteration, was initiated in 2002 (Figure 39 on the next page).

Figure 37. A Chinook Salmon (look for the light-colored triangle-shaped dorsal fin near the center of the photo, [circled in yellow]) constructs a redd in the Trinity River. Photo by Chris Laskodi, YTFP.

Figure 38. 'Fresh' Chinook Salmon carcasses in Reaches 1 and 2 of the Trinity River are marked with uniquely numbered jaw tags for a mark-recapture estimate of species abundance in this section of river.

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 40 on the next page).

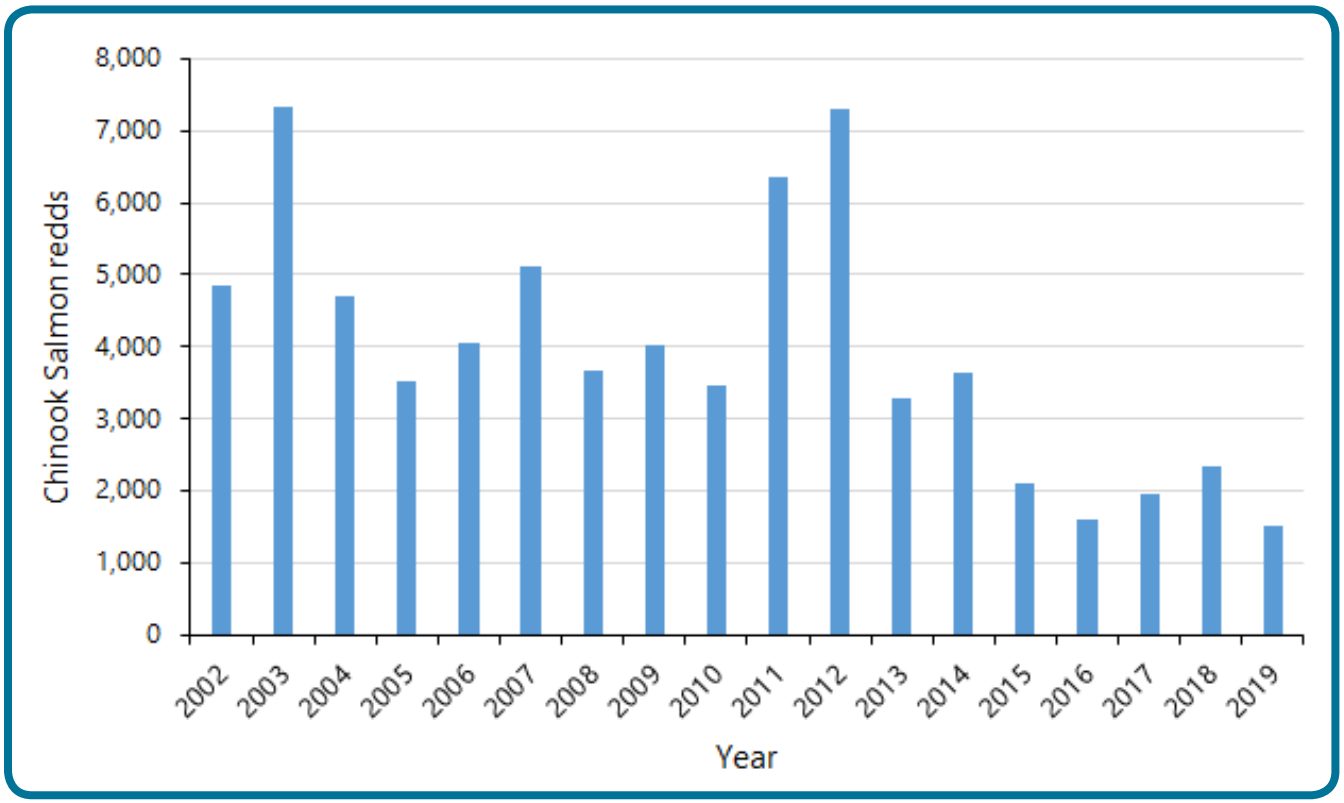

Figure 39. Estimated numbers of Chinook Salmon redds in the mainstem Trinity River, California, from 2002 to 2019.

Table 8. Estimated Numbers of Chinook and Coho Salmon Redds Observed in the Mainstem Trinity River in 2019

Species	Origin	2017
Chinook Salmon	All	2,343[b]
	Natural	1,447[b] (976-1,255)
	Hatchery	405 (266-546)
Coho Salmon[a]	All	27[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.
[c]Not enough Coho salmon female carcasses were found in 2019 to calculate separate estimates for natural- and hatchery-origin Coho Salmon redds.

