Upper Shields River Watershed Yellowstone Cutthroat Trout Conservation and Brook Trout Removal

Draft Environmental Assessment
2022

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Executive Summary

Yellowstone cutthroat trout (Figure 1) are a Montana native facing an uncertain future. This spotted golden fish with its namesake red slash along its jaw has disappeared from 67% of its historically occupied habitat in Montana. Habitat degradation, barriers to movement, dewatering, and historical overfishing have played roles in the decline. Currently, the greatest threats to Yellowstone cutthroat trout are nonnative trout and shrinking of habitat that remains cold enough in a warming climate. Concerted conservation efforts among multiple partners are working to protect the populations that remain and restore populations where possible. For more background on this stunning native trout see the Yellowstone cutthroat trout story map[1].

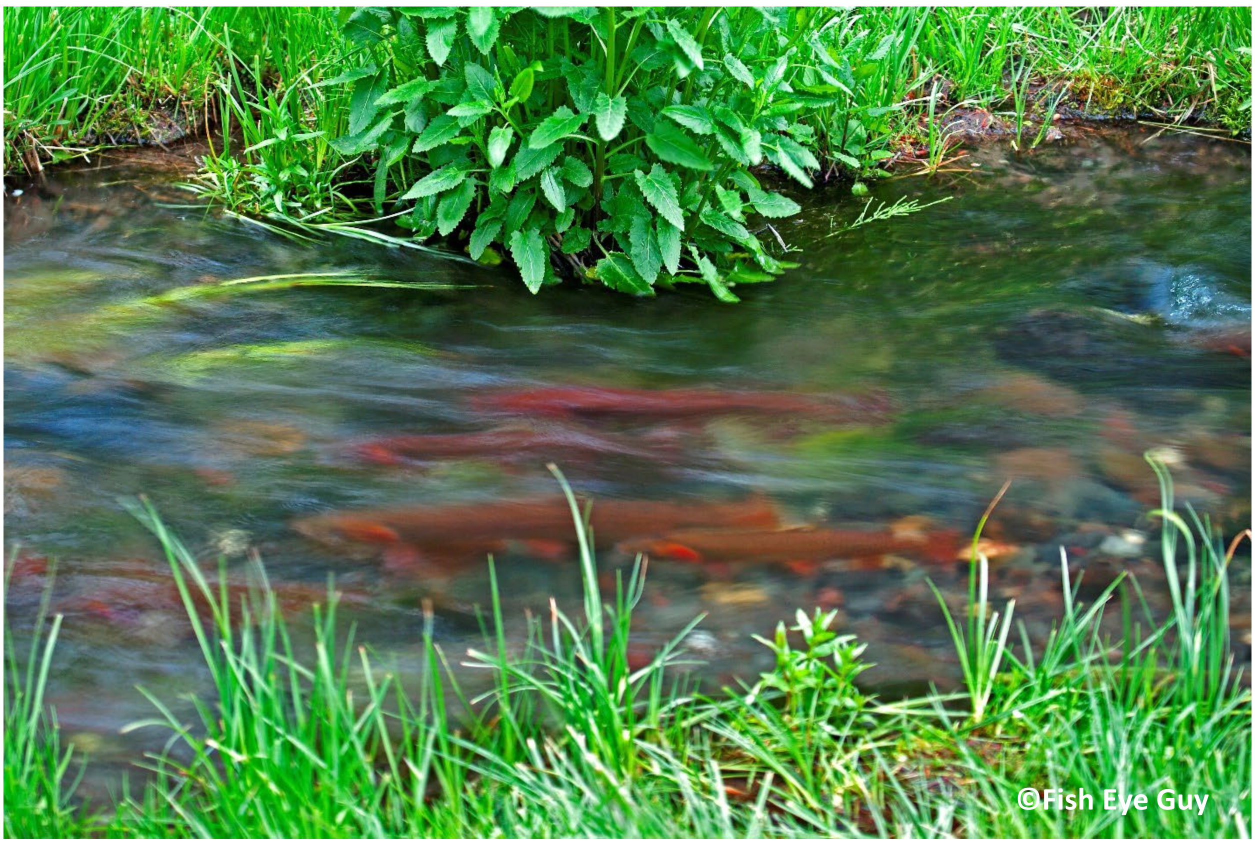

Figure 1. Yellowstone cutthroat trout in a small stream.

The population of Yellowstone cutthroat trout in the upper Shields River watershed (Figure 2) is among the highest priorities for protection. Recent establishment of brook trout has put this population at risk of disappearing. Brook trout use the same resources as Yellowstone cutthroat trout. Probably most harmful to Yellowstone cutthroat trout is that brook trout young use the same habitat and food as Yellowstone cutthroat trout young. As fall spawners, brook trout fry

[1] https://mtfwp.maps.arcgis.com/apps/Cascade/index.html?appid=fdf5c7af3413435da2c2190aab5ef9c3

head to this habitat after emerging in early spring and grow, while Yellowstone cutthroat trout are still incubating in the streambed. When Yellowstone cutthroat trout fry emerge in summer, much larger brook trout are living in the habitat young cutthroat trout need. Across the western United States, brook trout are pushing native cutthroat trout out of headwater streams. Additionally, cutthroat trout are less likely to remain in streams with brook trout than other nonnative trout.

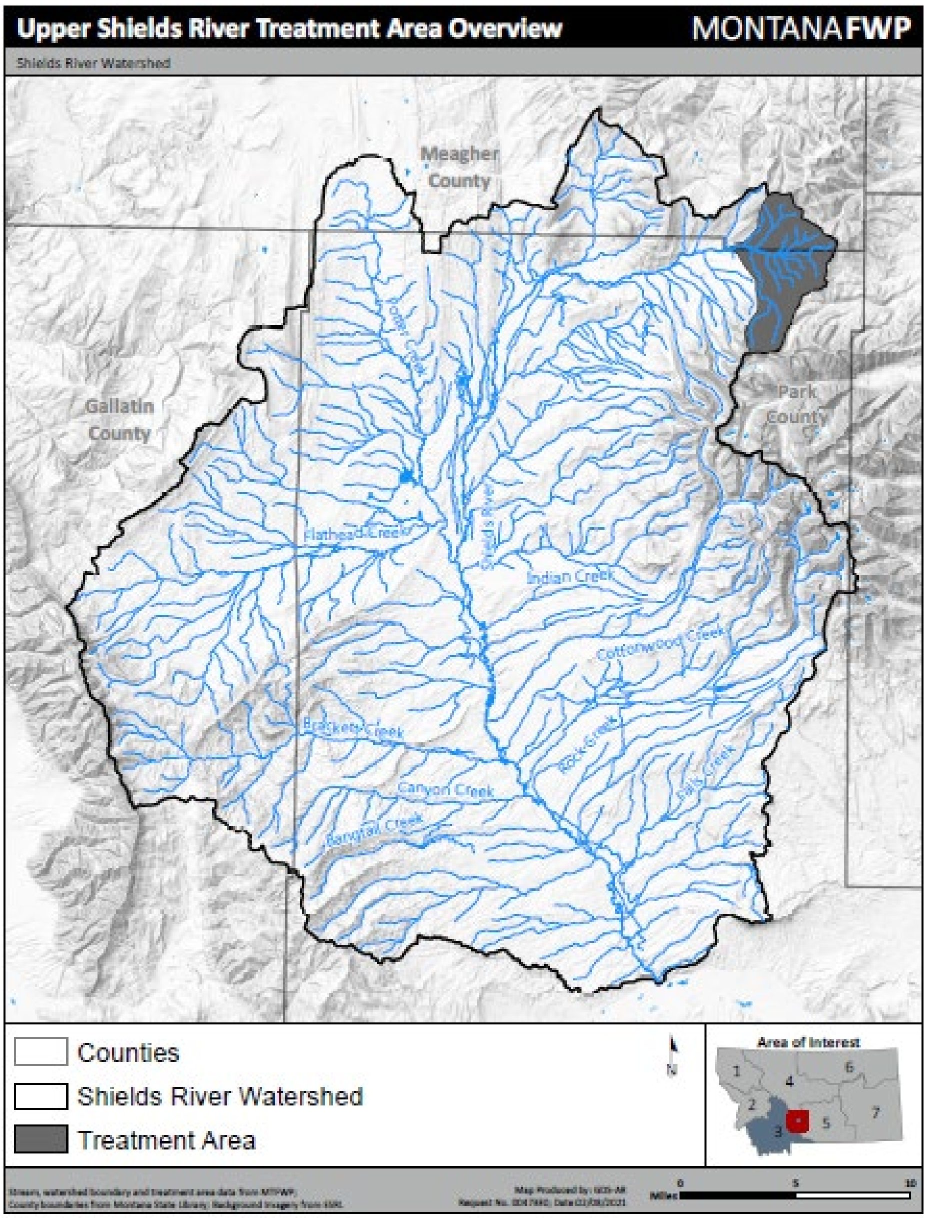

Figure 2. The Shields River watershed and upper Shields River project area.

The invasion of brook trout into the project area was documented during the 2000s. The invasion and establishment was rapid, and quick action was recommended to protect the area's

Yellowstone cutthroat trout. A barrier to upstream movement of fish was placed at the boundary of the Custer Gallatin National Forest (CGNF) which protects 27 miles of connected stream habitat for Yellowstone cutthroat trout from invasion of nonnative trout. Several years of mechanical removal reduced but did not eliminate brook trout, and brook trout quickly rebounded when removal effort was reduced. Brook trout effectively use woody debris to avoid capture, and the size and complexity of the project area guarantees mechanical removal with electrofishing would not remove all brook trout. Agencies do not have the resources for perpetual suppression efforts as other populations of cutthroat trout need protection.

The use of rotenone is the preferred alternative to save the upper Shield River's Yellowstone cutthroat trout because mechanical removal will not work to eliminate brook trout. Rotenone is a chemical produced by plants in the Southern Hemisphere, and Indiginous peoples have used it for centuries to collect fish for food.

The advantage of using rotenone is that brook trout can be eliminated within 1 to 3 treatments, and agencies can move on to protect other at risk cutthroat trout populations and restore lost populations. Rotenone is deadly to fish, and some gilled invertebrates and amphibians are vulnerable. Nevertheless, it breaks down rapidly in the environment and the nontarget insects and amphibians recover through natural mechanisms with full recovery typically documented within a year. Frogs and toads are vulnerable to rotenone while in the tadpole stage, and stream flow in the project area is too low for treatment post-metamorphosis; however, these animals have long life spans and tremendous reproductive potential. Populations recover rapidly from loss of tadpoles. Likewise, using the lowest effective concentration of rotenone for a short duration is the recommended practice to limit harm to nontarget organisms.

A complication in the project area is wildfire that burned much of the watershed in 2021. This burn has likely affected water quality and fish distribution. Within a few years, deadfall timber will add complexity and make moving around the project area much more difficult.

This environmental assessment (EA) evaluates the potential of the following two alternatives to affect the natural environment and humans.

Alternative 1. Protect a core conservation population of Yellowstone cutthroat trout by removing nonnative brook trout using rotenone. An initial pilot study on several tributaries in 2022 will inform treatment concentrations required in a watershed altered chemically and physically by recent wildfire. Native Yellowstone cutthroat trout and Rocky Mountain sculpin in the project area would be salvaged from the project area using electrofishing before treatment, held outside the treatment area during the rotenone treatment, and then returned to the stream after treatment has stopped. Where encountered, tadpoles would be netted and held

outside of the treatment area and returned after treatment. A deactivation station at the downstream end of the project area would break down the rotenone within 30 minutes stream travel time. Treatment would begin in 2022 and continue for up to 5 years or until monitoring has confirmed eradication of brook trout.

Alternative 2: No action

Under the no action alternative, agencies would not implement the project which includes salvage of existing Yellowstone cutthroat trout, treatment with rotenone, and return of salvaged fish to streams. The Yellowstone cutthroat trout in the project area would remain at risk of displacement by brook trout. An opportunity to safeguard a core conservation population in an area with high probability of remaining suitable in a warming climate would be lost. Not removing brook trout would jeopardize the project area's Yellowstone cutthroat trout which would be a substantial conservation loss for the Shields River watershed and potentially have range-wide ramifications for legal status of Yellowstone cutthroat trout when combined with other losses. The barrier at the downstream end of the project area would prevent Yellowstone cutthroat trout from recolonizing these waters.

Alternative 1 is the proposed action. As detailed in the thorough analysis of the evidence presented in the EA, the proposed actions would have short-term and minor effects on the natural and human environment. All brook trout, Rocky Mountain sculpin, and Yellowstone cutthroat trout evading capture during salvage would die. Some aquatic invertebrates and gilled amphibians would die; however, not all species or life history stages of organisms are vulnerable, and many would remain to recolonize treated waters. Rotenone would not pose a health risk to humans or wildlife.

MEPA requires public involvement and opportunity for the public to comment on projects undertaken by the acts' respective agencies. A 30-day public comment period will extend from May 23, 2022, to June 23, 2022. A public meeting will be held June 1 at the Livingston Public Library, 228 W Callender St, Livingston, MT 59047, from 5:30 to 7:00 p.m. and June 2 at the Wilsall Fire Hall, 207 Elliot St, Wilsall, MT 59086, from 5:30 to 7:00.

Comments must be received by 5:00 p.m. June 23, 2022.

Montana Fish, Wildlife & Parks
R-3 Fisheries
Upper Shields River Yellowstone cutthroat trout conservation
1400 South 19th Street
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Email comments to comment fwprg3@mt.gov.

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List of Abbreviations

DEQ	Montana Department of Environmental Quality
EA	Environmental Assessment
eDNA	Environmental DNA
EPA	U. S. Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera (mayflies, stone flies, & caddisflies)
FWP	Montana Fish, Wildlife & Parks
$KMnO_4$	potassium permanganate
MCA	Montana Code Annotated
MCTSC	Montana Cutthroat Trout Steering Committee
MEPA	Montana Environmental Policy Act
mg/L	Milligrams per liter
MNHP	Montana Natural Heritage Program
MOU	Memorandum of understanding
MRDG	Minimum requirements decision guide
NEPA	National Environmental Policy Act
ppb	Parts per billion
ppm	Parts per million
USFS	U. S. Forest Service
USFWS	U.S. Fish and Wildlife Service

1 PROPOSED ACTION and BACKGROUND

1.1 *Need for Proposed Action*

1.1.1 Background

Yellowstone cutthroat trout (Figure 3) are native to portions of Montana, Wyoming, Idaho, Nevada, and Utah and occupied cold, clean waters throughout their historical range. Yellowstone cutthroat trout share the honor of being Montana's state fish with westslope cutthroat trout. This stunning fish is an essential component of the natural character of trout-bearing waters in the Yellowstone River watershed and provides highly valued fishing opportunities and enjoyment of native fish in beautiful settings. Yellowstone cutthroat trout provide food for a diversity of animals including grizzly bears, osprey, eagles, and river otters, and are the top predator in aquatic systems when not paired with nonnative trout. A story map provides background on the history, ecology, and status of Yellowstone cutthroat trout.

Figure 3. Yellowstone cutthroat trout.

Yellowstone cutthroat trout have declined substantially in distribution and abundance (Figure 4), and in Montana, they occupy 33% of their historical range (Endicott et al. 2016). Range-wide, agencies, conservation groups, and landowners are working toward protecting, restoring, and conserving Yellowstone cutthroat trout to stave off more losses and ensure Yellowstone cutthroat trout do not decrease to the point they need protection under the Endangered Species Act or become extinct. The goal of the proposed action is to prevent the loss of a population of Yellowstone cutthroat trout that faces the dire threat of a recent brook trout invasion. Similar projects have been successful in protecting or restoring populations of native cutthroat trout throughout the western United States. Montana Fish, Wildlife & Parks (FWP) and its conservation partners implement several such projects in Montana each year as a common practice in native fish conservation and nuisance species removal.

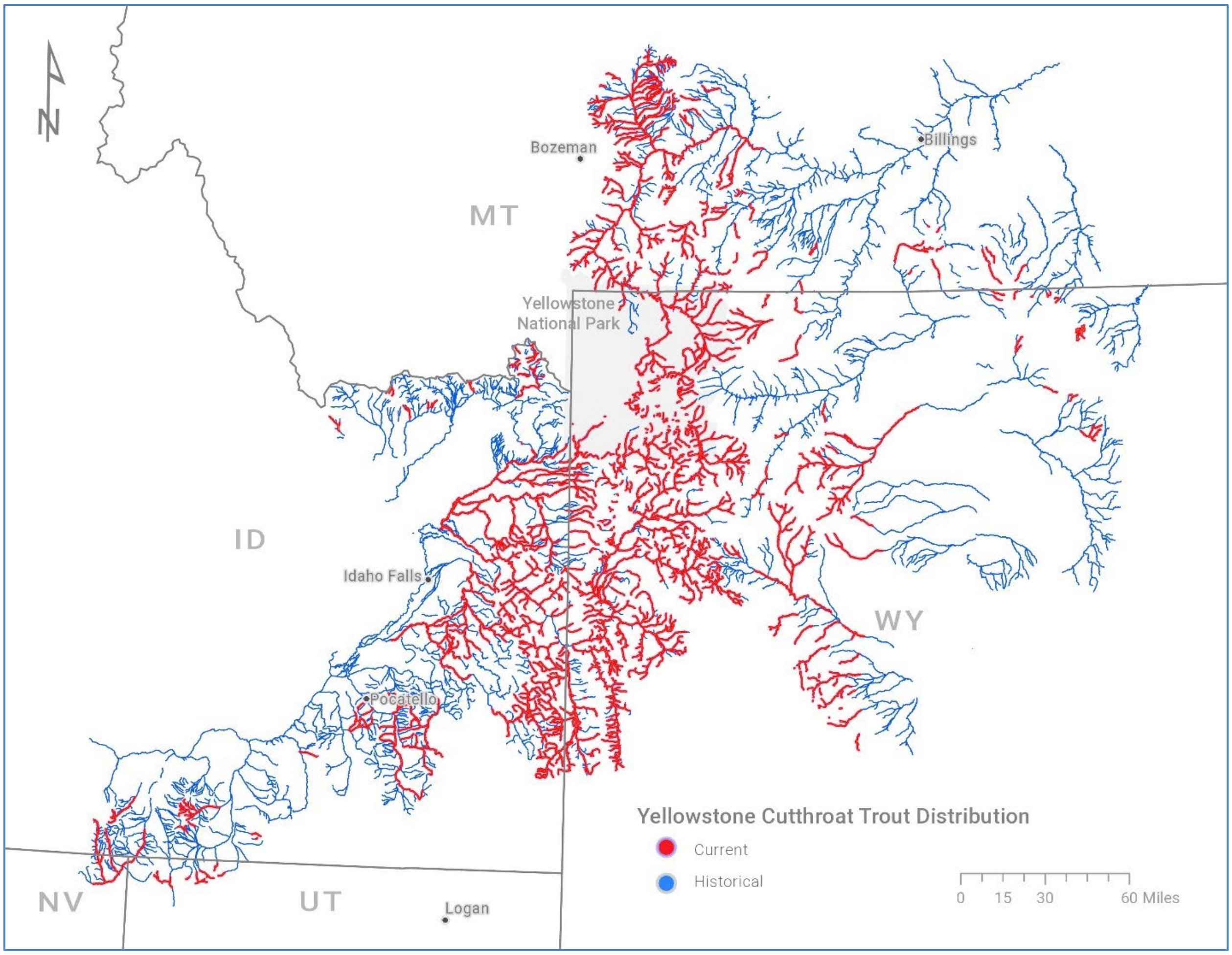

Figure 4. Historical and current distribution of Yellowstone cutthroat trout in their native range (Endicott et al. 2016).

The proposed action addresses the essential need to remove brook trout from the upper Shields River watershed (Figure 5). The area has tremendous conservation value for Yellowstone cutthroat trout and is designated as a core conservation area for this declining species with removal of brook trout being an identified conservation priority (Endicott et al. 2012; Shepard et al. 2015; FWP 2019). Cutthroat trout are less likely to persist alongside brook trout than with other nonnative trout (Griffiths 1988), and their ability to displace cutthroat trout is especially pronounced in headwater streams (Dunham et al. 2002).

