CANDIDATE CONSERVATION AGREEMENT WITH ASSURANCES FOR FLUVIAL ARCTIC GRAYLING IN THE UPPER BIG HOLE RIVER

Montana Fish, Wildlife & Parks

2017–2019 Annual Report

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Montana Fish, Wildlife & Parks

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Table of Contents

I. Introduction 4
II. Legal Status of Montana Arctic Grayling 6
III. Landowner Enrollment 6
IV. Big Hole Arctic Grayling CCAA Rapid Assessments and Compliance Monitoring 8
- **A. Surveys for Immediate Threats to Arctic Grayling** 8
- **B. Water Rights Compliance Evaluation** 8
- **C. Streamflow Monitoring required by CCAA** 8

V. Site-Specific Conservation Plans 10
- **A. Completed and Approved** 10
- **B. Extension Requests Approved by the USFWS** 10

VI. Conservation Measures 12
- **A. Entrainment Surveys** 12
- **B. Projects to Minimize or Eliminate Entrainment of Arctic Grayling** 13
- **C. Projects to Enhance Fish Passage** 14
- **D. Projects to Enhance Riparian and Stream Channel Habitat** 14
- **E. Projects to Improve Streamflows and Irrigation Water Management** 15
- **F. Projects to Expand Arctic Grayling Distribution into Historically Occupied Waters** 15

VII. Monitoring 16
- **A. Fish Population Monitoring** 16
- **B. Stream Temperature Monitoring** 20
- **C. Streamflow Monitoring** 23
- **D. FWP Monitoring of Compliance with Approved Site-Specific Plans** 25

VIII. Summary of Estimated Take Associated with the Big Hole Arctic Grayling CCAA 26
IX. NRCS Special Funding 26
X. Literature Cited 27

I. Introduction

A Candidate Conservation Agreement with Assurances (CCAA) is an agreement between the U.S. Fish and Wildlife Service (USFWS) and any non-Federal entity whereby non-Federal property owners who voluntarily agree to manage their lands or waters to remove threats to species at risk of becoming threatened or endangered receive assurances against additional regulatory requirements should that species be subsequently listed under the Endangered Species Act (ESA). According to the USFWS, since 2000 there have been 50 CCAA's approved in 24 different states that have more than 25.2 million acres enrolled by 717 landowners that cover 84 species. The project areas associated with these CCAA's range from a one-acre area aiming to protect the Greater and Lesser Cave Beetles in Kentucky to 7,214,287-acre area to protect Lesser Prairie Chicken in Colorado, Kansas, Oklahoma, New Mexico, and Texas (USFWS 2018).

The conservation goal of the CCAA for Fluvial Arctic Grayling in the Upper Big Hole River (Big Hole Arctic Grayling CCAA) is to secure and enhance a population of fluvial (river-dwelling) Arctic Grayling (*Thymallus arcticus*) within the upper reaches of their historic range in the Big Hole River drainage. Under the Big Hole Arctic Grayling CCAA, Montana Fish, Wildlife & Parks (FWP) holds an ESA section 10(a)(1)(A) Enhancement of Survival Permit issued to it by USFWS on August 1, 2006 and will issue Certificates of Inclusion to non-Federal property owners within the Project Area who agree to comply with all stipulations of the Program and develop an approved site-specific conservation plan (Figure 1). Site-specific conservation plans will be developed with each landowner by an interdisciplinary technical team made up of individuals representing FWP, USFWS, USDA Natural Resources Conservation Service (NRCS), and Montana Department of Natural Resources and Conservation (DNRC) (collectively the Agencies). The conservation guidelines of the Big Hole Arctic Grayling CCAA will be met by implementing conservation measures that:

1) Improve streamflows

2) Improve and protect the function of riparian habitats

3) Identify and reduce or eliminate entrainment threats for Arctic Grayling

4) Remove barriers to Arctic Grayling migration

This planning effort will help alleviate private property concerns, as well as generate support from private landowners to improve habitat conditions for Arctic Grayling throughout the Project Area. The goal for the Arctic Grayling population inhabiting the Project Area is to increase the abundance and distribution of Arctic Grayling within the Project Area (FWP and USFWS 2006).

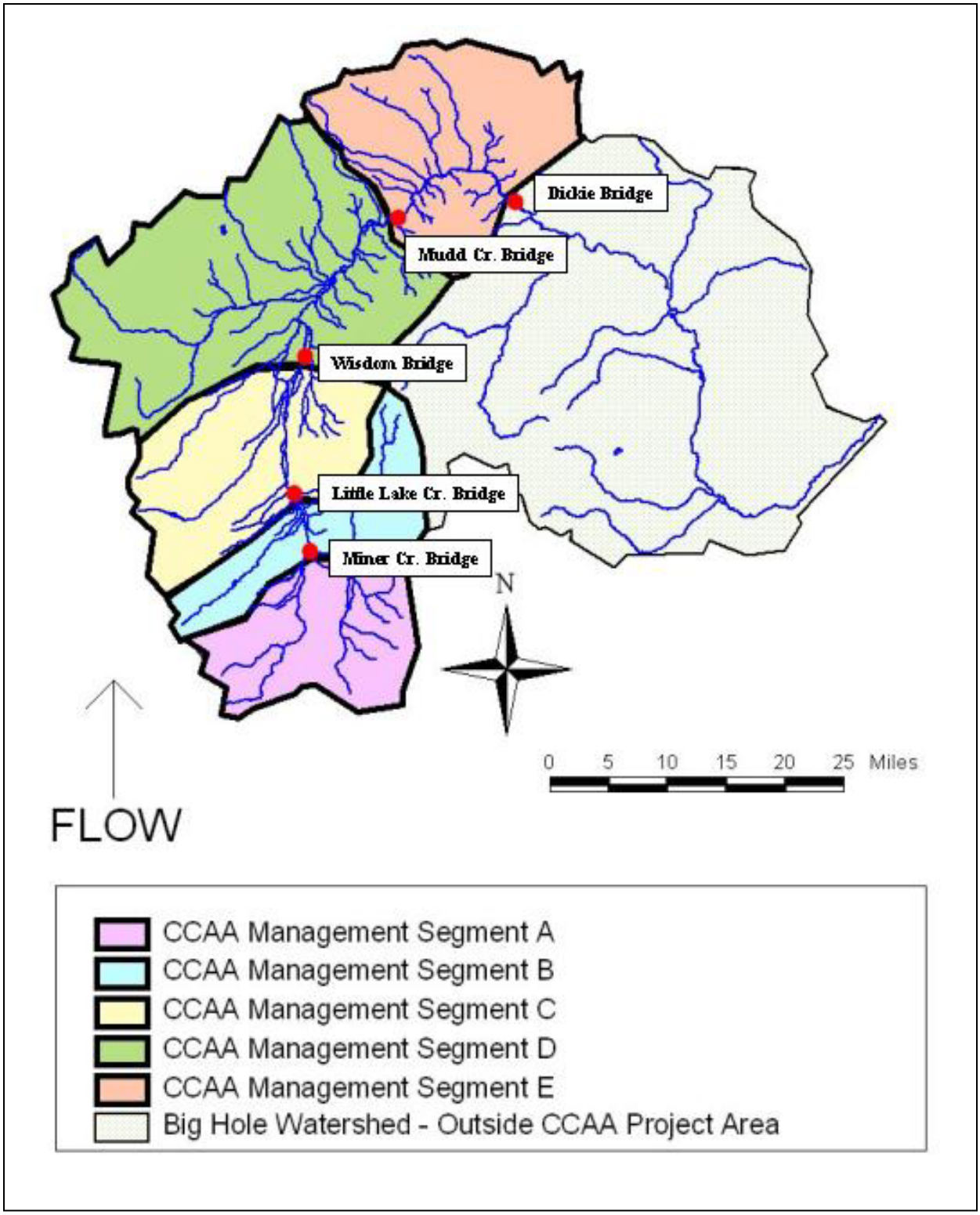

Figure 1. The Big Hole Arctic Grayling CCAA Project Area & Management Segments.

