Westslope Cutthroat Trout Status and Conservation within the Beaverhead, Red Rock and Ruby River Sub-basins of Southwest Montana

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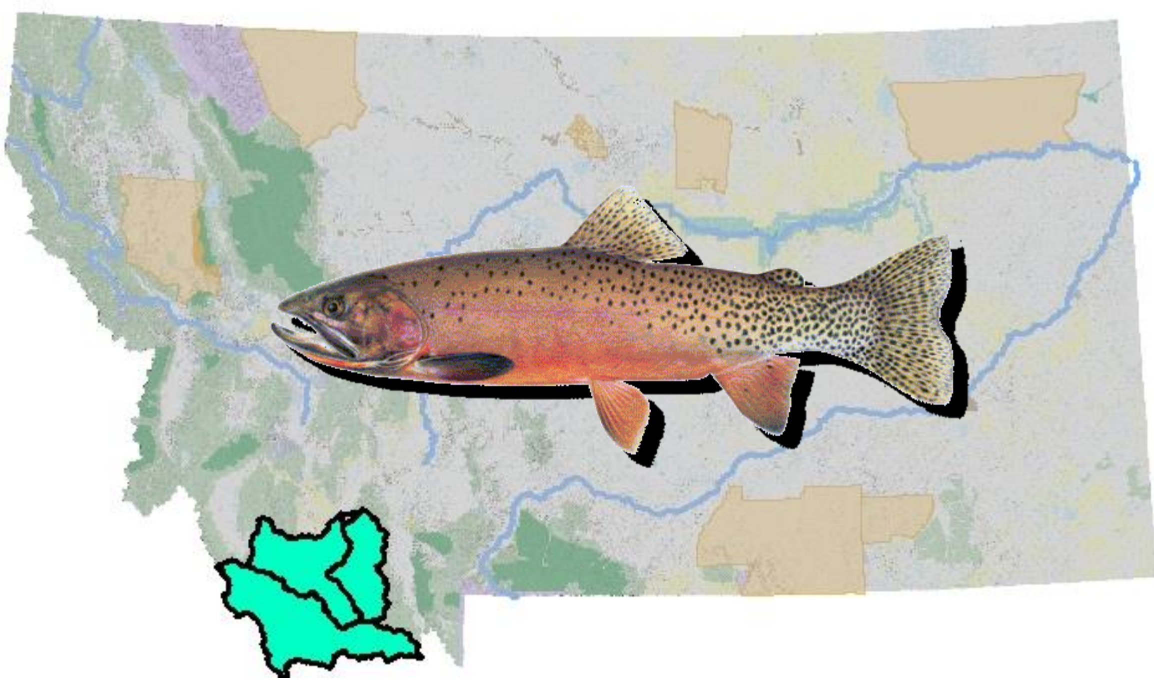

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APPENDICES

Introduction and Overview

Westslope Cutthroat Trout, *Oncorhynchus clarkii lewisi* (WCT) were first described by the Lewis and Clark Expedition in 1805 near Great Falls, Montana, and are recognized as one of 14 interior subspecies of cutthroat trout. The historical range of WCT includes Idaho, Montana, Washington, Wyoming, and Alberta, Canada. In Montana, WCT occupy the Upper Missouri and Saskatchewan River drainages east of the Continental Divide, and the Upper Columbia Basin west of the Divide. Although still widespread, WCT distribution and abundance in Montana has declined significantly in the past 100 years due to a variety of causes including introductions of nonnative fish, habitat degradation, and over-exploitation (Hanzel 1959, Liknes 1984, McIntyre and Rieman 1995, Shepard et al. 1997, Shepard et al. 2003). Reduced distribution of WCT is particularly evident in the Missouri River drainage where genetically unaltered WCT are estimated to persist in less than 5% of the habitat they once occupied, and most remaining populations are restricted to isolated headwater habitats (Shepard et al. 2003).

The declining status of WCT has led to its designation as a *Species of Special Concern* by the State of Montana, a *Sensitive Species* by the U.S. Forest Service (USFS), and a *Special Status Species* by the U.S. Bureau of Land Management (BLM). In addition, in 1997 a petition was submitted to the U.S. Fish and Wildlife Service (USFWS) to list WCT as “threatened” under the *Endangered Species Act* (ESA). USFWS status reviews have found that WCT are “not warranted” for ESA listing (DOI 2003); however, this finding was in litigation until 2008 and additional efforts to list WCT under ESA are possible in the future.

In an effort to advance range-wide WCT conservation efforts in Montana a Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout in Montana was developed in 1999 by several federal and state resource agencies (including BLM, Montana Fish, Wildlife & Parks [FWP], USFS, and Yellowstone National Park), non-governmental conservation and industry organizations, tribes, resource users, and private landowners (FWP 1999: MOU). The MOU outlined goals and objectives for WCT conservation in Montana, which if met, would significantly reduce the need for special status designations and listing of WCT under the ESA. The MOU was revised and endorsed by signatories in 2007 (FWP 2007). As outlined in the MOU’s, *the primary management goal for WCT in Montana is to ensure the long-term self-sustaining persistence of the subspecies in its historical range*. This goal can be achieved by maintaining, protecting, and enhancing all designated WCT “conservation” populations, and by reintroducing WCT to habitats where they have been extirpated.

An important element of the WCT management strategies outlined in the MOU’s was the cooperative development of sub-basin level (4th order HUC) plans that will address current status and conservation needs of WCT. This document fulfills this obligation for three sub-basins in the Upper Missouri River drainage of southwest Montana (Figure 1; Sections 1 – 3), and includes major elements recommended in the MOU’s for WCT management plans: the identification of WCT conservation populations (i.e., populations to be protected), the current status of each population, and short-term and long-term management actions required to maintain these populations. In addition, potential restoration efforts outside the current distribution of WCT and conservation priorities are presented.

Where necessary, specific WCT conservation projects identified in this document (e.g., removal of nonnative trout to protect a conservation population) will be developed with appropriate federal or state environmental assessment processes (MEPA/ NEPA) that include public involvement.

The area covered in this report encompasses about 4,782 square miles of the Upper Missouri River drainage, and includes three river sub-basins: the Beaverhead, Red Rock and Ruby (Figure 1). These three sub-basins include over 7,000 miles of perennial and ephemeral streams, although there are only about 3,800 miles of named streams. Significant public land management entities within the assessment area include the Beaverhead

– Deerlodge National Forest, BLM Dillon Field Office, FWP Region 3, Montana Department of Natural Resources, and United States Fish and Wildlife Service.