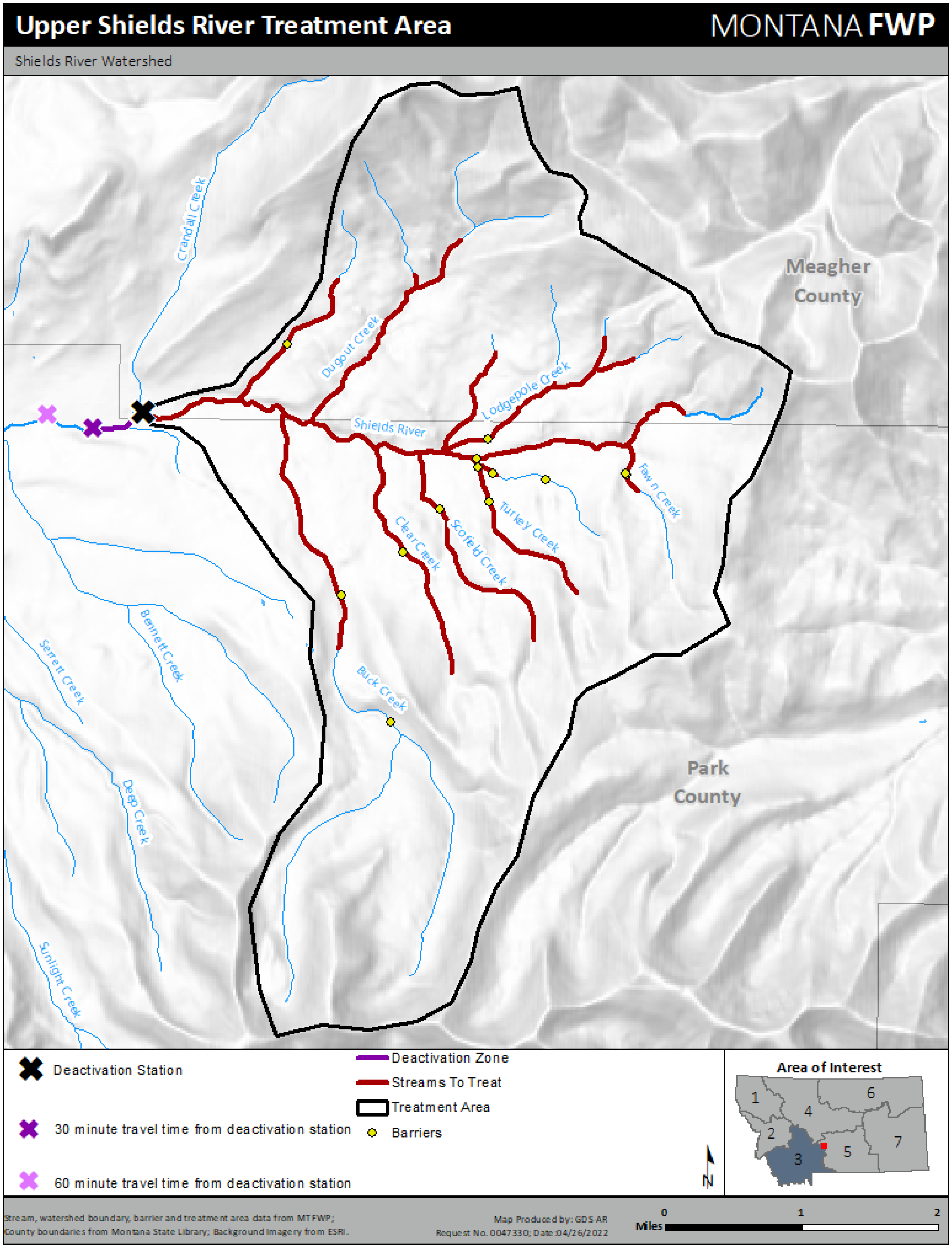

Figure 5. The upper Shields River Yellowstone cutthroat trout conservation project area.

Being at high elevation and at the northernmost extent of the Yellowstone cutthroat trout's native range, the project area provides an ideal location to secure a population of Yellowstone cutthroat trout. Climate change is constricting the amount of suitable habitat for cutthroat trout to higher elevations, and brook trout greatly diminish the probability of cutthroat trout being able to persist in a warming climate (Isaak et al. 2015; Isaak et al. 2017). These high elevation and northern areas will be among the few parts of the historical range that will be capable of supporting Yellowstone cutthroat trout within a few decades making protection of these populations a priority.

Rocky mountain sculpin, a nongame species of fish, also dwells in the project area. Project goals are to maintain the natural integrity of the project area which would include restoring this species to the project area after rotenone treatment. Invertebrates and amphibians would recover on their own through multiple, natural mechanisms. Rocky Mountain sculpin would be salvaged along with Yellowstone cutthroat trout before rotenone treatment, held outside treated waters in live cars in protected streams, then returned to the project area after treatment. Past experience has shown sculpin populations repopulate after being returned to reclaimed waters (FWP 2021).

Finding brook trout established in this stronghold for Yellowstone cutthroat trout was alarming given the grave threat brook trout pose to Yellowstone cutthroat trout. This recent invasion provided an opportunity to study the dynamics of brook trout invasion which was found to be rapid and a substantial threat to Yellowstone cutthroat trout in a core conservation area (Shepard et al. 2015). The primary conclusion was removing brook trout was necessary to prevent this population of Yellowstone cutthroat trout from disappearing.

FWP, the Wildlife Conservation Society, the Custer Gallatin National Forest (CGNF), and the U.S. Geological Service partnered in investigations to save the watershed's Yellowstone cutthroat trout while the invasion study (Shepard et al. 2015) was ongoing. Among goals of the investigations was to identify a location for a barrier and verify that the location would not block migratory Yellowstone cutthroat trout.

This planning effort coincided with extensive road improvements ongoing in the upper Shields River watershed designed to reduce sediment delivery to stream channels and to restore aquatic organism passage at stream crossings where warranted. Four undersized, perched culverts were left in place as temporary fish barriers to facilitate brook trout removal with electrofishing, prevent brook trout reinvasion, and to serve as holding waters for salvaged cutthroat trout. The outlets of three of these culverts were modified to increase their effectiveness for preventing upstream brook trout invasion. Once brook trout removal

objectives are met, temporary barriers will be replaced with aquatic organism passage culverts. A barrier blocking upstream movement of fish was constructed at the CGNF boundary near the campground and Crandall Creek in 2016 (Figure 6). This barrier defines the lower end of the treatment area and protects over 27 miles of habitat for Yellowstone cutthroat trout from nonnative fish invasion.

Figure 6. Constructed barrier protecting the upper Shields River project area.

Barriers bring trade-offs between allowing for connectivity and preventing displacement by nonnative species. Connectivity supports gene flow, allows fish to recolonize after catastrophic disturbance, and supports migratory life-history strategies. However, the threat brook trout pose to cutthroat trout in headwaters streams has made barriers a crucial tool in conservation of cutthroat trout (Thompson and Rahel 1998; Hilderbrand and Kershner 2000; Novinger and Rahel 2003; Peterson et al. 2008). Constructed barriers are protecting populations of cutthroat trout and other native trout in Montana and the western U.S. as essential measures to prevent further loss of populations and expand distribution of native fish within their historical range.

The amount and quality of habitat are key considerations in identifying appropriate locations to secure native trout upstream of a barrier. The upper Shields River barrier protects 27 miles of high-quality habitat for Yellowstone cutthroat trout from nonnative fish invasion, which greatly exceeds the minimum recommended amount of 5 miles of stream habitat (Hilderbrand and Kershner 2000), provides enough high-quality habitat to support a population of Yellowstone cutthroat trout (Peterson et al. 2008), and will be resilient to climate change (Isaak et al. 2017). Combined, these factors make the project area an ideal place to protect an at-risk population of Yellowstone cutthroat trout.

Mechanical removal of brook trout began in Fall 2014 and continued through the Fall 2020 (Belcer and Opitz 2020; Opitz and McCormack 2020). Yellowstone cutthroat trout were more abundant in most of the sampled reaches in the first three years (Figure 7); however, brook trout comprised a substantial proportion of trout captured. Removal effort was considerably less in 2018 and 2019, and the numbers caught reflected the reduced effort. In 2020, the sampling effort was greater than in the two previous years and focused on areas where brook trout had been most numerous in previous years. Brook trout were more abundant than Yellowstone cutthroat trout, accounting for 53% of all trout captured which is consistent with the findings of substantial reproduction of brook trout when removal pressure is lifted (Meyer et al. 2006). Longitudinal trends were similar among years with brook trout being most abundant in lower reaches of the main stem Shields River (Belcer and Opitz 2020; Opitz and McCormack 2020). The habitat is complex in these reaches (Figure 8), and woody debris is an obstacle to capturing brook trout with electrofishing.

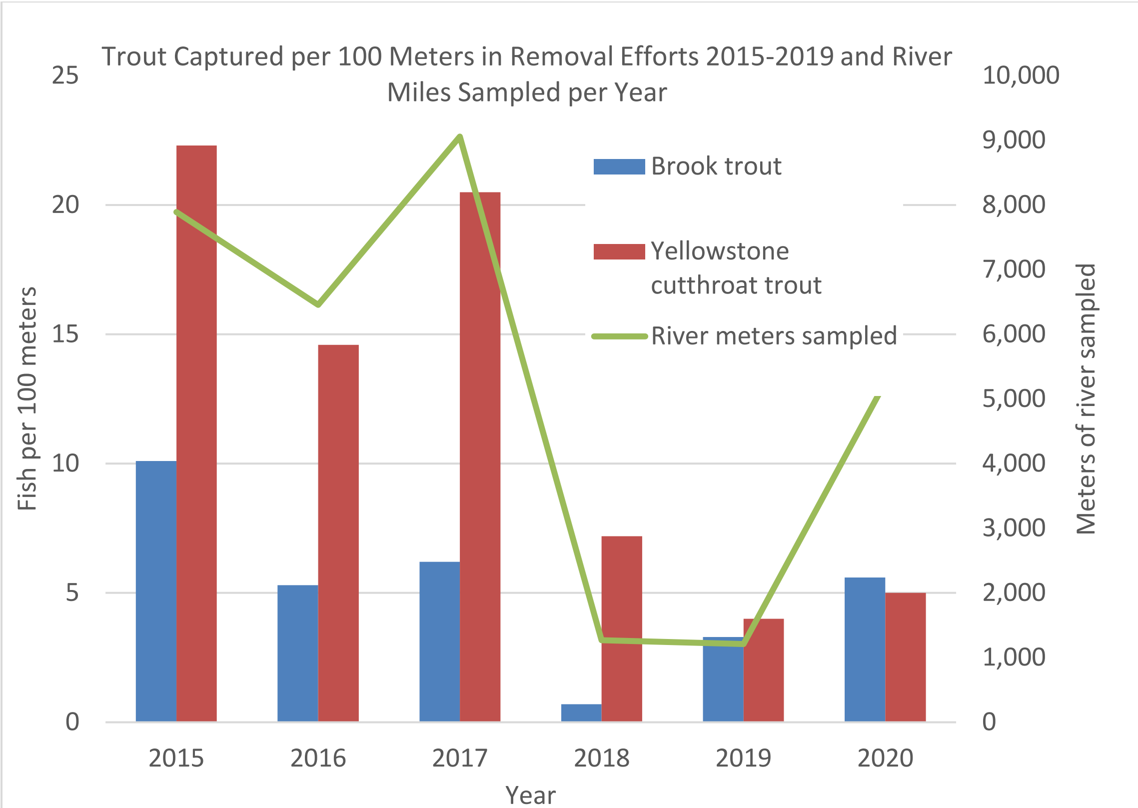

Figure 7. Number of fish per 100 m captured in reaches of the upper Shields River from 2015 through 2020 and number of river miles sampled in removal efforts per year.

Figure 8. Complex habitat in the downstream reach of the Shield River that provides cover for brook trout and reduces ability to capture fish while electrofishing.

In 2020, brook trout were exceptionally numerous in the lowest reach of the Shields River within the project area and vastly outnumbered Yellowstone cutthroat trout there (Belcer and Opitz 2020). Nearly 180 brook trout were captured in this reach compared to 48 Yellowstone cutthroat trout. Most brook trout caught here were juveniles. This finding provided additional confirmation for the need for a permanent solution to brook trout removal as explosive reproductive potential of brook trout can erase gains in suppression during years when staff availability, low flows, or natural events reduce or preclude removal efforts (Meyer et al. 2006).

Electrofishing in the tributaries found a varying degree of invasion (Shepard et al. 2015; Belcer and Opitz 2020; Opitz and McCormack 2020). Suppression of brook trout was apparent in many of the sampled reaches, but apparent eradication occurred only in reaches where brook trout numbers were initially low. Habitat is extremely complex in some tributaries, and deadfall timber blankets much of the stream. Brook trout are more likely to evade capture in complex habitat that provides cover and snags nets, and mechanical removal in large watersheds with complex habitat is infeasible (Meyer et al. 2006; Shepard et al. 2014).

1.1.2 Review of Research on Brook Trout Invasion and Displacement of Cutthroat Trout

Brook trout are not native to Montana and are among the greatest threats to the persistence of our native trout. The extent to which brook trout are displacing cutthroat trout throughout the West has been a conservation concern for decades. In a review, Griffiths (1988) found cutthroat trout less likely to be present in streams with brook trout than other nonnative trout. In Yellowstone National Park, brook trout had eradicated Yellowstone cutthroat trout from most streams where they were present (Gresswell 1995). Compounded with hybridization with rainbow trout, competition with brown trout (Al-Chokhachy and Sepulveda 2018), and constriction of suitable habitat due to climate change (Isaak et al. 2015; Isaak et al. 2017), habitat degradation, and dewatering, Yellowstone cutthroat trout face an uncertain future without implementation of projects such as this one.

The tendency for brook trout to invade new waters and displace cutthroat trout is the subject of considerable study. Researchers have investigated the conditions favorable for invasion, the biological features brook trout possess that promotes invasion success, and the factors that result in loss of cutthroat trout following invasion of brook trout. Review of the science with reference to brook trout invasion in the Shields River watershed provides justification for implementing the proposed action.

Invasion by brook trout has five components: transport, establishment, spread, effects on native organisms, and effects on humans (Dunham et al. 2002). In the Shields River watershed, the major transport phase was the repeated stocking of thousands of brook trout in the main

stem and several tributaries (Table 1 and Figure 9). The locations along the main stem where brook trout were planted are not ideal habitat for brook trout, and brook trout are relatively rare in the main river where introductions occurred (Berg 1975; FWP 2021), despite the transfer of hundreds of thousands of fish from the late 1930s through the mid-1950s. Tributaries do provide suitable habitat for brook trout, and the planted fish and their progeny spread to tributaries in the watershed where they are competing with and displacing Yellowstone cutthroat trout (Figure 10).

In the Shields River watershed, brook trout stocking began in the 1930s and continued near yearly through 1954 (Table 1). Over 278,000 brook trout were stocked in the main stem Shields River, and more than 162,000 brook trout were stocked in tributaries and a reservoir (Figure 9). Additional, unrecorded introductions were likely, and illegal fish transfers may still result in spread of brook trout in the Shields River watershed; however, most brook trout in the watershed are likely the progeny of the intentional, massive stocking events in the 1930s through 1950s. Intentional mass stocking of brook trout is the primary means of transfer to waters (Dunham et al. 2002).

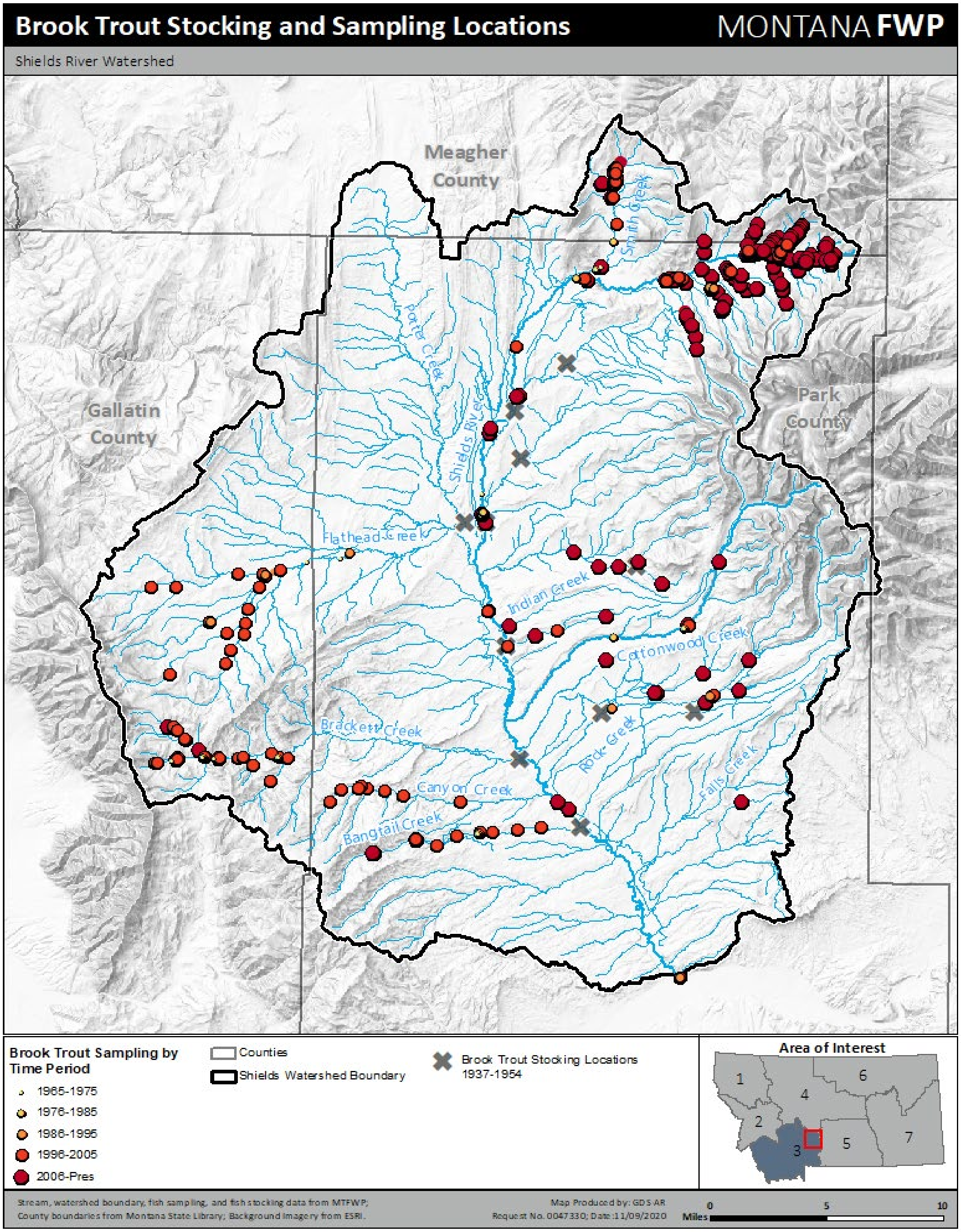

Figure 9. Locations of documented brook trout transfers in the Shields River from 1937 to 1954 and distribution of brook trout over time in the Shields River watershed (FWP 2021).

Table 1. Brook trout stocking data for sites in the Shields River watershed. Site name labels correspond with Figure 9.

