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FUTURE FISHERIES IMPROVEMENT PROGRAM

BIENNIAL REPORT

Summary of program activities for the period November 1, 2016 to October 31, 2018

CREDITS

This report can be found on the Montana Fish, Wildlife & Parks website:
http://fwp.mt.gov/fishAndWildlife/habitat/fish/futureFisheries/legislative/

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Background and Overview

LEGISLATION

The Future Fisheries Improvement Program (FFIP) was enacted in 1995 (MCA 87-1-272) to provide funding for the long-term enhancement of streams and stream banks, in-stream flows, water leasing, lease or purchase of stored water, and other programs that improve wild fish and aquatic habitats. It replaced the River Restoration Program that was authorized in 1989 and expanded opportunities to restore wild fish habitats, funded through a portion of fishing license sales.

The FFIP was supplemented and amended in 1999 when the legislature enacted the Bull Trout and Cutthroat Trout Enhancement Program (MCA 87-1-283), which emphasized the enhancement of habitat for the natural reproduction of bull trout and cutthroat trout. This component of the FFIP was established with funding from the Resource Indemnity Trust (RIT) fund. In 2013, the emphasis on native species was amended and expanded to all native fish species, not exclusively bull and cutthroat trout (MCA 87-1-283). This legislation called for the enhancement of native fish through habitat restoration, natural reproduction, and reductions in species competition. Once called the Bull Trout and Cutthroat Trout Enhancement Program, this supplement to the FFIP encompassed all native species and became the Native Species Enhancement Program (NSEP).

Legislative statute outlines the procedures and requirements of the FFIP, including approval of project funding. The Citizen Review Panel (Panel), appointed by the Governor and legislative body, assesses proposed projects independently and makes recommendations for funding. The Fish & Wildlife Commission is responsible for final funding approval.

Since the FFIP began, over 600 projects have been completed, creating a significant positive impact on fish habitat in Montana. Table 1 shows the impact of common project types. There has been enough riparian fence installed to stretch from Helena to Billings, and enough stream channel restored to stretch from Anaconda to Livingston. Almost 50 fish screens have been installed, and nearly 200 structures have been installed or removed to allow fish to move upstream and downstream.

TABLE 1. IMPACT OF COMMON PROJECT TYPES, SINCE 1996.

Project Type	Value
Miles of **riparian fence** installed	235
Miles of **channel restored**	133
Number of **fish screens** installed	48
Number of **fish passage** structures installed, or **barriers removed**	198
Number of **spawning structures** placed in a lake or reservoir	13,200
Instream flow added (cubic feet per second)	252

PROGRAM INFORMATION

As part of the enabling legislation for the FFIP, Montana Fish, Wildlife & Parks (FWP) must present a detailed report to each regular session of the legislature on the progress of the FFIP. This report includes Program activities and expenses since the last report, the project schedules, and the anticipated expenses for the ensuing 10 years' implementation of the FFIP.

PROGRAM GOALS AND FUNDING PRIORITIES

The overall goal of the FFIP, identified in the enabling legislation (MCA 87-1-272), is to provide for the protection and enhancement of Montana fisheries through voluntary enhancement of spawning streams and other habitats, and to improve natural reproduction and growth of wild fish populations.

The Panel developed specific guidance in 1995, stating that potential projects must accomplish one or more of the following goals to be considered for funding: 1) improve or maintain fish passage; 2) restore or protect naturally functioning stream channels or banks; 3) restore or protect naturally functioning riparian areas; 4) prevent loss of fish into water diversions; 5) restore or protect essential habitats for spawning; 6) enhance stream flow in dewatered stream reaches to improve fisheries; 7) improve or protect genetically pure native fish populations; or 8) improve fishing in a lake or reservoir.

When the NSEP (and RIT funding) was added to the FFIP, preference shifted to projects that restore, protect, or enhance habitat for native fishes, including those involving mineral reclamation. In 2013, FFIP funding preference expanded into Eastern Montana after all native species became eligible for funding and it was recognized that there were fewer projects completed in Eastern Montana.

Currently, the Panel considers the guidance and goals of the FFIP and considers other criteria during the review process, including:

- Evaluation of the cause of degradation and resolution (if possible), including a watershed approach.
- Benefit to the public, anglers, and/or native species.
- Cost share, public participation, and demonstration value.
- Planning and design that includes geomorphic, hydrologic, and biologic principles that promote natural function.
- Magnitude of benefit to wild fisheries.
- Landowner approval and participation.

FUNDING PROCESS & PUBLIC PARTICIPATION

Any entity that proposes a habitat project benefiting wild fish in Montana can be considered for funding under the FFIP. Project applications can be submitted to FWP twice each year and are considered for the subsequent funding period; winter funding cycle applications are due prior to December 1, and summer funding cycle applications are due prior to June 1.

Since the last biennial report, the Panel met to review project proposals four times: December 2016, June 2017, December 2017, and June 2018. After each meeting, funding recommendations formulated by the Panel were forwarded to the Montana Fish & Wildlife Commission (Commission) for final action during their regularly scheduled public meetings held in February and August for the winter and summer funding cycles, respectively.

For each individual funding cycle, there are several avenues for public comment prior to final approval by the Commission. All submitted project applications are posted on the FWP website to provide opportunity for public review and comment. Additionally, environmental assessments (EA's) are prepared for all projects approved for funding by the Panel and include a public comment period, except for projects that fall under categorical exclusion (ARM Rule 12.2.454). If the project is a sub-segment of a larger proposed action, or if the project takes place on federal lands, EA's are completed externally through the Montana Environmental Policy Act (MEPA) or National Environmental Policy Act (NEPA). Additional opportunities for public involvement and comment include attending public meetings of the Panel and the Commission. Press releases announce each upcoming grant cycle as well as the projects approved by the Commission.

PROGRAM UPDATES

Recent changes to the program include additional updates to the FFIP website, particularly in terms of monitoring and reporting. Storytelling has become a larger focus within the Program, and ArcGIS Online Storymaps will be used as an interactive way to display case studies and success stories. FWP's Fisheries Division has also begun working with the Communication and Education Division on a communications plan to improve reporting and public awareness of the FFIP. The November/December 2018 Montana Outdoors magazine featured the FFIP and two recently-funded projects.

Other projects in development include the merging of the FFIP database with the FWP Fisheries Information System (FIS), which will improve efficiency in reporting and allow restoration and fisheries data to be linked. Once the databases are updated, FFIP data will be more interactive and available to the public. An updated brochure is also in development, which will be used as a handout to provide Program information to the public.

Staffing and Membership

FUTURE FISHERIES CITIZEN REVIEW PANEL

The Panel is a critical component of the FFIP, serving as an independent body to review applications and make recommendations for funding. The 14-person Panel meets twice a year in mid-December and mid-June to discuss proposed projects and is available throughout the year to provide Program guidance.

The enabling legislation (MCA 87-1-272, MCA 87-1-283) called for the establishment of the Panel and identified specific categories of representation, including but not limited to the following:

- One member who is a representative of conservation districts;
- One member with expertise in commercial agriculture;
- One member with expertise in irrigated agriculture;
- One member from the private sector who is a fisheries restoration professional;
- Two members who are licensed Montana anglers;
- One member of the House of Representatives, chosen by the Speaker of the House;
- One member of the Senate, chosen by the Committee on Committees;
- One member with expertise in silviculture;
- One member who is a Montana high school student;
- One member with an expertise in mine reclamation techniques;
- One member with expertise in fisheries; and
- One ex-officio member from the Montana Department of Transportation with experience in highway impact mitigation.

An additional appointee was added by FWP to include a member with expertise in hydrology / geomorphology. Except for legislative appointments, Panel members are selected by the Governor or a Governor’s designee. Members serve a voluntary, two-year term and may be re-appointed for additional terms. Members of the Panel serving during the period of this report are in Table 2.

TABLE 2. REVIEW PANEL MEMBERSHIP (2016-2018).

CATEGORY	NAME, LOCATION	TERM START	TERM END
Conservation District	Clint Peck, Billings	Reappointed	7/1/2019
Commercial Agriculture	Alan Johnstone, Wilsall Vacant	Reappointed 7/1/2018	7/1/2018 7/1/2020
Irrigated Agriculture	Jim Stone, Ovando	Reappointed	7/1/2020

PROGRAM INFORMATION

CATEGORY	NAME, LOCATION	TERM START	TERM END
Restoration Professional	Karin Boyd, Bozeman	Reappointed	7/1/2019
Licensed Angler (1 of 2)	Joseph Willauer, Butte	Reappointed	7/1/2019
Licensed Angler (2 of 2)	Michael Johns, Bozeman	3/2016	7/1/2019
Silviculture/Forestry	Terry Chute, Helena	Reappointed	7/1/2019
High School Student	Meriwether Schrooer-Smith, Helena Dylan Yonce, Missoula	3/2016 7/1/2018	7/1/2018 7/01/2019
Mine Reclamation	Nancy Winslow, Missoula	Reappointed	7/1/2020
Fisheries	William (Bill) Wichers, Hamilton	3/2016	7/1/2019
MDT ex-officio	Bill Semmens, Helena	Reappointed	7/1/2019
Hydrologist	Chuck Dalby, Helena	Reappointed	7/1/2019
House of Representatives	Matt Regier, Kalispell	1/1/2017	12/31/2018
Senate	Jedediah Hinkle, Belgrade	1/1/2017	12/31/2018

FWP EMPLOYEES

Future Fisheries Improvement Program Funding

The enabling legislation for the FFIP (MCA 81-1-272) authorized the use of program funds for up to two additional full-time employees. FWP initially allocated two full time equivalents (FTE's) to the FFIP, but then transitioned to base license dollars to fund the two FTE's and their operations. Using base license dollars rather than funds allocated to the FFIP allowed more Program funds to be used for on-the-ground restoration.

Michelle McGree was employed as FWP staff during the report period. Michelle has been the Future Fisheries Improvement Program Coordinator (FFIPC) since 2014. The FFIPC is responsible for compiling and distributing project applications, visiting the sites of proposed projects, acting as FWP staff liaison for the Panel, developing and communicating FWP recommendations to the Panel, developing project agreements, processing and approving payments associated with completed restoration work, monitoring project implementation, effectiveness, and compliance, and maintaining a comprehensive FFIP database. Michelle also develops projects, coordinates with consultants and contractors who design and perform restoration projects, works with landowners and other citizens that need help developing project proposals, and assists with fish screening and fish passage project review.

Native Species Enhancement Program Funding

MCA 87-1-283 states, "In order to implement (the program), the department may expend revenue from the bull trout and cutthroat trout enhancement program for one additional FTE and one contractor to assist the review panel." In the past, the FTE was split among three individuals who were required to organize, complete, or maintain projects that were eligible for funding under the NSEP. Base license dollars were then used to fund this split FTE. Currently, only operations costs are used from the NSEP, to support the Panel meetings and supplemental monitoring activities related to NSEP-funded projects. Operations expenditures associated with the NSEP since the last report period (November 1, 2016 to October 31, 2018) equaled $15,032.72 and included four Panel meetings and one monitoring contract. The use of base license dollars to support employees for both the NSEP and FFIP allows maximum program dollars to be used for restoration.

Appropriations, Awards, & Expenditures

PROGRAM APPROPRIATIONS

The FFIP has been funded using base license dollars (River Restoration funds), while the NSEP has been funded primarily with Resource Indemnity Trust (RIT) funds and a small amount of base license dollars. River Restoration funds (MCA 87-1-257-258) are derived from a $0.50 earmark on resident fishing licenses and a $1.00 earmark on non-resident fishing licenses. NSEP funds (formerly the Bull Trout and Cutthroat Trout Enhancement Program) are derived from appropriations to the RIT fund (MCA 15-38-202). Past appropriations included $510,000 specifically earmarked by the 1995 legislature (26306, EI25) to construct a fish screen on the T&Y Diversion located on the Tongue River to prevent the loss of fish down the irrigation canal.

Since the inception of each program, FFIP appropriations averaged $665,416.67 per biennium (over 12 biennia) and $882,700 per biennium (over 10 biennia), for the FFIP and NSEP funding sources, respectively (Table 3). For the duration of the Program, the average amount appropriated per biennia is approximately $1.4 million. The cumulative total of funding since program inception is just over $16.8 million.

PROGRAM FUNDING

TABLE 3. LEGISLATIVE APPROPRIATIONS

LEGISLATIVE SESSION	FUND AND SUBCLASS	AMOUNT
1995	General License, 26306, E125 (earmarked)	$510,000.00
	River Restoration, 26301	$290,000.00
	General License, 02409, ET30	$220,000.00
	General License, 02409, ET2	$1,250,000.00
1997	River Restoration, 02149, 28466	$70,000.00
	General License, 02409, E131	$1,310,000.00
1999	River Restoration, 02149, E190	$300,000.00
	General License, 02409, E131	$1,170,000.00
	General License, 02409, 38011 (BT/CT)	$750,000.00
2001	River Restoration, 02149, EI115	$260,000.00
	General License, 02409, EI115	$750,000.00
	RIT, 02022, EI115 (BT/CT)	$850,000.00
2003	River Restoration, 02149, EI131	$210,000.00
	RIT, 02022, EI131 (BT/CT)	$700,000.00
2005	River Restoration, 02149, EI150	$190,000.00
	RIT, 02022, EI150 (BT/CT)	$1,000,000.00
2007	River Restoration, 02149, EI170	$314,000.00
	RIT, 02022, EI170 (BT/CT)	$1,000,000.00
2009	River Restoration, 02149, EI109	$150,000.00
	RIT, 02022, EI109 (BT/CT)	$1,000,000.00
2011	River Restoration, 02149, EI001	$274,000.00
	RIT, 02022, EI001 (BT/CT)	$1,000,000.00
2013	River Restoration, 02149, EI003	$190,000.00
	RIT, 02022, EI003	$600,000.00
2015	River Restoration, 02149, EI005	$277,000.00
	RIT, 02022, EI005	$1,000,000.00
2017	River Restoration, 02149, EI007	$250,000.00
	RIT, 02022, EI007	$927,000.00
TOTALS	FFIP (License + River Restoration)	$7,985,000.00
	NSEP (RIT + BT/CT funds)	$8,827,000.00
		$16,812,000.00
AVERAGE PER BIENNIUM	FFIP (License + River Restoration)	$665,416.67
	NSEP (RIT + BT/CT funds)	$882,700.00
		$1,401,000.00

PROGRAM FUNDING

FUNDING AWARDS

Since implementation of the FFIP in 1996, the Commission approved $16 million for restoration projects that are ongoing or completed which, in turn, generated approximately $52 million in available matching funds (Figure 1). Matching funds come from a wide array of sources, including federal agencies, state agencies, sportsman's groups, conservation groups, watershed groups, private foundations, private companies, and landowners. With FFIP and match combined, nearly $68 million of habitat restoration work has been undertaken in Montana since 1996 because of the FFIP.

The Panel and Commission have approved funding requests (full or partial) for 783 restoration projects (Table 4). Of these projects, 619 have been completed, 50 are ongoing, and 114 have been cancelled. All program funds previously committed to cancelled projects were subsequently reallocated to fund new habitat projects. The reasons for cancellations vary, but include:

- The applicant used other funding sources to complete the project.
- The landowner was unwilling to sign a project agreement. These project agreements apply to all funded projects and are put in place to ensure that there is protection for the investment in restoration (typically 20 years).
- The applicant was unable to secure the matching funds that were identified in the application.
- The landowner was never fully on board with the proposed project and backed out after funds were approved.
- The scope of the project significantly changed after funding was secured, requiring the applicant to re-apply to the FFIP or seek other sources of funding.

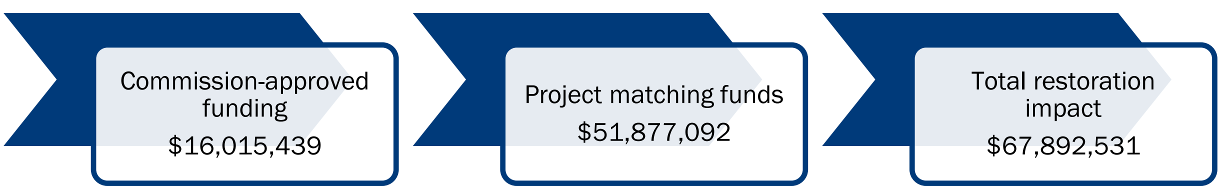


FIGURE 1. APPROVED FUNDING, MATCHING FUNDS, AND TOTAL DOLLARS SPENT ON COMPLETED OR ONGOING FUTURE FISHERIES IMPROVEMENT PROGRAM PROJECTS, SINCE 1996.

TABLE 4. STATUS OF FUTURE FISHERIES IMPROVEMENT FUNDED PROJECTS, BY YEAR, THROUGH NOVEMBER 1, 2018.

FUNDED PROJECTS PER YEAR					
Year	Ongoing	Cancelled	Complete	Ongoing maintenance	Total
1996		6	42		48
1997		6	39		45
1998		9	40		49
1999		7	43		50
2000		8	36		44
2001		8	27		35
2002		7	32	2	41
2003		8	33		41
2004		7	32		39
2005		3	28		31
2006		13	25	2	40
2007		2	34		36
2008		9	18		27
2009		3	28		31
2010		3	30		33
2011		8	22		30
2012		1	17		18
2013			19		19
2014	1	2	16		19
2015	4	1	29		34
2016	5	3	16		24
2017	13		10		23
2018	23		3		26
Total	46	114	619	4	783

Projects have been completed statewide since 1996 (Figure 2). However, fewer projects have been completed in eastern Montana. Because the NSEP funding originally targeted cutthroat trout and bull trout projects, those funds were limited to western Montana. In 2013, NSEP funding was expanded to include all native fish, creating opportunities for funding in additional areas. Increasing habitat enhancement in eastern Montana is a Program priority.

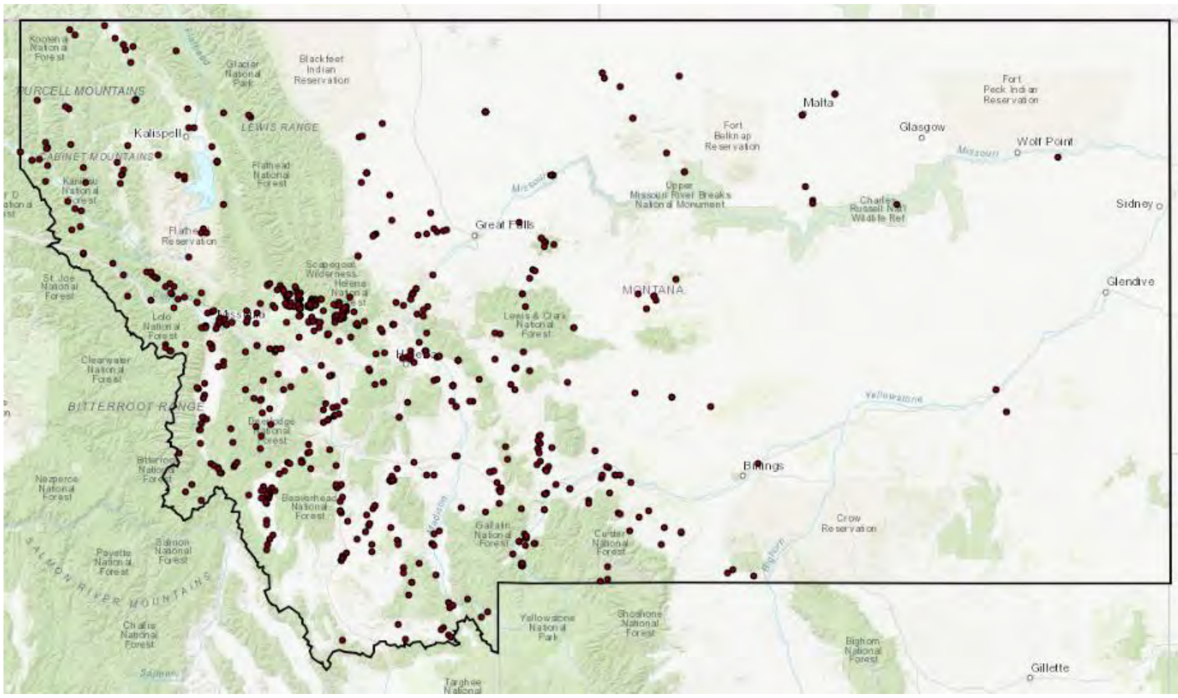


FIGURE 2. COMPLETED FUTURE FISHERIES IMPROVEMENT PROGRAM PROJECTS, 1996-2018.

EXPENDITURES

Table 5 lists all the FFIP projects that expended funds during the report period (November 1, 2016 to October 31, 2018). A total of $1,592,095.53 was expended on 65 restoration projects. Of these projects, 3 addressed long-term maintenance, 10 were granted funding prior to 2015, 30 were funded between 2015 and 2016, and 22 were funded in 2017 and 2018. Additionally, $15,032.72 was expended on program operations during this period. The operations expenditures were used to hire an intern for project monitoring and to facilitate Panel meetings. Most operations expenditures are absorbed by the FWP budget, which allows maximum FFIP funding to be available for on-the-ground projects.

PROGRAM FUNDING

TABLE 5. PROGRAM EXPENDITURES BETWEEN 11-1-2016 & 10-31-2018, SEPARATED BY PROGRAM (02022, NATIVE SPECIES ENHANCEMENT; 02149, RIVER RESTORATION /FUTURE FISHERIES IMPROVEMENT) AND SPENDING AUTHORITY SUBCLASS (EI001-EI007).
*** = FUNDS USED TRANSFERRED TO A SECOND PROJECT.**

			Subclass								
			02022 Native Species Enhancement Program				02149 River Restoration (FFIP)				
FFIP #	Description	Status	EI001	EI003	EI005	EI007	EI001	EI003	EI005	EI007	Grand Total
73643	Operations	Ongoing	$5,134.36		$9,898.36						$ 15,032.72
001-2017	Bender Creek fish barrier	Complete			$6,000.00						$ 6,000.00
001-2009	Big Creek water lease extension	Complete	$15,500.00		$15,500.00						$ 31,000.00
028-2010	Big Spring Creek channel restoration	Complete					$21,591.27	$10,312.40	$18,096.13		$ 49,999.80
027-2011	Big Spring Creek Machler supplement	Complete						$101,171.05	$3,828.95		$ 105,000.00
001-2016	Big Springs Creek Machler restoration	Complete							$50,000.00		$ 50,000.00
020-2017	Blackfoot River fish screen	Complete			$54,943.90						$ 54,943.90
001-2014	Bozeman Creek channel restoration	Complete						$30,000.00			$ 30,000.00
024-2015	Braziel Creek instream flow	Complete			$10,400.00						$ 10,400.00
013-2012	Browns Gulch fish passage/channel stabilization	Complete			$4,999.00						$ 4,999.00
003-2015	Bull River riparian restoration	Complete		$15,412.00	$13,870.00						$ 29,282.00
002-2018	Deep Creek instream flow	Ongoing							$6,000.00		$ 6,000.00
021-2017	Deer Creek road decommissioning	Complete				$7,140.00					$ 7,140.00
022-2017	Dry Creek channel restoration	Ongoing								$4,308.78	$ 4,308.78
003-2017	East Fork Bitterroot River riparian fencing reveg	Complete			$9,000.00						$ 9,000.00
020-2016	Elk Springs Creek habitat restoration	Complete		$45,000.00							$ 45,000.00
004-2018	Elliston Creek riparian fence	Complete				$11,880.00					$ 11,880.00
003-2014	French Creek fish barrier	Ongoing			$394.60						$ 394.60
005-2016	French Creek riparian fencing	Complete		$9,872.00	$(61.00)						$ 9,811.00
006-2015	French Gulch channel relocation	Complete		$25,066.91							$ 25,066.91
006-2016	French Gulch channel restoration	Complete		$68,152.02							$ 68,152.02
028-2015	French Gulch channel restoration	Complete		$19,095.00							$ 19,095.00
004-2017	Fresno Reservoir habitat enhancement	Complete							$1,283.72		$ 1,283.72
005-2018	Granite Creek culvert remo	Complete			$54,188.00						$ 54,188.00
008-2016	Hells Canyon Creek instream flow	Ongoing							$5,381.55		$ 5,381.55

PROGRAM FUNDING

			Subclass								
			02022 Native Species Enhancement Program				02149 River Restoration (FFIP)				
FFIP #	Description	Status	EI001	EI003	EI005	EI007	EI001	EI003	EI005	EI007	Grand Total
006-2017	Jack Creek riparian restoration	Complete							$10,014.48		$ 10,014.48
007-2018	Lincoln Spring Creek restoration	Ongoing				$9,000.00					$ 9,000.00
010-2016	Long Creek Channel Restoration	Complete	$13,990.00								$ 13,990.00
021-2016	Marias River Sanford Park fish habitat enhancement	Complete		$15,075.00							$ 15,075.00
008-2017	Marshall Creek fish passage	Complete			$6,798.73						$ 6,798.73
030-2015	Martina Creek channel restoration	Complete			$30,000.00						$ 30,000.00
022-2016	Monture and Dunham Creeks riparian fencing	Complete			$10,000.00						$ 10,000.00
010-2017	Moore's Creek channel and riparian restoration	Complete							$20,020.80		$ 20,020.80
009-2018	Moose Creek Gallatin restoration	Complete			$10,000.00						$ 10,000.00
011-2015	Mulherin Creek fish screen	Cancelled*		$20,000.00							$ 20,000.00
023-2016	Mulherin Creek fish screen	Cancelled*		$26,800.00							$ 26,800.00
012-2015	Musselshell River egge diversion removal	Complete		$4,897.26	$(4,897.26)						$ -
011-2017	Nevada Creek Channel Restoration	Complete			$22,687.06						$ 22,687.06
011-2017	Nevada Creek Channel Restoration	Complete							$24,312.94		$ 24,312.94
028-2018	NF Spanish Creek barrier supplement	Complete				$27,500.00					$ 27,500.00
011-2016	North Fork Dry Cottonwood Creek culvert replacement	Ongoing	$10,947.93		$2,736.07						$ 13,684.00
024-2016	North Fork Spanish Creek fish barrier	Complete			$60,000.00						$ 60,000.00
013-2018	Poorman Creek instream flow	Complete			$54,700.00						$ 54,700.00
014-2017	Racetrack Creek Johnson diversion replacement	Complete			$18,661.00						$ 18,661.00
028-2017	Rattlesnake Creek Cobban fish screen	Complete			$14,000.00						$ 14,000.00
025-2016	Rattlesnake Creek Williams fish screen	Complete		$9,978.85							$ 9,978.85
023-2013	Redwater River culvert fish passage	Complete	$57,000.00	$43,000.00							$ 100,000.00
016-2017	Sevenmile Creek fish passage	Complete							$21,362.50		$ 21,362.50
026-2016	Shanley Creek fish screen and water convservation	Complete		$15,250.00							$ 15,250.00
008-2014	Shields River fish barrier	Complete	$119,775.00								$ 119,775.00
027-2016	Shields River watershed YCT passage	Complete			$55,320.00						$ 55,320.00
039-2006	Skalkaho Creek Hedge siphon supplement	Ongoing			$4,273.67						$ 4,273.67

PROGRAM FUNDING

			Subclass								
			02022 Native Species Enhancement Program				02149 River Restoration (FFIP)				
FFIP #	Description	Status	EI001	EI003	EI005	EI007	EI001	EI003	EI005	EI007	Grand Total
040-2006	Skalkaho Creek Republican siphon supplement	Ongoing			$4,273.68						$ 4,273.68
048-2002	Skalkaho River fish screens	Ongoing			$1,859.77						$ 1,859.77
036-2015	Smith Slough spawning enhancement	Complete							$40,000.00		$ 40,000.00
016-2015	Stonewall Creek restoration	Complete		$21,000.00							$ 21,000.00
012-2016	Sucker Creek fish passage	Complete		$16,500.00	$16,500.00)						$ -
017-2015	T&Y fish screen repair	Ongoing			$1,855.38						$ 1,855.38
013-2016	Telegraph Creek Lilly Orphan Boy mine reclamation	Complete		$21,587.67							$ 21,587.67
023-2014	Tenmile Creek bank stabilization and fencing	Complete							$16,500.00		$ 16,500.00
024-2013	Tenmile Creek diversion repair	Complete						$14,018.00			$ 14,018.00
040-2015	Upper Lolo Creek sediment reduction	Complete		$12,306.20	$(6,306.20)						$ 6,000.00
014-2016	Vermillion River Miners Gulch restoration	Complete		$44,485.00	$(38,970.00)						$ 5,515.00
015-2016	Warm Springs fish passage	Complete			$43,703.00						$ 43,703.00
028-2016	Wasson Creek water rights lease renewal	Complete		$20,000.00							$ 20,000.00
018-2017	Williams Creek riparian fencing	Complete							$9,220.00		$ 9,220.00
TOTAL:			$222,347.29	$453,477.91	$453,327.76	$55,520.00	$21,591.27	$155,501.45	$226,021.07	$4,308.78	$1,592,095.53

ANTICIPATED EXPENSES

Since inception of the FFIP, the Commission has committed an average of $1,401,000 per biennium ($700,500 per year) to habitat enhancement projects (Table 4). Combined project expenditures for the last three biennia have totaled between $916,406 and $1.58 million, while appropriations have totaled between $790,000 and $1.27 million (Table 6).

TABLE 6. EXPENDITURES AND APPROPRIATIONS FROM THE LAST THREE BIENNIA.

	November 1-2012, October 31, 2014	November 1-2012, October 31, 2014	November 1-2012, October 31, 2014
Expenditures	$916,406	$1.40 million	$1.58 million
Appropriations	$790,000	$1.27 million	$1.18 million

The amount appropriated has been less than the amount expended for several biennia, made possible only as a result of unexpended carry-over from past appropriations (prior to 2007). Expenditure reporting typically reflects funds allocated in the previous biennia, as projects are usually completed between one and three years after the grant is awarded.

As the cost for restoration continues to increase, it is likely that the FFIP funding level and funding sources will need to be evaluated. In both the last two biennia, the funding process was required to use the prioritization procedure to deny the lowest-ranking applications. These projects were beneficial and likely would have received funding if it were available. The prioritization procedure had not been used to influence funding recommendations prior to 2016. As funding levels decrease and project requests increase, restoration potential will continue to be limited.

If funding was not limited, the Program would be expected to spend, at a minimum, an amount comparable to what was expended previously, which is estimated to be $7.0 million in a 10-year period or $1.4 million per biennium. However, this figure exceeds the appropriations currently available. Realistically, anticipated expenses will be equal to the appropriations available, which has been approximately $1.1 million per biennia or $5.4 million over a 10 year period.

With a 5:1 match, which has been achieved recently, the restoration impact of $5.4 million in 10 years would generate matching funds of $27 million and an overall expenditure of $32.4 million. These are valuable dollars for fisheries restoration, but also for Montana's recreation economy and the local contractors that complete the project installation.

RECENT PROJECTS

Approved and Completed Projects

PROGRAM PROJECT TYPES

Program funds have been used to complete many types of lake and stream habitat enhancements. Channel restoration and riparian fencing have been the most common treatments funded through FFIP and make up 24% and 22% of all completed projects, respectively (Figure 3). Additional prevalent restoration activities include fish passage improvement, bank stabilization or revegetation, diversion modification, instream flow leasing, fish screens, riparian restoration, barrier construction (native fish protection), and lake spawning and rearing habitat installation.

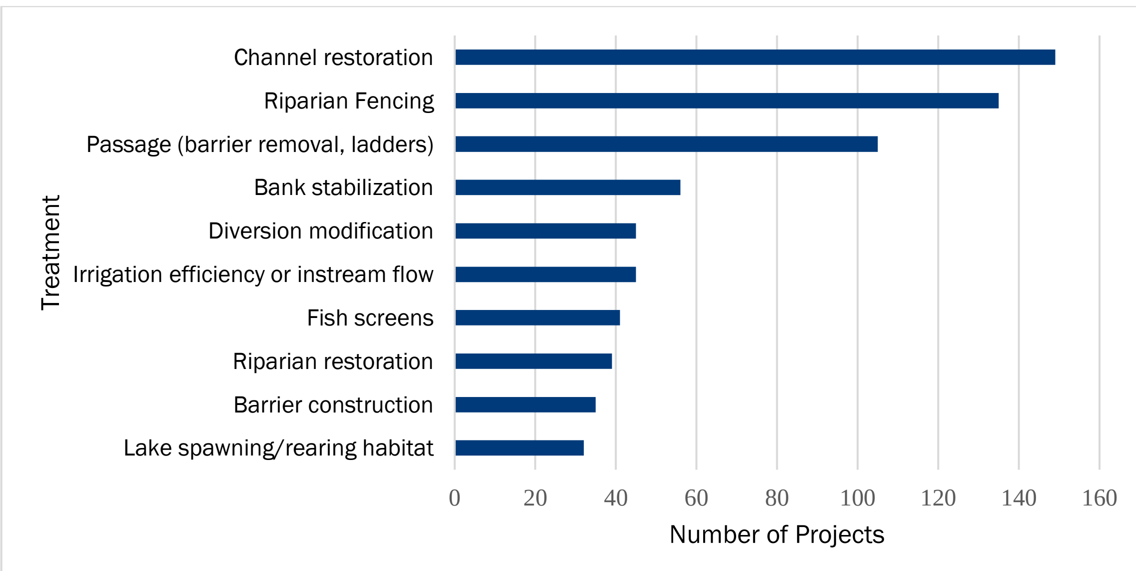


FIGURE 3. FUTURE FISHERIES IMPROVEMENT PROGRAM PROJECT TYPES, 1996–2018.

2017-2018 APPROVED PROJECT TYPES

In 2017 and 2018, most approved projects involved fish passage, followed by riparian fencing and channel restoration (Figure 4). Other common project activities included revegetation, barriers, and instream flow leases. Examples of fish passage projects include the removal or replacement of culverts, improving diversions, or decommissioning roads. These projects remove barriers to fish movement and reconnect them with important habitats for spawning or surviving. Fencing projects typically create exclosures around the stream and riparian areas or establish a riparian pasture to better control grazing and encourage vegetation growth around the stream. Fencing is often coupled with channel restoration projects where stream function and habitat is improved by adding sinuosity (bends) to straight reaches or moving a stream back to its original location. Revegetation is often a component of channel restoration projects where banks need to be held together for stability and various forms of vegetation and planted. Instream flow projects usually involve leases that keep water in the stream to benefit the fishery, particularly at times with low flow.

