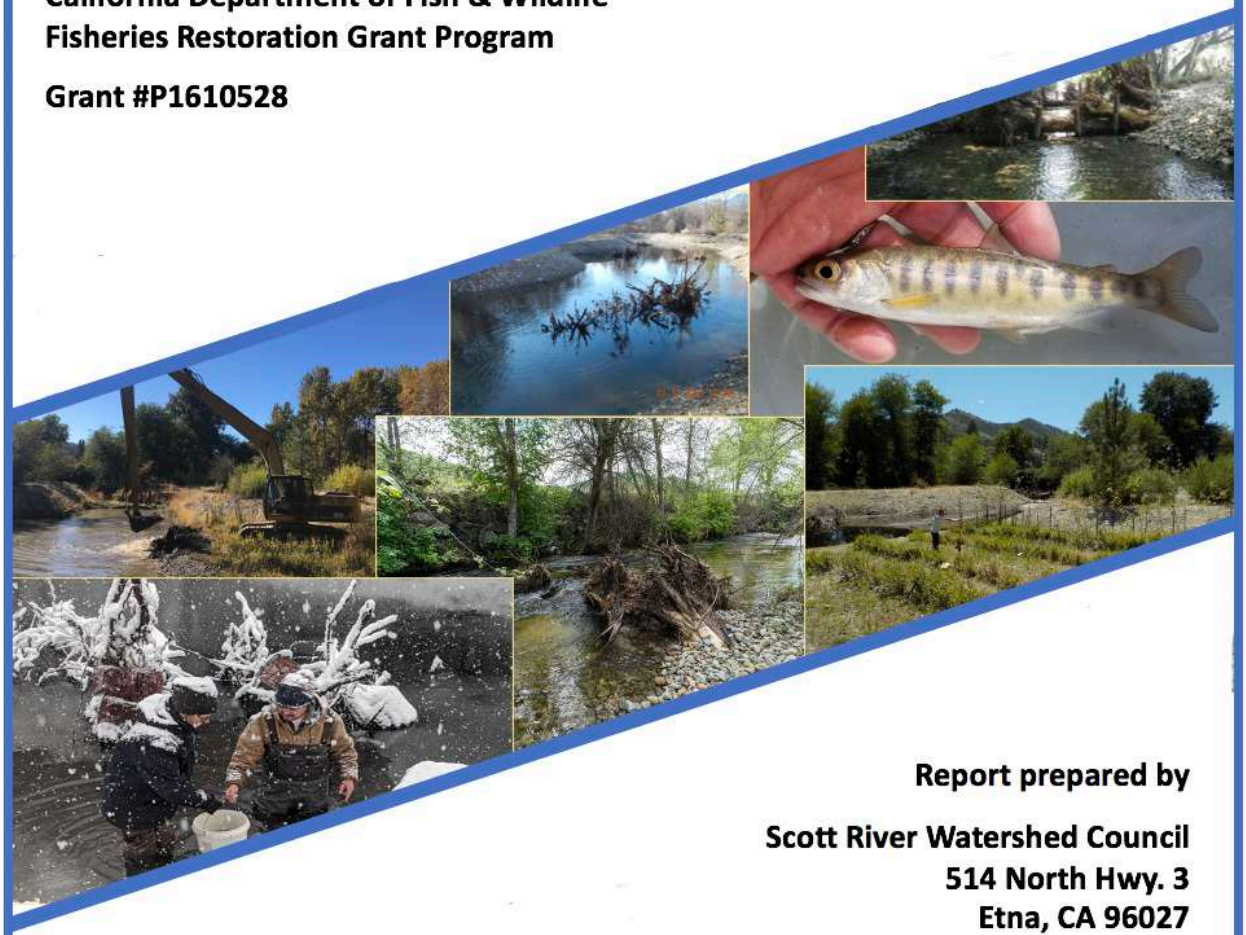
French Creek Instream & Off Channel Enhancement Project

SCOTT RIVER WATERSHED COUNCIL

Report prepared for

California Department of Fish & Wildlife
Fisheries Restoration Grant Program

Grant #P1610528



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February 28, 2021

Executive Summary

In response to declining instream conditions for California's salmonid populations, the California Department of Fish and Wildlife (CDFW) established the Fisheries Restoration Grant Program (FRGP) in 1981 with the goal of supporting restoration activities aimed to improve salmonid habitat conditions. In 2017, FRGP selected the Scott River Watershed Council's (SRWC) ***French Creek Instream and Off Channel Enhancement Project***, hereinafter referred to as "Project" for funding.

The Scott River Watershed has been identified as having one of the largest wild Southern Oregon Northern California Coast (SONCC) Coho Salmon (*Oncorhynchus kisutch*) populations in the State of California (National Marine Fisheries Service 2014). Within the Scott Watershed, French Creek has been identified as a key spawning and rearing stream (California Department of Fish and Game 2004). French Creek is one of two tributary streams that are connected to the Scott River during Coho spawning season every year, and typically supporting a significant amount of spawning that occurs in the watershed.

In spite of its health in comparison to other streams and watersheds, limiting factors for all life stages of Coho Salmon have been identified in French Creek. Deficits in spawning substrate (Cramer 2010), and over-summering and over-wintering habitat have decreased French Creek's carrying capacity from historical conditions. Poor riparian vegetation conditions have decreased primary productivity and water quality (National Marine Fisheries Service 2014).

Therefore, we took the approach of including a variety of features into an integrated restoration design to simultaneously address all of the identified limiting factors. Engineered Log Jams (ELJs) were placed in the mainstem French Creek to create scour pools for summer rearing, a side channel was constructed for slow water winter rearing habitat, spawning gravel was introduced to provide immediately available substrate suitable for spawning, an "inset floodplain" was constructed (inset floodplain) for allocanthous food inputs, and extensive riparian vegetation was planted to shade the stream and provide food and cover for terrestrial species and, in time, create shade for the constructed side channel.

Monitoring has shown that all of the habitat features were utilized by various life phases of Coho Salmon during different seasonal and flow conditions, indicating that the sum total of the habitat complex had a larger positive impact than any single feature would have had as a stand-alone intervention. The second major lesson learned was that while the project was developed prior to the full articulation of the "Process Based Low Tech" methodology, working in the degraded, yet dynamic conditions of French Creek, the Project was greatly benefited by being able to apply site stewardship and adaptive management activities in the 2 post-implementation years.

Acknowledgements

The authors of this document are Betsy Stapleton, Scott River Watershed Council Board of Directors President, Charnna Gilmore, Executive Director, Erich Yokel, Monitoring Supervisor and GIS Specialist, Darrell Mitchell, Field Technician and PIT Array Specialist, Monica Tonty, Fisheries Biologist and Humboldt State University Graduate Student.

The authors extend our gratitude to all the individuals, groups, and agencies who have contributed to this project since its beginning and have helped us better understand the beautiful watershed that we call home. Most importantly, a sincere thank you to the landowners of the Scott River Watershed who allow restoration actions to occur on their land.

We give thanks to the leadership of the Scott River Watershed Council Board of Directors Larry Alexander, Craig Thompson, Michael Stapleton, Kory Hayden, Matt Thomas and Jen Bray. A special thanks to field and office staff of the Scott River Watershed Council who have worked on this project, Linda Bailey, Isis Hayden, Shirley Johnson, Jess McArthur, Dale Munson, Emily Savides and Amanda Schmalenberger.

Thank you to both Dr. Darren Ward, Professor for Humboldt State University and Dr. Michael Pollock, National Oceanic and Atmospheric Administration who have provided a lot of time and expertise on our project effectiveness monitoring activities.

With much gratitude to the funding for this project provided by the California Department of Fish and Wildlife, United States Fish and Wildlife Service and the Klamath National Forest. Additionally, we give thanks to our project partners Cascade Stream Solutions and North River Construction.

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Project Purpose

French Creek Instream and Off Channel Enhancement Project was undertaken with the purpose of addressing all the identified limiting factors at the site to see if an improvement in spawning and rearing conditions for Coho Salmon would be met with a positive biological response. The Project components were engineered log jams (ELJs) in the main French Creek channel, a side channel, a small inset floodplain adjacent to the side channel, appropriately sized spawning gravel introduction, and extensive riparian planting. Monitoring of water quality and quantity, Coho Salmon utilization, growth, population, and spawning, as well as the site response to the restoration actions was initiated, extending over the following two years which encompassed both wet and dry water years.

The habitat improvement project was designed for a section of French Creek that was significantly entrenched with high velocities and a stable degraded condition with an alder corridor maintaining the cuboidal, incised and simplified profile. Designs goals and features of the instream habitat improvement included placement of coarse gravel and small cobble and unanchored large wood. These structures were designed to:

- Promote primary channel aggradation by providing deformable and mobile hydraulic controls.
- Augment coarse substrate suitable for coho spawning.
- Create instream large wood cover.
- Increase temporary storage of woody material.
- And improve bed material sorting.

Pool habitat created by the off-channel feature, as well as pools formed in response to large wood placement, were included to provide refugia with depth, cover and slower velocities for immediate habitat benefits for salmonids. Placement of larger wood in the main channel was designed to work with the stream dynamics, allowing natural gravel recruitment to occur during future seasons. Sediment deposition around the structures were designed to increase the potential for floodplain access as the riparian function improved.

The Side Channel was designed to complement the instream actions by providing slow water habitat for juvenile coho salmon throughout the year. During summer months when flows are low and portions of the main channel may offer limited habitat, the secondary channel was designed to provide slow water habitat with depths of 0.5 to 4 feet for juveniles to seek refuge from shallow stream conditions. In the winter when flows are fast in the primary channel, flows from the primary channel to the secondary channel were designed to be controlled by constricting the inlets and outlets of the secondary channel. Within the secondary channel, large wood was placed to provide habitat and minimize flow velocities.

Unlike many "off-channel" ponds constructed in other areas of the Klamath Basin that have a single connecting channel to the mainstem creek, the Project Side Channel feature was designed with both an inlet and an outlet for several reasons. With the incised primary channel, it was felt that splitting flow would decrease velocity in the main channel, reducing shear stress and further incision. Reduced velocities and shear stress were designed to decelerate the failure of the rock revetment on the right bank, extending the protection of the right bank landowner's agricultural operation, which extends to the top of the revetment. In addition, engineering guidelines from the application FRGP solication required both an inlet and an outlet for off-channel features.

Project Partners

The Project was funded by FRGP on June 1, 2017; funding included both implementation and project effectiveness monitoring. Support for additional engineering and project management was provided by United States Fish and Wildlife Service (USFWS) grant #F17AC00482 (Table 1).

TABLE 1. FRENCH CREEK INSTREAM AND OFF CHANNEL ENHANCEMENT PROJECT FUNDING.

Tasks	**FRGP**	**USFWS**	**SRWC Match**	**Total**
Personnel	$63,388	$3,091	$9,850	$76,329
Contractual Services	$88,627	$6,000	$10,000	$104,627
Material & Supplies	$31,245	$0	$3,580	$34,825
Electronic & Purchased Equip.	$5,353	$0	$0	$5,353
Streambed Alteration Agreement	$4,198	$0	$0	$4,198
Indirect Costs	$18,609	$909	$0	$19,518
Total	**$211,420**	**$10,000**	**$23,429**	**$244,850**

Supplemental funds for monitoring were also provided by FRGP grant #Q1910504 titled *Effectiveness & Validation Monitoring of Scott River Beaver Dam Analogue*. While the monitoring grant focused on evaluating beaver dam analogues (BDAs) effectiveness, it included this Project site as a comparison site to understand the relative benefits of BDA to other restoration approaches. Invasive weed management and riparian planting support was provided by SRWC's Youth Environmental Summer Studies (YESS) funded by the Klamath National Forest.

The work performed for this Project was solely on private lands. The support and willingness of landowners to allow this type of project to be implemented and monitored is one of the key reasons French Creek continues to play such a critical role in the survival of the Scott River Coho Salmon population. Engineering services were provided by Cascade Stream Solutions (PE#53319) and construction implementation and adaptive management activities were performed by North Rivers Construction (#866139).

French Creek, Scott River Watershed, Siskiyou County

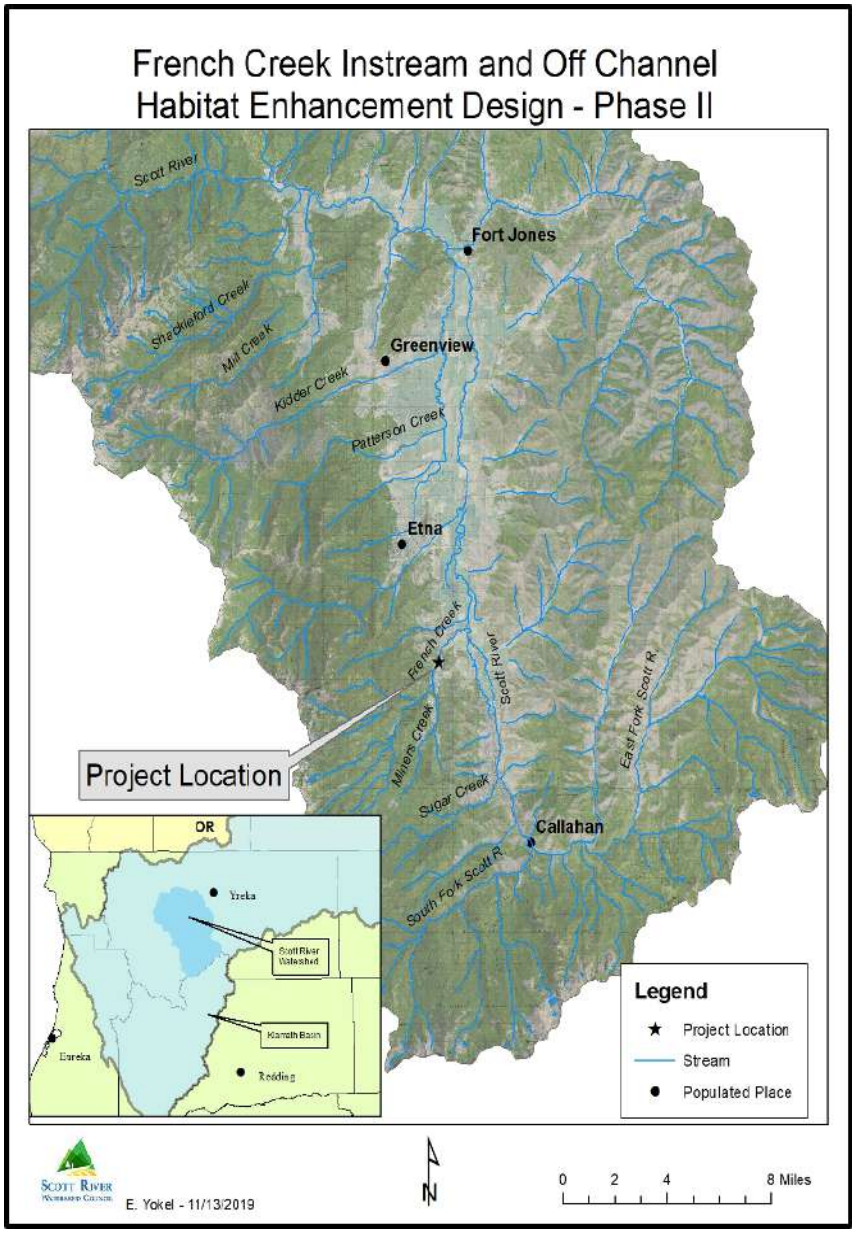
Location and Setting

French Creek is a spawning and rearing tributary for Coho Salmon and maintains connectivity and suitable water quality throughout summer during all water year types including critical drought, offering critical habitat for Southern Oregon Northern California Coho (SONCC) Salmon. These facts confirm the vital importance of restoring the French Creek habitats to their maximum potential function.

French Creek is a naturally granitic watershed with 63% of its 20,584 total acres considered granitic terrain (Sommarstrom 1990). The effects of gold mining, land development for agriculture, stream channelization, extensive beaver harvest and upslope road development have significantly reduced the quality and quantity of the available habitat for spawning and rearing salmonids. These cumulative anthropogenic impacts have fundamentally altered the stream channel morphology by the confinement of the stream channel resulting in loss of floodplain connectivity and channel degradation. The constrained channel morphology, lack of floodplain connectivity, paucity of instream woody debris and upslope roads and sediment sources significantly alters the magnitude of discharge and sediment transport processes. As a result, spawning gravels are limited, the overall stream system has been simplified, and the volume of high-quality rearing habitat has been dramatically reduced from historic conditions. These legacy impacts combined with current land use practices (e.g water extraction for agriculture), and a warming, drying climate, are leading to continued degradation and further reduction of the quality and quantity of the habitat for salmon and steelhead.

The Scott River watershed's water quality was listed as impaired by excessive sediment in 1992 and impaired by high temperature in 1998, pursuant to Section 303(d) of the Clean Water Act. Furthermore, the SONCC Coho Salmon Recovery Plan (National Marine Fisheries Service 2014) prioritized actions to increase summer and winter rearing habitat through increased floodplain connectivity through restoration of existing channel form and function and the construction of off channel ponds, alcoves, backwater habitats and old stream oxbows. This is based on the critical need to increase the quantity, quality and availability of complex, deep, slow water habitats for summer and over-winter rearing Coho Salmon within the Scott River system.

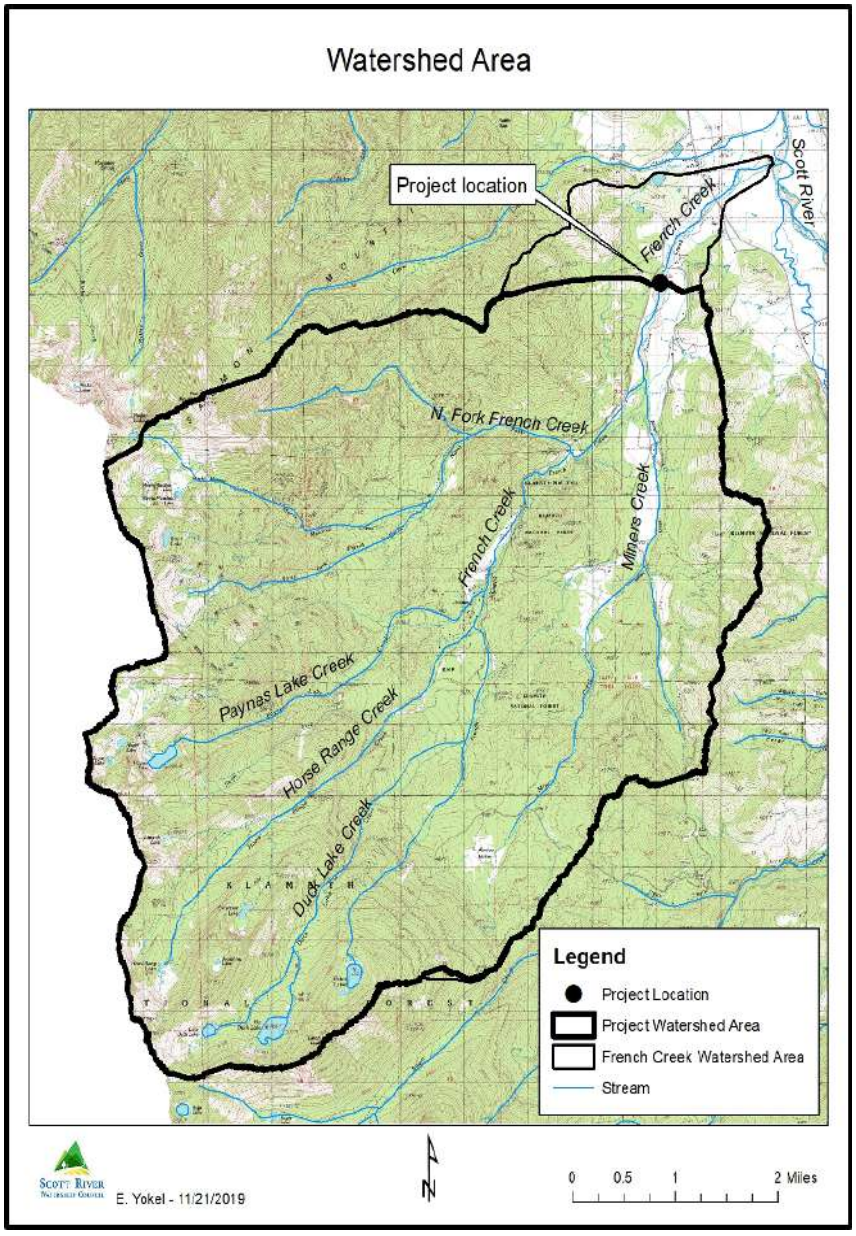
The Scott River watershed is part of the larger Klamath River basin in Siskiyou County, California. The Project addressed a 650-foot reach within the mid valley portion of French Creek (Map 1).



MAP 1. LOCATION OF PROJECT IN THE SCOTT RIVER WATERSHED AND OVERVIEW OF LOCATION OF THE SCOTT RIVER WATERSHED WITHIN THE KLAMATH RIVER BASIN.

French Creek is a 3rd order tributary and flows from the west flowing to the Scott River in a northeast direction. Numerous tributaries feed into French Creek and, when combined with the main stem, total 45.5 stream miles with the headwaters that originate within the Russian Wilderness located at 6000' to 7000' elevation. The Project watershed area is approximately 31.7 square miles, a significant portion of the 33.3 square mile French Creek watershed. The large watershed and high elevation of many of the

tributary creeks suggest that French Creek is relatively drought and climate change resilient (Map 2 and Table 2).



MAP 2. DETAILED OVERVIEW OF THE FRENCH CREEK WATERSHED, INCLUDING BOTH THE ENTIRE WATERSHED AND PROJECT WATERSHED AREAS.

TABLE 2. PROJECT BASIN CHARACTERISTICS FROM UNITED STATES GEOLOGICAL SURVEY STREAMSTATS (UNITED STATES GEOLOGICAL SURVEY 2019).

Basin Area	31.7 sq mi
Percent of Basin Area above 6000 ft	24.60%
Mean Basin Elevation	4707 ft
Maximum Basin Elevation	7964. ft
Mean Annual Precipitation in Basin	34.5 in

Land Use

Prior to the arrival of non-indigenous people, Native American tribes inhabited the Scott River watershed (Kroebe 1976). In the 1830s, the area was discovered by Hudson Bay fur trappers, setting the stage for the first significant anthropogenic impact to the Scott River and many of its tributaries, including French Creek, with the near extirpation of beaver (*Castor canadensis*) (Wells 1881). Starting in the 1850s, gold mining activities occurred throughout the Scott Watershed including French Creek and Miners Creek and was followed by commercial logging in the upper portion of the watershed (Sommarstrom 1990).

By the end of the 1990s, riparian fencing, also known as exclusionary fencing, began to be constructed throughout the Scott River, including French Creek and Miners Creek. According to landowner accounts, fencing along the Project reach occurred in 2000-2003. Prior to fencing, intensive grazing by cattle within the riparian zone was observed.

Today, the land use consists of privately owned agricultural operations on both sides of French Creek, however each side varies in the distance of exclusionary fencing from the current streambank and irrigation practices. Currently the left side (west) of the creek has a wide floodplain area and is fenced with exclusion fencing along the irrigated field utilizing a pivot irrigation system. The right side (east) also has exclusionary fencing, but the agricultural operation is closer to the creek and primarily utilizes flood irrigation. In recent years, the landowners on both sides of the Project have supported restoration activities within the French Creek, with the goal of enhancing habitats that support Coho Salmon.

Water Use

French Creek was adjudicated in 1958. The adjudication was managed by the Department of Water Resources until 2011, when the Siskiyou County Superior Court transferred 369 authority to the Scott Shasta Water Master District to administer the degree. The French Creek Adjudication allows for a total of 36.51 cubic feet per second to be diverted for agricultural activities and is one of only two creeks in the Scott Watershed that is currently actively water mastered. It is believed that nearly all agricultural diversions in French Creek have been fitted with fish screens. Most fish screens are privately maintained however there are known diversions and fish screens that are currently maintained by CDFW.

In the recent past, the Scott River Water Trust (SRWT) completed annual short term water lease transactions on Miners Creek and French Creek. There is a 1707 dedication in the French Creek drainage, however it lies below the Project reach, and therefore does not affect water quantity for the Project.

Water Quality

Given the highly erodible soils within the French Creek basin, high sediment loads have been documented (Sommarstrom 1990). There was an intense effort in the late 1990s and early 2000s to significantly reduce sediment delivery to the stream through various activities in the upper portion of the watershed relating to road maintenance and culvert reconstruction, however long-term monitoring on sediment inputs has not continued. Over and above that, determining actual sediment supply at any given time and space is difficult to achieve with any confidence and therefore is considered to be inevitably stochastic (Cramer 2010).

Evidence of extensive flooding in the valley dates back prior to Euro American settlers, however the most well documented events have occurred in the past two centuries (Helley and Lamarche 1973). Reports of several damaging floods in the 1800s and early 1900s exist, the largest flood on record for the USGS gage below Fort Jones (established in 1941) was on December 22, 1964, with river flows peaking at 54,600 cfs, causing extensive damage (US Geological Survey 2019) (Photo 1). Subsequently, some stream bank protection and channelization were constructed, either limiting or eliminating frequent floodplain inundation.

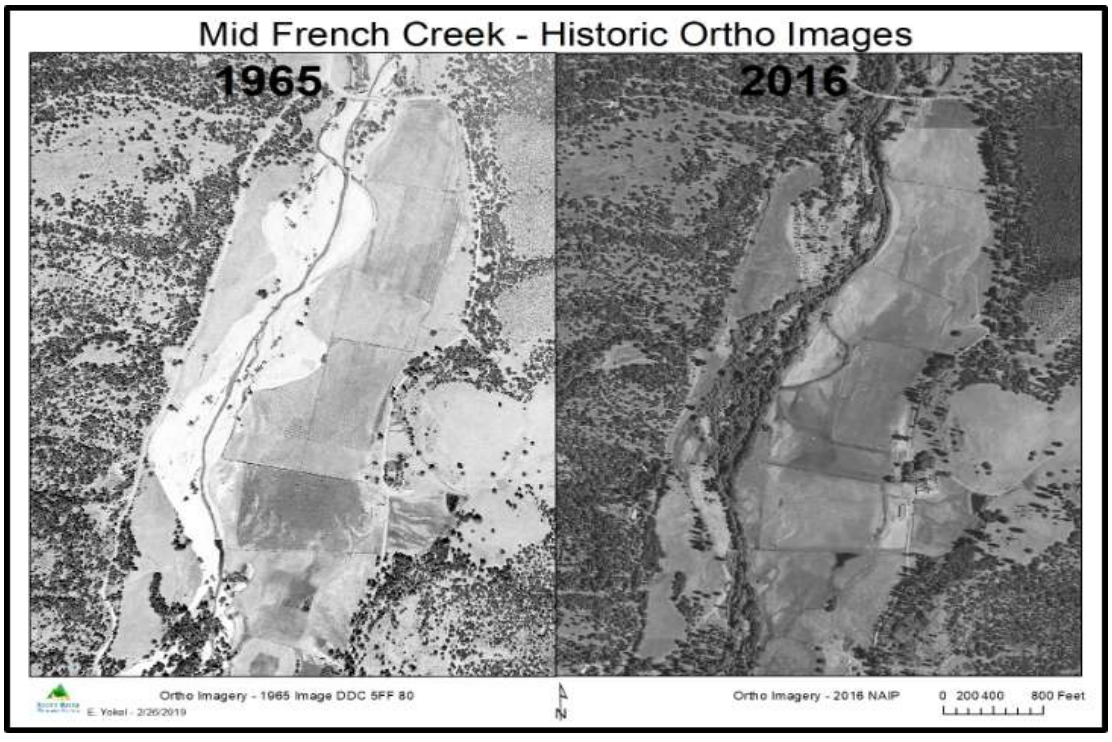


PHOTO 1. HISTORIC ORTHO IMAGE OF PROJECT AREA FROM 1965 COMPARED TO 2016.