Site Name	*1937*	*1938*	*1939*	*1940*	*1941*	*1946*	*1947*	*1948*	*1950*	*1951*	*1952*	*1953*	*1954*	*Grand Total*
1											5,000	10,720		15,720
2						19,200	13,200	776	5,000	10,950	14,400	46,580	11,760	121,866
3				5,400										5,400
4				6,000						2,000				8,000
5		6,200		27,000	20,800				2,000	2,000	19,000	40,720	10,000	127,720
Main stem total		**6,200**		**38,400**	**20,800**	**19,200**	**13,200**	**776**	**7,000**	**14,950**	**38,400**	**98,020**	**21,760**	**278,706**
Hoffman Reservoir									2,000					2,000
Basin Creek							8,000							8,000
Hammond Creek			6,667	5,400										12,067
Lena Creek				6,000						6,000				12,000
Muddy Creek	5,000	13,440		40,000	53,800				1,710					113,950
North Fork Elk Creek												10,000	6,000	16,000
Tributary and reservoir total														**162,017**
Grand total	**5,000**	**19,640**	**6,667**	**89,800**	**74,600**	**19,200**	**21,200**	**776**	**10,710**	**20,950**	**38,400**	**108,020**	**27,760**	**442,723**

Although the Shields River watershed is a stronghold for Yellowstone cutthroat trout, the distribution of brook trout, and their gains in abundance and distribution over time, threaten the watershed’s Yellowstone cutthroat trout. Brook trout are abundant in numerous headwater streams including Bangtail Creek, Brackett Creek, South Fork Horse Creek, and Smith Creek. In the Bangtail and Smith Creek watersheds, brook trout are displacing or have nearly displaced Yellowstone cutthroat trout (Figure 10). Wide distribution of brook trout throughout the Shields River watershed combined with their invasive ability puts the Shields River watershed’s status as a stronghold for Yellowstone cutthroat trout in jeopardy.

Establishment and spread allow for stepwise and expanding invasion into new habitat; however, several factors can limit spread of brook trout. In the high elevation project area with great capacity to accumulate mountain snowpack, cold water and heavy spring runoff may have been the factors limiting the establishment of brook trout for decades (Adams 1999; Cunjak et al. 2011) despite an established source of brook trout several miles downstream and individual brook trout pioneering into the project area. Being fall spawners, brook trout young are susceptible to extreme spring runoff (Cunjak et al. 2011). Brook trout did not evolve in high gradient, Rocky Mountain streams, and their eggs and alevins may be in the gravel during spring floods that rework the streambed and smash these vulnerable life stages. Likewise, newly hatched brook trout may not be able to withstand these extreme events and be swept from the project area. Yellowstone cutthroat trout fry do not suffer through spring runoff because they are spring spawners and their fry emerge in summer.

The Smith Creek watershed is notably different from the upper Shields River project area (Figure 11) which may explain the ability of brook trout to become established and displace Yellowstone cutthroat trout decades before they became established in the project area. Compared to the Smith Creek watershed with peak elevations ranging from 6,700 to 8,500 feet elevation, the upper Shields project area has considerable headwaters above 8,500-feet and approaches 10,000 feet for a substantial portion of its peak elevation. Higher elevations capture more snow than lower elevations.

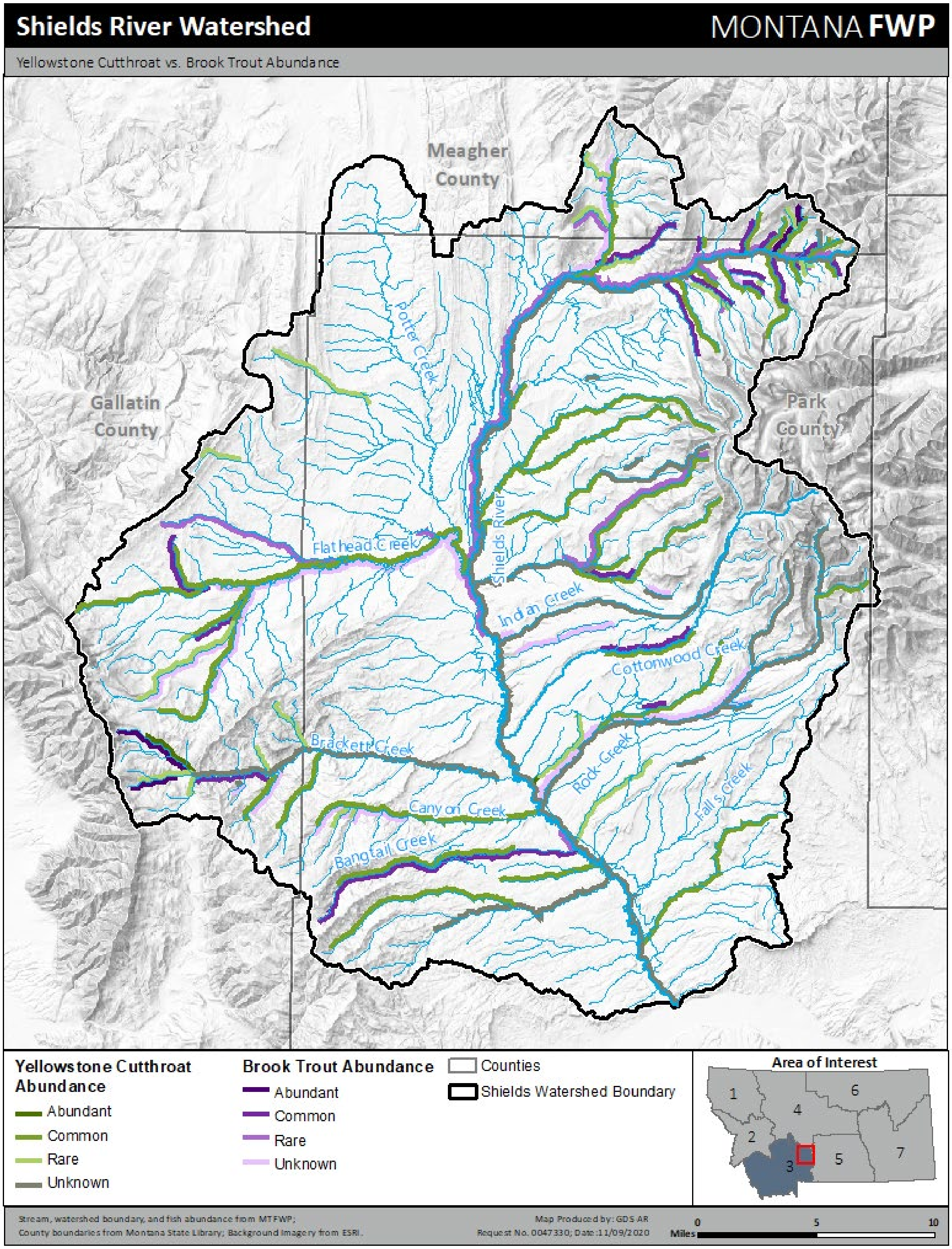

Figure 10. Abundance of Yellowstone cutthroat trout and brook trout in the Shields River watershed.

The hillslopes differ between watersheds as well. As evidenced by the tighter spacing of contour lines for much of the watershed encompassing the project area, this area has a steeper slope which speeds runoff compared to the more gently sloped Smith Creek watershed. Combined, these factors promote greater water yield and increased rapid runoff than occurs in the Smith Creek watershed. The resulting harsher spring runoff would be hard on brook trout fry eggs, and alevins still in the gravel, and could have limited brook trout invasion upstream of Smith Creek.

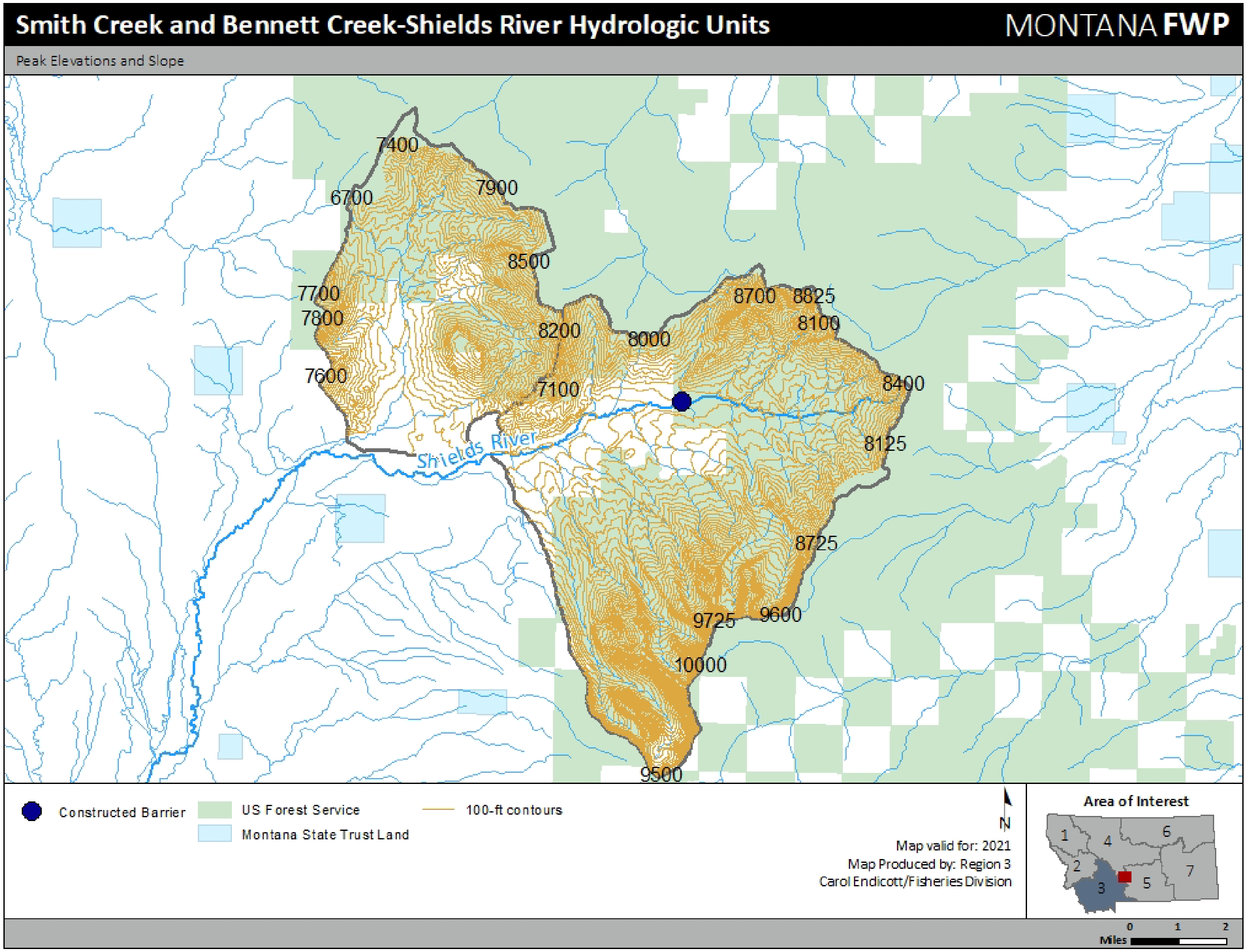

Figure 11. Comparison of elevation and slope of the Smith and Bennet Creek – Shields River hydrological units.

Gage station data for the Shields River near Livingston suggest prolonged drought beginning in late 1990s could have provided the window for brook trout to begin to become established in the project area and coincided with the period of spread and establishment (Figure 12). Although the gage station is 50 river miles downstream, maximum peak flows per year provide an indicator of basin-wide snowpack and the intensity of runoff within a year which likely reflects conditions in headwater tributaries. The decade in which brook trout invaded the basin corresponded with a decade of peak annual flows that did not exceed the 40-year average. The large flushing events that harm and limit success of brook trout fry likely did not occur in the project area during those years. Moreover, low flows and drought often result in warmer water temperatures which could also favor a brook trout invasion (Griffiths 1979; DeStaso and Rahel 1994; Adams 1999; Novinger 2000).

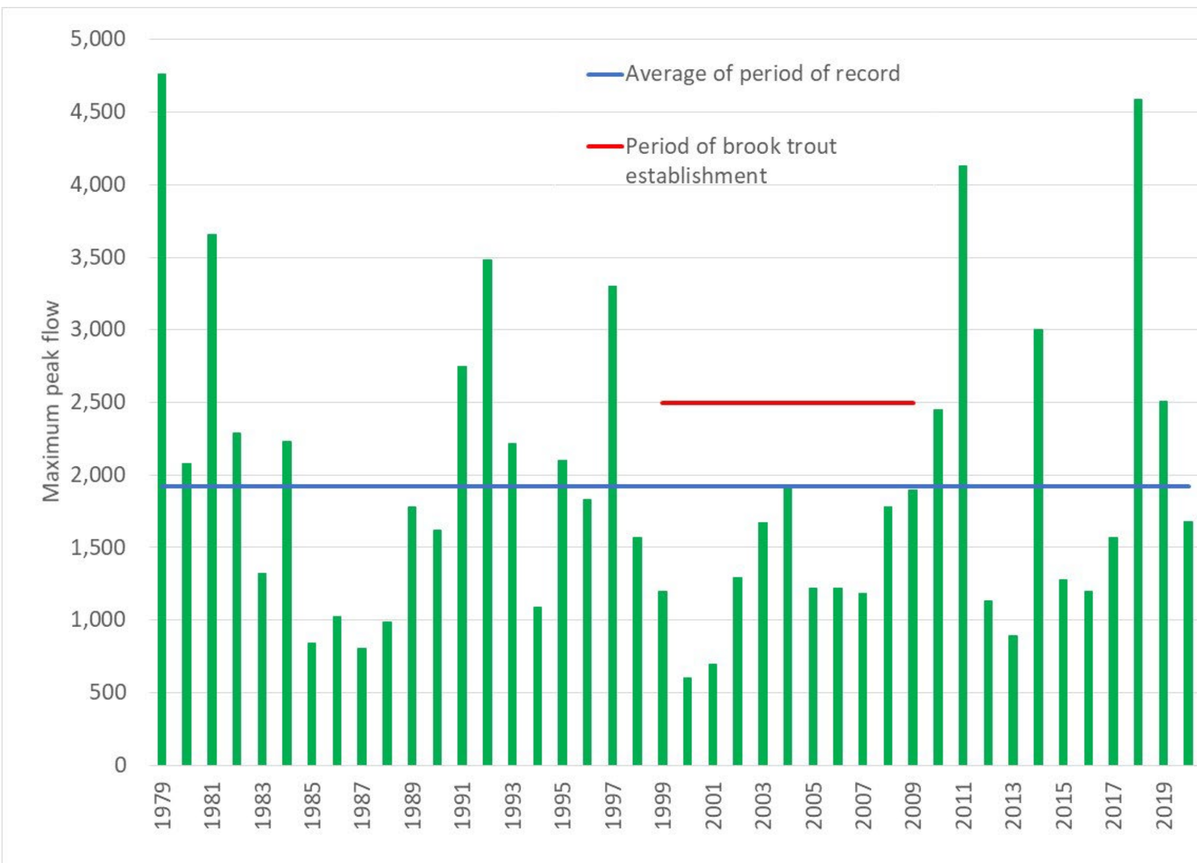

Figure 12. Maximum peak flows measured at gage station on the Shields River near Livingston (station 6195600) for period of record.

Effects of brook trout invasion on native fish is the fourth component of the invasion process (Dunham et al. 2002). Nonnative fish can eliminate native fish through hybridization, predation, or competition. Research on brook trout and cutthroat trout interactions in the Intermountain

West suggest brook trout displace cutthroat trout through competition for resources given substantial similarities in their habitat and food requirements (Griffiths 1988; Shepard 2010). The mechanisms that promote displacement of cutthroat trout are complex with behavioral interactions, habitat use, and nature of the habitat influencing the outcome (Dunham et al. 2002). Nevertheless, the overlap of habitat and food requirements between brook trout and cutthroat trout, known as niche overlap, allows brook trout to displace cutthroat trout in suitable habitats (Shepard 2010).

The most pronounced effect of brook trout on cutthroat trout may be reduction in survival of young ages (Novinger 2000; Dunham et al. 2002; Shepard et al. 2002; Peterson et al. 2004; McGrath and Lewis 2007; Shepard 2010). The offspring of fall spawning brook trout have several months of growth before cutthroat trout fry emerge in summer. The ability of the larger, older brook trout to exclude newly emerged and smaller Yellowstone cutthroat trout from necessary resources appears to account for failure of young cutthroat trout to survive. Yellowstone cutthroat trout did not evolve with a competitor for this habitat making occupation of critical rearing habitat by larger brook trout young especially harmful to Yellowstone cutthroat trout.

Research on the brook trout invasion into the project area (Shepard et al. 2015; Belcer and Opitz 2020; Opitz and McCormack 2020) is consistent with the large body of literature addressing the ability of brook trout to displace cutthroat trout. Brook trout became established during a period of favorable environmental conditions, a period drought, low snowpack, and warmer temperatures, and increased in number relative to Yellowstone cutthroat trout, and in some places became more abundant than Yellowstone cutthroat trout. Their ability to outnumber Yellowstone cutthroat trout in the lower reach of the project area after two years of reduced suppression effort has been observed by other researchers who concluded suppression was an ineffective tool in a large, complex watershed (Meyer et al. 2006; Shepard et al. 2014).

The last component of a brook trout invasion is its effect on humans (Dunham et al. 2002). Given their ability to displace cutthroat trout, brook trout affect the ability of state and federal agencies to conserve cutthroat trout as required under law. Conserving populations often includes construction of a barrier to upstream movement to fish which can bring considerable expense. Mechanical removal, which often only achieves suppression not eradication, requires field crews conducting multiple removal efforts over many years. This level of effort diverts resources from other areas where nonnative trout are threatening cutthroat trout and is expensive when accounting for the wages and travel required to implement a removal effort. In large, complex watersheds like the upper Shields River project area, mechanical removal is

more costly than chemical removal with rotenone and unlikely to be effective (Meyer et al. 2006; Shepard et al. 2014). Chemical removal of fish also requires funding, mobilization of field crews for one or more treatments, and followup monitoring; however, it has a greater chance of success which frees up resources to continue conservation actions elsewhere after brook trout are eradicated.

Another cost to humans of a brook trout invasion and resulting displacement of native cutthroat trout is a loss of biodiversity and part of the natural heritage of a wild place. Not all people value native cutthroat trout; however, many value them passionately. Failure to act brings the moral cost of losing part of our natural world, and cumulatively, failure to act threatens the persistence of Yellowstone cutthroat trout. We are answerable to future generations in protecting our natural world and its native inhabitants.

1.2 *Goal of Proposed Action*

The goal of the proposed action is to secure a core conservation population of Yellowstone cutthroat trout in the upper Shields River watershed by removing nonnative brook trout.

1.3 *Relevant Plans*

FWP is the lead agency for this project, and several documents justify the need for the project and prescribe the best practices to achieve the project goal of full eradication of brook trout (Table 2). These documents describe management, conservation, and restoration goals for Yellowstone cutthroat trout, listed or sensitive wildlife species, and criteria for maintaining the natural or aesthetic values of the surrounding landscape.

Table 2. Planning and strategy documents with relevance to conserving Yellowstone cutthroat trout in the upper Shields River watershed.

Agency	*Title*	*Website*
FWP	Statewide fisheries management plan 2019	Statewide Fisheries Management Program & Guide | Montana FWP (mt.gov)
FWP	Yellowstone cutthroat trout strategy for the Shields River (Endicott et al. 2012)	Yellowstone Cutthroat Trout | Montana FWP (mt.gov)
FWP	Yellowstone cutthroat trout: A wild survivor story map	Yellowstone Cutthroat Trout (arcgis.com)
Montana Cutthroat Trout Steering Committee (MCTSC)	Memorandum of understanding and conservation agreement for westslope trout and Yellowstone cutthroat trout in Montana (MCTSC 2007)	https://www.bing.com/search?q=memorandum+of+understanding+and+conservation+agreement+for+westslope+trout+and+yellowstone+cutthroat+trout+in+montana+%28mctsc+2007%29&form=ANNH01&refig=44c2d8a544994371977258d07b218fcb

Collaboration among entities is another component of the cutthroat trout recovery plan. Collaborators on Yellowstone cutthroat trout conservation in the upper Shields River watershed include FWP, the CGNF, the Shields Valley Watershed Group, and the Joe Brooks Chapter of Trout Unlimited. The National Park Service and the U. S. Geological Service provided fieldworkers during earlier phases of the project. The U.S. Geological Service likewise contributed funding towards the brook trout invasion study conducted by the Wildlife Conservation Society (Shepard et al. 2015).

FWP's piscicide policy (FWP 2017) prescribes the approach to minimize adverse effects on the ecological and human environment and monitor aquatic life before and after treatment. The policy includes instructions for determining the minimum effective concentration of rotenone to achieve a fish kill while minimizing harm to nontarget organisms. Deactivation of rotenone is also included in the policy with a secondary deactivation station being required as an added safety measure.