The Big Hole Arctic Grayling CCAA is a collaborative effort among private landowners, state and federal agencies, and non-government organizations. These stakeholders have agreed to work together for the common goals of conserving Arctic Grayling, improving the Big Hole watershed fish populations, addressing private property concerns, and enhancing the overall health of the upper Big Hole watershed.

The 2017–2019 report includes a summary listing of current enrollment, signed site-specific plans, conservation actions implemented, and FWP project funding as part of the Big Hole Arctic Grayling CCAA.

II. Legal Status of Montana Arctic Grayling

On August 19th, 2014, the USFWS announced its decision that the Upper Missouri River Distinct Population Segment (DPS) of the Arctic Grayling did not warrant protection under the Endangered Species Act (ESA; Federal Register 2014). The USFWS reached this conclusion after analyzing recent genetic information, and the significant conservation efforts carried out by private landowners, federal and state agency partners to improve conditions for Arctic Grayling in the Upper Missouri River basin. Subsequently a lawsuit was filed in federal district court to challenge the USFWS 2014 decision. The District Court upheld the USFWS decision in 2016, however the plaintiffs filed an appeal to the 9th Circuit Court. On February 8th, 2018 the 9th Circuit Court affirmed and reversed in part the District Court's summary on the 2014 listing decision. Specifically, the 9th Circuit Court panel affirmed that the service did not err in considering only the current range of Arctic Grayling. However, the panel ruled the USFWS acted in an arbitrary and capricious manner for considering all available biological data, dismissing the threats of low stream flows and high stream temperatures, and failing to explain the uncertainty of climate change impacts for Arctic Grayling habitat. The panel ruled to have the USFWS reassess the 2014 Arctic Grayling finding considering these opinions by July 2020. For a complete legal review prior to 2014 please review the USFWS 2014 legal decision (Federal Register 2014).

III. Landowner Enrollment

On August 1, 2006, the USFWS issued FWP an ESA section 10(a) (1) (A) Enhancement of Survival Permit # TE-104415, authorizing the Big Hole Arctic Grayling CCAA. The issuance of this permit allowed for the official enrollment of any non-federal landowner within the Big Hole Arctic Grayling CCAA Project Area. Enrolled non-federal landowners are provided incidental take coverage and regulatory assurances once the non-federal landowner, FWP, and the USFWS counter-sign the Certificate of Inclusion and the approved site-specific conservation plan for the enrolled property, if Arctic grayling become listed under the ESA. Currently, there are 32 landowners (Participating Landowners) that have enrolled 148,320 acres of private and 6,230 acres of DNRC leased land into the Big Hole Arctic Grayling CCAA (Figure 2). Enrollment for the Big Hole Arctic Grayling CCAA will remain open until 90 days prior to any final listing rule published by the USFWS in the Federal Register.

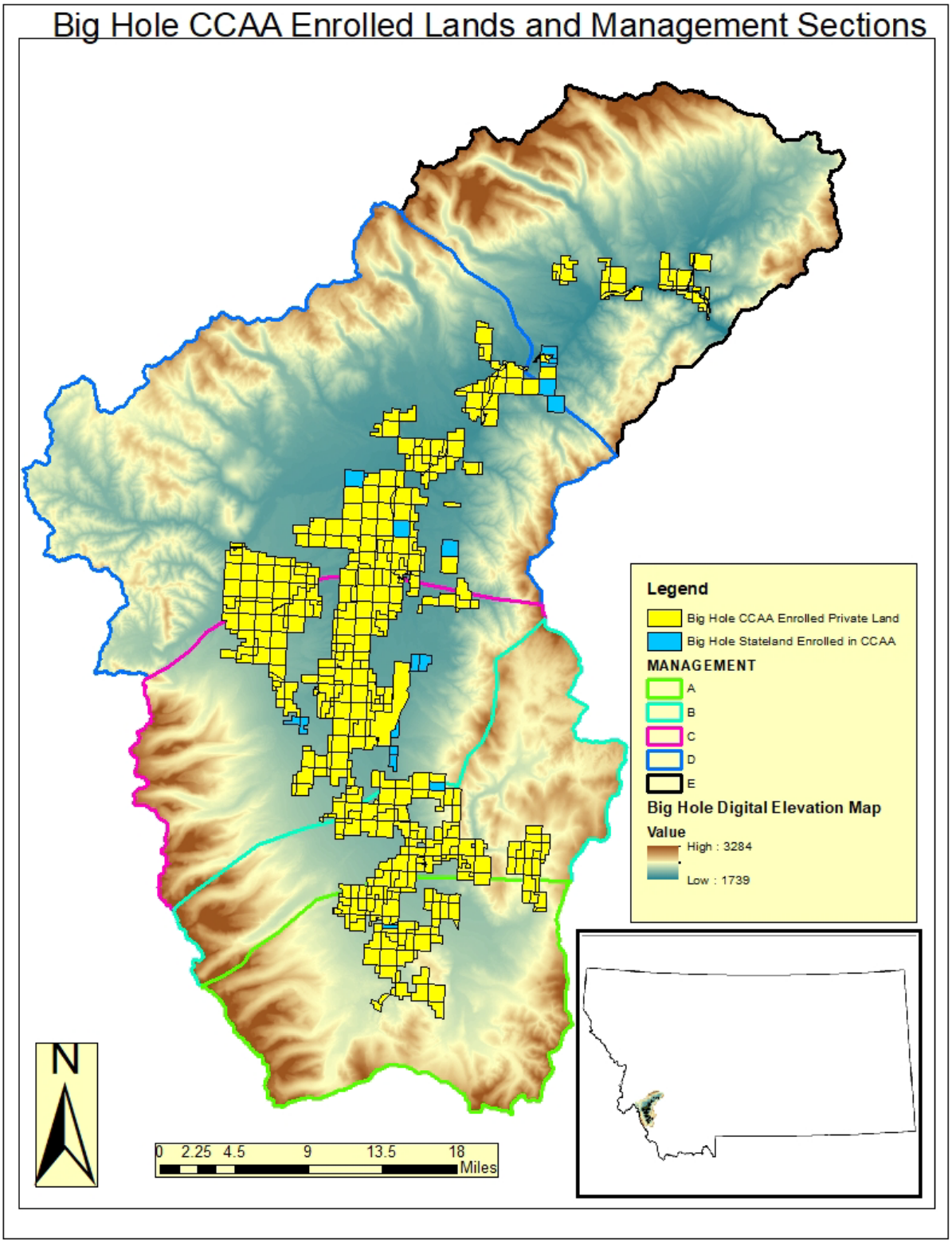

Figure 2. December 31st, 2019 Big Hole Arctic Grayling CCAA Program of private and state land enrolled. Enrolled land includes 32 private landowners and 148,320 private acres and 6,230 acres of DNRC leased lands.

IV. Big Hole Arctic Grayling CCAA Rapid Assessments and Compliance Monitoring

The Participating Landowners in the Big Hole Arctic Grayling CCAA allow the Agencies to complete a "rapid assessment" of the enrolled property within 90 days of enrolling. The rapid assessment focuses on identifying immediate threats to Arctic Grayling and validating water rights compliance. Immediate threats to Arctic Grayling may include structures, mechanical devices or pollutants that pose a threat of immediate mortality. Examples include unscreened pumping from or toxic effluent entering a stream. Additional information may be gathered during rapid assessments that assist with the development of the site-specific conservation plan with the Participating Landowner (Petersen and Lamothe 2006).