Fisheries

French Creek is one of two tributaries to the Scott River that has shown Coho Salmon presence every year since spawning surveys were started in 2001. The density of Coho Salmon redds observed in the Mid French Creek reach ranks as one of the highest tributaries utilized by Coho Salmon (Scott River Watershed Council 2018).

A limiting factor analysis for Coho Salmon in the Scott River performed by SRWC identified a lack of suitable rearing habitat during the summer and winter months as the probable limitation for smolt production (Scott River Watershed Council 2005). The CDFW Recovery Strategy corroborates this analysis, stating that the juvenile life stage is the limiting freshwater life stage for continued viability and success of the Scott River Coho Salmon population (California Department of Fish and Game 2004). The National Oceanic and Atmospheric Administration (NOAA) Fisheries Recovery Plan (National Marine Fisheries Service 2014) further states that "the limiting stresses for the Scott River Coho Salmon population are the degraded riparian habitat conditions and altered hydrologic function" with the severity of stresses affecting the fry, juvenile and smolt life stages ranked as "Very High" for these two stresses.

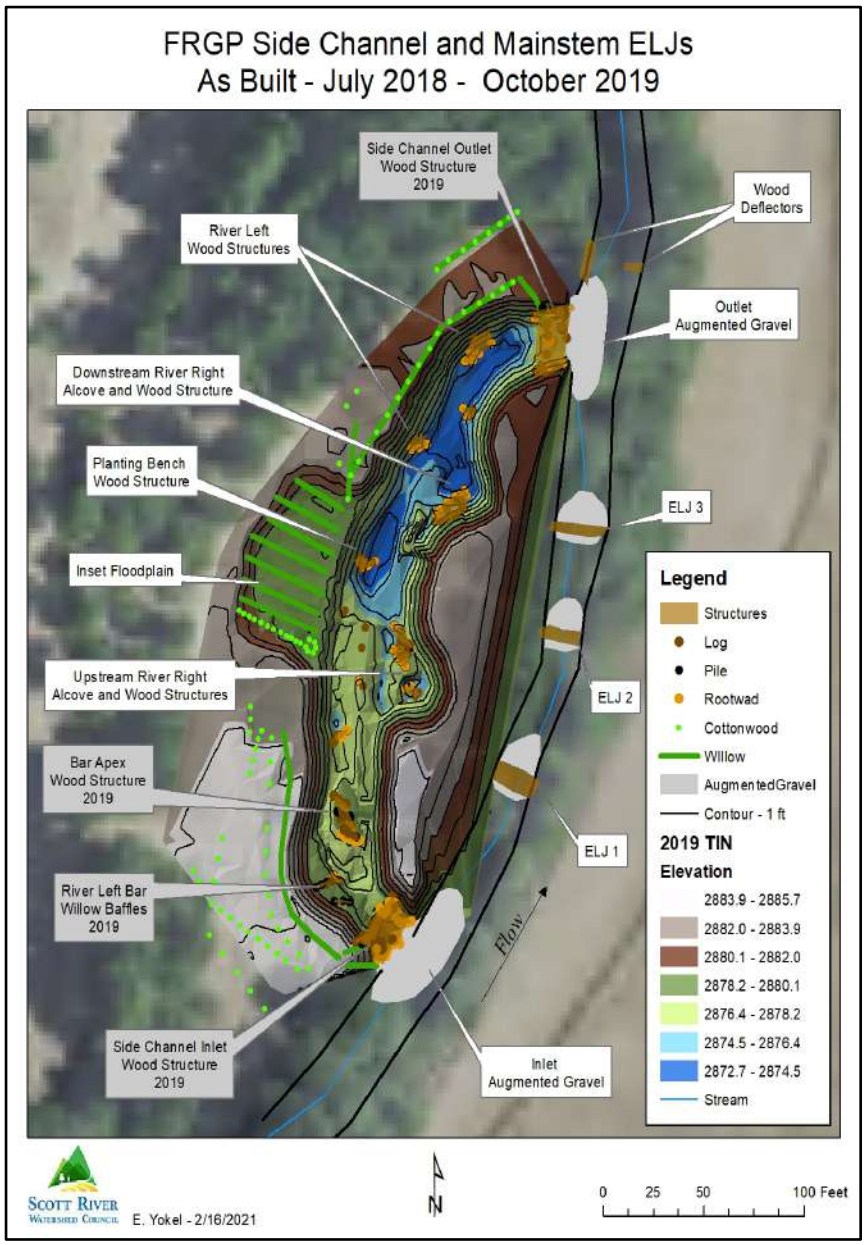
The NOAA Recovery Plan identifies six highest priority recovery actions for the Scott River watershed including increasing beaver abundance, constructing channel-ponds, alcoves, backwater habitat and old stream oxbows and restoring natural channel form and function, several of which are directly addressed by the Project's restoration actions. The restoration plans support prioritizing restoration investment in French Creek as French Creek, which is identified as a "key watershed" in the CDFW Recovery Strategy and a tributary with high intrinsic potential in the NOAA Recovery Plan.

Project Details

The Project included four primary construction elements consisting of the following: 1) Excavation of a channel with both an inlet and outlet, parallel to the mainstem French Creek; 2) Construction of three instream channel spanning engineered log jam (ELJs) in the main channel. and with bank log structures within the constructed side channel; 3) Introduction of spawning gravel; 4) Extensive planting. Designs for the Project were provided through an earlier FRGP funded project, *French Creek Instream Habitat Enhancement Project* (#P1310305), in which Cascade Stream Solutions, in partnership with the SRWC and CDFW, produced 100% engineered plans and specifications (Appendix A). Subsequent adaptive management actions were taken in 2019 and 2020. The result of the totality of these actions produced a stream reach that is now more complex than at baseline, offering a variety of habitat types during different environmental conditions (Map 3).

The Project reach is 650 ft in length and begins at French Creek RKM 3.0 extends to RKM 3.2. Pre-implementation, the channel was simplified with a cuboidal configuration and consisted of a long riffle.

The substrate consisted of cobble embedded in fine sands. The right bank was armored with rock revetment, likely placed after the historic 1964 flood. The rock revetment showed undercutting, some of which was caused by beaver burrowing, and some as a result of on-going incision in the reach. In addition, the rock revetment was in a process of "unravelling", with several large boulders displaced into the stream channel. The left bank was at a lower elevation than the right, but during the landowner's 20 years of observation, high flow never spilled out of the channel onto the adjacent floodplain. Both right bank and left bank had a galley wall of alders, but no other significant vegetation. Many of the alders showed signs of senescence, with several dead and dying trees tipping into the channel.



MAP 3. AS BUILT MAP OF FEATURES, STRUCTURES AND PLANTING INSTALLED FROM JULY 2018 TO OCTOBER 2019.

Project Implementation

On July 19, 2018, Project implementation began with the construction of a 310' distributary side channel (Photo 2). The "Side Channel" included several elements such as large wood (bank log structures), alcoves and a large inset floodplain, all intended to provide complexity under different flow regimes. Log structures were also installed at the margins of the inlet and outlet of the Side Channel to provide roughness, slowing the water to discourage the channel from capturing too much of the stream flow (Appendix C).

PHOTO 2. CONSTRUCTION OF SIDE CHANNEL – JULY 19, 2018.

The excavated depth of the channel was approximately 3 to 6 feet below the mainstem channel elevation near the inlet. A total of 4700 cubic yards of material was excavated and relocated to another location on the landowner's property, out of the floodplain to avoid re-introducing the material to the stream under high flow conditions. Within the channel, 50 large logs with rootwads were placed along the channel edges, burying the logs into the banks, leaving the rootwads exposed within the channel profile to add roughness and to provide cover for juvenile Coho Salmon (Appendix C).

Instream features, consisting of three ELJs and two bank log deflector structures were constructed within the mainstem of French Creek. The ELJs consisted of channel spanning log structures placed within a linear 340-foot reach between the inlet and outlet of the excavated channel. The structures were placed approximately 70 to 90 feet apart and were ballasted by burying a portion of logs into the bank and then driving 4" to 6" logs driven vertically (micro-piles), essentially pinning them into place (Appendix C). The placement of the structures was field fit in order to reduce the need to disturb existing riparian vegetation.

The two bank log deflector structures, one on either side of the mainstem, were installed below the outlet of the excavated channel. The right bank structure consisted of a single log which was pinned between two live streamside trees. Additional pinning using 4" to 6" logs driven vertically (micro-piles)

was done to discourage movement of the structure. Along the left bank, three logs with rootwads were anchored into the bank by burying the majority of the log into the bank (Appendix C).

Spawning gravel (size = 0.5”- 3”) was introduced in five locations within the project reach including both the inlet and outlet entrances and both upstream and downstream of each ELJ footprint. In total, approximately 35 cubic yards of gravel was distributed within the various locations (Appendix C).

The final component of the Project implementation phase was an emphasis on establishing riparian plants. As part of construction, a 2790 square foot inset floodplain on the west side of the evacuated side channel was created with the intent to be inundated during moderate and high flows (Appendix B). Original plans called for the planting of 300 willow (*Salix sp.*) stems and 16 cottonwood (*Populus trichocarpa*) poles however it was decided that a more robust planting element would be advantageous, and would incur a very minimal incremental cost increase, therefore ~2000 willows, 98 cottonwood and 3 box elders (*Acer negundo*) were planted. Plant material was dormant at the time work was done, hence the inclusion of the box elders.

On the constructed floodplain, willows were planted in seven rows perpendicular to the longitudinal profile and flow path of the Side Channel with the goal of diffusing high flow on the floodplain and capturing sediment. A few cottonwoods were also planted on the constructed floodplain. The willows were not caged, but the cottonwood poles were. The stems and poles were placed in trenches or holes and back filled. At the elevation of the original stream terrace, trenches or holes were dug into groundwater and both cottonwood poles and willow stems were planted. Extensive effort was performed on the backfilled cuttings to ensure that maximum soil to stem contact was achieved by “jetting” high pressure water to move fine material into the cutting locations, thereby removing air pockets. The depth from surface to groundwater varied from 6-10 ft. The substrate consisted of mixed sand and cobble similar to material on the surface (Photo 3).

Cottonwoods were planted at a spacing of approximately 10 feet per stem. Willow was placed in the trench at high density with stem counts greater than five per linear foot in the areas of highest density. Approximately 625 linear feet of willow was planted at the project site. Willow plantings were cut to approximately 6 inches above the ground to support root development. All cottonwood plantings were protected with caging to discourage browsing by both ungulates and beaver during the initial stage of establishment.

Photo 3. Cottonwood poles planted at a depth of ~10' into groundwater - March 2018.

As a result of runoff events of the WY2019, water surface elevations within the Side Channel inundated the inset floodplain for a significant period. Fine organic and inorganic sediment was deposited on the inset floodplain and high-density multi-species native plant recruitment was documented over the following year as a result (Photo 4).

PHOTO 4. PLANTINGS ON CONSTRUCTED FLOODPLAIN, BOTH PLANTED AND NATURAL RECRUITMENT – AUGUST 8, 2019.

As part of an ongoing effort by the landowners to control invasive weeds in the project reach, the YESS crew removed fifteen 55-gallon bags of weeds in July 2018. The YESS crew also removed weeds in the summer of 2019.

Project Site Evolution and Adaptive Management

During a high flow event in the winter of 2018- spring 2019, it was noted that approximately 75% of the stream flow was moving through the side channel, with only ~ 25% traveling through the main channel. As flows receded, it was noted that there had been extensive organic and inorganic sediment deposition into the side channel, reducing its depth and capacity (Photo 5).

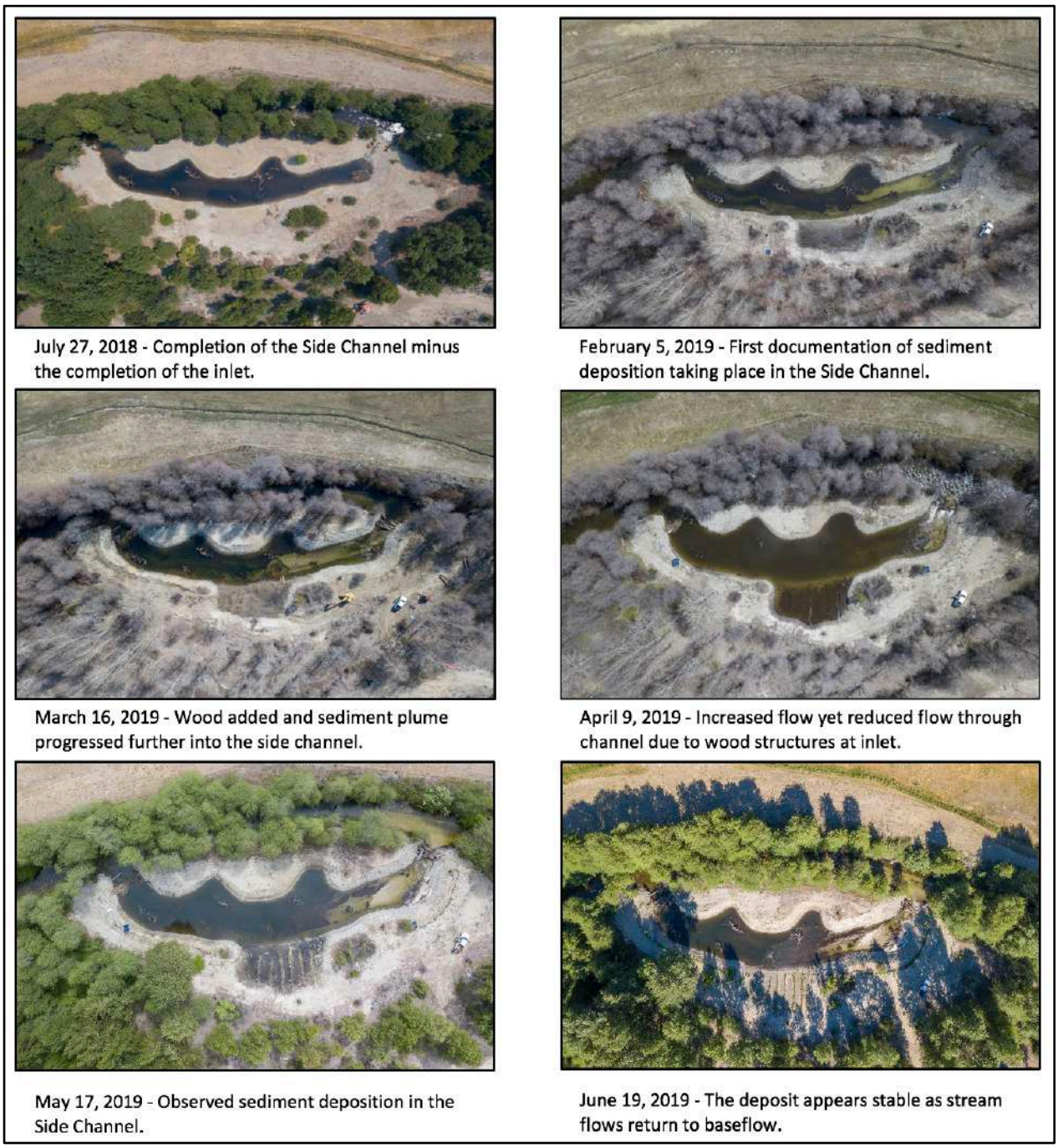
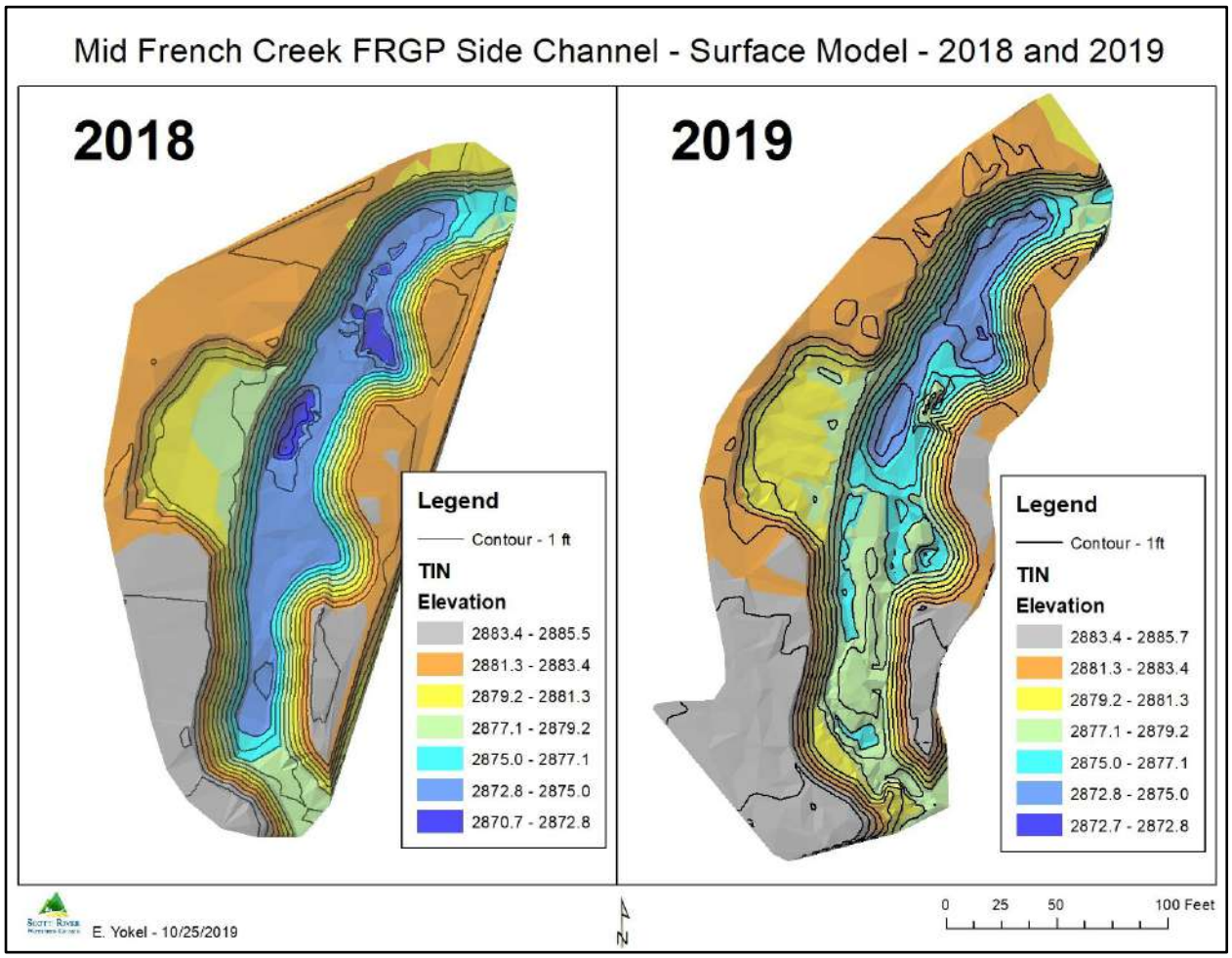


PHOTO 5. SERIES OF AERIAL PHOTOS OF SIDE CHANNEL AND THE SUCCESSION OF SEDIMENTATION. PHOTOS COURTESY CASCADE STREAM SOLUTIONS.

Comparison of the surface model generated from the as-built topographic survey performed in 2018 to a surface model and a survey performed in 2019 documented the location and depth of the stored sediment (Map 4).



MAP 4. 2018 AS BUILT AND 2019 SURFACE MODELS OF SIDE CHANNEL.

In response to the high flows of winter of 2018 - spring 2019, SRWC consulted with the project engineer, FRGP Project Manager and FRGP engineering staff and it was determined that adaptive management activities were appropriate (Table 3).

TABLE 3. ADAPTIVE MANAGEMENT ACTIONS BASED ON THE RESPONSE OF THE SYSTEM TO RESTORATION ACTIONS.

Date	Adaptive Management Action	Trigger	Goal
March 2019	Added wood structures were keyed into both inlet and outlet reducing flow into and out of the Side Channel, the elevation of was ELJs strategically lowered to increase transport capacity in the mainstem.	During high flows, ~70% of flow was going through the Side Channel.	Reduce flow into the Side Channel, increase transport through the main channel.
March 2019	Armoring side channel, left bank, above outlet	During high flows, overtopping was noted on the north bank of the Side Channel at outlet.	Reduce impact on Side Channel's bank in high flows.
October 2019	Additional wood in inlet were installed at the channel inlet and on the sediment bars	Excessive flow and sediment had entered the Side Channel even after the first adaptive management action.	Increase water and sediment transport in the main French Creek Channel, reduce sediment deposition in the Side Channel.
October 2019	Additional riparian planting the on deposited sediment bars	Once excessive flows entered Side Channel the velocity was reduced therefore allowed a significant amount of both organic and inorganic material to deposit within the upper portion of the Side Channel.	Stabilize sediment bars to reduce mobility of material
October 2020	Side Channel was excavated	Habitat volume greatly reduced, deeper cold (summer) and warm winter areas reduced. Want to maximum habitat volume until additional upstream restoration is undertaken to further increase stream habitat capacity and reduce sediment transport into reach.	Increase depth of water within the Side Channel to help attenuate water temperatures, particularly in summer and to increase the volume of habitat, both summer and winter.

March 2019: Three adaptive management actions were undertaken: 1) Wood structures and ~ 15 cubic yards cobble was installed at both inlet and outlet of the Side Channel to create roughness and to encourage more flow to remain within the main channel of French Creek, 2) The height on the upstream ELJ was lowered to allow more flow to remain in channel; and increase its carrying capacity; 3) Cobble rock (~ 3" to 5") was brought in and lined the north bank of the Side Channel to stabilize the bank and reduce erosion.

October 2019: Wood and riparian plantings were installed at the channel inlet and on the sediment bars downstream of the inlet to further reduce the inflow and stabilize and revegetate the deposited sediment (Photo 6). Two logs were placed on top of each other with the root wads off set and a third log was placed on top of the two logs into the inlet. All rootwads were placed on the water's edge of the river left of French Creek. Twelve 4-6" wood post piles were installed at angles to anchor the log structures.

Additionally, three 30-feet juniper logs were placed on the center bar with the root wads placed at the upstream water's edge. Twelve 4-6" wood post piles were installed at angles to anchor the log structures. Seven 4-6" wood post piles were installed in two lines (three posts in upstream location and four in downstream location) parallel to the flow line on the river left bar and then were weaved with willow cuttings.

To help stabilize the deposited bar, willow cuttings were planted on the inlet, center and river left bars. The excavator bucket was utilized to "pull back" sediment to expose water and willows were placed in the cavity and the sediment was subsequently replaced. Planted willow cuttings were cut with approximately 10-12 inches above ground. Cuttings were placed by hand in the bars.

PHOTO 6. SERIES OF BEFORE AND AFTER PHOTOS OF SIDE CHANNEL INLET AND DEPOSITITION OF SEDIMENT.

October 2020: To directly address the deposition of the sediment noted in 2019, approximately 225 cubic yards of excavated material was removed from the Side Channel and relocated to another location on landowner's property (Photo 7). The goal was to improve water quality, in particular summer water temperature by increasing the depth of water and allowing for increased stratification of the water column. At the end of the grant period (February 2021) there has been very little sediment deposition observed within the Side Channel.

PHOTO 7. REMOVAL OF SEDIMENT IN THE SIDE CHANNEL, OCTOBER 15, 2020.

Project Effectiveness Monitoring

Water Quality

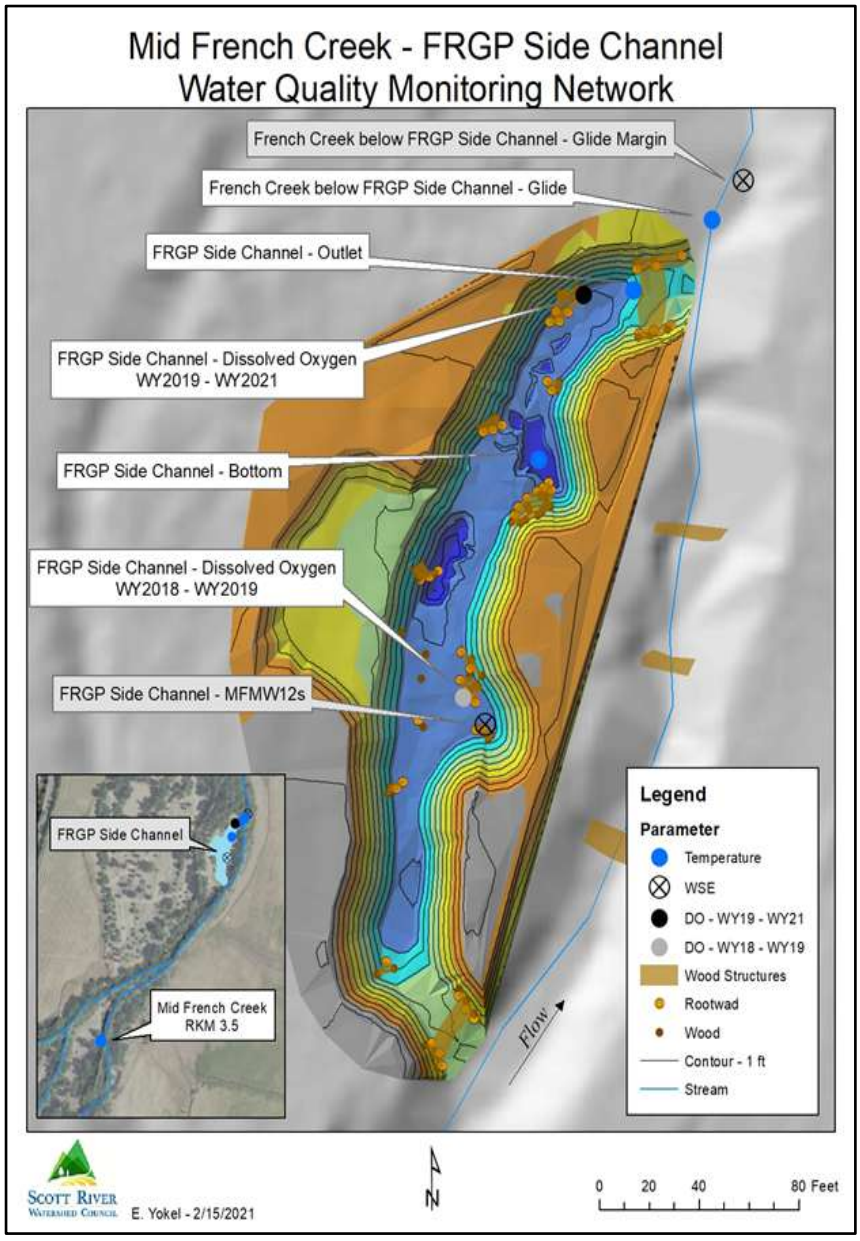
A network of water quality monitoring stations was installed in French Creek and the constructed Side Channel to document the water quality conditions before, during and after project implementation. Water temperature (Onset Computer Corporation Tidbit v2), water surface elevation (WSE) (Onset Hobo U20L pressure transducer) and dissolved oxygen (DO) (Onset Hobo U26 DO and temperature logger) loggers were installed in the mainstem French Creek and/or the Side Channel (Map 5). Loggers documented continuous (every 15 minute) data.