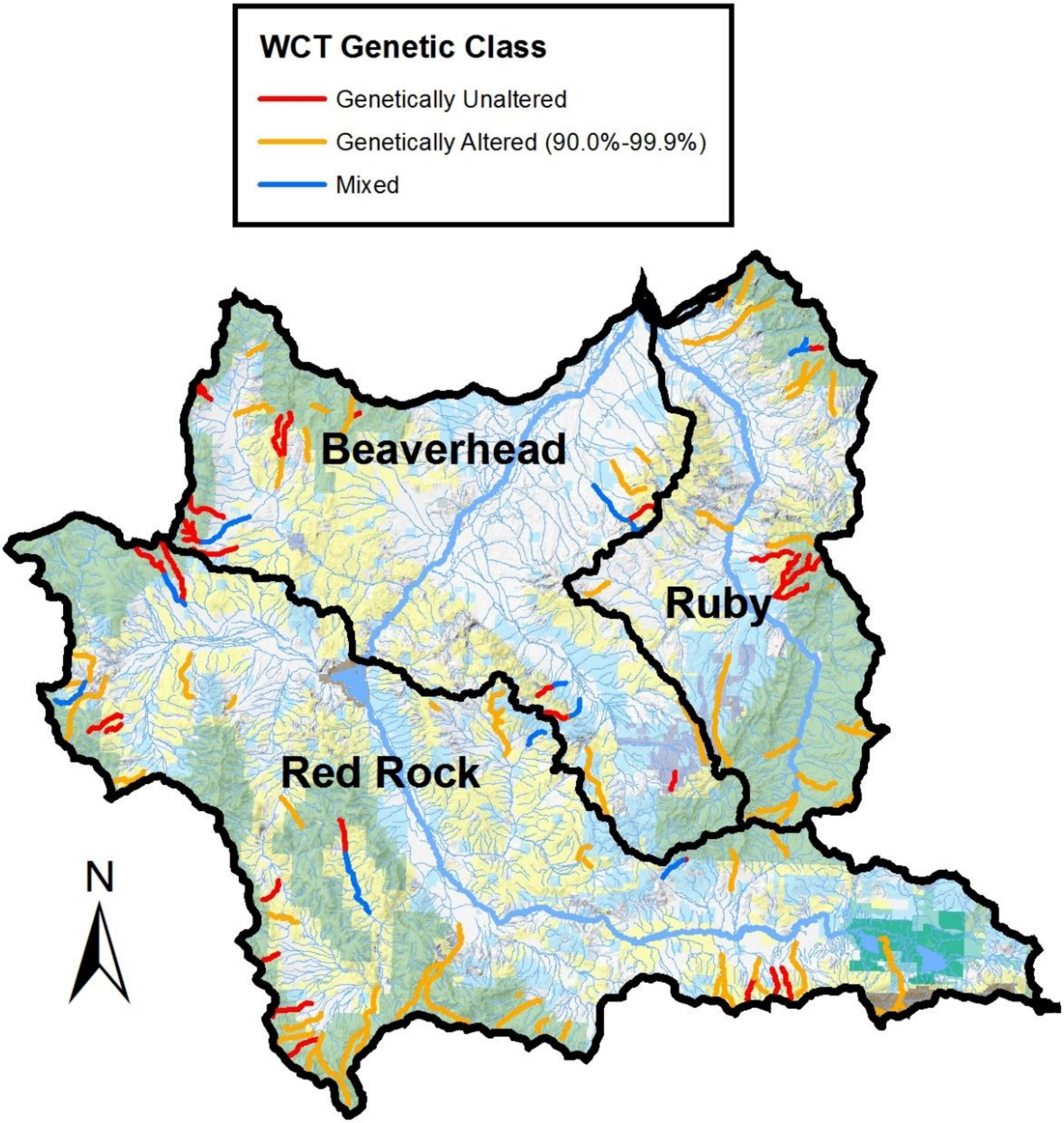

Figure 1. Distribution and genetic class of WCT conservation populations within the Beaverhead, Red Rock and Ruby River sub-basins (4th code HUC) of the upper Missouri River in southwest Montana.

WCT Status in the Beaverhead, Red Rock, and Ruby Sub-basins

Historically (circa 1800), WCT were the most broadly distributed fish species in southwest Montana and were estimated to have occupied about 3,366 miles of stream within the Beaverhead, Red Rock, and Ruby sub-basins, including all major rivers and connected tributaries (Table 1; Shepard et al. 2003). Historic WCT population characteristics would have included a large-bodied, fluvial life form, which migrated between the mainstem rivers and tributaries for spawning and rearing, and a smaller resident life form that would have resided in headwater streams where migration was limited. All remaining conservation populations in the assessment area are believed to persist as resident life forms and most occupy isolated headwater streams where distributions range from < 2,000 feet to several miles (mean distribution = 5.9 miles). Few populations maintain more than 2,500 fish. An analysis by Shepard et al. (1997) indicated most remaining populations in the Missouri River drainage face a high to very high risk of local extinction over the next 100 years due to threats such as habitat fragmentation and competition from or hybridization with nonnative trout. In this assessment, 83.6% (n=56) of the 67 conservation populations have been identified as "at-risk".

Table 1. Historic and current distribution of WCT in the Beaverhead, Red Rock and Ruby sub-basins of the upper Missouri River drainage.

Sub-basin	Estimated miles of stream historically occupied by WCT [a]	Estimated miles of stream currently occupied by *genetically unaltered* WCT (% of historic distribution) [b]	Estimated miles of stream currently occupied by *all* identified WCT conservation populations (% of historic distribution) [c]
Beaverhead	828	23.2 (2.8%)	90.7 (11.0%)
Red Rock	1,638	45.2[d] (2.8%)	194.9 (11.9%)
Ruby	900	30.3[e] (3.4%)	110.3 (12.2%)
Total	3,366	98.7 (2.9%)	395.9 (11.7%)

[a] based on, May 2009 Inland Cutthroat Trout Assessment Protocol data
[b] includes genetically unaltered populations, and unaltered segments of populations comprised of unaltered and altered fish (i.e., mixed populations)
[c] includes genetically unaltered, slightly altered (< 10% hybridization), mixed, and untested populations
[d] includes 11.4 miles of treated stream where genetically unaltered WCT have been re-introduced (Peet Creek)
[e] includes 26.1 miles of treated stream where genetically unaltered WCT have been re-introduced (Greenhorn Creek)

Conservation populations are divided into four categories to describe their genetic class and prioritize conservation efforts. *Genetically Unaltered* populations have no introgression or hybridization with nonnative trout based on genetic testing. *Mixed* populations include both genetically unaltered and hybridizing species (hybrid, Rainbow Trout or Yellowstone Cutthroat Trout). *Genetically Altered* populations are 1 – 10% introgressed, or insufficient evidence exists to conclude that the entire population is > 10% introgressed; these populations are considered a "hybrid swarm."

Sixty-seven WCT conservation populations occupy 395.9 miles of stream, or about 12% of their historic range, within the Beaverhead, Red Rock and Ruby sub-basins (Tables 1 and 2; Figure 1). Fifteen genetically unaltered populations occupy 98.7 miles comprising about 3% of the historic range. Two of these populations, representing about 36% (37 miles) of the genetically unaltered distribution, have been recently re-established by population restoration efforts in Greenhorn and Peet creeks (Tables 10, 14, 18). Streams in the assessment area with WCT conservation populations are listed in Table 3. Status, distribution, genetic class, and conservation needs for each population are presented in the individual sub-basin sections of this assessment (Sections 1 – 3).