1.4 *Overlapping Jurisdictions & Authority*

FWP has the authority and responsibility to implement native fish conservation projects in Montana. The Montana Code Annotated (MCA 87-1-702; MCA 87-1-201[9][a]) directs FWP to perform the following actions:

- Perform such acts as may be necessary to the establishment and conduct of fish restoration and management projects;
- Manage wildlife, fish, game, and nongame animals in a manner that prevents the need for listing under 87-5-107 or under the federal Endangered Species Act, 16 U.S.C. 1531, et seq; and
- Manage listed species, sensitive species, or a species that is a potential candidate for listing under the federal Endangered Species Act, U.S.C. 1531, et seq., in a manner that assists in the maintenance or recovery of those species.

1.5 *Estimated Commencement Date:*

The project would commence in July 2022 beginning with the pilot study component and additional fish survey. Subsequent full treatment would follow in 2023. Salvage and treatment would continue for up to 5 years or less if brook trout eradication is achieved. In similar watersheds, two consecutive years of treatment were effective in eradicating brook trout.

1.6 *Consultation*

Preparation of this EA included consultation with several entities. Under state policy, agencies going through the MEPA process must contact tribes with interest in the area. The

Confederated Salish and Kootenai Tribes have hunting and fishing rights in the Shields River watershed, and the Crow Tribe consider the Crazy Mountains to be sacred. FWP’s tribal liaison and diversity coordinator will review the EA and consult with tribal entities. The final proposed project shall include a detailed plan for including tribal perspectives and interests in the area. FWP’s tribal liaison will ensure any tribe that has an interest in the area will have their concerns be heard while following FWP Tribal Consultation Policy.

Consultation with the Montana Natural Heritage Program database finds several species of concern within the project area. Section 3 examines the potential for the project to disrupt or harm species of concern. Overall, these plants and animals would be resilient to all aspects of the project including presence of fieldworkers and release of rotenone.

2 Alternatives

2.1 *Alternatives Considered*

2.1.1 Alternative 1: Proposed Action

The proposed action would remove nonnative brook trout from a high elevation, high latitude watershed that is a stronghold for Yellowstone cutthroat trout using a formulation of rotenone (Figure 13). A barrier constructed in 2016 is the downstream extent of the project area, and natural flow or gradient barriers are the upper extent of fish distribution and proposed treated areas in the project area. Before rotenone treatment, Yellowstone cutthroat trout and Rocky Mountain sculpin would be collected using electrofishing, and these fish would be held in tributaries outside the treatment area. They would be released after sentinel fish show no evidence of toxicity. In other similar projects, waters were safe the day after treatment ceased, and salvaged fish were returned to the project area that same day. Fish, invertebrate, and amphibian populations recover within 1 to 5 years, with invertebrates and amphibians recovering first, followed by fish.

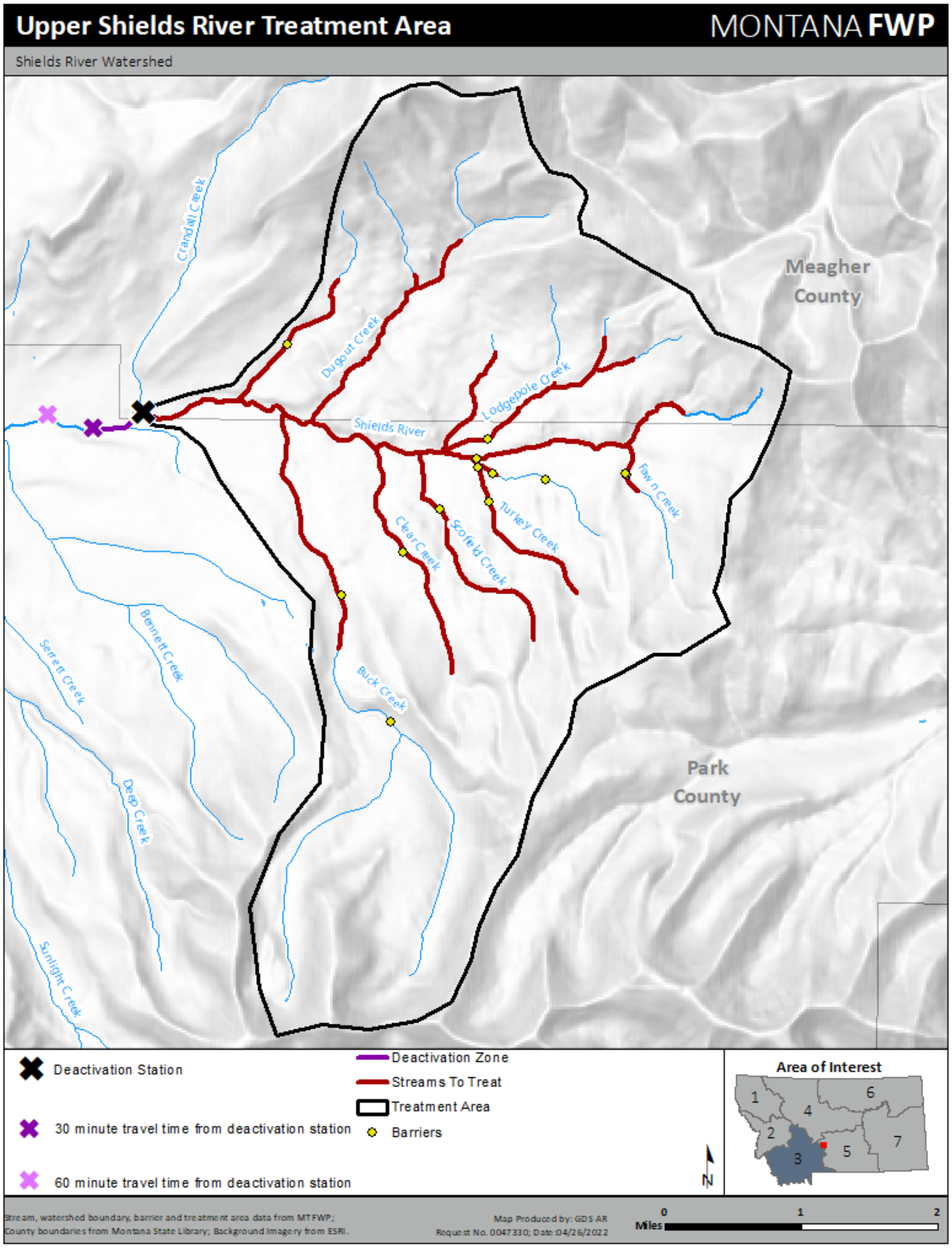

Figure 13. The upper Shields River Yellowstone cutthroat trout conservation project area.

The extent of the burn in the treatment area may have reduced Yellowstone cutthroat trout numbers in the project area. In Summer 2022, fieldworkers would conduct fish surveys using electrofishing to determine the status of Yellowstone cutthroat trout. In consultation with

FWP's fish geneticist, collection of eggs and milt, also referred to as gametes, may be among proposed actions if the population has been substantially reduced due to wildfire and the associated drought. The fertilized eggs would be incubated in the hatchery until the eyed state, then placed in remote site incubators within the project area but outside of waters proposed for treatment. The goal of this effort would be to increase numbers of fish to avoid genetic bottlenecks. Gamete collection would follow practices prescribed by the fish geneticist to ensure large enough representation of parental stock to avoid creating a genetic bottleneck.

Inflows of ash from the forest fires has potential to alter water chemistry in ways that affect the breakdown of rotenone. Burning sends most of the carbon stored in wood into the atmosphere and leaves behind various pollutants. The potential for these changes in water quality to alter breakdown and effectiveness of rotenone is unknown; therefore, the project would include travel time bioassays to determine how far rotenone travels before breakdown. These results would influence concentrations used and spacing of drip stations.

Rotenone is a naturally occurring substance derived from roots and stems of tropical plants in the pea family, including jewel vine (*Derris sp.*) and lacepod (*Lonchocarpus spp.*). Rotenone-bearing plants are native to Australia, southern Asia, Pacific island chains, and South America. Indiginous peoplew discovered its utility in killing fish and have used it for centuries to obtain fish for food. Rotenone has been part of fisheries management in North America since the 1930s. Montana implements several rotenone projects a year to conserve native fish, and this tool is an essential for effective removal of nonnative fish that threaten native species. Since 1990, FWP and partners have implemented over 115 rotenone projects to promote native fish conservation and sport fisheries management.

The formulation of rotenone chosen for this project is CFT Legumine™. This brand has advantages over other brands in that it does not use volatile organics to dissolve and disperse the relatively insoluble rotenone. CFT Legumine uses solvents and dispersants that break down rapidly in the environment and are not toxic at applied concentrations. The organic chemicals used in other formulations are unpleasant to fish which could cause them to find refuges from toxic concentrations of rotenone. In addition, CFT Legumine poses less of a health risk to applicators and lacks the unpleasant odor associated with volatile organic chemicals.

Piscicide projects in Montana must follow the requirements of the manufacturer's label (US EPA, Pesticide Product Label, PRENTOX CFT LEGUMINE FISH TOXICANT, 12/02/2013), standard operating procedures developed by the American Fisheries Society (Finlayson et al. 2018), and FWP's piscicide policy (FWP 2017). Combined, these instructions provide the steps to safe and effective implementation of rotenone projects. These documents include provisions to protect

environmental health, nontarget organisms, other water users, and human health. Under these protocols, applicators determine the lowest effective concentration of rotenone, appropriate spacing of drip stations, and follow proper handling and storage of the product. The concentration of rotenone is capped by law at 200 ppb, although projects removing trout typically are effective with far lower concentrations of rotenone at 25 to 50 ppb. A licensed applicator who is trained in these procedures must be onsite for the duration of rotenone treatment. Failing to follow the piscicide label or the standard operating procedures is a violation of state and federal law.

Rotenone dissolved in water enters fish through a thin layer of cells in the gills. This route of entry makes rotenone effective in killing fish at exceptionally low concentrations. Rotenone kills fish by preventing the mitochondria in cells from turning fat, glucose, and proteins into energy. Some aquatic invertebrates and gilled amphibians are vulnerable to rotenone at concentrations used in fish management projects; however, strategic timing of application and using the lowest effective concentration would minimize the toxicity of rotenone to these organisms (Finlayson et al. 2010; Vinson et al. 2010; Skorupski 2011). Mammals, birds, reptiles, and other non-gill respiring organisms do not have this rapid route into the bloodstream; therefore, the concentration of rotenone used in fisheries management does not affect these animals.

CFT Legumine would be applied to fish-bearing waters in the watershed (Figure 13).Turkey, Scofield, Clear creeks, and the unnamed tributary next to Lodgepole Creek are proposed for the pilot study as they represent the variability in burn severity. Several of these streams have barriers, and the pilot study would ensure that brook trout are absent from these waters, and the barriers would prevent reinvasion by brook trout before full treatment occurs. Yellowstone cutthroat trout salvaged before full treatment would be held in these tributaries during treatment and returned to the watershed after sentinel fish show no signs of distress for 4 hours. Rotenone would be dispensed in 18.20 miles of stream. The remaining 9 miles of stream that are not fish-bearing would provide a source of aquatic invertebrates to recolonize treated waters.

Standing waters are relatively rare in the project area. A pond formed by the constructed barrier (Figure 14) and wetland pools that connect to streams during high flows are the standing waters present in the project area. The small, off-channel waters would be treated with a backpack sprayer. The pond at the downstream end of the project area would have a mixture of stream water and rotenone formulation sprayed throughout the pond using a gas-powered pump.

Figure 14. Pond formed by the fish barrier at the downstream extent of the project area.

Wildfire in 2021 burned much of the project area in a mosaic of severity ranging from unburned to severely burned (Figure 15). Wildfire has potential to make several alterations in water chemistry and the physical environment that may affect toxicity and persistence of rotenone. Ash can change the pH of water which can alter natural breakdown of rotenone. Dissolved organic carbon contributed from burned vegetation could take up rotenone, reducing its toxicity and persistence. Removal of forest canopy could increase sunlight reaching surface water which would increase the rate of breakdown of rotenone whereas increased turbidity from erosion associated with wildfire could decrease the effectiveness of sunlight in breaking down rotenone. To evaluate the influence of these alterations, a pilot study would be conducted in July 2022 to evaluate how rotenone behaves in this newly-burned area. The findings would guide determination of effective concentrations and spacing of drip stations for the treatment.

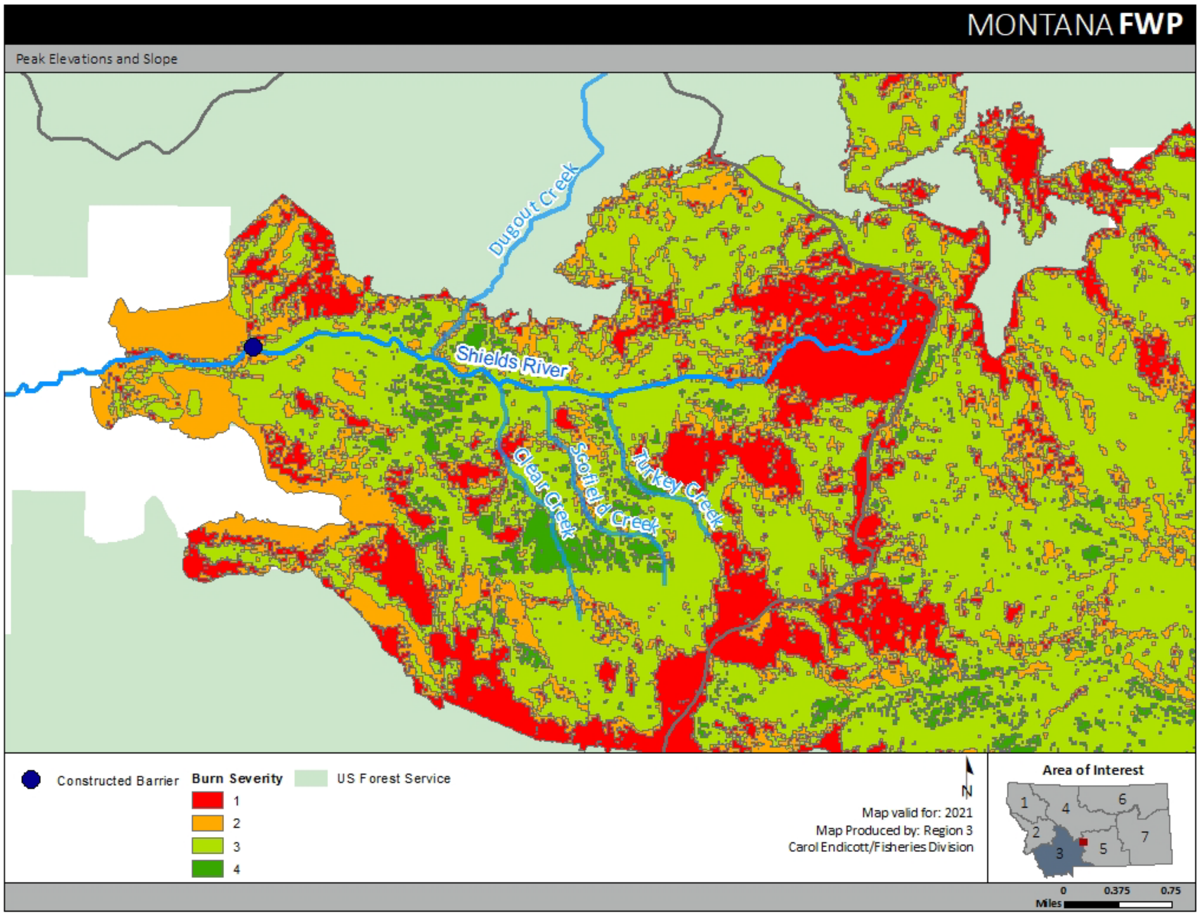

Figure 15. Wildfire severity across the project area in 2021.

The project area is also a grazing allotment, and although the CFT Legumine label has no provisions for protecting livestock from exposure, FWP's piscicide policy (FWP 2017) requires providing untreated water for livestock. Due to the wildfire, the allotment will be rested in 2022 which will eliminate the need to provide stock water and keep cattle from streams. In subsequent years, CGNF personnel would work with the grazing lessee to manage livestock within the project area to prevent livestock from contacting treated waters.

The primary means of dispensing liquid rotenone to streams would be from drip stations in accordance with all label requirements and following standard operating procedures (Finlayson et al. 2018) and FWP's piscicide policy. Drip stations are 5-gallon containers filled with the appropriate quantity of liquid rotenone diluted with stream water (Figure 16). A thin stream of diluted rotenone solution is released from the bottom of the standpipe. This mixture is trickled into the stream at about 80 ml/minute which will empty the contents in about 4 hours. Connected off-channel wetlands would be treated using backpack sprayers. The pond at the

downstream end of the project area would be treated by pumping a mixture of pond water and rotenone using a gas-powered pump.

Figure 16. Drip station dispensing diluted CFT Legumine.

Two tests guide determination of the lowest effective concentration of rotenone to be used in the project area and the required spacing of drip stations (Finlayson et al. 2018). These would be employed as part of the pilot study and before subsequent treatments. The serial dilution test exposes fish in stream water collected from the project area to a range of concentration of CFT Legumine. The highest concentration is within the limits established in the manufacturer's label, and it is illegal to exceed the limit of 4 ppm CFT Legumine. Effective concentrations are typically in the range of 25 to 50 ppb of rotenone which is 0.5 to 1 ppm of CFT Legumine. If this concentration is insufficient to achieve a fish kill, it can be adjusted higher within the manufacturer's limits.

Travel time bioassays allow determination of spacing of drip stations to ensure toxic concentration of the fragile rotenone molecule is maintained in the project area (Finlayson et al. 2018). The potential changes in water quality from the forest fire may affect the how quickly rotenone degrades in the environment. Sentinel fish placed at 30-minute stream travel time locations would allow evaluation of how long toxic concentrations of rotenone carried. Spacing

of drip stations would allow for a short distance of overlap of treated waters to prevent areas of sublethal concentration that would result in less effective treatment.

For the pilot study component of the project, rotenone would be deactivated downstream of the unnamed tributary west of Lodgepole Creek. For the full treatment, rotenone would be deactivated downstream of the constructed barrier which is the downstream extent of the treatment area. Rotenone would be deactivated by applying potassium permanganate, a strong oxidizer, which neutralizes rotenone within ½ hour of contact time within the stream. The procedure for deactivation on this project would be dictated by label requirements and stringent FWP protocols (FWP 2017). Deactivation must begin when rotenone is applied to the water at travel times less than 8 hours upstream of the deactivation station and must continue after the rotenone treatment ceases and until sentinel fish at the deactivation station can survive four hours without stress.

Dead fish would mostly be left to decompose, and their nutrients would foster recovery of the aquatic food web. Dead fish are visible for several days, but microbial action decays carcasses rapidly and scavengers eat carcasses. Dead fish would be collected at the USFS campground to avoid conflicts with scavenging bears. Placement of block nets at the downstream end of the deactivation zone would capture dead fish floating downstream to prevent them from causing a nuisance on private properties downstream.

Western toad tadpoles are sometimes abundant in the pond upstream of the constructed barrier. Mitigating effects on western toads would include netting as many as possible and holding them outside of the treatment area until it is safe to return them. Tadpoles would be held in streams or in aerated live cars while toxic concentrations of rotenone are present. They would be released to the pond after rotenone had cleared from the treatment area.

Posttreatment monitoring is an essential component of piscicide projects (Meronek et al. 1996). Monitoring of stream-dwelling macroinvertebrates would follow the requirements under FWP's piscicide policy (FWP 2017), which calls for checking the list of species of special concern at least one year in advance of the anticipated project date. This check yielded no observations of species of concern. Aquatic invertebrate sampling with this project would exceed requirements under the policy by collecting invertebrates a year before implementation of the project and in the days before treatment with 3 sampling locations in the project area, 1 in the deactivation zone, and 1 in an untreated control stream. The main stem Shields River downstream of the treatment and deactivation areas would be a suitable spot for the control sample. Two years of baseline data is a robust comparison to evaluate recovery of benthic communities.