A temperature logger was installed above the project location in WY2017 at RKM 3.5 (French Creek - RKM 3.5). Before construction commenced in 2018, a water temperature logger was installed below the Side Channel outlet (RKM 3.1 - French Creek below Side Channel - Glide) and WSE stations were installed upstream (RKM 3.2) and downstream (RKM 3.1 - French Creek below Side Channel - Glide Margin) of the project site to monitor potential effects of construction activities. Discharge measurements were performed at the upstream and downstream WSE to develop a rating curve to calculate continuous discharge during the period of construction to monitor potential flow losses. No alteration of stream discharge was noted during the period of construction and the upstream WSE station was removed in fall of 2018.

Upon completion of the Side Channel two temperature loggers, a WSE station and a DO logger were deployed in the feature on August 3, 2018. The temperature loggers were placed in the deeper water adjacent to the structure at the downstream river right alcove (Side Channel - Bottom) and in shallower water upstream from the outlet (Side Channel - Outlet). The WSE station (MFMW12s) was installed in the upstream river right alcove and the DO logger was deployed in deeper water adjacent to the wood structure in the upstream river right alcove.

A Trimble GNSS RTK was utilized to survey the reference point elevation of the WSE stations to mean sea level (NAVD88 vertical datum). The reference point elevation was utilized with empirical measurements to convert the continuous depth data to WSE. The temperature and WSE stations were downloaded on a quarterly schedule. The DO logger was downloaded and maintained (sensor membrane cleaned) on a biweekly schedule during the summer period of base flow and a biweekly to monthly schedule during the winter months to minimize the occurrence of fouling.

Continuous temperature and WSE data were converted to daily averages for analysis and presentation. The moving weekly average temperature (MWAT) was calculated for all stations and the maximum and minimum MWATs were determined for each station for each water year.



MAP 5. WATER QUALITY MONITORING NETWORK ESTABLISHED IN 2018 AT FRGP SIDE CHANNEL.

Analysis of the continuous water temperature at the water surface elevation station (MFMW12s) installed in the upstream River Right Alcove illustrates the effects of the sediment deposition on temperature (Figure 1). The temperature exhibits a surface water signal with high diurnal variation before mid-February 2019 with subsequent data exhibiting a groundwater signal with low diurnal variation. Comparison of the daily average temperatures at temperature loggers in the Side Channel and the mainstem French Creek illustrates the divergence of averages associated with the sediment storage from the runoff events in WY2019 (Figure 2).

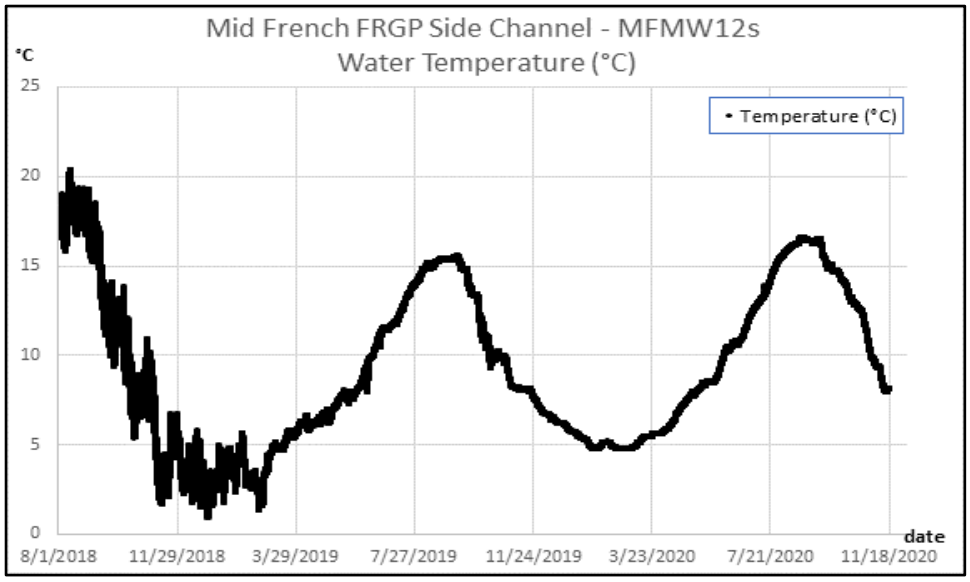


FIGURE 1. CONTINUOUS WATER TEMPERATURE (°C) WSE STATION MFMW12S.

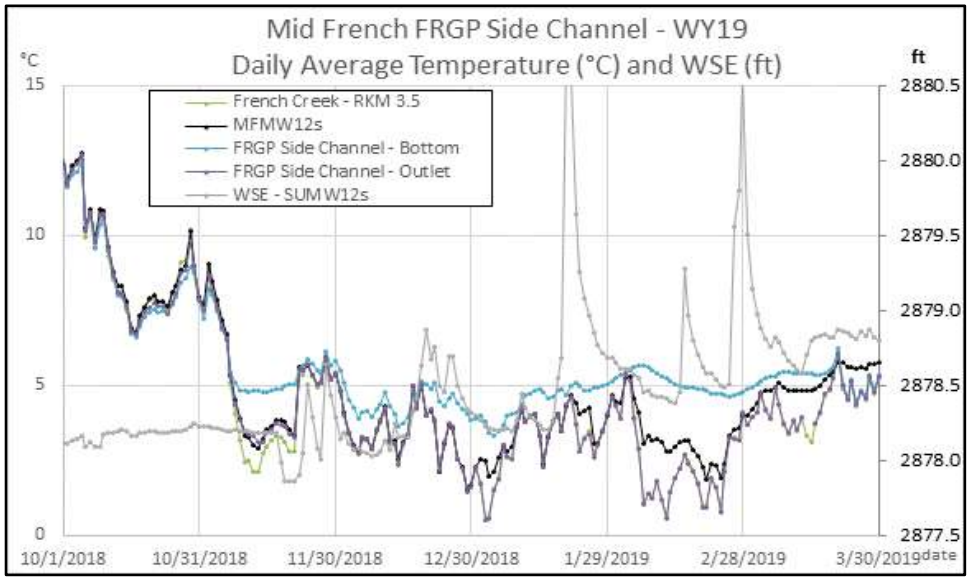


FIGURE 2. DAILY AVERAGE WATER TEMPERATURE AND WATER SURFACE ELEVATION (WSE).

Environmental Conditions

The Side Channel and Mainstem ELJs were installed during the base flow period of WY2018 - a critically dry year. Accumulated monthly precipitation has been documented in the Scott River Watershed at the USFS Ranger Station in Fort Jones since WY1938. The accumulated precipitation from October 1 to April 1, from October 1 - July 1 and from October 1 - September 30 was calculated from WY1938 - WY2020 and each water year was ranked by dryness (Dry Rank) with a rank of 1 indicating the driest year on record. The percent average of the snowpack's water equivalence from the April 1st snow surveys is included with the precipitation data (Table 4).

The three water years (WY18 - WY20) spanning the project include two critically dry water years (WY18 - 5th driest and WY20 - 4th driest accumulated precipitation from October 1 to April 1) and one average water year (WY19). The water quality data from WY19 and WY20 reflects the different environmental conditions of the two water years.

TABLE 4. ACCUMULATED PRECIPITATION AT FORT JONES AND APRIL 1 SNOWPACK BY WATER YEAR.

Water Year	Acc. Prec. (in) Oct. 1 - April 1	Dry Rank	Acc. Prec. (in) Oct. 1 - July 1	Dry Rank	Acc. Prec. (in) Oct. 1 - Sept.30	Dry Rank	April 1 Snowpack Water Equivalence % Average
WY18	8.1	5	12.2	7	12.2	6	36%
WY19	16.6	42	19.2	41	20.8	41	134%
WY20	7.0	4	9.5	4	10.1	3	44%
Average (83 Years)	17.2	--	20.0	--	21.3		--

The California Department of Water Resources (CDWR) operates a stream discharge station in French Creek at RKM 1.4 (F25650). The approved daily mean discharge data for WY18 - WY20 was retrieved from the CDWR Water Data Library (wdl.water.ca.gov). The French Creek discharge data illustrates the significantly higher flows during the winter and spring runoff period of WY19 as compared to the runoff period of WY20 (Figure 3). The base flow period of summer occurred later in the average WY19 (early August) then during the critically dry WY20 (mid-July). The different environmental conditions in WY19 and WY20 affected the observed water quality regimes during the base flow and runoff periods.

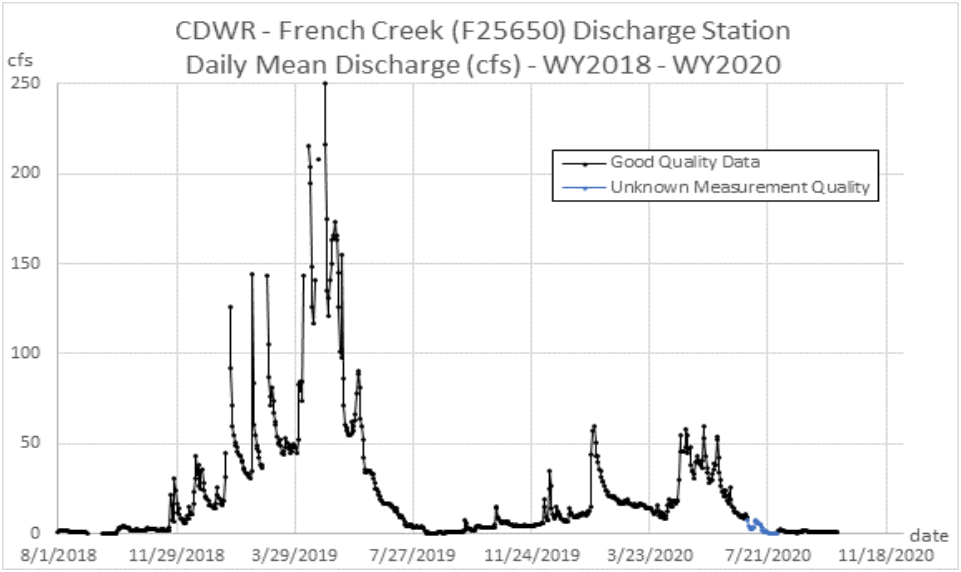


FIGURE 3. CDWR FRENCH CR (F25650) APPROVED DAILY MEAN DISCHARGE - FRENCH CREEK RKM 1.4.

Water Surface Elevation

Water surface elevation (WSE) was documented in the Side Channel and in French Creek below the Side Channel from August 2020 to present. The WSE in the Side Channel correlates to the stream discharge documented at the CDWR discharge station. During WY19 multiple WSE peaks were observed during the

late fall, winter and early spring months (November to April) corresponding to rain driven runoff events followed by a period in the spring (April to June) of sustained higher WSE corresponding to the snow melt. A downward limb of WSE corresponds to the decreasing discharge in French Creek to base flow (Figure 4).

During WY20 only one significant peak in WSE is observed during the precipitation driven period with depressed WSE during the historically dry months of February and March 2020. The WSE during the snowmelt period of WY20 was significantly lower than in WY19 and the base flow period was achieved at an earlier date.

Figure 4 illustrates the elevation of the "inset floodplain" installed on the river left of the Side channel along with the Side Channel's WSE. During the average WY19, the inset floodplain was inundated during the periods of precipitation driven runoff and snowmelt. The recurrence of inundation of the inset floodplain was reduced to a single runoff event in WY20.

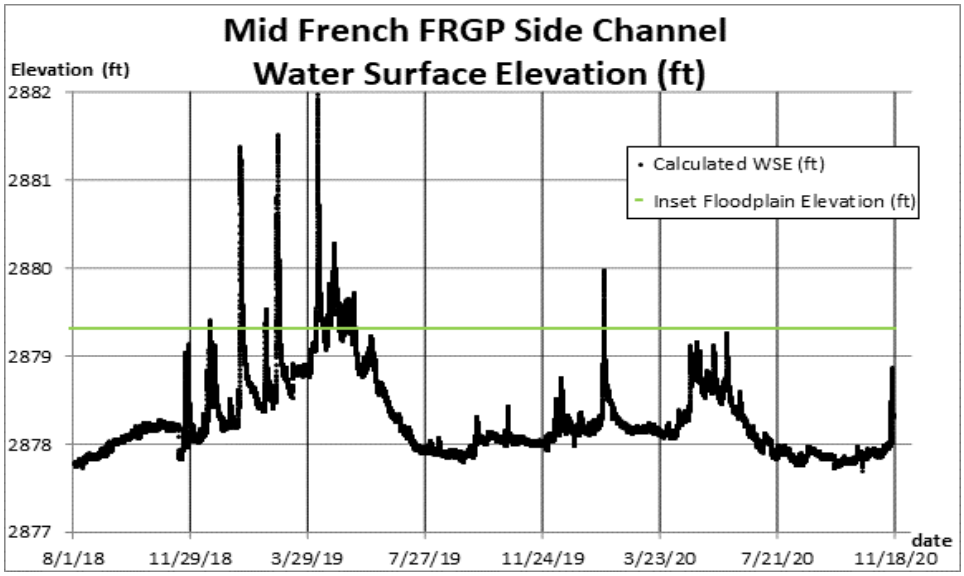


FIGURE 4. SIDE CHANNEL WATER SURFACE ELEVATION (WSE).

Comparison of the daily mean WSE in the Side Channel and in mainstem French Creek downstream of the Side Channel Outlet indicates that the WSE is the same during the periods of base flow and higher in the Side Channel during periods of runoff (Figure 5). The higher WSE in the Side Channel during runoff events is hypothesized to be due to the "backwater effect" created by the confluence of the flow in the Side Channel and mainstem French Creek along with the resistance from the outlet structure that was installed in March 2019. Throughout the base flow period of WY20 the WSE is identical at the two locations indicating a shared hydraulic control for both sites downstream of the mainstem WSE station.

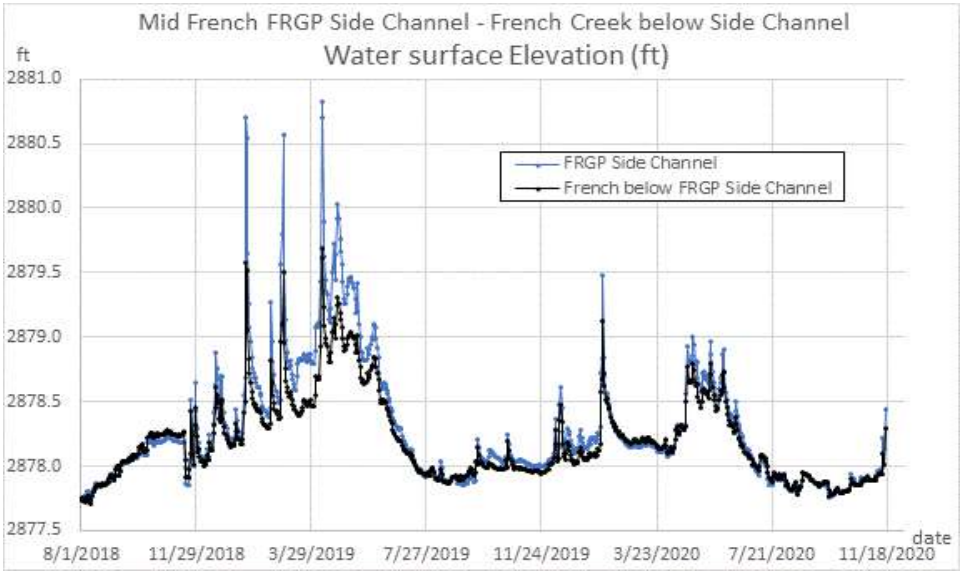


FIGURE 5. WATER SURFACE ELEVATION - SIDE CHANNEL AND FRENCH BELOW SIDE CHANNEL.

Water Temperature

Water temperatures (°C) documented in the Side Channel indicate groundwater input and/or stratification in the deepest areas of the feature compared to shallower areas and the mainstem. Comparison of the daily average, minimum and maximum temperatures in the Side Channel - Bottom site (Figure 6) to the Outlet site (Figure 7) illustrates that the diurnal fluctuation during winter and summer is less at the Bottom site indicative of groundwater inputs. The maximum temperatures observed in the Bottom site are also lower than those at the Outlet site during the base flow period of summer indicative of groundwater inputs to and/or stratification of the deeper water.

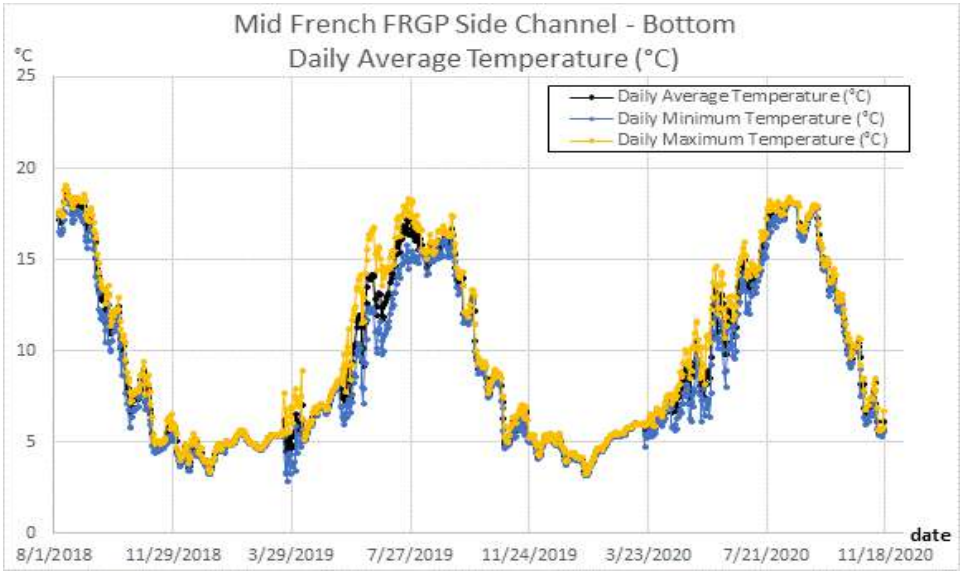


Figure 6. Average water temperature (°C) - Side Channel - Bottom - WY18 - WY21.

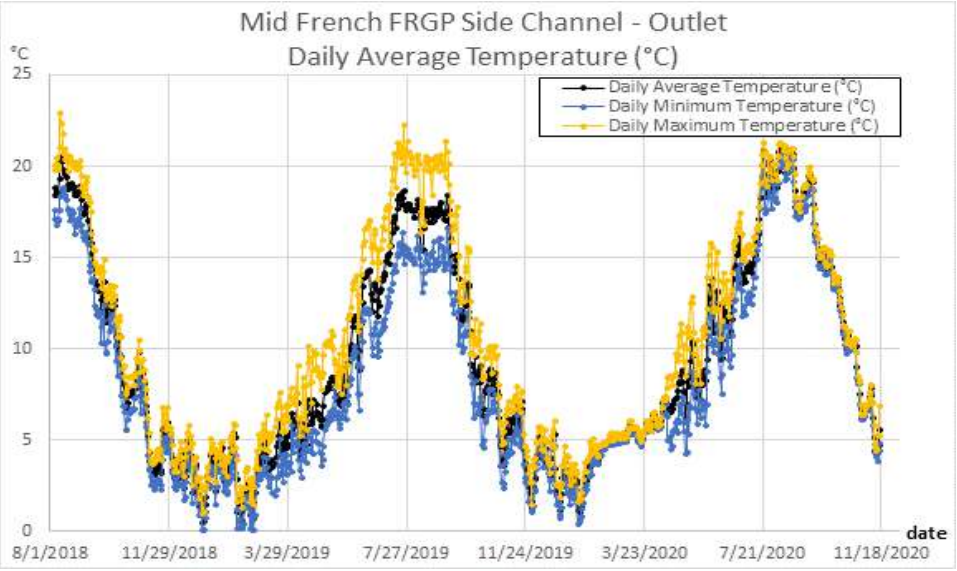


FIGURE 7. AVERAGE WATER TEMPERATURE (°C) - SIDE CHANNEL - OUTLET - WY18 - WY21.

The availability of cooler water in the deeper waters of the Side Channel during the summer offers cold water refuge to Coho Salmon. Additionally, the availability of warmer water during the winter months that are often characterized by extremely cold-water temperatures in the mainstem offers refuge in which the fish are able to better metabolize potentially increasing growth during the winter months.

Analysis of the daily average water temperatures (°C) at three locations in the Side Channel and two locations in the mainstem from WY18 - WY21 (Figure 8) corroborates the observation of a temperature difference in the Side Channel Bottom. It should be noted that the significant temperature difference observed in the upstream river right alcove at the MFMW12s WSE after the winter of WY19 is due to the stilling well becoming buried by sediment. The water temperatures at this site have a groundwater signal with a low diurnal fluctuation throughout the year.

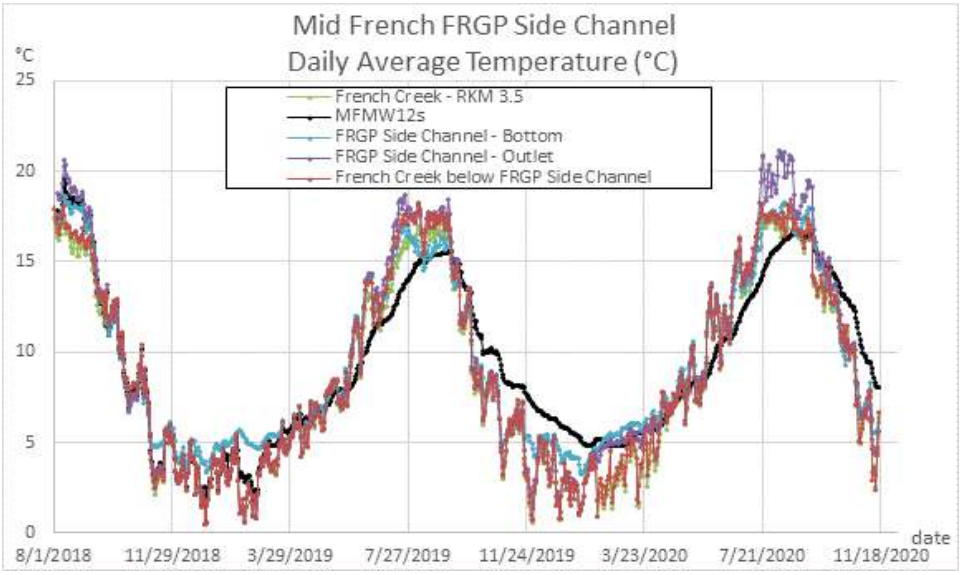


FIGURE 8. DAILY AVERAGE WATER TEMPERATURE (°C) - SIDE CHANNEL AND MID FRENCH CREEK - WY18 - WY21. DAILY AVERAGE WATER TEMPERATURE (°C) - SIDE CHANNEL AND MID FRENCH CREEK - WY18 - WY21.

Analysis of the daily average temperature (°C) during WY19 illustrates the warmer water temperatures during winter and cooler water temperatures in summer in the Side Channel Bottom in comparison to all sites with exception of MFMW12s (Figure 9).

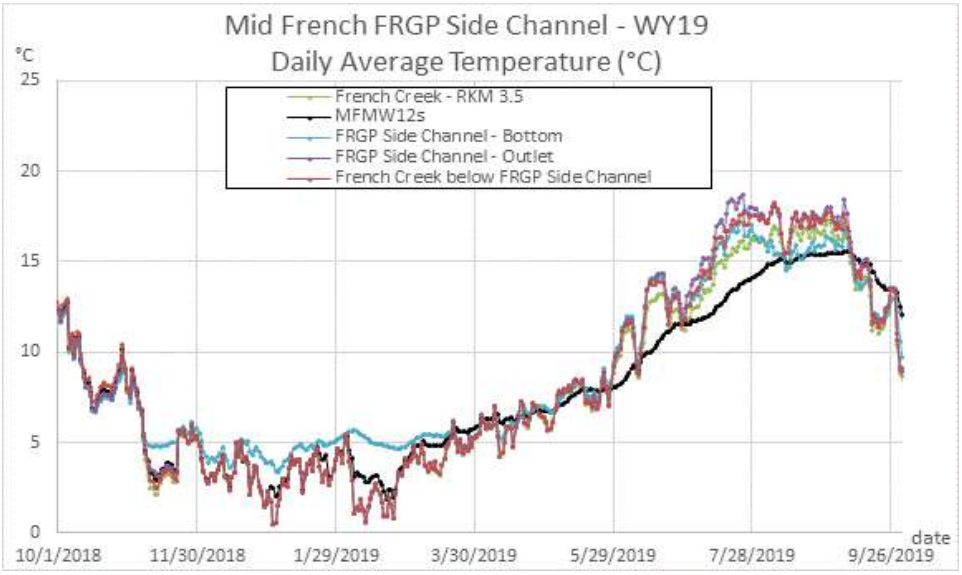


FIGURE 9. DAILY AVERAGE WATER TEMPERATURE (°C) - SIDE CHANNEL AND MID FRENCH CREEK - WY19.

The maximum moving weekly average temperatures (MWAT) during the summer of WY2019 for each station and date of occurrence was calculated (Table 5). The maximum MWAT (°C) at the three stations in the surface water of the Side Channel occurred on July 23rd or July 27, 2019. The maximum MWAT at the Side Channel Bottom station (16.8°C) is over 1°C cooler than at the Side Channel Outlet (18.4°C). The Side Channel Bottom maximum MWAT was also 0.9°C cooler than the maximum MWAT in the mainstem

below the Outlet (17.7°C) and 0.1°C cooler than the maximum at RKM 3.5 (16.9°C). It should be noted that the date of occurrence of the maximum temperatures are different at the different locations.

Table 5. Maximum MWAT (°C) and date of occurrence - WY2019.

		Maximum MWAT	
Location	WY	°C	Date
French Creek - RKM 3.5	WY2019	16.9	8/30/2019
Mid French FRGP Side Channel - MFMW12s	WY2019	15.5	7/23/2019
Mid French FRGP Side Channel - DO Logger	WY2019	18.1	7/23/2019
Mid French FRGP Side Channel - Bottom	WY2019	16.8	7/27/2019
Mid French FRGP Side Channel - Outlet	WY2019	18.4	7/23/2019
French Creek below FRGP Side Channel - Glide	WY2019	17.7	8/8/2019
French Creek below FRGP Side Channel - Glide Margin	WY2019	16.6	8/30/2019

The analysis of the minimum moving weekly average temperatures (MWAT) during the winter of WY2019 corroborates the hypothesis of GW inputs into the deeper waters of the Side Channel (Table 6). The minimum MWAT in the two main stem locations and the Side Channel Outlet location occurred on February 11, 2019 and are a very cold 1.3°C. The minimum MWAT at the Side Channel Bottom was several degrees warmer (3.7°C) and occurred at an earlier date. It is hypothesized that the low water temperatures observed in French Creek impede the growth of Coho Salmon during the winter months and the availability of warmer groundwater influenced off channel habitats could increase the growth and survival during this life stage.

TABLE 6. MINIMUM MWAT (°C) AND DATE OF OCCURRENCE - WY2019.