A. Surveys for Immediate Threats to Arctic Grayling

All surveys for immediate threats to Arctic Grayling have been conducted on enrolled properties. No immediate threats to Arctic Grayling were identified during the surveys. Monitoring of enrolled properties for immediate threats continues as site-specific conservation plans are being developed by the Agencies.

B. Water Rights Compliance Evaluation

Compliance monitoring for water rights associated with CCAA site specific plans was conducted for all properties in 2017 and 2018. In 2019, compliance monitoring was completed on the following properties: 1–8, 10–21, and 23–31. These efforts, completed by DNRC and FWP, included site visits on each property to assess compliance of flow rate and period of use with the landowner's water right. Some of the required monitoring for enrolled properties was provided by the District Court–appointed water commissioner. Also, continuous stage recorders installed in the Spokane, Strowbridge, Ferris, LaMarche, Huntley, and Pendleton ditches provided flow information for water rights compliance, instream flow conservation projects, and ongoing development of the site-specific plans. During 2019, staff availability was limited such that higher priority conservation actions precluded portions of the fall compliance monitoring. However, Agencies kept in contact with all enrolled landowners and all flow plans were initiated and adhered to (Table 1).

C. Streamflow Monitoring required by CCAA

In concert with the two USGS real-time streamflow gages located at Management Segments C and D (Figure 1), DNRC continued to operate and maintain three real-time streamflow gages located at Management Segments A, B, and E. In addition, DNRC continuously monitored flow in at least one tributary within each Management Segment and six key irrigation ditches.

Table 1. 2017–2019 Irrigation Meeting and Compliance Monitoring.

Property #	2017		2018		2019	
	Compliance Checks Completed	Irrigation Meeting	Compliance Checks Completed	Irrigation Meeting	Compliance Check Completed	Irrigation Meeting
1	Yes	Yes	Yes	Yes	Yes†	Yes
2	Yes	Yes	Yes	Yes	Yes†	Yes
3	Yes	Yes	Yes	Yes	Yes†	Yes
4	Yes	Yes	Yes	Yes	Yes†	Yes
5	Yes	Yes	Yes	Yes	Yes†	Yes
6	Yes	Yes	Yes	Yes	Yes†	Yes
7	Yes	Yes	Yes	Yes	Yes†	Yes
8	Yes	Yes	Yes	Yes	Yes†	Yes
9	Yes	Yes	Yes	Yes	No*	Yes
10	Yes	Yes	Yes	Yes	Yes†	Yes
11	Yes	Yes	Yes	Yes	Yes†	Yes
12	Yes	Yes	Yes	Yes	Yes†	Yes
13	Yes	Yes	Yes	Yes	Yes†	Yes
14	Yes	Yes	Yes	Yes	Yes†	Yes
15	Yes	Yes	Yes	Yes	Yes†	Yes
16	Yes	Yes	Yes	Yes	Yes†	Yes
17	Yes	Yes	Yes	Yes	Yes†	Yes
18	Yes	Yes	Yes	Yes	Yes†	Yes
19	Yes	Yes	Yes	Yes	Yes†	Yes
20	Yes	Yes	Yes	Yes	Yes†	Yes
21	Yes	Yes	Yes	Yes	Yes†	Yes
22	Yes	Yes	Yes	Yes	No*	Yes
23	Yes	Yes	Yes	Yes	Yes†	Yes
24	Yes	Yes	Yes	Yes	Yes†	Yes
25	Yes	Yes	Yes	Yes	Yes†	Yes
26	Yes	Yes	Yes	Yes	Yes†	Yes
27	Yes	Yes	Yes	Yes	Yes†	Yes
28	Yes	Yes	Yes	Yes	Yes†	Yes
29	Yes	Yes	Yes	Yes	Yes†	Yes
30	Yes	Yes	Yes	Yes	Yes†	Yes
31	Yes	Yes	Yes	Yes	Yes†	Yes
32	Yes	Yes	Yes	Yes	No*	N/A

Yes† -Landowner irrigation compliance completed in Spring and Summer, but precluded in Fall due to other priority conservation efforts

No* - Landowner irrigation compliance precluded due to other priority conservation efforts

V. Site-Specific Conservation Plans

Site-specific conservation plans are developed for each Participating Landowner by the Agencies and the landowner. The site-specific conservation plans identify conservation actions that will lead to improved streamflow, enhanced riparian and stream channel condition, improved fish passage and reduced levels of entrainment.

A. Completed and Approved

Currently 31 site-specific conservation plans have been implemented in the Big Hole CCAA program (Table 2). One site-specific conservation plan is currently in draft form; however, conservation efforts are being implemented with the participating landowners. Three site-specific plans will undergo the 10-year update in 2020. In 2019, property 2's site-specific plan was updated and implemented for another 10 years. All site-specific plans are 10-year agreements between the Participating Landowners, FWP, and the USFWS. Updates on the implementation of these site-specific plans, including compliance monitoring results, will be included annually in future reports. No new enrollment and site-specific plans have been developed between 2017 and 2019.

B. Extension Requests Approved by the USFWS

FWP did not submit approval for extensions to complete site-specific plans in 2017–2019. Extensions provided additional time to complete the SSP and document past and ongoing conservation actions for Arctic Grayling on the property receiving the extension.

Table 2. Property numbers of enrolled landowners and their associated CCAA management segment, enrolled acres, and enrollment status.

Property Number*	Management Segment(s)	Private Land Enrolled (Acres)	State Land Enrolled (Acres)	Enrollment Status	10 Year SSP Update
1	C & D	15,424.0	0	SSP Completed	2024
2	A	6,327.0	640	SSP Completed	2029
3	A & B	2,930.6	0	SSP Completed	2026
4	D and C	2,284.7	0	SSP Completed	2025
5	D	2,514.4	640	SSP Completed	2025
6	B and C	2,492.6	0	10-Year Update	2020
7	B	6,976.8	0	10-Year Update	2020
8	E	2,729.0	0	SSP Completed	2021
9	E	901.0	70	SSP Completed	2023
10	A	887.0	0	SSP Completed	2026
11	C	3,023.2	0	SSP Completed	2021
12	C & D	23,510.0	560	SSP Completed	2022
13	C & D	2,683.7	2,240	SSP Completed	2023
14	E	667.4	0	SSP Completed	2022
15	D	1,117.8	0	SSP Completed	2024
16	C	163.0	0	SSP Completed	2022
17	B & C	3,751.1	0	SSP Completed	2023
18	C	3,448.0	0	SSP Completed	2026
19	D	8,771.5	640	SSP Completed	2024
20	A and B	1,336.7	0	SSP Completed	2025
21	C	1,555.1	0	SSP Completed	2024
22	E	812.0	0	SSP Completed	2025
23	A, B, C & D	24,343.4	0	SSP Completed	2023
24	C & D	5,010.1	0	SSP Completed	2023
25	D & E	6,512.1	1,280	SSP Completed	2025
26	D	1,472.9	0	New Owner	N/A
27	A and B	4,136.7	160	SSP in Draft	N/A
28	E	333.3	0	SSP Completed	2027
29	A and B	6,277.2	0	SSP Completed	2025
30	A and B	880.0	0	SSP Completed	2024
31	E	1,629.0	0	SSP Completed	2024
32	B	3,418.8	0	New Owner	N/A

VI. Conservation Measures

Through the process of developing site-specific conservation plans for Participating Landowners, the Agencies identify projects that reduce or eliminate entrainment of Arctic Grayling, eliminate barriers to fish passage, maintain adequate streamflow and protect and/or improve riparian and stream habitat quality. Projects and related conservation efforts completed in 2017– 2019 are reported below.