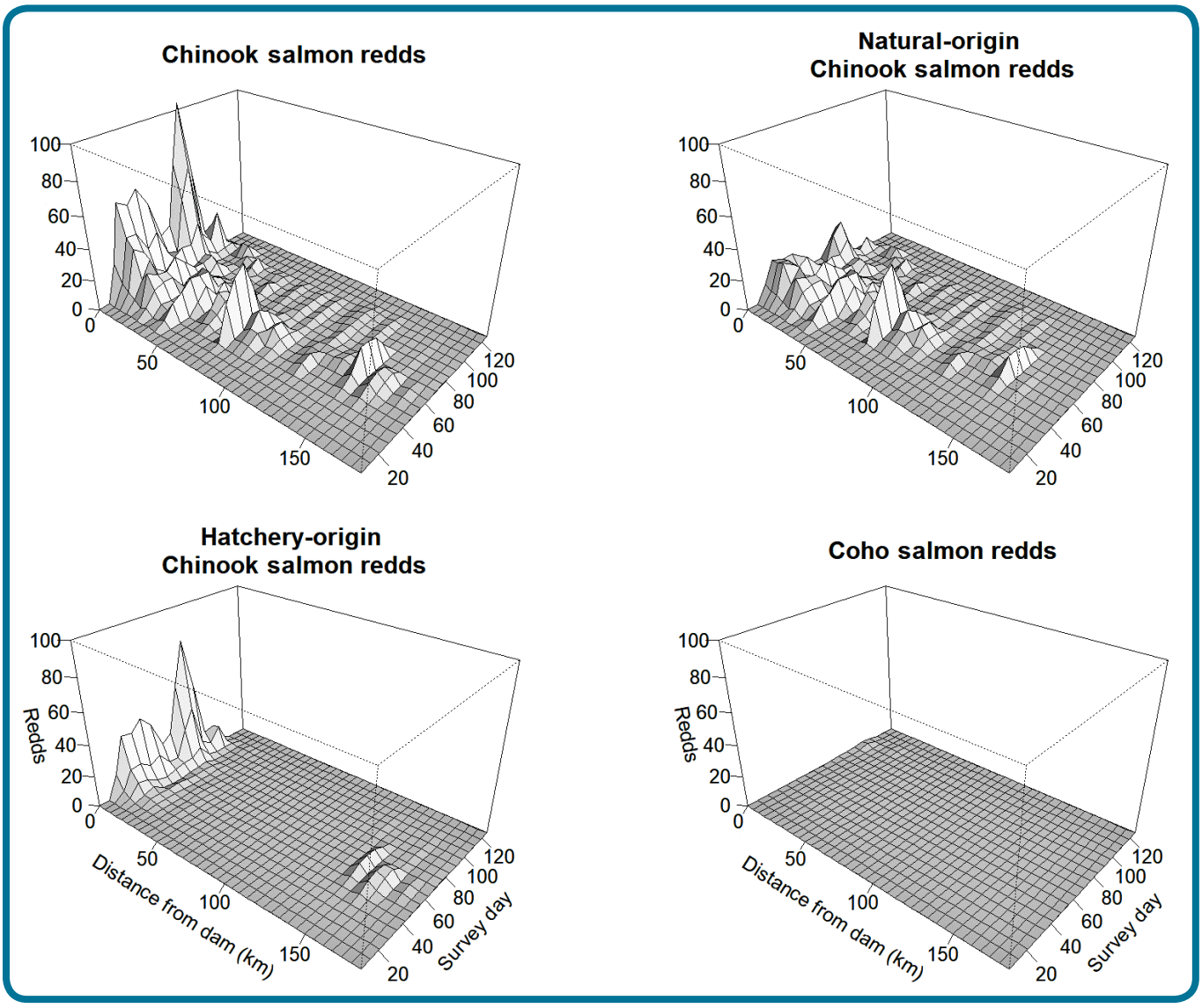

Figure 40. Spatiotemporal distribution of salmon redds observed in the mainstem Trinity River, California, in 2019. Pigeon Point and Burnt Ranch whitewater reaches were not surveyed. Survey Day l = September 1.

Salmonid Spawning Escapement and Harvest

TRRP supports monitoring for run-size and escapement, and harvest of naturally-produced and Trinity River Hatchery-produced spring and fall run Chinook (Figure 41) and Coho Salmon as well as adult fall steelhead. The estimated escapement of adult fall Chinook Salmon to natural spawning grounds in the Trinity River Basin (above Willow Creek weir) in 2019 is 6,229 fish, with an additional 153 spawning in the mainstem river and tributaries downstream of Willow Creek weir (Kier et al. 2020, in prep. and Klamath River Technical Team [KRTT] 2020). Estimates for 2019 indicate that 6,601 naturally-produced fall Chinook Salmon and 4,804 hatchery-produced fall Chinook Salmon returned to natural river areas or the Trinity River Hatchery (including age-2 jacks). Details on the 2019 escapement monitoring for Trinity River salmonids are provided in Table 9 and a recent perspective of adult naturally-produced fall Chinook Salmon escapement is presented in Figure 41.

Table 9. Preliminary 2019 Adult Escapement Estimates for Trinity River Salmonids Above Willow Creek Weir (Kier et al. 2020, in preparation)

Species	Natural Origin Escapement		Hatchery Origin Escapement	
	2019	Program Goal	2019	Program Goal
Spring Chinook Salmon	2,426	6,000	9,362	3,000
Fall Chinook Salmon	3,407	62,000	4,203	9,000
Coho Salmon	104	1,400	960	2,100
Fall Steelhead	3,671	40,000	1,124	10,000