		Minimum MWAT	
Location	WY	°C	Date
French Creek - RKM 3.5	WY2019	1.3	2/11/2019
Mid French FRGP Side Channel - MFMW12s	WY2019	2.1	1/3/2019
Mid French FRGP Side Channel - Bottom	WY2019	3.7	1/5/2019
Mid French FRGP Side Channel - Outlet	WY2019	1.3	2/11/2019
French Creek below FRGP Side Channel - Glide	WY2019	1.3	2/11/2019

The water temperatures in the critically dry WY20 are warmer at all sites during the base flow period due to the reduced stream discharge (Figure 10). The trends observed during WY19 persist during WY20 with the Side Channel Bottom being cooler during summer (maximum MWAT = 18.2°C) than the other surface water stations in the Side Channel and warmer during the winter (minimum MWAT = 3.4°C) than all stations (Table 7 and Table 8). Significant stratification is observed in the FRGP Side Channel during the summer of WY20 with the maximum MWAT at the DO Logger (21.4°C) warmer than at the Outlet and Bottom. The water temperatures in the Side Channel during the summer of 2020 are marginal to unsuitable for rearing juvenile Coho Salmon.

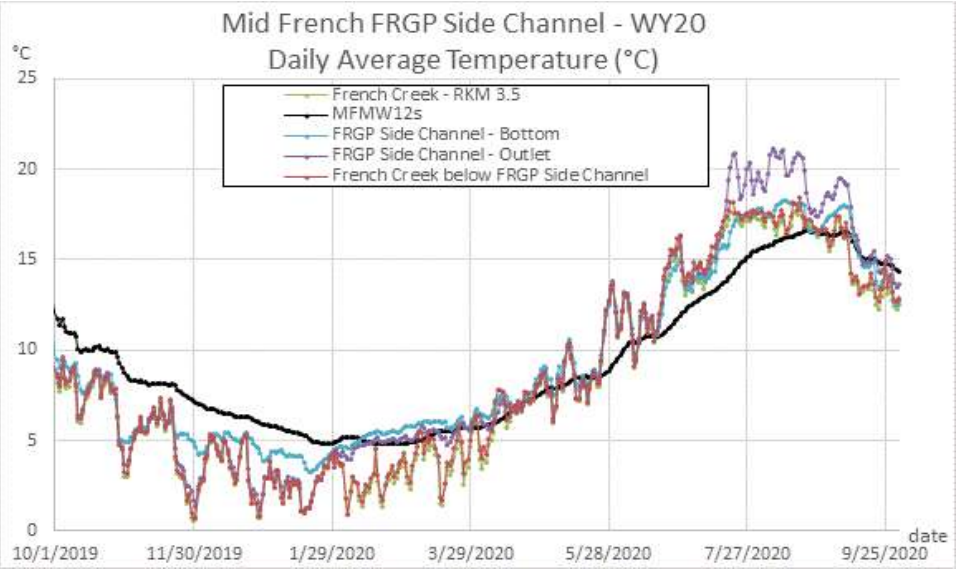


FIGURE 10. DAILY AVERAGE WATER TEMPERATURE (°C) - SIDE CHANNEL AND MID FRENCH CREEK - WY20.

TABLE 7. MAXIMUM MWAT (°C) AND DATE OF OCCURRENCE - WY2020.

		Maximum MWAT	
Location	WY	°C	Date
French Creek - RKM 3.5	WY2020	17.4	8/20/2020
Mid French FRGP Side Channel - MFMW12s	WY2020	16.5	8/11/2020
Mid French FRGP Side Channel - DO Logger	WY2020	21.4	8/12/2020
Mid French FRGP Side Channel - Bottom	WY2020	18.2	8/16/2020
Mid French FRGP Side Channel - Outlet	WY2020	20.9	8/11/2020
French Creek below FRGP Side Channel - Glide	WY2020	17.7	8/20/2020
French Creek below FRGP Side Channel - Glide Margin	WY2020	17	8/20/2020

TABLE 8. MINIMUM MWAT (°C) AND DATE OF OCCURRENCE - WY2020.

		Minimum MWAT	
Location	WY	°C	Date
French Creek - RKM 3.5	WY2020	1.4	12/2/2019
Mid French FRGP Side Channel - MFMW12s	WY2020	4.8	2/21/2020
Mid French FRGP Side Channel - Bottom	WY2020	3.4	1/22/2020
Mid French FRGP Side Channel - Outlet	WY2020	1.6	1/20/2020
French Creek below FRGP Side Channel - Glide	WY2020	1.5	1/20/2020

Dissolved Oxygen

A dissolved oxygen (DO) logger was deployed adjacent to the wood structure at the upstream river right alcove of the Side Channel on August 3, 2018. Continuous dissolved oxygen (mg/L) and temperature (°C) during the winter and early summer months of WY18 to WY19 indicate several periods of low dissolved

oxygen (Figure 11). After the completion and connection of the Side Channel in August 2018 the DO was less than 6 mg/L for the majority of time with periods of DO less than 4 mg/L. DO increase in September as temperatures decreased with DO reaching saturation during the higher flows and colder temperatures of winter. Several large decreases in DO were observed during the runoff period. During the spring of 2019, large amounts of organic material was observed deposited in the Side Channel and it is hypothesized that the DO logger sensor was buried in organic material and fine sediment. As the stream flow decreased to base flow in early July 2019 the dissolved oxygen fluctuated rapidly. On August 2, 2019, the location of the DO logger was found to be significantly altered by deposition of sediment and organic material and the logger was moved downstream to deeper water with observed utilization by juvenile Coho Salmon.

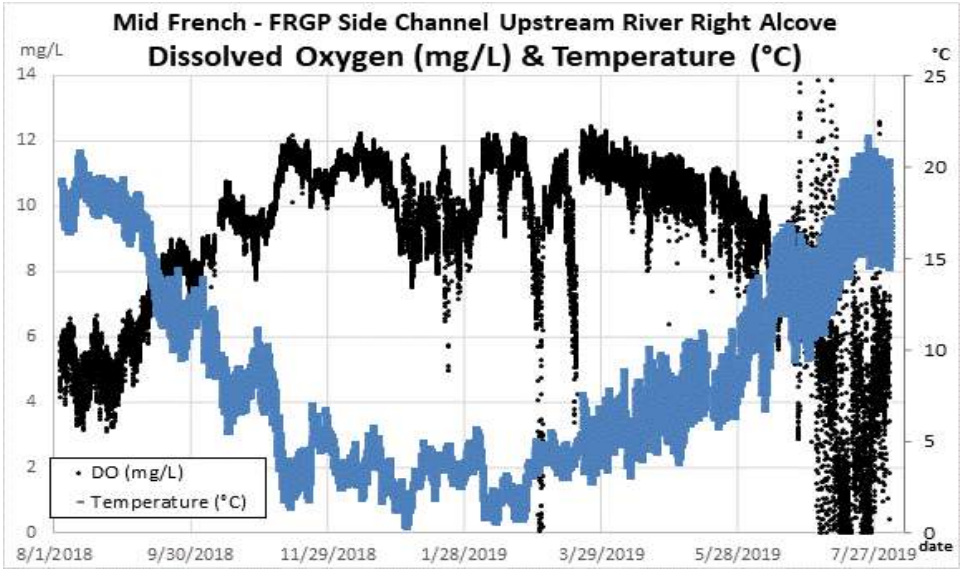


FIGURE 11. DISSOLVED OXYGEN (MG/L) AND TEMPERATURE (°C) - UPSTREAM LOCATION - WY18 - WY20.

The DO at the downstream site had significantly less diurnal fluctuation than that observed at the upstream site (Figure 12). DO was less than 6 mg/L for a majority of the base flow period of August to mid-September with instances of DO less than 4 mg/L observed in late August and September. DO increased and water temperatures decreased in late September and DO was saturated from October through the period of record. The DO logger battery failed in Late November and the logger was replaced.

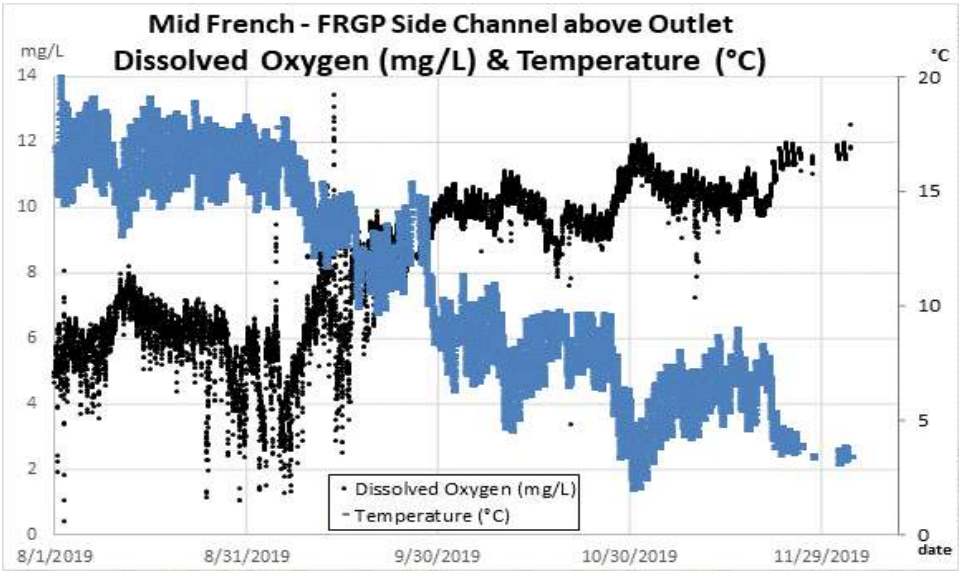


FIGURE 12. DISSOLVED OXYGEN (MG/L) AND TEMPERATURE (°C) - DOWNSTREAM LOCATION - WY19-WY20.

The DO during the base flow period of WY2020 showed critical impairments from late July through September (Figure 13) with periods of zero DO. The combination of high-water temperatures and large amounts of entrained organic material in the Side Channel potentially drove a large amount of respiration. The lack of inflow during the base flow period of WY20 exacerbated the DO impairment.

The inlet to the Side Channel had become obstructed with sediment during the winter of 2019 and a decision was made to allow the inlet to remain obstructed over the summer in order to keep cold water in the main French Creek channel.

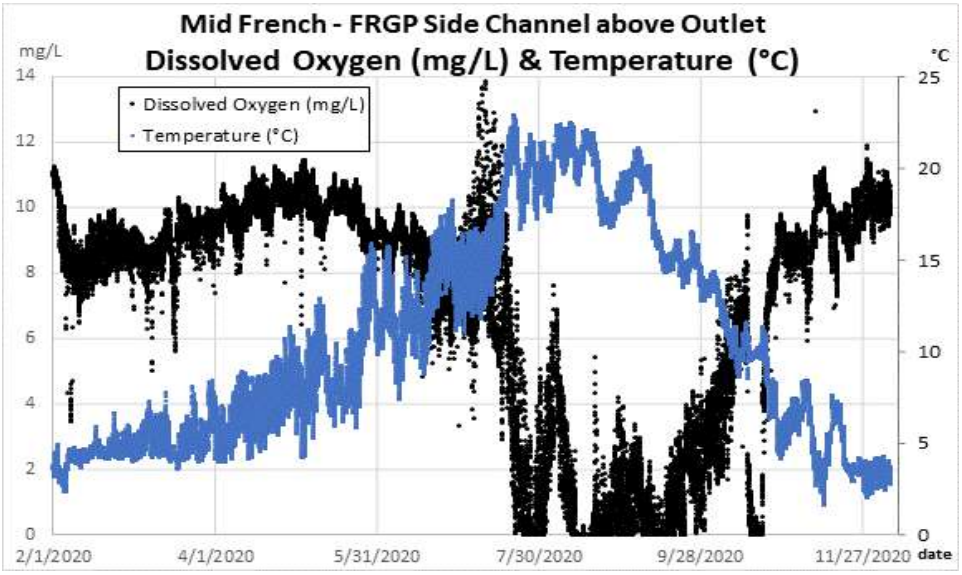


FIGURE 13. DISSOLVED OXYGEN (MG/L) AND TEMPERATURE (°C) - DOWNSTREAM LOCATION - WY20 -WY21.

Fisheries

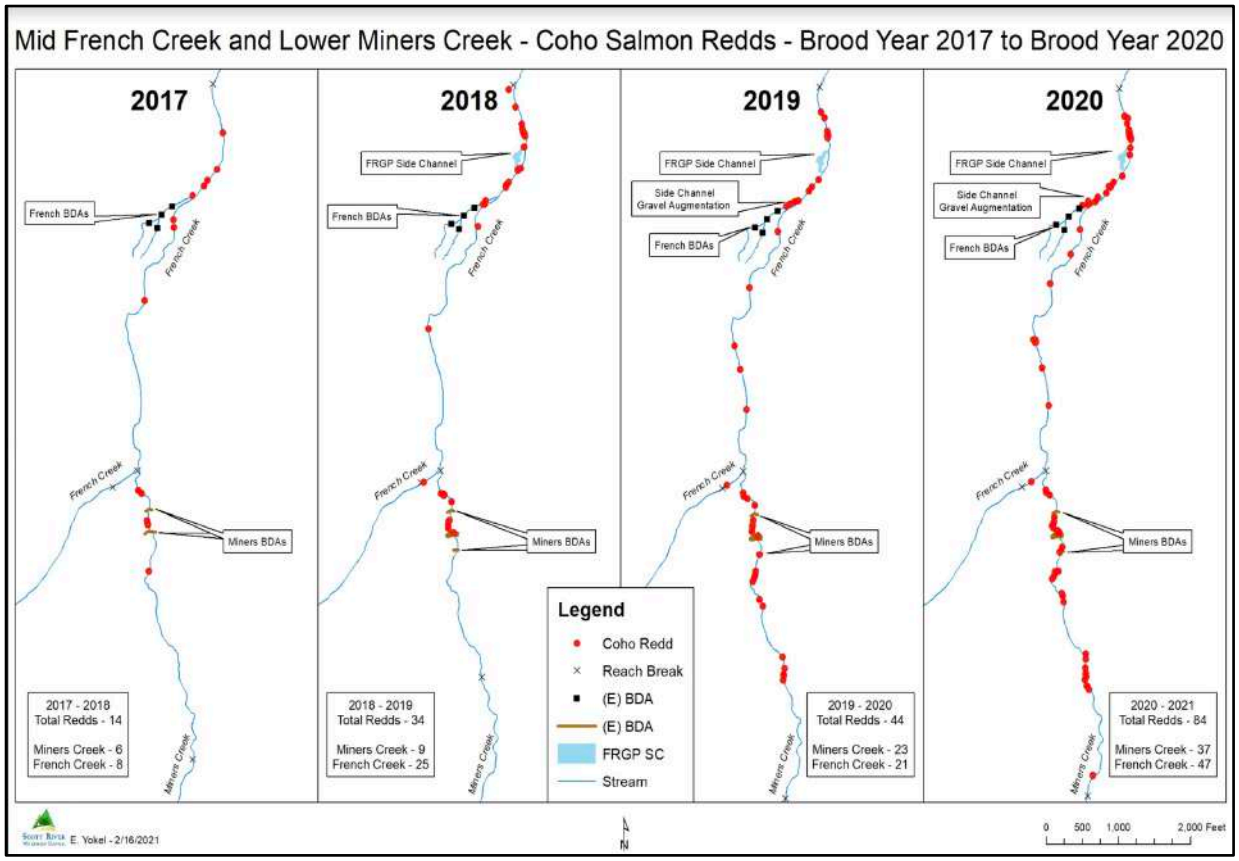
Spawning Surveys

Coho Salmon spawning surveys take place during the months of November, December and into January. Surveyors, generally at least two people wearing waders and felt soled boats, walk downstream in a given reach that has been granted landowner permission. Throughout the spawning season, surveys are repeated weekly within the same reach to document redd locations, redd size, redd substrate of material, live fish and carcasses.

Coho spawning surveys are done in collaboration with the California Department of Fish and Wildlife, United States Fish and Wildlife Service, Klamath National Forest, National Oceanic and Atmospheric Administration, Siskiyou Resource Conservation District), Quartz Valley Indian Reservation, and SRWC.

Adult Coho spawning ground surveys have been performed in Lower Miners Creek and Mid French Creek since the early 2000s. The spawning ground surveys have documented Coho utilization of French Creek during all brood years with some of the highest densities of spawning in the Scott River (Scott River Watershed 2018).

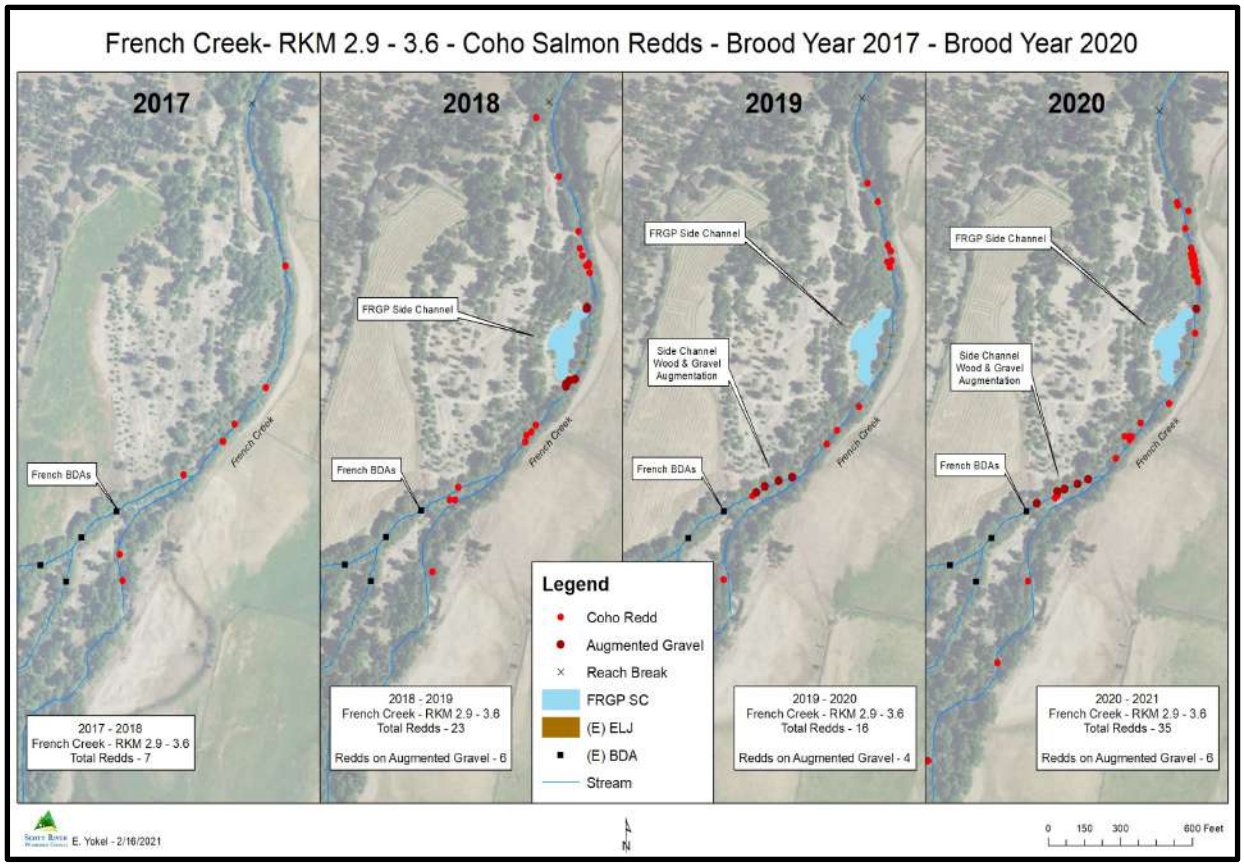
The population of documented Coho Salmon redds in the Lower Miners Creek and Mid French Creek reaches has increased significantly since 2017 (Brood Year 2017). A total of 14 Coho redds were observed in 2017 with 84 redds observed with the return of the Brood Year 2017 cohort in 2020 (Map 6). With the observed upward trajectory of utilization by adults in French-Miners the critical need to continue to increase carrying capacity for juveniles is essential.



MAP 6. BROOD YEAR 2017 TO BROOD YEAR 2020 COHO SALMON REDDS - LOWER MINERS CREEK AND MID FRENCH CREEK.

Mid French Creek is limited in the amount of available suitable sized sorted gravel for Coho spawning (Cramer 2010). The streambed is dominated by a bimodal distribution of cobble and small gravel/coarse sand (decomposed granite). As part of the Side Channel restoration project, spawning gravel was augmented in the mainstem of French Creek at the inlet and outlet of the Side Channel and at the three mainstem ELJs in July 2018 to enhance the area for spawning and support the growing population of adult Coho Salmon returning to French Creek.

During spawning ground surveys, adult Coho Salmon were observed in December 2018 utilizing the augmented gravel immediately after installation. Six Coho Salmon redds were observed in the augmented gravel at the Side Channel Inlet and Outlet (Map 7).



MAP 7. BROOD YEAR 2017 TO BROOD YEAR 2020 COHO SALMON REDDS - FRENCH CREEK RKM 2.9 - 3.6.

The majority of the area of augmented gravel in the two locations was disturbed in the redd formation process (Photo 8). Adult Coho Salmon were observed holding in the deep water of the Side Channel during the 2018 spawning season (Photo 9). Adults were also seen holding in the slow water above ELJ1 in all three post implementation spawning seasons. In the spawning season of 2018 adults were observed moving through the side channel on their way upstream, in subsequent seasons; after the channel's inlet and outlet were constricted, adults appeared to move upstream via the French Creek main channel. Coho Salmon are often observed spawning in areas of suitable gravel adjacent to a pool or deeper water habitat with complex fish cover. The introduction of augmented gravel adjacent to the deep water of the Side Channel enhanced the volume of the required spawning and cover habitats in critical habitat of French Creek.

Photo 8. Coho Salmon Redd on augmented gravel - December 2018.

PHOTO 9. COHO SPAWNING ON INTRODUCED GRAVEL AT SIDE CHANNEL OUTLET – DECEMBER 2018.

No Coho redds were observed on the augmented gravel during the spawning ground surveys performed in 2019 - 2020. The augmented spawning gravel at the Side Channel inlet was buried by deposited decomposed granite sediment during the runoff period of WY19. One Coho redd was observed on the augmented gravel at the Side Channel outlet during spawning ground surveys performed in January 2021.

Juvenile Rearing

Mark and recapture efforts were performed in the Side Channel and Mainstem ELJ Reach from January 2019 to February 2021 (Photo 10). Fish were primarily captured with seines during the base flow period of summer and early fall and baited minnow traps during the runoff period of winter and early spring. A fyke net was used during the summer and winter to sample deeper slow water habitats.

Captured salmonids (Coho Salmon and rainbow trout (*O. mykiss*)) were anaesthetized, identified by species and forklength (mm) and weight (g) biometrics were collected for each individual (Photo 10). Coho Salmon in good condition with forklength equal to or greater than 65 mm were marked with a 12mm PIT tag. The unique 15-digit code of each deployed PIT tag was recorded. All captured Coho Salmon were scanned with a Biomark HPR Plus PIT tag reader and recaptured fish were noted and the PIT tag code was recorded. Fish were returned to the habitat in which they were captured after handling.

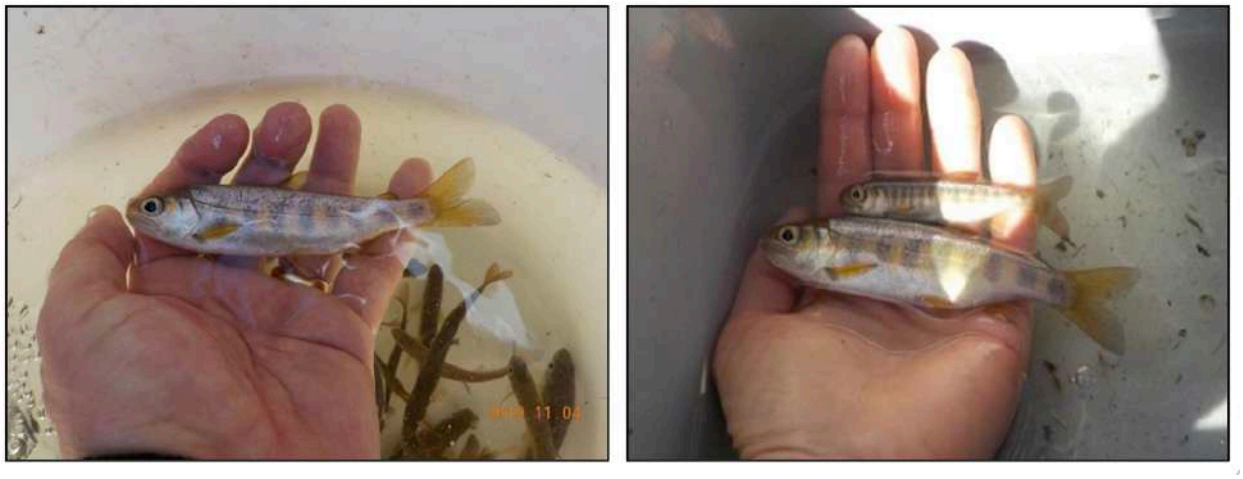


PHOTO 10. COHO SALMON CAPTURED IN THE SIDE CHANNEL - NOVEMBER 4, 2019.

In addition to the sampling effort in the Side Channel and Mainstem ELJ Reach, fish were sampled in the following additional sites: French Creek Control Pools (four unenhanced pools upstream of the Side Channel), the French Side Channel BDA Ponds, Lower Miners Creek BDA Reach and the Sugar Creek BDA Ponds (Sugar BP1 and Sugar BP2). The sampling of the diverse enhanced and unenhanced habitats in the Scott River allows for comparison between different habitat types during the period of summer and winter rearing.

PHOTO 11. TAGGING EVENT, SIDE CHANNEL - JANUARY 13, 2020.

Brood Year 2017

The French Creek Side Channel and Mainstem ELJ Reach were first sampled for fish on January 31, 2019 using baited minnow traps. A total of 138 Coho Salmon were captured in the Side Channel with six recaptures of previously marked fish (Table 9). Four Coho Salmon were captured in the Mainstem ELJ Reach during the January 31, 2019 effort (Table 10). The Coho Salmon recaptured in the Side Channel during the January 2019 effort were marked in the French Creek Control Pools (RKM 3.4 - 3.6) upstream of the Side Channel during the base flow period of WY18. It is hypothesized that the Coho Salmon rearing in the mainstem of French Creek migrated to the Side Channel during the periods of winter runoff due to the deep low velocity habitats with fish cover.