Table 2. Number and genetic class of WCT conservation populations in the assessment area.

Sub-basin	**Number of Conservation Populations by Genetic Class**			
	Genetically Unaltered	Mixed	Genetically Altered	**Total**
Beaverhead	5	4	6	15
Red Rock	9	5	20	34
Ruby	2	1	15	18
Total	**16**	**10**	**41**	**67**

Population-specific genetic information used for status determination can be accessed at the FWP web site (http://fwp.mt.gov/gis/maps/fishingGuide/) using the interactive Fishing Guide Mapper. The genetic class within each stream can be found by selecting Fish Distribution, Species of Concern – Genetic Status, and then selecting Westslope Cutthroat Trout from the drop-down window. Specific genetic samples can be viewed by selecting Sampling Locations, Genetic Samples, and then zooming in to select individual genetic sampling locations.

Table 3. Streams with WCT conservation populations, by sub-basin. Populations may include additional tributary streams not identified below.

Beaverhead	**Red Rock**		**Ruby**
Alkali	Basin	Muddy	Basin
Brays Canyon	Bean	Nicholia	California
Buffalo	Bear (Centennial)	NF Divide	Coal
Cat	Bear (Horse Prairie)	NF Everson	Corral
Cottonwood	Browns	Odell	Cottonwood
Dyce	Cabin	Painter	Divide
Farlin	Craver	Peet	Greenhorn
French	Deadman	Price	Harris
Jake Canyon	EF Clover	Rape	Idaho
Pole	East	Rock	Indian
Reservoir	Jones	Sage	Jack
Rock	Little Basin	Sawmill	Mill
Stone	Little Sheep	SF Everson	Nugget
Taylor	Long	Sheser	Peterson
Teddy	Meadow	Shineberger	Ramshorn
	Middle (Centennial)	Simpson	Robb
	Middle (Big Beaver)	Trapper	Sweetwater
			Wisconsin

WCT Conservation and Restoration in the Beaverhead, Red Rock, and Ruby Sub-basins

The (long-term ~ 30 year) restoration goal for WCT east of the Continental Divide (Upper Missouri River Basin upstream from and including the Judith River) is to restore secure conservation populations of WCT to 20% of their historic distribution. Populations of WCT are considered secure by FWP when they are isolated from non-native fishes, typically by a physical barrier to fish passage, have a population size of at least 2,500 fish, and occupy enough habitat (>5 miles) to ensure long-term persistence. The WCT conservation goal is intended to be proportionally applied to all major drainages within the Upper Missouri River Basin; thus, WCT should be restored to 20% of historic distribution in each of the Beaverhead, Red Rock, and Ruby sub-basins. As described by the Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout and Yellowstone Cutthroat Trout in Montana (FWP 2007), restoration should proceed in a manner that "*ensures the long-term, self-sustaining persistence of each subspecies distributed across their historical ranges,… 2) maintains the genetic integrity and diversity of non-introgressed populations, as well as the diversity of life histories represented by the remaining local populations, and 3) protects the ecological, recreational, and economic values associated with each subspecies.*"

Attainment of this goal, or even continued persistence of native WCT in the assessment area, over the next century is uncertain without significant drainage-wide conservation efforts. Over the last 150 years, the distribution of genetically unaltered WCT in the assessment area has been reduced by more than 95%. The leading causes for this decline have not diminished, and in some cases, are increasing. Over the short-term (1 to 25 years), many remaining WCT populations face a moderate to high risk of local extinction because of nonnative trout, poor habitat conditions, isolation, reduced distribution and population size, and the random effects of natural disturbances. Failure to address threats will increase the long-term (100+ years) likelihood that native WCT would be extirpated from most of their current range of southwest Montana.

Threats to Remaining WCT Populations

Nonnative trout – Nonnative trout are the primary factor limiting WCT persistence and attainment of our conservation goal; failure to address this threat will reduce or eliminate the benefits of addressing other threats and preclude successful WCT conservation. Since the late 1800's, numerous nonnative fish species have been introduced throughout southwest Montana, and nonnative Brook, Brown, Rainbow, Yellowstone Cutthroat, and hybrid trout have become the dominant species in most streams historically occupied by WCT. Brook and Brown Trout displace WCT through competition or predation, while Rainbow Trout and Yellowstone Cutthroat Trout readily hybridize with WCT resulting in populations entirely comprised of hybrid individuals or mixed populations of hybrid and genetically unaltered fish. Currently, the strongest remaining WCT populations are those isolated from nonnative species by natural or manmade barriers, while those not protected by barriers have reduced distribution and densities or are irreversibly hybridized. The likelihood of long-term persistence of conservation populations not protected by barriers is considered low.

Reduced distribution and abundance – Most remaining WCT populations in the assessment area occupy short sections of small headwater streams. Hilderbrand and Kershner (2000) suggested that 5 - 15 miles of habitat are required in most Rocky Mountains streams to maintain a genetically viable population of 2,500 cutthroat (> 75 mm). Few unaltered populations in the assessment area occupy >5 miles of continuous habitat and most persist in less than 2 miles, which results in few populations with more than 500 age-1 and older fish. In addition to potential genetic concerns (e.g., inbreeding depression), small populations are more vulnerable to stochastic events (e.g., extreme drought, forest fire and discharge events) and being replaced by nonnative trout.

Stream/riparian habitat condition – Stream habitat conditions vary greatly throughout southwest Montana. Near pristine habitat conditions can be found in many remote streams in most mountain ranges, while degraded streams are common in mid and low elevation areas. Reduced WCT abundance and distribution is commonly associated with historic and current land management activities (e.g., irrigation, logging, livestock grazing, and mining) that have resulted in chronic stream de-watering, sedimentation, channel alteration, riparian vegetation removal or modification, and temperature increases. Land management and stewardship practices, habitat protection regulations and guidelines, and habitat restoration projects have led to improvements in many areas; however, poor habitat condition remains a threat to several extant populations.

Spatial isolation – All remaining unaltered WCT populations in the assessment area are considered resident life forms that spend their entire life cycle within small stream systems isolated above natural (e.g., waterfalls, cascades, and beaver dam complexes) or man-made (e.g., dewatered stream reaches, perched culverts, irrigation diversions, and structures placed to purposely isolate populations) barriers. Although isolation is an important source of protection from nonnative trout, it can also create long-term threats to persistence if adequate habitat and genetic diversity is not present. Dispersal of fish between streams promotes gene flow among populations and recolonization of individual streams if local extinction occurs. These processes are prevented, and populations may require intervention via genetic rescue, when they become disconnected.