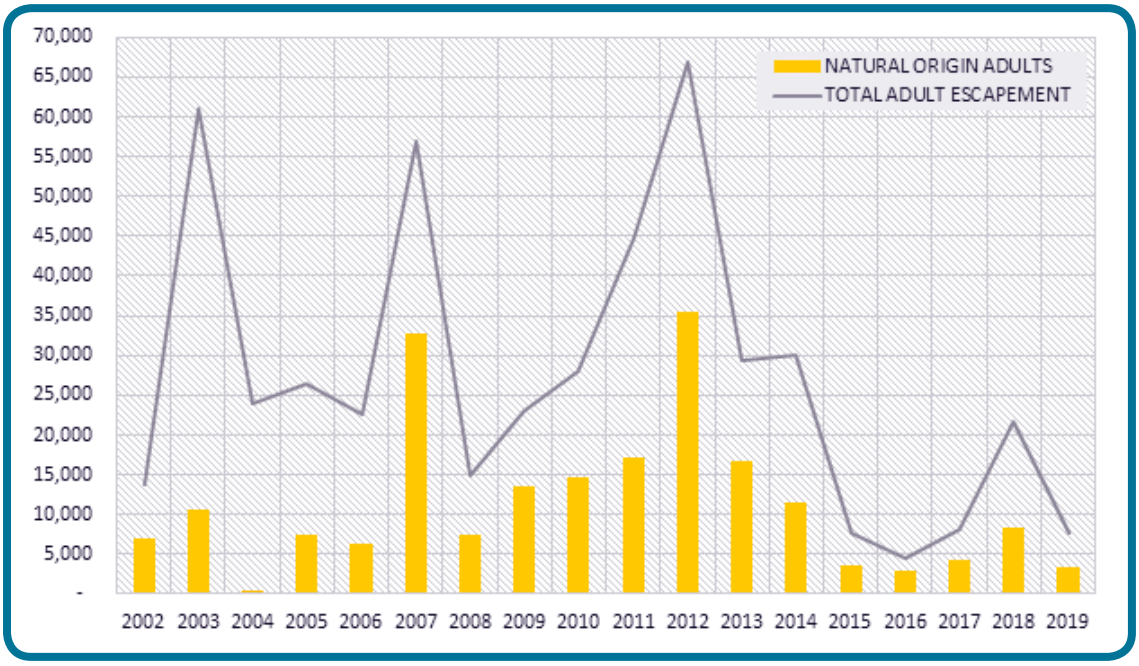

Figure 41. Naturally produced adult fall Chinook Salmon escapement upstream of Willow Creek Weir, 2002 - 2019 (includes returns to natural spawning areas and Trinity River Hatchery).

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-produced 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 (Figure 42).

In 2019, an estimated 337 adult fall Chinook Salmon were harvested in the recreational fishery on the Trinity River and 3,343 were harvested on the lower Klamath River (river mouth to Weitchpec). The estimated tribal harvest of adult fall Chinook Salmon was 2,065 fish by the Hoopa Valley Tribal fishery and 3,909 fish by the Yurok fishery. These estimates include both natural-origin and hatchery-origin fish.

Figure 42. Chinook salmon.

Data Management

Data stewardship for restoration efforts forms the basis for assessing restoration performance, measuring progress towards goals and objectives, Program planning, and designing channel rehabilitation projects and hydrographs. Effective data management produces high-quality future restoration and planning data suitable for analysis and synthesis to yield knowledge that can guide decision making.

The Program's online data portal (DataPort) at www.trrp.net/dataport preserves the usability of data and information across the partnership so that it is accessible to restoration professionals and to the public. Data stewardship encompasses practices that ensure project and program data are of good quality, secure, available, understandable, and usable through time.

Over 1,600 reports and other documents, and over 100 data packages, including reports and documents dating back to 1900, are searchable and retrievable at selectable levels from the DataPort library www.trrp.net/library (Figure 43). A growing number of data resources are managed through the DataPort, which are integrated into other portions of the website.

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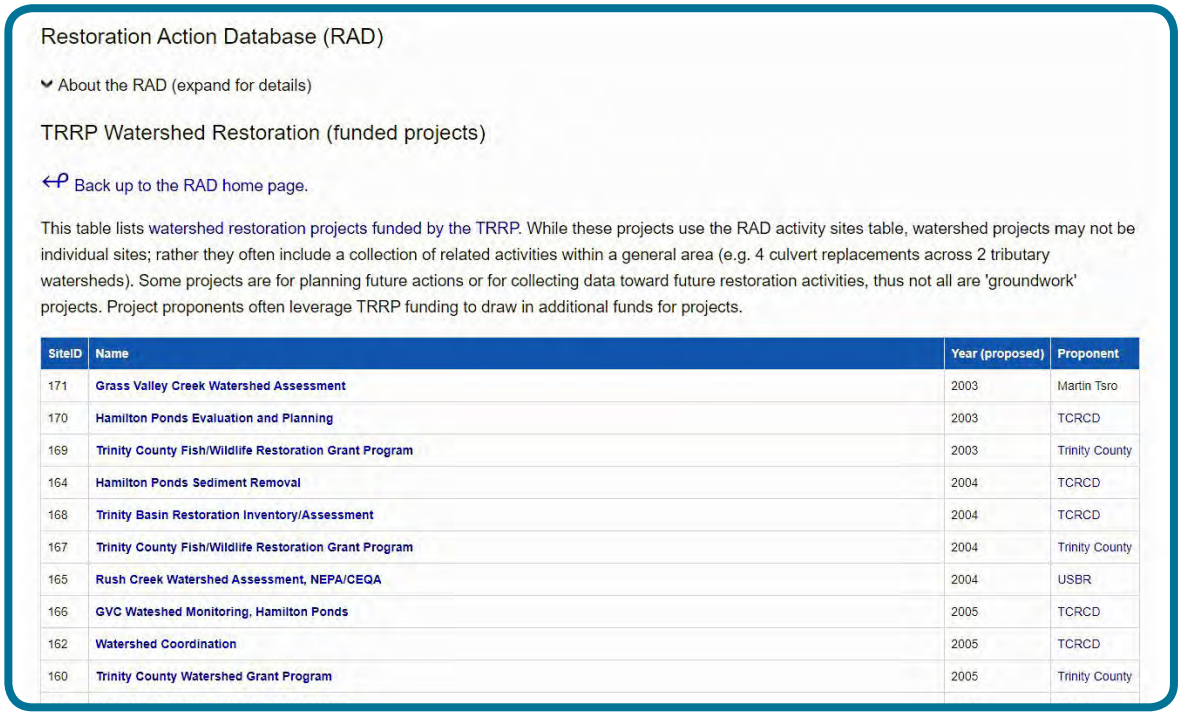

Restoration Action Database (RAD)

About the RAD (expand for details)

TRRP Watershed Restoration (funded projects)

Back up to the RAD home page.