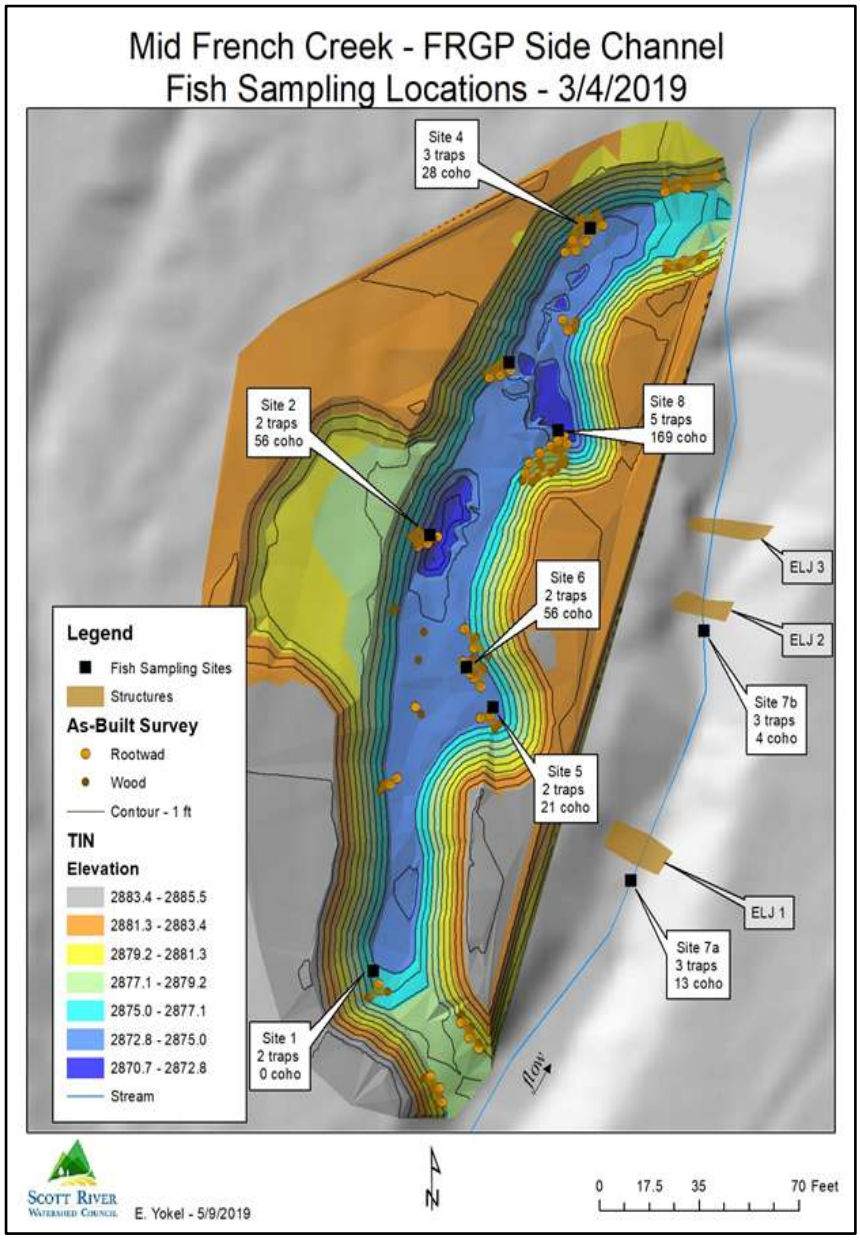
TABLE 9. TOTAL CATCH BY EFFORT FOR BROOD YEAR 2017 - SIDE CHANNEL.

		Coho Salmon			Rainbow Trout
Date	Sample Site	Total Catch	Marked	Recaptured	Total Catch
1/31/2019	FRGP Side Channel	138	123	6	13
3/4/2019	FRGP Side Channel	343	187	24	10
4/30/2019	FRGP Side Channel	19	0	2	0

TABLE 10. TOTAL CATCH BY EFFORT FOR BROOD YEAR 2017 - MAINSTEM ELJS.

		Coho Salmon			Rainbow Trout
Date	Sample Site	Total Catch	Marked	Recaptured	Total Catch
1/31/2019	Mainstem ELJs	4	0	0	1
3/4/2019	Mainstem ELJs	17	11	0	1

A fish sampling effort in the Side Channel and ELJ Reach was performed on March 4, 2019 with a total of 343 Coho Salmon captured in the Side Channel and 17 Coho Salmon captured in the Mainstem ELJ Reach (Map 8). Twenty-four Coho Salmon were recaptured in the Side Channel during the March effort. Fifteen of the recaptures were captured, marked and returned to the Side Channel during the January effort and nine were marked in the French Creek Control Pools during the base flow period of WY18. The observation of apparent fidelity of Coho Salmon to the Side Channel for the period from late January to early March indicates that the Side Channel provides suitable winter rearing habitat in French Creek. The significant difference in total catch between the Side Channel and Mainstem ELJs indicate that the Side Channel offers preferred habitats to Coho Salmon then the ELJ Reach during winter rearing conditions. Field observations during the winter of 2019 documented limited low velocity habitats in the ELJ Reach.



MAP 8. LOCATION AND CATCH OF FISH SAMPLING EFFORT - MARCH 4, 2019.

The final fish brood year 2017 sampling effort was performed on April 30, 2019 with 19 Coho Salmon captured in the Side Channel and two recaptured marked fish - one recapture was marked in the Side Channel in March 2019 and one recapture was marked in the Control Pools in 2018. It is hypothesized that the majority of the fish had outmigrated by the time of the sampling effort.

In conjunction with the fish sampling effort in the Side Channel and Mainstem ELJs on March 4, 2019, fish were sampled in the French Creek Control Pools and the Side Channel BDA Ponds on March 5th. Analysis of the average forklength (mm) of Coho Salmon from the four sample sites indicates the Coho Salmon in the Side Channel and BDA Ponds are larger on average than those captured in the mainstem

ELJ Reach and Control Pools (Table 11). It is unknown how long the fish captured in the Side Channel reared in the Side Channel (as indicated by the mixture of origin of the recaptured fish) complicating the attribution of increased growth to the Side Channel.

TABLE 11. AVERAGE FORKLENGTH (MM) OF COHO SALMON CAPTURED IN FRENCH CREEK - MARCH 4-5, 2019.

March 4 - 5, 2019 - Coho Salmon Forklength (mm)

Sample Reach	FRGP Side Channel	Mainstem ELJ Reach	Control Pools	Side Channel BDA Ponds
Average	85	76	81	87
Stan. Dev.	6.7	9.1	7.7	8.5
Minimum	64	61	64	69
Maximum	103	94	95	125
Count	277	17	39	74

A PIT tagged male adult Coho Salmon carcass was recovered in Miners on January 11, 2021. The individual fish was first captured and tagged in the Side Channel on January 31, 2019 and recaptured in the Side Channel on March 4, 2019 (Photo 12).

PHOTO 12. PIT TAGGED ADULT COHO SALMON CARCASS ON LOWER MINERS CREEK - JANUARY 11, 2021.

Brood Year 2018

Six fish sampling efforts occurred in the Side Channel and the Mainstem ELJ Reach targeting the Brood Year 2018 YOY from August 22, 2019 to March 18, 2020 (Photo 13). Juvenile Coho salmon were captured in the Side Channel and ELJ Reach during all efforts. A seine was used to sample both habitats during the August to November efforts and baited minnow traps and a fyke net were used during the January to March efforts.

PHOTO 13. 1+ COHO SALMON CAPTURED IN THE SIDE CHANNEL – AUGUST 22, 2019.

The total catch and the number of marked and recaptured Coho Salmon for each effort in the Side Channel and Mainstem ELJ Reach is illustrated in Table 12 and 13, respectively. Due to the different gear used and effort between the sampling events it is impossible to make assumptions about fish density between the sampling efforts and sampling sites - e.g., the low total catch on September 24, 2019 in the Side Channel is potentially due to the difficulty of seining the deep water of the Side Channel and a limited effort. More Coho Salmon were captured in the Side Channel than in the Mainstem ELJ reach during the winter and early spring months during WY20 - which corresponds to the trend observed in WY19. WY20 was a significantly drier year than WY19 with less runoff events and lower discharge throughout the majority of the winter and early spring months. The dry winter in WY20 led to impaired discharge and water quality during the base flow period reducing the volume and condition of available habitat in the Scott River watershed.

TABLE 12. TOTAL CATCH BY EFFORT FOR BROOD YEAR 2018 - SIDE CHANNEL.

		Coho Salmon			Rainbow Trout
Date	Sample Site	Total Catch	Marked	Recaptured	Total Catch
8/22/2019	FRGP Side Channel	84	81	0	3
9/24/2019	FRGP Side Channel	23	22	0	3
11/4/2019	FRGP Side Channel	173	152	19	1
1/14/2020	FRGP Side Channel	484	156	51	14
1/15/2020	FRGP Side Channel	218	13	30	10
3/18/2020	FRGP Side Channel	230	0	51	45

TABLE 13. TOTAL CATCH BY EFFORT FOR BROOD YEAR 2018 - SIDE CHANNEL.

		Coho Salmon			Rainbow Trout
Date	Sample Site	Total Catch	Marked	Recaptured	Total Catch
8/22/2019	Mainstem ELJs	151	92	0	11
9/24/2019	Mainstem ELJs	235	196	13	23
11/4/2019	Mainstem ELJs	129	50	28	17
1/14/2020	Mainstem ELJs	25	19	4	9
1/15/2020	Mainstem ELJs	58	0	13	9
3/18/2020	Mainstem ELJs	59	0	7	4

Analysis of the forklength (mm) histograms of the Coho Salmon captured in the Side Channel (n = 173) and ELJ Reach (n = 129) illustrates the larger sized fish captured in the Side Channel (Figure 14). The average forklength of Coho captured in the Side Channel (91 mm) is greater than those captured in the ELJ Reach (75 mm) and the French Control Pools (76 mm) during the week of October 28th - November 4, 2019 (Table 14). It is hypothesized that the Coho captured in the Side Channel in early November had been rearing in the Side Channel for some time and their superior condition is indicative of preferred habitat and increased feeding opportunities. The condition of the fish captured in the ELJ Reach is equivalent to those captured in the upstream Control Pools (Map 9).

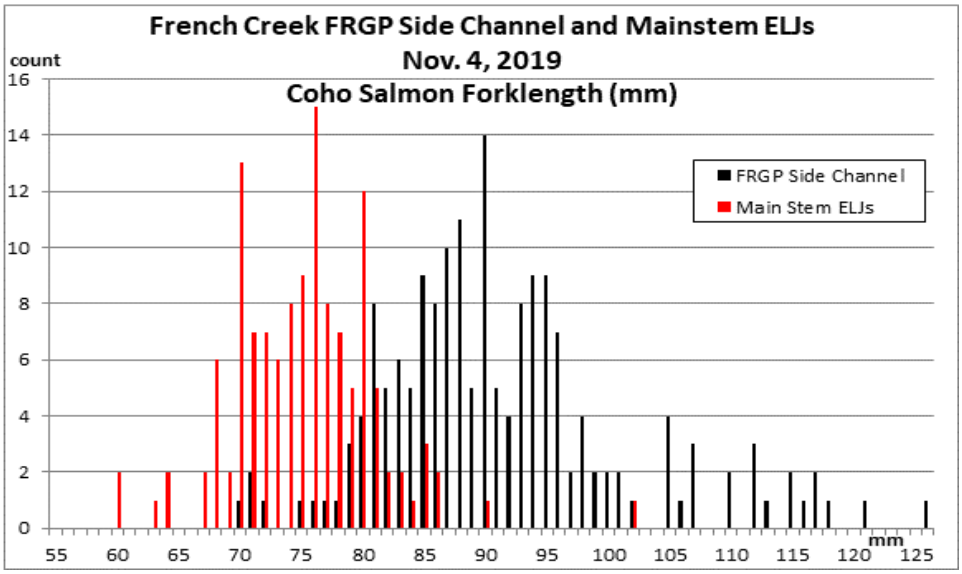
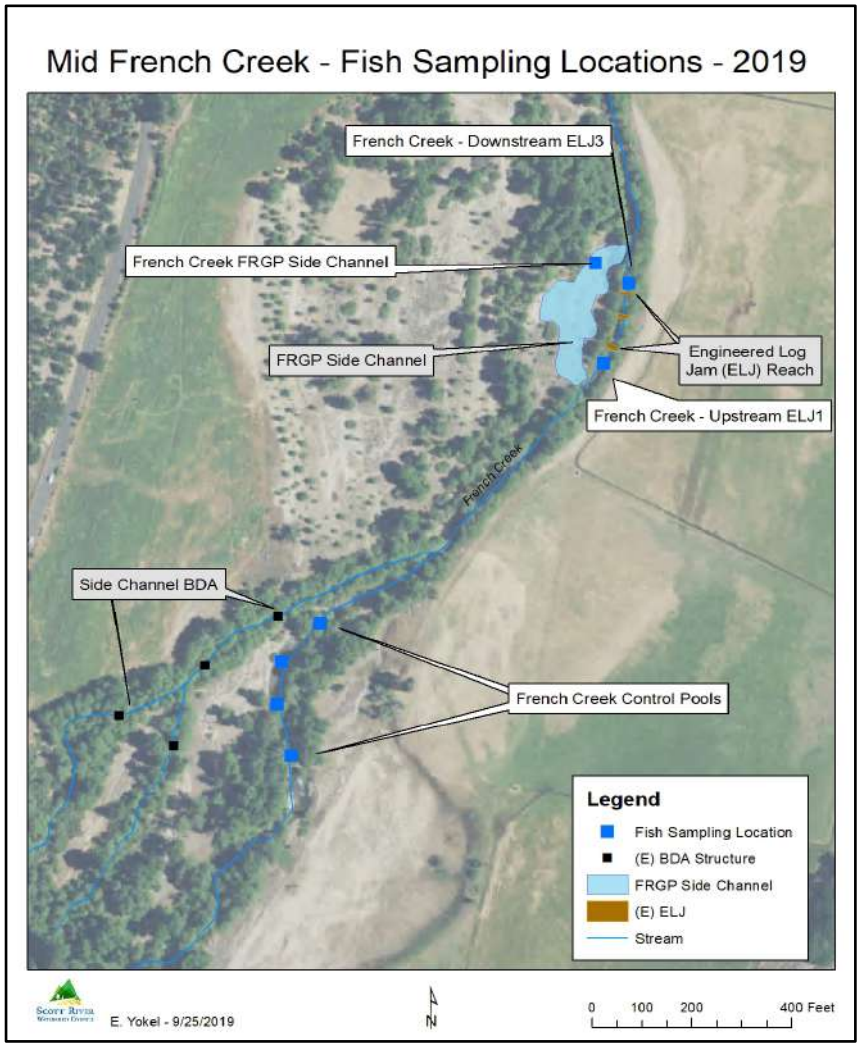


FIGURE 14. FORKLENGTH (MM) HISTOGRAM - COHO SALMON CAPTURED IN THE SIDE CHANNEL AND MAINSTEM ELJS - NOV. 4, 2019.

TABLE 14. AVERAGE FORKLENGTH (MM) IN THE SIDE CHANNEL, MAINSTEM ELJS & CONTROL POOLS – OCTOBER 28 - NOVEMBER 4, 2019.

Date	11/4/2019	11/4/2019	10/28 & 10/29/2019
Site	French FRGP SC	French ELJ Reach	French Control Pools
Average	91	75	76
Stand. Dev.	10.1	5.8	8.7
Minimum	70	60	57
Maximum	126	102	115
Count	173	129	583



MAP 9. MID FRENCH CREEK FISH SAMPLING LOCATIONS - BASE FLOW 2019.

In addition to the habitats sampled in French Creek, the Sugar Creek BDA Ponds were sampled at the same time frame from late July to March 2020. Analysis of growth across the different sampled habitats using average forklength of the captured Coho Salmon per sampling event shows that the Coho captured in the Side Channel were larger than the fish in all sample sites from early August through early

November (Figure 15). The average forklength of the captured fish on January 14-15, 2020 was less than the average forklength of the fish captured in the previous effort. It is hypothesized this is due to migration of fish into the Side Channel from the mainstem of French Creek between the November 2019 and January 2020 efforts.

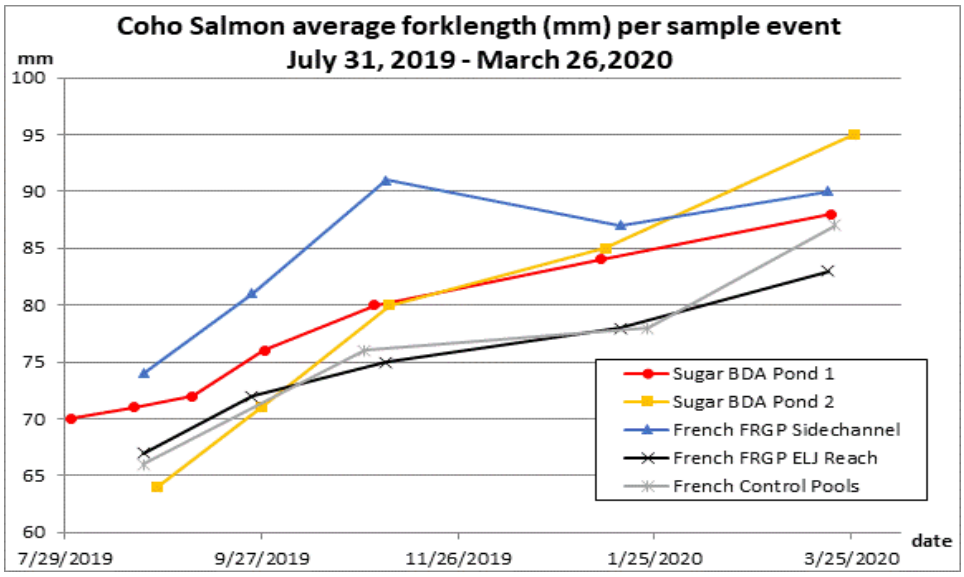


FIGURE 15. COHO SALMON AVERAGE FORKLENGTH (MM) PER SAMPLE EVENT.

The average forklength (mm) for each sampling effort in the three sample units of French Creek and two sample units in Sugar Creek is illustrated in Table 15. Analysis of average growth (mm/day) between the sampling efforts for each sample unit illustrates the greater growth observed in the Side Channel compared to the other sampled habitats during the base flow period (Table 16). During the period of late August to the beginning of November, Coho Salmon grew on average 0.23 mm per day in the Side Channel with average growth of 0.11 mm per day in the ELJ Reach and .15 mm per day in the Control Pools.

TABLE 15. COHO SALMON AVERAGE FORKLENGTH (MM), STANDARD DEVIATION OF FORKLENGTH (MM) AND SAMPLE SIZE PER SAMPLE EVENT.

Coho Salmon - Average Forklength (mm)

Sample Site	Date	Ave FL (mm)	Stand. Dev. (mm)	Count
Sugar BP1	7/31/2019	70	7.2	380
Sugar BP1	8/19/2019	71	6.6	351
Sugar BP1	9/6/2019	72	5.9	359
Sugar BP1	9/28/2019	76	6.5	217
Sugar BP1	10/31 - 11/1/2019	80	6.4	848
Sugar BP1	1/8 - 1/9/2020	84	6.1	486

Sample Site	Date	Ave FL (mm)	Stand. Dev. (mm)	Count
Sugar BP2	8/26/2019	64	5.1	104
Sugar BP2	9/27/2019	71	6.7	134
Sugar BP2	11/5/2019	80	8	234
Sugar BP2	1/10/2020	85	5.9	277

Sample Site	Date	Ave FL (mm)	Stand. Dev. (mm)	Count
French FRGP Side Channel	8/22/2019	74	4.8	82
French FRGP Side Channel	9/24/2019	81	7.6	23
French FRGP Side Channel	11/4/2019	91	10.1	173
French FRGP Side Channel	1/14 - 1/15/2020	87	10.7	569

Sample Site	Date	Ave FL (mm)	Stand. Dev. (mm)	Count
French ELJ Reach	8/22/2019	67	5.3	150
French ELJ Reach	9/24/2019	72	4.9	234
French ELJ Reach	11/4/2019	75	5.8	129
French ELJ Reach	1/14 - 1/15/2020	78	6.4	83

Sample Site	Date	Ave FL (mm)	Stand. Dev. (mm)	Count
French Control Pools	8/22/2019	66	6.7	439
French Control Pools	10/28 - 10/29/2019	76	8.7	583
French Control Pools	1/23/2020	78	8.6	149

TABLE 16. AVERAGE FORKLENGTH (MM) OF COHO SALMON PER SAMPLE EFFORT AND ELAPSED TIME (DAYS) AND AVERAGE GROWTH (MM/DAY) BETWEEN SAMPLE EFFORT.

Coho Salmon - Average Forklength (mm)

Sample Site	Date	Ave FL (mm)	Elapsed Days	mm growth/day
Sugar BP1	7/31/2019	70		
Sugar BP1	8/19/2019	71	19	0.05
Sugar BP1	9/6/2019	72	18	0.06
Sugar BP1	9/28/2019	76	22	0.18
Sugar BP1	10/31 - 11/1/2019	80	34	0.12
Sugar BP1	1/8 - 1/9/2020	84	69	0.06

Sample Site	Date	Ave FL (mm)	Elapsed Days	mm growth/day
Sugar BP2	8/26/2019	64		
Sugar BP2	9/27/2019	71	32	0.22
Sugar BP2	11/5/2019	80	39	0.23
Sugar BP2	1/10/2020	85	66	0.08

Sample Site	Date	Ave FL (mm)	Elapsed Days	mm growth/day
French FRGP Side Channel	8/22/2019	74		
French FRGP Side Channel	9/24/2019	81	33	0.21
French FRGP Side Channel	11/4/2019	91	41	0.24
French FRGP Side Channel	1/14 - 1/15/2020	87	71.5	-0.06

Sample Site	Date	Ave FL (mm)	Elapsed Days	mm growth/day
French ELJ Reach	8/22/2019	67		
French ELJ Reach	9/24/2019	72	33	0.15
French ELJ Reach	11/4/2019	75	41	0.07
French ELJ Reach	1/14 - 1/15/2020	78	71.5	0.04

Sample Site	Date	Ave FL (mm)	Elapsed Days	mm growth/day
French Control Pools	8/22/2019	66		
French Control Pools	10/28 - 10/29/2019	76	68	0.15
French Control Pools	1/23/2020	78	87	0.02

Brood Year 2019

Six fish sampling efforts were made in the Mainstem ELJ Reach during 2020 - 2021 and two efforts were performed in the Side Channel. Pandemic be damned. Coho Salmon were captured during every effort in the Mainstem ELJ Reach with large amounts captured from July through October using a seine. The total catch in the ELJ Reach decreased significantly during the runoff flows of winter in which baited minnow traps were placed in the limited deeper low velocity habitats with cover elements of the ELJ Reach (Table 17). The decrease in captured fish in the ELJ Reach in winter is hypothesized to be caused by the higher velocities during winter discharge in the mainstem habitat.

TABLE 17. TOTAL CATCH BY EFFORT FOR BROOD YEAR 2019 - MAINSTEM ELJS.

		Coho Salmon			Rainbow Trout
Date	Sample Site	Total Catch	Marked	Recaptured	Total Catch
7/7/2020	Mainstem ELJs	103	0	0	9
7/28/2020	Mainstem ELJs	617	135	1	48
10/8/2020	Mainstem ELJs	341	200	20	19
10/9/2020	Mainstem ELJs	322	0	104	47
12/15/2020	Mainstem ELJs	15	9	4	7
1/26/2021	Mainstem ELJs	55	4	4	12

Water quality in the Side Channel prohibited fish sampling during the base flow period of WY20. The Side Channel habitats were sampled after the increase in flow and fall redistribution that occurred in November 2020 for the first time on December 15, 2020. During the December 15th effort, 441 Coho Salmon were captured in the Side Channel with 34 recaptured fish that were previously marked in the ELJ Reach and French Control Pools in July to August. (Table 18). The Side Channel was sampled on January 26, 2021 with 50 recaptures of the 458-total catch. Future analysis of rate of growth for the individual marked fish will generate a greater understanding of utilization and growth in the restored habitats.

TABLE 18. TOTAL CATCH BY EFFORT FOR BROOD YEAR 2019 - SIDE CHANNEL.

		Coho Salmon			Rainbow Trout
Date	Sample Site	Total Catch	Marked	Recaptured	Total Catch
12/15/2020	FRGP Side Channel	441	206	34	12
1/26/2021	FRGP Side Channel	458	0	50	2

On October 8, 2020, an unenhanced reach upstream of the Side Channel inlet was sampled with a seine in conjunction with the ELJ Reach sampling. The sampled reach was of equivalent length to the ELJ Reach

and is representative of the habitat in the ELJ reach pre-treatment. A total of 43 Coho Salmon were captured (Table 19).

TABLE 19. TOTAL CATCH IN UNENHANCED REACH UPSTREAM OF SIDE CHANNEL INLET - OCTOBER 8, 2020.

		Coho Salmon			Rainbow Trout
Date	Sample Site	Total Catch	Marked	Recaptured	Total Catch
10/8/2020	Upstream ELJ Reach	43	24	0	8

Comparison of the average forklength of the Coho Salmon captured in the Side Channel and Mainstem ELJ Reach during the December 15, 2020 and January 26, 2021 efforts illustrates the Coho captured in the Side Channel are larger on average than those captured in the ELJ Reach (Table 20).

TABLE 20. AVERAGE FORKLENGTH (MM) IN THE SIDE CHANNEL AND MAINSTEM ELJS – DECEMBER 15, 2020 AND JANUARY 26, 2021.

December 15, 2020 and January 26, 2021 - Coho Salmon Forklength (mm)

	December 15, 2020		January 26, 2021	
Sample Reach	FRGP Side Channel	Mainstem ELJ Reach	FRGP Side Channel	Mainstem ELJ Reach
Average	74	73	77	70
Stan. Dev.	8.3	4.3	9.3	4.6
Minimum	57	64	61	60
Maximum	121	79	114	79
Count	440	15	224	55

Analysis of the forklength histogram of the captured fish on January 26, 2021 illustrates the larger fish captured in the Side Channel. The standard deviation of Coho captured in the Side Channel (9.3 mm) is greater than the standard deviation of the Coho captured in the ELJ Reach (4.6 mm) (Figure 16).

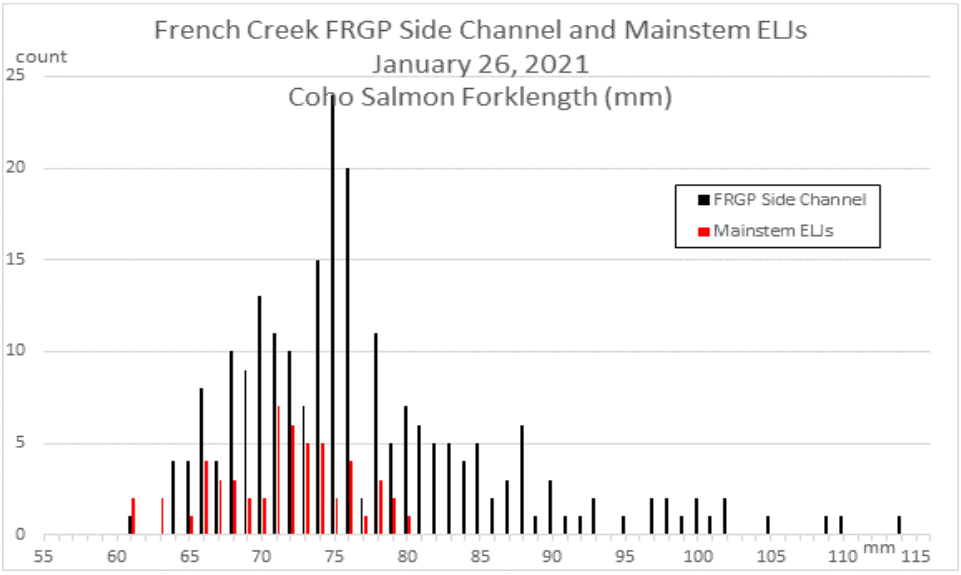


FIGURE 16. FORKLENGTH (MM) HISTOGRAM - COHO SALMON CAPTURED IN FRGP SIDE CHANNEL AND MAINSTEM ELJS - JANUARY 26, 2021.

The larger range of fish condition in the Side Channel is apparent in the forklength histogram and was observed when handling the fish (Photo 14). The observation of Coho Salmon with superior condition on average and a larger range of condition in the Side Channel during the winter of 2020-2021 corroborates the previous observations.