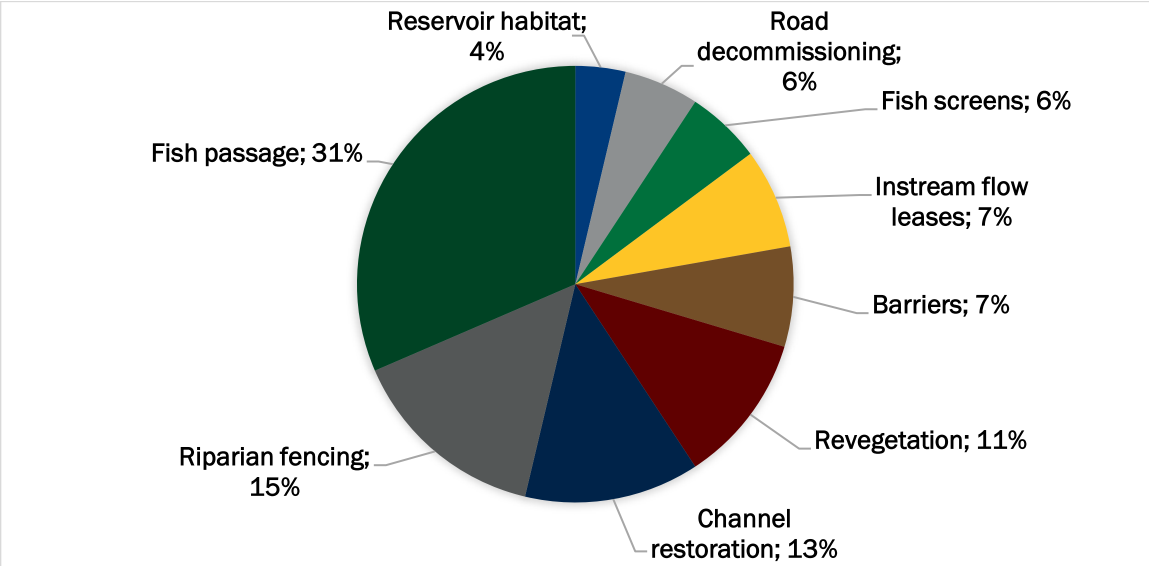


FIGURE 4. PERCENT OF EACH PROJECT TYPE, FUNDED IN 2017-2018 BIENNIUM

FUNDED PROJECTS

During the period of this report, the Commission approved funding or partial funding for 49 FFIP restoration projects totaling $1,194,814 (Table 7). These projects derived an additional $4,842,743 in matching funds and in-kind services from outside sources and had a total value of more than $6.2 million dollars. Of the 49 restoration projects approved, 11 were funded under the FFIP with base license (River Restoration) dollars, and 38 were funded under the NSEP with RIT funding. Narrative descriptions of individual projects can be found in the following section.

RECENT PROJECTS

TABLE 7. APPROVED PROJECTS LISTED BY NAME AND PROJECT NUMBER (FFIP #); FUNDING CYCLE WINTER 2017 (W17), SUMMER 2017 (S17), WINTER 2018 (W18) AND SUMMER 2018 (S18). RIT = RESOURCE INDEMNITY TRUST FUND, RR = RIVER RESTORATION FUND.

				Funding			
	FFIP #	Cycle	Project Name	FFIP Grant	Matching	Total Committed	Source
1	001-2017	W17	Bender Creek fish barrier	$6,000.00	$16,000.00	$22,000.00	RIT
2	002-2017	W17	Big Otter Creek riparian protection & improvement	$4,249.00	$5,672.33	$9,921.33	RR
3	003-2017	W17	East Fork Bitterroot River riparian fencing and revegetation	$9,000.00	$39,555.00	$54,762.00	RIT
4	004-2017	W17	Fresno Reservoir Habitat enhancement	$3,000.00	$3,582.00	$6,582.00	RR
5	006-2017	W17	Jack Creek riparian restoration	$10,014.48	$85,395.25	$110,904.85	RR
6	008-2017	W17	Marshall Creek fish passage	$8,000.00	$26,355.00	$34,355.00	RIT
7	009-2017	W17	Mill Creek fish ladder	$9,000.00	$15,096.00	$24,096.00	RR
8	010-2017	W17	Moore's Creek channel and riparian restoration	$20,020.80	$155,372.60	$195,414.20	RR
9	011-2017	W17	Nevada Creek channel restoration	$47,000.00	$156,435.00	$203,435.00	RIT
10	012-2017	W17	Ninemile Creek channel restoration	$20,000.00	$118,398.00	$150,398.00	RIT
11	013-2017	W17	North Fork Cottonwood Creek fish passage	$36,710.00	$90,250.00	$127,960.00	RIT
12	014-2017	W17	Racetrack Creek Johnson diversion replacement	$22,880.00	$13,550.00	$37,230.00	RIT
13	015-2017	W17	Sauerkraut Creek instream flow lease	$10,000.00	$66,354.80	$86,354.80	RIT
14	016-2017	W17	Sevenmile Creek fish passage	$21,362.50	$26,895.00	$52,466.25	RR
15	018-2017	W17	Williams Creek riparian fencing	$9,220.00	$9,120.00	$18,340.00	RR
16	020-2017	S17	Blackfoot River fish screen	$49,949.00	$124,205.20	$174,154.20	RIT
17	021-2017	S17	Deer Creek road decommissioning	$20,000.00	$21,675.00	$41,675.00	RIT
18	022-2017	S17	Dry Creek channel restoration	$9,258.00	$5,620.00	$14,878.00	RR
19	024-2017	S17	Horse Creek grazing mgmt and stream restoration	$26,228.00	$48,314.00	$74,542.00	RIT
20	025-2017	S17	LaValle Creek fish passage	$18,520.00	$24,631.00	$43,151.00	RIT
21	026-2017	S17	Little Warm Reservoir dam repair	$75,000.00	$321,385.80	$507,335.80	RR
22	028-2017	S17	Rattlesnake Creek Cobban fish screen	$14,000.00	$22,895.00	$36,895.00	RIT
23	029-2017	S17	Turkey Creek fish passage	$61,090.00	$61,810.00	$122,900.00	RIT
24	002-2018	W18	Deep Creek instream flow	$52,960.00	$54,000.00	$106,960.00	RR
25	003-2018	W18	Dry Creek fish passage	$48,521.00	$74,016.00	$122,537.00	RIT
26	004-2018	W18	Elliston Creek riparian fence	$11,880.00	$61,920.00	$73,800.00	RIT
27	005-2018	W18	Granite Creek culvert removal and fish passage	$54,188.00	$108,396.80	$162,584.80	RIT
28	006-2018	W18	Green Canyon Creek fish passage	$17,000.00	$24,068.00	$41,068.00	RIT
29	007-2018	W18	Lincoln Spring Creek restoration	$10,000.00	$80,910.00	$90,910.00	RIT
30	008-2018	W18	Monarch Creek culvert replacement	$18,066.18	$11,097.64	$29,163.82	RIT
31	009-2018	W18	Moose Creek Gallatin restoration	$10,000.00	$263,756.50	$273,756.50	RIT
32	010-2018	W18	Nevada Creek fish screening	In-kind	$100,752.00	$150,752.00	RIT
33	011-2018	W18	NF Dry Cottonwood Creek habitat enhancement	$6,432.50	$20,368.00	$26,800.50	RIT
34	012-2018	W18	NF Keep Cool Creek fish passage	$22,400.00	$150,247.50	$172,647.50	RIT
35	013-2018	W18	Poorman Creek instream flow	$54,700.00	$492,300.00	$547,000.00	RIT
36	014-2018	W18	Poorman Creek mining restoration	$25,000.00	$313,405.00	$338,405.00	RIT

RECENT PROJECTS

	FFIP #	Cycle	Project Name	Funding			
				FFIP Grant	Matching	Total Committed	Source
37	015-2018	W18	Prickly Pear Cr Tryan fish passage	$27,000.00	$91,592.00	$118,592.00	RR
38	016-2018	W18	Rock Creek realignment	$12,455.00	$14,852.45	$27,307.45	RIT
39	017-2018	W18	SF Dry Cottonwood Creek culvert replacement	$27,730.00	$41,773.00	$69,503.00	RIT
40	018-2018	S18	Brewster Creek fish passage	$16,000.00	$13,045.00	$29,045.00	RIT
41	019-2018	S18	Cedar Creek large woody debris	$28,660.00	$87,689.50	$116,349.50	RIT
42	021-2018	S18	Copper Creek decommissioning	$48,500.00	$409,253.50	$457,753.50	RIT
43	022-2018	S18	Cottonwood / NF Cottonwood passage & decommissioning	$36,500.00	$178,025.00	$214,525.00	RIT
44	025-2018	S18	Loneman Creek riparian fencing	$2,000.00	$3,366.30	$5,366.30	RIT
45	026-2018	S18	Mulherin Creek instream flow lease renewal	$38,175.00	$38,175.00	$76,350.00	RIT
46	027-2018	S18	Muselshell River Meathouse restoration	$58,644.50	$131,167.00	$189,811.50	RIT
47	028-2018	S18	NF Spanish Creek barrier supplement	$27,500.00	$372,500.00	$400,000.00	RIT
48	029-2018	S18	Ramshorn Creek fish barrier	$10,000.00	$32,500.00	$42,500.00	RIT
49	030-2018	S18	Wall Creek fish barrier	$20,000.00	$215,000.00	$235,000.00	RIT
TOTAL				$1,047,928.96	$3,888,820.72	$5,167,431.35	

Funded Project Descriptions

2017 APPROVED PROJECTS

Bender Creek fish barrier (001-2017)

Bender Creek (Beaverhead County) is a tributary to Johnson Creek and the North Fork of the Big Hole River. It supports a non-hybridized (pure) population of westslope cutthroat trout, but they were isolated to a less than 0.25-mile section of stream. Brook trout outcompeted cutthroat trout in much of the stream and were moving into the headwaters area. This project installed a treated lumber fish barrier immediately upstream of a bridge crossing (Figure 5). Now that the barrier is installed, cutthroat trout will be salvaged, and brook trout will be removed using rotenone. Westslope cutthroat trout will be returned to the stream and four miles of habitat would be open for the conservation of this species. **COMPLETED; $6,000, FWP.**

FIGURE 5. BENDER CREEK FISH BARRIER BEFORE (L) AND AFTER (R).

Big Otter Creek riparian protection and improvement (002-2017)

Big Otter Creek (Judith Basin County) is a popular recreational fishery for brown trout, rainbow trout, and brook trout. Currently, cattle congregate at the stream bottom of Big Otter Creek. This project will fence ¼ mile of stream to encourage vegetation and improve stream health and install a culvert on an ephemeral tributary to provide a better route for livestock movement and keep sediment out of the stream. **ONGOING; $4,249, LANDOWNER.**

East Fork Bitterroot River riparian fencing and revegetation (003-2017)

The East Fork of the Bitterroot River (Ravalli County) is a headwater stream to the Bitterroot River and supports populations of bull trout and westslope cutthroat trout. It is listed as impaired for sediment and temperature by the Department of Environmental Quality (DEQ). This project aimed to reduce sediment and thermal loading by increasing riparian vegetation and encouraging point bar development and sinuosity. Riparian fencing was installed along 2,000 feet of the stream, nursery plants and shrub transplants were used, and browse protectors were installed (Figure 6). The fencing configuration created a buffer and restoration activities should enhance natural recruitment and encourage bank repair. **COMPLETED; $9,000, BITTER ROOT WATER FORUM.**


FIGURE 6. EAST FORK BITTERROOT RIVER REVEGETATION BEFORE (L) AND AFTER (R).

Fresno Reservoir habitat enhancement (004-2017)

Fresno Reservoir (Hill County) was the second most fished waterbody in FWP Region 6 in 2015 and contains sportfish populations of yellow perch, walleye, northern pike, and black crappie. Fish abundance and condition are limited by prey availability and habitat. This project intends to install Christmas tree habitat structures at critical points in the reservoir for five years, which should improve spawning and rearing habitat for yellow perch, thereby improving sportfishing opportunities for perch and their predators. The applicant will monitor the response of the fish community. **ONGOING; $3,000, FWP.**

Jack Creek riparian restoration (006-2017)

Lower Jack Creek (Madison County), near the confluence with the Madison River, supports populations of brown trout and rainbow trout and has been the site of active channel migration and heavy erosion. This location was historically dynamic and experienced alterations such as channel straightening, placement of carbody bank armor, and unfavorable management practices (Figure 7). This project took place on three private property holdings with 1,200 feet of stream. Four actively eroding bank sites were restored with bankfull benches, sloping, and native plantings. **COMPLETED; $10,014.48, MADISON CONSERVATION DISTRICT.**

FIGURE 7. JACK CREEK RIPARIAN RESTORATION (L) AND AFTER (R).

Marshall Creek fish passage (008-2017)

Marshall Creek (Missoula County) is a tributary to the Clark Fork River located just upstream of the City of Missoula. It is an important source of natural westslope cutthroat trout recruitment and an area with a large angling population. This project continued fish habitat enhancement work in the lower watershed by replacing two undersized culverts that acted as velocity barriers during moderate and high flow periods with larger counter-sunk culverts that can accommodate 100-year flows and bankfull channel width (Figure 8). The goal was to enhance upstream fish passage for adult and juvenile cutthroat trout in an established spawning and rearing area. **COMPLETED; $8,000 awarded / $6,799 expended, FWP.**

FIGURE 8. MARSHALL CREEK FISH PASSAGE BEFORE (L) AND AFTER (R).

Mill Creek fish ladder (009-2017)

Mill Creek (Missoula County) is a tributary to the Clark Fork River and supports populations of rainbow trout, rainbow X cutthroat trout hybrids, brown trout, and mountain whitefish. In 2005, a fish ladder was installed to allow fish passage on the recruitment-limited and heavily fished stream. The ladder functioned adequately for a decade but needs replacement. This project will replace the fish ladder with a larger, more operational unit to provide year-round fish passage on Mill Creek. **ONGOING; $9,000, FWP.**

Moore's Creek channel and riparian restoration (010-2017)

Moore's Creek (Madison County) is a tributary to the Madison River immediately west of Ennis. The stream is believed to support rainbow, brown, and brook trout. The stream and riparian areas were highly degraded due to past management practices and channel manipulations and water quality is impacted by *E. Coli* and sediment. This project moved the stream channel from its position as a straight, confined channel to a location where the stream could have proper dimensions and function (Figure 9). The project improved riparian areas and water quality through fencing, riparian plantings, livestock management, and irrigation improvement. **COMPLETED; $20,020.80, MADISON CONSERVATION DISTRICT.**


FIGURE 9. MOORE'S CREEK CHANNEL AND RIPARIAN RESTORATION BEFORE (L) AND AFTER (R).

Nevada Creek channel restoration (011-2017)

Nevada Creek (Powell County) is a tributary to the middle Blackfoot River and supports populations of westslope cutthroat trout, rainbow trout, and brown trout. In the project area, the stream was historically straightened, and a non-functional riparian area caused the channel to erode and downcut. In 2010, an adjacent channel restoration project reduced sediment, increased stream complexity, improved riparian condition, and created fish habitat that resulted in increased trout abundance. This project is considered phase two and continued the restoration downstream. The channel was restored to proper dimensions, plantings and bank treatments were used to improve the riparian areas, and fence was installed to operate a grazing management system (Figure 10). **COMPLETED; $47,000, BIG BLACKFOOT CHAPTER OF TROUT UNLIMITED.**

FIGURE 10. NEVADA CREEK CHANNEL RESTORATION BEFORE (L) AND AFTER (R).

Ninemile Creek channel restoration (012-2017)

Ninemile Creek (Missoula County) is a tributary to the Clark Fork River and supports populations of westslope cutthroat trout, brook trout, and bull trout. Past placer mining practices and associated activities led to alteration of channel morphology, disconnection from tributaries, eroding banks, and fish passage barriers. This project is one phase of a much larger project that has been systematically restoring the upper Ninemile drainage. The FFIP-funded projects in many tributaries (e.g. Sawpit, Mattie V, Kennedy Creeks). Fish response, in the form of large spawning redds, was observed in 2016. This project involves revegetation of the site, re-sloping of site topography, and reconstruction of the stream channel. Mining spoil piles on Ninemile Creek will be removed to decrease sediment sources and establish a natural floodplain. **ONGOING; $20,000, TROUT UNLIMITED.**

North Fork Cottonwood Creek fish passage (013-2017)

North Fork Cottonwood Creek (Powell County) is a tributary to Cottonwood Creek in the Clark Fork River drainage and supports populations of westslope cutthroat trout and brook trout. An undersized culvert has been a partial barrier to fish passage on the Beaverhead Deer Lodge National Forest. This project will replace the culvert with a larger culvert specifically designed to enhance fish passage for native trout. The goal is to maintain a single, connected population of cutthroat trout throughout the three forks of Cottonwood Creek and enhance the long-term viability of a large conservation population of pure westslope cutthroat trout. **ONGOING; $36,710, CLARK FORK COALITION.**

Racetrack Creek Johnson diversion replacement (014-2017)

Racetrack Creek (Powell County) is a tributary to the Clark Fork River that supports populations of brown trout, mountain whitefish, westslope cutthroat trout, longnose sucker, and slimy sculpin. The project area was limited by dewatering in mid-to-late summer and high temperatures. Other complementary projects focused on improving instream flows, so this project built on those efforts by providing fish passage to the habitat features upstream to the Berg diversion (1.6 miles) and downstream to the lower, cold-water (groundwater) area of the creek. This project replaced an irrigation diversion that blocked upstream fish passage and entrained fish with a rock weir diversion that allows passage (Figure 11). The goal was to enhance fish passage and eliminate entrainment in a high priority watershed. **COMPLETED; $22,880 awarded / $18,661 expended, CLARK FORK COALITION.**

FIGURE 11. RACETRACK CREEK JOHNSON DIVERSION REPLACEMENT BEFORE (L) AND AFTER (R).

Sauerkraut Creek instream flow lease (015-2017)

Sauerkraut Creek (Lewis & Clark County) is a tributary to the Blackfoot River that supports populations of westslope cutthroat trout and bull trout. Historically, the upper reaches of Sauerkraut Creek were severely modified by mining and the middle and lower reaches were impaired by irrigation withdrawals. Since 2008, Sauerkraut Creek has been the focus of stream restoration and conservation efforts and the current project is a continuation of those efforts. This project would lease a minimum of 3.0 cubic feet per second (cfs) of water, up to 9 cfs, in a split-season water rights lease to augment stream flow, especially during the low-flow season, for 20 years. The goal is to improve conditions for resident and migratory cutthroat trout and bull trout that are most significant during the low flow season. **ONGOING; $10,000, TROUT UNLIMITED.**

Sevenmile Creek fish passage (016-2017)

Sevenmile Creek (Lewis & Clark County) is a tributary to Tenmile Creek that supports populations of brown trout and brook trout. In 2017, the Prickly Pear Land Trust acquired land in the Helena

Valley that included approximately 2.2 miles of Sevenmile Creek. The stream was heavily impacted by riparian clearing, intensive grazing, flow diversion, and channelization. As part of a larger project to improve the property, this project addressed a diversion that blocked fish passage and was in danger of having an avulsion. This project created 2,600 feet of new stream channel, created wetland areas in the old channel, and replaced the irrigation diversion (Figure 12). A functional floodplain was produced, fish habitat was created, and legal use of the water right was retained. **COMPLETED; $21,363; PRICKLY PEAR LAND TRUST.**


FIGURE 12. SEVENMILE CREEK FISH PASSAGE BEFORE (L) AND AFTER (R).

Williams Creek riparian fencing (018-2017)

Williams Creek (Judith Basin County) is a tributary to Big Otter Creek near Raynesford. It supports populations of brown trout, brook trout, and rainbow trout. Cattle were able to access the stream, so this project installed riparian fencing to control livestock access, constructed a water gap, and developed a spring for off-stream water (Figure 13). The goals were to improve fish habitat through riparian growth, reduced sedimentation, and overall stream health. **COMPLETED; $9,220, LANDOWNER.**

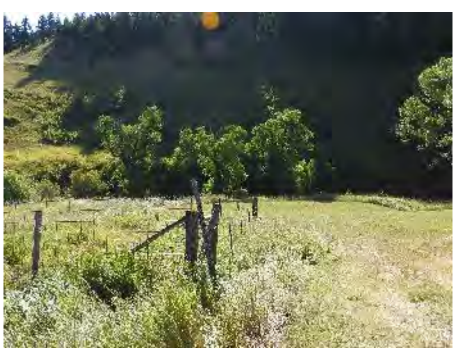



FIGURE 13. WILLIAMS CREEK RIPARIAN FENCING BEFORE (L) AND AFTER (R).

Blackfoot River fish screen (020-2017)

The mainstem Blackfoot River is a tributary to the Clark Fork River and supports two imperiled fish species: bull trout and westslope cutthroat trout. This project was in an area that is considered a migratory area for both bull and westslope cutthroat trout and is considered a critical bull trout area. This project screened an irrigation diversion by installing a low-maintenance Farmers-style fish screen with a headgate to allow for hydraulic control (Figure 14). A limited amount of instream wood and willow plantings were installed along the river bank margin to protect the new infrastructure. The goal was to eliminate fish entrainment, improve migratory corridors, and allow for efficient irrigation practices. **COMPLETED; $49,949 awarded / $54,944 expended (10% overage), BIG BLACKFOOT CHAPTER OF TROUT UNLIMITED.**

FIGURE 14. BLACKFOOT RIVER FISH SCREEN BEFORE (DIVERSION; L), AFTER (DIVERSION; CENTER), AND AFTER (SCREEN; R).

Deer Creek road decommissioning (021-2017)

Deer Creek is a tributary to Seeley Lake and is within the Marshall Creek Wildlife Management Area. It supports populations of native bull trout and westslope cutthroat trout. The property was purchased in 2010 and contains hundreds of miles of old logging roads. The overall goal of the Deer Creek area is to restore the integrity of headwater basins adjacent to and upstream of known spawning and rearing areas for native trout. This project removed numerous undersized culverts, decommissioned roads, reconstructed stream crossings, and completed large-scale revegetation. The goal was to protect and enhance native bull trout and westslope cutthroat trout populations. **ONGOING; $20,000, FWP.**

RECENT PROJECTS

Dry Creek channel restoration (022-2017)

Dry Creek (Gallatin County) is a tributary to the East Gallatin River. It supports a population of brown trout, but mountain whitefish, rainbow trout, and brook trout may be present. The Dry Creek drainage has experienced channelization, sedimentation, irrigation withdrawals, and fish passage problems. As part of a watershed effort, there are several projects to improve water quality, habitat, and stream function. This project will improve stream habitat in the lower section of Dry Creek, downstream of a fish passage project. Spawning, rearing, and resident trout habitat will be improved by re-naturalizing the channelized section downstream of the diversion upgrade. This includes the establishment of more pools and improved riparian habitat. Willow, aspen, and chokecherry will be planted to establish cover along the stream corridor. Large woody debris will be placed in the channel to form scour pools and provide overhead cover. The goal was to increase spawning, rearing, and resting habitat. **ONGOING; $9,258, TROUT UNLIMITED.**

Horse Creek grazing and stream restoration (024-2017)

Horse Creek (Park County) is a tributary to the Shields River, supports populations of nonhybridized Yellowstone cutthroat trout, and is of high conservation value. The project area has been degraded by grazing practices. The applicant proposes to install riparian fencing, create off-stream stock water, and restore eroding terraces by creating floodplain benches with wetland sod. Mature willow will be planted on site. The goal is to improve water quality and habitat in an important cutthroat trout stream. **ONGOING; $26,228, FWP.**

LaValle Creek fish passage (025-2017)

LaValle Creek (Missoula County) is a tributary to the Clark Fork River that supports only genetically pure westslope cutthroat trout. This population occupies approximately four to five miles of stream and is managed to sustain genetic purity. This project is intended to ensure connectivity within the reach they currently occupy. Two undersized culverts, likely serving as velocity barriers during high flow periods and disrupting natural hydrologic function, will be replaced with wood bridges that meet stream simulation and 100-year flood criteria. The goal is to enhance upstream passage for stream-resident, genetically pure westslope cutthroat trout and help ensure long-term persistence. **ONGOING; $18,520, FWP.**

Little Warm Reservoir dam repair (026-2017)

Little Warm Reservoir (Phillips County) is an on-stream reservoir for Little Warm Creek and contains game and prairie fishes. The primary species benefitting from improvements to the reservoir are walleye, yellow perch, and black crappie. Repairing the dam is expected to facilitate higher water levels, which is expected to improve the fisheries through improved spawning habitat, rearing habitat, and refuge under drought conditions. It would preserve water quantity and stabilize reservoir levels which should improve population densities and directly affect angler catch rates. **ONGOING; $75,000, LANDOWNER.**

Rattlesnake Creek Cobban fish screen (028-2017)

Rattlesnake Creek (Missoula County) is a tributary to the Clark Fork River that is a primary spawning tributary for both native bull trout and westslope cutthroat trout, as well as fluvial rainbow and brown trout. Rattlesnake Creek has several ditches, most of which were screened in 2002 with brencail-type screens. The brencail screen on the Cobban ditch did not function as intended; it required maintenance up to four times a day during high flow. The water users drilled holes in the screen to help alleviate the clogging. This project replaced the current screen with a vertical plate, paddlewheel-driven screen (Figure 15). The goal of the project was to prevent fish entrainment and increase spawning habitat for salmonids in the Rattlesnake Creek drainage. **COMPLETED; $14,000, TROUT UNLIMITED.**

FIGURE 15. RATTLESNAKE CREEK COBBAN FISH SCREEN BEFORE (L), AND AFTER (CENTER AND R).

Turkey Creek fish passage (029-2017)

Turkey Creek and an unnamed stream are tributaries to the Shields River (Park County). They support native Yellowstone cutthroat trout and provide habitat away from brook trout competition, due to a temporary perched culvert barrier and a natural bedrock barrier downstream. This project will replace culverts that are fragmenting populations within the protected stream reaches with aquatic organism passage (AOP) culverts and open critical habitat. The goal is to conserve and protect Yellowstone cutthroat trout and reduce sediment loading to streams. There is a mainstem barrier that was installed downstream that will eventually provide 27 miles of stream habitat for YCT. **ONGOING; $61,090, U.S. FOREST SERVICE.**

2018 APPROVED PROJECTS

Deep Creek instream flow (002-2018)

Deep Creek is a tributary to the Missouri River and supports populations of brown trout and rainbow trout (Broadwater County). Past projects on Deep Creek left additional water in-stream to benefit the fishery; however, in recent years several junior water users activated old water systems, making the instream flow protection vulnerable. Legally securing water is increasingly important. This project will protect a portion of water generated from several past water savings projects through instream flow leases. The goal is to legally establish a summer base flow to prevent dewatering the stream while maintaining crop irrigation. **ONGOING; $52,960, FWP.**

Dry Creek fish passage (003-2018)

Dry Creek is a tributary to the East Gallatin River and supports populations of brown trout, mountain whitefish, and rainbow trout (Gallatin County). Dry Creek has been seasonally disconnected from the East Gallatin for decades, as the stream captured by a large canal during irrigation season. Upstream fish migrations have been blocked by the canal and downstream migrations were intercepted by the canal. Other impacts to Dry Creek include channelization, sedimentation, and irrigation withdrawals. This project is a supplement to a past project application requesting riparian improvement of Dry Creek below the canal. The goal is to reconnect the lower reaches of Dry Creek with the upper reaches and expand habitat access as well as restore an important tributary stream that may be important spawning and rearing habitat and summer refugia. **ONGOING; $48,521, TROUT UNLIMITED.**

Elliston Creek riparian fence (004-2018)

Elliston Creek is a tributary to the Little Blackfoot River and supports populations of genetically pure westslope cutthroat trout and brown trout (Powell County). This project created a riparian pasture by separating Elliston Creek from the uplands. The timing of cattle grazing, the amount of forage plants utilized, and the amount of time for plants to recover will be controlled along the riparian area. This project installed 1.5 miles of wildlife-friendly fence will and restrict cattle grazing to 7-15 days (Figure 16). The goal was to create a permanent solution that will allow grazing and benefit riparian, stream, and fish habitat. Elliston Creek and the Little Blackfoot River are listed by the Department of Environmental Quality for sedimentation impairments and alteration to streamside vegetative cover in part due to grazing. **COMPLETED; $11,880, U.S. FOREST SERVICE.**

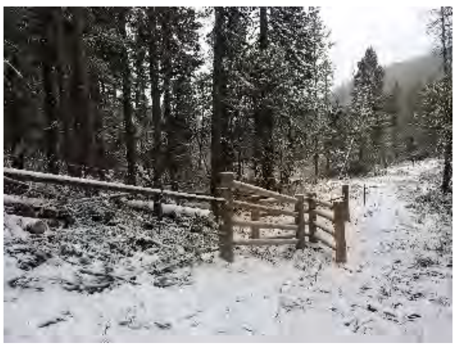


FIGURE 16. ELLISTON CREEK RIPARIAN FENCE (AFTER).

Granite Creek culvert removal and fish passage (005-2018)

Granite Creek is a tributary to West Fork Lolo Creek and supports populations of westslope cutthroat trout, bull trout, mountain whitefish, brook trout, and brown trout (Missoula County). Located on the Lolo National Forest, this project addressed lands that were formerly under Plum Creek Timber Company ownership. The road network is extensive and there are many failing culverts. Since 2006, over 113 roads have been decommissioned, 51 major culverts were removed, and 10 culverts were upgraded (Figure 17). This project affected 15 miles of stream and retained public access. Granite Creek is listed as a sediment impaired stream by Montana DEQ. The goal was to improve watershed health, connectivity, and habitat for salmonids in the lower Bitterroot and Clark Fork Rivers. **COMPLETED; $54,188, CLARK FORK COALITION.**

FIGURE 17. GRANITE CREEK CULVERT REMOVAL AND FISH PASSAGE BEFORE (L) AND AFTER (R).

Green Canyon fish passage (006-2018)

Green Canyon Creek is a tributary to Copper Creek in the Rock Creek watershed near Phillipsburg (Granite County) and supports populations of bull trout, westslope cutthroat trout, and mountain whitefish. This project will replace an undersized barrier culvert at a road crossing that is both perched and a partial fish barrier and is also at risk of failure from post-fire debris loading (Myers Fire). Environmental DNA (eDNA) sampling found bull trout below this undersized culvert but not above, which means this project could open additional habitat to bull trout. Approximately three miles of Green Canyon Creek is will be reconnected, including ½ mile of westslope cutthroat trout and bull trout spawning habitat. The undersized culvert will be replaced with a larger pipe with rock grade control structures and natural bed material to provide year-round passage. The goal is to reconnect native bull trout and westslope cutthroat trout habitat while also preventing potential catastrophic impacts of a road washout associated with post-fire debris. Copper Creek is considered to have an important population of bull trout and additional disturbance / sediment loading could have detrimental population-level impacts. **ONGOING; $17,000, TROUT UNLIMITED.**

Lincoln Spring Creek restoration (007-2018)

Lincoln Spring Creek is a tributary to Keep Cool Creek in the Blackfoot River drainage that supports westslope cutthroat trout, brown trout, and brook trout (Lewis & Clark County). This project is located one mile west of Lincoln and builds upon a stream restoration project implemented in 2008 where 9,000 feet of channel were restored. In the project location, past land use activities degraded the channel and encouraged fine sediment deposition that has been detrimental to macroinvertebrate production and salmonid spawning. Cover and woody riparian habitat are also sparse. This project will restore 4,400 feet of Lincoln Spring Creek and 0.47 acres of emergent wetlands by restoring proper pattern, profile, and dimensions of the stream, improving sediment transport ability, installing root mimicry structures to provide refugia, cover, and stability, and narrow the stream channel with finger bars. The goal is to restore the instream, riparian, and wetland functions of Lincoln Spring Creek to improve rearing, spawning, and overall habitat for native and non-native trout. **ONGOING; $10,000, BIG BLACKFOOT CHAPTER OF TROUT UNLIMITED.**

Monarch Creek culvert replacement (008-2018)

Monarch Creek is a tributary to Ontario Creek in the Little Blackfoot River drainage that supports populations of genetically pure westslope cutthroat trout, sculpin, mountain whitefish, and brook trout (Powell County). Bull trout have been detected genetically using environmental DNA (eDNA) in downstream Ontario Creek. This project will replace a culvert that is a partial fish barrier (at high flows) with a larger pipe-arch culvert. The goal is to improve spawning and rearing habitat for native salmonids and improve connectivity. Together with other passage improvements, approximately five miles of habitat will be connected. **ONGOING; $18,066, U.S. FOREST SERVICE.**

Moose Creek Gallatin restoration (009-2018)

The Gallatin River is a tributary to the Missouri River that primarily supports populations of rainbow trout and brown trout (Gallatin County). This project is located on U.S. Forest Service property in the Gallatin Canyon, and enhanced streamside vegetation, added riparian fencing, improved trail systems, stabilized streambanks, and developed designated access sites for all user types. This included 145 feet of streambank stabilization with bioengineering techniques, almost 11,000 square feet of riparian plantings, 1,460 feet of riparian fencing, 1,000 feet of trails, a stairway to the river, boat ramp, kayak launch, and interpretive signs (Figure 18). Wild fish habitat is expected to be enhanced by rebuilding streambanks, enhancing streamside vegetation, installing riparian fencing, and focusing river access in specific locations. The goal was to reduce fine sediment and enhance riparian areas while providing safer and more directed access to the river. **COMPLETED; $10,000, GALLATIN RIVER TASK FORCE.**

FIGURE 18. MOOSE CREEK GALLATIN RESTORATION BEFORE (L) AND AFTER (R) CONSTRUCTION.