This table lists watershed restoration projects funded by the TRRP. While these projects use the RAD activity sites table, watershed projects may not be individual sites; rather they often include a collection of related activities within a general area (e.g. 4 culvert replacements across 2 tributary watersheds). Some projects are for planning future actions or for collecting data toward future restoration activities, thus not all are 'groundwork' projects. Project proponents often leverage TRRP funding to draw in additional funds for projects.

SiteID	Name	Year (proposed)	Proponent
171	Grass Valley Creek Watershed Assessment	2003	Martin Tsro
170	Hamilton Ponds Evaluation and Planning	2003	TCRCD
169	Trinity County Fish/Wildlife Restoration Grant Program	2003	Trinity County
164	Hamilton Ponds Sediment Removal	2004	TCRCD
168	Trinity Basin Restoration Inventory/Assessment	2004	TCRCD
167	Trinity County Fish/Wildlife Restoration Grant Program	2004	Trinity County
165	Rush Creek Watershed Assessment, NEPA/CEQA	2004	USBR
166	GVC Wateshed Monitoring, Hamilton Ponds	2005	TCRCD
162	Watershed Coordination	2005	TCRCD
160	Trinity County Watershed Grant Program	2005	Trinity County

Figure 43. RAD screenshot.

Watershed Work Group

The Watershed Work Group identifies and implements 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. The work group planned field visits to review previous projects and refine priorities moving forward in 2020.

—Data Management continued

The TRRP.net home page www.trrp.net itself has a table of current river flows and multiple graphs that are resourced from the DataPort. The Restoration Action Database (RAD) www.trrp.net/dataport/rad/ is a new resource on the website comprised of a collection of tabular data on completed projects within the TRRP focal reach and also includes watershed improvement projects and previous non-TRRP efforts (Figure 43).

In 2019, the Trinity River View went live at www.trrp.net/riverview (Figure 44). This page allows visitors to see conditions at a point-in-time on the river from a rafting point-of-view along the entire restoration reach of the river, just below Lewiston Dam to the North Fork Trinity River at Helena.

Figure 44. Trinity River view screenshot.

Environmental Compliance and Mitigation

NEPA, CEQA, and Other Mandates

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

The TRRP informs the Northern California community, including partners, collaborators, and public and private stakeholders, about its proposals. Public meetings are held during the early stages of channel rehabilitation design development. Subsequent meetings continue to inform the public on designed modifications made based on stakeholder input and associated monitoring and evaluation before, during, and after project construction and revegetation (Figure 45 on the next page).

In the same way that TRRP works with private landowners to implement projects that support both private and public objectives, TRRP works with Federal partners to ensure that environmental compliance meets the needs of collaborating government agencies. As part of this effort, Reclamation is working with Federal land managers (i.e., BLM and USFS) and the North Coast RWQCB as a state regulator to meet environmental and regulatory requirements for participating entities.

Channel Rehabilitation

In 2019, TRRP staff worked closely with partner agencies, the BLM and USFS, and the North Coast RWQCB to meet environmental requirements for analysis and disclosure, as well as permitting needs for the upcoming Dutch Creek and Chapman Ranch Phase B channel rehabilitation projects. The Chapman Ranch Phase A project was constructed in 2019 and the Dutch Creek channel rehabilitation project was authorized in late 2019 when a Finding of No Significant Impact (FONSI) was signed by the Federal co-lead agencies for NEPA, Reclamation and BLM, and a separate FONSI Decision Notice was signed by the USFS as a cooperating agency. The USFS FONSI will allow TRRP construction to proceed on Shasta-Trinity National Forest managed lands for the first time since the restoration actions were authorized in 2000.

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Designs go through multiple iterations, and models are used to show stakeholders various design alternatives.