PHOTO 14. COHO SALMON ON LEFT (FL ≈ 99 MM); COHO SALMON ON RIGHT (FL ≈ 66MM) CAPTURED IN THE SIDE CHANNEL - JANUARY 26, 2021.

POPULATION ESTIMATES

Paired mark and recapture sampling events were performed in the ELJ Reach and French Control Pools on October 7 - 10, 2020. Population estimates for the two sample units were calculated by Monica Tonty (Humboldt State University Graduate Student) supported by the FRGP, grant #Q1910504 titled *Effectiveness & Validation Monitoring of Scott River Beaver Dam Analogue,* using multiple methods. The

estimated population of Coho Salmon in the ELJ Reach (n = 672) is greater than the estimated population in the four Control Pools (n = 537). The first population estimate only includes taggable fish (≥ 65 mm), while the second includes those under taggable size (<65 mm). Paired surveys were done between 10/7-10/9/2020 (Table 21).

TABLE 21. FALL 2020 JUVENILE COHO SALMON LOCAL POPULATION ESTIMATES (N) USING A CHAPMAN RATIO-BASED ESTIMATOR.

Site	N ≥ 65mm	SD	2.5% CI	97.5% CI	N incl. <65mm	SD	2.5% CI	97.5% CI
French Control Pools	439	9.76	420	458	537	21.97	494	580
French ELJs	464	23.71	418	511	672	39.56	595	750

Comparison of French Control Pool population estimates for coho greater than or equal to 65 mm (N) using different methods: Chapman ratio-based estimator, Huggins Closed Capture Model - a maximum likelihood method (Max LL), and two parameter expanded-data augmented Bayesian approaches: one with constant detection probability (Model0) and one with individual heterogeneity in detection probability (Modelh) (Table 22).

TABLE 22. COMPARISON OF FRENCH CONTROL POOL POPULATION ESTIMATES FOR COHO GREATER THAN OR EQUAL TO 65 MM (N) USING DIFFERENT METHODS: CHAPMAN RATIO-BASED ESTIMATOR, HUGGINS CLOSED CAPTURE MODEL.

	N	sd	2.5% CI	97.5% CI
Chapman	439	10	420	458
Max LL	457	9	440	474
Model0	457	12	436	482
Modelh	538	23	500	591

The Chapman ratio-based estimator is a variation of the Lincoln-Peterson population estimator that accounts for small-sample bias, calculated as follows:

$$\hat{N} = \frac{(M+1)(C+1)}{R+1} - 1$$

Where:

N=Estimate of total population size

M= Total number of coho salmon marked on day one

C= Total number of coho salmon captured on day two

R= Number of coho salmon recaptured on day two.

The population estimate was expanded to include fish too small to tag (<65 mm) by using the average ratio of fish caught that were less than 65 mm (Table 21).

Additional methods of population estimates are shown for the French Control Pools in Table x4. These methods derive likelihood-based population estimates from mark-recapture data. The Huggins Closed Capture Model uses the probability of capture (p) and the probability of not being captured (1-p) (Lukacs 2020). The data is described as a series of capture histories: 01, 10, 11, and 00. For example, capture history "01" is an individual that was not captured on day one and was captured on day two. The probabilities for each capture history are defined as:

$P(x_{10}) = (p)(1-p)$ (probability of being encountered on 1st occasion only)
$P(x_{11}) = (p)(p)$ (probability of being encountered on both occasions)
$P(x_{01}) = (1-p)(p)$ (probability of being encountered on 2nd occasion only)
$P(x_{00}) = (1-p)(1-p)$ (probability of never being encountered)

Because we do not know the true number of individuals with capture history "00", it is estimated. The p with the highest probability of seeing the observed number of fish with capture history "10", "11", and "01" is the maximum likelihood value. Using this value, the number of fish with capture history "00", and thus the total population size, can be calculated as follows:

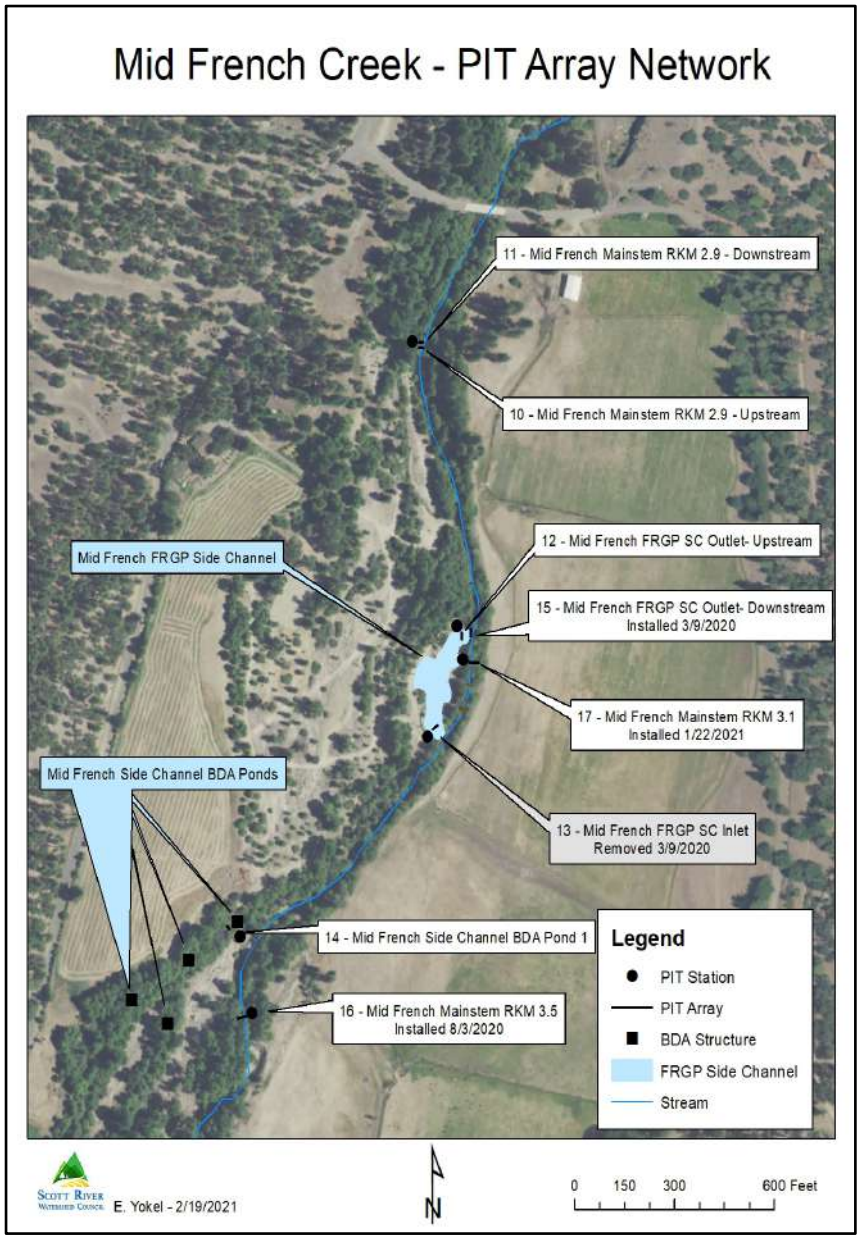
$r = x_{10} + x_{11} + x_{01}$ (this is the minimum number known alive)
P(capture) = 1-(1-p)(1-p) (probability an animal was *ever* captured)

$$\hat{N} = \frac{r}{P(capt)}$$

The Bayesian approaches are similar to the Huggins Closed Capture Model, but instead many individuals with the capture history "00" are artificially added to the dataset (Kéry and Schaub 2011). Then the probability that a "00" individual is actually in the population is estimated. This is called parameter-expanded data augmentation. Model0 is a version of this Bayesian approach with constant detection probability among individual fish, while Modelh is a version where there is binomial random variation in detection probability of individual fish, representing things like "trap-happiness" or "trap-shyness".

PIT Tag Arrays - Movement

In conjunction with the mark and recapture PIT tag effort, remote PIT tag arrays were installed in the outlet and inlet of the Side Channel in June 2019. These arrays are part of a network of arrays in Mid French Creek installed to document movement and survival of the marked fish (Map 10). The PIT tag arrays record the 15-digit PIT ID and time of detection when a marked fish is in the vicinity and/or passes through the channel spanning antenna.



MAP 10. LOCATION OF REMOTE PIT ARRAYS IN MID FRENCH CREEK.

Analysis of the unique detections per day at the remote PIT array in the Side Channel outlet and the stream stage during runoff events in late January 2020 indicates a significant increase in detections associated with increasing stage and discharge (Figure 17). It is hypothesized that this increase in detections during the periods of increased discharge is due to the fish migrating from the higher velocity mainstem habitats to the complex low velocity habitats in the Side Channel.

Single arrays were installed in the Side Channel inlet and outlet prohibiting the ability to detect direction of movement. The inlet array was moved on March 9, 2020 to the outlet (downstream of the outlet structure and outlet array that is upstream of the structure) creating “paired” arrays that enable the

detection of movement direction at the Side Channel outlet. Diurnal movement from an Off Channel Pond in Sugar Creek to the mainstem Sugar BDA Pond has been observed during the late winter and early spring, triggering an interest to see if this pattern of habitat utilization could be detected at this location. The paired arrays at the outlet created the ability to detect direction of movement to document if fish are moving between the Side Channel and mainstem habitats.

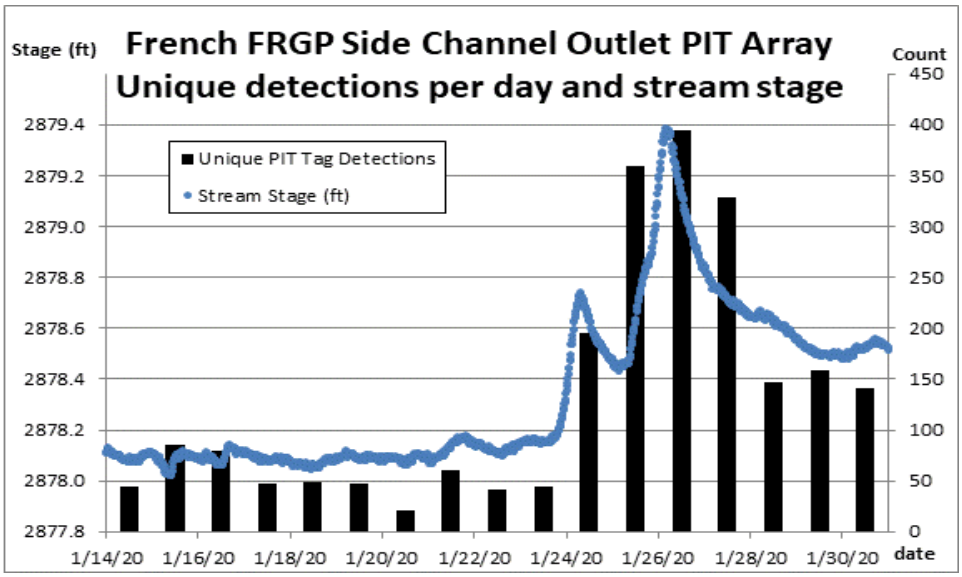


FIGURE 17. SIDE CHANNEL OUTLET PIT ARRAY STATION – UNIQUE PIT TAG DETECTIONS PER DAY AND FRENCH CREEK STREAM STAGE - JANUARY 2020.

Presumably due to poor water quality during the critically dry summer of WY20, Coho Salmon were not utilizing the Side Channel habitat in the oversummering period. The first precipitation and runoff events occurred from November 13 - 19, 2020. A significant increase in the number of unique marked fish detected at the upstream outlet array was observed in conjunction with the runoff events as observed in January 2020.

Analysis of the paired array data confirmed 165 moved upstream into the Side Channel outlet from the mainstem in November. Another 38 were only detected on the downstream outlet antenna, so it cannot be confirmed that they went into the Side Channel, and 11 were detected on the upstream outlet antenna without first being detected on the downstream antenna. These fish possibly entered the Side Channel via the inlet, which did not have an antenna. An additional 23 moved into the side channel in mid-late October and continued to be detected in November. The mean first date of detection for fish on the upstream outlet antenna was 11/18/2020 (Figure 18).

Analysis of movement at the paired outlet arrays show that many fish showed back and forth movement over one day after initial arrival. Eleven fish showed more extensive back and forth movement between the Side Channel and the mainstem French over multiple days in November. None of these fish were detected on any other antennas during this time, so it is unclear where they were going. An additional

array was installed in the Mainstem French Creek upstream of the Side Channel Outlet in January 2021 to try to detect the fish that have been observed moving between the Side Channel and mainstem habitats.

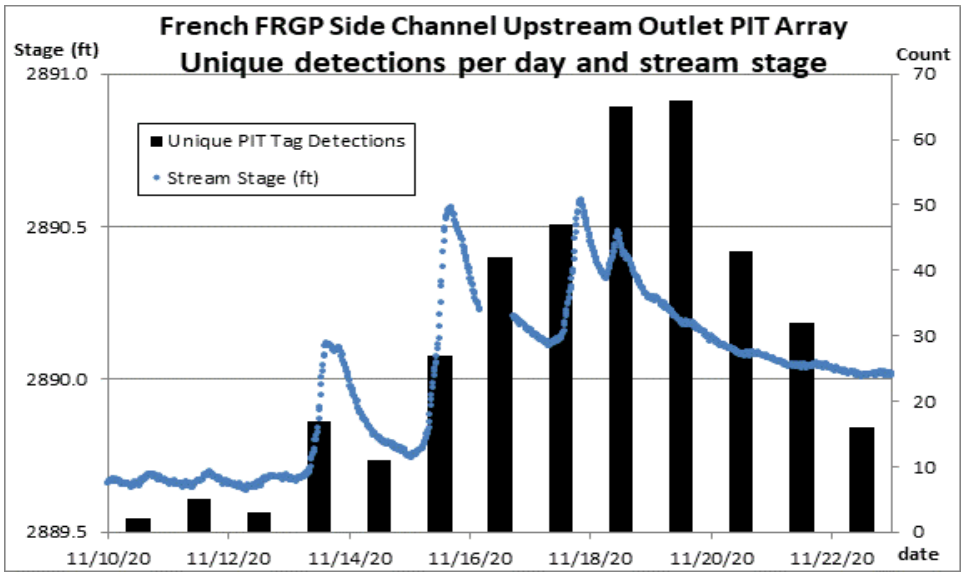


FIGURE 18. SIDE CHANNEL UPSTREAM OUTLET PIT ARRAY STATION – UNIQUE PIT TAG DETECTIONS PER DAY AND FRENCH CREEK STREAM STAGE - NOVEMBER 2020.

A fish sampling effort in the Side Channel on December 15, 2020 recaptured 34 marked Coho Salmon. All 34 recaptured fish during the sampling event were detected by the outlet antennas. 29 were detected in November. Three of those were only detected on the upstream antenna, so it is unclear if they came in through the outlet or inlet. The other five recaps were detected in early December, with one of those only detected on the downstream antenna. The future analysis of the biometric data from the mark and recapture efforts and the remote array detections will enable a better understanding of successful life strategies of Coho Salmon in enhanced and unenhanced habitats.

The ongoing monitoring and research effort funded by the CDFW FRGP program, grant #Q1910504 titled *Effectiveness & Validation Monitoring of Scott River Beaver Dam Analogue*, will continue to analyze the PIT tag data from the mark and recapture efforts and remote arrays to better understand the growth, movement, habitat utilization and survival of juvenile Coho Salmon in the Scott River.

Planting and Vegetative Response

On October 8, 2020 a survey for planting survival was undertaken; 62 of 82 cottonwoods were viable (76%), 2 of 3 boxelders (67%) and a visual estimate of 85% of the willow stems.

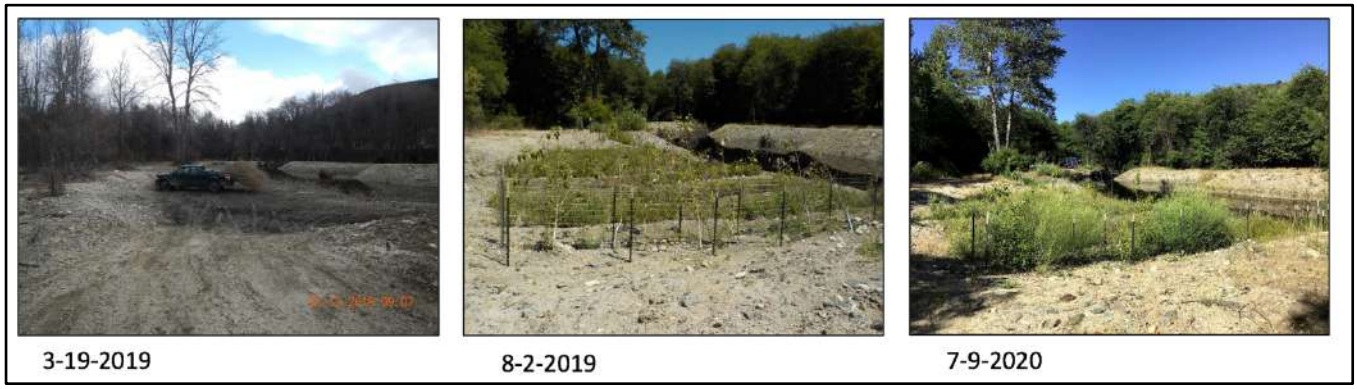


PHOTO 15. CONSTRUCTED FLOODPLAIN

SRWC watered the planting along the upper terrace in the late fall of 2019 due to the lack of precipitation events normally experienced by that time of year.

Of interest was the remarkable natural recruitment that occurred on the inset floodplain and along the Side Channel banks after the high flow events (Photo 16). Essentially the entire surface of the floodplain became vegetated with a wide variety of species including willow, alder, cottonwood, cattails, rushes, monkey flowers and other unidentified species.

PHOTO 16. PLANTED WILLOWS IN ROW IN BACKGROUND, NATURALLY RECRUITED VEGETATION IN THE FOREGROUND - JULY 2019.

Multispecies use

While monitoring and understanding the use of the constructed habitat complex by species other than salmonids was not a formal part of the project, many adventitious observations were made.

Other Aquatic Species

Several lamprey ammocetes have been captured and released during fish sampling events. Steelhead were routinely caught in the ELJ reach during fish sampling efforts; very few were found to be utilizing the Side Channel. All steelhead had biometric data collected before being released. Dace and marbled sculpin were frequently captured during sampling events. In the winter of 2021, ~14 bullfrog tadpoles were captured in the French Creek mainstem . A few giant pacific salamanders have also been captured. A western pond turtle was observed during direct observation surveys in the Side Channel.

Beavers

Interest in working with beavers to utilize their ecosystem engineering abilities to accelerate ecological recovery has increased since the Project was conceived and designed, so understanding their interaction with the Project is of interest. Pre-project, beaver were known to utilize not only the Project reach, but also upstream and downstream, for at least ten years prior to Project implementation as evidenced by chews sticks, scat, burrows and willow browse. No dam building had been observed.

Within 1 week of project completion, beaver browse of willow and cottonwoods adjacent to the Side Channel were observed. These areas had not been previously grazed by beavers. Over the following year, a game camera placed at the Side Channel outlet regularly documented beavers entering and leaving the Side Channel, often carrying vegetation to their known burrow located in the banks of the mainstem. In 2018, the photos included the presence of juvenile beavers as well as two adults (Photo 17).

In 2019, evidence of beaver utilization of the site, and as well as upstream and downstream of the site, ceased. It is unknown what caused the loss of beavers at the site, whether it was caused by natural predation or human removal.

PHOTO 17. BEAVER ACTIVITY AT OUTLET OF THE SIDE CHANNEL – AUGUST 29, 2018.

Waterfowl, Piscivores and other birds

The Project reach had not been observed to support waterfowl or significant piscivore usage prior to Project implementation. Subsequent to implementation, usage by Canadian geese, wood ducks, mallards, mergansers, king fishers, night herons and great blue herons has been routinely observed (Photo 18). Kildeer, waxwings, dippers, cliff swallows have also been observed.

PHOTO 18. MALE WOOD DUCK IN THE SIDE CHANNEL OUTLET - SEPTEMBER 2018.

Other Species

Game cameras have detected deer, mountain lion, bears, fox, possums and raccoons at the site (Photo 19).

PHOTO 19. JUVENILE BLACK TAIL DEER BROWSING PLANTED WILLOW ON THE INSET FLOODPLAIN - AUGUST 2018.

Discussion

Site response and adaptive management

The project was approached with formal engineering and with the intention to create relatively static restoration features, however the inherent stochasticity of the stream system required a total of 3 adaptive management interventions to maximize habitat benefits. It is unknown at the time of this report what adaptive management actions may be warranted in the future if it is desired to maintain the form and function of the Project's current features.

The theory of process-based restoration was just in its infancy, and not fully available as a conceptual model at the time the Project was developed. Even if it had been, the constrained channel, right bank revetment, presence of nearby downstream irrigation infrastructure, high sediment loads and small project footprint would have brought into question the appropriateness of taking a process-based design approach to the project, however, even with engineered designs, but without the ability to "let nature take its course' at the site, site stewardship was required.

The amount of sediment, particularly organic material, being transported through the reach was under appreciated prior to the start of the project. While problematic in terms of reducing the habitat volume in the Side Channel, the organic material deposited on the inset floodplain jump started a robust vegetative response. A significant amount of sediment accumulated upstream of ELJ 1, aggrading the stream channel by several feet (visual assessment). Indicating the potential to use French Creek's high sediment loads to aggrade the incised channel.

To understand whether this Project took the most effective approach to restoration, alternative conceptual approaches are considered here: 1) Rather than creating a small restoration feature at a discrete site we could have, worked at a larger reach scale (if there had been landowner willingness) which would have allowed more room for stream evolution to create positive impacts; 2) We could have invested in more extensive pre-project engineering analysis and designed more "hardened" restoration features; 3) We could have allowed the processes that took place to fill the constructed Side Channel with sediment, losing Coho rearing habitat in exchange for a wetland feature.

We believe that we achieved a reasonable balance of adaptively managing the created habitat to maximize the restoration dollar investment for Coho Salmon. Without more extensive (and expensive) engineering analysis and the creation of hard restoration features, adaptive management needs were required. Similar needs should be anticipated and routinely included in almost all project planning and funding. If a larger scale, more process-based approach had been undertaken, the observed sediment deposition could have been used to a greater extent as a Project asset, rather a liability, however landowners were not ready at the time to allow larger processes to take place on their property.

The fundamental premise of adaptive management is that projects that are implemented within dynamic and highly altered systems such as French Creek, and the larger Scott River, are going to require some level of adaptive management to aid in achieving project objectives. Our experience strongly suggests that this is true even if the projects are "engineered. Doing so should not be viewed as a negative outcome, but rather as anticipated and strategic. Adaptive management should therefore be anticipated in the project development, funding and permitting. "Lessons learned" are often opportunities that can and should guide future restoration actions, and lessons learned from this Project are currently being applied to on-going planning and design efforts in French Creek.

As a result of this Project, several restoration designs are underway immediately upstream of the Project. These projects are designed to capture and store sediment on the floodplain and also utilize it to aggrade the incised channel. These new efforts will increase the benefit of this Project by integrating the lessons learned and also by reducing sediment inputs into the Project area, thereby extending the Side Channel's useful life as a Coho rearing habitat.

Water Quality

Water quality parameters of temperature and DO varied between the main channel and constructed Side Channel during different seasons and different water years. On the whole, water quality conditions were good throughout the habitat complex, except in the Side Channel during the extreme drought of 2020, when both temperature and DO were inhospitable to salmonids. There was pre-project concern that splitting flow between the main channel and Side Channel would alter both flow and the baseline good water quality in the main channel, but this did not occur. Good water quality was monitored in the main channel throughout the Project.

The differences in temperature between the Side Channel and main channel offered a variety of thermal regimes, and Coho were found to move between the habitats. The poor water quality in the Side Channel in the summer of 2020 was not desirable but must be viewed in context of the crashing water quality and the dewatering of streams across the watershed, and not as a standalone problem of the Project.

The variety of thermal regimes created by the habitat complex offered multiple micro-habitats for fish to move between as needed. Previous research has shown that salmonids can utilize warmer, high productivity habitats for feeding and return to cooler ones for refugia. Under very low flow conditions, the decision to allow the Side Channel inlet to remain blocked by winter sediment appeared to have been correct as it kept high quality water in the Main channel, where fish were able to survive through the summer in the very limited habitat available. Intensive efforts to lease all of the available agricultural water in French Creek were undertaken in 2020, likely keeping the stream connected and increasing the available habitat. This experience points out the need to view project effectiveness in the context of larger reach and regional conditions.

Fisheries

All life phases of Coho salmon utilized all of the created habitat features at some point during the Project. Both winter and summer juvenile rearing habitat were created and utilized. The introduction of spawning gravel was a novel approach to restoration in the Scott Watershed and spawning was observed on the gravel 2 out of 3 years. A reach upstream with similar length and with habitat conditions to the Project site's pre-implementation condition yielded 43 Coho, while an event on the same day in the ELJ reach yielded 343 Coho. Obviously, no fish reared in the Side Channel prior to construction, as it was dry ground. Habitat capacity and Coho usage of the Project reach was clearly increased. The presence of spawning, both summer and winter usage, and identification of juveniles who remained at the site through their entire juvenile life stage suggest that the restoration habitat actually increased the population of Coho at the site, as well as offering prefeential habitat for fishes from other stream reaches. In addition, the fish sampled from the Side Channel have been consistently larger than those from the ELJs and the French Creek Control Pools, likely providing the fish utilizing the habitat a survival advantage.

The Project was a success in terms of supporting French Creek's important population of Coho salmon. A Coho Salmon tagged at the site was identified as a spawning adult 1 mile upstream of the Project, suggesting that the site is producing adults in excess of those that the habitat can support. Year over year spawning in the French and Miners Creek system has increased for the last four years, a trend not evident across the rest of the Klamath Basin. While not conclusive, and beyond the scope of this Project to determine, these observations are suggestions that by increasing habitat capacity for all life phases, the Project has actually increased the population of Coho Salmon at the site, rather than simply offering preferred habitat for a stable population. The possibility that a more widespread implementation of restoration projects targeting all life stages would produce sufficient adult returns to push fish to stray to depopulated streams appears real.

The data collected at this site is extensive, and more data is being collected as part of the on-going FRGP BDA monitoring project. Further analysis of existing and new data will offer additional insights about the effectiveness of the Project. A specific recommendation for future data analysis is to perform a detailed analysis of individual tagged fish growth data in relation to movement and fidelity to the Side Channel using mark and recapture data in conjunction with the passive array detection data for Brood Year 2018 and Brood Year 2019 Coho.

Bibliography

California Department of Fish and Game. 2004. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission.

Helley, E.J., and Lamarche, V. (1973). Historic flood information for northern California streams from geological and botanical evidence.

Kéry, M.,and M. Schaub. 2011. Bayesian Population Analysis using WinBUGS: A Hierarchical Perspective. Academic Press.

Kroeber, A.L. 1976. Handbook of the Indians of California. New York, N.Y.

Lukacs, P. 2020. Closed population capture-recapture models. Page 14.1-14.38 Program MARK: a gentle introduction.

National Marine Fisheries Service. 2014. Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon (Oncorhynchus kisutch). National Marine Fisheries Service. Arcata, CA.

Scott River Watershed Council. 2005. Initial Phase of the Scott River Watershed Council Strategic Action Plan. Etna California.