Long-term monitoring sections would be selected to monitor the effectiveness of the rotenone treatment and status of Yellowstone cutthroat trout populations within five years after the final rotenone treatment. These reaches would be added to the monitoring schedule for Yellowstone cutthroat trout populations.

2.1.2 Alternative 2: No Action

Under the no action alternative, agencies would not implement the project which includes salvage of existing Yellowstone cutthroat trout, treatment with rotenone, and return of salvaged fish to streams. The Yellowstone cutthroat trout in the project area would remain at risk of displacement by brook trout. An opportunity to safeguard a core conservation population in an area with high probability of remaining suitable in a warming climate would be lost. Not removing brook trout would jeopardize the project area's Yellowstone cutthroat trout which would be a substantial conservation loss for the Shields River watershed and potentially have range-wide ramifications for legal status of Yellowstone cutthroat trout when combined with other losses. The barrier at the downstream end of the project area would prevent Yellowstone cutthroat trout from recolonizing these waters.

2.2 *Alternatives Considered but Dismissed*

2.2.1 Mechanical Suppression

Under this alternative, project partners would attempt to eradicate brook trout through electrofishing and capture in hoop nets. This alternative would bring considerable expense and would not achieve the goal of eradication of brook trout. FWP and the CGNF have been mechanically removing brook trout from the project area from Fall 2014 through 2020 with modest suppression despite substantial effort. The size and complexity of the project area makes full eradication of brook trout an unlikely outcome (Meyer et al. 2006; Shepard et al. 2014). Gains in suppression are lost in years when the effort is lower. Natural events and competing projects may temporarily reduce the ability for crews to remove brook trout which would allow brook trout to rebound (Meyer et al. 2006). Therefore, mechanical removal is an infeasible means of eradicating brook trout from this critical refuge for Yellowstone cutthroat trout.

2.2.2 Angling

Angling would not successfully eradicate brook trout. Unlike piscicide, anglers cannot target young-of-the-year fish. Furthermore, many of the tributaries are steep, small streams with abundant deadfall timber that severely limit access to streams. Few anglers would desire to fish these waters given the difficulty in fishing them and the relatively low abundance and small size of the fish. Any reductions in fish numbers from angling would free resources for the next

generation of brook trout. The size of the watershed, the great complexity of habitat in tiny streams, and the inefficiency of angling to capture fish eliminate angling as an effective way to eradicate brook trout.

3 Affected Environment and Predicted Environmental Consequences

3.1 *Land Use*

3.1.1 Alternative 1: Proposed Action – Land Uses

Recreation and livestock grazing are the primary land uses in the project area. Treatment would occur in July when stream flows are sufficient to transport rotenone throughout the treatment area. Stream flows are often too low in tributaries during September, a usual time to treat with rotenone, necessitating earlier treatment. This timing places the project outside of hunting season which is a primary land use in the area.

During project implementation, the treatment area would be closed to the public. This closure would be short term. Signs would alert recreationalists as to the closure and press releases would alert the public. Closures would be short-term and not during hunting season when the area gets substantial use.

Quality of angling would be reduced for a few years after the project. Although the pretreatment salvage of Yellowstone cutthroat trout would collect and protect as many Yellowstone cutthroat trout as possible, some fish would remain in the streams and would die. The salvaged fish would repopulate the streams rapidly with full recovery typically occurring in 3 to 5 years. Followup monitoring in streams treated under the same methods of salvage of native Yellowstone cutthroat trout followed by their return found recovered populations with all size classes present including an abundance of fish over 14 inches (FWP 2021). Likewise, Rocky Mountain sculpin returned to Lower Deer Creek following rotenone treatment were abundant, and the age composition indicated high survival and successful reproduction in the reclaimed waters (FWP 2021).

Limited ability to harvest fish is currently available in the project area. Regulations allow for 20 brook trout per day and in possession; however, brook trout suppression in the project area has not allowed brook trout to become abundant enough that anglers have had established opportunities to harvest brook trout there. Brook trout would remain abundant and widespread throughout suitable habitat in Montana providing opportunities to fish for and harvest this popular game species.

Fishing regulations allow for limited harvest of cutthroat trout in the project area. Regulations currently allow for a daily and possession limit of one cutthroat trout. Following recovery of the Yellowstone cutthroat trout population, FWP would consider changes to regulations to increase limits for Yellowstone cutthroat trout in the project area. Yellowstone cutthroat trout-bearing waters east of the project area have a 5 cutthroat trout possession and daily limit, and the populations withstand the limited harvest that occurs. Should the regulations change to allow increased harvest of Yellowstone cutthroat trout, anglers would have increased opportunity to enjoy a meal of Yellowstone cutthroat trout within the established limits.

3.1.2 Alternative 2: No Action

Land uses would be unaffected by the no action alternative.

3.1.3 Comparison of Alternatives

Implementing the proposed action would have minor and short-term effects on land uses in the upper Shields River watershed, and no cumulative effects on existing land uses would be expected. Visitors to this part of the Custer Gallatin National Forest would encounter fieldworkers during the Yellowstone cutthroat trout and Rocky Mountain sculpin salvage efforts, and the area would be closed to recreation during piscicide treatment. The generator running to dispense potassium permanganate would be a short-term disturbance at the campground, although closure of the area to the public would result in only fieldworkers being present during operation of the deactivation auger. Yellowstone cutthroat trout populations would recover within 3 to 5 years from fish returned to the project area. No past, present, or reasonably foreseeable actions would interact with the proposed action to cumulatively effect land uses.

Not implementing the project would alter recreation by allowing brook trout to eliminate a population of Yellowstone cutthroat trout. Anglers would not have the opportunity to catch native Yellowstone cutthroat trout in this beautiful setting. Brook trout would continue to provide recreational fishing in Montana, and more waters are managed for brook trout fisheries than native trout fisheries (FWP 2019) so removing the recently invaded brook trout would not affect overall opportunity to fish for and harvest brook trout. The effects of not implementing the project include loss of angling opportunity for Yellowstone cutthroat trout within their historic range and loss of a core conservation population of Yellowstone cutthroat trout (Endicott et al. 2016).

3.2 *Soils*

3.2.1 Alternative 1: Proposed Action

Soils would be unaffected by the proposed action.

3.2.2 Alternative 2: No Action

The no action alternative would not affect soils.

3.2.3 Comparison of Alternatives

Neither alternative would affect a direct or indirect effect on soils. Vegetation

3.2.4 Alternative 1: Proposed Action—Vegetation

Under the proposed action, fieldworkers would trample vegetation; however, this disturbance would be short-term, minor, and limited to camping areas, the riparian corridor, and near trails. Trucks used to transport personnel and gear would get an undercarriage wash before entering the project area to limit the spread of noxious weeds.

Project activities have little to no potential to affect the plant species of special concern (Table 3). The areas where fieldworkers would be present do not provide habitat for these species as they occur on gravelly slopes, talus, or scree slopes, and fieldworkers would be unlikely to disturb these habitats during the project.

Table 3. Plant species of concern observed in the upper Shields River watershed.

Common Name	***Scientific Name***	***Global Rank***	***State Rank***
Snow Indian paintbrush	*Castilleja nivea*	G3	S2
Fan-leaved fleabane	*Erigeron flabellifolius*	G3	S3
Linear-leaf fleabane	*Erigeron linearis*	G5	S1
Northern twayblade	*Listera borealis*	G4	S2
Rocky Mountain twinpod	*Physaria saximontana var. dentata*	G3T3	S3

G1 or S1 = at high risk because of extremely limited and/or rapidly declining population numbers, range and/or habitat, making it highly vulnerable to global extinction or extirpation in the state.

G2 or S2 = at risk because of very limited and/or potentially declining population numbers, range and/or habitat, making it vulnerable to global extinction or extirpation in the state.
G3, S3, T3 = potentially at risk because of limited and/or declining numbers, range and/or habitat, even though it may be abundant in some areas. T refers to a subspecies that is a species of concern of this level.
G4 = Apparently secure, though it may be quite rare in parts of its range, and/or suspected to be declining.
G5 = common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range.

3.2.5 Alternative 2: No Action

The no action alternative would not affect vegetation.

3.2.6 Comparison of Alternatives and Cumulative Effects

For the chemical removal alternative, the presence of fieldworkers short-term and minor effect on vegetation. Trampling streamside vegetation would be the primary disturbance. Only a few

workers will be walking a given stream reach over one or two days each year to access drip station locations or apply rotenone via backpack sprayer. This short-term and minor level of vegetation trampling would not be discernable from that resulting from existing wildlife, livestock, or recreational use, although the presence of humans could introduce noxious weeds into the project area. Vehicles used in transporting fieldworkers and equipment would get an under-carriage wash to remove noxious weed seeds. The no action alternative would not affect vegetation. Livestock grazing in the project area has the greatest effect on streamside vegetation. The low level of vegetation trampling from field workers would not be of sufficient intensity or duration to have cumulative effects with livestock grazing. Therefore, no long-term effects on vegetation are expected with the implementation of the proposed action.

3.3 *Wildlife and Fish*

3.3.1 Alternative 1: Proposed Action

Changes in the Diversity and Abundance of Game Animals and Birds

Given the wildness of the surrounding area, the project area supports an abundance of game species including moose, elk, mule deer, white-tailed deer, black bear, coyote, and gray wolf. Upland game birds including dusky grouse and ruffed grouse are also likely present. Furbearers such as pine martens and snowshoe hares also likely occur within the project area.

Activities related to the proposed action would have short-term and minor effects on game species. Fieldworkers would be present in and along streams for about a week during fish salvage. Likewise, rotenone treatment would result in fieldworkers being along streams to operate drip stations for several days. This disturbance would temporarily displace game species from treated waterways; however, streams comprise a tiny fraction of the landscape and presence of fieldworkers would be a short-term disturbance.

Yellowstone cutthroat trout and brook trout are the game fish currently present in the project area. Fish salvage would entail capturing as many Yellowstone cutthroat trout as possible using electrofishing and transporting them to protected waters in the watershed by hatchery truck. As electrofishing does not result in capture of all fish, some Yellowstone cutthroat trout would evade capture and die during the rotenone treatment. The salvaged fish would reproduce resulting in recovery of fish populations within 3 to 5 years.

Diversity or Abundance of Nongame Species

Mammals

A diversity of mammals is present in the project area, and the project would result in short-term and minor disturbance associated with presence of fieldworkers. Mammals would also have potential for short-term exposure to rotenone with ingestion of treated water or fish and invertebrates killed by rotenone being the primary routes of exposure. See 3.5 Water Resources for review of the research on low concentrations of applied rotenone and rapid breakdown of rotenone in the environment.

Exposure through eating dead fish and invertebrates or drinking treated water would not harm mammals. Likely scavengers of dead fish and invertebrates include mink, black bears, wolves, otters, and birds such as ravens, magpies, bald eagles, and golden eagles. The exceptionally low concentrations of rotenone in treated water and its strong tendency to break down and become absorbed to organic matter means wildlife would not receive doses that would be harmful.

Species that consume fish or invertebrates of aquatic origin would experience short-term reduction in food availability. The species likely to eat fish are generalists in the feeding habits and can switch to other food sources. Moreover, reductions in aquatic invertebrates are slight to moderate (Skorupski 2011) leaving a substantial number of invertebrates for species like American dippers. The resurgence of numbers of invertebrates in the weeks following piscicide treatment mitigate the slight to moderate reduction resulting from piscicide treatment. See Stream-Dwelling Aquatic Invertebrates for the review of effects of rotenone on invertebrate populations and their recovery.

A substantial body of research has explored the acute and chronic toxicity of rotenone and other potential health effects, and exposure to the concentrations in water and dead animals is far lower than concentrations that would be toxic (EPA 2007). Rotenone breaks down rapidly in the digestive tract of mammals (AFS 2002), and potential exposure to rotenone from fish removal projects is far lower than levels shown to result in acute or chronic toxicity. The concentration of active ingredient rotenone used for fish removal projects ranges typically from 0.025 – 0.2 ppm which is equivalent to 25 ppb – 200 ppb. These concentrations are many times lower than concentrations found to be toxic. For example, a 22-pound dog would have to drink nearly 8,000 gallons of treated water or eat 660,000 pounds of rotenone-killed fish within 24 hours to receive a lethal dose (CDFG 1994). A half-pound mammal would need to eat 12.5 mg of pure rotenone, or drink 66 gallons of treated water within 24 hours to receive a lethal dose (Bradbury 1986).

Dead fish take up to 2 weeks to decay; however, this availability of dead fish would not result in exposure that would cause chronic toxicity as rotenone has low toxicity when eaten and concentrations in fish tissue would be low and short-lived. In laboratory studies where rotenone was not subjected to environmental conditions that promote its breakdown, animals fed rotenone survived amounts that were far greater than is possible from fish removal treatments. Rats fed 75 ppm of rotenone per day for over 2 years weighed significantly less than rats not fed rotenone and had smaller litters; however, this exposure did not result in mortality, birth defects, or cancer (Marking 1988). Likewise, dogs fed 200 mg of rotenone daily for 6 months weighed less than dogs not fed rotenone, ate less, and had diarrhea and mild anemia (Marking 1988). For rats and dogs, taste aversion was likely limiting their intake of food and contributing to the lower weights.

The dose and duration of exposures in these laboratory studies with rats and dogs (Marking 1988) were far greater than field exposure from drinking treated water or eating rotenone-killed fish or invertebrates. In trout streams in Montana, the effective concentration of active ingredient rotenone is generally 0.025 to 0.05 ppm, and application at each drip station lasts 4 to 6 hours. Streams would have concentrations toxic to fish and some invertebrates for less than 24 hours. Likewise, concentrations in dead fish and invertebrates would be minute and would quickly bind with the organic matter in the dead animal and be rendered nontoxic. The amount of rotenone present in the environment would be exceedingly short-lived and minute compared to exposures in laboratory studies that found minor health problems after months to years of daily consumption of high levels of rotenone (Marking 1988).

Other toxicological studies provide evidence that the proposed project would not result in chronic health problems for wildlife drinking water or eating fish carcasses. Rotenone exposure has not been shown to result in birth defects (HRI 1982), gene mutations (VanGoetham et al. 1981; BRL 1982), or cancer (Marking 1988). Rats fed diets containing 10 to 1000 ppm of rotenone over 10 days did not experience reproductive dysfunction (Spencer and Sing 1982). This combination of studies provides robust evidence that rotenone application to eradicate fish does not approach concentrations or durations of potential exposure that would harm wildlife drinking water or eating dead fish or invertebrates.

Birds

Birds have potential to be exposed to rotenone through drinking treated water or scavenging dead fish and invertebrates. Like mammals, birds' digestive tracts rapidly break down rotenone. Furthermore, the concentration of rotenone in waters treated in fish removal projects is far lower than concentrations found to be harmful. A ¼-pound bird, which is smaller than an

American crow, would have to drink 100 quarts of treated water or eat more than 40 pounds of rotenone-killed fish within 24 hours for a lethal dose (Finlayson et al. 2000).

Numerous species of birds rely on prey of aquatic origin, and rotenone has potential to temporarily decrease prey species. Fish numbers would be reduced as the salvage effort would not capture all Yellowstone cutthroat trout or Rocky Mountain sculpin, and fish evading capture would die during the treatment. This short-term reduction in fish numbers would limit fish as a food source. Belted kingfishers, and to a lesser extent American dippers, are the species of bird present in the project area that consume fish. These birds are mobile and can move to more productive feeding grounds until the fishery recovers. Returning salvaged Yellowstone cutthroat trout and Rocky Mountain sculpin to streams as soon as rotenone degrades would provide fish for fish-eating birds.

Invertebrates would be slightly to moderately reduced in numbers, but recovery of invertebrate numbers and biomass is rapid (see Stream-Dwelling Aquatic Invertebrates). American dippers eat aquatic invertebrates and do not migrate. This species would have a short-term reduction in forage base followed by rapid recovery of biomass, then diversity, would make this a minor and short-term reduction. Monitoring of American dippers on Lower Deer Creek the year after rotenone treatment found American dippers to be abundant with a previously unidentified nest found and numerous young birds that had fledged that summer (FWP, internal data).

Reptiles

Reptiles, especially western terrestrial gartersnakes, have potential to be exposed to rotenone-treated water and are among the likely scavengers of dead fish and invertebrates. The low concentration of rotenone in the water and dead fish would likely not result in toxic exposure to reptiles. Like in mammals and birds, rotenone would break down rapidly in the digestive tract of reptiles.

Amphibians

The project area supports two species of amphibian (Table 4). Amphibians are closely associated with water and have potential to be exposed to rotenone during piscicide treatment. Adult, air-breathing amphibians have low vulnerability to rotenone as applied at fish killing concentrations (Chandler and Marking 1982; Grisak et al. 2007; Billman et al. 2011; Billman et al. 2012), but gill-breathing larvae are vulnerable (Grisak et al. 2007; Billman et al. 2011; Billman et al. 2012). In the laboratory, tadpoles of Columbia spotted frogs and western toads died when exposed to 1.0 ppm of CFT Legumine for 96 hours (Billman et al. 2011).

Table 4. Amphibians likely present in the upper Shields River watershed project area.

Common Name	Scientific Name	Gilled Phase Coincide with Proposed Treatment Timing?	State Status	USFS Status
Columbia spotted frog	*Rana luteiventris*	Yes	S4	
Western toad	*Anaxyrus boreas*	Yes	S2	

S4= In Montana, the species is apparently secure, although it may be rare in parts of its range, and/or expected to be declining.
S2=At risk because of very limited and/or declining population numbers, range, and/or habitat, making it vulnerable to global extinction or extirpation from the state.

Field investigations of amphibian populations after treatment of streams and lakes with rotenone have found amphibians to be resilient to rotenone treatment. In a treated lake and wetlands, the effects of rotenone on Columbia spotted frog tadpoles were short-term and minor as they returned to or substantially exceeded pretreatment numbers the following year and maintained those numbers for three years in follow up monitoring (Billman et al. 2012). Columbia spotted frogs have great reproductive potential and rebound dramatically after rotenone treatment. Despite near total mortality of Columbia spotted frog tadpoles during piscicide treatment in High Lake in the Specimen Creek watershed in Yellowstone National Park, Columbia spotted frog tadpoles were nearly triple pretreatment abundance in the three years following piscicide treatment (Billman et al. 2012). The high tolerance of adults to rotenone, the presence of numerous adult age classes, their substantial reproductive potential, lack of fish, and abundance of habitat and forage likely contributed to increased numbers of tadpoles compared to the pretreatment baseline.

The field studies in Yellowstone National Park most resemble proposed treatment in the upper Shields River watershed as rotenone was applied before tadpoles had metamorphosed and experience near total mortality (Billman et al. 2012). The same species are present, and these long-lived amphibians, up to 14 years for both species, provides numerous age classes to reproduce and make up for a loss of a year class.

Investigation of the response of amphibians to rotenone projects in 10 alpine lakes in Montana found no significant differences between abundance and species composition of amphibians counted 2 to 4 years before rotenone application and following rotenone application (Fried et al. 2018). This project area shared some species of amphibian with the upper Shields River project area. Treatment with rotenone in this large-scale project did not result in reduction of observations of Rocky Mountain tailed frogs, long-toed salamanders, western toads, and Columbia spotted frogs. This general resilience to rotenone treatment across amphibian taxa

indicates amphibians have the ability to withstand rotenone projects under established protocols to limit mortality of nontarget organisms (FWP 2017; Finlayson et al. 2018).

Although species and life stages of amphibian may vary in their tolerance to rotenone, research in Norway yielded comparable results to the field studies in Montana (Amekleiv et al. 2015), suggesting a general tolerance of rotenone by frogs and toads in the same genera as Columbia spotted frogs and western toads. The common frog (*Rana temoraria*) and common toad (*Bufo bufo*) were present pretreatment, and eggs, tadpoles, and adults were in the lake the next year leading the authors to conclude that CFT Legumine rotenone formulation had little effect on the amphibians in the treated lake.