Many of the causes of population decline are well understood, corrective measures have been identified, and there are numerous examples of conservation efforts that have restored long-term viability to at-risk populations. However, as identified in the individual sub-basin section of this assessment (Sections 1 -3), threats to most populations have not been formally addressed. Formal management regulations and recommendations have been established to address some threats to remaining WCT populations including riparian and watershed management guidelines, stocking of headwater lakes, private pond permitting, and protective angling regulations for stream dwelling WCT. However, regulations generally do not eliminate specific threats to individual populations, and more site-specific management actions (e.g., barrier placement and nonnative trout removal) are often necessary to protect populations. Conservation of extant populations in their native habitat is essential for maintaining the existing genetic diversity that evolved through local adaptation; however, in some instances this may be impractical due to highly degraded and isolated habitats, or an inability to eradicate nonnative trout and transfer of fish or gametes from these extant populations to new streams may be required to preserve the genetic diversity and legacy of the population. Mitigation measures to reduce common threats are described in Appendix 1.

Conservation Priorities

Each WCT population has been characterized by threat status to describe conservation needs and develop priorities. *At-risk* populations are those not isolated from nonnative fishes or other threats. Populations that have been isolated from nonnative fishes, usually by a physical barrier, and other potential threats are *protected*. For the purposes of this assessment, a population is deemed *secured* if it maintains at least 2,500 fish > 75 mm; (Hilderbrand and Kershner 2000), occupies at least 5 miles of stream, and there are no immediate threats to the population. Threat status of conservation populations in the assessment area is described by Table 4 and Figure 2.

Table 4. Threat status of conservation populations in the assessment area.

Sub-basin	**Threat Status of Conservation Populations**			
	Total Number	Number At-risk (%)	Number Protected (%)	Number Secured (%)
Beaverhead	15	8 (53.3%)	6 (40.0%)	1 (6.7%)
Red Rock	34	28 (82.4%)	6 (17.6%)	0
Ruby	18	16 (88.9%)	2 (11.1%)	0
Total	**67**	**52 (77.6%)**	**14 (20.1%)**	**1 (1.5%)**

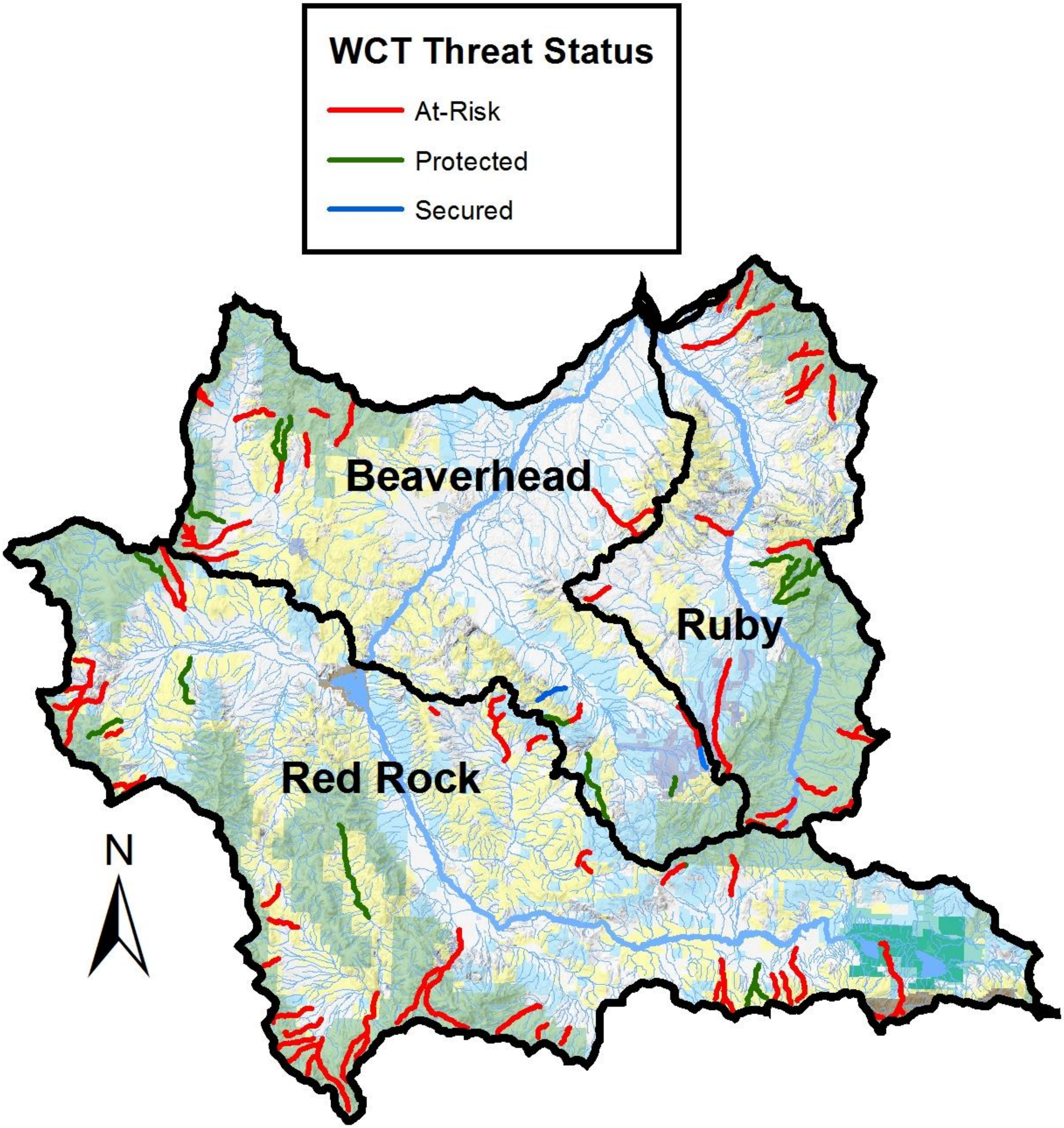

Figure 2. Threat status of WCT Conservation populations (genetically unaltered, genetically altered <10% introgressed and mixed) within the Beaverhead, Red Rock and Ruby sub-basins.

Conservation of extant WCT populations is our highest priority. The foundation of long-term WCT conservation is the preservation of remaining local populations that represent the genetic legacy of native upper Missouri WCT and will serve as principal sources for restoration of the subspecies. To achieve long-term WCT conservation goals, all remaining populations, especially those that have no evidence of genetic introgression, must be protected from immediate threats like nonnative trout and habitat degradation. Protection of at-risk populations is the most critical short-term need for the conservation of WCT in upper Missouri River drainage and a primary focus of management efforts. Currently, 77.6% of populations in the assessment area are considered at-risk (Table 4 and Figure 2). All at-risk populations in the assessment area could be protected by installation of 46 barriers, removal of nonnative trout from 307 miles of stream, and genetic rescue of 2 populations (Table 5).

Table 5. Number and type of conservation actions required to protect "at-risk" conservation populations.

Sub-basin	**"At-risk" Populations**	**Barriers**	**Miles of nonnative trout removal** [a]	**Genetic rescue** [b]
Beaverhead	8	6	76.7	0
Red Rock	28	26	151.1	1
Ruby	16	14	80.0	1
Total	52	46	307.8	2

[a] calculated by subtracting stream miles inhabited only by genetically unaltered WCT (i.e., no non-native trout) from total stream miles inhabited by conservation populations within each sub-basin (Tables 10, 14 and 18).
[b] genetically unaltered populations that are more than one standard deviation less than mean He (Appendix 6).