A. Entrainment Surveys

In 2017, FWP completed entrainment surveys on 6.74 miles of irrigation ditch on 6 enrolled properties (Table 3). A total of three grayling were captured in one irrigation ditch during entrainment surveys and returned to the Big Hole River mainstem. The three captured grayling were young-of-the-year (YOY). Other fish species identified during the surveys include: Eastern Brook Trout (*Salvelinus fontinalis*), Brown Trout (*Salmo trutta*), Mountain Whitefish (*Prosopium williamsoni*), Burbot (*Lota lota*), Longnose Dace (*Rhinichthys cataractae*), Mottled Sculpin (*Cottus bairdi*), Longnose Suckers (*Catostomus commersoni*), and White Suckers (*Catostomus Catostomus*).

Table 3. FWP electrofishing entrainment surveys completed in 2017 in the upper Big Hole watershed as part of the Big Hole Grayling CCAA requirements.

Date	SOURCE	Miles	Number of Grayling Rescued
6/16/2017	Rock Creek	0.69	0
6/21/2017	Big Hole River	0.52	0
6/21/2017	Bryant Creek	0.43	0
6/21/2017	Big Hole River	0.43	0
6/21/2017	Deep Creek	0.22	0
6/28/2017	York Gulch Tributary	0.36	0
6/28/2017	York Gulch	0.31	0
6/28/2017	York Gulch	0.56	0
6/28/2017	York Gulch	0.36	0
6/28/2017	York Gulch	0.35	0
6/29/2017	Big Lake Creek	0.46	0
6/29/2017	Rock Creek	0.50	0
6/29/2017	Rock Creek	0.43	0
7/5/2017	Big Hole River	0.57	0
10/12/2017	Big Hole River	0.55	3
	Total	**6.74**	**3**

In 2018, FWP completed entrainment surveys on 2.5 miles of irrigation ditches on three enrolled properties (Table 4). No grayling were captured during entrainment. Fish species identified during the surveys include: Eastern Brook Trout, Brown Trout, Rainbow Trout, Mottled Sculpin, Longnose Suckers, and White Suckers.

Table 4. FWP electrofishing entrainment surveys completed in 2018 in the upper Big Hole watershed as part of the Big Hole Grayling CCAA requirements.

Date	SOURCE	Miles	Number of Grayling Rescued
6/12/2018	Berry Creek	0.34	0
6/12/2018	Big Hole River	0.45	0
6/12/2018	Big Hole River	0.36	0
6/19/2018	LaMarche Creek	0.44	0
6/19/2018	LaMarche Creek	0.37	0
10/9/2018	Big Hole River	0.54	0
	Totals	**2.50**	**0**

In 2019, FWP completed entrainment surveys on 1.32 miles of irrigation ditches on two enrolled properties (Table 5). A total of 22 YOY grayling were captured in one irrigation ditch during a two-pass entrainment survey and returned to the Big Hole mainstem. FWP will evaluate options to reduce or eliminate entrainment in this ditch. Other fish species identified during the surveys include: Eastern Brook Trout, Brown Trout, Mountain Whitefish, Burbot, Longnose Dace, Mottled Sculpin, Longnose Suckers, and White Suckers.

Table 5. FWP electrofishing entrainment surveys completed in 2019 in the upper Big Hole watershed as part of the Big Hole Grayling CCAA requirements.

Date	Source	Miles	Number of Grayling Rescued
8/23/2019	Big Hole River	1.08	22
9/9/2019	Big Hole River	0.17	0
9/9/2019	Big Hole River	0.06	0
	Total	**1.31**	**22**

B. Projects to Minimize or Eliminate Entrainment of Arctic Grayling

Low channel gradients preclude using screens to reduce entrainment in parts of the Study Area; however, fish screens installed on La Marche and Rock creeks have successfully prevented grayling entrainment. The Agencies currently are evaluating design options for a large ditch downstream of Wisdom that has repeatedly entrained graying YOY. Rescue operations will continue in the ditch downstream of Wisdom until a fish exclusion device is installed.

C. Projects to Enhance Fish Passage

During 2017–2019 the Agencies completed nine fish passage improvement projects (fish ladders, bridges, weirs, culvert replacements, and a siphon; Table 6).

Table 6. Upper Big Hole Watershed fish passage projects completed in 2017–2019 as part of the Big Hole Arctic Grayling CCAA. Projects include improving or modifying irrigation diversions to provide fish passage, installing fish ladders or installing bridges.

2017			2018			2019		
Associated Waterbody	**Enrolled Landowner**	**Project Component**	**Associated Waterbody**	**Enrolled Landowner**	**Project Component**	**Associated Waterbody**	**Enrolled Landowner**	**Project Component**
Governor Creek	23	Bridge	Bryant Creek	8	Bridge	N/A		
Swamp Creek Lower	22	Fish Ladder	NF Miner Creek	6	Bridge			
Hamby Creek	27	Fish Ladder	Swamp Creek	1	Fish Ladder			
Hamby Creek	27	Fish Ladder						
Hamby Creek	28	Fish Ladder						

D. Projects to Enhance Riparian and Stream Channel Habitat

During 2017–2019 the Agencies and Participating Landowners implemented 15 riparian habitat projects to enhance stream function and riparian habitat on 10 properties (Table 7).

Table 7. Upper Big Hole Watershed riparian and stream channel improvement projects completed in 2017–2019 as part of the Big Hole Arctic Grayling CCAA. Projects include improving riparian habitat through stock water development, stream restoration, channel activation, riparian pasture fence, etc.

2017			2018			2019		
Associated Waterbody	**Enrolled Landowner**	**Project Component**	**Associated Waterbody**	**Enrolled Landowner**	**Project Component**	**Associated Waterbody**	**Enrolled Landowner**	**Project Component**
NF Miner Creek	6	Stock Water	Seymour Creek	9	Fence	Warm Springs	7	Fence
Steel Creek	13	Stock Water	Big Hole	23	Fence	Big Hole	10	Stream Restoration
Swamp Creek	23	Stock Water	Warm Springs Creek	29	Fence	Big Hole	16	Stream Restoration
Swamp Creek	23	Fence	NF Miner Creek	6	Fence			
Little Swamp Creek	27	Fence	Rock Creek	24	Channel Activation			
Big Hole	10	Stream Restoration						

E. Projects to Improve Streamflow and Irrigation Water Management

During 2017–2019 the Agencies partnered with participating landowners to implement 11 projects on seven enrolled properties to enhance the ability to control and measure irrigation withdrawals and reduce the need to divert water for livestock watering purposes (Table 8).

Table 8. Upper Big Hole Watershed streamflow and irrigation management projects completed in 2017–2019 as part of the Big Hole Arctic Grayling CCAA. Projects include installing headgates, PODs, ditch maintenance, and stock tank and spring development.

2017			2018			2019		
Associated Waterbody	**Enrolled Landowner**	**Project Component**	**Associated Waterbody**	**Enrolled Landowner**	**Project Component**	**Associated Waterbody**	**Enrolled Landowner**	**Project Component**
Swamp Creek	22	Headgate	Swamp Creek	1	Headgate	Englejard Creek	3	Headgate
Hamby Creek	27	Headgate				Big Hole	2	Solar Panel for Stocktank
Hamby Creek	27	Headgate				Big Lake Creek	1	Stocktank Repair
Rock Creek	11	Stock Tank						
Hamby Creek	27	Headgate						
Hamby Creek	27	Headgate						

In addition to improvements to irrigation infrastructure, the Big Hole Arctic Grayling CCAA requires reductions to irrigation diversions in response to streamflow dropping below established seasonal flow targets at each of the five gaging stations (Miner Lakes Road, the mouth of Miner Creek, the Wisdom Bridge, Mudd Creek Bridge, and Dickie Bridge). A total of 52 ft^3/s in 2017, 18.5 ft^3/s in 2018, and 202 ft^3/s in 2019 were returned to the Big Hole or its tributaries in accordance with site plans and flow targets.