Nevada Creek fish screening (010-2018)

Nevada Creek is a tributary to the Blackfoot River and supports populations of westslope cutthroat trout, rainbow trout, brown trout, and other non-game species (Powell County). Many projects have been completed in the Nevada Creek drainage and this project is intended to continue the momentum and improve populations of native species. In the project area, the existing diversion is a debris dam with logs, tarps, sandbags, and other materials that create a fish barrier during most flows. The diversion also creates a backwater effect that has altered Nevada Creek. This project would eliminate entrainment of trout with the fish screen installation (which allows diversion of 15 cfs), install a headgate and sluice gate, provide bed and bank stability, and restore fish passage. A grade control weir would be installed to allow diversion of water. The goal is to eliminate entrainment of trout down an irrigation diversion while providing fish passage and bed and bank stability within the stream channel. *This project will use a purchased fish screen that was intended for a cancelled project.* **ONGOING; IN-KIND SCREEN, BIG BLACKFOOT CHAPTER OF TROUT UNLIMITED.**

North Fork Dry Cottonwood Creek habitat enhancement (011-2018)

North Fork Dry Cottonwood Creek is a tributary to Dry Cottonwood Creek and the Clark Fork River near Deer Lodge and supports populations of 95% pure westslope cutthroat trout (Deer Lodge County). This project will address excessive riparian and aquatic habitat damage from summer grazing on a U.S. Forest Service allotment. Off-stream water will be developed, livestock presence near the stream will be reduced, and shrub growth along the channel will be encouraged. Riparian tree felling will be completed on approximately two miles of riparian area to impede livestock access to the stream banks. The goal is to enhance westslope cutthroat trout spawning and rearing habitat along three miles of stream by reducing livestock impact. **ONGOING; $6,433, CLARK FORK COALITION.**

North Fork Keep Cool fish passage (012-2018)

North Fork Keep Cool Creek is a tributary to Keep Cool Creek and the Blackfoot River and supports fluvial, genetically pure westslope cutthroat trout (Lewis & Clark County). This project will address the existing stream crossing near stream mile 10.1 on U.S. Forest Service property that is undersized, a barrier at most flows, and creates impairments to the stream channel. A bottomless steel plate pipe arch will be installed with grade control step pools, which will allow uninhibited aquatic organism passage and replicate the streambed throughout the crossing. Additionally, the stream crossing will promote natural morphology, correct road drainage problems, and eliminate delivery of sediment. The culvert will accommodate bankfull and an appropriate floodplain, as well as a 100-year flood event. The goal of this project is to improve connectivity and support migratory life histories of native species. **ONGOING; $22,400, BIG BLACKFOOT CHAPTER OF TROUT UNLIMITED.**

Poorman Creek instream flow (013-2018)

Poorman Creek is a tributary to the Blackfoot River and supports populations of pure westslope cutthroat trout and bull trout (Lewis & Clark County). Poorman Creek is a high priority stream and is listed as critical bull trout habitat. Low streamflow has been identified as a limiting factor in bull trout recruitment from Poorman Creek. Before the water rights to be acquired in this transaction were changed to instream flow 15 years ago, the stream would regularly dry up in the late summer/early fall. Trout Unlimited has worked with the water rights owner to increase flows in Poorman Creek, and now the Clark Fork Coalition can hold the title to the water rights and partner on restoration efforts. The purchase was 18 cubic feet per second of instream flow with a minimum flow agreement. The goal is to permanently keep the stream reach from dewatering and retain valuable habitat for fish and aquatic species. **COMPLETED; $54,700, CLARK FORK COALITION.**

Poorman Creek mining restoration (014-2018)

Poorman Creek is a tributary to the Blackfoot River and supports populations of pure westslope cutthroat trout and bull trout (Lewis & Clark County). Poorman Creek is a high priority stream and is listed as critical bull trout habitat. This project will take place on U.S. Forest Service property where the stream and riparian area has been highly modified by past mining activities. The stream was channelized, large wood and pools are lacking, and waste rock deposits eliminated a floodplain, restricted floodplain area, and confined the channel make it in entrenched. This project will restore the disturbed reach of Poorman Creek and its floodplain. Tailings will be removed, new channel will be constructed, large wood would be incorporated to improve habitat quality, and an undersized stream crossing will be upgraded. The goal is to restore a reach of Poorman Creek impacted by mining activities, improving floodplain connectivity, instream habitat quality, riparian areas, and fish passage. **ONGOING; $25,000, BIG BLACKFOOT CHAPTER OF TROUT UNLIMITED.**

Prickly Pear Creek Tryan fish passage (015-2018)

Prickly Pear Creek is a stream in the Helena Valley that flows into Lake Helena and the Missouri River (Lewis & Clark County) and supports populations of rainbow trout and brown trout. This project is located six miles above the confluence with Lake Helena; the Tryan diversion dam is a partial barrier to fish during the non-irrigation season and a full barrier during irrigation season when check boards are in place. Large, migratory rainbow trout are commonly found below the Tryan diversion in the spring and few fish can negotiate the structure. Brown trout have not been documented passing the structure in the fall during their spawning migration due to the height of check boards or the structure when boards are removed. This project will construct step-pool structures in the stream to facilitate passage when the check boards are out and construct a fish bypass channel around the diversion that would be activated when check boards are in place. The goal is to provide fish passage around an existing diversion dam and reduce excessive bank erosion above and below the diversion dam. This section of Prickly Pear Creek contains wild reproducing resident brown trout and migratory rainbow trout from Lake Helena. Both rainbow trout and brown trout are popular fish for anglers in the Helena Valley. **ONGOING; $27,000, FWP.**

Rock Creek realignment (016-2018)

Rock Creek is a tributary to the Big Hole River near Wisdom and supports populations of Arctic grayling, as well as other salmonids (mountain whitefish, brook trout, brown trout, and rainbow trout), burbot, and native non-game fish (Beaverhead County). A ½ mile reach of Rock Creek that flows through Big Hole Grazing Association property was captured by an irrigation ditch sometime between 1960-1979, making the existing channel into a high-flow channel. The irrigation ditch has become the primary channel fish habitat, but it is unstable with excessive erosion, poorly established vegetation, and limited fish habitat. This project would return the stream to the original Rock Creek channel and use the intact riparian corridor and floodplain to improve habitat and reduce sediment inputs as well as improve overall stream health and water quality. The goal is to improve fish habitat, stream function, and water quality to increase populations of Arctic grayling in the Big Hole drainage while using minimal construction. **ONGOING; $12,455, FWP.**

South Fork Dry Cottonwood Creek culvert replacement (017-2018)

South Fork Dry Cottonwood Creek is a tributary to Dry Cottonwood Creek and the Clark Fork River and supports conservation populations of 95-98% pure westslope cutthroat trout (Deer Lodge County). In the 23-square mile Dry Cottonwood drainage, two culverts are major fish barriers, and this project would address one of them. The design is a steel pipe-arch stream simulation culvert with a streambed constructed inside (and will accommodate a 100-year flood). Because the project site was altered by historic placer mining, the location of the culvert is slightly different because of the existing grades, and the existing culvert will remain as an overflow channel. The goal is to reconnect three miles of native trout habitat through improved upstream passage. The North Fork Dry Cottonwood Creek culvert replacement was partially funded by Future Fisheries (RIT013-2017). **ONGOING; $27,730, CLARK FORK COALITION.**

Brewster Creek fish passage (018-2018)

Brewster Creek (Granite County) is a tributary to Rock Creek and supports populations of westslope cutthroat trout and bull trout. Brewster Creek is a spawning tributary for lower Rock Creek and contains resident and migratory westslope cutthroat trout, bull trout (low levels), and other trout and non-game fish. This project would remove a culvert that is the only major fish passage on lower Brewster Creek and is located 400 feet upstream of the confluence with Rock Creek. A farm bridge would be installed so Brewster Creek could be reconnected to Rock Creek. The goal is to reconnect habitat for bull trout, westslope cutthroat trout, and other aquatic species. **ONGOING; $16,000, TROUT UNLIMITED.**

Cedar Creek decommissioning (019-2018)

Cedar Creek (Mineral County) is a tributary to the middle Clark Fork River and supports populations of westslope cutthroat trout, bull trout, and mountain whitefish. It is listed as a priority bull trout watershed and core bull trout habitat. Activities important to bull trout recovery include removal of riparian roads, improving instream habitat, and restoring mining claims. Within the project area, Cedar Creek was impacted by placer mining, leaving much of the riparian corridor disturbed. Railroad and road systems also contributed to confinement of the stream channel. This proposal is phase three of a larger project and would relocate the road, create a floodplain, and install large wood structures in one mile of stream to encourage instream habitat development. The goal is to improve overwintering, spawning, and rearing habitat for bull trout, westslope cutthroat trout, and other aquatic species through reduced erosion, cooler water temperatures, and increased habitat. **ONGOING; $28,660, TROUT UNLIMITED.**

Copper Creek large woody debris (021-2018)

Copper Creek (Lewis & Clark County) is a third-order tributary to the Landers Fork, which feeds the upper Blackfoot River and flows 14 miles entirely through U.S. Forest Service land. It contains populations of bull trout and pure westslope cutthroat trout and is listed as critical bull trout habitat. Telemetry studies have traced bull trout originating from Copper Creek as far as 100 miles downstream. In the project area, the stream recently accessed old channels, and in 2014 part of the road eroded into the stream. Sediment has been identified as a limiting factor for bull trout habitat and therefore this project, which involves eliminating a chronic source of sediment to Copper Creek, has been identified as a priority for restoration. This project would decommission approximately one mile of road adjacent to Copper Creek. The goal is to re-establish floodplain connectivity and function, restore the riparian corridor, and eliminate a chronic source of sediment while maintaining public access. **ONGOING; $48,500, BIG BLACKFOOT CHAPTER OF TROUT UNLIMITED.**

Cottonwood / North Fork Cottonwood passage & decommissioning (022-2018)

North Fork Cottonwood Creek is a tributary to Cottonwood Creek (Powell County), which flows into the middle Blackfoot River. It supports populations of bull trout and westslope cutthroat trout. Cottonwood Creek is a high priority tributary and is listed as critical bull trout habitat and a bull trout core area stream. At the North Fork Cottonwood Creek crossing there is an undersized culvert that inhibits fish passage. This culvert would be replaced with a bottomless arch structure that would accommodate flood capacity, fish passage, and transport debris and bedload. The adjacent road would be rerouted approximately 400 feet upstream from its current location. The historical floodplain along Cottonwood Creek would be reestablished. The goal is to improve fish passage, reestablish floodplain connectivity and function, restore the riparian corridor, eliminate a chronic source of sediment, and retain public access. Future Fisheries funding has helped complete several other projects in the drainage. **ONGOING; $36,500, BIG BLACKFOOT CHAPTER OF TROUT UNLIMITED.**

Loneman Creek riparian fencing (025-2018)

Loneman Creek (Sanders County) is a tributary to the Little Thompson River and contains westslope cutthroat trout. The Little Thompson River is impacted by sediment, nutrients, and water temperature, and monitoring indicates that Loneman Creek has elevated temperature when compared to a nearby reference stream. The project area is negatively impacted by cattle, which have unrestricted access to the creek. This project proposes to install exclusion fencing to allow the stream to recover and improve habitat, shade, and reduce temperatures, nutrients, and sediment. The goal is to encourage recovery of the stream and riparian areas, improve water quality, and enhance aquatic habitat. **ONGOING; $2,000, LOWER CLARK FORK WATERSHED GROUP.**

Mulherin Creek instream flow lease renewal (026-2018)

Mulherin Creek (Park County) is a tributary to the Yellowstone River and supports populations of Yellowstone cutthroat trout, mountain whitefish, and mottled sculpin. rainbow trout and brown trout are also in the project vicinity. Mulherin Creek is important coldwater habitat and a stronghold for YCT refugia, spawning, and recruitment. This project will renew a 20-year old instream flow lease that has been successful in retaining minimum flow and important aquatic habitat in Mulherin Creek. The goal is to continue instream flow benefits and provide quality habitat for conservation of Yellowstone cutthroat trout. **ONGOING; $38,175, FWP.**

Musselshell River Meathouse restoration (027-2018)

The Musselshell River (Musselshell County) is a tributary to the Missouri River and supports populations of sauger, channel catfish, smallmouth bass, and native minnows. In the area near Roundup, the applicants intend to restore the floodplain and riparian area on a newly-purchased property near an abandoned mine that also experiences flooding. This project would excavate and remove waste coal from the area, remove berms, create a floodplain that could accommodate a more natural flow pattern, and install habitat in the riparian area that is expected to create floodplain nursery habitat and additional cover for fish. The goals are to mitigate flooding events, improve the fishery and riparian habitat, improve recreational access, and reclaim a mine site. Past projects on the Musselshell River have encouraged fish passage (Egge diversion removal, 2015; Deadmans Basin diversion dam fishway, 2014). **ONGOING; $58,645, MUSSELSHELL COUNTY.**

North Fork Spanish Creek barrier supplement (028-2018)

North Fork Spanish Creek (Madison County) located on property owned by Turner Enterprises, Inc. aims to restore westslope cutthroat trout to 17 miles of historical stream habitat and 9 acres of high mountain lake habitat. The project would install a fish barrier on North Fork Spanish Creek, use piscicides to remove non-native brook trout and hybridized westslope cutthroat trout, and re-establish westslope cutthroat trout (Figure 19). This project is considered the best and largest opportunity to restore native westslope cutthroat trout in the in the Gallatin River sub-basin. This project was initially funded in 2016 ($60,000), and this grant was a supplement based on higher than expected construction costs. **COMPLETED; $27,500, LANDOWNER.**

FIGURE 19. NORTH FORK SPANISH CREEK BARRIER BEFORE (L) AND AFTER (R) CONSTRUCTION.

Ramshorn Creek fish barrier (029-2018)

Ramshorn Creek (Madison County) is a tributary to the Ruby River and, if completed, would support populations of westslope cutthroat trout and Rocky Mountain sculpin above the barrier and brook trout, brown trout, and rainbow trout below the proposed barrier. As part of the project, a fish passage barrier would be installed in conjunction with an irrigation delivery structure that will ensure delivery of water and reduce maintenance and avoid channel manipulation. This project is in the Ruby watershed and is an essential component in implementing native fish restoration in Ramshorn Creek and its tributaries. The goal is to conserve an important population of westslope cutthroat trout in the Ruby watershed. **ONGOING; $10,000, RUBY VALLEY CONSERVATION DISTRICT.**

Wall Creek fish barrier (030-2018).

Wall Creek (Madison County) is a tributary to the Madison River and supports populations of 95% pure westslope cutthroat trout. Currently, rainbow trout are allowed access to Wall Creek and can hybridize with westslope cutthroat trout. To prevent further dilution of genetic purity and risk losing westslope cutthroat trout conservation status, the applicant intends to install a fish barrier that will isolate the conservation population. The barrier would protect nearly eight miles of headwater streams and contribute to the restoration goal for westslope cutthroat trout east of the Continental Divide. **ONGOING; $2,000, U.S. FOREST SERVICE.**

Implementation Monitoring

The FFIPC or an FWP representative monitored 51 sites for implementation (completion; Table 8, Figure 20). All these projects were completed, with funds expended, between November 1, 2016 and October 31, 2018, and were located within Regions 1- 6. Implementation monitoring by the FFIPC facilitated discussions about technique successes and failures with applicants and landowners.

Many of these projects are discussed above in *Recent Projects*, but selected projects not otherwise described in this or previous reports are described below, denoted by asterisks (*).

TABLE 8. PROJECTS MONITORED FOR IMPLEMENTATION (AT COMPLETION) SINCE THE LAST BIENNIUM (NOV 1, 2016 - OCT 31, 2018). * = PROJECT DESCRIPTION TO FOLLOW.

FFIP #	Region	Project Name	Waterbody	Completed
001-2017	3	Bender Creek fish barrier	Bender Creek	2017
001-2009	3	Big Creek water lease renewal	Big Creek	2018
028-2010*	4	Big Spring Creek Channel restoration	Big Spring Creek	2017
001-2016*	4	Big Spring Creek Machler restoration	Big Springs Creek	2017
027-2011*	4	Big Spring Creek Machler supplement	Big Springs Creek	2016
020-2017	2	Blackfoot River fish screen	Blackfoot River	2017
019-2016*	3	Bostwick Creek fish barrier	Bostwick Creek	2017
001-2014*	3	Bozeman Creek at Bogart channel enhancement	Bozeman Creek	2017
024-2015	2	Braziel Creek instream flow	Braziel Creek	2017
010-2014	2	Browns Gulch channel restoration	Browns Gulch	2016
013-2012	2	Browns Gulch fish passage and channel stabilization	Browns Gulch	2018
003-2015*	1	Bull River riparian restoration	Bull River	2017
003-2017	2	East Fork Bitterroot River riparian fencing and revegetation	East Fork Bitterroot River	2017
020-2016*	3	Elk Springs Creek habitat restoration	Elk Springs Creek	2016
004-2018	2	Elliston Creek riparian fence	Elliston Creek	2018
005-2016*	3	French Creek riparian fencing	French Creek	2017
006-2015*	3	French Gulch channel relocation	French Gulch	2016
028-2015*	3	French Gulch channel restoration	French Gulch	2017
006-2016*	3	French Gulch channel restoration	French Gulch	2017
005-2018	2	Granite Creek culvert removal and fish passage	Granite Creek	2018
006-2017	3	Jack Creek riparian restoration	Jack Creek	2017
010-2016*	3	Long Creek channel restoration	Long Creek	2016
021-2016*	4	Marias River Sanford Park fish habitat enhancement	Marias River	2017
008-2017	2	Marshall Creek fish passage	Marshall Creek	2017
030-2015*	2	Martina Creek channel restoration	Martina Creek	2017

FFIP #	Region	Project Name	Waterbody	Completed
016-2012	3	Miner Creek riparian enhancement	Miner Creek	2017
022-2016*	2	Monture and Dunham Creeks riparian fencing	Monture/Dunham Creeks	2017
010-2017	3	Moore's Creek channel and riparian restoration	Moore’s Creek	2017
009-2018	3	Moose Creek Gallatin restoration	Moose Creek	2018
012-2015*	5	Musselshell River Egge diversion removal	Musselshell River	2017
011-2017	2	Nevada Creek channel restoration	Nevada Creek	2017
028-2018	3	NF Spanish creek barrier supplement	North Fork Spanish Creek	2018
024-2016	3	North Fork Spanish Creek fish barrier	North Fork Spanish Creek	2018
013-2018	2	Poorman Creek instream flow	Poorman Creek	2018
014-2017	2	Racetrack Creek Johnson diversion replacement	Racetrack Creek	2017
028-2017	2	Rattlesnake Creek Cobban fish screen	Rattlesnake Creek	2018
025-2016*	2	Rattlesnake Creek Williams fish screen	Rattlesnake Creek	2017
023-2013*	6	Redwater River culvert fish passage	Redwater River	2017
016-2017	4	Sevenmile Creek fish passage	Sevenmile Creek	2018
026-2016*	2	Shanley Creek fish screen and water conservation	Shanley Creek	2016
008-2014*	3	Shields River fish barrier	Shields River	2017
027-2016	3	Shields River watershed YCT passage	Shields River	2018
036-2015	3	Smith Slough spawning enhancement	Smith Slough	2018
016-2015*	2	Stonewall Creek restoration	Stonewall Creek	2016
013-2016*	2	Telegraph Creek Lilly Orphan Boy mine reclamation	Telegraph Creek	2017
023-2014	4	Tenmile Creek bank stabilization and fencing	Tenmile Creek	2017
024-2013	4	Tenmile Creek diversion repair	Tenmile Creek	2016
014-2016	1	Vermillion River Miners Gulch restoration	Vermillion River	2017
015-2016*	2	Warm Springs Creek fish passage	Warm Springs Creek	2017
028-2016*	2	Wasson Creek water rights lease renewal	Wasson Creek	2017
018-2017	4	Williams Creek riparian fencing	Williams Creek	2018

IMPLEMENTATION MONITORING

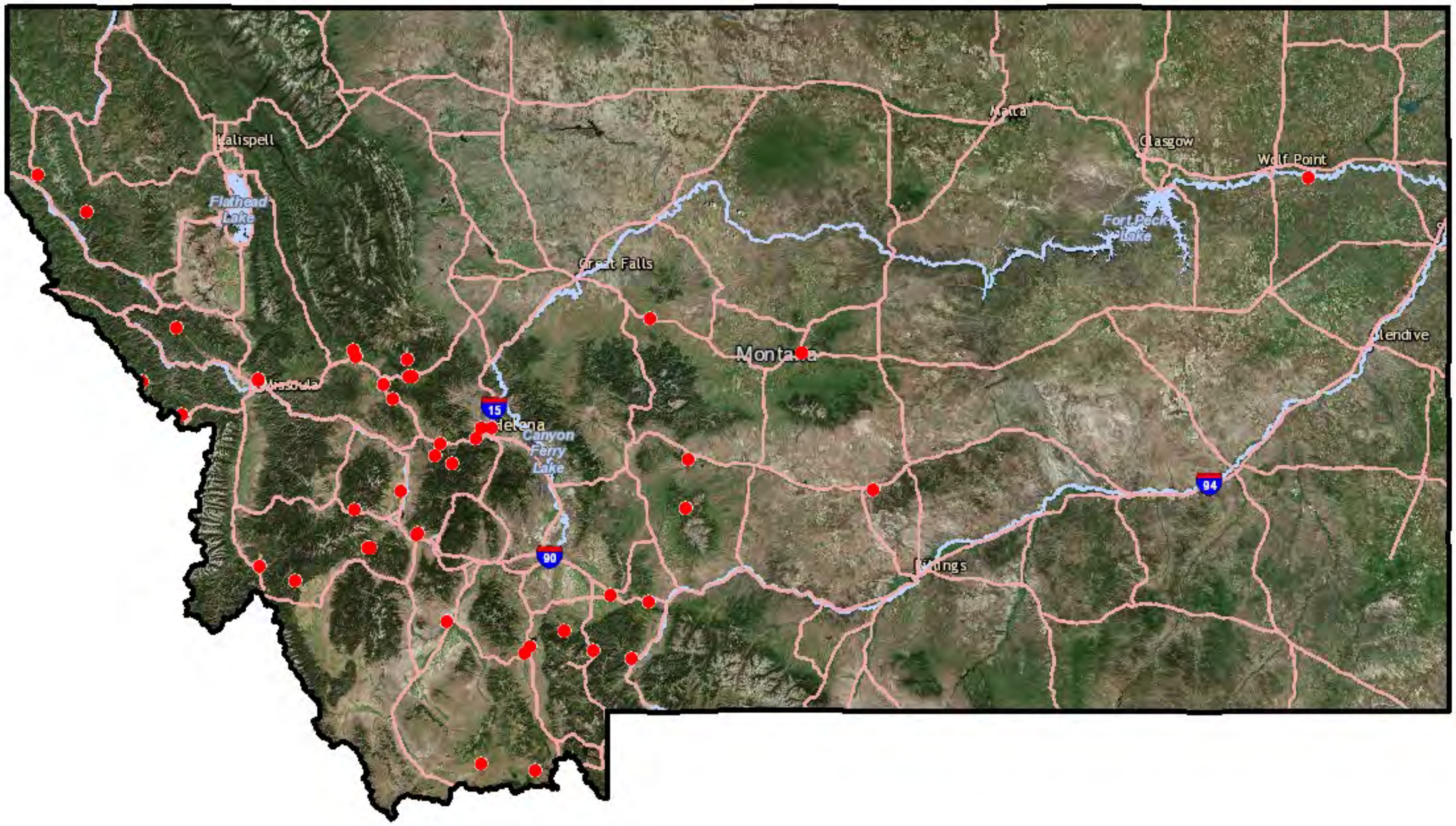


FIGURE 20. MAP OF PROJECTS COMPLETED SINCE LAST BIENNIUM (11/1/2016- 10/31/2018).

Big Spring Creek Machler restoration (028-2010 / 027-2011 / 001-2016)

Big Spring Creek (Fergus County) supports a very popular rainbow trout and brown trout fishery. A reach of Big Spring Creek, located on property owned by Machler immediately downstream of Lewistown, was channelized in the 1960's, resulting in a straight and entrenched channel with degraded habitat characteristics (Figure 21). In part, this channelization project created the impetus for the ultimate passage of the Montana Natural Streambed and Land Preservation Act (310 law). The project returned meanders to the straightened channel and created a functional floodplain for 3,200 feet of the stream, resulting in the addition of about 1,200 feet of new channel. The project is located on a new FWP fishing access site with a permanent walk-in public easement.

FIGURE 21. BIG SPRING CREEK DURING CONSTRUCTION (L, ORIGINAL CHANNEL) AND POST CONSTRUCTION (R, 2017).

Bostwick Creek fish barrier (019-2016)

Bostwick Creek (Gallatin County) is a tributary to Trout Creek and the East Gallatin River near Bozeman that currently supports populations of brook trout, hybrid (westslope x rainbow) trout, and pure westslope cutthroat trout (WCT). Two years ago, pure WCT were moved from Bostwick to Placer Creek, also within the Gallatin watershed. Bostwick Creek likely still holds many pure WCT. This project modified an existing weir structure to create a concrete fish barrier and isolate WCT from non-native fish species (Figure 22). The biologist will perform fish removals upstream of the barrier for 2-3 years using intensive electrofishing methods. The goal is to preserve the native population.

FIGURE 22. BOSTWICK CREEK FISH BARRIER BEFORE (L) AND AFTER MODIFICATION (R).

Bozeman Creek at Bogart channel enhancement (001-2014)

Bozeman Creek (Gallatin County) is a tributary to the East Gallatin River that supports a mixed salmonid assemblage. A portion of the stream, as it flows through Bogart Park within the city of Bozeman, was historically channelized. This reach of stream was entrenched with high, unstable banks, little hydraulic diversity and poor fish and wildlife habitat (Figure 23). This project realigned approximately 820 feet of the channelized stream to improve plan form, profile and cross-sectional characteristics. Additionally, an inset floodplain was constructed, and the riparian vegetative community was augmented. As part of the overall project, recreational amenities were installed to protect resources and better accommodate public use. The purpose of the project was to improve the stream, including nature-based recreation and environmental education purposes.

FIGURE 23. BOZEMAN CREEK RESTORATION BEFORE (L) AND AFTER CONSTRUCTION (R, 2017).

Bull River riparian restoration (003-2015)

Bull River (Sanders County) is a tributary to the lower Clark Fork River and supports a community of brown trout, bull trout, mountain whitefish, and westslope cutthroat trout. The Bull River drainage provides the most important spawning and rearing habitat for native westslope cutthroat trout and bull trout in the Cabinet Gorge reach of the lower Clark Fork River. However, Bull River is impaired by sedimentation and physical habitat alterations caused by bank erosion, roads, and upland load. This project addressed bank erosion by controlling non-native reed canary grass with weed barrier, and by planting native shrubs and trees along approximately 11,000 linear feet of river (Figure 24). The goal is to improve streambank stability over time and re-establish a healthy riparian area to reduce sediment loading and enhance wild fish habitat.

FIGURE 24. BULL RIVER EXCLOSURE INSTALLATION (L) AND VEGETATION GROWTH (R, 2017).

Elk Springs Creek habitat restoration (020-2016)

Elk Springs Creek (Beaverhead County) is in the Centennial Valley and flows into Upper Red Rock Lake. The stream was historically populated by Arctic grayling and was one of Montana's most prolific Arctic grayling spawning populations. In the early 1900's, the stream was altered, and habitat was fragmented and degraded, leading to the diversion of Elk Springs Creek into a shallow wetland marsh. The stream was reconnected to Upper Red Rock Lake in 2016 as part of a separate, but related, project. The intent of the project was to improve grayling populations by improving connectivity, restoring stream function, and improving suitable spawning areas. The project removed sediment deposited by McDonald Pond, imported spawning gravels where needed, and restored natural channel dimensions and sinuosity to the stream (Figure 25). Because of this project, Elk Springs Creek could be an additional major spawning tributary for Arctic grayling.

FIGURE 25. ELK SPRINGS CREEK BEFORE (L) AND AFTER (R) CONSTRUCTION.

French Creek riparian fencing (005-2016)

French Creek (Deer Lodge County) is a tributary to Deep Creek in the Big Hole watershed that currently supports populations of rainbow trout and brook trout but is part of a larger project to restore westslope cutthroat trout and Arctic grayling. The project installed riparian fencing around an area that had highway improvements. The existing fence was in poor condition, no longer functional in some locations, and difficult to repair. The new fence is above the riparian area, allowing for unimpeded wildlife movement through the riparian area, reduced livestock impacts, and better maintenance (Figure 26). The goal of the project was to keep livestock off the stream and riparian area, which will be increasingly important when native species are established.

FIGURE 26. FRENCH CREEK RIPARIAN FENCING POST CONSTRUCTION.

French Gulch channel restoration (006-2015 / 028-2015 / 006-2016)

French Gulch (Deer Lodge County) is a tributary to French Creek, which flows into Deep Creek and the Big Hole River. Placer mining activities occurred in the French Gulch drainage from the mid-19th century to the early 1890's, resulting in stream habitat that was degraded by channel straightening, the presence of large dredge spoils, increased stream gradient, reduced riparian area width, and isolation of the stream from its floodplain. The purpose of this project was to restore habitat impacted by placer mining. Restoration activities included reconstruction of the floodplain and stream channel, redirecting the streamflow, and plugging the old channel (Figure 27). The new channel was vegetated with transplanted material or bioengineering techniques. The goal was to increase the number of westslope cutthroat trout and Arctic grayling in French Gulch by repressing the existing non-native fishery, addressing the habitat limitations, and potentially opening habitat to fluvial fish from French Creek. The larger watershed activities include the French Creek barrier, which may be constructed as soon as 2019.

FIGURE 27. FRENCH GULCH CHANNEL RESTORATION BEFORE (TOP) AND AFTER (BOTTOM, 2016).

Long Creek channel restoration (010-2016)

Long Creek (Beaverhead County) is a tributary to the Red Rock River, upstream of Lima Reservoir, which supports a small population of Arctic grayling. The stream functionality has been described as poor due to channel incision, high rates of bank erosion and fine sediment export, partial dewatering, absence of low-water habitat diversity, and absence of recruiting streamside woody vegetation. This project installed nine armored riffle-and-sod grade controls over approximately 3.7 miles of channel, eventually resulting in a pool/riffle morphology (Figure 28). Runoff and low-flow water elevations were raised through the installation of hardened riffles, increasing floodplain connectivity. Abandoned side-channel areas were re-activated, allowing fish and aquatic species to migrate at baseflow conditions. Grazing in the riparian area will be managed. The overall goal is to re-establish a self-maintaining floodplain environment that would result in an improved and more resilient ecological condition for Arctic grayling.

FIGURE 28. LONG CREEK RESTORATION PROJECT BEFORE (TOP) AND AFTER (BOTTOM) CONSTRUCTION.

Marias River Sanford Park fish habitat enhancement (021-2016)

The Marias River (Liberty County) is in north central Montana and is impounded by Tiber Dam. Wild brown trout, stocked rainbow trout, and burbot are located within the project area, which is approximately one mile downstream of Tiber Dam, located at a public campground. This project restored 360 feet of eroding bank with a 3-tiered willow soil lift, re-graded an additional 40 feet of bank to improve stability, and added two engineered log jams to provide trout habitat through pool scour and cover (Figure 29). The goal was to provide trout habitat and prevent further erosion. A second goal of the project was to stabilize the bank so that high flow dam releases, which are necessary for pallid sturgeon recovery, are possible and do not lead to further bank erosion.

FIGURE 29. MARIAS RIVER BEFORE (L) AND AFTER (R) CONSTRUCTION.

Martina Creek channel restoration (030-2015)

Martina Creek (Missoula County) is a tributary to Ninemile Creek and supports populations of westslope cutthroat trout and brook trout. It was heavily altered by mining and some logging, and the creek contains dredge ponds, cascading channels, and braiding. The impairments included impeded upstream fish migration, dredge ponds that contribute to increased water temperature, and placer mine tailings leading to sedimentation and impacted floodplains. This project addressed these issues by moving large piles of dredge mining tailings, filling mining cutslopes and dredge ponds, and reconstructing the stream channel to connect Martina Creek to Ninemile Creek (Figure 30).

FIGURE 30. MARTINA CREEK; BEFORE CONSTRUCTION, THE STREAM WAS DIVERTED INTO A DREDGE POND (TOP) AND AFTER CONSTRUCTION THE STREAM WAS RETURNED TO ITS CHANNEL (BOTTOM L), WITH THE POND FILLED (BOTTOM R).

Monture and Dunham Creeks riparian fencing (022-2016)

Monture Creek (Powell County) is a tributary to the middle Blackfoot River originating in the Bob Marshall Wilderness. Dunham Creek is a tributary to Monture Creek. Both streams are bull trout core areas, listed as critical habitat, and support spawning areas for fluvial westslope cutthroat trout and bull trout. Dunham Creek also supports pure populations of westslope cutthroat trout. This project was completed on private land on the lower reaches of Monture and Dunham Creeks, within the Two-Creek Ranch. A portion of the riparian area was included in a previous grazing management system, but the existing fence was no longer functional (Figure 31). This project replaced old fence and installed new fence to protect two miles of Dunham Creek and eight miles of Monture Creek. Three-strand electric fence was used in areas of higher use, and single-strand electric was used in lower pressure areas. The intent was to protect critical native fish habitat and ensure recruitment potential for wild populations. This location may be the most critical bull trout spawning area in the Blackfoot.

FIGURE 31. FAILING JACKLEG FENCE (L) AND NEW FENCE (R) ON MONTURE AND DUNHAM CREEKS.

Musselshell River Egge diversion removal (012-2015)

The Egge Diversion (Golden Valley County), on the Musselshell River, was in place for nearly 100 years. A 2011 flood flanked the diversion and led to severe erosion on the adjacent bank (Figure 32). This project maintained the recent connectivity in the Musselshell River by removing the fish barrier and allowing natural streamflow, opening a continuous 24-mile reach for passage and connecting the tributaries Big Coulee and Painted Robe Creeks, which contain species of concern northern redbelly dace, hybrid finescale dace, spiny softshell turtles, and many other native species. Fatmucket clams are also found in this area. The erosion on the adjacent bank was repaired using bioengineered soil lifts instead of rock riprap and was one of the first major bioengineering efforts in Eastern Montana.

FIGURE 32. PRE-PROJECT FLANKED DIVERSION (L) AND POST PROJECT RESTORATION (R) ON THE MUSSELSHELL RIVER.

Rattlesnake Creek Williams fish screen (025-2016)

Rattlesnake Creek (Missoula County) is a tributary to the Clark Fork River that is a primary spawning tributary for both native bull trout and westslope cutthroat trout, as well as fluvial rainbow and brown trout. Rattlesnake Creek has several ditches, most of which were screened in 2002 with brencail-type screens. The brencail screen on the Williams ditch was undersized and did not function as intended; this project replaced the brencail-type with a coanda-type fish screen (Figure 33). The intent of the project was to prevent fish entrainment and increase spawning habitat for salmonids in the Rattlesnake Creek drainage.