Consultation with the senior zoologist at MNHP yielded support for removal of nonnative fish to benefit amphibians (Bryce Maxell, MNHP, personal communication). Amphibians co-evolved with native fish species, and their populations likely benefit from removal of nonnative fish. He supported this project as being beneficial to native fish and amphibians compared to the potential condition of extirpation of Yellowstone cutthroat trout by brook trout. The amphibians present in the project area co-evolved with Yellowstone cutthroat trout. Nonnative trout may exert different predation pressure on stream-dwelling species and riparian species (Benjamin et al. 2011; Lepori et al. 2012). Establishment of a co-evolved assemblage of fish, invertebrates, and amphibians mimics the biological integrity of streams throughout the upper Yellowstone River watershed in Montana.

Nongame Fish

Rocky Mountain sculpin are the only nongame fish species present in the project area. This species would be captured along with Yellowstone cutthroat trout during the salvage effort, held outside the treatment area during piscicide treatment, and returned to the project area's waters as soon as sentinel fish show no signs of toxicity. Rocky Mountain sculpin that evade capture during the salvage would likely not survive rotenone treatment. The relative tolerance of sculpin to rotenone has not been studied; however, dead sculpin are commonly seen during rotenone treatment so substantial to total mortality of sculpin remaining in streams is likely. Reintroduction of sculpin is common practice in native fish restoration projects using rotenone, and their populations rebound rapidly.

Zooplankton

Zooplankton would be restricted to the pond formed by the constructed barrier and perhaps some stream-adjacent wetland pools. Rotenone has greater initial effects on abundance and diversity of zooplankton in lakes than on stream-dwelling invertebrates given the longer period of exposure and their permeable bodies (Vinson et al. 2010). Biomass of zooplankton recovers

rapidly; however, zooplankton community composition can take from 1 week to 3 years to return to pretreatment conditions (Beal and Anderson 1993; Vinson et al. 2010).

Like stream-dwelling invertebrates, zooplankton have life history strategies that aid in rapid recolonization following disturbance (Havel and Shurin 2004). Recovery of zooplankton varies among taxa with a dramatic bloom of early colonizers in the first few months (Beal and Anderson 1993). Other taxa take longer to recover, but diversity and abundance can return as quickly as 6 months. The number and diversity of zooplankton increased in Devine Lake in the Bob Marshall Wilderness in Montana following a rotenone treatment (Rumsey et al. 1996). Densities of zooplankton in upper and lower Martin lakes near Olney, Montana, were like or greater than pre-rotenone treatment two years after treatment (Schnee 1996). Although rotenone is toxic to zooplankton, field studies confirm the effects are short-term and minor with populations rebounding first in biomass then in diversity. The decay of fish carcasses in the treated lakes provides nutrients that fuel the zooplankton rebound.

Zooplankton have multiple ways to recolonize standing waters (Havel and Shurin 2004). Many species of zooplankton are capable of asexual reproduction which favors rapid recolonization from existing eggs and zooplankton that survived treatment. Moreover, lakes have a long-term bank of dormant eggs. Wind, animals, and humans disperse dormant eggs from neighboring lakes. Zooplankton communities would likely follow the typical occurrence of rapid recolonization of early colonizing species. The zooplankton community would recover in a few months to a few years. The rapid recovery of numbers would reset the food web and provide fertile waters for the return of fish over the short-term.

Research in Norway demonstrated rapid recovery of zooplankton using CFT Legumine concentrations and duration of exposure in lakes. Zooplankton were sampled before application of CFT Legumine immediately after treatment and 1-year posttreatment (Amekleiv et al. 2015). CFT Legumine had an initial negative effect on zooplankton with none detected immediately after treatment. The relative abundance of zooplankton changed from pretreatment to 1-year post treatment with some species comprising a much higher proportion of the zooplankton community post treatment. In addition, overall abundance of zooplankton increased considerably post treatment. Removal of common roach (*Rutilus rutilus*), a species of minnow that preys on zooplankton, was attributed to greater posttreatment zooplankton biomass.

Stream-Dwelling Aquatic Invertebrates

Rotenone can result in temporary reduction of gilled aquatic invertebrates in streams, but they are resilient and recover rapidly. Invertebrates that are most sensitive to rotenone also tend to

have short life cycles which results in the highest rates of recolonization (Cook and Moore 1969; Engstrom-Heg et al. 1978). Although gill-respiring invertebrates are a sensitive group, many are far less sensitive to rotenone than fish (Schnick 1974; Chandler and Marking 1982; Finlayson et al. 2010). Due to their short life cycles (Wallace and Anderson 1996), strong recolonization ability (Williams and Hynes 1976), and generally high reproductive potential (Wallace and Anderson 1996), aquatic invertebrates are capable of rapid recovery from disturbance (Boulton et al. 1992; Matthaei et al. 1996).

Fisheries managers are using CFT Legumine across continents in native fish conservation projects, and they use similar protocols which allows for generalizations among studies. Practices to limit mortality of nontarget organisms include using the lowest effective concentration to kill fish and limiting the duration of exposure. Consistently, studies of aquatic invertebrates in streams treated with CFT Legumine under current practice show the populations recover within a year (Skorupski 2011; Kjærstad et al. 2015; Bellingan et al. 2019). Mortality of aquatic invertebrates associated with rotenone application as proposed for this project is slight to moderate (Skorupski 2011) leaving a substantial proportion of invertebrates unharmed. These survivors reproduce and contribute to recovery of the community.

Treatment with rotenone mimics environmental stressors under which aquatic invertebrates evolved. Streams are prone to periodic disturbance such as floods, wildfire, and extreme drought, and these events can kill or displace invertebrates from reaches of stream. Aquatic invertebrates are adapted to periodic disturbance and have several mechanisms to recolonize depopulated reaches. Combined, these mechanisms result in rapid recovery of aquatic invertebrates affected by rotenone treatment or reduced by natural disturbance.

Aquatic invertebrates have a strong tendency to drift (Townsend and Hildrew 1976; Williams and Hynes 1976; Brittain and Eikeland 1988) which is transport of invertebrates by stream flow. Aquatic invertebrates are adapted to running waters, but they can be dislodged or they may actively drift to avoid predation or find new food patches (Brittain and Eikeland 1988). The importance of drift in dispersal of stream-dwelling invertebrates is an area of extensive study. Moreover, drift is what makes fly fishing with nymphs possible as a sport as artificial nymphs mimic naturally drifting invertebrates.

Downstream drift of invertebrates is the major mechanism by which aquatic invertebrates recolonize streams and accounted for over 40% of invertebrates recolonizing experimentally depopulated reaches of stream (Williams and Hynes 1976). Fishless headwater reaches are not treated with rotenone, and these areas have tremendous capacity to contribute high diversity and large numbers of invertebrates (Wipfli and Gregovich 2002; Hollis 2018). The amount of

energy contributed from aquatic and terrestrial invertebrates and detritus drifting from 1 kilometer (0.62 miles) of fishless headwaters could support 100-2000 young of the year salmonids (Wipfli and Gregovich 2002). The abundance of aquatic invertebrates drifting from fishless headwater reaches was enough to support 25% of the adult trout in fish-bearing waters (Hollis 2018). The rate of invertebrate drift in mountain streams in Montana can be considerable with 15.6 invertebrates drifting per cubic meter per second flow being reported (Skorupski 2011). Although rate of drift varies with numerous factors (Brittain and Eikeland 1988), treated reaches of stream would receive a substantial, continuous supply of invertebrates from untreated headwaters which would contribute to rapid recovery of invertebrate populations. The short-term reduction of fish would also contribute to recovery of invertebrate populations which would in turn feed Yellowstone cutthroat trout as their numbers increase through natural reproduction.

Reproduction by aerial adults is the secondary mechanism aquatic invertebrates use to recolonize streams. Reproduction by winged adults accounted for 28% of invertebrates recolonizing experimentally depopulated reaches of stream (Williams and Hynes 1976). Having a winged adult state that flies upstream to reproduce or disperse from neighboring areas counteracts the constant passive or active drift of larval invertebrates and allows for repopulating reaches following disturbance.

Movement of invertebrates from deeper in the substrate and from downstream are other mechanisms of recolonization. Upstream movement of aquatic organisms is a relatively minor mechanism for recovery (Williams and Hynes 1976) and would likely not be a large contributor to recovery in streams with a downstream barrier. In contrast, invertebrates moving up from deeper in the streambed have better potential to contribute to recovery. Experimentally, this source contributed about 18% of invertebrates recolonizing a depopulated reach (Williams and Hynes 1976). Eggs, pupae, and larvae deeper in the streambed may be resistant to rotenone or not receive lethal concentrations of rotenone, especially in reaches with substantial groundwater contribution which would dilute rotenone applied at the surface. Fieldworkers in Montana reported impressive hatches of caddisflies, mayflies, and midges in streams and lakes during treatment and the day after treatment with rotenone. These observations confirm that rotenone does not kill all invertebrates, and recolonization by reproducing adults can begin immediately after treatment.

Because piscicide has potential to alter abundance and species composition of aquatic invertebrates over the short-term, FWP piscicide policy requires pretreatment sampling of benthic aquatic invertebrates (FWP 2017). FWP will collect baseline samples for comparison

with post treatment macroinvertebrate samples. Post treatment monitoring would allow for evaluation of short-term and long-term trends in community composition and recovery.

Potential Effects on Species of Special Concern and Sensitive, Threatened or Endangered Species

Presence or potential presence of species of concern comes from field sampling and observations and the Montana Natural Heritage Program database. The Montana Natural Heritage Program (MNHP) maintains a database and field guide on species distribution, status, ecology, life history strategies of animals, and sightings throughout the state. This database provided the technical basis for determining potential effects on species of special concern. The database includes a comprehensive list of citations to support information presented in the field guide and this document.

The project area is within the range of numerous species of special concern and species designated as sensitive by the USFS (Table 5). The ranges delineated are broad and may not reflect the suitability of habitat for a given species occurring within the project area. This evaluation focuses on species likely to live and breed in a high elevation, forested, montane environment during the treatment period in August and includes observations of species, evidence of breeding, or other indicators of a species' presence

Table 5: Species of special concern, and threatened species with ranges overlapping the project area.

Group	*Scientific Name*	*Common Name*	*State Rank*	*USFS*
Mammals	*Gulo gulo*	Wolverine	S3	
Mammals	*Lynx canadensis*	Canada Lynx	S3	Threatened
Fish	*Oncorhynchus clarkii bouvieri*	Yellowstone Cutthroat Trout	S2	
Birds	*Strix nebulosa*	Great Gray Owl	S3	
Birds	*Ammodramus bairdii*	Baird's Sparrow	S2B	
Amphibians	*Bufo boreas*	Western Toad	S2	

S3 = Potentially at risk because of very limited and/or declining numbers, range, and/or habitat, making it vulnerable to extirpation in the state

Threatened = included for protection under the Endangered Species Act as a threatened species

S2 = At risk because of very limited and/or declining numbers, range, and/or habitat, making it vulnerable to extirpation in the state.
B = indicates breeding populations at risk.

The potential for wolverines to experience disturbance from proposed project activities is limited. Wolverines have been observed in the general area in the past 5 to 10 years, and the overall number of observations since data have been collected in the 1970s ranges from 25 to 38 wolverines (MNHP 2021). Wolverines prefer large tracts of mountainous, roadless

wilderness (Groves 1988), and the project area is relatively heavily roaded. Moreover, wolverines in Montana have expansive home ranges with females averaging nearly 150 square miles and males averaging 162 square miles (Hornocker and Hash 1981). The combination of road avoidance and the small proportion the project area that comprises the expansive home ranges of this roaming species would result in minor and short-term disturbance to wolverines if they happen to be present. Project activities have potential to temporarily displace wolverines from marginal habitat.

The project has low potential to disturb Canada lynx due to the relatively low probability that they would be present in the project area based on lack of contemporary observations and preference for forested areas, most of which were burned to varying degree by the American Fork fire in 2021. Canada lynx may be present in the project area, but this is not within designated critical habitat (USFWS 2017). The MNHP has few sightings of Canada lynx in the general area, and all observations are greater than 20 years old (MNHP 2021).

A combination of poor habitat suitability post-fire, closure of the area during treatment, rarity of observations documenting their presence, and relatively short duration of project implementation would result in low probability that the project would disturb Canada lynx. Any encounters with fieldworkers would be brief, and lynx would only need to move a short distance to avoid fieldworkers as fieldworkers would rarely be present outside of stream corridors. Closure of the project area to the public during treatment would limit human disturbance from the proposed action and would not be measurably different from the disturbance resulting from typical recreation and forest management activities. All motorized transportation associated with the proposed action would occur on routes open to the public for motorized use. With the project area closed to the public, there would not be a measurable increase in use on motorized routes during the implementation period ,and there would be no potential for increased disturbance from motorized traffic to Canada lynx.

Canada lynx eat mostly snowshoe hare but will switch to grouse when hare populations are low. Habitat for these prey species is limited within the recently burned project area. Lynx do not eat fish, and any exposure to rotenone killed fish would be incidental, short-term, and would not pose a health risk. Canada lynx may drink treated water; however, the concentration of rotenone in treated water is well below thresholds that would present a health risk. The primary limiting factor for lynx is modifying their habitat, and this project would not modify habitat. For these reasons, the proposed action is expected to have *no effect* to Canada lynx. Because no vegetation management is proposed and because the project is not within designated critical habitat, the proposed action would have *no effect* to Canada lynx critical habitat.

Yellowstone cutthroat trout are a state species of concern. The goal of the project would be to protect a high elevation population of Yellowstone cutthroat trout at the northernmost part of its range. The goal is compatible with state law and Montana's fisheries management plan (FWP 2019). Salvaging Yellowstone cutthroat trout before rotenone treatment would reduce mortality of Yellowstone cutthroat trout due to exposure to rotenone; however, a sizable number of Yellowstone cutthroat trout would evade capture and perish, and treatment in the following year would yield fewer captured Yellowstone cutthroat trout than the first year. The population of Yellowstone cutthroat trout would recover in 3 to 5 years. Moreover, the population would be safe from brook trout which eliminate them from their native habitat (Griffiths 1988; Gresswell 1995; Dunham et al. 2002; Shepard 2010). The short-term reduction in Yellowstone cutthroat trout abundance would be mitigated by their rapid recovery in a relatively large watershed free of non-native fishes.

Great gray owls live year-round in Montana, and the MNHP has recent evidence of breeding and relatively recent and frequent observations of this impressive bird in the general project area (MNHP 2021). Their status as a state species of concerns relates to how forest management practices such as fire suppression and related changes in forest succession may affect their habitat availability (Hayward and Verner 1994). The project would result in short-term and minor disturbance to great gray owls. These birds breed in winter, and their young would have fledged by the time the project is implemented. Moreover, great gray owls are generally tolerant of the presence of humans. In 2013, a great gray owl became a local celebrity near the Bozeman library by taking up residence for over a week in nearby spruce. This owl drew constant crowds and appeared indifferent to the spectacle it caused. This project would bring fieldworkers into potentially occupied habitat; however, the disturbance would be short-term, minor, and likely well-tolerated by great gray owls.

Western toads are a species of concern with apparent declines in the western states potentially being related to chrytid fungus. Western toads are resilient to rotenone projects. This toad breeds in slow areas in streams and likely breed in off-stream wetlands in the project area. Adults have thick, impermeable skin and tend to occupy terrestrial areas. Adults would not be affected and would reproduce the next spring. Treatment timing could result in mortality of remaining tadpoles as low late season flows require treating earlier than is preferred to protect amphibians. The western toad's impressive reproductive potential would offset any unlikely mortality of tadpoles. Females can produce an extraordinary number of eggs with a record clutch size of 20,000 eggs observed in Montana (Maxell et al. 2003). Netting tadpoles from the standing waters they inhabit and holding them outside the treatment area in fresh waters would be an additional mitigative action.

Fieldworkers working on brook trout removals and data collection aimed at supporting planning for this project have been observing amphibians in the project area for years. Columbia spotted frogs are abundant, and western toads were seen on several occasions. Fieldworkers examined likely rearing areas for aggregates of western toad tadpoles in 2021 and found none. Project timing may coincide with sensitive stages for larval amphibians, so if aggregations are found they would be rescued and returned after treatment.

Investigation into the response of amphibians to large-scale piscicide projects have found western toad populations to show not apparent population level effects (Fried et al. 2018). Likewise, toads of the genus *Bufo* remained abundant in Norway following treatment of waters using CFT Legumine at concentrations proposed for this action suggesting a general resilience of toads to rotenone projects under the proposed protocols (Amekleiv et al. 2015).

Creation of a Barrier to the Movement or Migration of Animals

No barrier would be created as part of this action. After brook trout are eradicated from the treatment area, temporary barriers would be removed to provide connectivity for the watershed's Yellowstone cutthroat trout.

Increase in Conditions That Would Stress Wildlife

The two-week effort of Yellowstone cutthroat trout salvage followed by treatment with rotenone would require fieldworkers to drive roads and a few fieldworkers to dispense rotenone on each tributary stream. Off-trail activities would be limited to stream corridors and would not expand into uplands. Because activities would occur during a public closure, the proposed action would not result in a measurable increase in activities with potential to stress wildlife as although fieldworkers would be present, recreationalists would not. Stream corridors comprise a small proportion of the landscape which would limit human encroachment into wildlife habitat. Planning the project for late summer or early fall would be well past sensitive periods with newborn species of all vertebrate species.

3.3.2 Alternative 2: No Action

This alternative would leave Yellowstone cutthroat trout with a species with proven ability to outcompete native cutthroat trout the ability to take advantage of their apparent advantage in early life history stages. The no action alternative would result in a high likelihood of loss of core conservation population of Yellowstone cutthroat trout.

3.3.3 Comparison of Alternatives and Cumulative Effects

The proposed action would secure population of Yellowstone cutthroat trout imperiled by a relatively recent invasion of brook trout. Some aquatic invertebrates and some gilled

amphibians would die; however, aquatic organisms evolved in disturbance prone environments and have multiple means to recover as has been documented in numerous studies. Rotenone would not harm other species of wildlife. The presence of fieldworkers would result in short-term disturbance to wildlife. Timing the project for early-August into September would be past sensitive, early life stages of wildlife. Because the project will occur during an area closure to the public, there is no potential for cumulative effects to wildlife with public recreation.

The no action alternative would likely result in the loss of a core conservation population of Yellowstone cutthroat trout in an area that will be resilient to climate change. Alternatively, as state and federal agencies are required by law to protect species of concern and sensitive species, continued mechanical suppression of brook trout may become the means to protect Yellowstone cutthroat trout in the project area. Mechanical suppression would require yearly or near yearly presence of fieldworkers electrofishing streams. This disturbance would need to continue in perpetuity to protect Yellowstone cutthroat trout which would stretch the presence of fieldworkers into a long-term disturbance of wildlife in the project area. The continued effort in the project area would take resources away from other at-risk populations of Yellowstone cutthroat trout.

3.4 ***Water Resources***

3.4.1 Alternative 1: Proposed Action

Changes in Water Quality from Use of Piscicide

The proposed project would intentionally introduce a liquid formulation of rotenone to surface water to remove nonnative brook trout and release of potassium permanganate at the downstream end of the project area to deactivate the rotenone. The changes in water quality would be short-term and minor, and its spatial extent would be limited by deactivation and natural breakdown of rotenone and potassium permanganate.

Several factors influence rotenone's persistence and toxicity. Warmer water promotes deactivation of rotenone which has a half-life of 14 hours at 75 °F and 84 hours at 32 °F (Gilderhus et al. 1986; Gilderhus et al. 1988) meaning that half of the rotenone is deactivated and no longer toxic at that time. As temperature and sunlight increase, so does the rate of deactivation of rotenone. Bright sunlight in June deactivated 15 ppb rotenone in 10 cm of water to nontoxic concentrations in 2-3 hours (Brown 2010). Higher alkalinity (>170 mg/L) and pH (>9.0) also increases the rate of deactivation. Rotenone tends to bind to and react with organic molecules, and availability of organic matter substantially decreases the persistence of rotenone (Dawson et al. 1991). Dilution from groundwater upwelling or inflows from untreated tributary streams also contributes to the deactivation of rotenone.