F. Projects to Expand Arctic Grayling Distribution into Historically Occupied Waters

One of the CCAA Arctic Grayling population goals is for Arctic Grayling to reoccupy or utilize habitats in historically occupied waters within the Big Hole Arctic Grayling CCAA Project Area (FWP and USFWS 2006). RSI's were deployed in Trail Creek and Wise River from 2017-2019 and Twin Lake Creek in 2017, although grayling have not been subsequently observed in these streams. Reintroductions also occurred in McVey Creek in 2017 and 2018, with grayling YOY observed in 2019. Long Branch Creek also received introductions in 2018 and 2019; however, the success of this reintroduction is unknown. Lastly, grayling will be reintroduced into Bender Creek in 2020.

VII. Monitoring

The Big Hole Arctic Grayling CCAA requires specific monitoring associated with the conservation measures implemented under this agreement and the resulting biological responses of the Arctic Grayling population. FWP, under the guidance of geneticists and with the approval of USFWS, began using genetic monitoring for Big Hole grayling in 2016 (Table 12). Justification for this monitoring is listed below:

> Determining trends in population abundance of rare or highly migratory fish species can be difficult. Genetic analysis is an effective alternative or supplemental method to determine the health and long-term persistence of fish populations (Schwartz et al. 2007). Using non-lethal sampling techniques geneticists can analyze the structure of an Arctic Grayling population and determine its long-term viability by estimating genetic diversity in a population (A_r), effective number of breeding individuals that produced a given cohort (N_b), and ultimately the overall genetic effective population size (N_e). These estimates provide important population information on potential rate of loss of genetic variability and inbreeding depression, population dynamics, and the efficacy of management actions. Moreover, genetic data ensure that conservation efforts maintain the historic diversity found within and among Arctic Grayling populations, and thus, the continued evolutionary legacy of the species [Upper Missouri River Arctic Grayling Conservation Strategy, in preparation].

Additionally, stream temperature and discharge are monitored on each of the 10 reaches (FWP and USFWS 2006). Mainstem reaches are located near the lower boundary of each management segment (A through E) and tributary reaches include Governor Creek, Miner Creek, Rock Creek, Steel Creek and Deep Creek. Additional monitoring is conducted to evaluate restoration projects.

A. Fish Population Monitoring

In 2017, FWP conducted electrofishing surveys to determine N_b in the Big Hole River drainage. Surveys were conducted on 13 reaches over a total of 17.9 miles. A total of 61 YOY grayling were captured, and genetic samples were taken. Sixty-three genetics samples, including two from entrainment surveys, were used to calculate N_b. N_b for the 2017 grayling cohort was 155 (95% CI 103–290; Table 9). Other species sampled included brook trout, brown trout, rainbow trout, burbot, sculpin, longnose dace, white suckers, and longnose suckers.

Table 9. Grayling captured during 2017 Fall one-pass electrofishing surveys in the Big Hole River watershed.

Reach Location	Reach Length (mi.)	Number of Arctic Grayling YOY
Deep Creek	2.18	0
Fish Trap Creek	0.29	0
Howell Creek	0.59	0
Howell Creek Side Channel	0.42	15
Mudd Creek	0.10	0
Upper Plimpton Creek	0.61	0
Plimpton Creek	3.13	15
Pintler Creek	0.81	5
Rock Creek	1.84	0
Squaw Creek Side Channel	0.80	7
Steel Creek	3.30	4
Swamp Creek	2.70	15
York Gulch	1.13	0
Total	**17.90**	**61**

In 2018, FWP conducted electrofishing surveys to determine N_b in the Big Hole River drainage. Surveys were conducted on 10 reaches over a total of 17.5 miles. A total of 128 YOY grayling were captured, and genetic samples were taken. All 128 genetics samples were used to N_b. N_b for the 2018 grayling spawn was 145 (confidence interval: 115–191; Table 10). Other species sampled included brook trout, brown trout, rainbow trout, burbot, sculpin, longnose dace, white suckers, and longnose suckers.

Table 10. Grayling captured during 2018 FWP Fall one-pass electrofishing surveys in the Big Hole River watershed.

Reach Location	Reach Length (mi.)	Number of Arctic Grayling YOY
Deep Creek	2.06	0
Howell Creek	0.82	0
Howell Creek Side Channel	0.88	20
Plimpton Creek	3.13	45
Pintler Creek	0.51	2
Rock Creek	2.44	0
Squaw Creek Side Channel	0.80	28
Steel Creek	3.03	24
Swamp Creek	2.70	9
York Gulch	1.13	0
Total	**17.50**	**128**

In 2019, FWP conducted electrofishing surveys to determine N_b in the Big Hole River drainage. Surveys were conducted on 10 reaches for a total of 16.6 miles. A total of 380 YOY grayling were captured, and genetic samples were taken. Due to budgetary constraints, 145 genetics samples were used to calculate N_b. N_b for the 2019 grayling spawn was 333 (confidence interval: 204–510; Table 11). Other species sampled included brook trout, brown trout, rainbow trout, burbot, sculpin, longnose dace, white suckers, and longnose suckers.

Table 11. Grayling captured during 2017 FWP Fall one-pass electrofishing surveys in the Big Hole River watershed.

Reach Location	Reach Length (miles)	Number of Arctic Grayling YOY
Deep Creek	2.06	11
Howell Creek	0.59	0
Howell Creek Side Channel	0.88	8
Pintler Creek	0.51	12
Plimpton Creek	3.13	261
Rock Creek	2.44	0
Sqauw Creek Side Channel	0.8	27
Steel Creek	3.03	43
Swamp Creek	2.7	18
York Gulch	0.46	0
Total	**16.6**	**380**

Table 12. Estimates of family summary statistics and N_b for Arctic Grayling from the Big Hole River. N is number of individuals genotyped, FS families is the estimated number of full-sibling families, FS^1 is the number of estimated full-sibling families of size 1, FS^1/N is the proportion of FS^1 in the sample, and FE is family evenness. N_b shows estimates of the effective number of breeders, based on 12 microsatellites. LCI and UCI are the lower and upper (respectively) 95% confidence intervals for the N_b estimate from each year

Year	N	FS	FS^1	FS^1/N	FE	N_b	LCI	UCI
2007	50	45	40	0.800	0.991	**107.1**	76.2	171.7
2008	30	28	26	0.867	0.993	**77.2**	47.6	175.7
2009	128	99	82	0.641	0.973	**77.6**	66.7	91.4
2010	46	41	37	0.804	0.987	**92.4**	66.1	146.0
2011	66	57	51	0.773	0.984	**81.9**	64.5	108.9
2012	56	55	54	0.964	0.998	**289.0**	142.8	5050.9
2013	49	48	47	0.959	0.998	**432.7**	171.7	∞
2014	88	80	73	0.830	0.992	**268.4**	166.8	614.1
2015	56	55	54	0.964	0.998	**181.9**	109.2	465.5
2016	51	46	41	0.804	0.991	**96.1**	68.0	155.3
2017	63	57	53	0.841	0.987	**155.4**	103.3	289.7
2018	128	112	99	0.773	0.989	**145.2**	115.1	191.3
2019	145	133	121	0.834	0.994	**332.8**	203.7	510.1

B. Stream Temperature Monitoring

From 2017–2019, FWP collected stream temperature data throughout the upper Big Hole Watershed (See Tables 13–15). Stream temperature data were collected at the upper boundary of the project area, Big Hole Arctic Grayling CCAA standardized monitoring sites that include one mainstem and tributary location within each management segment (A–E; Figure 3).