FIGURE 33. RATTLESNAKE CREEK BEFORE (BRENCAIL-TYPE SCREEN, TOP) AND AFTER (COANDA-TYPE SCREEN, BOTTOM).

Redwater River culvert fish passage (023-2013)

The Redwater River (McCone County), located south of Poplar, is one of the largest tributaries to the lower Missouri River in Montana and is extremely important for the overall ecological function of the system. The Redwater River supports a very high diversity of fish species, including several Montana species of special concern (northern redbelly dace, sauger, Iowa darter and sturgeon chub). A county road crossing, the Nickwall Crossing, was acting as an upstream fish passage barrier most of the time. This crossing currently consisted of four, 24-inch diameter, concrete culverts spaced across the stream and were perched above the streambed (Figure 34). The road crossing, located about 1.25 miles upstream from the confluence with the Missouri River, essentially blocked upstream fish passage to about 25 miles of river habitat. This project re-constructed the stream crossing by installing four 12-foot wide by 5-foot tall box culverts. The new culverts were embedded below stream grade by about one foot and were backfilled with gravel to provide resting areas for slower swimming fish species.

FIGURE 34. REDWATER RIVER BEFORE (L) AND AFTER (R) CULVERT REPLACEMENT.

Shanley Creek fish screen and water conservation (026-2016)

Shanley Creek (Missoula County) is a tributary to Cottonwood Creek in the Blackfoot River drainage. It is a bull trout core area stream and supports pure populations of westslope cutthroat trout (WCT). Several other projects have been completed in Shanley Creek, including road decommissioning and stream crossing upgrades on the University of Montana Bandy Experimental Ranch in 2015. This project also took place on the same ranch and replaced a paddlewheel fish screen that was no longer functional with a flat panel screen (Figure 35). The goal of the project was to eliminate fish entrainment and improve control of diverted stream flow. The original fish screen installation shifted the fish community to favor WCT.

FIGURE 35. OLD, NON-FUNCTIONAL FISH SCREEN (TOP) AND NEWLY INSTALLED SCREEN AND HEADGATE (BOTTOM).

Shields River fish barrier (008-2014)

The Shields River (Meagher County) is one of the few remaining strongholds for native Yellowstone cutthroat trout. However, expanding brook trout populations are threatening the persistence of these native fish, especially in the headwaters. This project constructed a fish migration barrier at an existing U.S. Forest Service road crossing located within the Shields River headwaters, just downstream from the confluence of Crandall Creek (Figure 36). The barrier structure is a precast box culvert that replaced an existing bridge and created a 4.2-foot drop from the end of the apron. Additionally, a berm was installed along the west side of the channel to protect the existing road. By-pass pipes were installed within the berm and in the existing road to allow for drainage during flows that exceed bankfull flows. As part of the project, non-native brook trout will be removed from upstream waters by electrofishing and the use of piscicides. Salvaged Yellowstone cutthroat trout would be returned to reclaimed waters. A design component of this project allows for the new barrier to be removable with relative ease should the opportunity to expand Yellowstone cutthroat trout conservation efforts to downstream waters if the need arises.

FIGURE 36. SHIELDS RIVER FISH BARRIER DURING CONSTRUCTION (L) AND AFTER INSTALLATION (R).

Stonewall Creek restoration (016-2015)

Stonewall Creek (Lewis & Clark County) is a tributary to Keep Cool Creek, within the Blackfoot River drainage, that contains westslope cutthroat trout. This project is in an area that has been impacted by placer mining. Tailing piles confined the creek, the floodplain had limited connectivity, and the riparian area did not function well. This project restored this section of Stonewall Creek by removing tailings piles, adding woody debris complexes to the stream, and restoring the adjacent floodplain and riparian area (Figure 37). The goal of this project was to contribute to the recovery of westslope cutthroat trout by expanding suitable habitat and improving water quality on-site and downstream of the project.

FIGURE 37. STONEWALL CREEK PLACER TAILINGS (TOP) AND POST-PROJECT RESTORATION (BOTTOM).

Telegraph Creek Lilly Orphan Boy mine reclamation (013-2016)

Telegraph Creek (Powell County) is a tributary to the Little Blackfoot River south of Elliston that supports brook trout, brown trout, and westslope cutthroat trout. Lilly Orphan Boy mine is an abandoned hard rock mine that contaminated Telegraph Creek. Initial sampling results showed that elevated levels of heavy metals existed in waste rock and sediments of Telegraph Creek, and surface water quality standards were exceeded for arsenic, cadmium, copper, lead, and zinc. The project removed the mine waste and reconstructed the stream to restore natural dimension, pattern, and profile (Figure 38). The overall goal was to restore the ecological function of Telegraph Creek and improve sediment and water routing, diversity of habitat, water quality, and water temperatures.

FIGURE 38. TELEGRAPH CREEK TAILINGS (L) AND RESTORED CREEK (R). PHOTOS WERE TAKEN IN SAME LOCATION.

Warm Springs Creek fish passage (015-2016)

Warm Springs Creek (Deer Lodge County) is a tributary to the Clark Fork River within the Beaverhead Deerlodge National Forest that contains bull trout and westslope cutthroat trout. An existing culvert was undersized, acted as a velocity barrier for fish, promoted bedload deposition upstream, and increased scour downstream (Figure 39). This project replaced the undersized culvert with a precast concrete bridge. The goal was to replace the structure, thereby allowing unimpeded fish movement throughout much of the Warm Springs Creek headwaters and increasing access to 10 miles of habitat.

FIGURE 39. WARM SPRINGS CREEK BEFORE (L) AND AFTER (R) CONSTRUCTION.

Wasson Creek water rights lease renewal (028-2016)

Wasson Creek (Powell County) is a tributary to Nevada Spring Creek in the Blackfoot River drainage. Historically, Wasson Creek was habitat for westslope cutthroat trout (WCT). Currently, upper Wasson

Creek hosts an isolated population of pure-strain westslope cutthroat trout. Irrigation on lower Wasson Creek dewatered the creek and the WCT were largely isolated from the rest of the drainage (Figure 40). High temperatures and lack of flow represented barriers to migration in and out of Wasson Creek. The instream flow lease achieved in 2007 led to a substantial success—in both reduced water temperature and increased numbers of WCT. Monitoring has also shown an increase in migration and spawning activity. This project renewed the instream flow lease and intends to continue the success in restoration for another ten years.

FIGURE 40. WASSON CREEK INSTREAM FLOW IMPACTED AREA.

Effectiveness Monitoring

In 2017 and 2018, project effectiveness monitoring was reduced due to unexpected budget cuts in the Fisheries Division. Nonetheless, 55 projects were monitored for long term success in 2017-2018 (Figure 41, Table 9).

A Yellowstone cutthroat trout intern was hired in 2017, Kyrsten Wolterstorff, to work with Yellowstone cutthroat trout restoration biologist Carol Endicott and perform monitoring in Park, Gallatin, and Meagher counties. Ms. Wolterstorff monitored 16 sites, listed in Table 9 as YCT-I. Michelle McGree, FFIPC (or in conjunction with FWP staff), also monitored projects for compliance and effectiveness in 2017 and 2018 (39 sites). These projects were monitored as part of a strategy to investigate effectiveness of older projects, a in conjunction with other FFIP or FWP duties.

TABLE 9. PROJECTS MONITORED IN 2017-2018, BY THE YELLOWSTONE CUTTHROAT TROUT RESTORATION INTERN (YCT-I) OR THE FUTURE FISHERIES IMPROVEMENT PROGRAM COORDINATOR (FFIPC). FFIP # = INDIVIDUAL PROJECT NUMBER.

FFIP #	Project Name	Monitor
004-2008	Cottonwood Creek irrigation diversion replacement	YCT-I
008-2002	East Boulder Spring Creek stream relocation and stockwater	YCT-I
039-2002	East Gallatin River bank restoration	YCT-I
009-2002	Elk Creek spring corral bypass	YCT-I
047-2003	North Fork Fridley Creek fish passage and water lease	YCT-I
045-2004	North Fork Horse Creek center pivot	YCT-I
048-2003	North Fork Horse Creek fencing	YCT-I
022-2004	North Fork Horse Creek fish screen	YCT-I
026-1997	Richardson Creek riparian fencing	YCT-I
016-2001	Shields River bank stabilization	YCT-I
053-1998	Shields River and Elk Creek fencing	YCT-I
047-2003	South Fork Fridley Creek fish ladder	YCT-I
018-2007	South Fork Ross Creek habitat and wetland enhancement	YCT-I
021-2007	Thiel Creek fish barrier	YCT-I
022-2007	Thompson/Story creeks riparian protection	YCT-I
024-2011	Willow Creek channel restoration	YCT-I
035-2001	Big Otter Creek corral relocation	FFIPC
023-2015	Big Otter Creek fencing and stock tank	FFIPC
024-1997	Big Spring Creek	FFIPC
002-2003	Brackett Creek	FFIPC
008-1999	Cottonwood Creek bank stabilization	FFIPC
009-2000	Cottonwood Creek channel restoration	FFIPC
006-2004	Deep Creek	FFIPC

EFFECTIVENESS MONITORING

FFIP #	Project Name	Monitor
007-2004	Deep Creek	FFIPC
017-1996	Deep Creek Channel Restoration	FFIPC
026-2015	Deep Creek streamflow improvement	FFIPC
007-2003	Dupuyer Creek	FFIPC
006-2008	East Fork Bull River channel stabilization	FFIPC
023-1997	Elk Creek	FFIPC
006-2001	Elk Creek Channel Restoration	FFIPC
012-1999	Elk Creek restoration	FFIPC
041-1999	Elk Creek restoration	FFIPC
009-2008	Enders Spring Creek channel restoration	FFIPC
005-2010	Fleshman Creek flood control	FFIPC
041-2002	Locke Creek	FFIPC
028-2001	Locke Creek irrigation conversion and lease	FFIPC
034-2010	Magpie Creek culvert fish passage	FFIPC
032-2005	Magpie Creek fish passage	FFIPC
057-1996	Missouri River bank stabilization	FFIPC
010-2015	Moore's Creek Grazing and Water Quality Enhancement	FFIPC
038-2010	Nevada Creek channel restoration	FFIPC
023-2004	Otie Reservoir	FFIPC
014-2005	Pilgrim Creek channel restoration	FFIPC
036-2006	Poorman Creek bridge	FFIPC
020-2014	Prickly Pear Spring Creek Bank Stabilization	FFIPC
053-1999	Prospect Creek	FFIPC
018-2011	Skelly Gulch fish barrier	FFIPC
026-2003	South Fork Bull River	FFIPC
026-1998	Spring Coulee Creek	FFIPC
020-2001	Teton River	FFIPC
017-2006	Teton River bank stabilization	FFIPC
019-2005	Thompson River riparian restoration	FFIPC
039-2015	Trail Creek fish screen	FFIPC
026-2010	Vermilion River Chapel slide stabilization	FFIPC
022-2001	White Pine Creek stabilization	FFIPC

EFFECTIVENESS MONITORING

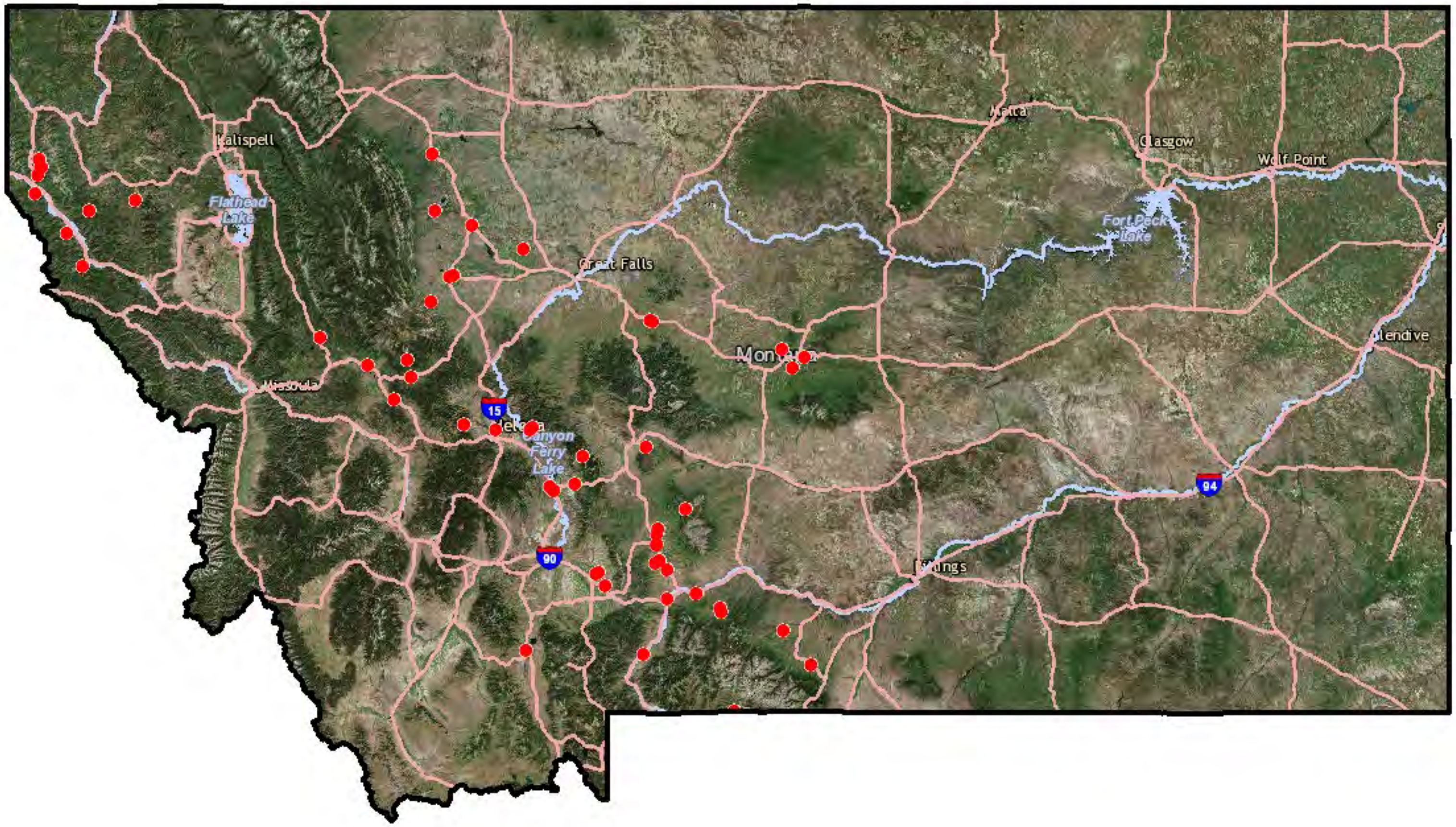


FIGURE 41. MAP OF PROJECTS MONITORED FOR EFFECTIVENESS IN 2017 AND 2018.

EFFECTIVENESS MONITORING

PROCEDURES

The goal of this effort was to document the condition of projects that received funding from the FFIP (Table 9, Figure 41). When available, background information was compiled for each project. Sources included FWP's database and the local biologists' internal files. Information obtained included pre-project photos, fish survey data, and project designs. This information often provided a baseline of pre-project conditions that allowed evaluation of the success of the specific project. Other projects were slated for evaluation; however, difficulties in contacting landowners, or failure to get permission to access the sites limited the number projects visited.

One or more field observers visited each site and filled out an assessment form that included descriptions of fields of conditions at the project site, and whether the project met the terms of the agreement. Photos provided additional documentation of site conditions, and the coordinates of the locations of the photos were obtained with a handheld GPS unit.

Following field data collection, the field observer or observers prepared a narrative that described the project area and compared baseline conditions to current conditions. Other components of the narrative were compliance with the terms in the agreement, an assessment of whether the project was successful in meeting project goals, and recommendations for improvements. Mapping locations of photo points on aerial photos linked field conditions to a recent aerial view of the project area.

Synthesis of pre-project information and field observations allowed assessment of the success of the project. Evaluation of projects also documented shortcomings and failures and provided recommendations for improvements or future study. Individual results and photographs are described below.

YELLOWSTONE CUTTHROAT TROUT RESTORATION INTERN MONITORING

Projects evaluated included those benefiting native, species of concern, including Yellowstone cutthroat trout and westslope cutthroat trout. Of course, other native species benefit from improvements in habitat and water quality, and these include mountain whitefish, rocky mountain spotted sculpin, and several species in the sucker and minnow families. Nonnative, but economically and recreationally important species including brown trout, rainbow trout, and brook trout also benefit. These popular game fishes attract anglers worldwide, and investments in improving habitat for these species bring considerable benefit to local communities.

Cottonwood Creek diversion replacement (004-08)

Cottonwood Creek is a tributary of the Shields River that originates in the Crazy Mountains at Cottonwood Lake and joins the Shields River near Wilsall, MT. Cottonwood Creek supports slightly hybridized Yellowstone cutthroat trout, along with brook trout, brown trout, and likely Rocky Mountain spotted sculpin. Cottonwood Creek is a chronically dewatered stream and flows near its mouth are often nearly or entirely depleted by late summer.

The Natural Resources Conservation Service (NRCS) district conservationist worked with the landowner to replace the existing structure with a check dam equipped with a Denil fish ladder to allow fish passage, and a screw gate at the diversion to decrease water loss through the existing leaking check boards. He requested grant application assistance and stated the diversion structure would be designed following the biological requirements and structural elements the NRCS was using to replace irrigation diversions in the Big Hole River watershed that were blocking movement of Arctic grayling. NRCS was providing technical and financial assistance to the project through their Technical Service Provider Program and the Environmental Quality Incentives Program, or EQIP.

Pre-project photos document large logs with tarps backwatered the stream to deliver to the diversion (Figure 42). Considerable water leaked through the check boards at the head gate. The water savings with replacement of the leaking check boards with a Waterman gate would be beneficial and an appropriate use of FFIP funds.

FIGURE 42. LOGS CHECKING COTTONWOOD CREEK'S FLOWS TO DELIVER WATER TO THE PIN-AND-PLANK HEAD GATE (L). WATER LEAKING INTO DITCH WHEN CHECK BOARDS WERE BLOCKING FLOW (R).

Field Visit 2017

On August 23, 2017, Krysten Wolterstorff visited the site to evaluate the condition of the diversion and determine if the Denil fish ladder and Waterman gate had been installed, as required by the agreement. Neither feature was present (Figure 43). The diversion dam was a wooden pin and plank structure spanning the stream. A notch where a check board was not present could provide passage to some species and age classes of fish at certain flows but placing a board in this location would block upstream movement of fish. Water leaking through the check boards at the diversion resulted in considerable flow within the canal.

FIGURE 43. IRRIGATION DIVERSION ON COTTONWOOD CREEK.

Conclusions

This project did not meet the design or contractual requirements of the FFIP grant program. The existing structure does not provide the same level of fish passage as a Denil fish ladder, and the check boards in the head gate allow water to continue to leak. This project provided no benefit to fish in Cottonwood Creek, although the landowner reported that the new structure is a significant improvement to his operation. Because this portion of Cottonwood Creek currently has multiple channels, fish passage may be less of a concern. The effect of entrainment is unknown.

The events leading to the change in scope—namely the absence of the fish ladder and headgate—is unknown. The project was over-budget and a decision to scale down may have been made by the consultant or NRCS, but not documented or translated to FWP or the landowner. Regardless, the lesson learned was to ensure the project is completed before reimbursing all the grant funds (which is the current procedure).

East Boulder Spring Creek stream relocation and stock water (008-02)

The East Boulder Spring Creek is a small, unmapped tributary of the East Boulder River. Within the project area, the stream flowed through corrals, which resulted in damage to the stream banks and contributed sediment and nutrients that would eventually reach the East Boulder River. The proposed project entailed diverting 500 ft. of the spring around existing corrals into a historical channel and providing off-stream sources of water for livestock. Five automatic stock waters would provide an alternative source of water to livestock. Species of fish expected to benefit included rainbow trout, brown trout, and potentially Yellowstone cutthroat trout.

Pre-project photos illustrate the heavy use by livestock, trampled banks, and near lack of vegetation along the stream and within the corrals (Figure 44). This corral meets the EPA's criteria as a point source of pollution, and the combination of bank erosion and accumulation of manure made this stream a source of nutrients and sediment to the East Boulder River. In addition, it its pre-project condition, the stream provided exceptionally poor habitat for fish.

FIGURE 44. PRE-PROJECT PHOTO FOR THE EAST BOULDER SPRING CREEK CHANNEL REALIGNMENT AND STOCK WATER PROJECT (L) AND CORRALS ON EAST BOULDER SPRING CREEK (R).

Field Visit 2017

On August 16, 2017, Kyrsten Wolterstorff visited the project site to evaluate if the project was consistent with the FFIP application and to determine if the project had been beneficial to fish. Fencing had been installed, and cattle had no access to the creek. The riparian area was primarily a sedge community with little recruitment of riparian shrubs. Often, spring creeks do not provide suitable conditions for establishment of woody vegetation, so sparse woody vegetation was likely natural. The restored stream channel was relatively narrow and deep, consistent with a Rosgen E channel. The watering devices were in place; however, they were dry, as cattle were not currently occupying the corrals.

FIGURE 45. CURRENT VIEW OF THE RELOCATED SPRING CREEK (L) AND EXAMPLE OF AN OFF-STREAM WATER SOURCE FOR CORRALS INSTALLED AS PART OF THIS PROJECT (R).

Conclusions

Projects that either reroute streams from corrals or move corrals off-stream are relatively inexpensive and have pronounced benefits to stream health, fish habitat and water quality. This project is no exception, and the actions taken restored health to this small spring creek and eliminated a point source of nutrients and sediment that would ultimately pollute the East Boulder River. FFIP funds were well spent on this project.

East Gallatin River bank restoration (039-02)

Introduction

The East Gallatin River originates east of Bozeman, with Rocky Creek, Kelly Creek, and Bridger Creek being major tributaries. This popular fishery supports rainbow trout, brown trout, mountain whitefish, longnose sucker, longnose dace, and sculpin. Recreational use of this stream is substantial, and in 2013, this stream ranked as the 15th most heavily fished body of water in FWP's Region 3, an area encompassing numerous renowned trout streams and rivers.

The East Gallatin River faces numerous pressures. Historically, agriculture had been the primary land use along the stream, and livestock grazing and forage crop production had reduced riparian function and caused bank erosion along portions of the river. In recent decades, residential development has boomed along the river. Some landowners favor Kentucky bluegrass lawns to the streams edge, and this shallow-rooted grass provides poor bank protection.

Agricultural producers and new residential owners share interest in preventing erosion of valuable land. Reinforcing banks using large rock, or riprap, had been a traditional means of stabilizing eroding banks; however, this approach has numerous disadvantages, such as arresting natural fluvial processes, concentrating the force of flows on banks downstream, reducing aesthetics, and being costly. In some cases, streams have eroded around riprap, leaving the rock stranded, and resulting in considerable loss of land. In addition, rock hardened banks do not provide the same beneficial function as a healthy riparian zone. Nevertheless, persuading design engineers and landowners to use softer, bioengineered approaches, in the face of rapidly retreating banks, was challenging at the time of this project.

Patrick Byorth, now with Trout Unlimited, was the FWP biologist managing this project, and he provided photos and project background. The goal of this project was to provide a showcase for alternatives to bank armoring. The project occurred along three eroding banks on a single property. These vertical, eroding banks were retreating rapidly and threatening a bridge and buildings. The fluvial processes resulting in shear stress on banks varied among the banks. For banks 1 and 2, a mid-channel bar was diverting flood flows into these banks, in what was an otherwise straight reach (Figure 46). This mid-channel bar was recontoured with the intent of restoring riffle/pool periodicity and improving sediment transport.

FIGURE 46. MID-CHANNEL BAR THAT WAS EXERTING PRESSURE ON BANKS 1 AND 2 ON THE EAST GALLATIN RIVER.

The third bank was on the outside of a meander bend and had vertical, eroding banks with slight protection afforded by woody debris and sparse shrubs. The cottonwoods were from an earlier attempt to stabilize this reach by anchoring large wood into the bank. Much of the large wood had been swept away, and the bank was laterally mobile.

FIGURE 47. BANK 3 ON THE EAST GALLATIN RIVER, SHOWING CABLED-IN COTTONWOODS THAT WERE PART OF AN EARLIER BANK STABILIZATION EFFORT.

Bank 1: Armor the Toe of the Bank and Re-Slope with Fabric and Shrubs

The first eroding bank had the potential to redirect flows against the footing of the bridge. The bank above the bank full margin was re-sloped to a 3:1 slope or less and covered with biodegradable erosion control blanket. Willows and dogwoods were planted at bank full edge, and the upper bank was planted with native grasses and sedges. The toe of the bank, below the bank full margin, was armored with natural cobble materials sized to resist the estimated 20-year flood modeled for that part of the river.

FIGURE 48. POST-CONSTRUCTION PHOTO OF BANK 1.

Bank 2: Fabric Encapsulated Soil Lifts

In addition to restoring a naturally functioning stream bank, this treatment was designed to protect an existing bridge and adjacent farm buildings. Compacted soil lifts wrapped in biodegradable erosion control fabric were constructed on a 2:1 slope. The soil lifts were vegetated with native grasses, sedges, and shrubs. Cobbles estimated to resist a 50-year flood event were installed along the toe of the bank.

FIGURE 49. EXAMPLE OF FABRIC-ENCAPSULATED SOIL LIFTS ON BANK 2.

Bank 3: Juniper or Straw Bale Revetment

Earlier efforts to stabilize this bank entailed cabling large cottonwood trunks into the shoreline. Some cottonwoods were still in place and had slowed the bank erosion to a limited extent, but additional treatment was considered necessary to reduce flow velocities at the bank interface. The bank treatment entailed attaching juniper revetments to the existing cottonwood bank treatments. Revetments were commonly used in the 1990s and early 2000s. The conceptual approach was to provide bank protection and increase roughness, which would trap sediments, allowing banks to build on the installed features.

FIGURE 50. JUNIPER REVETMENTS CABLED INTO BANK 3.

Field Visit 2017

On June 29, 2017, Kyrsten Wolterstorff visited the project site, accompanied by a landowner. She evaluated the condition of the three treated banks and received insight from the landowner, who was a collaborator on the project and watched the performance of the 3 approaches to bank restoration since project implementation in 2002. An aerial view of the project area is informative in evaluating the response of the channel and stream banks to the different bank restoration approaches (Figure 51).

FIGURE 51. AERIAL VIEW OF THE PROJECT AREA SHOWING LOCATIONS OF THE THREE TREATED BANKS.

As described above, bank 1 was re-sloped, covered with erosion control fabric, revegetated, and stabilized at the toe with installation of rock modeled to be mobile at a 20-year recurrence interval event. This bank was stable with grasses and sedges providing most of the vegetative cover (Figure 52). The erosion control fabric was no longer visible and had likely decomposed with recovery of the bank vegetation, as is the intent when using this biodegradable material. The bank margin was vertical, with a 10-inch, 90° bank angle. The rock placed at the toe had been transported from under the bank, resulting in a stable undercut, which is an important habitat feature for fish. Fencing protected the bank from livestock over-use, and hoof shear or obvious types of disturbance from livestock were absent. A gravel bar had formed closed to the opposite bank; however, it was considerably smaller than the bar that had been excavated and was not apparently exerted erosive force on banks 1 and 2.

FIGURE 52. BANK 1 ON THE EAST GALLATIN RIVER BANK RESTORATION PROJECT, VIEWED FROM DOWNSTREAM (L) AND REESTABLISHED GRAVEL BAR NEAR BANK 1 (R).

The second bank was treated with soil lifts encapsulated with erosion control fabric, revegetated, and cobbles large enough to be mobilized by a 50-year recurrence interval flood were placed at the toe of the bank. This treatment resulted in conditions like the first bank, with a bank angle of 90°, banks stabilized with grasses and sedges. The erosion control fabric decomposed with establishment of vegetation, and according to the landowner, the fabric has not been visible in years (Figure 53). Like the first bank, the rock toe had been transported away, resulting in an undercut bank.

FIGURE 53. BANK 2 ON THE EAST GALLATIN RIVER RESTORATION PROJECT.

The third bank treatment entailing cabling juniper revetments to existing cottonwood logs was unsuccessful. Most of the cottonwood and junipers had washed away, the vertical, eroding banks were about 5-ft. high, and a hanging fence post were indicative substantial lateral adjustments (Figure 54). The juniper revetment treatment was unsuccessful in meeting project objectives.

FIGURE 54. BANK 3 ON THE EAST GALLATIN RIVER BANK RESTORATION PROJECT (L) AND VERTICAL EXPOSED STREAM BANK AND EVIDENCE OF LATERAL MOVEMENT, AS INDICATED BY THE HANGING FENCE POST (R).

Conclusions

This demonstration project of three alternatives to riprap is an example of adaptive management, where different approaches allow evaluation of effectiveness, and identify actions that do not work. The first two treatments, which entailed bioengineered approaches of re-sloping banks, installing soil lifts, revegetation, and installation or rock toes, were successful, whereas the revetment approach was not. Revetments were a popular approach in the 1990s and early 2000s; however, revetments have fallen out of favor after multiple failures. A confounding factor in evaluating the causes of failure of this approach, compared to the others, it that this bank was on the outside of a meander bend, which naturally receives more shear stress during high flows, compared to straighter reaches. Nevertheless, a mid-channel bar had contributed to erosion on banks 1 and 2, and these banks remained stable, despite the reestablishment of a small in-channel gravel bar following recovery of riparian vegetation.

The size of rock installed in the toe of banks is a judgment call that requires evaluation of the acceptable level of risk. Vegetation may take a few years to stabilize banks, and these new banks may fail if a large flood occurs soon after restoration. Installation of rock toes can maintain bank stability until vegetation recovers. Smaller rock brings greater risk if a flood of significant magnitude washes them away before the banks recover. Conversely, larger rock may prevent the banks from being deformable for a longer period and alter fluvial processes if not adequately deformable. Project planners need to evaluate regional regression equations of flood recurrence intervals and confer with FWP biologists in selecting the appropriate size rock, especially in flashy, flood prone streams.

The undercut banks on banks 1 and 2 suggest that a flow of at least a 50-year recurrence interval occurred after restoration. Gage station data for the East Gallatin River covers only the past 2 years. Nevertheless, the East Gallatin River has had notable floods that have inundated stream adjacent properties. In 2008, the Bozeman Daily Chronicle reported a flood that was estimated to be less than a 20-year recurrence interval flood that flooded numerous nearby homes, and the paper reported major flooding in 2011, but did not estimate the magnitude of the flood. Despite significant flooding, banks 1 and 2 withstood relatively large flood events and flood waters removed the rock, leaving undercut banks in its place.

The use of erosion control fabric was successful in this project; however, conversations with stream restoration practitioners indicate a recent move away from the use of this material. Making generalized statements about the relative merits of erosion control fabric is beyond the scope of this report; however, for this project, the fabric held the first 2 banks together long enough for vegetation to become established, and it has since biodegraded, or is no longer visible.

Despite the failure of bank 3 to remain stable, this project was a suitable use of FFIP funds. The project demonstrated softer approaches to bank restoration can be effective and showed revetments to be a practice with considerable potential to fail. FFIP monitoring in 2016 found similar results for cottonwood revetments installed in the Shields River.

In addition to the learning experience, restoring these banks reduced sediment loading to the East Gallatin River and improved habitat for fish along their margins. In contrast, the continued lateral erosion of bank 3 is detrimental to fish habitat and water quality, as it results in a wider, shallower channel and increases sediment and thermal loading. Moreover, this erosion results in loss of valuable land, which is detrimental to the landowner. Encouraging a strategic approach to bioengineered bank restoration along the East Gallatin River through locally led planning would be beneficial to the health of the river and in the interest of adjacent landowners.

Elk Creek Spring corral bypass (009-02)

Elk Creek is a tributary of the East Boulder River, near McLeod, MT. A small spring creek flowed through corrals on before entering Elk Creek and carried a substantial load of fine sediment and nutrients into Elk Creek, and ultimately the East Boulder River, which is less than 500 yards downstream of the project area. The East Boulder River is a popular recreational fishery supporting brown trout, rainbow trout, and the occasional Yellowstone cutthroat trout. The goal of this project was to reduce loading of sediment and nutrients to Elk Creek and the East Boulder River.

Pre-project photos a small, straightened spring creek that had experienced heavy, long-term disturbance by cattle. The stream was surrounded by bare ground, or closely cropped grasses (Figure 55). Hoof shear was present and contributed to loading of sediment into the stream. Concentrating livestock on this small stream resulted in accumulation of manure. The absence of a healthy riparian area meant the functional attributes of filtering sediment and nutrients, providing shade and fish cover, and maintaining channel form and function were entirely disrupted.

FIGURE 55. VIEW OF THE SPRING CREEK BEFORE PROJECT IMPLEMENTATION.

The solution to reduce or eliminate contributions of sediment and nutrients from this spring creek was to divert 80 ft. of the stream into an underground pipe. Installation of a stock tank provided an alternative water source. A fence was installed to manage cattle's access to Elk Creek.

Field Visit 2017

On August 16, 2017, Kyrsten Wolterstorff visited the Elk Spring Creek bypass project. She noted that fencing to protect Elk Creek had been installed, and although in slight disrepair, it was functioning to control livestock's access to the stream channel (Figure 56). The riparian area supported abundant shrubs, and all age classes of shrubs were present. This area appears to be the 50-ft. buffer between the corrals and Elk Creek mentioned in the application that was to filter runoff from the area of animal concentration.

FIGURE 56. RIPARIAN FENCING LIMITING LIVESTOCK ACCESS TO ELK CREEK AND THE BUFFER STRIP BETWEEN THE CORRALS AND SURFACE WATER.

Kyrsten verified the stream had been piped under the corrals, and that alternative stock water had been provided. The inlet and outlet of the pipe were easily located (Figure 57). In addition, the stock water component of the project had been installed (Figure 58), and cattle no longer relied on surface water, which eliminated bank trampling and near-stream sources of sediment and nutrients. The operator reported the waterer occasionally clogged, but regular maintenance easily remedied this problem.