FWP's piscicide policy (FWP 2017) requires deactivation of rotenone using potassium permanganate, a strong oxidizer. Potassium permanganate would minimize exposure beyond the treatment area. Pretreatment stream flow measurements would determine if contributions of groundwater increase flows to the point that additional potassium permanganate would be needed. Potassium permanganate deactivates rotenone within 15 to 30 minutes of mixing time with stream water. This reach of stream is the neutralization or deactivation zone. Full deactivation of rotenone requires delivery of potassium permanganate at a rate that maintains a residual concentration of potassium permanganate of 0.5-1.0 ppm after 30 minutes stream travel time. At this point, neither rotenone nor potassium permanganate would be present at toxic concentrations, and any residual would continue to degrade into nontoxic constituents.

Deactivation would occur with the pilot study and full treatment. For the pilot study, the deactivation station would be set up on the Shields River downstream of the lowest tributary proposed for this project. During full treatment, the deactivation station would be set up at the downstream end of the constructed fish barrier. The release of potassium permanganate would begin when rotenone is an estimated 8 hours of stream travel time from the downstream end of the project area. Potassium permanganate turns stream water bright purple; however, it breaks down rapidly as it oxidizes rotenone. In previous projects using FWP's current piscicide policy (FWP 2017), sentinel fish indicated neither rotenone nor potassium permanganate were toxic within 20 minutes of stream travel time.

CFT Legumine is 5% rotenone, and the remaining constituents are inert ingredients used to dissolve and disperse the relatively insoluble rotenone. The inert ingredients in CFT Legumine do not include the organic solvents used in other formulations. The inert solvents and dispersant have the advantage of having low to no toxicity at the concentrations applied, and they break down rapidly in the environment (Fisher 2007). Many constituents are used in products like toothpaste, sunscreen, and eye drops (Fisher 2007). The low concentrations, general lack of toxicity, and rapid breakdown of the inert ingredients in water does not pose a risk to health or violate water quality standards.

Monitoring the effectiveness of potassium permanganate in deactivating rotenone would occur at a site 30 minutes' streamflow time downstream from the potassium permanganate application site. Maintenance of the target concentration of potassium permanganate of 0.5–1.0 ppm would be determined with a handheld chlorine meter. Caged fish placed at the site would provide additional evidence of whether potassium permanganate was successful in deactivating rotenone. Survival of caged fish at the 30-minute site indicates the potassium permanganate has successfully degraded the rotenone to nontoxic concentrations. Application of potassium permanganate would continue until caged fish placed immediately upstream of

the deactivation zone survive for 4 hours without distress indicating the natural breakdown of rotenone upstream of the deactivation zone.

Dead fish would be present during and after this project. Collecting fish at the campground and erecting nets to prevent dead fish from floating downstream into privately owned lands would reduce the number of dead fish encountered by people. Elsewhere, a relatively small proportion of dead fish would be noticeable as sinking, rapid decomposition, and scavenging by wildlife would contribute to disappearance of killed fish.

The impoundment formed by the fish barrier would likely collect dead fish floating from upstream and fish present in the pond. In lakes, most fish sink. About 70% of fish in treated lakes in Washington did not surface (Bradbury 1986). Cooler water temperatures and greater depths inhibit surfacing of dead fish. In warm water ponds supporting members of the sunfish family, nearly all fish surfaced except when temperatures were < 58 °F when most fish sank and decomposed, and cool temperature and depth were attributable for the sinking of dead fish (Parker 1970).

The cold stream temperatures in the project area would be conducive to dead fish sinking. Therefore, a relatively small proportion of dead fish would be visible, and those fish would decompose and be eaten by scavengers. Nevertheless, the pond at the downstream end of the project area is next to a campground, and fish that do not sink could accumulate on the shoreline where they would decay and present objectionable odors and unsightly carcasses. Dead fish could attract bears, and dogs brought by campers could eat and roll in dead fish. Fish that do not sink would be collected and disposed of either off-site or sunk in the pond by popping their air bladders to avoid conflicts with wildlife and unpleasant sights and smells.

Residence time of water in the pond is short and water would be unlikely to have the residence time needed to result in an algal bloom associated with nutrients released from decaying fish, although temporary nutrient enrichment has caused algal blooms in standing waters. In Washington, 9 of 11 lakes treated with rotenone had an algal bloom shortly after treatment, and an estimated 70% of the phosphorus contributed from dead fish remained in the lake with decomposition of fish (Bradbury 1986).

Though unlikely given the short residence time of water in the pond above the barrier, nutrient loading from dead fish may temporarily contribute to aesthetically unappealing algal blooms; however, keeping the nutrients within the pond is beneficial in replenishing the food web. High elevation lakes and streams tend to be nutrient-poor, so nutrients contributed from fish carcasses stimulates phytoplankton production which promotes rapid recovery of zooplankton

and other invertebrates in treated lakes. Rotenone kills zooplankton, but biomass of zooplankton recovers rapidly following rotenone treatment (Beal and Anderson 1993; Vinson et al. 2010). Algae take up the nutrients released by decaying fish, and zooplankton and other aquatic invertebrates feed on the algae. This rapid recovery of algae and invertebrates provide abundant food for when fish are returned to the lake.

Potential Effects on Groundwater Quality

No contamination of groundwater is anticipated from this project. Rotenone-treated water could go subsurface in losing stream reaches and lakes; however, rotenone binds to the streambed sediments, soil, and gravel, and does not persist in groundwater (Engstrom-Heg 1971; Engstrom-Heg et al. 1978; Skaar 2001; Ware 2002). Rotenone moves only 1 inch in most soil types except sandy soils where it moves about 3 inches before binding to soils (Hisata 2002). In California, studies of wells in aquifers near to and downstream of rotenone application have never detected rotenone, rotenolone, or any of the organic compounds in formulated products (CDFG 1994). CFT Legumine does not contain the organic compounds used in other formulations of rotenone. The inert solvents and dispersants in CFT Legumine would not contaminate groundwater given their low toxicity and rapid breakdown.

Case studies in Montana have concluded that rotenone does not move measurably in groundwater (FWP unpublished data). At Tetrault Lake, neither rotenone nor inert ingredients were detected in a nearby domestic well which was sampled 2 and 4 weeks after the lake was treated despite being down gradient and within the same aquifer as the lake. FWP has sampled wells and groundwater in several piscicide projects that removed fish from ponds, and no rotenone or inert ingredients were detected in ponds ranging from 65 to 200 feet from treated waters. Likewise, rotenone applied to streams has not resulted in contamination of neighboring wells or groundwater. No rotenone was found in domestic wells adjacent to Soda Butte Creek and drawing from the same aquifer.

The Groundwater Information Center provides a database of wells throughout Montana and allows determination of proximity of domestic or stock water wells to the project area (GWIC 2021). No wells are within the CGNF. The closest wells are 4 river miles downstream from the project area. One is about 270 yards from the Shields River, and the other is about 0.7 miles from the river. The distance from the treatment area and stream, combined with rotenone’s tendency to bind with soils and organic matter (Hisata 2002), place these wells out of reach of potential contamination.

Effects on Other Water Users

Irrigation, stock water, domestic uses, and recreation are the potential water uses for most rotenone projects. The CFT Legumine label, the standard operating procedures for piscicide use in fisheries management (Finlayson et al. 2018), and FWP's piscicide policy (FWP 2017) include provisions for protecting other water users from contact with rotenone. Requiring deactivation at the downstream extent of the treatment area augments natural break down and limits the spatial extent of treated waters to an established deactivation zone. Potassium permanganate is released using a power auger, and this strong oxidizer breaks down rotenone within 30 minutes of stream travel time. A secondary station would be placed at the 30-minute travel time location.

Field data collected in July 2021 allows for estimation of the travel time downstream of the deactivation station. The estimated 30-minute travel time location is about 0.4 miles from the deactivation station (Figure 17). Sentinel fish would be placed at the 30-minute travel time location, and a secondary deactivation station placed there would be activated if fish showed signs of stress. Additional sentinel fish would be placed at the 60-minute travel time location to evaluate the effectiveness of deactivation of rotenone. Field data collected in July 2021 allow for prediction of travel time for planning purposes, but this study would be repeated just before rotenone treatment to finalize locations. A treatment later in the season would have less water and a correspondingly shorter deactivation zone. Flows dropped 75% between July and October stream flow measurements in the project area.

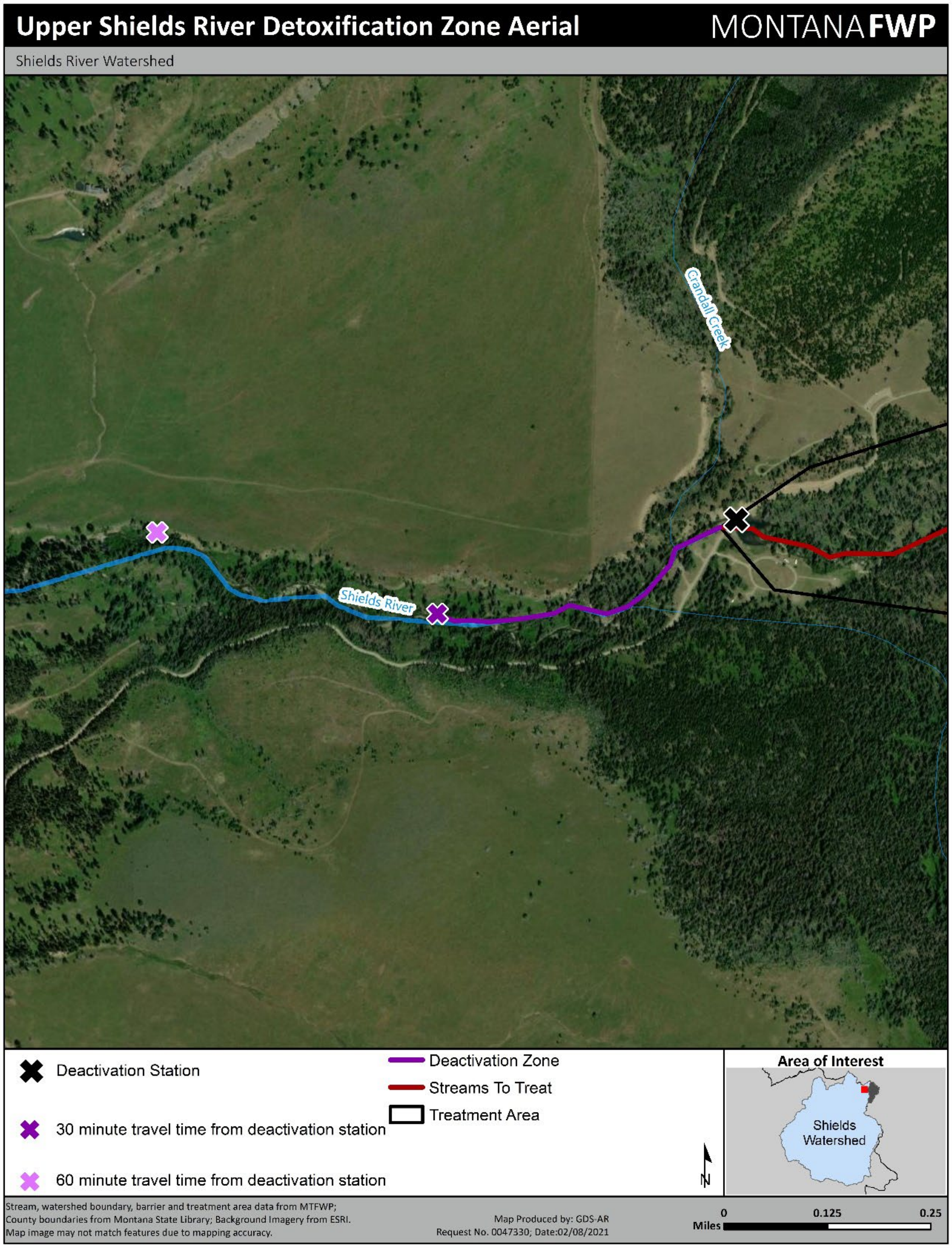

Figure 17. View of deactivation zone downstream of constructed barrier. Visible fence line shows boundary between Custer Gallatin National Forest and private property.

Several features of the deactivation zone would assist in rapid breakdown of rotenone and limit its toxicity to the reach of the Shields River within national forest. Crandall Creek enters the Shields River just downstream of the barrier, and these fresh inflows would dilute rotenone, and dilution is a major contributor to rotenone deactivation. Furthermore, this stretch of the Shields River has multiple channels that split flows nearly equally. The travel time study followed the fastest moving water; however, substantial portions of the stream's flow would flow through slower moving glides where the channel splits. The water flowing in these glides would have more time to react with potassium permanganate which would facilitate breakdown. Likewise, stream flow in these glides is shallow and exposed to sunlight which contributes to rapid breakdown of rotenone (Brown 2010). Downstream of the 60-minute travel location, Bennett Creek flows into the Shields River which would further dilute any residual rotenone and potassium permanganate.

The current practices that require determination of lowest effective dose and deactivation of rotenone were developed to prevent mortality of fish and nontarget organisms beyond the deactivation zone. In Montana, escape of rotenone past the project boundaries has been rare. Since 1990, FWP and partners have implemented 115 rotenone projects in Montana, mostly in streams. Substantial escape of rotenone resulting in a fish kill downstream of the deactivation zone has occurred only twice in 30 years which is less than 1% of rotenone projects implemented in Montana during those decades.

Although rare, these events prompted development of procedures in 2014 to prevent rotenone escape and following these protective measures is required under policy and law. Since these practices have been put in place, agencies have implemented numerous rotenone projects safely, and toxic concentrations of rotenone have been contained within the deactivation zone except for a single incident of slight spread beyond an area where placer mining had greatly altered local hydrology. Future projects in streams with similar disturbance would increase protective measures to contain rotenone within the deactivation zone. The deactivation zone in the upper Shields River project area does not have the kind of alteration that would reduce the effectiveness of deactivation and has numerous features that would expedite breakdown of rotenone and potassium permanganate.

Review of water rights maintained on the Department of Natural Resources and Conservation's website ([DNRC Water Right Query System [mt.gov]]) identified stock water rights and in-stream flow reservations being within the area likely to receive toxic concentrations of rotenone and be exposed to potassium permanganate (Figure 17). The CFT Legumine label has no provisions for exposure of livestock to treated waters; however, standard operating procedures and policy require livestock be given an alternative source of water during rotenone treatment. This added

measure of protection, combined with the extremely low toxicity of rotenone when ingested in treated water, would not negatively affect livestock or pets (see Changes in Water Quality from Use of Piscicide). Potential exposure, even without protective measures, is far below levels shown to cause ill effects. Rotenone treatment would not affect in-stream flow reservations for fish. The CGNF would work with the grazing lessee to ensure livestock have access to clean water during treatment should they be present. Treating twice in 2022 while the grazing allotment is being rested would avoid potential exposure to rotenone by cattle.

Application of rotenone in the project area, and detoxification with potassium permanganate at the downstream end of the treatment area would not affect domestic water supplies or irrigation uses. The nearest surface water diversion for irrigation is a headgate located 5 miles downstream of the end of the project area. Rotenone and potassium permanganate would be entirely degraded before reaching an irrigation diversion. No surface water rights for domestic uses would be exposed to rotenone or potassium permanganate. Water rights for domestic use are either wells or developed springs and are too far from treated waters for rotenone or potassium permanganate be able to infiltrate.

Relevance to State of Federal Water Quality Standards

Montana DEQ issues a pesticide general permit on a five-year cycle to FWP that allow FWP to apply piscicides. FWP and other piscicide applicators must develop a pesticide discharge management plan as a condition for coverage under the permit. For FWP, the plan consists of procedures and protocols described in FWP's piscicide policy (FWP 2017), the American Fisheries Society's standing operating procedures for rotenone application (Finlayson et al. 2018), annual training, and critical review of projects by FWP's piscicide committee.

3.4.2 Alternative 2: No Action

Under the no action alternative, no changes relating to state or federal water quality standards would occur, and no permits would be necessary

3.4.3 Comparison of Alternatives and Cumulative Effects

Implementing the proposed action would result in release of rotenone into fish-bearing waters in the Shields River watershed, upstream of a constructed barrier. As rotenone is a highly reactive molecule, it would break down quickly through natural processes, and deactivation would be accelerated by mixing with potassium permanganate at the constructed barrier. Potassium permanganate in turn breaks down into nontoxic constituents as it oxidizes the rotenone. Stream and lake water would be toxic to fish, some invertebrates, and gilled amphibians for a few hours each day of stream treatments. The inert ingredients have low toxicity and brief period of persistence.

Irrigation uses also have potential to be affected by rotenone; however, deactivation at the barrier would limit the occurrence of rotenone and potassium permanganate to an estimated 600 yards past the deactivation station. Surface water diversions for irrigation are well downstream of the deactivation zone and would be unaffected. Livestock drinking stream water would receive a minute dose that would not pose a health risk; however, as an added measure, providing livestock an alternative source of water would prevent exposure. Dead fish would release nutrients into stream water which would jumpstart recovery of invertebrate populations. There are no past, present, or reasonably foreseeable actions with potential to interact with the proposed action to cumulatively effect water resources. The no action alternative would not affect water resources.

4 Effects on the Human Environment

4.1 *Aesthetics and Recreational Opportunities*

4.1.1 Alternative 1: Proposed Action

Recreation and livestock grazing are the primary land uses in the project area. The pilot study portion of the project would be implemented in July 2022 which does not coincide with hunting season and would take place in relatively remote tributaries that do not receive appreciable fishing pressure. The subsequent full treatments would occur in late August 2022 pending availability or early September 2022 pending availability of fieldworkers and would not conflict with hunting season which brings many recreationalists to the area. People hiking, camping, and fishing would encounter fieldworkers during the Yellowstone cutthroat trout salvage, and fieldworkers would occupy the USFS campground. Dispersed camping sites occur throughout the project area, so the public would still have opportunity to enjoy the area during the fish salvage. Single treatments are rarely effective in larger areas with complex habitat. Treatments would follow for up to 5 years with electrofishing and sampling of eDNA guiding spatial scope of subsequent treatments. Typically, eradication is achieved in 2 to 3 treatments in a watershed of this size and complexity. The public would be temporarily excluded from treated streams while toxic concentrations of rotenone are present. This exclusion would not occur during hunting season

During rotenone treatment, the project area would be closed to the public. This measure is to prevent people from having contact with treated waters. Press releases would alert the public to the closure during treatment. Signs placed near Wilsall, Montana, at the turn off on Highway 89 to the upper Shields River would alert recreationalists to presence of fieldworkers and area closures.

Fish populations would be suppressed for about 3 years after the final rotenone treatment. Salvaged Yellowstone cutthroat trout returned to the project area would reproduce rapidly as is typical of species with high reproductive potential in an environment with reduced competition for resources. Lower Deer Creek and Soda Butte Creek are projects where Yellowstone cutthroat trout were salvaged before rotenone treatment and returned the day after treatment ceased. Yellowstone cutthroat trout populations in both streams recovered dramatically within 5 years and now support healthy Yellowstone cutthroat trout populations and provide lively fishing opportunities.

The nature of fishing opportunities would change somewhat with implementation of the project. Yellowstone cutthroat trout would be the only fish available, and catchable Yellowstone cutthroat trout have greatly outnumbered brook trout given the relative recency of the invasion and the ongoing suppression efforts. Anglers are permitted to harvest one Yellowstone cutthroat trout per day and have one in possession. In contrast, daily and possession limits on brook trout are 20 fish. Brook trout would remain abundant and well-distributed in suitable waters allowing anglers opportunities elsewhere. With recovery of the Yellowstone cutthroat trout population in the project area, changes in fishing regulations to increase the allowable harvest of Yellowstone cutthroat trout in the project area is a potential future action.

The presence of dead fish would temporarily affect aesthetics. Dead fish would be gathered in areas where humans congregate like the campground. Block nets erected downstream from the treatment area would capture dead fish before they reached occupied reaches of private properties downstream. Dead fish in more remote portions of the watershed would decompose and be scavenged making their presence a short-term and minor impairment of aesthetics.