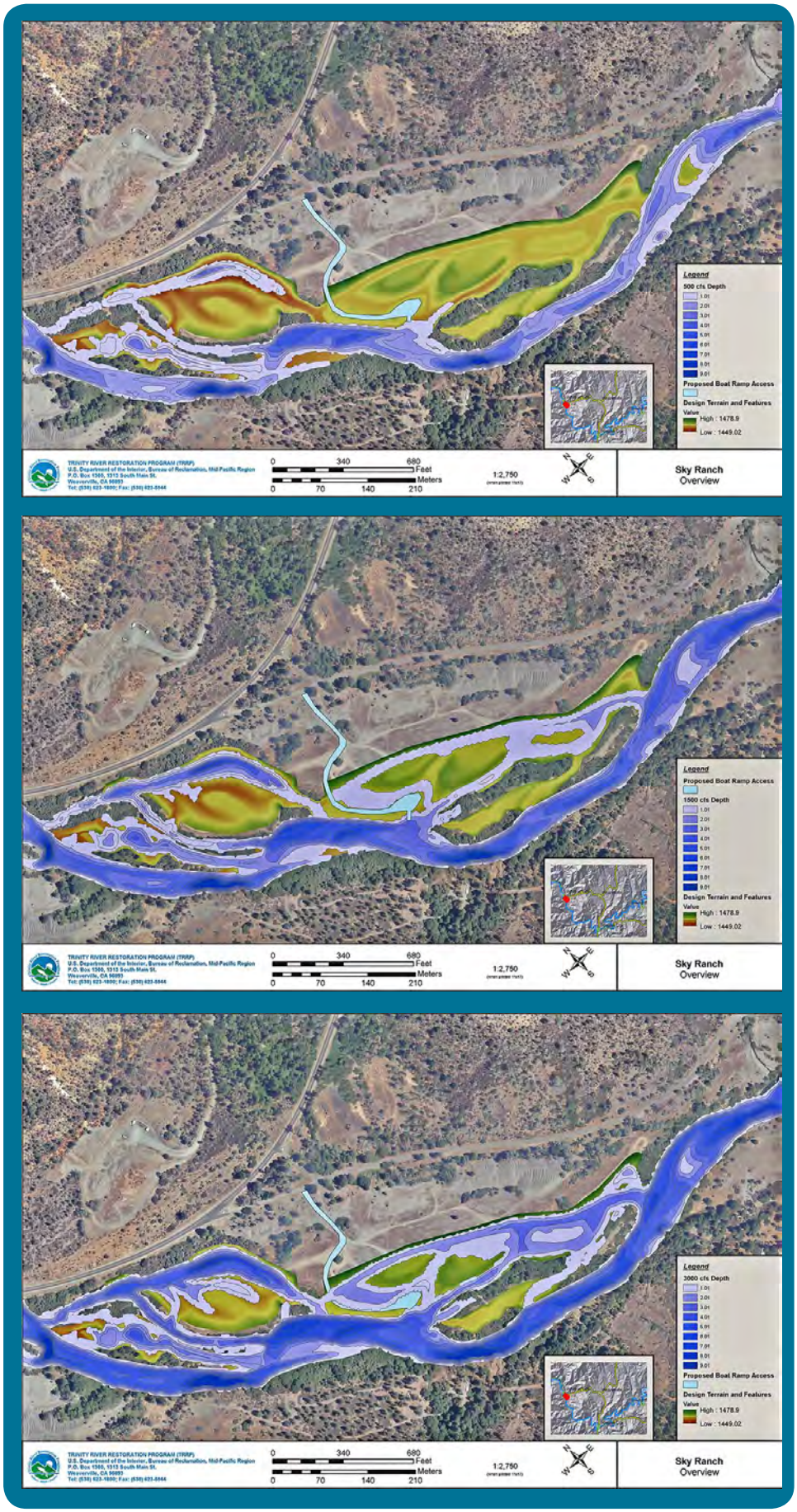

Figure 45. Water depth and terrain elevations for flows of 500 cfs (top), 1,500 cfs (middle), and 3000 cfs shown for a proposed design at Sky Ranch.

—NEPA, CEQA, and Other Mandates continued

Turbidity

Turbidity, a measure of suspended solids in water, quantified in nephelometric turbidity units (NTU), is typically low in the Trinity River during summer. Turbidity in the Trinity River naturally increases during storms or other runoff events and may also be caused by construction or other human activities in the river. As the CEQA lead agency for the Master EIR, the North Coast RWQCB worked with TRRP to develop water quality mitigation measures for TRRP activities, such as gravel augmentation or channel rehabilitation.

TRRP's General Water Quality Certification (R1-2015-0028) (Pursuant to Section 401 of the Clean Water Act (33 USC 1341) states that "turbidity levels at the point of compliance (500 linear feet downstream of the point impact) greater than 20 percent above naturally occurring background or 20 NTUs whichever is greater" (California WQCB, 2015). The summer construction period and this permit condition ensures that TRRP restoration activities minimize impacts to the Trinity River ecosystem. During 2019 summer channel rehabilitation construction, contractors used turbidity barriers and other mitigation measures to minimize sediment impacts and to remain within permit conditions during the in-river construction season (Figure 46). A short-term spike in turbidity was measured at the North Fork Trinity River monitoring site during the release of water from Lewiston Dam from September 2 to September 5, 2019 for the HVT's Boat Dance Ceremony.

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Figure 46. Looking upstream at two new river meanders that were created at the project site. Barriers were built and left in place during side-channel excavation to mitigate turbidity. When excavation was complete, the turbidity barriers were slowly removed to maintain turbidity permit requirements. (Photo by Aaron Martin, YTFP).

—NEPA, CEQA, and Other Mandates continued

Biological Assessments

TRRP's continued work on the Biological Assessments (BA) to address potential new effects of restoration activities on species (or their habitats) listed as threatened or endangered and to update its programmatic coverage under the ESA.

The TRRP office completed its Programmatic BA to analyze the impacts of its channel rehabilitation, sediment management, and watershed restoration projects, as well as its scientific monitoring program, on Endangered Species Act of 1973 (ESA) listed marine and anadromous species in December 2019. Primary among the potentially impacted species and habitats evaluated is the threatened Southern Oregon/Northern California Coast Evolutionary Significant Unit of Coho salmon. The TRRP initiated formal consultation when they provided NOAA Fisheries with the BA. Now, TRRP staff are collaborating with public land managers, the BLM and USFS, to provide NOAA Fisheries clarifications, as needed, so that a Biological Opinion (BiOp) may be completed to cover TRRP activities by summer 2020. The updated BiOp will replace the 2000 Biological Opinion, as amended, (NMFS[5] 2000) that has covered TRRP activities since the 2000 Trinity ROD was signed.

For wildlife, the TRRP is finishing work on their Programmatic BA to evaluate the potential effects of TRRP activities, including watershed restoration, on the Northern Spotted Owl (*Strix occidentalis caurina*) and Marbled Murrelet (*Brachyramphus marmoratus*), and their designated critical habitats. This BA implements conservation measures to reduce disturbances to ESA listed species so that if these measures are followed, the disturbance to individuals will be insignificant and discountable. Because the determination is that TRRP activities are Not Likely to Adversely Affect (NLAA) ESA listed wildlife species, the consultation is "informal," and should be more quickly completed than formal Coho Salmon consultation.

The Program is now working with its Federal land manager partners and the USFWS to finalize the wildlife BA. The intent is to obtain a "Letter of Concurrence" (LOC) from the USFWS that TRRP activities may be implemented so that they will be able to get a determination of NLAA for the ESA-listed species. Prior to implementation, site specific projects will be evaluated to determine whether they may be covered under the TRRP's forth coming Programmatic LOC and NLAA determination.

[5]National Marine Fisheries Service (now NOAA Fisheries).

These updates to Federal ESA compliance documentation should streamline the implementation of TRRP activities in future years and should help to cover the increasing need for State and Federal environmental documentation.