Establishing secure WCT populations is our secondary priority. One population in the assessment area is presently considered secured (Table 4). Secured populations require minimal management to persist over the long-term (> 100 years). Factors that influence long-term persistence include population size, genetic variability, connectivity among populations, and demographic and environmental stochasticity. While many existing WCT populations have persisted for decades at low abundances (< 500 fish) that occupy short distances of stream (< 2 miles), the likelihood for long-term persistence of these populations is lower than populations that maintain thousands of individuals over many miles of stream. Ultimately, attaining the goal of "*long-term self-sustaining persistence"* will require reintroducing WCT to portions of their historic range and establishing several large interconnected populations (meta-populations). Because most WCT populations in the assessment area will require increases in distribution and abundance to secure their long-term persistence, conservation actions that simultaneously protect and secure populations will be emphasized.

In the immediate future, WCT conservation efforts within the assessment area will be directed towards protecting and securing genetically unaltered populations (Figure 3). Effort will focus on protection of highly threatened populations that can be maintained with conservation actions and expansion of smaller populations where the potential loss of genetic variation is greatest. Where genetically unaltered populations are rare, conservation efforts will be directed towards protection of genetically altered conservation populations and establishment of new populations using unaltered populations within the assessment area as donor sources. The decision to establish new populations will depend upon the number and geographic extent of genetically unaltered populations that are protected and secured within each sub-basin. When there are a relatively large number of secure populations over a wide geographic area within a basin, conservation will focus on maintaining those populations. When populations are sparse or concentrated in a restricted portion of a basin, conservation efforts will focus on both protecting and securing existing populations and establishing new populations in portions of the basin that are not currently occupied.

Figure 3. Assessment area WCT conservation action priorities.

Highest Priority	→	Lower Priority
Protecting and securing genetically unaltered populations	"Replication" of genetically unaltered populations into historically fishless or reclaimed streams, including as metapopulations. Protecting and securing genetically altered conservation populations	"Replication" of genetically altered populations into historically fishless or reclaimed streams.

<u>Conservation Strategy and Approach</u>

Securing genetically unaltered populations – All genetically unaltered populations that are not protected by a barrier to non-native fishes will be inventoried to determine whether a suitable barrier location and type exists. Implementation of projects to isolate existing populations will be dependent on barrier cost and the number of stream miles it is likely to protect. Barriers that cost less than $30,000 and protect extant populations of genetically unaltered fish in at least 5 miles of stream will be pursued as our highest conservation priority. Instances where barrier costs exceed $30,000 or protect fewer than 5 miles will be evaluated on a case-by-case basis to determine whether in situ protection should occur or more cost-effective conservation measures are available.

"Replication" of genetically unaltered populations – Single population replication will only be considered in situations where the aboriginal population is not presently isolated from non-native fishes by a physical barrier and barrier installation is not cost-effective (i.e., >$30,000 to protect < 5 miles of stream). Populations at stochastic or demographic risk of extirpation because of limited habitat (< 5 miles) will also be considered as candidates for replication on a case-by-case basis. Replication projects will be developed opportunistically and prioritized for implementation when cost-effective alternatives in nearby drainages are feasible.

Creation of meta-populations – Reintroduction of WCT to longer, interconnected reaches of stream (i.e., > 20 miles) where they currently do not exist is an essential element of long-term WCT recovery. However, the cost to install barriers that protect these lengths of stream is inherently high ($50,000 to $500,000) because they must be placed lower in drainages where wider valley widths necessitate larger structures. More stringent design requirements (i.e., barrier function up to the 50-year storm event and structural stability up to the 100-year storm event) are also imposed because of the time and cost that must be committed to these projects. Larger project areas also typically include more diverse land ownership and may have broader social considerations. Therefore, criteria were established to guide selection of potential population restoration projects (Table 6). These populations will typically be established using several unaltered donor populations from within or among sub-basins in the assessment area.

To guide assessment and prioritization of potential meta-population reintroduction sites within the assessment area, in 2016 we contracted basic survey and preliminary cost estimation of several sites where barrier installation seemed topographically feasible and at least 20 miles of habitat would be provided. This allowed comparison of barrier cost, stream length, restored population size, long-term climate resiliency (i.e., drainage area >2400 meters in elevation with low solar insolation), and project cost per WCT restored (Table 7). The projects identified do not represent all potential meta-population restoration alternatives in the assessment area and selection of these, or other sites, for implementation requires additional project development, including public input and environmental analysis through MEPA or NEPA. However, future projects will be prioritized for development using this or other similar criteria to ensure the cost-effectiveness of WCT conservation is maximized.

Restoration populations will be re-founded using aboriginal genetically unaltered WCT populations in southwest Montana, with emphasis placed on those within the assessment area (Leary et al. 1998). This will facilitate preservation of unique genetic, ecological and behavioral characteristics of native upper Missouri River WCT, which is a primary goal of WCT conservation in Montana (FWP 2007). It is expected that many remaining wild populations have limited genetic variability due to founder effects, genetic drift and small population size; therefore, restoration efforts will include several wild donor populations to ensure genetically viable populations are established. The primary reintroduction method will be transfer of live, wild WCT. To ensure transfers maximize viability of the restored population while minimizing impacts to donor populations 1) no more than 20% < 75mm and no more than 10% of >75 mm fish in the donor population should be transferred, 2) transfer should occur over at least two years, 3) fish should be collected from throughout the donor stream, and 4) multiple age classes should be selected (Appendix 3).

The use of hatchery WCT (e.g., FWP's MO12 strain) will be limited to sterile (i.e., triploid) fish and only considered when public demand calls for large numbers of fish to be introduced over a short period of time to rapidly establish recreational fisheries while wild strains are concurrently introduced as the long-term founder source.

Although application of criteria that results in secured threat status is useful in quantifying current and desired population condition, many WCT populations will never reach this status due to habitat constraints and the requirement of protection from nonnative species with barriers. Populations that have less than 2,500 individuals and /or occupy less than five stream miles may require periodic supplementation (i.e., introduction of individuals from other populations) to maintain or increase genetic variability. These "genetic rescue" efforts would mimic natural mixing between populations and theoretically result in increased resiliency to changing environmental conditions and the conservation of unique genetic characteristics.

Ultimately, regardless of conservation efforts, some populations will be lost to natural disturbance or other causes. Recolonization of vacant habitats and long-term self-sustaining persistence of WCT is best achieved through natural meta-population dynamics. Several opportunities exist in the assessment area to connect multiple populations in relatively large habitat patches, but these opportunities are rare (identified Sections 1 – 3) due to technical, logistical, and social constraints. Consequently, for the foreseeable future, most populations will remain isolated, and reintroduction using unaltered populations within the assessment area will be necessary to reestablish extirpated populations.

Table 6. Standards and requirements for WCT restoration projects.