In 2017, stream temperature data were collected in the Big Hole River at Miner Lakes Road, the confluence with Miner Creek, Wisdom Bridge, and Dickie Bridge. Two thermographs were lost on the Big Hole River at Saginaw Bridge and Mudd Creek Bridge. The 2017 Big Hole River tributary sites included Governor Creek, Miner Creek, Rock Creek, Steel Creek, and Deep Creek. Stream temperature data were recorded at 60-minute intervals from May 2nd through October 1. The 2017 data were summarized maximum and mean temperature for the monitoring period and hours and days exceeding 21.1º C (70º F) and 25º C (77º F; Table 13). The thermal stress threshold for salmonid species is considered 21.1º C (70 º F; Behkne 1991), and 25º C (77º F) represents the upper incipient lethal temperature for Arctic Grayling (Lohr et al. 1996).

Table 13. Stream temperature monitoring results for 2017.

Monitoring Site (Big Hole Arctic Grayling CCAA Management Section	Mean Seasonal Temperature ºC (ºF)	Maximal Seasonal Temperature ºF (ºC)	Cumulative Hours Exceeding 25º C (77º F)
Big Hole River Dickie Bridge	14.6 (58.3)	24.3 (75.9)	0
Big Hole River Miner Confluence	13.2 (55.7)	21.7 (71.1)	0
Big Hole River Miner Lakes	12.0 (53.5)	21.7 (71.1)	0
Big Hole River Wisdom Bridge	14.6 (58.3)	23.4 (74.1)	0
Deep Creek	12.4 (54.3)	21.8 (71.2)	0
Governor Creek	13.5 (56.3)	23.6 (74.6)	0
Miner Creek	13.1 (55.7)	22.0 (71.7)	0
Rock Creek	13.8 (56.9)	23.2 (73.7)	0
Steel Creek	14.9 (58.8)	25.0 (76.9)	2

In 2018, stream temperature data were collected in the Big Hole River at Miner Lakes Road, the confluence with Miner Creek, Wisdom Bridge, and Dickie Bridge. Two thermographs were lost on the Big Hole River at Saginaw Bridge and Mudd Creek Bridge. The 2018 Big Hole River tributary sites included Governor Creek, Rock Creek, Steel Creek, and Deep Creek. One tributary site thermograph was lost on Miner Creek. Stream temperature data were recorded at 60-minute intervals from May 5th through October 1. The 2018 data were summarized maximum and mean temperatures for the monitoring period and hours and days exceeding 21.1º C (70º F) and 25º C (77º F; Table 14). The thermal stress threshold for salmonid species is considered 21.1º C (70 º F; Behkne 1991), and 25º C (77º F) represents the upper incipient lethal temperature for Arctic Grayling (Lohr et al. 1996).

Table 14. Stream temperature monitoring results for 2018.

Monitoring Site (Big Hole Arctic Grayling CCAA Management Section	Mean Seasonal Temperature ºC (ºF)	Maximal Seasonal Temperature ºF (ºC)	Cumulative Hours Exceeding 25º C (77º F)
Big Hole River Dickie Bridge	14.4 (58.0)	23.6 (74.6)	0
Big Hole River Miner Confluence	13.1 (55.6)	22.1 (71.7)	0
Big Hole River Miner Lakes	11.7 (53.1)	20.8 (69.5)	0
Big Hole River Wisdom Bridge	14.6 (58.4)	23.7 (74.6)	0
Deep Creek	12.0 (53.6)	20.8 (69.4)	0
Governor Creek	13.5 (56.3)	23.1 (73.6)	0
Rock Creek	13.6 (56.4)	21.1 (70.0)	0
Steel Creek	14.6 (58.4)	23.2 (73.7)	0

In 2019, stream temperature data were collected in the Big Hole River at Saginaw Bridge, Miner Lakes Road, the confluence with Miner Creek, Wisdom Bridge, Mudd Creek Bridge, and Dickie Bridge. The 2019 Big Hole River tributary sites included Governor Creek, Rock Creek, Miner Creek, Steel Creek, and Deep Creek. Stream temperature data were recorded at 60-minute intervals from May 2nd through October 1st. The 2019 data were summarized maximum and mean temperatures for the monitoring period and hours and days exceeding 21.1º C (70º F) and 25º C (77º F; Table 15). The thermal stress threshold for salmonid species is considered 21.1º C (70 º F; Behkne 1991), and 25º C (77º F) represents the upper incipient lethal temperature for Arctic Grayling (Lohr et al. 1996).

Table 15. Stream temperature monitoring results for 2019.

Monitoring Site (Big Hole Arctic Grayling CCAA Management Section	Mean Seasonal Temperature ºC (ºF)	Maximal Seasonal Temperature ºF (ºC)	Cumulative Hours Exceeding 25º C (77º F)
Big Hole River Dickie Bridge	14.0 (57.2)	24.2 (75.5)	0
Big Hole River Miner Confluence	12.7 (54.9)	21.7 (71.1)	0
Big Hole River Miner Lakes	11.61 (52.9)	20.7 (69.3)	0
Big Hole River Mudd Creek	14.7 (58.5)	25.1 (77.2)	1
Big Hole River Wisdom Bridge	14.0 (57.3)	23.9 (75.0)	0
Big Hole River Saginaw Bridge	10.1 (50.2)	19.2 (66.5)	0
Deep Creek	11.8 (53.2)	21.9 (71.4)	0
Governor Creek	13.0 (55.3)	23.9 (75.0)	0
Miner Creek	12.7 (54.9)	22.0 (71.5)	0
Rock Creek	12.7 (54.9)	18.4 (65.1)	0
Steel Creek	13.9 (57.0)	24 (75.1)	0