Environmental Mitigation

TRRP's objective is to have no net loss of wetland and riparian vegetation within our activity areas. To meet this goal, measures are taken to avoid, minimize, and mitigate short-term adverse effects during restoration actions. Measures such as saving riparian vegetation in place or salvaging plants for replacement later in floodplain habitats, are used during construction now to more quickly return post-construction habitat to more functional riverine habitat. Over time, revegetation monitoring has enhanced understanding of planting performance and contributed to new methods to increase vegetation survival. Early designs relied heavily on planting cottonwood and willow poles, which are cuttings from live trees that can root themselves if planted under the right conditions. Monitoring results indicated that survivability was increased when poles were planted directly into the water table and the soils amended with organic and water holding materials. In response, the TRRP now creates more low-lying areas to plant wetland plants and irrigates upland container stock in areas where the water table could not be reached. These techniques have improved the success of both planted and naturally regenerated plants at restoration sites and will hopefully allow vegetative self-maintenance in the future.

Drought and high temperatures can substantially reduce the survival rate of native plants, which means that crews must return to the project sites to monitor and counter vegetation losses to keep native plant survival at or above replacement requirements. Other methods are used to counter invasive species which can out-compete native vegetation, such as Dyer's woad (*Isatis tinctoria*), star-thistle (*Centaurea solstitialis*), and tree-of-heaven (*Ailanthus altissima*) (Figure 47).

Figure 47. Invasive species harm native vegetation and habitats (Dyer's woad (top), star-thistle (middle), and tree-of-heaven (bottom)).

Cultural Resources

Much of TRRP's work is confined to the floodplain, where historic resources have lost much of their integrity during flood events. However, the large scope of the channel rehabilitation projects and the remaining historic sites along the river (e.g., Trinity Historical Mining District) highlight the need for a comprehensive analysis of historic resources throughout the restoration reach. Pre-project surveys at channel rehabilitation sites enable TRRP to design around areas that might be of historic interest. Cultural resource reports summarizing surveys at future projects sites are underway to support current channel rehabilitation proposals.

FEMA Floodplain Mapping and County Floodplain Development Compliance

New Flood Insurance Rate Maps (FIRM), also called Flood Hazard Maps, became effective for the Trinity River in 2016. The TRRP continues to work with Reclamation's Technical Service Center, Trinity County, and the Federal Emergency Management Administration (FEMA) to update the FIRMs to include changes from projects constructed in 2017 and 2019 through the Letter of Map Revision (LOMR) process.

Trinity County submits a Conditional Letter of Map Revision (CLOMR) application prior to construction and follows up with a LOMR application based on surveyed conditions and hydraulic modeling post-construction to ensure that projects maintain or decrease flood elevations around structures.

Reclamation conducts hydraulic modeling of the design condition to evaluate impacts of the proposed project on flood elevations and assists the County in submitting the CLOMR application.

Public Outreach in 2019

TRRP is committed to engaging the community and stakeholders in a variety of ways. Whether through public events, education opportunities, public meetings, or online resources, TRRP strives to inform and collaborate with a diverse group of stakeholders.

Public Events

TRRP engages with community members to share the habitat restoration approach at a variety of public events. Two public rafting trips on the river in 2019 provided opportunities for stakeholders, river-front private property owners, and people interested in learning more about the Trinity River to see the river from a unique perspective with a host of natural resource and river restoration professionals (Figure 48).

Figure 48. TRRP sponsors free rafting trips for the public as an opportunity to share information about the river and the efforts to recover naturally spawning salmon and steelhead.

Public Meetings and Workshops

TRRP holds formal and informal public meetings to increase public knowledge and understanding of program activities. Improving public understanding will help facilitate a collaborative process that incorporates public input. Several of these meetings were held in 2019 to describe projects proposed for implementation in the future and to provide information on restoration objectives. These meetings provide an important venue for the community to ask questions on restoration activities and provide input and feedback on restoration activities.

TRRP held a Flow and Gravel Recommendation informational meeting on April 12, 2019 to provide a forum for community residents to learn about the 2019 flow release schedule based on the forecast wet water year designation and the associated gravel augmentation recommendations. In addition to meetings to describe proposed projects and their potential environmental impacts, TRRP staff regularly meet with various stakeholders in a variety of field and office visits (Figure 49).

A formal public meeting was held on November 28, 2019 on the proposed channel rehabilitation projects in the Junction City area, including the Chapman Ranch Phase A and B, Dutch Creek, and Sky Ranch, and Oregon Gulch projects.