Criteria	**WCT Restoration Standards / Requirements**
Habitat Suitability	*Fishless*: The restoration reach is naturally fishless, or nonnative trout can be eradicated using piscicides or other removal techniques. Nonnative trout removal opportunities can be limited by habitat complexity, water chemistry, and social constraints. *Stream Length*: Introduction of WCT to drainages with > 5 miles of stream length, particularly those with multiple tributaries, will provide the best opportunities for long-term population survival. Shorter stream reaches are suitable locations to replicate "at-risk" populations until larger stream reaches are available. *Habitat characteristics*: The restoration reach maintains stream flow, temperature, productivity, and micro habitats (pools, spawning gravel, vegetation, etc.) that are suitable for long-term population persistence.
Stream Isolation	It is essential that the restoration reach is isolated from nonnative trout by a natural fish barrier, or a permanent man-made structure. Barrier construction can be limited by topography (e.g., wide valley widths) or cost (e.g., large or remote streams).
Native Fauna	Because stream dwelling invertebrates and amphibians of SW Montana have co-evolved with WCT, WCT restoration to historically occupied habitat or introductions into historically fishless streams are not expected to result in local extirpation of invertebrate or amphibian species. The presence of native fish or stream breeding amphibians may require measures (e.g., capture and holding) that reduce impacts of piscicides prior to a treatment.
Social Impacts	Broad public support is necessary for successful WCT conservation. WCT restoration issues, such as loss of important nonnative trout fisheries, wilderness area introductions, nonnative trout removal techniques, and cost, should be thoroughly examined in an Environmental Assessment process open to the public.
Restoration Area Management	Land and fisheries management practices within identified restoration areas should be consistent with WCT conservation and population viability. For example, these may include restrictive angling regulations for WCT and restrictive lake and pond stocking policies. Management that contributes to sustainable riparian and stream health are important; however, pursuing larger projects often de-emphasizes the need for more restrictive land use changes because of the overall quantity of habitat.

Table 7. Cost-effectiveness comparison of potential metapopulation restoration sites in the assessment area.

Barrier location	Miles of habitat provided	Expected restored WCT population size	High-elevation Acres with Low Solar Insolation	Barrier cost	Cost per WCT restored
Medicine Lodge Creek	192	53,484	6737	$538,261	$10.06
Cabin Creek	127	8,884	1371	$338,596	$38.11
Meadow Creek	19	2,088	469	$268,679	$128.68
Nicholia Creek	67	11,580	2555	$430,037	$37.14
Deadman Creek	27	8,529	1315	$335,074	$39.29
Robb Creek	65	1,547	795	$408,049	$263.77
Ledford Creek	45	4,984	1376	$320,739	$64.35
Odell Creek	29	6,492	459	$305,786	$47.10
Sage Creek	87	18,788	232	$351,631	$18.72
Divide Creek	27	5,076	65	$323,671	$63.76
Selway Creek	48	29,224	127	$336,655	$11.52

Recommended Implementation Schedule and Cost

We will attempt to protect or secure at least one population every year and complete one meta-population creation project every five years. At this rate it will take about 40 years and $1,500,000 to protect all at-risk populations with feasible barrier construction sites (~35-40 of 56). It will cost an additional $3,500,000 to construct barriers required for 8 metapopulation restoration projects over that timescale, which would increase WCT distribution by over 500 miles and satisfy the conservation goal for the assessment area. However, based on current threats, the likelihood of periodic catastrophic events, and the annual loss of genetic variability many remaining unprotected populations will be lost within 25 years without conservation efforts. Resources are not currently available to implement this schedule at the present or a faster rate, and in many locations, protecting and securing populations may be unattainable with existing topographic constraints. Dedicated funding would result in much faster and more certain conservation. If funding for barriers were available, protection of most at-risk populations could occur in less than five years with existing personnel. Because metapopulation restoration projects require more time to complete, additional resources to pay for both barriers and personnel would be required to implement more than one of these projects every five years within the assessment area.

Measuring WCT Conservation Success

The goal of WCT conservation is ensuring long-term self-sustaining persistence of WCT throughout 20% of their historic range. In southwest Montana, the best short-term measurements towards this goal are: 1) increasing the number of aboriginal populations that are protected and secured, and 2) increasing the number of genetically unaltered populations established from aboriginal sources. Additional genetic studies and population inventories may result in gain or loss of conservation populations and adjustments to the extent of current distribution. The number and status of conservation populations will be reviewed and updated annually for each sub-basin in conjunction with the range-wide WCT status assessment and monitoring efforts outlined in the MOU for Westslope Cutthroat Trout and Yellowstone Cutthroat Trout in Montana (FWP 2007).

Modifications to this Document

This document will be revised on an annual or semi-annual basis in-order to document and detail changes in status and conservation needs of WCT in the assessment area, progress of conservation and restoration efforts, and changes in sub-basin priorities. Updates will be a collaborative process using all available data sources.

Sub-basin Assessments: Sections 1 – 3

The following sections summarize WCT status and conservation needs in each of the three sub-basins of the assessment area: the Beaverhead, Red Rock, and Ruby (Figure 1). The primary objectives of these sections are to identify conservation populations, describe current status of each population, and propose actions necessary to protect and conserve each population. In addition, potential restoration efforts outside the current distribution of WCT and conservation priorities within each sub-basin are presented.

By sub-basin and conservation population, these sections outline:

1. Status overview
2. Genetic class assignment and rationale
3. Threat status and rationale
4. Actions required to maintain populations and on-going conservation efforts

Conservation Populations: Definition and Identification Methodology

The foremost objective of this document is to identify WCT "conservation populations" in each of the three sub-basins. Conservation populations maintain the remaining genetic diversity, local adaptations, life history forms, and phenotypic (visual appearance) variations of the species in the assessment area; as such, these populations are a keystone to WCT conservation and restoration. As signatories of the cutthroat trout MOU's (FWP 1999 and 2007), federal and state resource agencies have agreed to commit resources necessary to provide habitat that is suitable for viable conservation populations. Necessary management actions may include: habitat protection, restoration and enhancement, fishing regulations that protect WCT or liberalize harvest of nonnative trout, and control or eradication of nonnative fish species. Changes in the status (at risk, protected, and secured) and number of conservation populations over time will provide a basis for assessing whether conservation and restoration actions are succeeding.

The principal criterion applied towards identifying a population for conservation status was whether the population was ≤ 10% genetically introgressed (i.e., hybridization levels with RBT or YCT), which is a generally accepted introgression level where the phenotypic characteristics of WCT have been maintained (Leary et al. 1996; Utah Division of Wildlife Resources 2000). This is a more conservative approach to defining conservation populations than the most recent USFWS status review which allowed up to 20% introgression (DOI 2003). All WCT populations in the assessment area that have been tested as ≤ 10% introgressed were identified as a conservation population. No populations *conclusively* tested with > 10% introgression were identified for conservation status; however, several populations with > 10% introgression were identified for conservation status because genetic results were not conclusive (e.g., small samples sizes).

Fundamentally, the only difference in management between the different conservation population classes is that in most situations, donor sources (gametes or live fish) for restoration efforts will only be from genetically unaltered populations and that in the short-term, genetically unaltered and mixed populations will receive a greater share of discretionary resources.