FIGURE 57. INLET OF PIPE THAT PASSES THE UNNAMED SPRING CREEK UNDER THE CORRALS ADJACENT TO ELK CREEK (L) AND OUTLET OF PIPE (R).

FIGURE 58. OFF-STREAM STOCK WATER OF THE ELK CREEK SPRING CREEK BYPASS PROJECT.

Conclusions

This project met its objectives by eliminating, or substantially reducing sediment loading, to Elk Creek and the East Boulder River by placing this small spring creek in a pipe under the corrals. Although it met its objectives and likely had a positive effect on receiving waters, the practice of placing a spring creek in a pipe underground brings some undesirable outcomes. Small spring creeks have ecological functions and values disproportionate to their size. Small spring creeks can provide spawning habitat, support a diversity of aquatic life, and their riparian areas provide valuable habitat to a host of species. By burying the spring creek, these functions were eliminated. Moreover, the 80-ft. pipe is possibly a barrier to fish movement, which prevents fish from accessing much of the habitat this spring provides.

The rationale for piping the stream under the corrals instead of moving the corrals off-stream, or rerouting the stream around the corrals, was not included in the FFIP application. Cost and site-specific conditions may have influenced this decision. Nevertheless, piping the spring creek comes at an ecological cost. In addition, this approach may not be allowable under the Streambed Protection Act, or 310 law, for many streams. At the time this project was implemented, the Sweet Grass Conservation District did not consider a stream of this size jurisdictional under the 310 law. Therefore, this project would not have undergone the permitting process. Their criteria for determining which streams are jurisdictional have changed since 2002, and the Streambed Protection Act may now apply to this type of stream.

Regardless of the jurisdictional status of a stream, projects funded by the FFIP should restore the values and functions of the stream being altered. These days, the FFIP panel would likely consider these factors in awarding funds, with diversion of the stream around corrals, as was done in the East

Boulder Spring Creek project described above, or moving the corrals off-stream, being preferable alternatives.

North Fork Fridley Creek fish passage and water lease (047-03)

North Fork Fridley Creek is a tributary to the Yellowstone River near Emigrant, MT. Its connectivity with the Yellowstone River was eliminated in the 1930s with construction of the Park Branch Canal, which intercepted North Fork Fridley Creek's flow about 100 yards from its confluence with the Yellowstone River. This loss of connectivity eliminated North Fork Fridley Creek as a spawning stream for fluvial Yellowstone cutthroat trout. Moreover, capturing the stream's flow into the canal left the channel downstream of the canal dry.

The North Fork Fridley Creek project addressed the loss of connectivity and dewatering through several actions implemented in 2004. North Fork Fridley Creek was placed in a 25-meter-long culvert under the Park Branch Canal (Figure 59). Channel grading and installation of a series of step pools upstream of the culvert (Figure 60) controlled the grade, so the culvert was at grade and not overly steep, which would have presented a velocity barrier through the culvert.

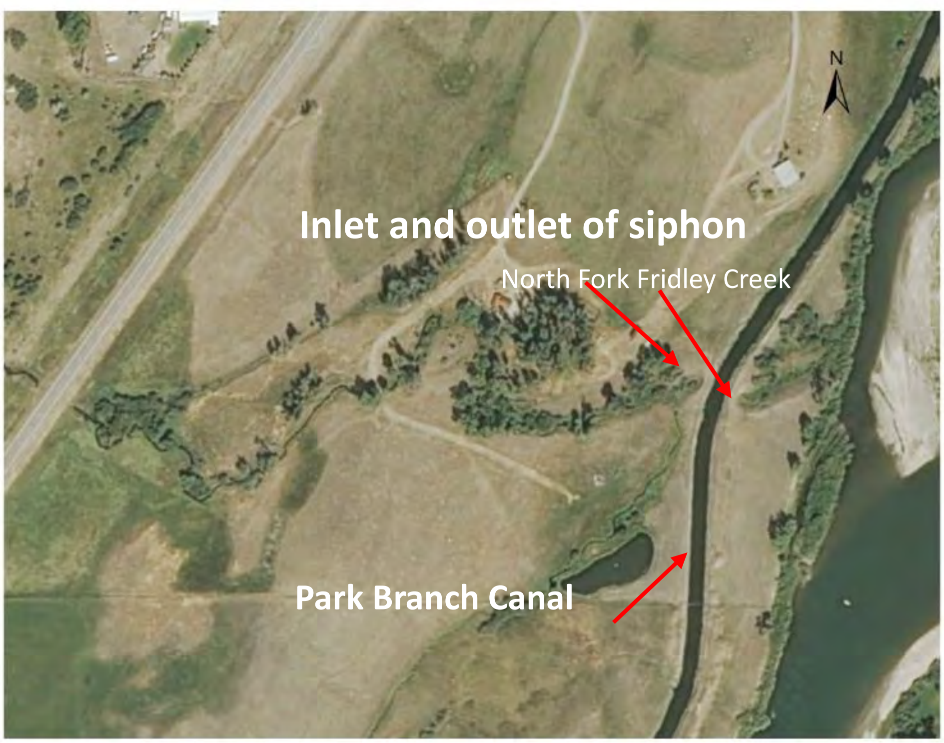


FIGURE 59. AERIAL VIEW OF NORTH FORK FRIDLEY CREEK AND THE PARK BRANCH CANAL.

FIGURE 60. STEP/POOL SEQUENCE CONSTRUCTED UPSTREAM OF THE CULVERT DIVERTING NORTH FORK FRIDLEY CREEK UNDER THE PARK BRANCH CANAL, TO MATCH PRE-PROJECT GRADE AND PROVIDE FISH PASSAGE FROM THE YELLOWSTONE RIVER.

Maintaining in-stream flows entailed converting from flood irrigation to sprinklers. Hay pastures had been flood-irrigated with water diverted from Fridley creek during late season, low flows. The project included drilling a groundwater well and installing two micro-pivot sprinklers to replace water obtained from North Fork Fridley Creek. The water user's water right was the senior-most right on North Fork Fridley Creek, and the alternative water source allowed the water rights holder to convert their irrigation right to maintain in-stream flows.

This project garnered considerable attention, as it demonstrated collaborative conservation with in-kind funds and services provided by the landowner, FWP, the NRCS, Trout Unlimited, the Gallatin Valley Land Trust, and Land and Water Consulting. A short video featuring this project, among others, was shown locally at several public events, and is still available on YouTube (Water Partners).

Post-project fish sampling occurred on in April of 2005 and 2013, and August of 2012 (Figure 61). Sampling downstream of the siphon found the assemblage of salmonid species present in the adjacent Yellowstone River and Rocky Mountain Spotted sculpin. rainbow trout and brown trout were the most abundant trout. Juvenile Yellowstone cutthroat trout were captured immediately below the siphon in 2005. Yellowstone cutthroat trout were also present in 2012. These fish ranged from 2 to 3 inches in length, which indicates they were not spawners staging to migrate upstream but may have been recruits from North Fork Fridley Creek.

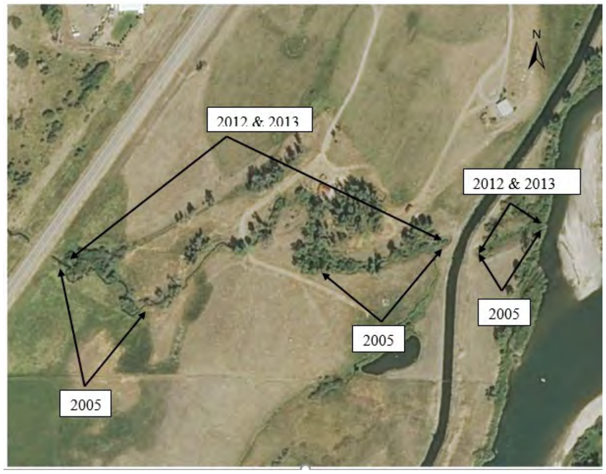


FIGURE 61. AERIAL VIEW OF NORTH FORK FRIDLEY CREEK SHOWING SAMPLING SECTIONS.

TABLE 10. NUMBER OF FISH CAPTURED IN THE DOWNSTREAM SECTION OF NORTH FORK FRIDLEY CREEK IN APRIL 2005 AND 2013, AND AUGUST 2012.

Species	*2005*	*2012*	*2013*	*Total*
brook trout	4		1	5
brown trout	30	4	14	48
mountain whitefish	4			4
rainbow trout	34		22	56
Yellowstone cutthroat trout	12		1	13
Total	84	4	38	126

The spring sampling events are of interest, as Yellowstone cutthroat trout, the species targeted to benefit from the project are spring spawners. Upstream of the siphon, Yellowstone cutthroat trout were rare or missing during the three sampling events, and two rainbow trout × Yellowstone cutthroat trout were captured (Table 11). brown trout and rainbow trout were relatively abundant, and brook trout were comparatively rare. During the 2013 sampling event, the presence of several ripe male and gravid female rainbow trout exceeding 15 inches in length suggested the project was successful in providing passage through the constructed step/pools and siphon under the Park Branch Canal. The Yellowstone cutthroat trout present in 2012 and 2013 were small fish, less than 6 inches in length, indicating their presence was unrelated to spawning, but could be recruits from North Fork Fridley Creek upstream of the siphon.

TABLE 11. NUMBER OF FISH CAUGHT IN THE UPPER SECTION OF NORTH FORK FRIDLEY CREEK IN APRIL IN 2005 AND 2012, AND AUGUST 2012.

Species	*2005*	*2012*	*2013*	*Total*
brook trout	4		3	7
brown trout	13	14	16	43
rainbow trout	6	16	8	30
RBT × YCT	1		1	2
Yellowstone cutthroat trout		1	1	2
Total	*24*	*31*	*29*	*84*

The apparent absence of fluvial Yellowstone cutthroat trout upstream of the Park Branch Canal may not be a function of inability to access North Fork Fridley Creek through the constructed step pools and siphon. Fluvial rainbow trout were capable of such movement. The sampling was early in the spawning period, and potentially missed any Yellowstone cutthroat trout spawning run, as they spawn later in the spring.

Field Visit 2017

Kyrsten Wolterstorff visited the project site on June 30, 2017 and was accompanied by the landowner, who has had considerable interest in the success of this project. The step/pool sequence was still present and appeared unchanged since its post-construction condition (Figure 62). In addition, the siphon conveying North Fork Fridley Creek under the Park Branch Canal was still in place and remained at the constructed grade. Although not part of the FFIP grant, the landowner had installed a hotwire fence to exclude livestock. The riparian area was in excellent condition, with cottonwoods, alders, willows, and sedge-lined banks. The streambed was a mix of silt and gravels, although silt comprised most of the particles. On a subsequent visit on July 24, 2017, Krysten found three redds, and this timing coincided with the Yellowstone cutthroat trout spawning period.

FIGURE 62. NORTH FORK FRIDLEY CREEK DOWNSTREAM OF SIPHON UNDER PARK BRANCH CANAL (L) AND EMERGING FROM DOWNSTREAM END OF SIPHON UNDER PARK BRANCH CANAL (R).

The water savings portion of the project was also implemented and still being used. Aerial photos show the center-pivots and location of the well that supplied the pivots with water (Figure 63). On-the-ground observations further confirmed the presence of the irrigation system installed to replace water diverted from North Fork Fridley Creek (Figure 64).

FIGURE 63. AERIAL VIEW OF THE PROJECT AREA ON NORTH FORK FRIDLEY CREEK SHOWING IMPLEMENTATION OF ALL ELEMENTS OF THE PROJECT.

FIGURE 64. CENTER PIVOT INSTALLED AS A WATER SAVINGS MEASURE FOR NORTH FORK FRIDLEY CREEK (L) AND PUMPING STATION SUPPLYING WATER TO CENTER PIVOTS (R).

Conclusions

All elements of the North Fork Fridley Creek project were implemented as required, and installation of a hot wire fence was an additional measure that protected the stream from over use by livestock. The presence of fluvial rainbow trout upstream of the Park Branch Canal indicates the project was successful in providing passage to North Fork Fridley Creek after about 70 years of being inaccessible. The well and center pivots provide an alternative source of water, which allows water to remain in North Fork Fridley Creek, so fish can access the stream and fry can out-migrate.

The timing of fish sampling confounds conclusions of whether fluvial Yellowstone cutthroat trout access North Fork Fridley Creek for spawning. Sampling occurred in April, which coincides with the rainbow trout spawning run, but may be too early to find Yellowstone cutthroat trout fluvial spawners. The presence of observable redds in late July suggests Yellowstone cutthroat trout do use North Fridley Creek for spawning. As evidenced by the rapid return of a spawning run to Rock Creek with removal of a passage barrier in 2010, Yellowstone cutthroat trout can pioneer previously inaccessible streams. Capture of ostensible Yellowstone cutthroat trout juveniles below the culvert suggest that some recruitment may have occurred upstream of the siphon.

Recommendations to provide more information on the use of North Fork Fridley Creek by Yellowstone cutthroat trout include electrofishing later in the spring, installing a fish trap upstream of the siphon, and deploying fry traps to coincide with outmigration of Yellowstone cutthroat trout fry.

The high levels of fine sediment may be a limiting factor for Yellowstone cutthroat trout spawning success in North Fork Fridley Creek. Examination of aerial photos suggest the sediment is naturally sourced, as the riparian corridor appears to be well-vegetated along its entire length. Nevertheless, opportunities to decrease sediment loading may be available and should be pursued with landowner collaboration.

North Fork Horse Creek center pivot (045-04)

Introduction

North Fork Horse Creek originates on the west flanks of the Crazy Mountains and flows west until its confluence with Middle Fork Horse Creek, which soon meets the south fork, forming the main stem. North Fork Horse Creeks supports nonhybridized Yellowstone cutthroat trout. This project is 1 of 3 occurring on the same property

The purpose of the project was to maintain in-stream flows in North Fork Horse Creek. The existing irrigation system was in disrepair and the ditch lost water to evaporation and infiltration. Grant funds from several sources went into purchase of a center pivot and the pipelines, pumps, and electronic components of the irrigation system. In exchange for the contributions towards the pivot, the landowner agreed to limit the use of his water from May 1 to June 25, except for a 10-day period after July 15. In addition, he agreed to ensure flows did not drop below 1 cfs.

Field Visit 2017

On June 22, 2017, Kyrsten Wolterstorff visited the project site. The center pivot was in place and being used to irrigate a hay pasture (Figure 65). Although not photographed, the pipe diverting water to the center pivot was in place at the fish screen (North Fork Horse Creek fish screen (022-04)) and delivering water through the pipe eliminated evaporative water loss or seepage.

FIGURE 65. CENTER PIVOT NEAR NORTH FORK HORSE CREEK.

Conclusions

A center pivot had been installed, along with a more efficient way of delivering water to the pivot. Compliance with the water use agreement was not possible with a 1-day site visit; however, the landowner reports compliance. Given the investment in North Fork Horse Creek, more monitoring is warranted to evaluate if in-stream flows are being maintained. In addition, a fish sampling would be useful in determining if Yellowstone cutthroat trout have benefited from the projects implemented in North Fork Horse Creek.

North Fork Horse Creek fencing (048-03)

Introduction

Riparian fencing was another component of the multiple actions taken to benefit the nonhybridized Yellowstone cutthroat trout in North Fork Horse Creek. Actions included replacing fencing that excluded livestock from a steep, erodible bench adjacent to the stream and installation of new fence to protect the stream at the downstream end of the property. Pre-project photos show the fence in need of repair (Figure 66), and heavy grazing in the riparian area in the reach adjacent to the bench resulting in closely cropped herbaceous vegetation, reduced recruitment of riparian shrubs, and channel widening.

FIGURE 66. FENCE AT TOP OF BENCH IN NEED OF REPAIR (L) AND EVIDENCE OF INCOMPATIBLE LIVESTOCK GRAZING ON NORTH FORK HORSE CREEK (R).

FIGURE 67. DEGRADED STREAM HABITAT (L) AND DOWNSTREAM END OF PROPERTY SLATED FOR RIPARIAN FENCING (R).

Field Visit 2017

On June 22, 2017, Kyrsten Wolterstorff and Carol Endicott visited the property to determine if the fencing had been installed and evaluate the condition of the stream and riparian area. A robust fence had been constructed down-gradient from the bench and was an effective barrier to livestock (Figure 68). This hillslope showed no evidence of disturbance by livestock. This area had a dense, coniferous overstory, with a robust understory of herbaceous vegetation and mixed-aged shrub community.

FIGURE 68. NEW FENCE INSTALLED TO PREVENT LIVESTOCK FROM ACCESSING NORTH FORK HORSE CREEK FROM BENCH (L) AND TYPICAL VIEW OF THE FENCED OFF HILL SLOPE PROTECTED BY FENCING INSTALLED ALONG THE TOP OF THE BENCH (R).

North Fork Horse Creek apparently benefited from reduced disturbance from livestock accessing the stream from the bench. The stream was a healthy foothills stream with a gravel streambed, stable banks, and a robust riparian area vegetated with sedges, forbs, and dense shrubs (Figure 69). The opposite bank is under different ownership, and the residence is relatively close to the stream. This residential reach lacked a dense shrub community; however, herbaceous vegetation maintained bank stability, and the stream channel was stable. The conditions on the cross-stream neighbor's property had improved with implementation of the project.

FIGURE 69. TYPICAL VIEW OF NORTH FORK HORSE CREEK IN REACH PROTECTED BY FENCE INSTALLED ON THE BENCH.

Fencing and installation of off-channel stock water had a positive effect on the riparian pasture at the downstream end of this property. Tall grasses within the pasture obscure much of the riparian fence; however, posts are visible at several locations (Figure 70). This photo replicates a pre-project photo. Indicators of improvement in the health of the riparian area include an apparent increase in density of willows, and the existing willows no longer have the umbrella-shaped morphology typical of grazed riparian areas. With exclusion of livestock from the riparian area, an alternative source of stock water was required. Kyrsten noted 2 automatic waterers within the fenced area. Combined, the fencing and off-stream water supply are complementary best management practices for sustainable livestock production adjacent to streams.

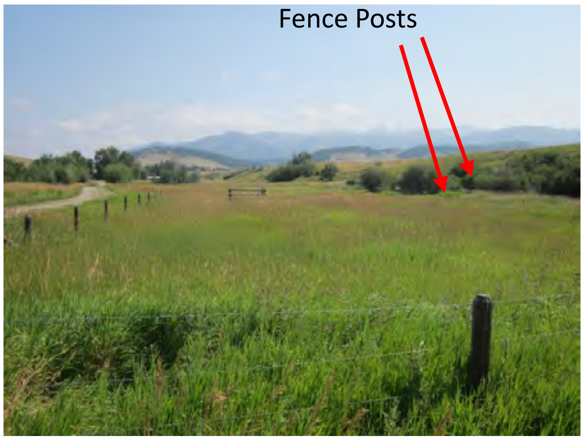


FIGURE 70. PASTURE AT DOWNSTREAM OF PROPERTY WITH RIPARIAN FENCING (L) AND OFF-STREAM STOCK WATERER (R).

Conclusions

Installation of fencing to control livestock's access to riparian areas, and providing off-stream water, are an effective and low-cost measures to maintain stream health and fisheries on working ranches. These projects are effective uses of FFIP funds and their effectiveness is repeatedly demonstrated in post-project monitoring.

While evaluating the North Fork Horse Creek fencing project, Kyrsten noted areas of heavy livestock use, and resulting degradation of riparian areas and bank erosion on an adjacent property. If the landowner is willing, implementing similar actions on this property would further increase the ability of North Fork Horse Creek to continue to support a healthy population of Yellowstone cutthroat trout.

North Fork Horse Creek fish screen (022-04)

Introduction

The goal of this project was to increase water use efficiency and prevent entrainment of nonhybridized Yellowstone cutthroat trout into an irrigation system on North Fork Horse Creek. The existing diversion was a wooden pin and plank structure that delivered water to an open ditch (Figure 71). Diversions that closed with check boards are notoriously leaky. Moreover, the ditch was an inefficient mode of delivering water, as it leaked and loss water to evaporation.

FIGURE 71. PIN AND PLANK IRRIGATION DIVERSION ON NORTH FORK HORSE CREEK.

The entire irrigation delivery system was replaced with a new diversion, fish screen, and delivery pipe (Figure 72). A Waterman head gate replaced the leaky wooden structure (Figure 73). The head gate delivered water to a pipe, which led to a turbulent fountain fish. These screens are placed in a concrete frame or corrugated metal tank. Water delivered to the screen flows up through a fountain pipe, then flows over a screen that delivers water to the irrigation system. A bypass pipe delivers fish back to the stream (Figure 74). On North Fork Horse Creek, a wooden structure spanned the stream that allowed placement of check boards to divert water into the head gate at lower flows.

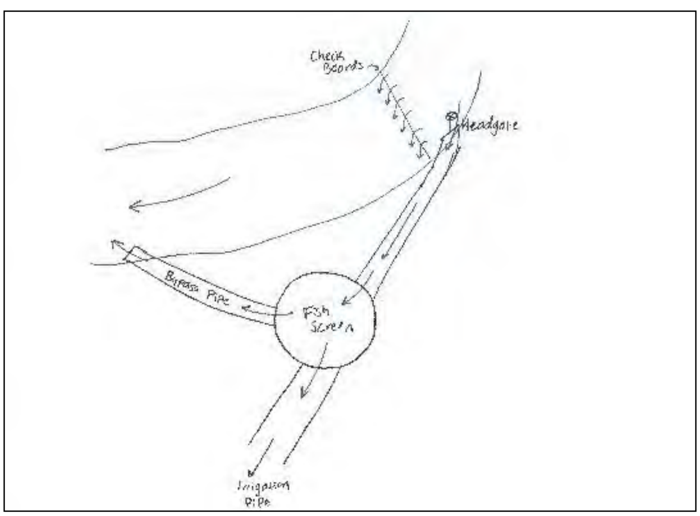


FIGURE 72. PLAN VIEW OF NEW IRRIGATION DIVERSION SYSTEM FOR NORTH FORK HORSE CREEK.

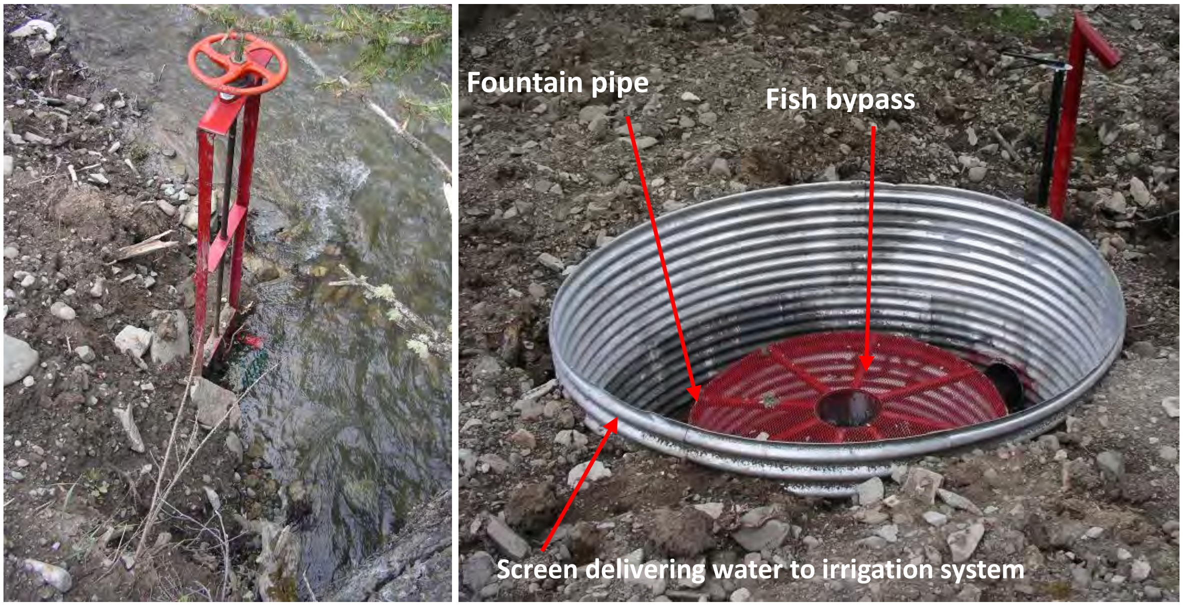


FIGURE 73. WATERMAN HEAD GATE (L) AND TURBULENT FOUNTAIN SCREEN (R) ON NORTH FORK HORSE CREEK AFTER INSTALLATION.

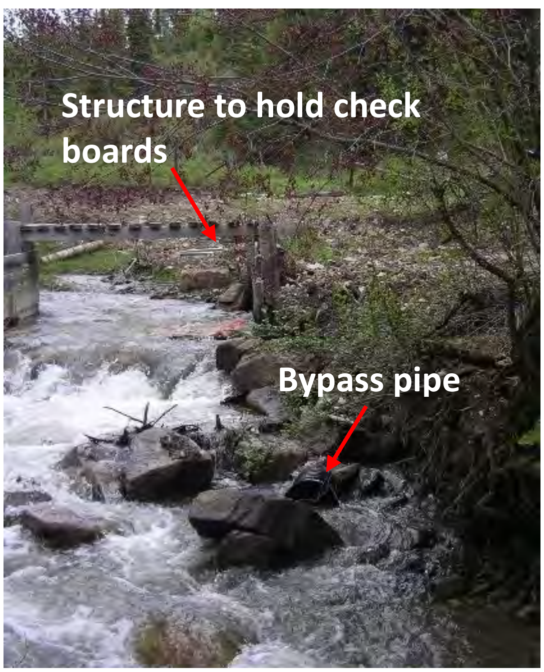


FIGURE 74. BYPASS PIPE AND STRUCTURE INSTALLED TO PLACE CHECK BOARDS TO DIVERT WATER TO HEAD GATE DURING LOW FLOWS.

Field Visit 2010 and 2017

The fish screen on North Fork Fridley Creek has been visited several times. On August 11, 2010, Carol Endicott viewed the screen while it was not in use. Some detritus had settled on the face of the screen, but no fish were impinged. The detritus may have collected as the irrigation ceased for the season and flows decreased. The absence of dead fish on the screen suggested the turbulence was sufficient to flush fish off the screen. In addition, no dead fish were present in the tank surrounding the fountain, indicating the bypass pipe has sufficient draw to move fish back to the stream.

FIGURE 75. TURBULENT FOUNTAIN SCREEN WHEN NOT IN USE (L) AND IN USE (R) ON NORTH FORK HORSE CREEK.

On June 22, 2017, Kyrsten Wolterstorff and Carol Endicott checked on the function of the screen. The turbulence was substantial and appeared to be sufficient to move detritus and fish off the screen. A substantial amount of water flowed through the bypass pipe (Figure 76). The check boards were in place and were likely a temporary barrier to fish movement.

FIGURE 76. BYPASS PIPE (L) AND CHECK BOARDS IMPOUNDING FLOWS TO DELIVER WATER TO THE HEAD GATE (R).

Conclusions

Fish screens perform the important function of preventing entrainment of fish into irrigation canals; however, they can be problematic. Turbulent fountain screens have the advantage of no moving parts, but they may be unsuitable in detritus-rich streams, abrasive to fish, and require careful design. Engineered designs are not available for this screen. Nevertheless, the landowner reported this screen has been functioning well to deliver water to the irrigation ditch for a decade and required no maintenance.

The potential for the check boards to block fish movement is another consideration. According to the FFIP application, the previous diversion had been a total barrier to fish movement. The difference with the current checking of water is that the duration of diversion was decreased by a month as a condition of funding. Instead of diverting from May 1 through July 15, the water user agreed to restrict use to May 1 through June 25, with a 10-day period of use after July 15. This timing coincides with the spawning period for Yellowstone cutthroat trout. However, flows may not be checked during much of the spawning period, as it coincides with spring runoff, when flows are elevated.

Recommendations for this project, along with the complementary actions of water savings and riparian fencing, address the opportunity to evaluate the response of the Yellowstone cutthroat trout population in North Fork Horse Creek to the cumulation of conservation actions. A follow-up fish survey would be informative. Likewise, installing a trap at the out flow of the bypass pipe on the fish screen would be useful in evaluating if fish are being bypassed, and if the screen causes injury.

Richardson Creek riparian fencing (026-97)

Introduction

Richardson Creek is a tributary in the Fourmile Creek drainage within the Castle Mountains, east of White Sulphur Springs. This project was part of a larger effort to restore riparian health and function, and stream morphology, to several streams within grazing allotments in the Lewis & Clark National Forest. Surveys conducted by U.S. Forest Service personnel found these streams to be impaired due to uncontrolled access by livestock, with 1.6 miles of Richardson Creek deemed to need recovery and protection. Riparian exclosures and development of off-stream stock water were the prescribed actions to improve function and health of these streams.

The health of Richardson Creek is of specific concern, because it supports slightly to nonhybridized westslope cutthroat trout. Westslope cutthroat trout are exceptionally rare in the upper Missouri River watershed. Risks to the westslope cutthroat trout living in the Fourmile Creek watershed include isolation, which does not allow for gene flow or recolonization following catastrophic events, and sympatry with brook trout. brook trout regularly outcompete westslope cutthroat trout, especially in headwater streams.

Available information includes pre-project photo points from 1996, matched with follow-up photos from 2005. The stream and riparian area had recovered substantially with installation of riparian fencing. Vertical eroding banks had stabilized with dense stands of sedges and willows (Figure 77). Although seasonality can bias interpretation of the photos, the stream and riparian area had recovered substantially. Herbaceous vegetation was closely cropped in the pre-fencing photo but was tall and dense after 8 years of rest. A second pair of before and after photos showed similar recovery following exclusion of livestock, with banks not showing signs of trampling, and riparian shrubs being more robust and dense (Figure 78).

FIGURE 77. PRE- AND POST-FENCING PHOTOS TAKEN ON A MEANDER BEND ON RICHARDSON CREEK, 1996 (L) AND 2005 (R).

FIGURE 78. PRE- AND POST-FENCING PHOTOS OF RICHARDSON CREEK, 1996 (L) AND 2005 (R).

Field Visit 2017

On August 3, 2017, Kyrsten Wolterstorff visited the restoration project on Richardson Creek. GPS data indicated she examined the entire length of the fenced area. The riparian exclosures were still in place, and a healthy riparian area and stable stream channel were present within the fenced area (Figure 79). A water gap between fenced areas showed indications of heavy use by livestock (Figure 80)

FIGURE 79. RIPARIAN FENCING (L) AND STREAM CHANNEL WITHIN THE RIPARIAN EXCLOSURE (R) ON RICHARDSON CREEK.

FIGURE 80. WATER GAP BETWEEN FENCED REACHES ON RICHARDSON CREEK.

Conclusions

The Richardson Creek fencing project was among the earliest projects funded under the FFIP. Marked improvements were evident in the post-project photos taken in 2005. In 2017, the fence was still in place, and functioning to limit cattle access to the stream and riparian area. Controlling livestock around streams is an effective way of improving habitat and water quality, and an effective use of FFIP funds.

Shields River bank stabilization (016-01)

Introduction

The Shields River is a major tributary of the Yellowstone River, located northeast of Livingston. The river supports a popular recreational fishery for brown trout and mountain whitefish, although low numbers of Yellowstone cutthroat trout are present in the main stem. Other native species include two species of sucker, Rocky Mountain spotted sculpin, longnose dace, and low numbers of brook trout.

Eroding banks are common on the Shields River, and the cause of bank erosion varies, with mechanical alterations to the river plan form, reduction in riparian health and function, encroachment of roads, bridges, and railroad berms contributing locally. Moreover, the Shields River has naturally high bed load supply, flashy hydrograph, and considerable recruitment of large woody debris, as much of the mainstem is within a cottonwood gallery forest. These natural factors can also exert pressure on stream banks.

This project addressed an eroding bank on the Shields River that was cutting a 7-ft high, vertical-walled terrace. Reports on the location of the eroding bank are conflicting. The FFIP database places with project in T4N R9E section 29, whereas, a professional paper prepared by a graduate student working on the project places the treated bank several miles upstream. Project photos are consistent with the FFIP database, as they show a road close to the eroding bank, and aerial photos do not show an adjacent road on the site shown in the professional paper. Nevertheless, comparisons of on-the-ground photos with aerial photos do not allow for certainty of the location of the treated bank. Because the bank could not be field verified, this report is conjectural, and an additional site visit is recommended to confirm the location and assess the success of the restoration effort.

This project used an experimental approach to bank restoration with an emphasis on bioengineered bank stabilization, augmented with temporary use of concrete blocks to allow riparian vegetation to become established over 1 to 2 growing seasons (Figure 81). The blocks were installed along the bank line, a 10-ft wide floodplain was constructed behind the blocks, the vertical terrace was sloped to a 2:1 grade. The floodplain was to be covered with locally harvested sod mats; however, only 50% of sod mats were usable, as the soils within the sod were a silty loam that lacked cohesivity. Because the sod mats were damaged and unusable, much of the area was seeded with a Timothy and orchard grass seed mix. Three hundred sandbar willow root stock were planted using a sharp shooter shovel to dig the holes. Supplemental irrigation with a small pump and hose was used to promote establishment of willows, as their roots were slightly above the water table. Three weeks after project construction, a progress report stated the willows and grasses were doing well.

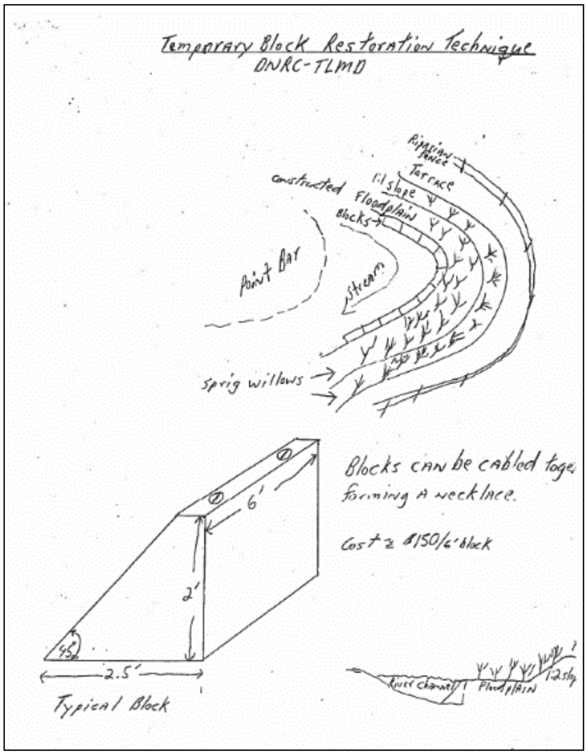


FIGURE 81. CONCEPTUAL APPROACH TO STABILIZING BANKS WITH TEMPORARY USE OF CONCRETE BLOCKS TO PROTECT THE RE-SLOPED AND VEGETATED BANK AND FLOODPLAIN UNTIL VEGETATION BECAME ESTABLISHED.