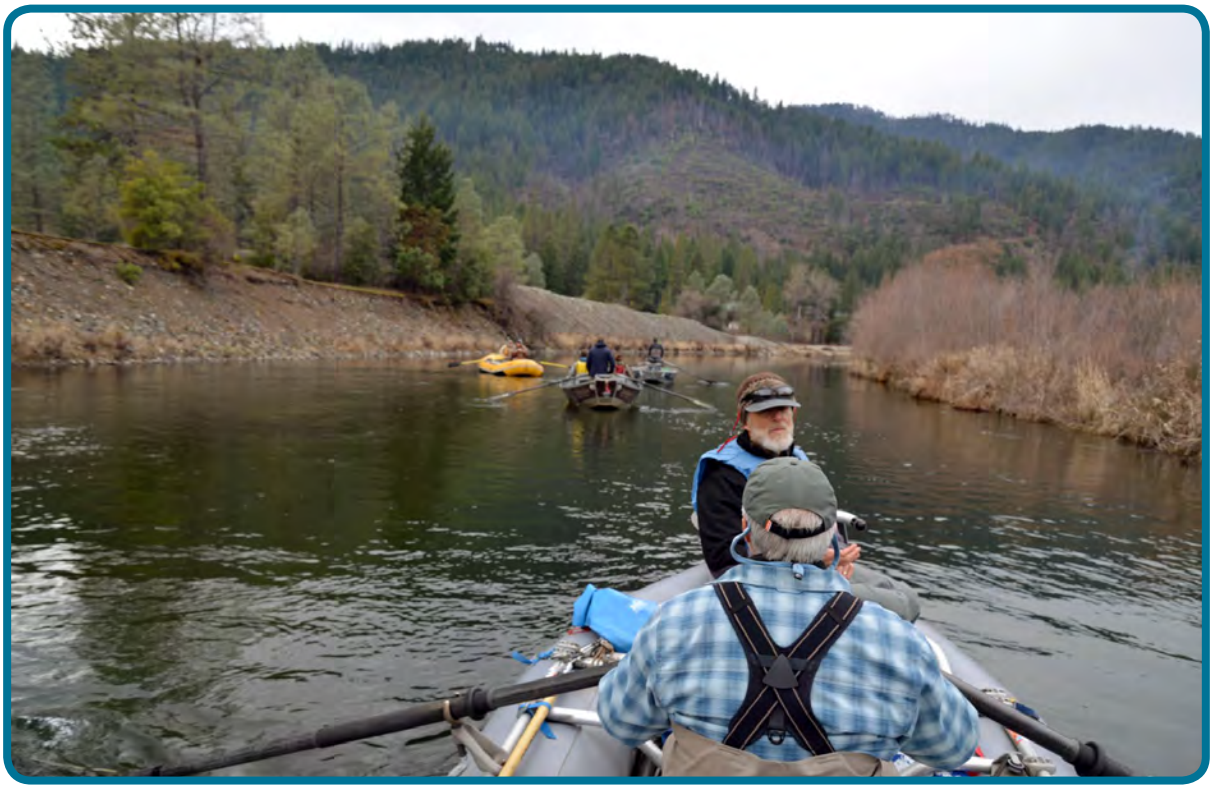

Figure 49. Design team members and TRRP staff meet with interested stakeholders, such as fishing guides to discuss previous and future channel rehabilitation sites.

Figure 50. Students from the Trinity River area participated in the Environmental Camp in 2019 and learned about water quality for salmonids, stream flow monitoring, and riparian and plant ecology among other environmental education topics.

Community Events and Education

The TRRP continues to provide financial support to the Trinity County Resource Conservation District for the Trinity River Salmon Festival, Trinity County Fair, Day at the Wetlands, Weaverville Summer Day Camp, and sixth grade Environmental Camp (Figure 50). In 2019, the TRRP expanded interactive learning opportunities to connect more community youth with the species, natural cycles, and cultural importance of the Trinity River to inspire the next generation of river stewards. In addition, the TRRP overhauled the office windows to display informational posters on Program history and activities (Figure 51).

Program Informational Materials

TRRP continued funding for the publication and distribution of Trinity County Resource Conservation District's newsletter, the Conservation Almanac. The almanac reaches over 300 people every quarter and highlights the importance of Trinity County's natural resources and the benefits of a healthy watershed.

Several articles regarding the Program's 2019 activities appeared in various regional media. The Program also funds the outreach website, www.trinityriver.org.

Figure 51. TRRP's new window displays.

In addition to resources on Trinity River flows, calendar announcements, scientific data, technical papers, and other information are regularly updated on TRRP the website www.trrp.net/.

Trinity River Restoration Program

Looking Ahead: 2020 Program Activities

In 2020, the Program continues 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 2020 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
- Continue channel rehabilitation site design and implement the first major restoration effort on National Forest System Lands at the Dutch Creek Channel Rehabilitation Project

Flow Management

In accordance with the adaptive management mandate, the Program continues to monitor and tailor flow releases to more effectively emulate natural variability. At the beginning of FY2020, the TMC offered guidance to TRRP staff to "continue and/or initiate studies that analyze the effects of synchronizing Lewiston Dam flows and tributary flows on TRRP goals, contingent on available funding, that assist in the development of potential environmental documents to support adaptive management of the 2000 ROD flow releases." This guidance originates from limitations on when TRRP can release water for restoration and fishery management purposes. Legally, TRRP may not release ROD water before April 17 or after October 15, when the flow is held at a constant 300 cfs during a time when the river would naturally be fluctuating in response to rain and snow storms and when some very important runs of salmonids are growing and migrating out to sea. To give fish natural hydrological cues, access to seasonally inundated habitats, and other benefits of natural hydrologic rhythms, TRRP needs to complete the environmental review process outlined in NEPA. Towards this end, several research projects beginning in FY 2020 will examine the influence of natural flow variations, similar to what is seen in Trinity River tributaries, on the health and productivity of the Trinity River.

Channel Rehabilitation

TRRP will begin construction on the Dutch Creek channel rehabilitation project approximately five miles upstream from Junction City, California. In addition to implementation on the Dutch Creek project, TRRP design groups will continue developing and reviewing designs and regulatory permitting for Chapman Ranch Phase B, Sky Ranch, and Oregon Gulch channel rehabilitation projects. The Chapman Ranch Phase B project design is near completion and moving towards being permitted for construction in FY 21.

Environmental Compliance

The Program will continue its consultation with NOAA Fisheries and the USFWS under Section 7 of the ESA to broaden the area of the analysis so that the resulting Biological Opinions may be used to support restoration activities on federally funded, federally permitted, or carried out on federally managed lands throughout the Trinity River watershed. The Program continues to work with Trinity County on updating FEMA's Flood Insurance Rate Maps for the 2017 completed Deep Gulch and Sheridan Creek, the 2019 Chapman Ranch Phase A and the proposed Dutch Creek projects.