Scott River Watershed Council. 2018. Restoring Priority Coho Habitat in the Scott River Watershed Modeling and Planning Report, Phase I. Etna, California.

Sommarstrom, S, Kellogg, Elizabeth Kellogg, J. 1990. Scott River Basin Granitic Sediment Study. Prepared for the SRCD, Etna CA.

U.S. Geological Survey. 2019. The StreamStats program, online at http://streamstats.usgs.gov, accessed on July 19, 2019.

Wells, H.L. 1881. History of Siskiyou County, California. D.J. Stewart & Co., Oakland (reprinted in 1971).

CONSTRUCTION PLANS FOR

French Creek Habitat

Fish Passage and Habitat Enhancement Project

JUNE 2016

Approved by:

Landowner: _____, Date
Scott Valley Watershed Council: _____, Date

Leonard Joey Howard *6.13.2016*
CALIFORNIA REGISTERED
PROFESSIONAL ENGINEER NO. # 53319
Cascade Stream Solutions, LLC

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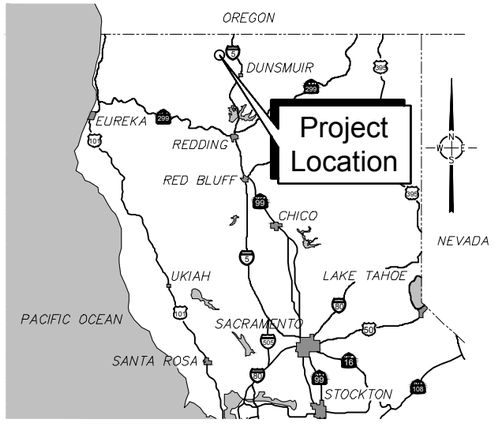
GENERAL NOTES

1. TOPOGRAPHY IS BASED ON SISKIYOU WATERSHED COUNCIL SURVEYS CONDUCTED IN 2014 AND LIDAR DATA SUPPLIED BY USFWS. CONTRACTOR NOTIFY SISKIYOU RCD IF CONTRACTOR NOTES DISCREPANCIES BETWEEN THE PLANS AND THE STREAM BANK.
2. CONTRACTOR SHALL NOTIFY USA NORTH AT 811 OR 1-800-227-2600 OR WWW.USANORTH.ORG TO REQUEST IDENTIFICATION AND LOCATION OF EXISTING UNDERGROUND UTILITIES. CONTRACTOR SHALL CONTACT USA NORTH 2 TO 14 DAYS BEFORE PLANNED EXCAVATION DATE.
3. THIS PROJECT IS SUBJECT TO REQUIREMENTS OF PERMITS ISSUED BY VARIOUS REGULATORY AGENCIES. THE CONTRACTOR IS RESPONSIBLE TO UNDERSTAND AND PERFORM ALL WORK IN ACCORDANCE WITH THE REQUIREMENTS OF THE PERMITS. PRIOR TO COMMENCING WORK THE CONTRACTOR SHALL COORDINATE WITH THE OWNER'S REPRESENTATIVE TO VERIFY THE MOST RECENT COPY OF ALL APPLICABLE PERMITS ARE INCORPORATED IN TO THE PROJECT CONSTRUCTION DOCUMENTS.
4. THE CONTRACTOR IS RESPONSIBLE FOR DEVELOPING AN EROSION CONTROL AND POLLUTION PREVENTION PLAN FOR CONSTRUCTION ACTIVITIES. THIS PLAN MUST BE APPROVED BY THE OWNER'S REPRESENTATIVE PRIOR TO CONSTRUCTION ACTIVITIES COMMENCING FOR THIS PROJECT.
5. WHEN CONDITIONS IN THE FIELD DO NOT CONFORM WITH INFORMATION IN THESE PLANS AND/OR WHEN UNUSUAL CIRCUMSTANCES ARISE DURING CONSTRUCTION, THE CONTRACTOR SHALL IMMEDIATELY CONTACT THE OWNER'S REPRESENTATIVE.
6. IN THE EVENT THAT ANY ARCHEOLOGICAL ARTIFACTS ARE UNCOVERED DURING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL STOP ALL WORK IMMEDIATELY IN THE AREA AND CONTACT THE OWNER'S REPRESENTATIVE. WORK IN THE AREA SHALL NOT RESUME UNTIL APPROVED BY THE OWNER'S REPRESENTATIVE.



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Drawing Information	
Date	13 June 2016
Status	CHECKSET
Designer	JH
Drafter	JH
Checked	
File Name	French Creek Final Design 3-201609
Plotted Scale	0 1/2 1

Revisions		
No.	Date	Description

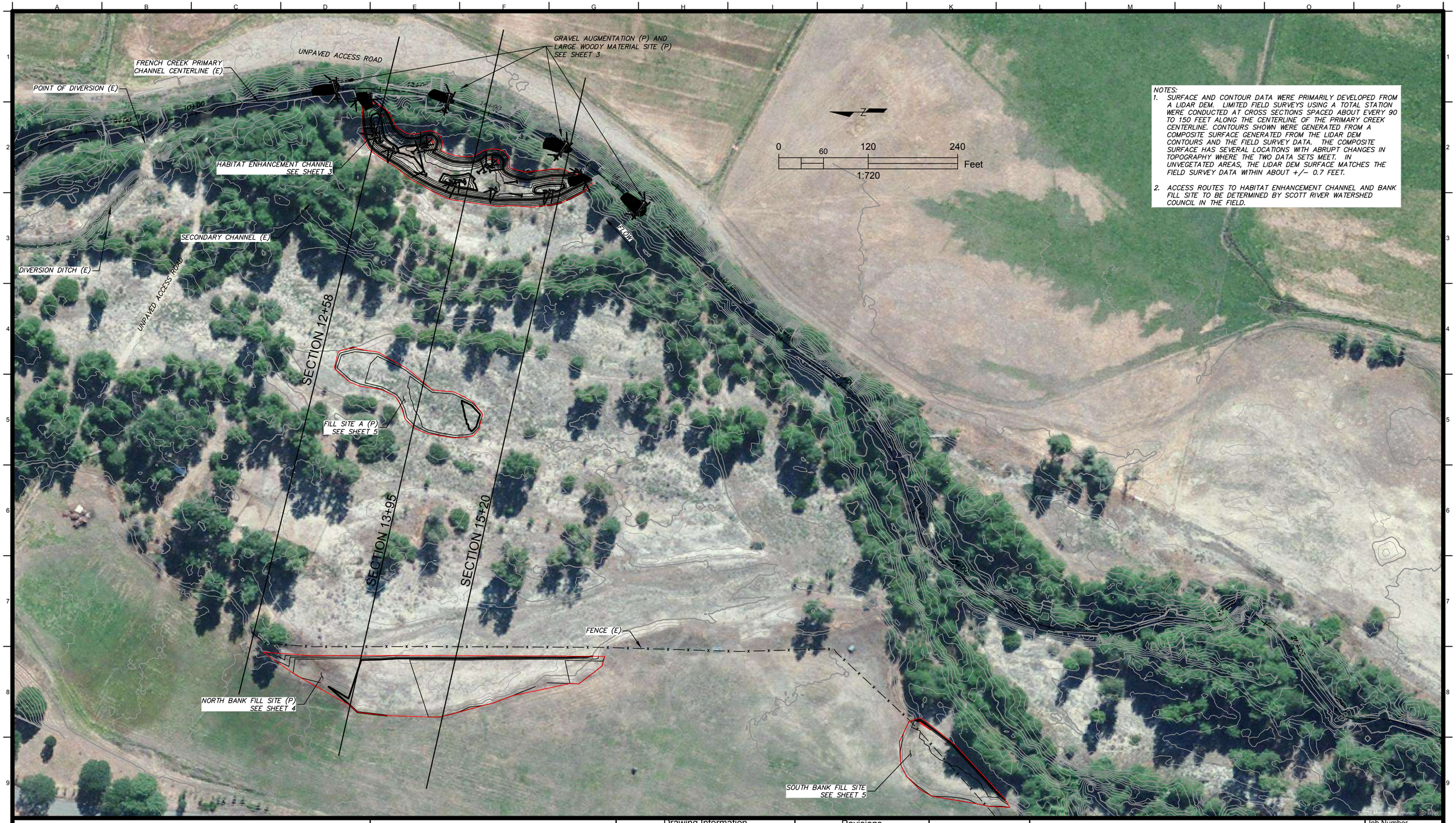
French Creek Habitat Enhancement Project

Cover Sheet

Job Number 2014-111

Sheet Number 1

of 7



NOTES:

1. SURFACE AND CONTOUR DATA WERE PRIMARILY DEVELOPED FROM A LIDAR DEM. LIMITED FIELD SURVEYS USING A TOTAL STATION WERE CONDUCTED AT CROSS SECTIONS SPACED ABOUT EVERY 90 TO 150 FEET ALONG THE CENTERLINE OF THE PRIMARY CREEK CENTERLINE. CONTOURS SHOWN WERE GENERATED FROM A COMPOSITE SURFACE GENERATED FROM THE LIDAR DEM CONTOURS AND THE FIELD SURVEY DATA. THE COMPOSITE SURFACE HAS SEVERAL LOCATIONS WITH ABRUPT CHANGES IN TOPOGRAPHY WHERE THE TWO DATA SETS MEET. IN UNVEGETATED AREAS, THE LIDAR DEM SURFACE MATCHES THE FIELD SURVEY DATA WITHIN ABOUT +/- 0.7 FEET.
2. ACCESS ROUTES TO HABITAT ENHANCEMENT CHANNEL AND BANK FILL SITE TO BE DETERMINED BY SCOTT RIVER WATERSHED COUNCIL IN THE FIELD.

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Drawing Information	
Date	13 June 2016
Status	CHECKSET
Designer	JH
Drafter	JH
Checked	
File Name	French Creek Final Design 3-201605
Plotted Scale	0 1/2 1

Revisions		
No.	Date	Description

REGISTERED PROFESSIONAL ENGINEER EDWARD J. HOWARD No. 53199 Exp. 06/30/15 CIVIL STATE OF CALIFORNIA

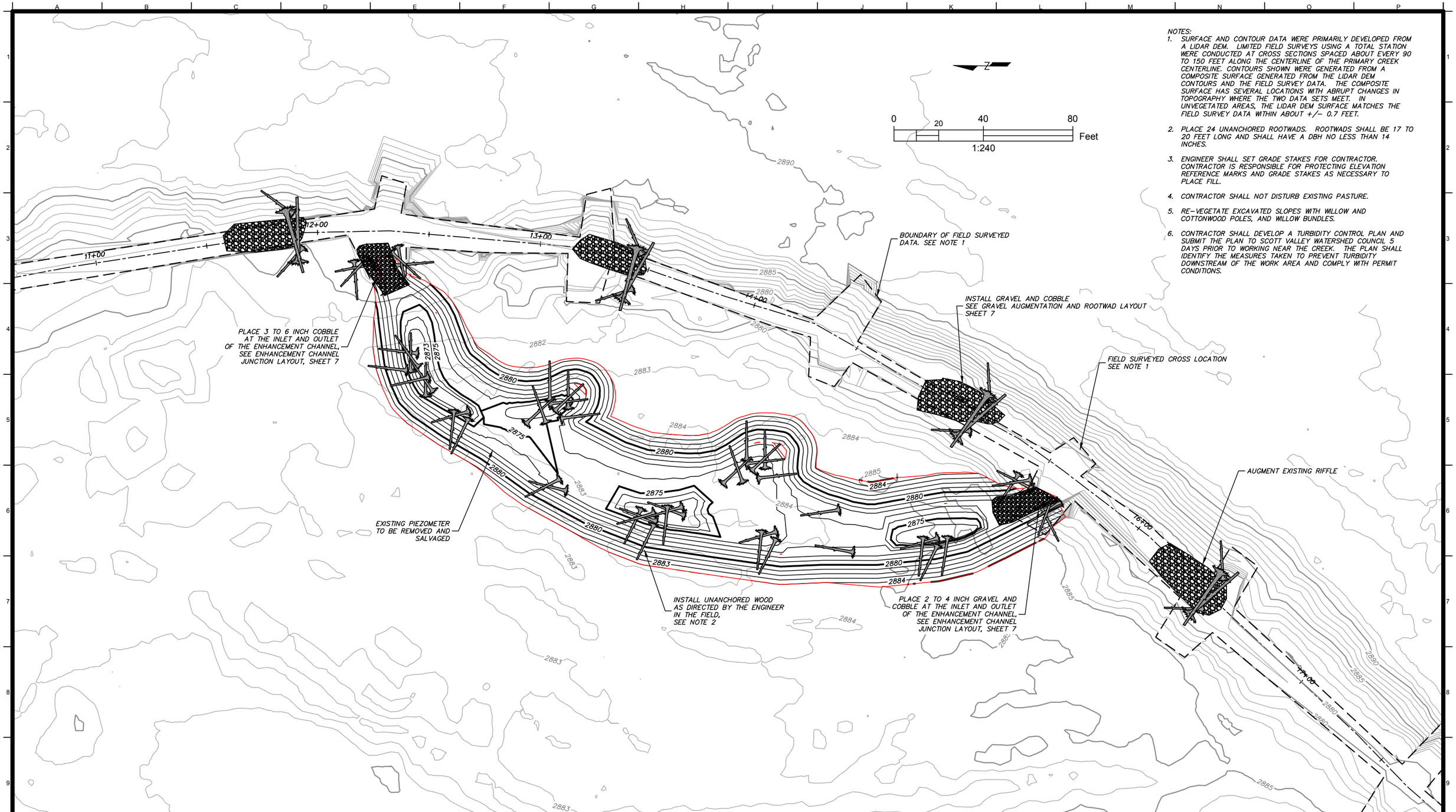
French Creek Habitat Enhancement Project

Project Site Plan

Job Number 2014-111

Sheet Number 2

of 7



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2. PLACE 24 UNANCHORED ROOTWADS. ROOTWADS SHALL BE 17 TO 20 FEET LONG AND SHALL HAVE A DBH NO LESS THAN 14 INCHES.
3. ENGINEER SHALL SET GRADE STAKES FOR CONTRACTOR. CONTRACTOR IS RESPONSIBLE FOR PROTECTING ELEVATION REFERENCE MARKS AND GRADE STAKES AS NECESSARY TO PLACE FILL.
4. CONTRACTOR SHALL NOT DISTURB EXISTING PASTURE.
5. RE–VEGETATE EXCAVATED SLOPES WITH WILLOW AND COTTONWOOD POLES, AND WILLOW BUNDLES.
6. CONTRACTOR SHALL DEVELOP A TURBIDITY CONTROL PLAN AND SUBMIT THE PLAN TO SCOTT VALLEY WATERSHED COUNCIL 5 DAYS PRIOR TO WORKING NEAR THE CREEK. THE PLAN SHALL IDENTIFY THE MEASURES TAKEN TO PREVENT TURBIDITY DOWNSTREAM OF THE WORK AREA AND COMPLY WITH PERMIT CONDITIONS.

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Drawing Information	
Date	13 June 2016
Status	CHECKSET
Designer	JH
Drafter	JH
Checked	
File Name	French Creek Final Design 3-201605
Plotted Scale	0 1/2 1

Revisions		
No.	Date	Description

REGISTERED PROFESSIONAL ENGINEER
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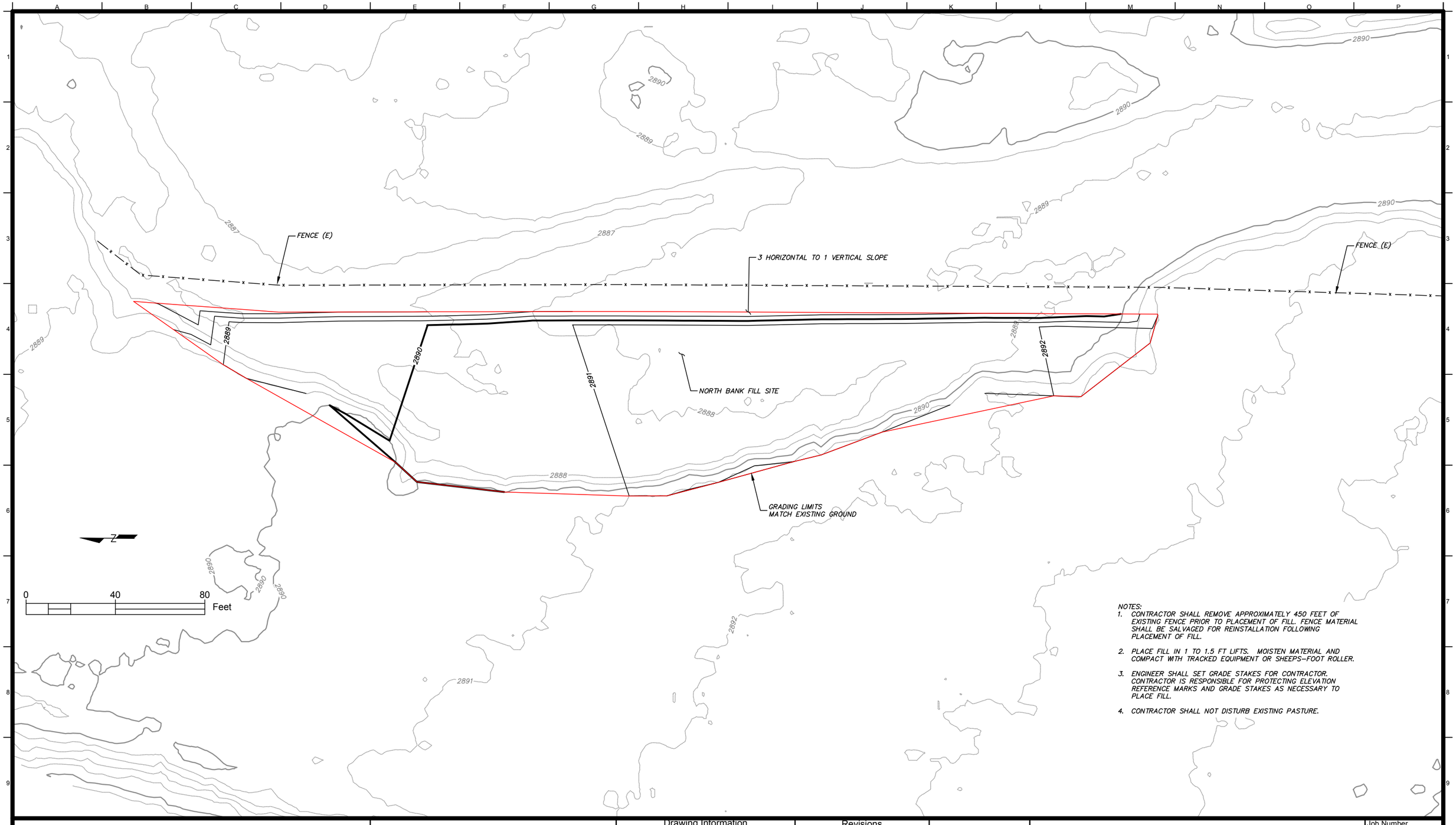
French Creek Habitat Enhancement Project

Habitat Enhancement Channel Grading Plan

Job Number 2014-111

Sheet Number 3 of 7



NOTES:

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2. PLACE FILL IN 1 TO 1.5 FT LIFTS. MOISTEN MATERIAL AND COMPACT WITH TRACKED EQUIPMENT OR SHEEPS–FOOT ROLLER.
3. ENGINEER SHALL SET GRADE STAKES FOR CONTRACTOR. CONTRACTOR IS RESPONSIBLE FOR PROTECTING ELEVATION REFERENCE MARKS AND GRADE STAKES AS NECESSARY TO PLACE FILL.
4. CONTRACTOR SHALL NOT DISTURB EXISTING PASTURE.

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Drawing Information	
Date	13 June 2016
Status	CHECKSET
Designer	JH
Drafter	JH
Checked	
File Name	French Creek Final Design 3-201605
Plotted Scale	0 1/2 1

Revisions		
No.	Date	Description

REGISTERED PROFESSIONAL ENGINEER
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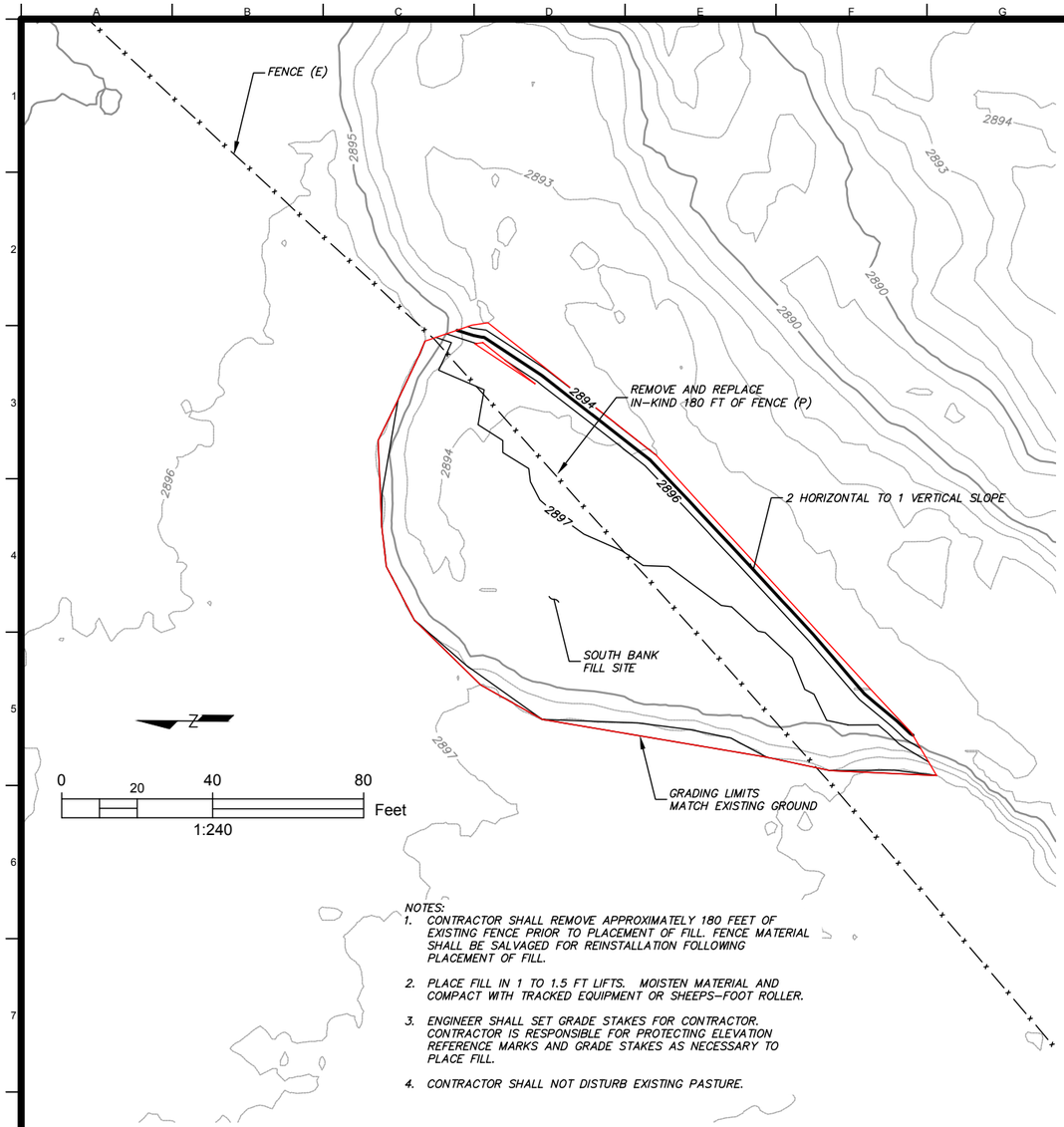
STATE OF CALIFORNIA

French Creek Habitat Enhancement Project

North Bank Fill Grading Plan

Job Number 2014-111

Sheet Number 4 of 7



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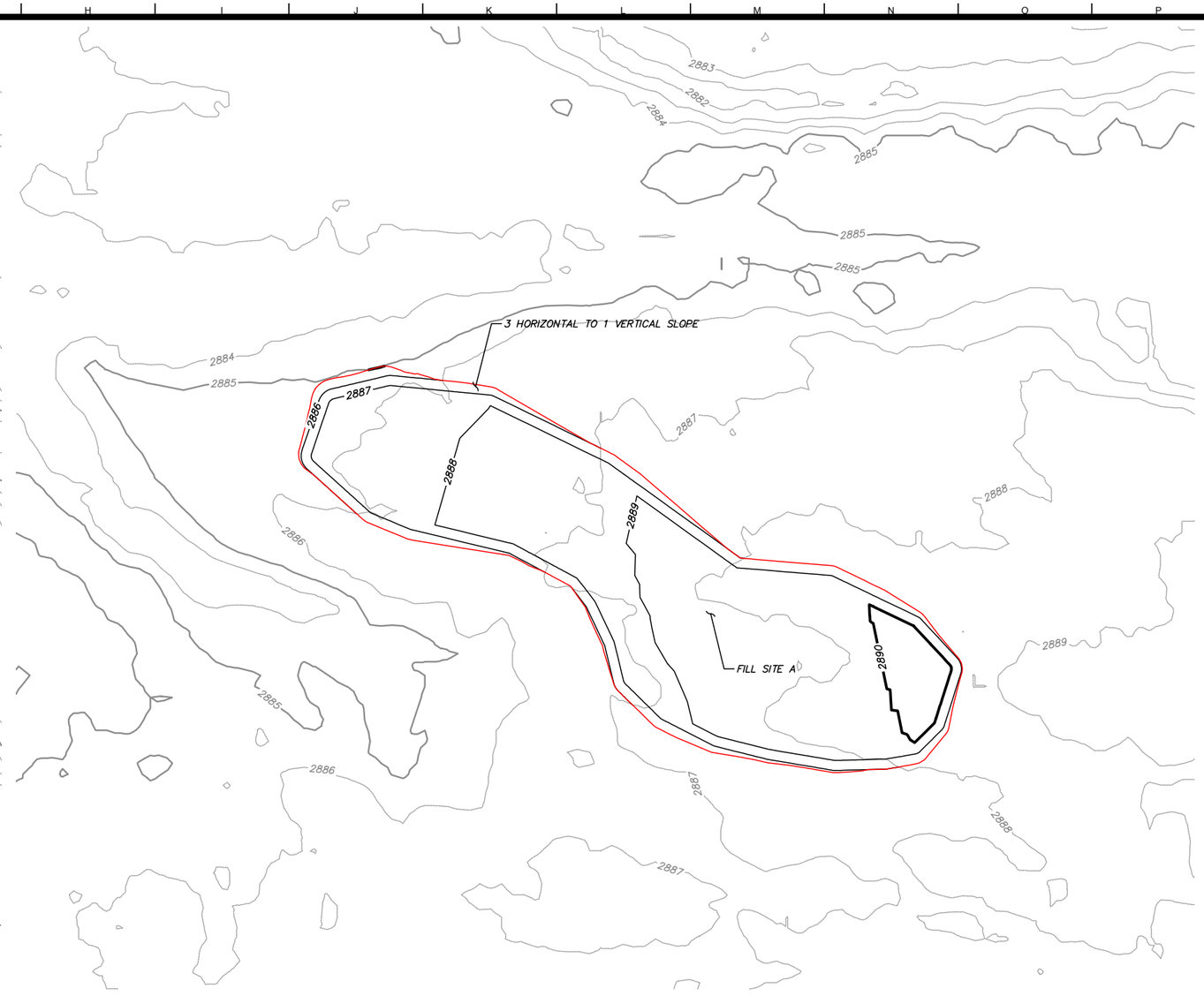
2. PLACE FILL IN 1 TO 1.5 FT LIFTS. MOISTEN MATERIAL AND COMPACT WITH TRACKED EQUIPMENT OR SHEEPS-FOOT ROLLER.
3. ENGINEER SHALL SET GRADE STAKES FOR CONTRACTOR. CONTRACTOR IS RESPONSIBLE FOR PROTECTING ELEVATION REFERENCE MARKS AND GRADE STAKES AS NECESSARY TO PLACE FILL.
4. CONTRACTOR SHALL NOT DISTURB EXISTING PASTURE.