While the best available information was used to identify and classify conservation populations (Table 1; Figure 1), in some instances, these were derived from sparse abundance, distribution, and genetic data. It is expected that additional genetic testing will change the classification of some conservation populations from "genetically unaltered" to "mixed" or "genetically altered." Any populations that have not been sampled in the past 10 years or with less than 25 samples should be resurveyed to assess genetic composition (Appendix 7).

Section 1: Beaverhead Sub-basin

Overview

Beaverhead WCT Status and Threats:

- Number of Conservation populations: 15 (4 unaltered; 5 mixed; 6 altered)
- Populations at risk: 53% (8 of 15)
- Genetically unaltered populations at risk: 50% (2 of 4)
- Populations considered protected: 40% (6 of 15)
- Populations considered secured: 1 (Jake Canyon Creek)
- Significant threats:
  - Brook Trout (EBT): 8 populations
  - Other trout (YCT, RBT, CT hybrids): 11 populations
  - Small population size: 6 populations (< 1,000 fish)
  - Livestock grazing: 8 populations
  - Limited distribution: 6 populations (inhabit < 5 miles of stream)

Table 8. Genetic class and threat status of WCT conservation populations in the Beaverhead sub-basin.

Genetic Class	**Status of Conservation Populations**			
	At-risk	Protected	Secured	**Total**
Unaltered	2	3	0	**5**
Mixed	2	1	1	**4**
Altered	4	2	0	**6**
Total	**8**	**6**	**1**	**15**

Table 9. WCT conservation populations identified in the Beaverhead River sub-basin.

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Alkali (Blacktail)	4874 4564	Genetically Unaltered	Genetically tested as 100% WCT	7/27/16 FWP, Jaeger (25 SNP) 100% WCT 8/30/12 BLM, Hutchinson (25 SNP) 100% WCT
Brays Canyon (Grasshopper)	4891 4038 4011 3661 3007 316	Genetically Unaltered	Genetically tested as 100% WCT	8/14/17 FWP, Jaeger (50 SNP) Both Fish Transfers 100% WCT 8/8/16 FWP, Jaeger (50 SNP) 100% WCT 6/21/10 FWP, Nelson (26 Indel) 100% WCT
Buffalo (Grasshopper) - Straight Fork - Middle Fork - Left Fork -Right Fork	???? ???? 4876 4875 3006 3005 3004 3003	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT.	8/21/18 FWP, Jaeger (50 SNP) 25 Above USFS Rd. Culvert 25 Conglomerate of all 4 tribs. Awaiting Results 7/12/16 FWP, Jaeger (25 SNP) Lower: 99.54% WCT 0.46% RBT Upper: 100% WCT 7/4/06 USFS, Brammer (17 PINE) 100% WCT LF & RF 7/7/04 (3 PINES) SF 7/7/04 (5 PINES)

Stream (s)	Genetic Report Number	Genetic Class	Rationale for status	Date, Collector, Number Sampled, Type of Test and Results
Cat (Rattlesnake)	4729 3002 1033	Genetically Altered	Genetically tested as 96.5% WCT	7/24/14 FWP, Jaeger (25 SNP) 96.5% WCT 3.5% RBT 6/29/2004 USFS, Brammer (10 PINE) 100% WCT 9/27/1994 USFS Brammer (3 Allozymes) 100% WCT
Cottonwood Above barrier (Blacktail) Below barrier	4889 4566 4565 3982 3259 3258 1353 650	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT.	8/23/17 FWP, Jaeger (50 SNP) Fish Transfers 100% WCT 8/30/16 FWP, Jaeger (61 SNP) 7/8/13 BLM, Hutchinson (25 SNP) 100% WCT above waterfall 7/8/13 BLM, Hutchinson (25 SNP) 95% WCT below waterfall
Dyce (Grasshopper) - EF Dyce - WF Dyce	4034 3663 3312 1003 324 4019 3242 770	Genetically Unaltered	Genetic analysis indicating presence of both unaltered and hybridized WCT.	EF 6/1/10 BLM, Hutchinson (25 SNP) 100% WCT WF 4/22/10 BLM, Hutchinson (25 SNP) 99.8% WCT 0.02 RBT All genetic samples before 2010 are irrelevant because Dyce Creek was treated with rotenone that year.
Farlin (Grasshopper)	4732 3062 462	Genetically Altered	Genetically tested as 99.5% WCT	8/28/08 BLM, Hutchinson (25 Indel) 99.5% WCT 0.5% YCT 8/17/99 FWP, Oswald (25 PINES) 100% WCT 10/9/90 (5 Allozymes) USFS, Browning 100% WCT
French (Rattlesnake) - Trout	914	Genetically Altered	Genetically tested as 95.5% WCT	6/13/94 USFS, Browning (11 Allozymes) 95.5% WCT 4.5% RBT
Jake Canyon (Blacktail)	4924 4046 649	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT.	7/24/17 FWP, Jaeger (25 SNP) 99.92% WCT 0.08 RBT 7/28/10 BLM, Hutchinson (55 Indel) 100% WCT 7/28/1992 FWP, Oswald (10 Allozymes) 100% WCT
Pole (Grasshopper) - WF Pole	3000 2993 321	Genetically Unaltered	Genetically tested as 100% WCT	9/7/04 USFS, Brammer (23 Indel) 100% WCT 7/20/2004 USFS, Brammer (3 PINES) 100% WCT 11/15/1989 USFS, Vore (8 Allozymes) 100% WCT
Reservoir (Grasshopper)	4925 4871 3042 3001 202	Genetically Unaltered	Genetically tested as 100% WCT	7/27/17 FWP, Jaeger (25 SNP) 100% WCT 7/13/16 FWP, Jaeger (25 SNP) 100% WCT 7/6/04 USFS, Brammer (10 PINES) 100% WCT
Rock (Blacktail)	4732 1236 1235 1099	Genetically Altered	Genetically tested as 96.9% WCT	7/18/14 FWP, Jaeger (25 SNP) 96.9% WCT 2.7% YCT 0.4% RBT 8/13/97 USFS, Brammer (5, 6 Allozymes) 100% WCT

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Stone (Ruby Mtns.) - LF Stone - MF Stone - Mine Gulch - Winnipeg	???? ???? 4930 4730 3036 2976	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT.	7/17/18 BLM Hutchinson LF Stone (25 SNP) MF Stone (25 SNP) Awaiting test results 8/8/17 BLM Hutchison (26 SNP) 100% WCT 7/23/14 FWP, Jaeger (25 SNP) 98.8% WCT 1.2% YCT 4/5/05 FWP, Nelson (30 PINES) 100% WCT 10/01/04 FWP Oswald (50 PINES) 100% WCT
Taylor (Grasshopper)	4374 2994 1258 1253	Genetically Altered	Genetically tested as 97.4% WCT	6/27/12 BLM, Hutchinson (24 SNP) 97.4% WCT 2.6% YCT 4/14/05 USFS, Brammer (24 PINES) 100% WCT 8/20/97 USFS, Browning (5 Allozymes) 81.6% WCT 8/13/97 USFS, Wagner (10 Allozymes) 100% WCT
Teddy (Blacktail)	4563 689	Genetically Altered	Genetically tested as 94.4% WCT	8/29/12 BLM, Hutchinson (25 SNP) 94.4% WCT 3.8% RBT 1.5% YCT 8/29/92 FWP, Oswald (10 Allozymes) 94.4 WCT 2.5% RBT 3.1% YCT

Table 10. Characteristics that define threat status of WCT conservation populations in the Beaverhead sub-basin.