4.1.2 Alternative 2: No Action

Not implementing the project would likely result in the eventual displacement of Yellowstone cutthroat trout from this northernmost stronghold that is at an elevation likely to remain cold enough to support Yellowstone cutthroat trout in a changing climate. Anglers would lose another location to target native cutthroat trout in a beautiful setting. Brook trout have wider distribution across Montana than native cutthroat trout, so not implementing the project would contribute to reduced diversity in fishing opportunities.

4.1.3 Comparison of Alternatives and Cumulative Effects

Implementing the project would result in short-term disturbance to recreation associated with the presence of fieldworkers during fish salvage efforts and public closure during rotenone treatment. Recreational fishing opportunity would be temporarily affected by a temporary

reduction in the abundance of Yellowstone cutthroat trout. Yellowstone cutthroat trout populations recover rapidly when returned to reclaimed streams. Removal of brook trout would protect recreational fishing for native cutthroat trout which is an increasing rare angling opportunity. The Forest Service will be conducting road maintenance on the Shields loop road over the next few years. This activity may temporarily prevent the public from driving around the entire loop road, but all areas could still be accessed by driving one way or another around the loop. Therefore, the proposed action does not have potential for cumulative effects to public recreation with past, present, or reasonably foreseeable activities.

The no action alternative would result in eventual loss of a core conservation population of Yellowstone cutthroat trout and eliminate the opportunity to fish for native cutthroat trout in a beautiful, serene setting. Cumulatively, climate change and nonnative fishes are reducing the habitat occupied by Yellowstone cutthroat trout, and not implementing the project would contribute to the cumulative loss of Yellowstone cutthroat trout populations.

4.2 *Community and Taxes*

4.2.1 Alternative 1: Proposed Action

The proposed action would not affect the community beyond the already stated recreational and conservation benefits. Taxes would not be affected.

4.2.2 Alternative 2: No Action

The no action alternative would not have short-term effects on the community. Over the long term, the cumulative effects of failing to follow through on native fish restoration projects increases the likelihood of including Yellowstone cutthroat trout for protection under the Endangered Species Act. Listing could have a far-reaching effect in communities throughout the Yellowstone cutthroat trout's native range as it would reduce flexibility in the land and water management activities of landowners, agencies, agriculture, and extractive industries.

4.2.3 Comparison of Alternatives and Cumulative Effects

The proposed action would not affect the community or taxes. Allowing a population of Yellowstone cutthroat trout to be displaced by brook trout would increase justification for listing the fish for protection under the Endangered Species Act. ESA listing would not be beneficial to rural communities or governments as it would decrease flexibility in land management options. Because the proposed action would not affect the community or taxes, it would not have potential for cumulative effects with past, present, or reasonably foreseeable actions.

4.3 *Air Quality*

4.3.1 Alternative 1: Proposed Action

A portable generator would be used at the detoxification station to power the volumetric feeder used to deliver potassium permanganate. This would result in a short-term and minor release of exhaust into the air. Likewise, rotenone would be applied to the pond at the downstream end of the project area with a gas-powered pump which would be run for several hours. The exhaust would quickly dissipate making effects on air quality minor and short-term. Backpack sprayers used in wetlands and backwaters would release a mist of liquid rotenone formulation, but rotenone is not volatile and would quickly fall out of suspension. Applicators would wear respirators to prevent inhalation of the dilute liquid rotenone solution mist.

CFT Legumine does not have an objectionable odor. Its solvents and dispersants give the chemical a slight soapy smell that is undetectable once diluted for application in the stream.

4.3.2 Alternative 2: No Action

This alternative would not affect air quality.

4.3.3 Comparison of Alternatives and Cumulative Effects

The proposed activity would have minor, short-term effects on air quality with localized release of exhaust and diluted rotenone formulation mist. There are no past, present, or reasonably foreseeable actions that would interact with the low-level effects of the proposed action to affect air quality. The no action alternative would not affect air quality.

4.4 *Noise and Electrical Effects*

4.4.1 Alternative 1: Proposed Action

The generators to power the auger dispensing potassium permanganate, and the pump to treat the downstream impoundment would result in noise and temporary release of exhaust that would dissipate rapidly. The proposed action would not have effects on any electrical systems. The area would be closed to the public during operation of the power auger, so few people outside of the fieldworkers operating the deactivation station or staying in the campground would hear the auger or smell fumes.

4.4.2 Alternative 2: No Action

This alternative would not affect noise or electrical services.

4.4.3 Comparison of Alternatives and Cumulative Effects

The proposed action would bring short-term noise from generators. Because the project area is closed to the public during project implementation, there are no potential for cumulative effects related to noise. The no action alternative would not affect noise.

4.5 ***Risk or Health Hazards***

4.5.1 Alternative 1: Proposed Action

This project would result in release of a liquid formulation of rotenone into waters in the project area and release of potassium permanganate downstream of the constructed barrier. Oxidation with potassium permanganate would render rotenone nontoxic within 30 minutes of stream travel time. Analysis of risks to human health from exposure to liquid rotenone follows information provided by the EPA (EPA 2007) and a study of the toxicity and persistence of the active and inert ingredients in CFT Legumine (Fisher 2007).

Toxicity evaluations examine acute and chronic toxicity. Acute toxicity is the adverse effect of a highly toxic substance from a single exposure or multiple exposures in a short space of time that result in substantial health risks. Rotenone ranks as having high acute toxicity through oral and inhalation routes of exposure, and low acute toxicity through exposure to skin (EPA 2007).

Several factors would be protective of the health of workers handling CFT Legumine and prevent harmful exposure to rotenone. The low concentration of rotenone in CFT Legumine. It comprises 5% of the formulation, or 5 g/L. No one would be handling pure rotenone. Furthermore, the label for liquid rotenone requires applicators to wear a dust/mist respirator, splash safety goggles, impervious gloves, and coveralls. The personal protective equipment would prevent inhalation, ingestion, and dermal exposure. Goggles would protect eyes from contact with liquid rotenone. Likewise, applicators at the deactivation station would wear personal protective equipment to limit exposure to potassium permanganate.

Applicators would supply containers of liquid rotenone to fieldworkers responsible for operating a given drip station or backpack sprayer. Flow measurements taken the day before would determine the amount of liquid rotenone in the containers required to achieve the target concentrations of rotenone in streams, usually 25 to 50 ppb. Bioassays would determine the lowest effective concentration which could be adjusted upward to achieve a fish kill. Liquid rotenone would be mixed with stream water in drip station containers or backpack sprayers. Operators handling liquid rotenone would also wear eye protection, a protective mask, and gloves to prevent exposure to the diluted liquid rotenone. In either case, applicators handling undiluted liquid rotenone and operators applying diluted liquid rotenone to surface waters

would not be exposed to rotenone at levels that would be acutely toxic, as personal protective equipment would prevent exposure, and accidental exposure would be to low concentrations of rotenone.

Chronic exposure is repeated exposure from ingestion, inhalation, or dermal contact with the target chemical (EPA 2007). Chronic exposure, as defined in toxicity analyses for humans, is about 10% of the life span. Application of piscicide in upper Shields River watershed would likely last less than 7 days. Applicators handling undiluted product have potential for brief contact with rotenone for considerably less than 10% of their life span. Under label requirements ,they are required to wear personal protective equipment. Protective eyewear, coveralls, gloves, and dust and mist respirators provide ample protection against any contact with rotenone. Likewise, operators dispensing diluted liquid rotenone at drip stations or with backpack sprayers and undiluted liquid rotenone from IV bags would wear personal protective equipment to prevent exposure.

Exposure to rotenone by eating dead fish is highly unlikely, and streams and lakes would be closed to the public during treatment. Signs posted at trailheads and access areas would inform the public of the presence of dead fish and alert people to not eat dead fish. Microbes work quickly on dead fish, so decay is obvious within a few hours and these fish would not be appealing to humans looking for a meal. Signs warning the public and rapid onset of decomposition of dead fish would result in extremely low probability that humans would eat rotenone-killed fish.

Although consumption of rotenone contaminated fish is unlikely, in the rare chance someone ate rotenone-killed fish or fish that left the project area without receiving a lethal dose, this exposure would not result in a health risk. The EPA evaluated the potential dose of rotenone from eating dead fish. In each step of their analysis, they factored safety into their equations to develop a risk analysis that would be highly protective of human health (EPA 2007). The EPA chose safety levels for females 13-49 years old as a potentially sensitive group (EPA 2007). In determining potential exposure from consuming fish, the EPA used maximum residues in fish tissues killed by rotenone. This concentration is a conservative estimate of potential exposure as it includes rotenone accumulated in tissues other than muscle tissue, such as kidneys and liver, which would not be palatable to humans but may have higher concentrations of rotenone than muscle. The EPA concluded that acute dietary exposure from the unlikely occurrence of eating rotenone-killed fish resulted in a dietary risk below their level of concern. Therefore, people eating rotenone-killed fish, despite posted warnings, would not face a health risk.

The EPA developed toxicological endpoints for several types of exposure to rotenone in treated waters and included uncertainty factors to ensure endpoints would be conservative and most protective of human health (EPA 2007). Rotenone projects would result in exposures far below the no observable effects level for acute dietary exposure, chronic dietary exposure, incidental short-term exposure from consumption of rotenone-killed fish, and short, intermediate, and long-term dermal exposure. Personal protective equipment worn by workers would reduce potential for exposure within this margin of safety. Closing public access to the streams and lakes are extra precautionary actions designed to provide added assurance that human health would not be at risk from rotenone projects.

The EPA concluded risks from chronic exposure to rotenone-treated water in streams conveyed low risk to humans (EPA 2007). Rotenone's rapid breakdown in the environment and deactivation with potassium permanganate would limit the duration rotenone is present in treated waters. The label prohibits use of rotenone near waters diverted for domestic use, and this remote watershed does not provide water for domestic uses.

The requirement that the public be notified of rotenone in treated waters would also protect human health for the short duration it is present in streams and lakes. Notifying the public through local papers, public meetings, and placing signs at access points would alert the public to the area closure and presence of rotenone in treated water.

The temporary closure of waters to recreational uses is an added safety measure to protect human health. Application concentrations of less than 90 ppb of rotenone does not pose a threat to humans engaged in recreational activities after it is applied to water and has been mixed (EPA 2007). In comparison, concentrations of rotenone typical of fish removal projects in similar areas involving trout is generally around 25 to 50 ppb although they can be adjusted higher within label limits if the usual range is not effective. When the application level is lower than 90 ppb, signs may be removed and the closure lifted immediately after the application is complete. For stream treatments exceeding the 90 ppb level, signs can be removed following a 24-hour bioassay demonstrating survival of fish, analytical chemistry showing less than 90 ppb rotenone, or 72 hours, whichever is less. For standing water treatments over 90 ppb, signs must remain posted for up to 14 days unless fish do not die during a 24-hour bioassay or rotenone is measured to be less than 90 ppb in the water.

The inert ingredients in CFT Legumine do not pose a threat to human health (Fisher 2007). Inert ingredients are primarily solvents and dispersants needed to dissolve and disperse the relatively insoluble rotenone. The emulsifier Fennedefo[99]™ comprises the bulk of the inert ingredients in CFT Legumine. This inert additive is a formulation of fatty acids, resin acids, and polyethylene

glycols, which are common constituents in soaps and other consumer products such as soft drinks, toothpaste, eye drops, and suntan lotions. Its concentration in treated waters would be many orders of magnitude lower than concentrations that are toxic, and it breaks down rapidly in the environment. Other trace constituents are organic compounds used in the extraction of rotenone from the raw plant parent material and are at minute concentrations and would be undetectable in streams or lakes and far below toxic concentrations. In contrast, Prenfish and other formulations of rotenone use organic solvents to dissolve and disperse rotenone, and CFT Legumine does not contain these chemicals except in trace amounts. The low toxicity and concentration of inert ingredients, combined with the rapid breakdown in the environment, would not pose a threat to human health or the environment.

The solvent n-methylpyrrolidone comprised 10% of CFT Legumine. The safety data sheet for n-methylpyrrolidone provided toxicity information that confirms Fisher's assertion that this chemical would not be toxic as applied in piscicide projects (Fisher 2007). Mice exposed to 1,000 ppm/day for 3 months showed no adverse effects. The combination of its exceptionally low concentration in treated water and its rapid breakdown in the environment mean n-methylpyrrolidone would not present a threat to human health or the environment.

The occupational risks to humans is low if proper safety equipment and handling procedures are followed as directed by the product labels (EPA 2007). The major risks to human health from rotenone come from accidental exposure during handling and application. This is the only time when humans are exposed to concentrations that are greater than that needed to remove fish. To prevent accidental exposure to liquid formulated or powdered rotenone, the Montana Department of Agriculture requires applicators to be:

- Trained and certified to apply the pesticide in use,
- Equipped with the proper safety gear, which, in this case, includes respirator, eye protection, rubberized gloves, hazardous material suit,
- Have product labels with them during use,
- Contain materials only in approved containers that are properly labeled, and
- Adhere to the product label requirements for storage, handling, and application.

Concern over a potential link between rotenone and Parkinson's disease often emerges with piscicide projects. Research into the links between rotenone and Parkinson's disease include laboratory studies intended to induce Parkinson's-like symptoms in laboratory animals as a tool for neuroscientists to understand the mechanism of Parkinson's disease (Betarbet et al. 2001; Johnson and Bobrovskaya 2014), epidemiological studies of Parkinson's disease in farmworkers

(Kamel et al. 2007; Tanner et al. 2011), and laboratory studies evaluating risks associated with inhalation of rotenone powder (Rojo et al. 2007).

The studies aimed at creating Parkinson's like lesions as a tool for neuroscientists to study the disease (Betarbet et al. 2001; Johnson and Bobrovskaya 2014) do not provide a relevant model for field exposure during piscicide treatments. These studies entailed continuous injection of high concentrations of rotenone into the bloodstream for long durations with a chemical carrier to facilitate absorption into tissues. Such studies differ substantially from piscicide projects in terms of dose, duration, and mode of delivery and are not relevant to this project.

Follow up investigation to Betarbet et al. (2001) did not find a causal link between rotenone despite the link found in the previous laboratory study (Höglinger et al. 2006). These researchers concluded that Parkinson's-like lesions found with high exposure to rotenone in lab rats was inconsistent with idiopathic Parkinson's disease suffered by humans. These researchers concluded the symptoms induced in lab rats with high exposure were like atypical cases of Parkinson's disease, and the use of rotenone in fish removal projects does not result in the type of exposure that caused Parkinson-like lesions in lab rats treated with high levels and long durations of rotenone fed intravenously with a chemical carrier to assist in absorption.

Epidemiological studies have proposed a link between pesticide use in general and Parkinson's disease. Definitive evidence of a causal link between rotenone exposure and Parkinson's disease has not been found as results of epidemiological studies have been highly variable (Hubble et al. 1993; C L Lai et al. 2002; Guenther et al. 2011; Tanner et al. 2011). A widely-cited study reported a positive correlation between agricultural use of rotenone with Parkinson's disease (Tanner et al. 2011). Review of methodologies and assumptions in these studies demonstrates the difficulties in using epidemiological data in hazard identification (Raffaele et al. 2011). These after-the-fact studies cannot assess variability in rotenone formulations, dose, frequency of exposure, and whether workers used personal protective equipment. Moreover, exposure to other pesticides is a complicating factor as farm workers usually have exposure to multiple pesticides. Epidemiological studies do not allow evaluation of the extent to which other factors such as age and genetics contribute to development of the disease.

A review conducted by neuroscientists reiterated the usefulness of rotenone in inducing Parkinson's like lesions as a laboratory model to study the disease and noted the correlation of increased Parkinson's disease in rural areas where exposure to pesticides is likely (Radad et al. 2019). Nevertheless, they could not find a causal link between rotenone use in agriculture and Parkinson's disease. These authors further note the rapid breakdown of rotenone in the environment, and the extreme concentrations and unnatural delivery methods required to

induce Parkinson's-like lesions in laboratory animals. The use of rotenone in fish removal projects with personal protective equipment would not be enough to achieve pathology that occurs with intentional exposure of test animals in the laboratory to long durations and exceptionally high concentrations of rotenone combined with a chemical carrier.

Application of rotenone in fish management projects is dissimilar to past application in agriculture, so epidemiological studies are not relevant to fish removal projects when conducted according to label requirements. Rotenone-applied pesticide in agriculture and on pets and livestock was in powder form which would have considerable potential to become airborne. In contrast, the rotenone in CFT Legumine is in liquid form, so no particles would be transported by air currents. The concentration of rotenone required to achieve a fish kill is minute whereas the rate of application in agriculture is unknown. Finally, personnel handling rotenone wear protective equipment that prevents or minimizes exposure through inhalation, ingestion, and contact with skin with use of personal protection equipment and does not resemble exposure likely experienced by farmworkers who may have not been wearing protective equipment and had greater potential for exposure to multiple pesticides.

4.5.2 Alternative 2: No Action

This alternative would have no effect on human health or related hazards.

4.5.3 Comparison of Alternatives and Cumulative Effects

The proposed action would pose minimal risk to human health if applicators use prescribed protective gear while applying liquid rotenone. The protective measures exceed those recommended by the EPA (EPA 2007). The low concentration of rotenone used in piscicide projects and its brief duration in the environment would not pose a threat to human health from contact with treated water. Likewise, although signs would alert the public to not eat killed fish, the concentration of rotenone in fish tissues would not pose a risk to human health. The use of protective gear, minute concentrations over short durations, and rapid breakdown of rotenone in the environment would ensure that the proposed action does not have direct or indirect effects to humans. Because the proposed action with adherence to policy, procedures, and mitigations would not have effects to human health, there is no potential for cumulative effects. The no action alternative would have no effects on human health.

4.6 *Cultural Resources*

4.6.1 Alternative 1: Proposed Action

This alternative would not affect cultural resources because no ground ground-disturbing activities are part of the proposed action. Therefore, there is no potential for cumulative effects to cultural resources.

4.6.2 Alternative 2: No Action

This alternative would not affect cultural resources.

4.6.3 Comparison of Alternatives and Cumulative Effects

Neither alternative would affect cultural resources.

5 Need for an Environmental Impact Statement

Evaluation of the environmental, social, cultural, and economic effects of the proposed alternative found any effects to be short-term and minor. Moreover, the proposed action would be beneficial in achieving conservation goals for Yellowstone cutthroat trout. The community would benefit from protecting and improving the status of this native fish.

Evaluation of the no action alternative found this alternative would have no negative effects on most aspects of human health or the environment. However, this alternative would likely result in the loss of a core conservation population of Yellowstone cutthroat trout. Protecting genetically unaltered Yellowstone cutthroat trout cutthroat trout is the highest priority under the MOU for cutthroat trout conservation in Montana (MCTSC 2007). State and federal law authorizes agencies and their partners to implement projects that protect imperiled populations of Yellowstone cutthroat trout.

Finally, FWP reviewed the alternatives and found the proposed alternative would have no, or only short-term and minor effects on all the categories evaluated. Therefore, there is no need for the preparation of an environmental impact statement.

6 Public Participation

6.1 *Public Involvement*

Public notification of the EA release and opportunities will be through the following media:

- Legal notices posted in *The Livingston Enterprise, The Bozeman Daily Chronicle, The Billings Gazette,* and *The Big Timber Pioneer.*
- Direct mailing to adjacent landowners and interested parties
- Public notices on the FWP webpage (*http://fwp.mt.gov*) and its Facebook page (https://www.facebook.com/#!/MontanaFWP)
- A public meeting will be held in on June 1 at the Livingston Public Library, 228 W Callender Street, Livingston, MT 59047, from 5:30 to 7:00 p.m.
- A second public meeting will be held in on June 2 at the Wilsall Fire Hall, 207 Elliot Street, Wilsall, MT 59086, from 5:30 to 7:00 p.m.

Copies of this EA will be available for public review at FWP Region 3 Headquarters at 3 and on the FWP website (*http://fwp.mt.gov*).

6.2 *Public Comment Period*

The public comment period will extend for 30 days beginning May 23, 2022, and ending June 23, 2022. Written comments must be received by 5:00 p.m. on June 23, 2022.

Send comments to:

R-3 Fisheries
Upper Shields River Yellowstone cutthroat trout conservation
1400 South 19th Street
Bozeman, MT 59718

Email comments to comment fwprg3@mt.gov.

6.2.1 Parties Responsible for Preparation of the EA

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