Photos from the construction show eroding banks, the constructed floodplain and the 2:1 slope to the terrace, along with installation of concrete blocks (Figure 82). The length of treated area was not reported; however, project photos indicated this bank was of considerable length.

FIGURE 82. PROJECT CONSTRUCTION PHOTO SHOWING EXISTING ERODING BANK (L) AND CONCRETE BLOCKS INSTALLED ALONG THE BANK LINE (R).

Post-construction photos show a dense mixed stand of nonnative grasses and sandbar willow adjacent to the concrete barriers (Figure 83). Apparently, a cobble toe was installed along the length of the bank treatment, as cobble extends onto the concrete and is at the toe of an eroding reach that was not covered with concrete blocks. The outer meander bend is an erosional area, not a depositional area, so it is unlikely that cobbles accumulated naturally. Neither the application nor post-project report mention installation of a cobble toe.

FIGURE 83. STABILIZED BANK ON THE SHIELDS RIVER (L) AND REMOVAL OF CONCRETE BLOCK AND INSTALLATION OF ROCK TOE (R).

Photos illustrating the removal of the concrete barriers show the barrier left a bare, vertical bank. The nonnative agricultural grasses did not provide the root mass typical of riparian species, which promote soil cohesion and resilience against erosion. A cobble toe was clearly installed as part of the project, although this action was not described in background materials or the project budget.

Background information includes photos that were apparently taken several years after removal of the concrete blocks (Figure 84). Willow survival was negligible, although the nonnative grasses had colonized the constructed floodplain. Remnants of the installed rock toe were still visible, but much of it had apparently been washed away, leaving undercut banks. As shallow-rooted, nonnative grasses line the banks, the long-term stability of this bank is questionable.

FIGURE 84. POST-PROJECT PHOTO DATED 2007

Field Visit 2017

On August 22, 2017, Kyrsten Wolterstorff and Carol Endicott visited the project site. As noted, determining the bank that had been treated was problematic. A portion of the bank considered most likely to be the treated bank supported a community of nonnative grasses and Canada thistle (Figure 85). A cobble toe was present, as opposed to the raw dirt that was present before treatment. Nevertheless, the bank had receded several feet. Large woody debris had been deposited at the site and was providing bank protection. More aggressive efforts at bank stabilization were apparent with riprap being present at the downstream end of the bank.

FIGURE 85. STREAM BANK POTENTIALLY BEING THE RESTORED BANK (L) AND BANK ARMORING AND LARGE WOODY DEBRIS (R)

Looking upstream at the putative restored bank, reed canary grass had invaded the riparian area (Figure 86). This nonnative species is exceptionally invasive and hard to control. Although it functions to maintain bank stability, it does not provide the same ecological values as a native shrub community.

FIGURE 86. REED CANARY GRASS INFESTATION ALONG PUTATIVELY RESTORED BANK.

Conclusions

Uncertainty as to which bank was the subject of restoration confounds determining the effectiveness of the approach to stabilize eroding banks. Survey of a considerable length of Shields River within the designated property, and examination of aerial and on-the-ground photos did not confirm with certainty that the area evaluated was the bank shown in Figure 82. Although not included as part of this project, the riparian area was fenced, so disturbance from livestock was no longer altering banks, which would promote natural recovery.

Conclusions on the suitability and expense of using concrete blocks to provide temporary protection are possible with the available information. Notably, the FFIP application and project completion letter include scope and budget for installation and removal of concrete blocks as the only armoring occurring in this project; however, project photos show installation of a substantial cobble toe along the bank margin and potentially along the row of concrete blocks. Consequently, bank recovery cannot be attributed to the use of concrete blocks, as a rock toe was installed to protect the vertical, dirt banks formed by the blocks. The cobble may have been obtained locally; however, it still would need to be transported to the bank and installed with an excavator, which would substantially increase costs.

The project claimed to be a bioengineered approach; however, the concrete blocks are not consistent with bioengineered bank restoration in current practice. Construction of a floodplain bench adjacent to an eroding terrace is a common approach used currently; however, aggressive bank armoring, such as was employed in the project, is not. Projects vary in their use of toe armoring and erosion control fabric, and these are site specific, and based on hydrologic modeling and magnitudes of floods of selected recurrence intervals. Each bank restoration project faces the risk of a flood disturbing the restored bank before vegetation has the time to become established. Stream practitioners must weigh risks of failure against over-armoring banks, so that they are not deformable. A substantial risk with the concrete block approach is that the stream can cut behind the row of block and flush away the new floodplain.

A final consideration in evaluating this process is whether a 310 permit could be obtained for installing concrete blocks for the duration described in the application. Concrete blocks or Jersey barriers may be placed in stream channels during the irrigation season to funnel water towards a diversion. Nevertheless, they must be removed when irrigation ceases for the season. This approach is likely illegal under Montana Natural Streambed and Land Preservation Act, or 310 law.

In conclusion, the experimental use of concrete blocks in providing temporary protection of recently constructed and vegetated floodplain benches would likely have been unsuccessful without supplemental installation of the substantial rock toe. The concrete blocks left the face of the bank highly susceptible to erosion. Furthermore, bank armoring of this degree has the potential to force flood flows to jump behind the concrete blocks. Finally, seeding with shallow-rooted nonnative grasses would do little to promote bank stability.

Shields River and Elk Creek fencing (053-98)

Introduction

This project was initiated by the Upper Shields Watershed Association and Park Conservation District on the behalf of numerous landowners on the Shields River near Wilsall, and Elk Creek, a small tributary. The Shields supports Yellowstone cutthroat trout and a popular recreational fishery for brown trout and mountain whitefish, in addition to other members of the native fish assemblage. Elk Creek supports a population of nonhybridized Yellowstone cutthroat trout.

The project was a relatively large-scale effort to implement best management practices (BMPs) associated with cattle production on several ranches. BMPs included installation of riparian fencing along 2 miles of the Shields River and establishment of stock water in the uplands. The goals were to recover the health, vitality, and vigor of the riparian areas, reduce sediment loading to the Shields River and Elk Creek, protect natural fluvial processes, and improve private property values, while accommodating agricultural land uses adjacent to these streams.

Across these properties, more than 800 cattle and other livestock grazed the riparian zones. Pre-project photos of the Shields River portion of the project are limited. One photo shows portion of a mature cottonwood gallery forest with closely cropped grasses and livestock within the riparian area (Figure 87). The second photo is an overview of the portion of the Shields River used as winter pasture. Determining the influence of livestock throughout the project area is not possible from these photos. The lack of an extensive photographic record of pre-project conditions is common with projects that predated common use of digital cameras and limits the ability to demonstrate recovery. Nevertheless, 800 cattle can exert considerable pressure on riparian areas, stream banks, and channel morphology, so substantial disturbance and degradation was likely.

FIGURE 87. PRE-PROJECT RIPARIAN AREA FOR IMPLEMENTATION OF BEST MANAGEMENT PRACTICES.

FIGURE 88. PORTION OF SHIELDS RIVER USED FOR WINTER PASTURE.

Other photos are dated 2000 and 2002, and document conditions soon after implementation of BMPs. Photos include documentation of a stock tank (Figure 89). Photos are that are likely from Elk Creek show variable conditions, with healthy reaches, areas where the channel was overly wide and devoid of riparian shrubs (Figure 90), and a reach with considerable down cutting and an exposed, highly erodible terrace. Historically, beavers likely had considerable influence on Elk Creek, and much of the stream was impounded by beaver dam complexes. Near extinction of beavers in the mid-1800s removed their influence on streams across the landscape of the West. These streams tend to be especially susceptible to channel down-cutting, as beaver dams trapped sediments for millennia, resulting in fine-grained banks that are susceptible to erosion and head-cutting.

FIGURE 89. STOCK TANK INSTALLED AS PART OF BMPS FOR THE SHIELDS RIVER AND ELK CREEK PROJECT (L) AND HEALTHY RIPARIAN AREA AND INTACT STREAM MORPHOLOGY ON ELK CREEK IN 2002 (R).

FIGURE 90. OVERLY WIDE CHANNEL, BANK EROSION, AND RIPARIAN DEGRADATION (L) AND CHANNEL DOWNCUTTING (R) ON ELK CREEK IN 2002.

The Shields River is more resilient to disturbance than Elk Creek, as its cobble bed is not susceptible to vertical adjustments, and cobbles in the stream banks make them more resilient to trampling. Photos from 2002 show a mature cottonwood gallery forest, but little recruitment of cottonwoods from suckering and a lack of riparian shrubs (Figure 91). Another photo from 2002 shows a bank devoid of riparian vegetation, vegetated with closely cropped grasses, which suggests continued, heavy use by livestock.

FIGURE 91. FENCED REACH OF THE SHIELDS RIVER IN 2002.

Field Visit 2017

Kyrsten Wolterstorff walked reaches of fenced stream on 3 properties on the Shields River but did not access the Elk Creek portion of the project. She walked the entire reach of each property and interviewed two of the landowners.

Property 1

Kyrsten evaluated this portion of the project on August 17, 2017 and mapped the fencing and stock watering devices installed through this project (Figure 92). Riparian fencing was installed on the east side of the river. The west side was not fenced but did not appear to be grazed. The landowner reported he was currently grazing 20 heifers in the riparian area.

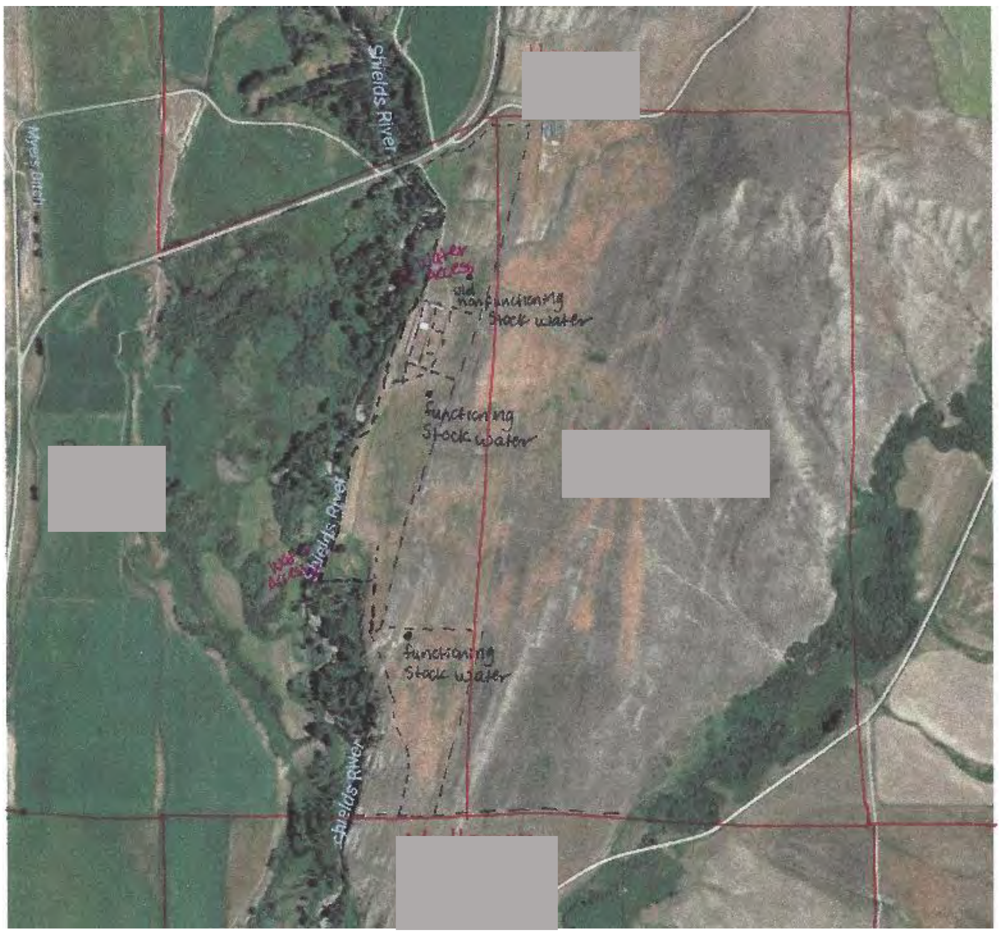


FIGURE 92. AERIAL VIEW OF THE PROPERTY AT THE DOWNSTREAM END OF THE PROPERTY. THE RED LINE EAST OF THE RIVER SHOWS THE EASTERN EXTENT OF THE PROPERTY.

The fence was in good condition, and grazing pressure within the riparian area was light. Much of the riparian area was within a mature cottonwood gallery forest; however, shrubs and cottonwoods were recruiting on point bars (Figure 93). Owing to the substantial bed load supply, the channel was braided in some areas, but occupied a single thread in others. Dense riparian understory was present and afforded high quality habitat for wildlife (Figure 94). A hay field encroached on the stream bank on the west side of the river, and banks were calving due to lack of root protection, the cobble toe provided some protection against erosion.

FIGURE 93. VIEW OF FENCED SECTION OF THE SHIELDS RIVER SHOWING RECRUITMENT OF WOODY VEGETATION ON POINT BARS (L) AND ON THE SHIELDS RIVER PROPERTY 1.

FIGURE 94. RIPARIAN AREA WITH DENSE UNDERSTORY (L) AND HAY PASTURE ON WEST BANK OF RIVER AND BANK EROSION (R).

The landowner reported the fence worked well in allowing him to manage grazing within the riparian area. The off-channel stock tanks have been problematic, with 1 failing, and others going out intermittently. He installed stanchion type water access points to provide stock water when the tanks are not working. He lost 7 calves with failure of a stock tank, and said they are costly to run.

Property 2

The next property was adjacent to property 1, with a bridge over the Shields River being the boundary (Figure 95). The fencing was installed and functional. Cattle had access to the river in some sections, as evidenced by slight hoof sheer and manure, but they were not having a negative effect on riparian vegetation, stream banks, or channel stability. Fish were abundant in this reach. Other species of wildlife included kingfishers, assorted songbirds, a long-eared owl, and boreal toads. Canada thistle was abundant, and knapweed and reed canary grass were also present.

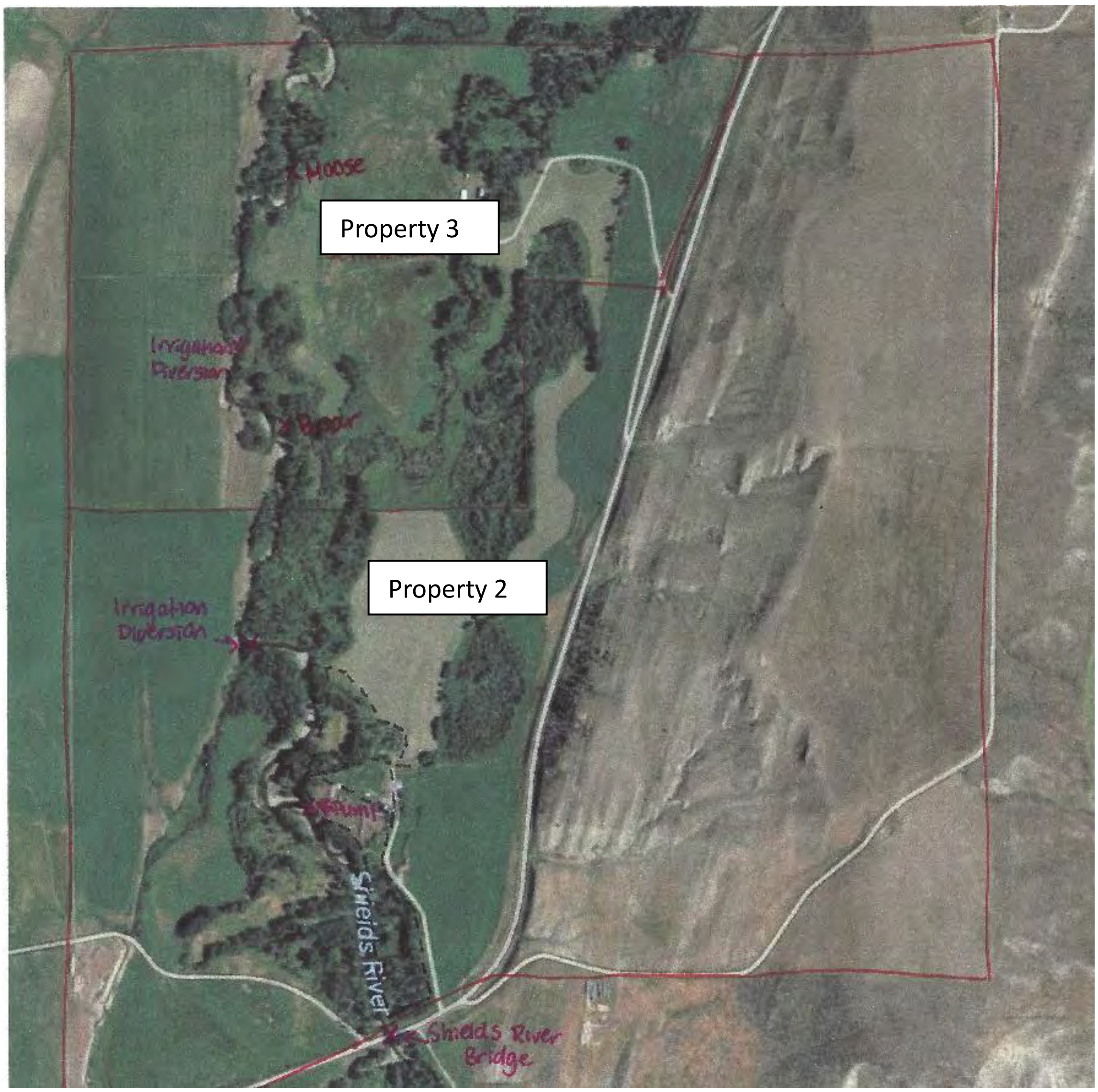


FIGURE 95. PROPERTIES 2 AND 3 ON THE SHIELDS RIVER.

The Shields River flows through a cottonwood gallery forest and is single thread throughout the property (Figure 96). An old attempt at bank stabilization using riprap was only partially protecting the stream, as the channel had moved away from a considerable length of the applied rock. Although not locally derived, the streambed was heavily silted throughout the reach (Figure 97). The Shields River is listed as impaired for siltation by the Department of Environmental Quality, and the watershed group has a plan to reduce sediment loading from bank erosion, hill slope erosion, and roads.

FIGURE 96. TYPICAL VIEW OF PROPERTY 2 (L) AND OLD RIPRAP THAT WAS NO LONGER NEAR THE CHANNEL.

FIGURE 97. SILTATION OF THE SHIELDS RIVER'S STREAMBED.

Property 3

Although fencing and development off-stream stock water benefited the length of the Shields River treated in this project (Figure 95), Kyrsten observed this reach to have the best habitat of all the reaches (Figure 98 and Figure 99). The channel was stable, had high quality pools with large woody debris. Some light browse was present, but no signs that cattle accessed the stream. The landowner does not produce livestock but does grow irrigated hay. Localized infestation of reed canary grass was the only feature that detracted from the functions and values of the riparian area. Similarly, the streambed was heavily silted; however, the fine sediment was likely contributed from upstream sources.

The landowner was enthusiastic about the portion of river flowing through his property, and its ecological and recreational values. He stated the fishing was phenomenal and was continually improving. He claimed he caught mostly Yellowstone cutthroat trout of considerable size. Field observations indicated high quality for wildlife in general, with presence and sign of moose, black bear, and plentiful white-tailed deer. Chokecherries were abundant and providing an important late summer food source for bears and birds.

FIGURE 98. HIGH QUALITY POOL, WITH LARGE WOODY DEBRIS AND RECRUITMENT OF WOODY VEGETATION ON RECENT ALLUVIAL BARS.

FIGURE 99. SHIELDS RIVER WITH MIXED CONIFER AND COTTONWOOD OVERSTORY (L) AND INFESTATION OF REED CANARY GRASS (R) ON PROPERTY 3.

Conclusions

The project was among the earliest funded through the FFIP, and is often the case with these early projects, baseline information is limited. Few photos are available, and no narrative description of site conditions exist, which limits the ability to describe the extent to which the river and riparian area responded to implementation of BMPs. Nevertheless, 800 cattle with full access to the stream likely reduced vegetated cover, limited recruitment of woody species, trampled banks, and otherwise contributed to loading of nutrients and sediment. Evidence of use by livestock is limited or unapparent within the project area, and the stream and riparian area are typical of a healthy valley river. Invasion of reed canary grass and siltation were the only obvious deviations from an unaltered state. Wildlife thrived within this portion of the Shields River, which is a testament of the stewardship of the landowners involved in the project.

The failure of some of the stock tanks is of concern. It is unclear how water was delivered to the tanks and the reason for failure. Technical assistance through the NRCS is recommended for future projects to ensure stock tanks are using the latest technology and are unlikely to fail. Loss of calves to inoperable stock tanks is unacceptable.

The high levels of fine sediment on the streambed in this portion of the Shields River does not appear to be the result of local contributions of fine sediment or related to decreased sediment transport capabilities because of an overly wide channel. The headwaters of the Shields River are naturally rich in fine sediment, and sources of sediment loading from human activities have been identified and their relative contributions have been estimated. This reach is downstream of 2 5th-code watersheds that are in the top 10 contributors for sediment loading from stream banks, according to the watershed restoration plan developed for the Shields River watershed. Future restoration planning should focus on approaches to decrease sediment loading, as it will be beneficial to this reach of the Shields River, as it has high aesthetic, recreational, and conservation values.

South Fork Fridley fish ladder (047-03)

Introduction

South Fork Fridley Creek is a tributary of the Yellowstone River located upstream of Emigrant in Paradise Valley. An irrigation diversion that used check boards to divert its flows into an irrigation canal was a barrier to upstream movement of fluvial spawners (Figure 100). The solution was to replace the existing diversion with a similar diversion equipped with a Denil fish ladder, constructed in 2008. The ladder was constructed with cast concrete, with wooden baffles installed at 45° angles.

FIGURE 100. IRRIGATION DIVERSION ON SOUTH FORK FRIDLEY CREEK.

FIGURE 101. NEWLY CONSTRUCTED FISH LADDER (L) AND WOODEN BAFFLES (R) ON SOUTH FORK FRIDLEY CREEK

Soon after construction was completed, South Fork Fridley Creek experienced a flood of significant magnitude. Emergency riprap was installed to keep the stream from cutting around the new structure. This flood also embedded the baffles with cobble, making them impossible to remove without mechanical assistance.

The water user leaves the boards in until July 4 in most years, and the Yellowstone cutthroat trout spawning run usually extends beyond that date. Yellowstone cutthroat trout were observed spawning upstream of the ladder on July 24, 2009, so the stream has potential to be a source of recruitment of Yellowstone cutthroat trout fry, when the check boards are out.

Monitoring 2017

Assessment of the South Fork Fridley fish screen included visual inspection of the ladder, installation of a trap to capture fluvial fish ascending the ladder, and trapping fry out-migrating downstream of the fish ladder. The Denil fish ladder was designed according to the established standard, with closely spaced baffles that create turbulence that dissipates energy. Visual inspection of the ladder found highly turbulent water; nevertheless, the velocity appeared to be substantial in the ladder and may exceed the burst swimming ability of fish. Other observations were that cobbles had embedded the baffles, which are now immobile. In addition, the baffles are wooden and have swollen. Digging out the cobbles or using a mechanical winch may be advisable to reset the baffles. A second set of baffles is stored at the Livingston Fisheries Office; however, metal baffles may be an improvement, as they would not swell, and may be easier to extract in cleaning the ladder, despite their greater weight.

FIGURE 102. DENIL FISH LADDER ON SOUTH FORK FRIDLEY CREEK.

Kyrsten operated a fish trap at the upstream end of the ladder to see if fish were using it to access South Fork Fridley Creek. The trap was in place beginning in June and was pulled at the end of the irrigation season around July 4, 2017.

Conclusions

The ability for fish to pass through the South Fork Fridley fish ladder is questionable. The diversion is in operation until around July 4th each year, and rainbow trout and Yellowstone cutthroat trout can be expected to move into spawning streams in this time. The lack of fish captured at the upstream end of diversion suggests fish cannot swim through the ladder, or they are not attracted to the ladder. Flows through the ladder may be a velocity barrier, and perhaps the cobbles filling the bottom are preventing the baffles from providing sufficient turbulence to provide areas with slower moving water. Nevertheless, Yellowstone cutthroat trout have been seen spawning in South Fork Fridley Creek, so fish are accessing the stream when the check boards are out.

Recommendations include clearing the cobble and removing the baffles to check their condition. Another set can be installed if they are damaged. In addition, personnel with expertise in fish passage should evaluate if the ladder is passable in its current condition.

South Fork Ross Creek habitat and wetland enhancement (018-07)

Introduction

South Fork Ross Creek is a small spring creek that flows into Smith Creek, a tributary of the East Gallatin River. This portion of the Gallatin River watershed is rich in spring creeks, and these streams have considerable potential ecological value. Spring creeks are summer cool and winter warm, and often maintain a thermal regime that is ideal for growth of salmonid fishes year-round. Likewise, spring creeks help maintain cooler temperatures in their receiving waters through their surface flow and groundwater contributions, which is important during late season low flows and may help these streams be resilient to our changing climate. Spring creeks can provide high quality spawning streams.

Spring creeks often have high recreational value. Fish can grow large in their cool, productive waters. Game species may move into spring creeks seasonally to escape warmer waters in neighboring free-stone streams.

South Fork Ross Creek and a small, unnamed tributary were the subject of several restoration actions to improve fisheries values, transport fine sediment, provide for fish passage, and increase in-stream flows. Application materials indicated livestock grazing, dewatering, and beavers had increased the amount of fine sediment in South Fork Ross Creek and its tributary. Proposed actions included regrading 1,430 feet of South Fork Ross Creek and 1,000 feet of its tributary, restoring a natural plan form, and narrowing and deepening the channel. Installation of sod mats would create banks in the reconfigured and deepened channel. A 100 to 300-ft buffer would be established between the stream and agricultural activities, primarily hay production.

Accumulations of one to three feet of fine sediment on the streambed was a primary concern, and increasing the sediment transport capacity of the channel, by narrowing and deepening the channel would improve holding and spawning habitat. Pre-project photos are unlabeled, so interpretation is conjectural. Nevertheless, South Fork Ross Creek appeared to be relatively overly wide, with heavy siltation of the streambed (Figure 103). Other photos showed highly turbid flows or a poorly defined channel, suggesting relatively recent use by livestock, or inadequate stream flow for channel maintenance. Nevertheless, thick sedges maintained stable banks, and mature willows were present.

FIGURE 103. SOUTH FORK ROSS CREEK PRE-PROJECT VIEW (L), TURBIDITY (C), AND HUMMOCKY, POORLY DEFINED CHANNEL.

Photos presumably of the unnamed tributary show sedge covered stream banks and variability in channel width (Figure 104). Willows were rare to absent along the channel. Formation of a sedge covered, mid-channel bar suggested insufficient energy to maintain a narrow, deep E channel that is typical of spring creeks.

FIGURE 104. UNLABELED PHOTO POTENTIALLY SHOWING UNNAMED TRIBUTARY.

Field Visit 2017

On August 4, 2017, Kyrsten Wolterstorff visited the South Fork Ross Creek project site, accompanied by the landowner. The channel had reverted to its overly wide configuration, and accumulation of fine sediment was again substantial (Figure 105). A robust stand of undisturbed sedges occupied the bank line, so lateral adjustments were not the result of bank erosion. Fine sediment did not fill in the entire channel, as a discrete reach maintained clean gravel (Figure 105).

FIGURE 105. OVERLY WIDE CHANNEL (L), ACCUMULATION OF FINE SEDIMENT (C), AND EXPOSED GRAVEL (R) ON RESTORED PORTION OF SOUTH FORK ROSS CREEK.

The photographic coverage of post-treatment of the unnamed tributary of South Fork Ross Creek is limited and does not provide information on substrate or channel dimensions. Field notes indicate horses have access to this stream, and channelization and down-cutting is present upstream of the project area.

The landowner reported that in a few years after restoration, he witnessed considerable use of South Fork Ross Creek by spawning fish. The stream morphology reverted to pretreatment conditions within a few years. Despite the failure of this project to secure high quality spawning and holding habitat for fish, wildlife benefited, especially waterfowl.

Conclusions

Spring creek restoration presents challenges, and these projects have often not been an effective use of FFIP funds and have not resulted in a sustained high-quality spring creek habitat. Reasons for the lack of success of these projects remain conjectural; however, the pliability of sedge dominated banks may be related. Historically, spring creeks were groundwater fed, and irrigation return flows were not a factor in their hydrology. A cause of the retreat of sedge-dominated banks is that irrigation return flows augment late season flows, and push the pliable banks laterally, thereby decreasing depth and increasing width.

As the FFIP and other funding sources have contributed substantially to spring creek restoration, and these streams have high ecological and conservation value, approaches to spring creek restoration need thorough review, application of an adaptive approach, where stream restoration practitioners learn from successes and failures.

Thiel Creek fish barrier (021-07)

Introduction

Thiel Creek is a small stream flowing north from the foothills of the Beartooth Mountains, until its confluence with West Red Lodge Creek. The goal of this project was to protect a nonhybridized population of Yellowstone cutthroat trout in Lower Deer Creek, which is about 30 miles northwest of Thiel Creek. In 2006, the Derby Fire burned much of the Lower Deer Creek watershed. The severity of the burn was sufficient to cause fisheries managers to plan for potential mass wasting and ash flows that could extirpate Yellowstone cutthroat trout from Lower Deer Creek.

The goal was to secure a subpopulation of Yellowstone cutthroat trout from Lower Deer Creek in another location, and these fish could be used to repopulate Lower Deer Creek if catastrophic disturbance extirpated the stream's fish. Thiel Creek was selected as the sanctuary for brood stock, as a small, relatively inexpensive barrier could be constructed, and the site was easily accessible by road.

Thiel Creek is relatively low gradient and located within an unconfined valley. Ideally, a barrier construction site is constrained laterally by rock walls, which prevent the stream from cutting around the structure at high flows. The risk to Lower Deer Creek's Yellowstone cutthroat trout population offset concerns for the potential for the barrier to fail during floods, as it was needed to be functional for a few years, although reestablishment of a Yellowstone cutthroat trout in Thiel Creek would be also be a desirable outcome, if the barrier survived over the long-term. The design called for a concrete barrier to span the Thiel Creek's floodplain (Figure 106). A metal apron would prevent formation of a scour pool downstream of the barrier. The structure was to be a leap barrier over most flows.

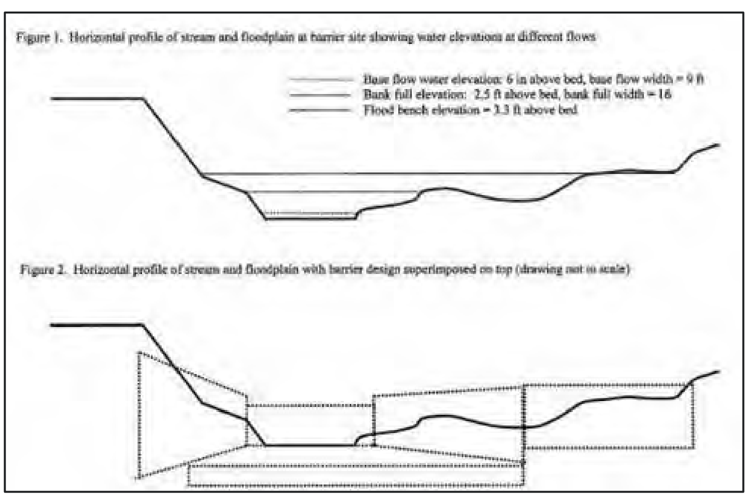


FIGURE 106. CONCEPTUAL DESIGN FOR THE THIEL CREEK BARRIER.

Thiel Creek supported an abundance of brook trout, and this species is incompatible with Yellowstone cutthroat trout. Before introduction of Yellowstone cutthroat trout salvaged from Lower Deer Creek, a substantial brook trout removal effort occurred upstream of the barrier, with over 3,000 brook trout removed from two miles of stream and placed downstream of the barrier. Yellowstone cutthroat trout from Lower Deer Creek were stocked upstream of the barrier in 2007.

Subsequent electrofishing efforts indicated Yellowstone cutthroat trout did not stay in Thiel Creek. Thiel Creek is a small, gravel-bed stream flowing through rangeland (Figure 107), and Lower Deer Creek is a montane stream with a predominantly cobble substrate (Figure 107). As the habitat in Thiel Creek was considerably different than Lower Deer Creek, the Yellowstone cutthroat trout likely left. Efforts to establish or reestablish Yellowstone cutthroat trout since this project has used egg boxes or remote site incubators, so fry become imprinted on the new stream.

FIGURE 107. TYPICAL VIEW OF THIEL CREEK UPSTREAM FROM THE CONSTRUCTED BARRIER (L) AND OF LOWER DEER CREEK (R).

Field Visit 2017

Kyrsten Wolterstorff and a field crew went to the Thiel Creek barrier on June 21, 2017. Their objectives were to determine the condition of the barrier and sample fish upstream. The electrofishing effort upstream of the barrier yielded only brook trout, reconfirming the attempt to establish a population of Lower Deer Creek outside of their natal watershed was unsuccessful.

The fish barrier was present (Figure 108); however, it is in disrepair. Concrete on the right side of the barrier was crumbling. In addition, Kyrsten observed the potential for large flows to cut around the left side of the barrier. Otherwise, the barrier was built as described in the FFIP application, with exception that the apron was concrete, not metal, as proposed in the application.

FIGURE 108. THE THIEL CREEK FISH BARRIER (L) AND CRUMBLING CONCRETE ON THE RIGHT SIDE OF THE BARRIER (R).