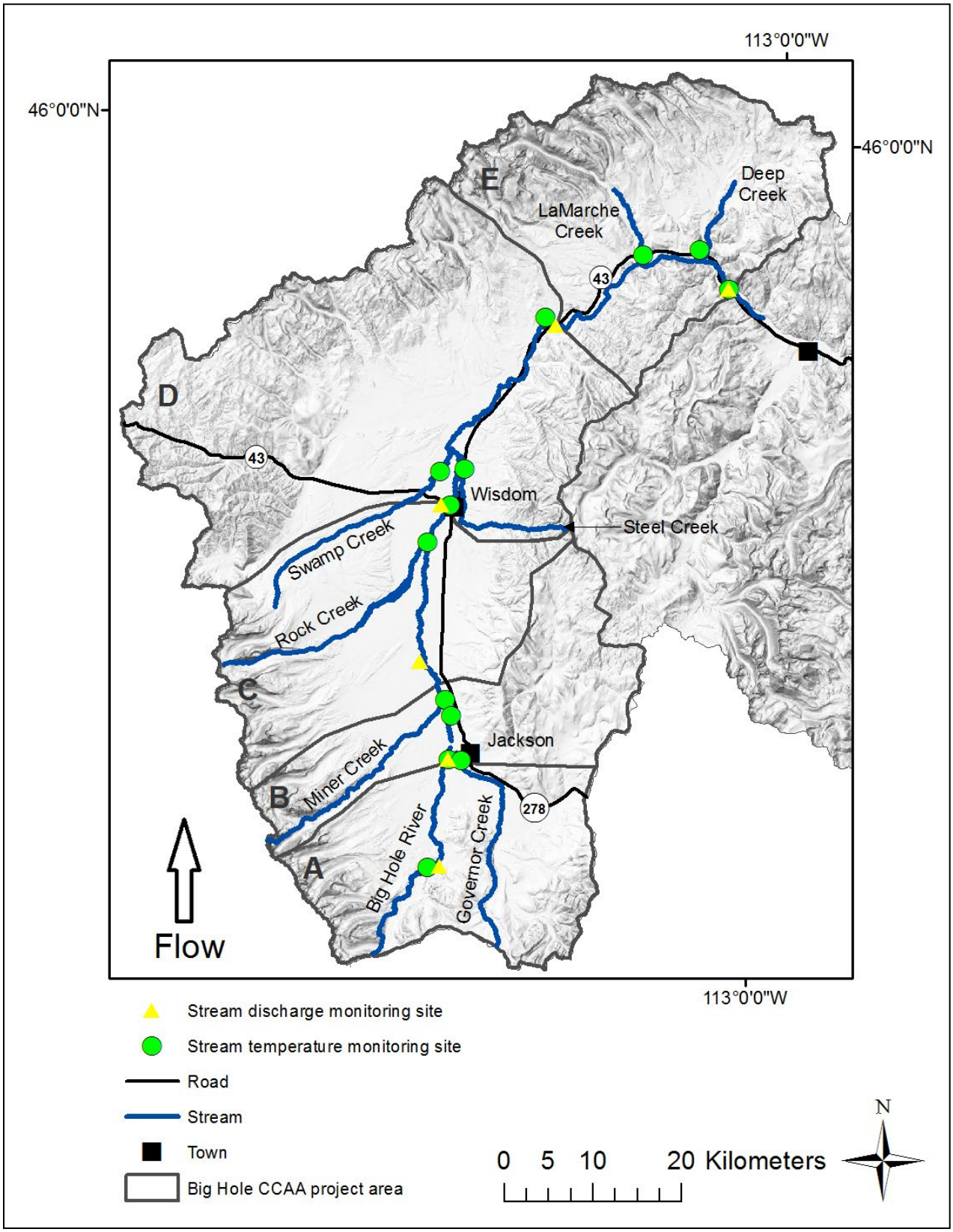
113°0'0"W
46°0'0"N
46°0'0"N
E
LaMarche Creek
Deep Creek
43
D
43
Wisdom
Steel Creek
Swamp Creek
Rock Creek
C
Jackson
Miner Creek
B
278
Big Hole River
Governor Creek
A
Flow
113°0'0"W
Stream discharge monitoring site
Stream temperature monitoring site
Road
Stream
Town
Big Hole CCAA project area
0 5 10 20 Kilometers
N

Figure 3. Stream temperature (green circle) and stream discharge (yellow triangle) monitoring sites in the Big Hole Arctic Grayling CCAA Project Area.

C. Streamflow Monitoring

Along with two USGS real-time streamflow gages located at management segments C and D, DNRC continued to operate and maintain four real-time streamflow gages located at the upper project boundary and at management segments A, B, and E (Figure 3). In addition, DNRC continuously monitored flow in at least one tributary within each management segment and six key irrigation ditches.

Snowpack and precipitation data were monitored by NRCS (available at www.nrcs.gov), and results are based on the period-of-record (1981–2010).

In 2017, the Big Hole basin snowpack was 105% (median) and precipitation was 111% of average. Slightly above normal snowpack and precipitation resulted in Big Hole Arctic Grayling CCAA stream discharge targets being met 84% of the time (Figure 4).

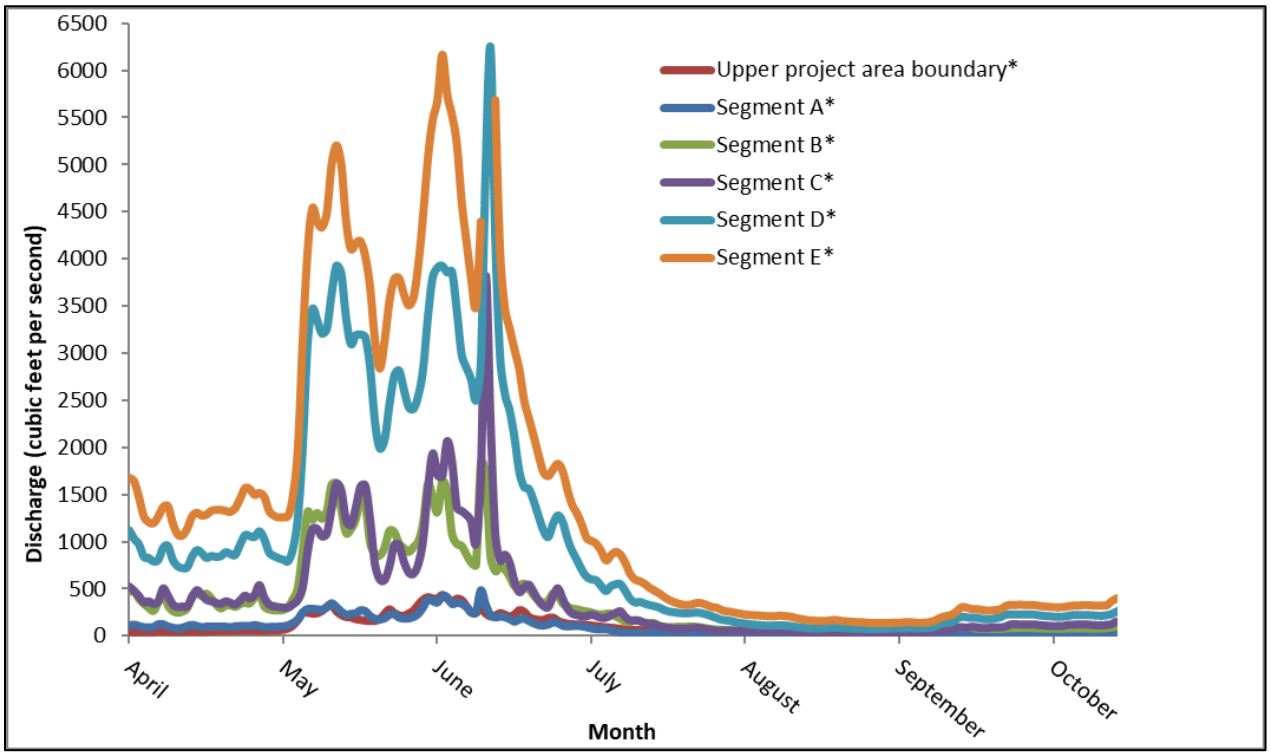

Figure 4. Stream discharge data collected from the Big Hole River at real-time gaging stations located at the upper Big Hole Arctic Grayling CCAA project area boundary (Saginaw Bridge) and the lower boundary of each Big Hole Arctic Grayling CCAA management segment (A–E) in 2017.

In 2018, the Big Hole basin snowpack was 145% (median) and precipitation was 117% of average. Above normal snowpack and precipitation resulted in Big Hole Arctic Grayling CCAA stream discharge targets being met 87% of the time (Figure 5).