Stakeholder Involvement

Outreach and other forms of 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 area
- Planning a Programmatic Science Symposium, expected to happen during March 2021

Implementation Monitoring and Synthesis Reporting

TRRP continues to expand its approaches to monitor physical habitat changes at channel rehabilitation sites, gravel transport, and physical and biological responses to flow releases to track the effectiveness of channel rehabilitation projects, sediment management, and restoration flows.

The habitat monitoring group will leverage the entire large wood database (2005-present), including site re-visits to assess inter-annual large wood dynamics and longevity of wood installations to inform future augmentation efforts. This is part of a larger TRRP-wide emphasis on developing long-term assessments of all restoration implementation efforts.

To develop a cohesive program-wide approach to monitoring, interdisciplinary work groups of the TRRP continue their efforts with TMC and leadership to refine their objective and metric targets for their various disciplines.

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 geographic processes, hydraulic action is also known as erosion.

Hydrograph. A chart that displays the change of a hydrologic variable over time. A discharge hydrograph, for example, shows the rate of flow (discharge) past a specific point in a river on the x axis and the time on the y 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 (x,y,z) 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 LiDAR and ground-based scanners, sonar methods for bathymetry (underwater topography), and recent methods for processing photographs with computer vision techniques. Point clouds often include thousands to millions of points.

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

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

Restoration 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.

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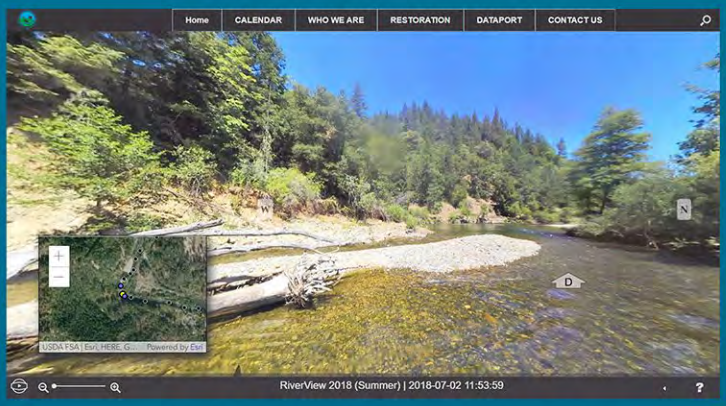
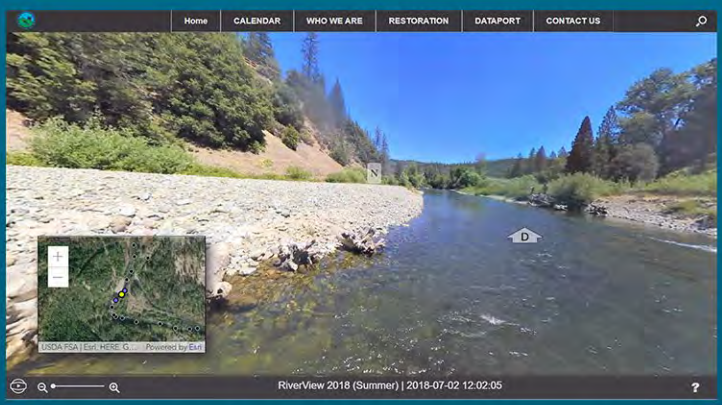
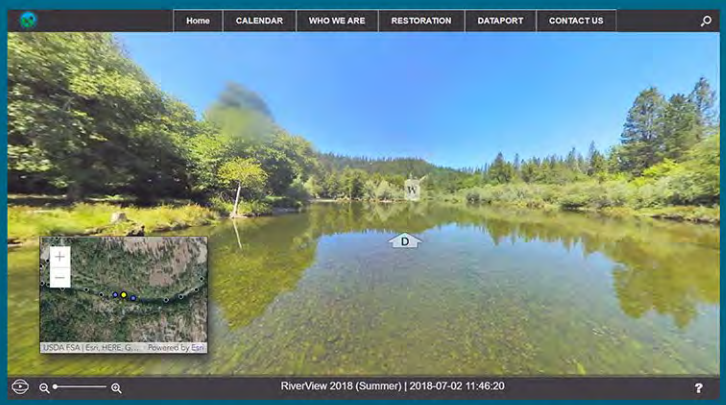
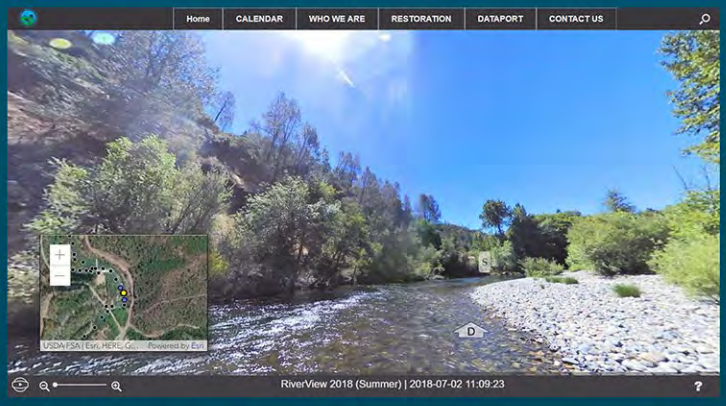
On the back cover: *Several views from the River Ware system, developed in 2018, that can be viewed at: www.trrp.net/dataport/riverview/*









Visit http://www.trrp.net/dataport/riverview/ to view the River View system.

The map in the lower left corner will show where you are at on the river. Any dot can be clicked on to transport you there. Click and drag the photo to turn your view a full 360º, stopping at any angle. On a cell phone or similar device with directional sensors, you should be able to turn the phone to turn your view.

An orange arrow pointing to the right can be clicked on to display a description that may include links to other information. Clicking anywhere else rotates the photo to that spot. More information can be found by clicking on the question mark in the lower right hand corner of the screen.