Conclusions

The Thiel Creek barrier was built according to the specifications described in the FFIP application, except that a concrete apron was installed in place of a metal apron. The goal of securing Yellowstone cutthroat trout outside of the Lower Deer Creek was unsuccessful. The trout apparently left soon after being transferred to Thiel Creek. The substantial differences in habitat and water chemistry may have caused the translocated fish to find the habitat unsuitable. Recent efforts at translocating cutthroat trout to new waters use egg boxes or remote site incubators, so the fry are imprinted on that stream.

Currently, the barrier is not benefiting fish. It is likely detrimental to the resident brook trout, as it blocks movement. Moreover, it is in disrepair and has potential to fail, with the left side being vulnerable to erosion, and the right side experiencing damage. Its location in open rangeland make it considerably less secure than a barrier confined by rock walls. FWP biologists in Region 5 should reexamine the need for this structure, evaluate the risk of its failure, and consider alternative uses, should it be reparable and secured. Mechanical removal of brook trout was unsuccessful in Thiel Creek, and its dense shrub cover would likely impede additional removal efforts. If reestablishment of a population of Yellowstone cutthroat trout is desired, chemical removal of brook trout would likely be necessary. Thiel Creek provides about seven miles of stream habitat upstream of the barrier, which exceeds the recommended minimum of five miles of habitat to promote long-term persistence of an isolated population.

Thompson / Story Creeks riparian protection (022-07)

Introduction

Thompson Creek is a spring creek that flows north from Belgrade to its confluence with the East Gallatin River. It flows mostly through irrigated hay pasture and rangeland, and livestock grazing had resulted in degradation of riparian health and vigor, and bank erosion. Unfortunately, no photos are available to illustrate the pre-project state of the stream and riparian area; however, an aerial photo details the plan for fencing and water access points. A similar project was slated for neighboring Story Creek; however, we were unable to contact the landowner.

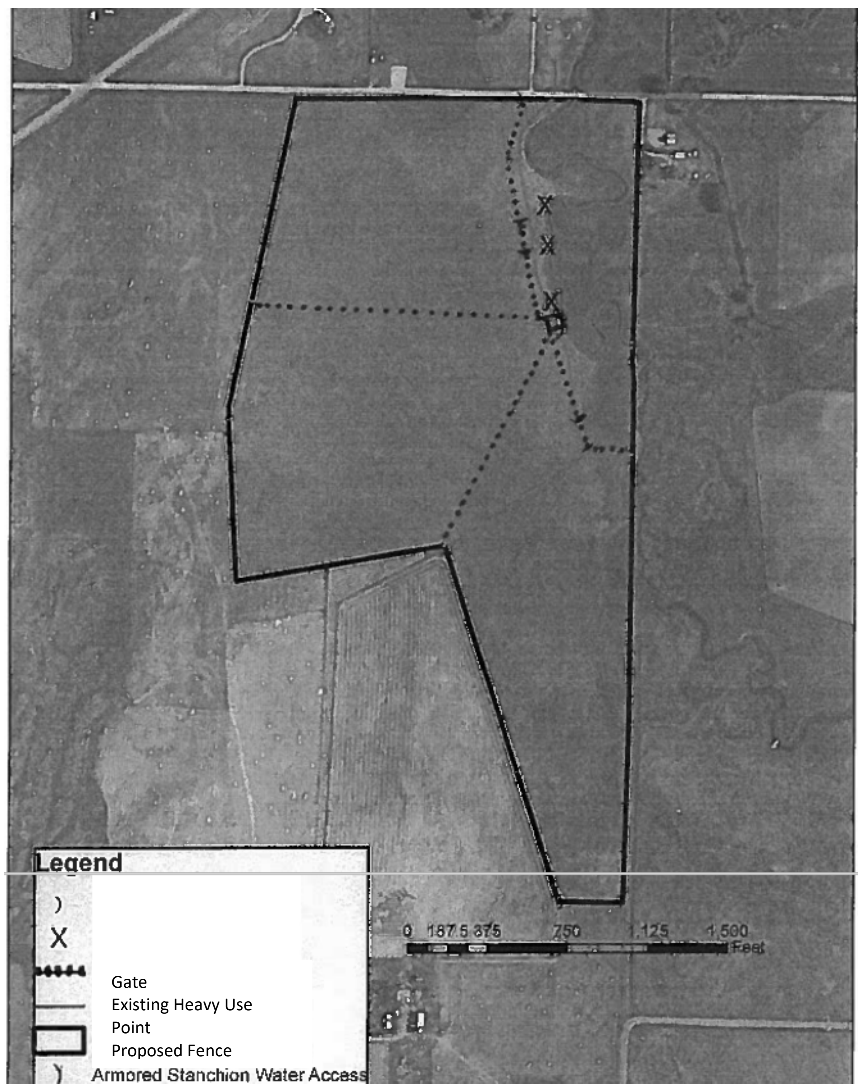


FIGURE 109. AERIAL PHOTO OF PLAN TO CONTROL LIVESTOCK AROUND THOMPSON CREEK.

The goal of the project was to protect Thompson Creek's riparian area and stream channel. Thompson Creek is a tributary of the East Gallatin River, and improving stream habitat could be beneficial to spawners migrating from the East Gallatin River.

Field Visit 2017

Kyrsten Wolterstorff visited the Thompson Creek project on August 8, 2017. The riparian area was fenced (Figure 110), although not according to the FFIP application. Some hoof shear and manure were present, but grazing pressure was otherwise light.

FIGURE 110. RIPARIAN FENCING (L) AND SLIGHT TRAMPLING BY LIVESTOCK (R) ON THOMPSON CREEK.

Armored water gaps had been installed as described in the FFIP application (Figure 111). Although it was unclear if the grazing followed a developed grazing management plan, the combination of fencing, water gaps, and limited use of the riparian area resulted in dense herbaceous vegetation within the riparian area. Shrubs were sparse to absent; however, many spring creeks do not provide habitat suitable for establishment of riparian shrubs.

FIGURE 111. ARMORED WATER GAP ON THOMPSON CREEK.

The amount of fine sediment choking the streambed was a factor limiting the ability of Thompson Spring Creek to meet project goals of providing spawning habitat for fish migrating from the East Gallatin River (Figure 110 and Figure 112). The channel was relatively shallow and wide. Combined with the buffered flows typical of spring creeks, the stream lacks the energy to transport fine sediment from its bed.

FIGURE 112. THOMPSON CREEK'S STREAMBED, SHOWING HIGH LEVELS OF FINE SEDIMENT AND SPARSE GRAVEL.

Conclusions

This project demonstrates the effectiveness of fencing and establishing protected water sources for cattle in promoting riparian health and reducing erosion, and the general failure of many spring creek projects to meet the goals of providing high quality habitat and spawning. Although Thompson Spring Creek is unlikely to be a source of recruitment of trout to the East Gallatin River, controlling livestock near the stream has likely reduced sediment and nutrient loading. The benefits extend to the East Gallatin River, which is on DEQ's list of impaired waters for sediment and nutrients.

Willow Creek channel restoration (024-11)

Introduction

Willow Creek is a small unmapped spring creek near Silver Gate, Montana. Long-time residents reported an impressive spawning run of Yellowstone cutthroat trout from Soda Butte Creek and likened the activity to salmon runs in Alaska. The run collapsed in the years following the 1988 wildfires that burned in and around Yellowstone National Park. The steep, adjacent hillslopes were severely burned, and erosion following the fire resulted in loading of fine sediment that exceeded this small stream's ability to transport. Yellowstone cutthroat trout still spawned in the stream, but only in isolated areas where width, depth, and gradient allowed for exposed gravel. The community, the Beartooth Alliance, and the Magic City Fly Fishers were instrumental in raising awareness and funds to restore Willow Creek's spawning run of Yellowstone cutthroat trout.

The stream flows through residences and business in Silver Gate. For much of its length, the riparian area was functioning and healthy, but the channel was overly wide, and the streambed mucky (Figure 113). Dense stands of aquatic macrophytes further trapped and held sediment. The reaches that still supported spawning were considerably more narrow, deep, and had a gravel substrate (Figure 114). Although the impressive runs were gone, Yellowstone cutthroat trout still spawned in Willow Creek, and it supported some resident Yellowstone cutthroat trout.

FIGURE 113. VIEW OF WILLOW CREEK SHOWING THE OVERLY WIDE CONFIGURATION TYPICAL OF MUCH OF THE CHANNEL (L) AND POOR SPAWNING HABITAT.


FIGURE 114. REACH OF WILLOW CREEK USED FOR SPAWNING (L) AND SPAWNING YELLOWSTONE CUTTHROAT TROUT.

The restoration approach was to excavate the channel 1-ft deeper than the desired bed elevation, construct a narrow and deep channel, using straw wattles at the edge of the banks. The muck excavated from the existing channel was placed behind the wattles and planted with container stock of sedges and rushes (Figure 115). Much of the muck substrate appeared to be soot delivered from the surrounding hillsides after the 1988 wildfires. Spawning size gravel was imported to the stream, and was one foot deep, providing substantial depth for Yellowstone cutthroat trout to dig redds. Several culverts were replaced with larger, squashed pipes to improve flow and sediment conveyance. Restoration occurred in May of 2013.

FIGURE 115. NEW BANK BUILT WITH STRAW WATTLE AND BACK FILLED WITH SEDIMENT EXCAVATED FROM CHANNEL.

Field Visit 2017

Carol Endicott and Kyrsten Wolterstorff visited Willow Creek on August 24, 2017. Beavers had impounded the upper 70 feet of channel (Figure 116). Otherwise, the channel had retained its constructed dimensions (Figure 117). Substantial amounts of fine sediment had accumulated in some areas; however, significant portions had clean gravel that was suitable for spawning. No fish were observed in Willow Creek; however, Soda Butte Creek had been treated with rotenone in 2015, as part of a Yellowstone cutthroat trout conservation effort aimed at eradicating invasive brook trout. Nevertheless, locals reported few sightings of Yellowstone cutthroat trout in Willow Creek after construction, and the ability of fish to swim into Willow Creek from Soda Butte Creek was questioned, given a substantial drop near the confluence, and accumulation of a large cobble bar in Soda Butte Creek upstream of the confluence. The abrupt change in channel grade was noted during a previous visit; however, Willow Creek's slope towards Soda Butte Creek was gradual during the site visit.

FIGURE 116. BEAVER IMPOUNDED REACH OF WILLOW CREEK.

FIGURE 117. TYPICAL REACH OF WILLOW CREEK, RETAINING ITS CROSS-SECTIONAL DIMENSIONS (L) AND GRAVEL SUBSTRATE (R).

Conclusions

Willow Creek is one of the few spring creek restoration projects assessed over the past 2 years that has not shown substantial changes in width and depth of the restored channel. Moreover, although fine sediment was present at levels higher than desirable, the streambed was a marked improvement from the muck dominated bed that had been in place.

Yellowstone cutthroat trout had 2 years to return to Willow Creek to spawn before application of piscicide, and some of the salvaged fish were returned to Willow Creek. Nevertheless, the low number of Yellowstone cutthroat trout following the piscicide project means their apparent absence is because the stream is inaccessible, or the habitat is unsuitable. Continued monitoring as the fishery recovers, and imprinting Yellowstone cutthroat trout on Willow Creek using remote site incubators may jump start the return of a spawning run to Willow Creek.

YCT-I MONITORING CONCLUSIONS

Projects evaluated in 2017 included a range of types of project including providing for fish passage, controlling cattle’s access to streams and riparian areas, bank and stream restoration, and increasing water use efficiency to maintain in-stream flows. Success was variable among projects, and in some cases, additional evaluation or modifications are warranted.

Projects that exclude or limit livestock from streams and riparian areas continue to be effective ways to promote riparian health and function, maintain high quality habitat for fish, and reduce loading of pollutants. These simple and relatively low costs projects are repeatedly shown to be effective and FFIP funds are well spent on these projects.

Fish passage projects varied in their success. FFIP provided funds for a fish ladder and Waterman gate on an irrigation diversion on Cottonwood Creek in the Shields River watershed; however, these elements were not installed, in violation of the agreement signed by the landowner. This unfortunate case emphasizes the need to have sound verification that the project was instructed according to the agreement before the landowner is paid. Fish passage on North Fork Fridley Creek was successful in allowing fluvial rainbow trout to access the stream under the Park Canal siphon. Future monitoring should coincide with the Yellowstone cutthroat trout spawning period. The ability for fish to pass through the Denil ladder on South Fork Fridley Creek. The end of irrigation diversion on this stream may precede the Yellowstone cutthroat trout spawning run; however, the absence of rainbow trout from the traps suggest it is not passable. Additional investigation on water velocity and hydraulics is warranted.

Bank restoration projects varied in success. The bioengineered approach using coir fabric, seeding, willow sprigging, and installation of rock toes were successful on the East Gallatin River. Nevertheless, bank restoration technology continues to evolve, and projects should follow adaptive management by evaluating a wide variety of approaches that succeeded or failed. Juniper revetments are a technology that has a high probability of failure. The project on the Shields River that used concrete blocks as a temporary means to maintain bank stability left a vertical bare bank and required installation of a rock toe. In general, stream restoration practitioners should emphasize natural channel design with the degree of armoring at the toe of the bank balance the need for deformability against the risk for failure.

Spring creeks have potential for high ecological value, with thermal regimes in the range that is optimal for growth of salmonids, and a tendency to support high biomass of aquatic invertebrates. Spring creeks are sensitive to disturbance and do not have the power to rework their channel and transport fine sediment when relieved of excessive grazing pressure. Spring creek restoration projects have mixed success, with many being failures. The reconstructed channels often do not maintain the constructed deep, narrow cross sections, and they become choked with fine sediment. Future spring creek restoration projects should be evaluated considering the factors that have resulted in success or failure, with FFIP funds being spent on projects most likely to be successful.

Several projects included elements to increase water use efficiency to maintain in-stream flows. Except for the Cottonwood Creek diversion project, where the efficient head gate was not installed, other projects replaced diversion of surface water with ground water, or voluntarily decreased water use in exchange for financial assistance towards purchase of a center pivot and piping to more efficiently deliver water. The effect of these projects on stream flows have not been quantified, and stream flow monitoring is advisable.

FFIP funds are often spent on construction of barriers to secure populations of native cutthroat trout. The barrier on Thiel Creek did not result in a protected population of Yellowstone cutthroat trout and is at risk of failing. FWP needs to develop a strategy for what to do with this structure.

FUTURE FISHERIES IMPROVEMENT PROGRAM COORDINATOR MONITORING

Monitoring completed by the Future Fisheries Improvement Program Coordinator (FFIPC) was done to fill in the gaps of the long-term monitoring program. Because the duties of FFIPC are varied and time-consuming, monitoring was restricted to a few weeks a year and to opportunities combined with required meeting travel or implementation monitoring.

In 2017 and 2018, additional effort was focused on monitoring projects in the Sun River drainage and the Thompson Falls area, where projects had not been monitored for several years. The FFIPC also focused on the 5-year photo monitoring sites chosen in the late 2000s. The goal of FFIPC monitoring was not focused on species, but rather on sites that had not been monitored since their completion more than 5 years ago. Projects with land-use components were a main focus, as those types of projects tend to have more compliance questions than project types that require little maintenance (e.g. barriers or bridges).

Overall, the FFIPC was able to monitor 39 sites for effectiveness. In the next biennium, the photo monitoring sites will be updated to reflect active and expired projects, and the FFIPC will continue to focus on overdue monitoring areas.

Big Otter Creek corral relocation (035-2001)

Big Otter Creek (Judith Basin County) supports a mixed salmonid fishery that includes brown and brook trout. The applicant moved a corral that was on the stream to a new location. Approximately 2,400 feet of stream was treated.

This project was visited in 2014, and again in 2018 while monitoring a new project on the same property. The new corral remains functional and the old corral location is no longer impacted by livestock. Weeds have become an issue, and the landowner intends to address them in 2019. Overall, the corral relocation and fencing has been successful in repairing the riparian area. This area of Big Otter Creek has been the focus of many land-use FFIP projects and the overall value has been great in terms of riparian area development and reduction of sediment.

Big Otter Creek fencing and stock tank (023-2015)

Big Otter Creek (Judith Basin County) is a tributary to Belt Creek that supports populations of brook trout, brown trout, and rainbow trout. The project involved the rehabilitation of a highway underpass for livestock use, the building of a bridge, installation of fencing, and addition of a stock tank (Figure 118). The landowner is using a new route to move cattle and is protecting the stream from livestock impacts. The goal of this project was to prevent stream degradation and represents a proactive approach to protect the stream from imminent negative impacts.

In 2018, this project location was visited while monitoring an adjacent project (018-2017). The fence and riparian areas were in good condition. Some weeds were present, but riparian areas have not been grazed. The landowner reported that the project has been successful and is working as intended.

The area has recovered significantly. Soil was added the bridge to encourage cattle to cross, which has been successful.

FIGURE 118. BIG OTTER CREEK RIPARIAN RESTORATION BEFORE (L) AND AFTER (R) RESTORATION.

Big Spring Creek (024-1997)

A 2,400-foot section of Big Spring Creek (Fergus County) near Lewistown was channelized just after the turn of the century. The project site was located on an FWP fishing access site (Brewery Flats) and involved reconstructing a naturally meandering stream channel using modern stream restoration techniques. Approximately 4,000 feet of new channel was constructed (completed in 1999 and 2000).

Monitoring in 2017 showed considerable willow growth (Figure 119). Some riparian enclosures were in place, but natural recruitment is having the highest success rate. The stream had only minor adjustments after 17 years. Some lateral erosion was present near a walking trail bench, but minimal overall. The project has been very successful in its goal to reconstruct the stream to its natural channel and establish natural riparian vegetation. This project site is public and used for walking, bicycling, bird watching, and angling. It is the ideal project for the FFIP: angling opportunities and fisheries habitat have increased substantially.

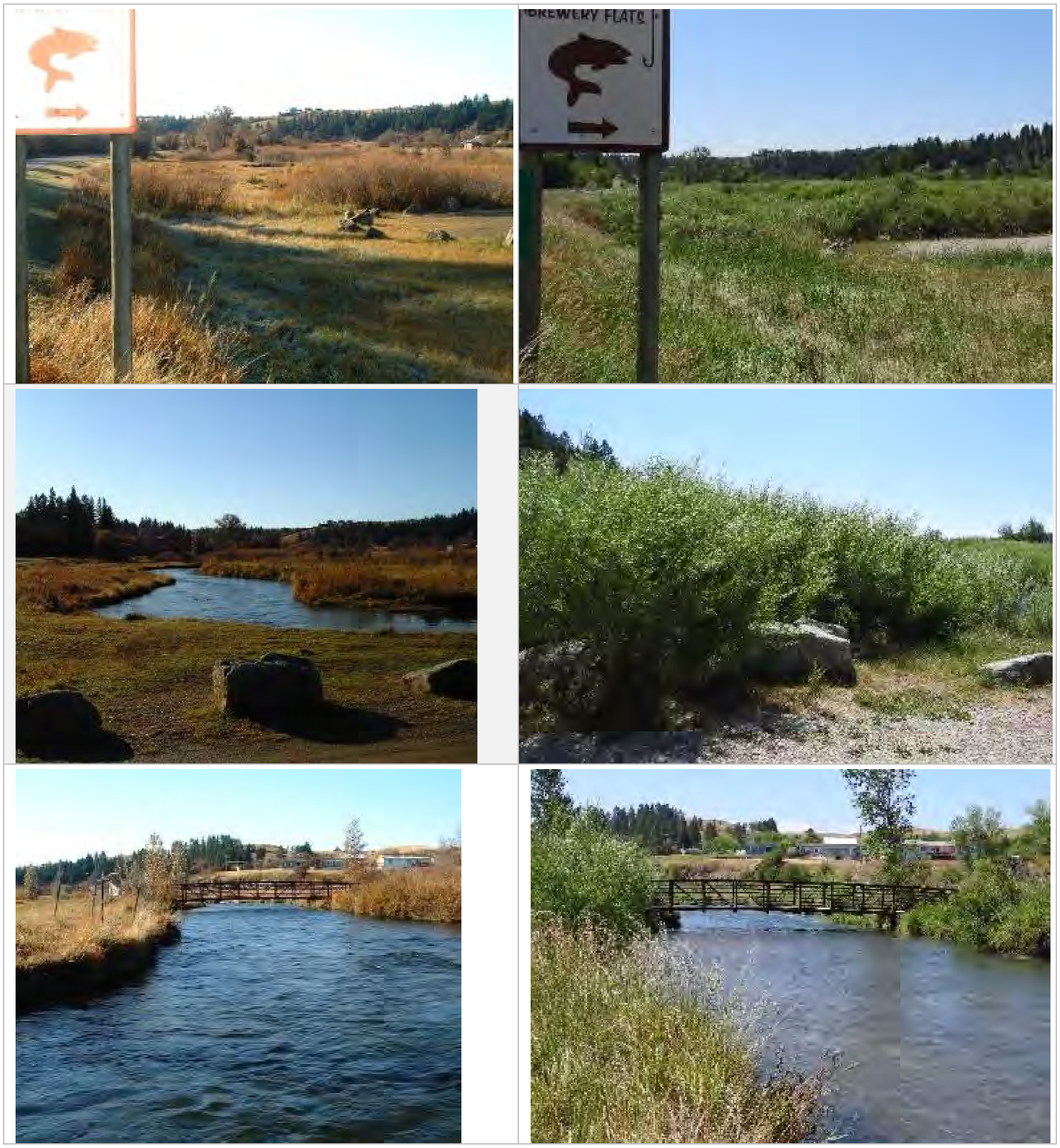


FIGURE 119. EFFECTIVENESS MONITORING PHOTOS AT BREWERY FLATS. AFTER CONSTRUCTION (2009, L) AND CURRENT (2017, R).

Brackett Creek (002-2003)

Brackett Creek (Park County), which enters the Shields River near the town of Clyde Park, supports brown trout as well as Yellowstone cutthroat trout. Just upstream from the mouth, on the Lazy S Ranch, the stream was severely degraded due to removal of riparian vegetation and channelization that occurred under previous ownership. This project involved restoration of about four miles of channel as well as removal of irrigation diversions that are barriers to fish passage (Figure 120).

This site was visited as part of a FFIP project tour, led by Yellowstone Cutthroat Trout Restoration Biologist Carol Endicott, where current Panel members gained on-the-ground experience with historical projects. The stream was wider than expected and some erosion remained, but the channel form has generally been maintained. It is functioning as intended and is considered a successful project. The areas of erosion could potentially be improved with the addition of woody vegetation. Willows were not dominant throughout much of the project site.

FIGURE 120. BRACKETT CREEK AFTER PROJECT CONSTRUCTION (L) AND IN 2017 (R).

Cottonwood Creek bank stabilization (008-1999)

Cottonwood Creek (Fergus County) was damaged from livestock grazing. This project fenced the riparian area to exclude livestock and involved stabilizing approximately 200 feet of a high eroding bank using back sloping, rock veins, sod mats, willow clumps, and root wads (Figure 121). It was completed in 1999.

In 2017, the stream was observed downstream of the project site as the landowners could not be reached. Aerial photography was used to compare channel form over the years at the project site. It was evident that the project was successful in taking pressure off the bank. Fencing appears to be in good condition and riparian area looks healthy. This project appears to have been successful in repairing the riparian area.

FIGURE 121. COTTONWOOD CREEK IN 1999 (AFTER COMPLETION; L) AND IN 2017 (SLIGHTLY DOWNSTREAM OF PROJECT SITE, R)

Cottonwood Creek channel restoration (009-2000)

This reach of Cottonwood Creek (Fergus County) located on the Floyd Maxwell ranch was incised and suffered from steep, raw, eroding banks. This project created 2,700 feet of newly restored channel and moved the stream to the new channel, allowing it to regain access to its floodplain. It was completed in 2001 and monitored in 2011 (Figure 122).

In 2017, the FFIPC met with the landowner, who was confused about the exact project location. Nonetheless, the landowner indicated that there have been dying cottonwood trees, meaning that the floodplain connection may be limited. Conditions upstream and downstream of the site showed erosion and some bank stabilization problems. Aerial photography showed topography in 2017 similar to 2011 conditions, when the channel straightened during a high flood event. At that time, riparian condition was considered good. This project may have improved erosion to some degree, but after a discussion with the local fisheries biologist, it appears the problems are much bigger in scope. Any additional improvements would need to consider the watershed. The project is considered minorly successful, and probably had most of the benefit before the 2011 channel adjustment. Lessons learned from this project include evaluation of the watershed and other limitations in project development.

FIGURE 122. PROJECT SITE IN 2011 (10 YEARS POST-CONSTRUCTION)

FIGURE 123. AERIAL VIEW OF SITE, 2017 (16 YEARS POST-CONSTRUCTION).

Deep Creek (006-2004)

This project (Broadwater County) involved repair of selected project sites that failed. To repair the sites, treatments included backsloping of eroded banks, revegetation, and the installation of juniper revetments to protect banks while the vegetation was established (Figure 124).

In 2017 the FFIPC visited the site with the fisheries biologist, Ron Spoon. Mr. Spoon noted that the use of juniper revetments had limited success and were washed out in most cases, but believed they contributed to downstream woody debris jams/habitat. Some banks appeared stabilized in the locations where vegetation developed, but the areas most prone to failure were outside bends where scour tends to be highest. Overall, the project appears to have been partially successful. However, the use of juniper revetments is no longer common practice due to its rate of failure. Additionally, rock toe was not part of project and that may have kept banks in place for a longer period.


1999 (pre-project)


1999


2017 (13 years post project)


2017

FIGURE 124. DEEP CREEK PROJECT SITE, COMPLETED IN 2004.

Deep Creek (007-2004)

This project on lower Deep Creek (Broadwater County) made irrigation improvements to eliminate a diversion and create off-stream watering. Fencing and a hardened crossing was installed. The goal was to improve the distribution of cattle and reduce riparian grazing.

In 2017, the FFIPC and fisheries biologist Ron Spoon visited the site. Mr. Spoon noted that the project area was particularly useful in the winter and had a significantly positive impact on the riparian area.

It has been very successful in reducing the impact from livestock. This project is part of a larger watershed effort to improve Deep Creek.

FIGURE 125. DEEP CREEK PROJECT SITE IN 2008 (PROJECT COMPLETION, L) AND 2017 (9 YEARS POST PROJECT, R). WATERGAP AND OFF STREAM WATER.

Deep Creek channel restoration (017-1996)

In Deep Creek (Broadwater County), trout recruitment was believed to be limited by heavy siltation caused by channel shortening and grazing practices. This project was intended to stabilize eroding streambanks, regain stream length, and install riparian fencing. The project was completed to address 20 miles of stream. It was completed in 1999 (Figure 126).

In 2009, the riparian condition was excellent with no observed livestock use. Stabilized banks were mostly retained, and willow recovery was considered good. There was one observed bank slump and it was noted that there could be some future erosion in the area. By 2017, the specific site had experienced extensive erosion and a vertical bank was again present (Figure 124). The primary method of bank stabilization used in this project was juniper revetments, which have washed out in most places that they were installed, especially in high risk areas such as meander bends.

This project had high success for at least 10 years, but by 20 had reverted to an erosive bank. The degree of success is hard to determine based on the duration of this project. It is considered moderately successful because it created a benefit for over 10 years. However, the lessons learned concern the use of juniper revetments for long-term bank stabilization. That specific treatment has largely been replaced with more effective methods. This project also shows how a small area of maintenance can unravel a project without intervention or repair. Had the small area of erosion been repaired, much of the bank treatment may have stayed in place.

1996 (before)

1998

2009

2017

FIGURE 126. DEEP CREEK PROJECT SITE FROM 1996 TO 2017.

Deep Creek streamflow improvement (026-2015)

Deep Creek (Broadwater County) is a tributary to the Missouri River near Townsend that primarily supports brown trout and rainbow trout and has been the focus of restoration projects for many years. Sediment inputs, high temperatures, and reduced streamflow are all factors that have affected the stream. This project proposed to eliminate an open ditch and install a screened pump to deliver water to irrigators (Figure 127). The applicant predicted this would improve stream flow along two miles of Deep Creek, reduce water temperature, and eliminate fish entrainment into the former ditch.

In 2017, the FFIPC visited the site fisheries biologist Ron Spoon. The pump is doing well and is functional for the landowner. Part of the original funding discussion requested that the riprap installed be vegetated with willow, which can reduce some of the negative impact of riprap-induced stream velocity on adjacent streambanks. The willow did not take and was reportedly not installed well. Overall the project was successful in water conservation but could have benefited from improved techniques or better construction oversight of the to riprap installation.

FIGURE 127. DEEP CREEK PUMP SITE AT COMPLETION (L) AND IN 2017 (R).

Dupuyer Creek (007-2003)

Dupuyer Creek (Pondera County) supports a mixed salmonid fishery that includes both rainbow and brook trout. Stream banks were degraded due to management practices of a previous owner. This project involved riparian fencing, back sloping, channel shaping, and bank stabilization using erosion control fabric and vegetation. Approximately 0.75 miles of stream were treated including 400 to 600 feet of stream bank.

According to the local fisheries biologist Dave Yerk, much of this project was blown out, but it was redone with U.S. Fish and Wildlife Service funding. It likely it washed out again. In terms of bank stabilization this project is considered unsuccessful, however riparian fencing is likely a success as long as the riparian area is managed appropriately.

East Fork Bull River channel stabilization (006-2008)

East Fork Bull River (Sanders County) supports native bull and westslope cutthroat trout. A high flow event that occurred in November 2006 caused extensive stream bank failure and triggered a slide that routed the channel into a steep eroding slope. This project involved routing the stream away from the slope and creating habitat features that are favorable for fish. Approximately 800 feet of stream was treated (Figure 128).

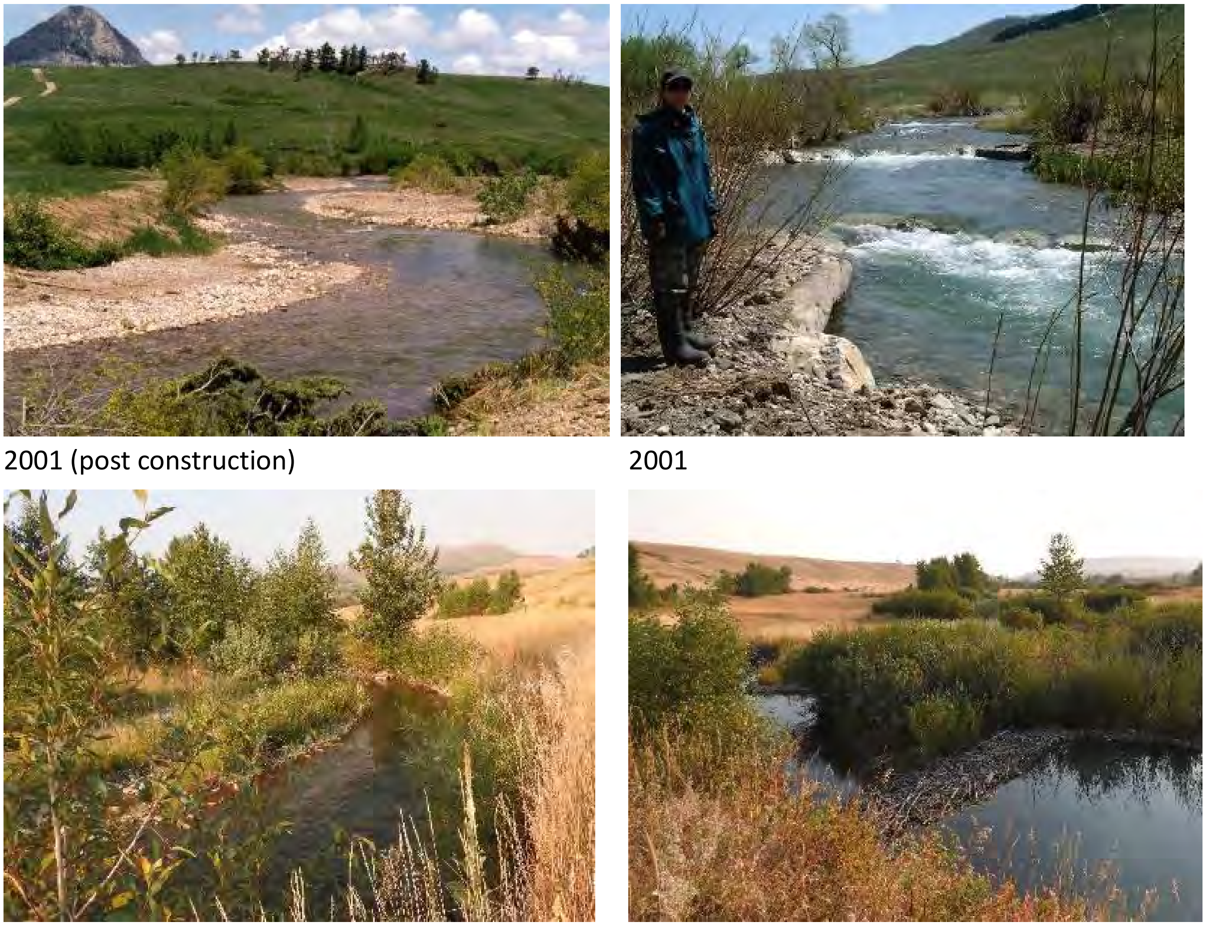
When the project site was visited in 2018, it was largely intact and functional. Much of the wood in the banks and as grade controls were retained, which is notable for a 10-year-old project in a high energy stream system. This project is considered highly successful in meeting its objectives of moving the stream away from a slide and incorporating stability and habitat complexity.

FIGURE 128. EAST FORK BULL RIVER CHANNEL STABILIZATION AFTER CONSTRUCTION (L) AND IN 2017 (R).

Elk Creek Channel restoration (023-1997) and (006-2001)

Fish habitat in the upper reaches of Elk Creek (Lewis & Clark County) near Augusta was damaged due to forest fires and runoff. This project moved the stream to its old channel and stabilized banks with root wads and woody vegetation. In 1999, approximately 1.5 miles of stream was treated (Figure 130).

In 2001, fencing was installed. The goal was to improve water quality, reduce sedimentation, and improve the riparian corridor. In 2017, the project was in great condition with a healthy riparian area and little to no browsing by livestock. Past erosive areas were showing evidence of healing. This project is considered successful from both the landowner and from the FFIP. It is being managed as intended with healthy riparian and stream areas.



2001 (post construction) 2001

2017 2017

FIGURE 129. ELK CREEK RESTORATION PROJECT, 2000-2017.