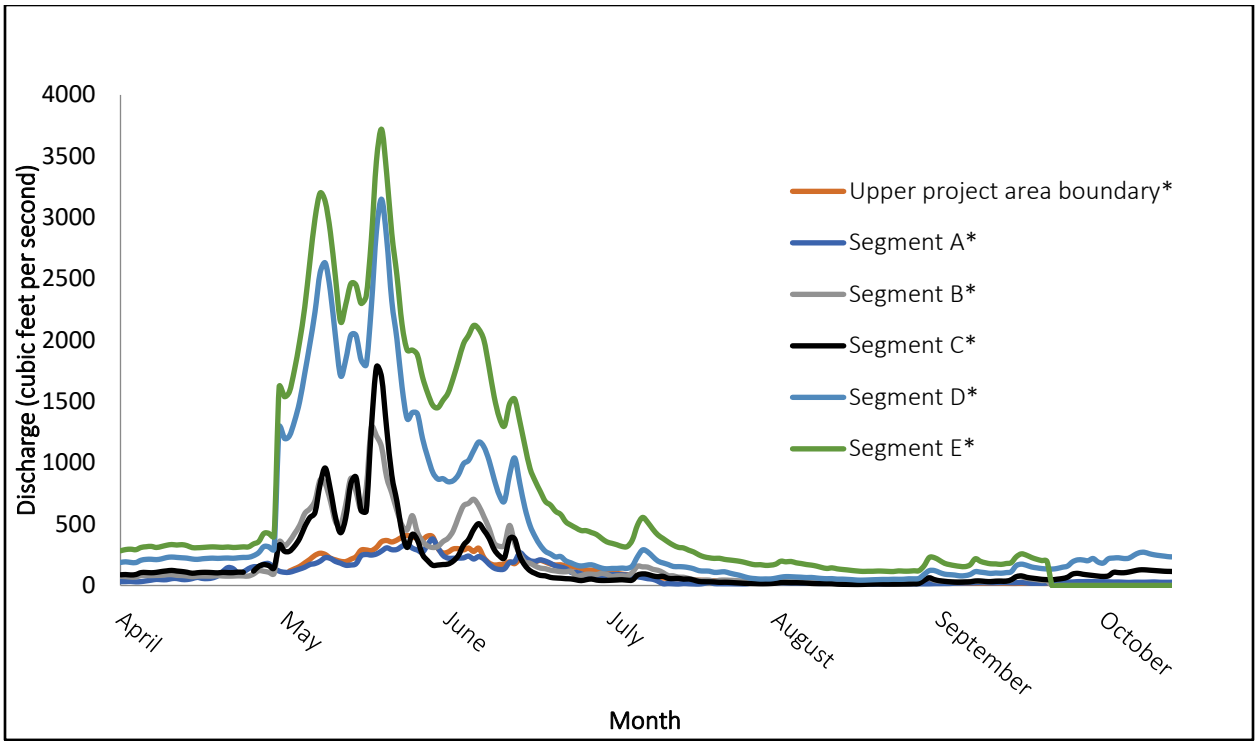

Figure 5. Stream discharge data collected from the Big Hole River at real-time gaging stations located at the upper Big Hole Arctic Grayling CCAA project area boundary (Saginaw Bridge) and the lower boundary of each Big Hole Arctic Grayling CCAA management segment (A–E) in 2018.

In 2019, the Big Hole basin snowpack was 94% (median) and precipitation was 96% of average. Below normal snowpack and precipitation resulted in Big Hole Arctic Grayling CCAA stream discharge targets being met 76% of the time (Figure 6).

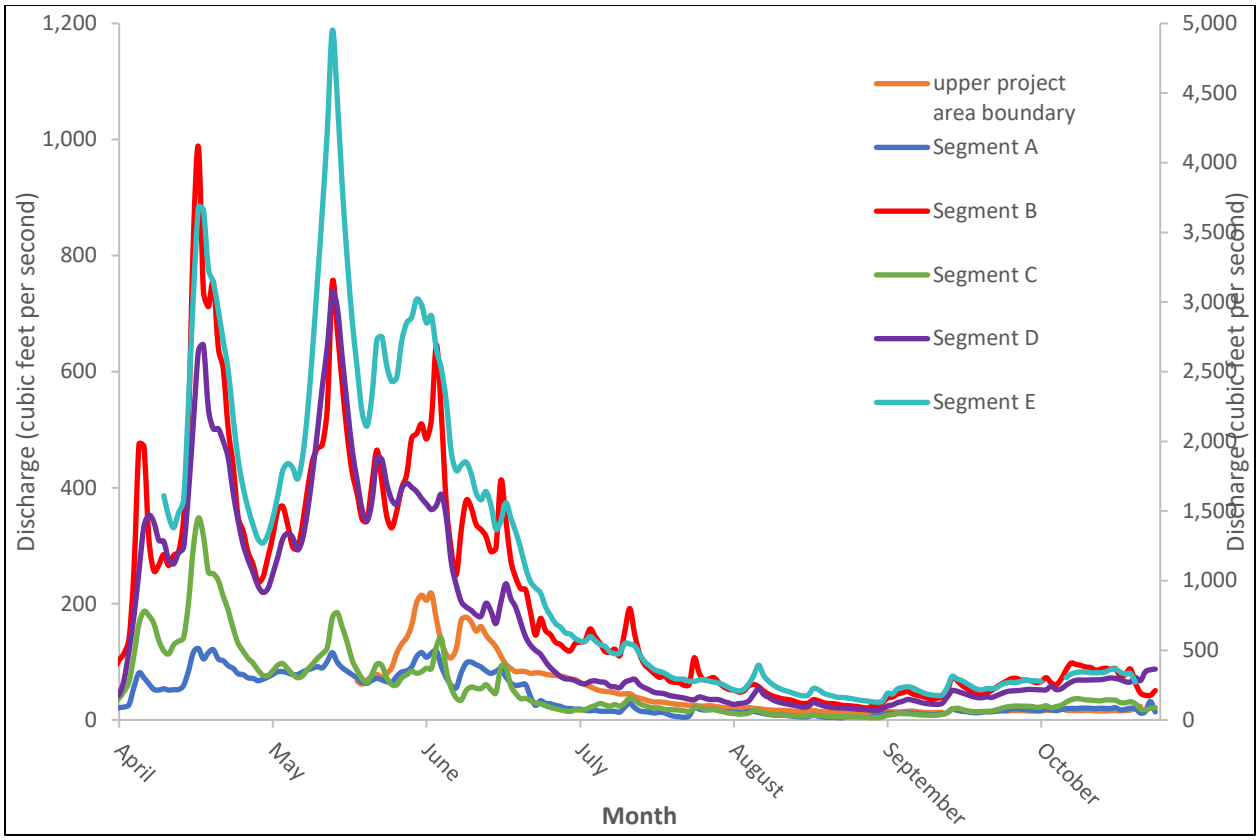

Figure 6. Stream discharge data collected from the Big Hole River at real-time gaging stations located at the upper Big Hole Arctic Grayling CCAA project area boundary (Saginaw Bridge) and the lower boundary of each Big Hole Arctic Grayling CCAA management segment (A–E) in 2019.

D. FWP Monitoring of Compliance with Approved Site-Specific Plans

The monitoring of compliance with approved site-specific plans has occurred annually on the following Properties: 1–32. All landowners with approved site-specific plans followed their plan in 2017 through 2019. FWP field personnel checked the amount of water being diverted by the landowners, the trend of riparian areas under a grazing or riparian management plan, the ability of fish to access fish passage structures and for any evidence of immediate threats of harm or mortality to on the enrolled properties. The initial compliance meetings focus on expectations for monitoring the riparian management and irrigation diversion agreements in the approved site-specific plan. The necessary field forms for documenting actions are provided to the landowners at that time.

VIII. Summary of Estimated Take Associated with the Big Hole Arctic Grayling CCAA

In 2014, the USFWS determined that listing the upper Missouri River Basin Distinct Population Segment of Arctic Grayling, as threatened or endangered under the Endangered Species Act was not warranted. Due to the current legal status of Arctic Grayling, ESA-defined take (harm, harass or kill) did not apply to the implementation or monitoring of the Big Hole Arctic Grayling in 2017–2019.

IX. NRCS Special Funding

In 2018, the NRCS secured funding for a 4-year, permanent seasonal position in cooperation with FWP and DNRC. The position was hired by FWP to assist with CCAA grazing management plans, fisheries monitoring, and CCAA monitoring. This position was hired in the spring of 2018–2019 through FWP and DNRC. The position will be rehired in February of 2020 through the duration of the agreement. The NRCS will continue to pursue and meet the obligations of existing EQIP contracts with enrolled landowners in 2020.

X. Literature Cited

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