SOUTH BANK FILL SITE



FILL SITE A

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Revisions		
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REGISTERED PROFESSIONAL ENGINEER
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French Creek Habitat Enhancement Project

South Bank Fill and Fill A Site Grading Plan

Job Number
2014-111

Sheet Number
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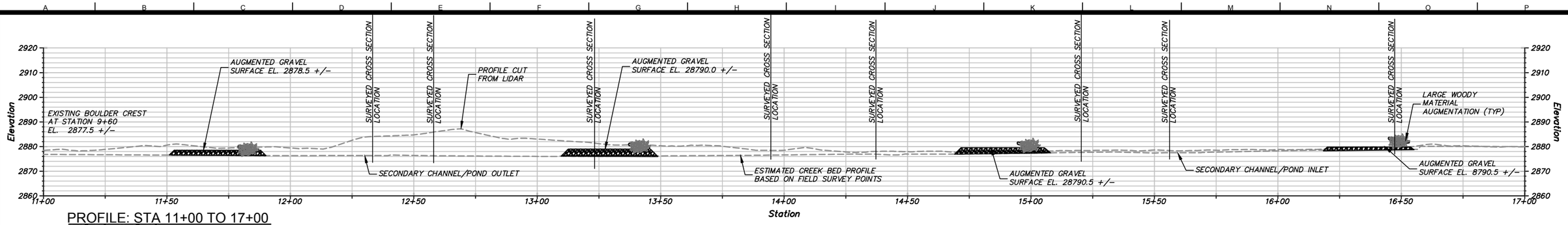

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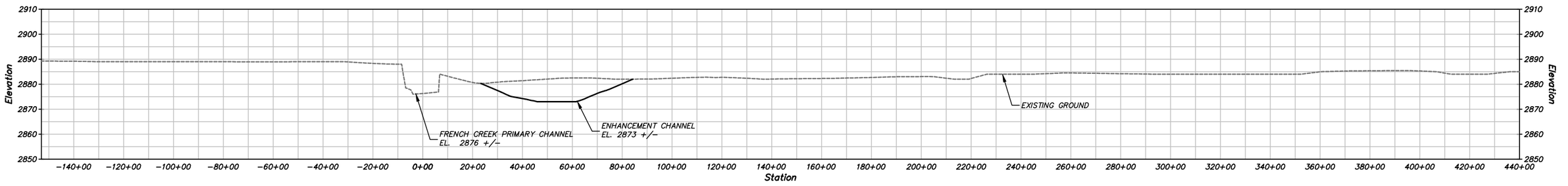

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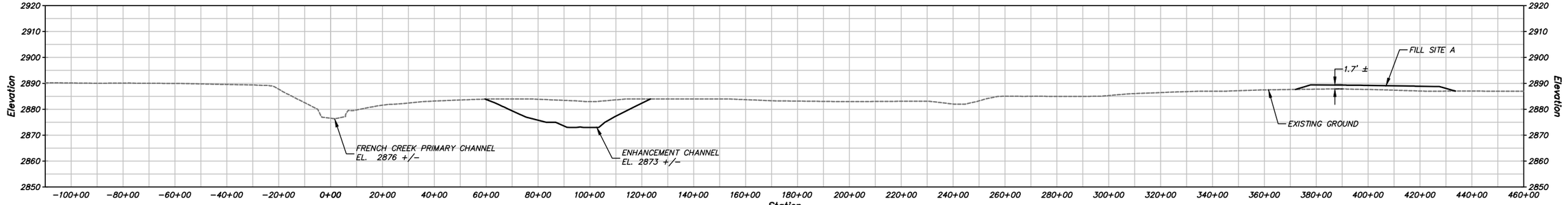

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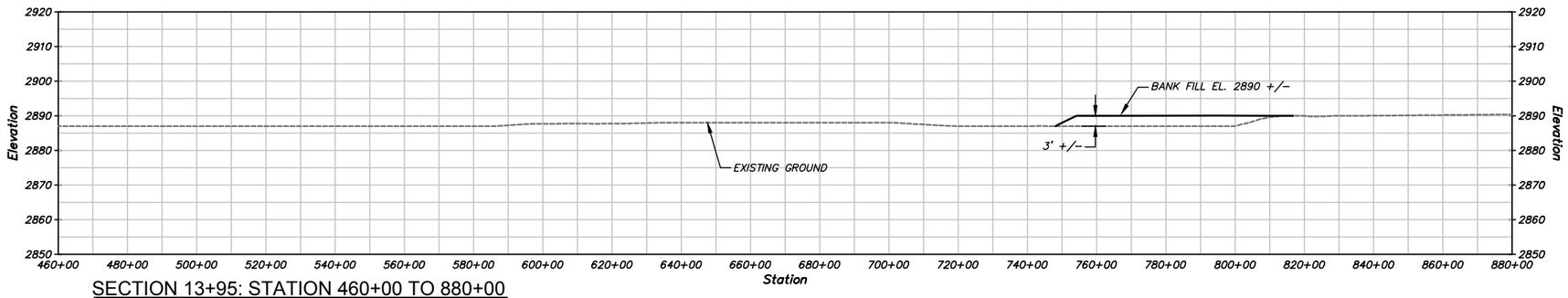

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REGISTERED PROFESSIONAL ENGINEER LEONARD J. HOWARD No. 53139 Exp. 06/30/15 CIVIL STATE OF CALIFORNIA

French Creek Habitat Enhancement Project Primary Channel Profile & Cross Section

Job Number 2014-111

Sheet Number 6

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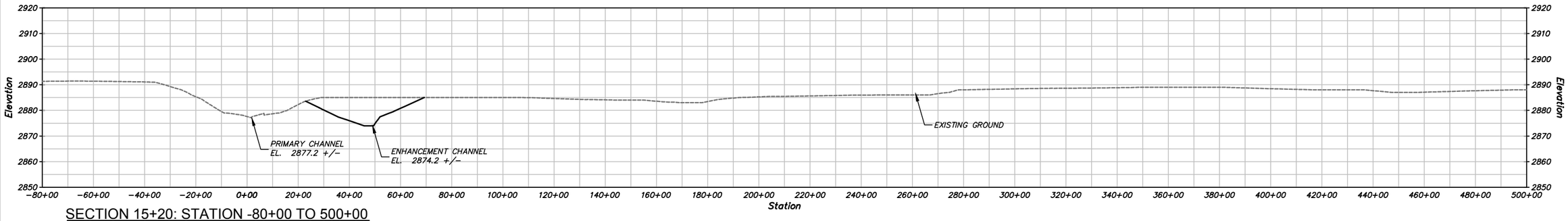

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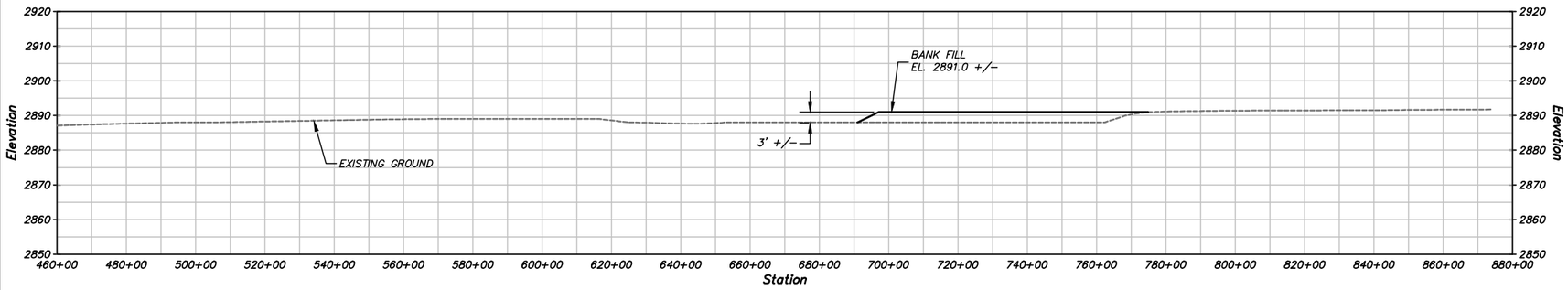

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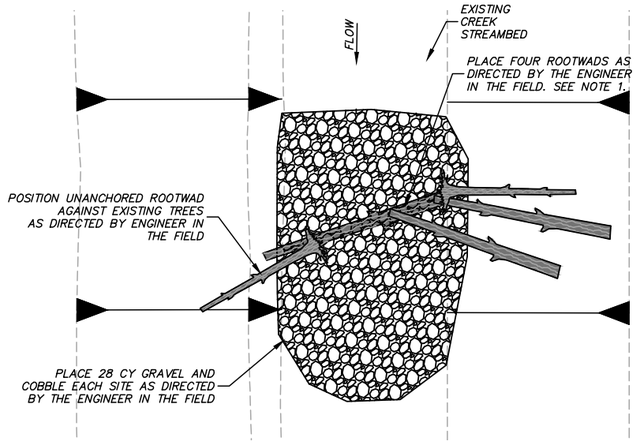
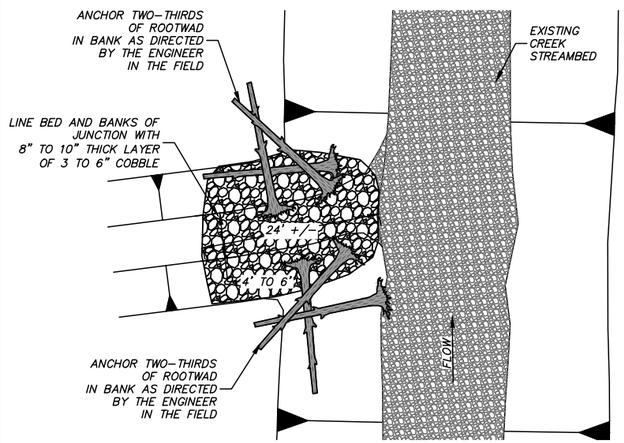


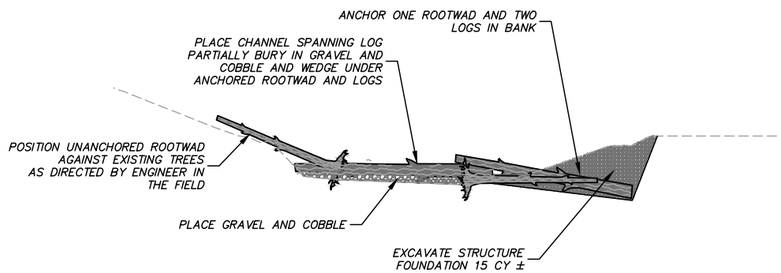
GRAVEL AUGMENTATION AND ROOTWAD PLACEMENT LAYOUT
NOT TO SCALE

NOTES:
1. CONTRACTOR SHALL PLACE ROOTWADS ALONG THE STREAMBANK AS DIRECTED BY THE ENGINEER IN THE FIELD. ROOTWADS SHALL BE PLACED IN A MANNER THAT FORMS A DEBRIS JAM WITH EXISTING ROOTED VEGETATION AND REDUCES THE POTENTIAL FOR MOBILIZATION BY CREEK FLOWS.
2. EQUIPMENT SHALL OPERATE FROM THE BANKS TO PLACE ROOTWADS AND GRAVEL/COBBLES. EQUIPMENT SHALL NOT ENTER THE CREEK.
3. THE AVERAGE ELEVATION OF THE AUGMENTED GRAVEL SHALL BE WITHIN 0.2 FEET OF THE ELEVATION SPECIFIED ON THE PLANS. THE AVERAGE ELEVATION WILL BE MEASURED BY THE ENGINEER IN THE FIELD. NO PORTION OF THE AUGMENTED GRAVEL AREA SHALL DEVIATE MORE THAN 0.3 FEET FROM THE SPECIFIED ELEVATIONS.
4. PLACE 24 UNANCHORED ROOTWADS. ROOTWADS SHALL BE 17 TO 30 FEET LONG AND SHALL HAVE A DBH NO LESS THAN 18 INCHES.
5. GRAVELS USED FOR AUGMENTATION SHALL BE WASHED, FREE OF SILTS AND SANDS, AND BE FROM THE SCOTT RIVER WATERSHED.
6. CONTRACTOR SHALL TAKE MEASURES TO MAINTAIN TURBIDITY LEVELS DOWNSTREAM OF THE PROJECT SITE WITHIN LEVELS SPECIFIED BY THE PERMITS. WHEN TURBIDITY DOWNSTREAM OF THE PROJECT SITE EXCEED MAXIMUM LEVELS SPECIFIED BY THE PERMITS, THE CONTRACTOR SHALL CEASE INSTREAM GRAVEL AUGMENTATION AND ROOTWAD PLACEMENT UNTIL TURBIDITY LEVELS REACH ACCEPTABLE LEVELS.



ENHANCEMENT CHANNEL JUNCTION
NOT TO SCALE

MATERIAL SCHEDULE PER STRUCTURE			
MATERIAL	QTY.	DIA. (IN)	LENGTH
CHANNEL SPANNING LOG	1	15 TO 18	25
ANCHORED ROOTWAD	1	15 TO 18	20
ANCHORED LOG	2	15 TO 20	20
UNANCHORED ROOTWAD	1	15 TO 18	20
EXCAVATION	15 CY		
GRAVEL AND COBBLE(50% 0.5 IN TO 1.5 IN; 50% 1.6 IN TO 3 IN)	28 CY		



GRAVEL AUGMENTATION AND ROOTWAD PLACEMENT SECTION
NOT TO SCALE

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Drawing Information	
Date	13 June 2016
Status	CHECKSET
Designer	JH
Drafter	JH
Checked	
File Name	French Creek Final Design 3-201605
Plotted Scale	0 1/2 1

Revisions		
No.	Date	Description

REGISTERED PROFESSIONAL ENGINEER LEONARD J. HOWARD No. 53119 Exp 06/30/15 CIVIL STATE OF CALIFORNIA

French Creek Habitat Enhancement Project
Cross Sections & Large Wood Structure Layouts

Job Number 2014-111

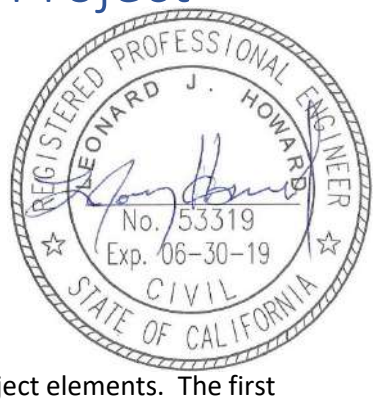
Sheet Number 7 of 7

French Creek Habitat Enhancement Project – Closeout Report

Date 12.27.2018

Prepared by: Joey Howard, P.E. Lic. No. 53319

Joey Howard, certifies the habitat enhancement features were completed according to the grant.



The French Creek River Habitat Enhancement Project included three primary project elements. The first element included excavation of a 310-foot-long side channel through a high terrace and installing a mix of large wood and fine textured wood in the pond. The second element included construction of three anchored channel spanning wood structures with spawning gravel along the primary French Creek Channel. The third element involved construction of two large wood structures along the bank.

The constructed project was modified from the original design to better fit the site and improve habitat conditions. A channel spanning wood structure was not installed because temporary construction access would have required removing live trees along the bank. Cascade determined that the benefit of the instream structure was less than the benefit of maintaining several live trees. The large wood was used to construct two structures along the bank and downstream of the side channel outlet. Additionally, a 2790 square foot bench was excavated on the west side of the side channel to increase the area of riparian plants and provide food and materials for beaver and other wildlife. The area will be inundated during moderate and high flows. The duration of inundation is likely to be a week to a month per year. The as-built survey is provided in Attachment A.

Photograph 1 shows the upstream project reach in 2018, prior to construction. Photograph 2 shows the upstream project reach in December 2018 following construction. Brief descriptions and photographs of the constructed project elements are provided below.

Side Channel Excavation

The constructed side channel is designed to reduce shear stresses in the primary channel and provide off channel, low velocity habitat throughout the year. About 4700 cubic yards was excavated from a high terrace to form a side channel. The side channel was excavated to a depth of about 3 to 6 feet below the primary channel elevation near the inlet. The side channel receives surface flow from French Creek. The side channel is about 310 feet long and about 50 rootwads were placed in the side channel. Willow and cottonwood cuttings will be planted in the winter/spring of 2019. Photographs 3, 4, and 5 show the side channel inlet, the side channel, and outlet, respectively.

Channel Spanning Log Structures

Three anchored channel spanning log structures were constructed along primary channel. These structures were positioned to limit disturbance to existing riparian vegetation and provide instream habitat and complexity along the 340-foot-long reach between the inlet and outlet of the side channel. Prior to installing the anchored log structures the reach was a relatively straight run with a relatively

uniform bed material and limited instream complexity. The anchored log structures are positioned about 70 to 90 feet apart. Logs are ballasted by burying a portion of the logs in the bank and installing micro-piles. Small cobble and spawning sized gravel were placed up and downstream of the structures.

Bank Log Structures

Two log structures were placed on the right and left bank downstream of the side channel outlet. The right bank structure consists of a log placed between two live tree trunks. Micro-piles were driven to anchor the log in place. Fine textured wood and branches were stuffed underneath the log and between the piles to provide cover for juvenile salmonids. Fine textured wood can be placed seasonally to provide additional cover. Three rootwads were pinned between trees on the left bank downstream of the side channel outlet. Structure locations and photographs are provided in Attachment A.

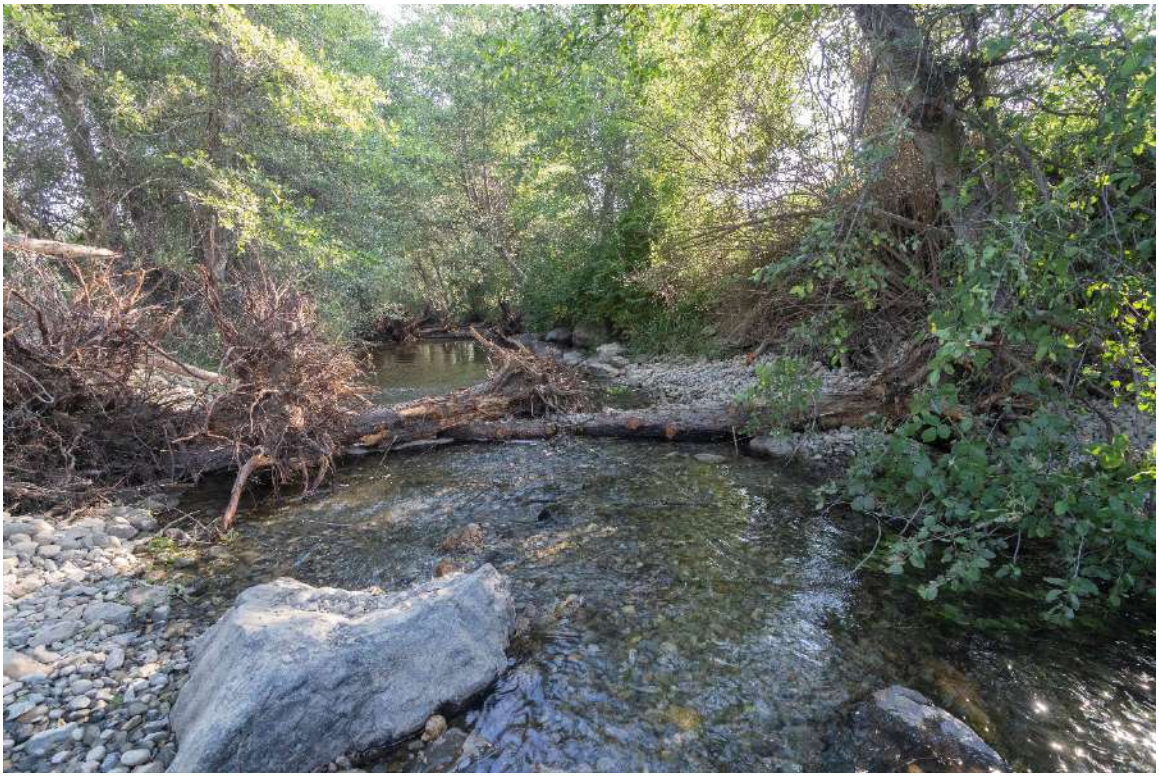
Photograph 1. 2017 Aerial photograph of project reach prior to construction

Photograph 2. 2018 Aerial photograph of upstream constructed side channel prior to planting.

Photograph 3. Side Channel Inlet

Photograph 4. Side Channel

Photograph 5. Side Channel outlet



Photograph 6. Channel spanning wood jam at summer low flow

Photograph 7. Channel spanning wood jam during winter flow

Photograph 8. Channel Spanning Wood Structure

Attachment A: As-Built Plan

ROOTWAD STRUCTURE

CHANNEL SPANNING WOOD STRUCTURE AND GRAVEL AUGMENTATION

CHANNEL SPANNING WOOD STRUCTURE AND GRAVEL AUGMENTATION

NOTE:
PRE-PROJECT TOPOGRAPHY IS BASED ON 2010 LiDAR DATA. LIDAR ACCURACY IS COMPROMISED BY DENSE VEGETATION. INACCURACIES IN LIDAR TOPOGRAPHY EXIST WITHIN FRENCH CREEK BED AND BANK. AS-BUILT SURVEY WAS PERFORMED BY SCOTT RIVER WATERSHED COUNCIL IN 2018 FOLLOWING EXCAVATION OF THE POND. DATA WAS COLLECTED USING RTK GPS.

ROOTWAD STRUCTURE

CHANNEL SPANNING WOOD STRUCTURE AND GRAVEL AUGMENTATION

SIDE CHANNEL WITH WOOD STRUCTURES

DATE SIGNED: 2018.12.26

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Drawing Information	
Date	26 December 2018
Status	CHECKSET
Designer	JH
Drafter	JH
Checked	
File Name	AS-Built
Plotted Scale	0 1/2 1

Revisions		
No.	Date	Description

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French Creek Habitat Enhancement Project

As-Built Grading Plan and Structure Placement

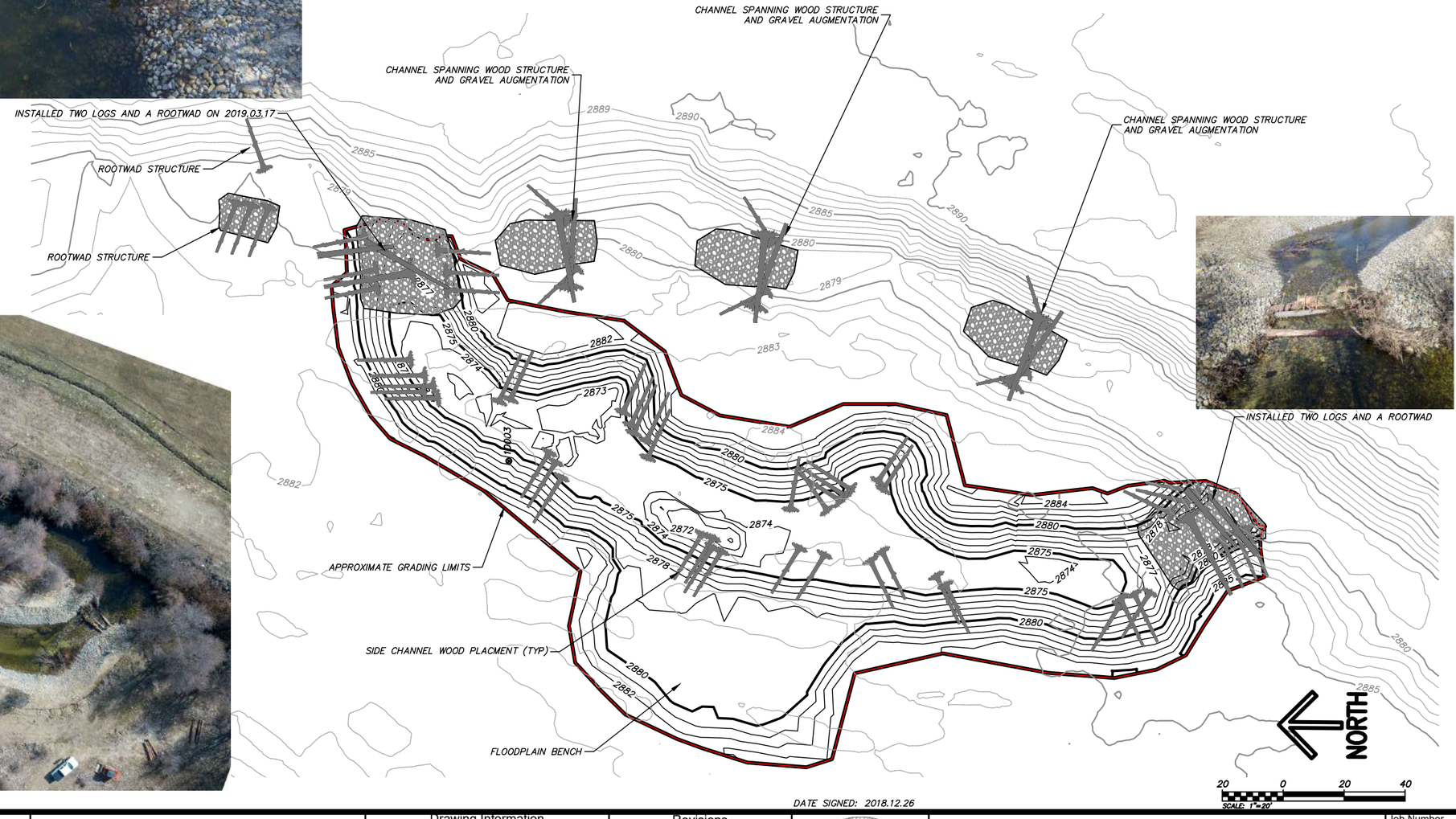
Job Number 2014-111

Sheet Number 1

1 of 1

NOTE:
PRE-PROJECT TOPOGRAPHY IS BASED ON 2010 LiDAR DATA. LIDAR ACCURACY IS COMPROMISED BY DENSE VEGETATION. INACCURACIES IN LIDAR TOPOGRAPHY EXIST WITHIN FRENCH CREEK BED AND BANK. AS-BUILT SURVEY WAS PERFORMED BY SCOTT RIVER WATERSHED COUNCIL IN 2018 FOLLOWING EXCAVATION OF THE POND. DATA WAS COLLECTED USING RTK GPS.

AERIAL VIEW OF SIDE CHANNEL TAKEN ON 2019.03.17



DATE SIGNED: 2018.12.26

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Drawing Information	
Date	17 March 2019
Status	CHECKSET
Designer	JH
Drafter	JH
Checked	
File Name	AS-Built 20190317
Plotted Scale	0 1/2 1

Revisions		
No.	Date	Description

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French Creek Habitat Enhancement Project

As-Built Grading Plan and Structure Placement

Job Number
2014-111

Sheet Number
1

1 of 1