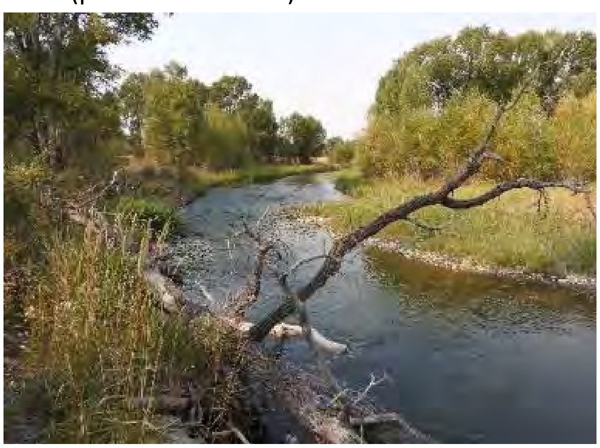
Elk Creek restoration (012-1999)

Elk Creek (Lewis & Clark County), located near Augusta, supports a significant spawning run of brown and rainbow trout from the Sun River. This project, on the Scherrer Ranch, treated eroding banks using root wads and willow plantings and made the channel narrower and deeper. It was completed in 1999, and approximately 2,300 feet of stream was treated.

When it was monitored in 2017, the past project was evident. There has been some erosion, but the project has been maintained to meet its original goals. Even though there was no grazing plan recorded, fencing is in good condition and browsing is minimal. The channel appears to be functional and transporting sediment. Some erosive areas were present, but they were not abundant. Weeds were prevalent throughout the observed reach. The landowner was not present, so it is unclear how the project area is managed. Overall, this project is considered successful in meeting its original goals and objectives. Weed management could improve its efficacy.


2000 (post construction)


2002 (3 years post construction)


2017


2017

FIGURE 130. ELK CREEK CHANNEL RESTORATION, 2000-2017.

Elk Creek restoration (041-1999)

Elk Creek (Lewis & Clark County) near Augusta has been the site of several stream restoration projects. This project involved restoration of 2,100 feet of stream on the Artz Ranch that had been damaged by grazing practices. Three reaches were restored to prevent a meander cutoff. Treatments included narrowing the channel, pool development, bank shaping, willow plantings, and placement of root wads and tree revetments. Fencing was not installed as part of project, but a grazing management plan was a component (Figure 128).

A 2017 site visit indicated that the current landowner was not familiar with project, but her son gave some input on location. When walking the site, it was noted that the riparian area was in good condition, with plenty of vegetation present. Some weeds were noted in the area. Condition of the riparian vegetation had improved since construction, point bars have developed, and stream has an obvious floodplain. Overall, the project continues to meet its goal of preventing a meander cutoff and retains a vegetated riparian area.

FIGURE 131. ELK CREEK CHANNEL RESTORATION, AFTER COMPLETION (L) AND IN 2017 (R).

Enders Spring Creek channel restoration (009-2008)

Enders Spring Creek (Powell County) is a tributary to the North Fork Blackfoot River. Limited numbers of bull trout have been sampled in the stream, but it is severely degraded from past grazing practices. This project involves restoring approximately two miles of stream. Treatments included narrowing and deepening the channel, increasing sinuosity, adding woody debris and placement of sod mats to stabilize newly formed stream banks (Figure 132).

In 2018, this site was visited as part of a FFIP project tour. The stream was in great shape and looked very similar to its 2011 photos. This is significant, considering that it is a spring creek and these types of projects tend to become over-wide or not scour enough to retain clean spawning gravels. This stream has mostly retained its form and clean gravel 10 years later. Ryen Neudecker (Big Blackfoot Chapter of Trout Unlimited) was unsure of fishery response, but a spawning redd was visible during the site visit. Although the fish weren't present, the species was likely rainbow trout or westslope cutthroat trout. Overall, this project is considered successful and is one of the best examples of spring creek restoration observed by the FFIPC.

FIGURE 132. ENDERS SPRING CREEK AFTER CONSTRUCTION (2011; L) AND 2018 (R).

Fleshman Creek flood control (005-2010)

Fleshman Creek (Park County), a tributary to the Yellowstone River near Livingston, supports a mixed salmonid assemblage. The lower 2.7 miles of the stream were severely degraded due to urbanization within the city of Livingston. This proposed project was part of a much larger flood control project and involved restoring this reach of Fleshman Creek to a more natural and flood resistant state by replacing undersized culverts, removing point and non-point sources of pollution, narrowing over-widened portions of the channel and incorporating bank stabilization and re-vegetation (Figure 133). This project called for stabilizing a 3,050 foot reach of stream using encapsulated soil lifts, followed by the placement of spawning gravel.

Several site locations were visited in 2017 as part of a FFIP project tour. The project appeared to be generally successful but because it is in the town of Livingston, there have been a few issues including erosion and mowing grass too close to the stream (Figure 134). Overall, this project has been successful in mitigating flood-related impacts and reducing water quality degradation from the city of Livingston. Although there are minor issues, they are generally related to the location of the project in an urban area.

FIGURE 133. FLESHMAN CREEK BEFORE (2010; L) AND AFTER (2015; R) CONSTRUCTION.

FIGURE 134. FLESHMAN CREEK IN 2017. MOWING ADJACENT TO THE STREAM (L) AND ABUNDANT RIPARIAN DEVELOPMENT (R).

Locke Creek (041-2002)

Locke Creek (Park County) supports a spawning run of pure Yellowstone cutthroat trout from the Yellowstone River. A previous project on Locke Creek secured a water lease to improve stream flow. This project restored fish passage past two diversion structures and improved spawning habitat using in-stream debris and gravel. The riparian area was fenced and revegetated. Approximately 0.33 miles of stream was treated (Figure 135).

Upon visiting the site in 2017, it was noted that the electric fencing not installed. However, there appeared to be sufficient riparian growth at the time of inspection, indicating that the riparian area has been managed. The small, lower diversion that was modified for fish passage could not be seen due to shrub growth. Gravel in the stream looked packed and dirty, and no redds or juvenile fish were seen. Several adult fish (4-8" in length) were observed, located mostly between the railroad culvert and the first road culvert.

There were a few concerns about the site, including the observation that the railroad culvert could now be a barrier. Additionally, the apron on the diversion that was converted into a barrier appears to be slightly collapsing. It was also noted that the stream channel downstream of interstate was silty, but with a lot of willow cover. The area upstream of interstate had sparse shrub cover and may be contributing sediment.

Overall, the project appears to be successful in creating fish passage at the diversion structures. However, spawning habitat has not been improved and a new passage barrier may be present. Additional investigation into the sediment contributions, fish passage, and the success of Locke Creek as a spawning tributary.

FIGURE 135. LOCKE CREEK BEFORE (2001; L) AND AFTER (2017; R).

Locke Creek irrigation conversion and lease (028-2001)

Locke Creek (Park County) is a small but significant tributary to the Yellowstone River near Livingston. Locke Creek supports an important spawning run of Yellowstone Cutthroat trout. Because of an irrigation diversion, only the lower 0.15 miles of Locke Creek was accessible for spawning. This project replaced a diversion with a well, reduced the acreage irrigated, and improved fish passage in the creek and made an additional 0.35 miles available for spawning. Electric fencing was installed in the riparian corridor to improve riparian conditions and a windmill was built to generate electricity and pump water from the well. Five cubic feet per second (cfs) of water was leased for in-stream purposes.

According to Andy Brummond, FWP water rights specialist, the pump diversion was removed, and the windmill was never installed. When the site was visited in 2017, it was noted that the new pump was installed and in use, with the wheel lines running (Figure 136). Currently, the owners no longer divert any water from the stream.

Although the current operation varies from the original application, the original intent of keeping water in the stream has been maintained, making it an overall successful project. The needs of the landowners were balanced with the goals of the program, which is the best way for FFIP to be successful long term.

FIGURE 136. LOCKE CREEK IRRIGATION, 2017.

Magpie Creek culvert fish passage (034-2010)

Magpie Creek (Lewis & Clark County), a tributary to Canyon Ferry Reservoir, supports a spawning run of rainbow trout. The lower 1.5 miles of the stream provide habitat for spawning rainbow trout, with the best habitat located in the upper 0.25 miles of the stream, just upstream of a Denil style fish ladder that provides passage around an in-stream pond. A couple of undersized culverts were inhibiting upstream passage to this prime spawning habitat (Figure 137). This project called for replacing these two culverts with bridges using precast concrete abutments and recycled timber stringers. The project was partially completed due to damage from the 2011 flood event.

In 2017, part of the project was observed at the Norwegian Wood golf course. According to Eric Roberts, the fisheries biologist, two bridges were supposed to be constructed and only one was constructed and in place. The second location had the existing culvert wash out and a headcut developed before the bridge was installed. The second bridge has either been put in place or will be.

Overall, this project was successful in creating fish passage in Magpie Creek. The delay in the second bridge construction is disconcerting, and a follow-up is needed to ensure compliance.

FIGURE 137. MAGPIE CREEK BEFORE (L) AND AFTER (R; 2017).

Magpie Creek fish passage (032-2005)

Magpie Creek (Lewis & Clark County) supports a spawning run of rainbow trout from Canyon Ferry Reservoir. A perched culvert at a county road crossing and a short distance upstream from the mouth, was a barrier to fish movement. This project installed of a series of rock drop structures below the culvert that brought the level of the stream up allowed fish to pass through the culvert (Figure 138).

This project was monitored in 2017 and stream flow was sufficient for fish passage, but because the culvert was not embedded, there was concern that the culvert may impede passage at certain times of the year—particularly with high flow and limited resting spaces for fish. Fisheries biologist Eric Roberts noted that the rock ramp is functioning as intended. Overall, this project has been successful in meeting its goal of installation and maintenance of a rock ramp to encourage fish passage.

FIGURE 138. MAGPIE CREEK BEFORE (L; 2000), IN 2001 (C), AND IN 2017 (R).

Missouri River bank stabilization (057-1996)

A side channel of the Missouri River near Townsend was heavily used for spawning by brown and rainbow trout from Canyon Ferry Reservoir. Portions of the side channel were experiencing severe erosion due to past grazing practices. This project involved riparian fencing, back-sloping the banks, keying the toe of the slope with rock, and re-vegetation with sod and willows (Figure 139). Approximately 700 feet of bank was treated.

In 2017, the site was visited site with Ron Spoon, fisheries biologist. The side channel was essentially disconnected from river, which has been the case since the early 2000s (Figure 140). It is likely that significant flow reaches site only in high water events. Aside from the wetland value, this project has no fishery benefit. The installed structures remain in place but are now vegetated and unused. Grazing still occurs, although it likely has minimal impact to fishery at that location. The project was unsuccessful because the side channel was abandoned. Future projects should consider likelihood of channel movement, if possible. This project is now expired, having reached its 20-year life.

FIGURE 139. MISSOURI RIVER SIDE CHANNEL BEFORE CONSTRUCTION (L, 1996) AND AFTER CONSTRUCTION (1997, R).

FIGURE 140. MISSOURI RIVER SIDE CHANNEL IN 2004 (L) AND 2017 (R).

Moore's Creek grazing and water quality enhancement (010-2015)

Moores Creek (Madison County), is a tributary to the Madison River with perennial streamflow. It is believed to contain rainbow, brown, and brook trout. In a 3,200-foot section of Moores Creek on the Goggins Ranch, the applicant installed electric riparian fencing, hardened crossings, two water gaps in areas where livestock are rotated, and off-channel water sources for the pastures and corrals. The ranch uses a rest-rotation grazing program. This project also involved working with the Ennis High School Science club to plant willows. The project goal was to improve the fishery and have demonstration value.

In 2018, the site was visited site with Sunni Heikes-Knapton, Madison Conservation District Administrator (Figure 141). The entire project was viewed project from hospital parking lot and in-depth at the Goggins Ranch. Since completion, vegetation has been established and the ranch continues to operate as needed. Overall, the project has been successful in maintaining a vegetated channel with protection from livestock, while also meeting the needs of the ranch.

FIGURE 141. MOORES CREEK ON THE GOGGINS RANCH, 2018.

Nevada Creek channel restoration (038-2010)

Nevada Creek (Powell County) is a tributary to the middle Blackfoot River that supports a mixed salmonid fishery. The stream, located immediately downstream of Nevada Creek Reservoir, was over-widened, suffered from bank erosion, and was deficient of suitable woody riparian vegetation. This project involved restoring the dimension, pattern and profile on approximately 4,400 feet of stream channel (Figure 142). The work involved constructing a meandering channel with well-defined pools and a low width-to-depth ratio. Stream bank stability was enhanced with the placement of toe wood and log vanes and with the transplanting of woody riparian shrubs. An existing diversion was reconstructed, and a fish screen was installed. Grazing management was expected to improve with the installation of riparian fencing.

In 2018, as part of a FFIP tour, the channel reconstruction and fencing components were monitored for long-term effectiveness. Despite high flows after construction, the channel has largely retained its shape/stability. There have been some repairs done to areas that began to unravel, but the project has been successful overall in retaining an appropriate channel configuration. Its location downstream of a reservoir is not helpful when it comes to mobilizing sediment. Electric fence is being used, and although the riparian buffer is not as large as desired, it serves the needs of the ranch. This project has great demonstration value in the drainage. Recent work has been completed and proposed by the Big Blackfoot Chapter of Trout Unlimited to continue the restoration work downstream.

FIGURE 142. NEVADA CREEK BEFORE (L) AND AFTER (2018; R).

Otie Reservoir (023-2004)

Otie Reservoir (Stillwater County) is a nine-acre impoundment that is fed by a small un-named spring creek that is approximately 0.24 miles long. The reservoir and creek presently support a population of rainbow trout. This project involves renovating the reservoir with fish toxicants, restoring the spring creek, and re-introducing native Yellowstone cutthroat trout (YCT).

Since project completion, there has been little information available for Otie Reservoir. It is owned by a private individual. It is believed that restoration/habitat improvement work was completed and YCT were stocked. Public access was allowed for some time but when the YCT were large, the public access was stopped. Currently, it is likely that spawning habitat is limited and the YCT have died naturally.

The project agreements do not specifically address public access, so there is no way to legally request that the public be allowed on site. Access may have been encouraged or implied, or perhaps the applicants believed the population of YCT would benefit downstream areas. Regardless, the project appears to be unsuccessful in terms of YCT restoration, spawning, and public fishing opportunity. The lesson learned is that when access is a critical component of a project, access agreements must be a part of the FFIP agreement process to ensure public use for the duration of the project.

Pilgrim Creek channel restoration (014-2005)

Pilgrim Creek (Sanders County) enters the Clark Fork River at Cabinet Gorge Reservoir. The stream supports bull and cutthroat trout as well as several non-native salmonids. The stream suffered from channel straightening, floodplain encroachment, clearing of riparian vegetation, and riparian logging.

The drainage also has a history of catastrophic fires. The project involved reconstructing approximately 1600 feet of channel, rebuilding the floodplain, and revegetating stream banks.

According to fisheries biologist Ryan Kreiner, the Reishus property on Pilgrim Creek appears to be doing well. The brook trout populations are thriving. The project has been successful in retaining its stream habitat improvements, but the population has shifted to favor non-native brook trout.

Poorman Creek bridge (036-2006)

Poorman Creek (Lewis & Clark County) supports a mixed salmonid fishery that includes bull trout as well as genetically pure westslope cutthroat trout. A pair of culverts located approximately three miles upstream from the mouth were barriers to fish migration. This project involved replacement of the existing culverts with a bridge (Figure 143).

In 2018, this site was visited as part of Future Fisheries tour. The bridge is easily accessible, in good condition, and appears to have been very successful in improving migratory corridors.

FIGURE 143. POORMAN CREEK CULVERT (2002; L) TO BRIDGE (2018; R).

Prickly Pear Spring Creek bank stabilization (020-2014)

This unnamed spring creek enters Prickly Pear Creek approximately 6.5 miles upstream from the its confluence with Lake Helena. It supports brown and rainbow trout. Habitat in the spring creek was degraded by livestock grazing, an undersized culvert at a road crossing, and intrusion by Prickly Pear Creek. Prickly Pear Creek had channel alignment and debris issues, so this project called for improving pool and riffle habitat in selected meander bends of the spring creek, replacing the culvert with a bridge, and reconnecting the original confluence with Prickly Pear Creek (Figure 144). Prickly Pear Creek was realigned in some locations, with some juniper/willow/rock revetments and debris cleanup.

The site was visited in 2018, and the project appeared to be functional in several places with vegetation growing and becoming established. However, erosion occurs in several places of Prickly Pear Creek. The stream may be making adjustments and it may need to be monitored again in the coming years. The Spring Creek portion looks good with exposed gravels. The project has been a success.

FIGURE 144. UNNAMED TRIBUTARY TO PRICKLY PEAR CREEK AFTER CONSTRUCTION (2015; L) AND IN 2018 (R).

Prospect Creek (053-1999)

Prospect Creek (Sanders County) is a tributary to the Clark Fork River near Heron. The stream was degraded over the years due to construction of roads and pipelines and removal of riparian vegetation. The stream supports a mixed trout population including westslope cutthroat and bull trout. This project treated approximately three miles of stream with intensive revegetation, bank stabilization using rootwads, rock, and native material revetments, floodplain grade controls and brush bars to limit sediment delivery to the channel, and channel shaping to restore the natural dimensions and facilitate sediment and bedload transport. The goal of the project was to recreate a stable bank full channel and functioning floodplain.

In 2018, this project was visited from public roads, but not all photos could be replicated. It was difficult to determine where the treatments were installed. However, 2009 monitoring indicated that the stream moved away from treated reaches, which could explain why the FFIPC was unable to determine where habitat improvement took place. The structures are most likely gone or abandoned. Aerial photographs are most useful to show the evolution of the project in the last 18 years (Figure 145).

Prospect Creek is a dynamic system dominated by cobble (Figure 146). Erosion is unlikely to be a large issue in terms of sediment input and is more likely a concern for landowners in the floodplain. The stream appears to be moving fairly actively within its floodplain and is likely significantly affected by downed trees and other debris in the floodplain. The riparian area is overall highly vegetated, and livestock does not appear to be an issue. The project was not successful in its original design, but the stream appears to be mostly functional within its floodplain. The lesson learned is to avoid stabilization techniques in areas with significant channel movement within a floodplain.

FIGURE 145. CHANGES IN PROSPECT CREEK CHANNEL 2005 (RED LINE) TO 2017 (AERIAL BACKGROUND).

FIGURE 146. AN EXAMPLE OF PROSPECT CREEK, WITHIN THE PROJECT AREA (2018).

Skelly Gulch fish barrier (018-2011)

Skelly Gulch (Lewis & Clark County) is a tributary to Sevenmile Creek and ultimately Tenmile Creek located near Helena that supports a genetically pure population of westslope cutthroat trout in the headwaters. An existing road crossing on the stream acted as a partial barrier to upstream migration of non-native brook trout. This road culvert was undersized and under threat of being breached during a high water event. This project replaced the existing culvert with a larger, much longer culvert set on a steeper slope. The outlet has a two-foot outfall drop to a concrete splash pad. The configuration of this new culvert created conditions that should prevent brook trout from further invading the headwaters and the pure westslope cutthroat trout population found there.

In 2017, fish were sampled above and below the barrier. No brook trout were found above the barrier, and the project continues to function as intended.

South Fork Bull River (026-2003)

South Fork Bull River (Sanders County) supports a mixed salmonid fishery that includes bull and cutthroat trout. A large landslide that occurred in the early 1990s caused braiding and relocation of the channel and a head cut was moving through the landslide area. This project reconstructed and reconnected about 1,400 feet of channel and revegetation of riparian areas.

Currently, the South Fork Bull River project looks great and has grown in so much it is difficult to see where the work was done. The fisheries biologist Ryan Kreiner noted that there was initially a large increase in westslope cutthroat trout at that site, but since then the brook trout have come back and the fishery is split 50/50. The project has been successful in restoring the slide and retaining a vegetated stream channel. The shift to more non-natives is not ideal, but perhaps unavoidable.

Spring Coulee Creek (026-1998)

Spring Coulee Creek (Teton County) became severely degraded over the years because it received water from a trans-basin irrigation reservoir at flows that far exceeded the natural flows that formed the original channel. The flow management situation was corrected. This project stabilized eroding banks using conifer tree revetments and willow plantings and installed riparian fencing. Approximately 0.5 mile of stream was treated. In 2017, the fisheries biologist noted that the project looked good and is considered successful.

Teton River (020-2001)

Teton River (Teton County) upstream of the town of Choteau supports a modest population of brown and rainbow trout. The reach suffered from seasonal dewatering, instability, and excessive braiding. Grazing and irrigation practices (annual construction of gravel berms) were the primary causes of instability. This project included returning the channel to a single thread, stabilizing banks with rootwads and willow sprigs, and constructing permanent rock weirs in the vicinity of the diversions. This was a demonstration project, with the hope being that other irrigators will use their own resources or other grants to install similar improvements on their diversions.

In 2017, Dave Yerk, fisheries biologist, noted that a few years ago the irrigation company removed several of the large rocks at the weir. It is not known how the project has functioned and will require a follow up to determine the level of success and compliance.

Teton River bank stabilization (017-2006)

The Teton River (Teton County) near Choteau supports an important local fishery for rainbow trout and brown trout. This project stabilized stream banks on a section of school trust land that was overgrazed by back-sloping, planting willow clumps and sprigs, seeding with native grass, installation of electric fencing, and installation of erosion control fabric. Approximately 900 feet of stream bank was treated (Figure 147).

In 2017, the project site was in good condition. The fencing was intact and protecting the stream. There was very little disturbance observed on the property. The treatments appeared to have been successful; the stream has narrowed and created a wetland area in the floodplain.

2006 (before construction)

2006 (after construction)

2017

2017

FIGURE 147. TETON CREEK BANK STABILIZATION, 2006-2017.

Thompson River riparian restoration (019-2005)

The Thompson River (Sanders County) supports a mixed salmonid fishery, including bull and cutthroat trout. Unfortunately, reed canary grass invaded much of the drainage and out-competed native shrubs such as dogwood, snowberry and willow. Reed canary grass provides less shade than native flora resulting in higher water temperatures. The purpose of this project was to replace reed canary grass with a native shrub assemblage along approximately 2000 feet of channel.

According to the fisheries biologist Ryan Kreiner, in the project area there are some trees that are doing well and others that are not. There is interest in improving the plantings along this stretch of river. It appears to be moderately successful in vegetating the bank with woody species.

Trail Creek fish screen (039-2015)

Trail Creek (Missoula County) is a tributary to Morell Creek near Seeley Lake. Trail Creek supports westslope cutthroat trout, bull trout, and brook trout populations. This project screened the last of three unscreened diversions within the Trail/Morrell Creek watershed. This diversion entrained trout and acted as an obstruction to upstream fish passage (Figure 148). The goals of this project were to replace the existing diversion structure with a rock cross vane and armored riffle that allows fish passage, stream channel function, and bedload movement. A McKay-style, flat-plate fish screen with a paddlewheel was installed with flow measuring devices in each ditch and downstream of the diversion.

In 2018, as part of a FFIP project tour, the site was visited, and the project appears to be in place and functional. The project has been successful and was largely intact after a high flow year in 2018.

FIGURE 148. TRAIL CREEK BEFORE (L) AND AFTER (2018; R) CONSTRUCTION.

Vermilion River Chapel slide stabilization (026-2010)

Vermilion River (Sanders County), a tributary to the Clark Fork River located near the town of Trout Creek, supports a mixed salmonid fishery including westslope cutthroat trout and bull trout. A watershed assessment conducted in 2007 identified the Chapel slide, a large eroding mass waste located just downstream of Vermillion Falls, as the highest priority site for restoration in the drainage for improving westslope cutthroat trout and bull trout populations. This project moved the existing channel away from the toe of the slide and into a historic channel, installing grade control and fish habitat features and re-shaping about 700 feet of the existing channel into a floodplain (Figure 149).

The site was visited in 2018, and the slide appeared to be stabilized and vegetated. The plantings were watered, which improved the success rate. This project has been successful in its goals to reduce sediment and stabilize the slide. It appears to have been beneficial to bull trout as well. This project is a great example of a location where hardened stabilization has been successful.

FIGURE 149. VERMILLION RIVER CHAPEL SLIDE STABILIZATION BEFORE (L) AND AFTER (2018; R).

White Pine Creek stabilization (022-2001)

Whitepine Creek (Sanders County) is a tributary to Beaver Creek that subsequently flows into Noxon Reservoir. The stream supports a mixed salmonid fishery that includes brook, brown, and cutthroat trout. Brook trout are the predominant species in most reaches. The stream suffered from a variety of impacts including logging, grazing, and roading. This project involved a variety of treatments to improve the stream including channel reconstruction, bank stabilization, revegetation, and improvements to facilitate fish passage.

Ryan Kreiner, fisheries biologist, noted that this is a very dynamic system and the stream actively moves within its floodplain. The aggradation/degradation appears to be balanced with high input of trees that likely shape the channel on a regular basis. The project may have been initiated to address infrastructure (homes and properties in the floodplain), but the stabilization was not completely effective. The project was repaired in 2004 but was ultimately unsuccessful.

The site was visited in 2018 and it was evident that the channel had been actively shifting in places (Figure 150; Figure 151). The landowners have been frustrated with the dynamic system so close to their homes. Although it is considered an unsuccessful project, the lessons learned are that bank stabilization isn't successful in highly mobile systems that experience constant fluctuations. A consideration of this program should be placed on allowing a stream to move within its floodplain. Roads were highly armored in places, as the stream is actively putting pressure on some areas. Fine sediment is not likely to be a significant issue in this stream.

Ultimately, projects installing hard structures into dynamic streams should be avoided. Enhancements to these highly-mobile systems should consider the constant movement of the channel.

FIGURE 150. WHITE PINE CREEK (2018), A HIGHLY MOBILE SYSTEM.

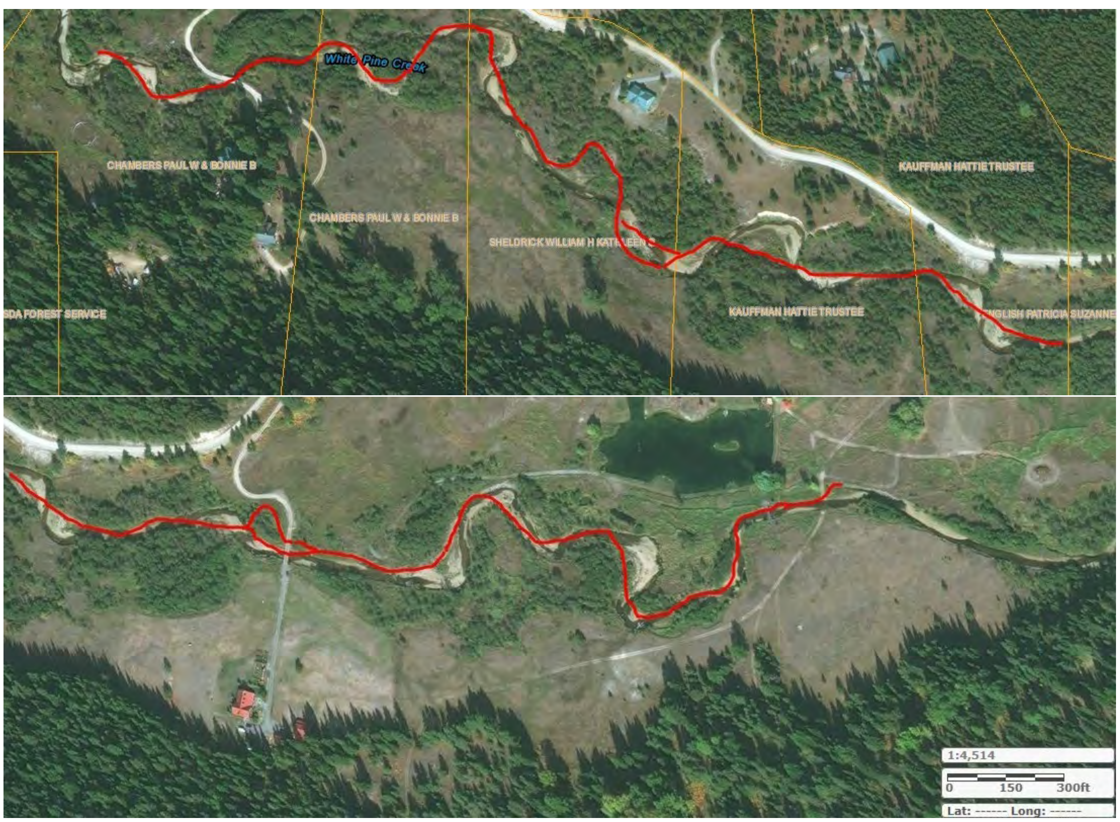


FIGURE 151. WHITE PINE CREEK MOVEMENT, FROM 2005 (RED LINE) TO 2017 (AERIAL BACKGROUND) AT TWO LOCATIONS WITHIN THE PROJECT AREA.

FFIPC OVERALL CONCLUSIONS

Monitoring completed by the FFIPC or FWP staff found generally successful projects. Several projects, however, were not successful or had unsuccessful components. Many of the failures were related to unfavorable natural events that are beyond the control of an applicant. Other failures were related to treatments that did not work effectively in the particular location they were used. Most commonly, projects that did not consider the watershed, surrounding stream, or the behavior of the stream in question had a higher rate of failure.

Many of the projects reviewed as part of this report provided valuable information to the FFIP and will help guide future funding decisions. The greatest benefit from effectiveness and implementation monitoring is to learn what works, what doesn't, and why. Much has been learned from the FFIP since 1996, making project review by FWP staff, the Panel, and the Commission a constantly improving process.

Overall, project applicants tend to be in compliance with their project agreements. Some project components have shifted or changed, often due to the needs of the landowner, but the intent of the project remains intact in most cases. The success of the FFIP has been overwhelming, and a significant positive impact has been made to the waters of Montana due to the Program and its partners.

EXPIRING PROJECTS

Expiring Projects

Project agreements are developed with an anticipated project life of 20 years. There can be exceptions, however, as is the case for certain types of projects like instream flow leases or lake habitat enhancement (e.g. Christmas trees begin to degrade upon installation). Unless a shorter duration agreement is approved, projects are expected to be maintained for 20 years and the applicant or landowner must agree to those terms to receive funding.

The first FFIP projects were initiated in 1996; therefore, certain projects began to reach their 20-year commitment in 2016. The 20-year commitment begins when a project is completed. Each year there are more projects that will reach the end of their contractual life. The projects that expired in 2017 and 2018 are listed below (Table 12).

Once a project is expired, the status is updated in the database and the project file is kept for an additional five years. After five years has passed, the file will be uploaded electronically, and the paperwork will be moved to record storage for an additional five years.

TABLE 12. FFIP PROJECTS THAT EXPIRED IN 2017 OR 2018.

FFIP #	Project Name	Completed	Application Year
002-1997	Fisher River channel restoration	1997	1997
003-1996	O'Brien Creek	1997	1996
003-1997	Stinger Creek	1997	1997
004-1997	Middle Fork Rock Creek riparian fence	1997	1997
006-1997	Poorman Creek	1997	1997
016-1997	Stone Creek restoration	1997	1997
017-1997	Ruby River diversion stabilization	1997	1997
018-1996	Lake Frances Shoreline Stabilization	1997	1996
020-1997	Black Butte Creek	1997	1997
021-1997	Missouri River bank stabilization	1997	1997
022-1997	Sun River inventory and design	1997	1997
027-1996	Bear Paw Reservoir Shoreline Habitat Enhancement	1997	1996
027-1997	Bynum Reservoir	1997	1997
028-1997	Hauser Reservoir spawning structures	1997	1997
033-1996	Dry Creek	1997	1996
033-1997	Yellowstone River	1997	1997
034-1997	Mud Creek restoration	1997	1997
036-1997	Rock Creek	1997	1997

EXPIRING PROJECTS

FFIP #	Project Name	Completed	Application Year
041-1996	Prickly Pear Creek Riparian Fence and Bank Stabilization	1997	1996
042-1996	Saint Regis River Restoration	1997	1996
044-1996	Cottonwood Creek	1997	1996
046-1996	Blackfoot River Bank Restoration	1997	1996
046-1997	Sun River	1997	1997
048-1996	Blanchard Creek	1997	1996
049-1996	Elk Creek	1997	1996
051-1996	Bitterroot River Fence	1997	1996
053-1996	Echo Lake Bass Rearing Habitat	1997	1996
055-1997	Muskrat Creek barrier	1997	1997
056-1997	Yellowstone River bank restoration	1997	1997
057-1996	Missouri River Bank Stabilization	1997	1996
001-1998	Bearpaw Lake rearing habitat	1998	1998
003-1998	Beaverhead River fencing	1998	1998
004-1998	Big Creek restoration	1998	1998
005-1997	Clark Fork River riparian fence	1998	1997
006-1998	Bynum Reservoir	1998	1998
009-1997	Chamberlain Creek diversion improvements	1998	1997
010-1997	O'Brien Creek	1998	1997
010-1998	Deep Creek	1998	1998
011-1997	North Fork Blackfoot River fish screen	1998	1997
011-1998	Bull River	1998	1998
012-1997	Monture Creek restoration	1998	1997
013-1997	Salmon Creek restoration	1998	1997
013-1998	Hughes Creek restoration	1998	1998
014-1996	Big Hole River	1998	1996
016-1998	Missouri River Bank Stabilization	1998	1998
024-1996	Nelson Reservoir Spawning and Rearing Vegetation	1998	1996
026-1996	Fresno Reservoir Spawning and Rearing Vegetation	1998	1996
028-1998	Bear Creek	1998	1998
031-1997	Fresno Reservoir Spawning Substrate	1998	1997
038-1997	McCabe Creek barrier removal	1998	1997
039-1997	Johnson Gulch	1998	1997
040-1997	Gilbert Creek and Shanley creeks maintenance	1998	1997
047-1997	Sun River	1998	1997
050-1997	Canyon Creek restoration	1998	1997

EXPIRING PROJECTS

FFIP #	Project Name	Completed	Application Year
052-1997	Careless Creek	1998	1997
054-1996	Magpie Creek Fish Passage	1998	1996
054-1998	Smith Creek riparian fence	1998	1998
055-1996	Teton River	1998	1996
18b-1998	North Fork Blackfoot River	1998	1998
18d-1998	North Fork Blackfoot River bank stabilization	1998	1998