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Alkali	2.5	2.5	1 per100 m (40 unaltered Fish)	Natural barrier 7 ft. rock waterfall	State	Limited distribution, natural barrier could fail, poor habitat, livestock grazing, heavy siltation	Protected
Brays Canyon	5.1	5.1	19 per 100 m (1559 unaltered fish)	Perched culvert with concrete splash pad	FS	Brook Trout, livestock grazing	Protected
Buffalo - LF Buffalo - RF Buffalo - SF Buffalo	9.5	5.6 (Upstream of FS Rd. 7351)	14 per 100 m (2140 fish) (1261 unaltered fish)	Unknown, likely irrigation withdraws	FS, Private	No barrier, hybridization, livestock grazing	At-risk
Cat	1.7		14 per 100 m (383 fish)	Cascades	FS	Hybridization, livestock grazing, cascade may not be a permanent fish barrier	At-risk
Cottonwood	5.1	0.6 RM Upstream of Barrier	50 per 100 m (4039 Fish) (521 unaltered fish)	Cascades protect upper reach	BLM, FS, Private	None in upper reach, Brook Trout, hybridization,	Protected (upper) At-Risk (lower)
Dyce - EF Dyce - WF Dyce	13.1 RM Upstream of Barrier		13 per 100 m (2740 Fish) once repopulated	Perched culvert	BLM, FS	Livestock grazing, heavy siltation	Protected
Farlin	3.4		14 per 100 m (766 Fish)	None known	BLM, FS, Private	No barrier, Brook Trout, hybridization, poor habitat, livestock grazing	At-risk
French - Trout	5.7		Unknown	None known	FS	No Barrier, Brook Trout, hybridization	At-risk
Jake Canyon	4.4	unknown	49 per 100 m (3298 fish)	Man-made wood fish barrier, dry stream reach	BLM, State, Private	Hybridization, livestock grazing	Secured
Pole - WF Pole	4.1	4.1	Unknown	None known	FS, State	No Barrier, hybridization, Brook Trout, livestock grazing	At-risk
Reservoir	5.3	5.3	9 per 100 m (767 unaltered fish)	Unknown, likely irrigation withdraws	FS, State, Private	No barrier, hybridization, livestock grazing, heavy siltation	At-risk
Rock	6.9		14 per 100 m (1555 fish)	Dam protects upper portion of the drainage	State, Private	Poor habitat, livestock grazing	Protected (upper)

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
							At-risk (lower)
Stone - LF Stone - MF Stone - Mine Gulch - Winnipeg	12.8	unknown	10 per 100 m (2060 fish)	Dry channel subs out	BLM, Private	Hybridization, livestock grazing, heavy siltation	At-risk
Taylor	3.4		11 per 100 m (601 fish)	Dry channel subs out	FS, BLM, Private	Hybridization moving up the drainage, no barrier, Brook Trout, hybridization, livestock grazing	At-risk
Teddy	7.7		6 per 100 m (744 fish)	Reservoir levee with a spillway	BLM, State, Private	Hybridization, livestock grazing	Protected

[a] relevant to "mixed" populations where there are genetically unaltered and altered segments of the population that exist in the same stream.
[b] WCT population sizes were calculated by averaging 100 m population estimates from throughout the drainage and extrapolating to the number of river miles occupied.

Table 11. Actions required to maintain conservation populations in the Beaverhead sub-basin

Stream (s)	**Population Status and Conservation Needs**
Alkali	***Genetic Class:*** Genetically Unaltered ***On-going projects***: Demographic and genetic monitoring. The Nature Conservancy completed an incised channel restoration project within the core habitat of this population in 2016. The overall goal of this project is to raise the water table upstream of an old pond levee so that the stream can access its floodplain. Over time this is expected to improve riparian health and fish habitat within the treated stream reach. ***Short-term (protect):*** This population is protected by a natural barrier located at 44.86396 -112.24819. The barrier is a 7 ft. waterfall with no plunge pool; water splashes onto a flat rock surface. This barrier resulted from a head cut in the stream bed, which consists of compressed mud or shale. Based on field surveys, 2.5 miles of stream are protected and occupied by WCT above this barrier. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75 mm within Alkali Creek due to lack of fish-bearing habitat. Demographic surveys downstream of the barrier are needed to decide whether Alkali Creek could support a secured population of 2500 fish >75mm. A barrier that includes more habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** This is a small, sparse population; about 40 WCT are distributed at 1 fish per 100 meters. Currently there are only genetically unaltered WCT and Rocky Mountain sculpin (RM COT) above the barrier. Genetic samples collected in 2016 (25 SNP) confirmed that this population is genetically unaltered, however three polymorphic loci were noted in the test results.
Brays Canyon	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring, EBT removal. In 2015 and 2016 EBT were removed chemically from the 0.9 miles above a perched culvert barrier and by multiple pass electrofishing in the remainder of the upstream drainage. Beginning in 2017 and continuing in 2018, electrofishing removal was focused in reaches where EBT presence was suggested by drainage-wide eDNA sampling that was conducted at 250m intervals. Brays Canyon Creek is one of six donor streams being used to repopulate the Greenhorn Creek WCT project area (via live fish transfers). Transfers of 47 and 57 WCT from Brays Canyon Creek were released into the N.F. of Greenhorn Creek in 2016 and 2017, respectively. ***Short-term (protect):*** Brays Canyon Creek WCT are protected by a perched culvert barrier with a concrete splash pad. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Removal of EBT will alleviate all immediate threats. Brays Canyon Creek supported 1795 and 1548 WCT in 2015 and 2016, respectively. Once EBT are eradicated and unaltered WCT re-populate the lower 0.9 miles that was chemically treated, secured status (2500 WCT >75 mm) will be attained. ***Additional comments:*** There are presently about 19 WCT per 100 meters of stream. Forty of 53 and 15 of 15 estimated EBT remaining in 2015 and 2016 were respectively removed. Following eDNA sampling, five EBT were removed in 2017 and three were removed in 2018. Electrofishing removal in conjunction with eDNA sampling will continue until all EBT are extirpated. No EBT reproduction has been documented since 2016 and all three of the fish removed in 2018 were reproductively mature females between 148-154 mm.
Buffalo - LF Buffalo - RF Buffalo - SF Buffalo	***Genetic Class:*** Mixed ***On-going projects:*** Demographic and genetic monitoring. In 2018 genetic samples were collected to better understand the spatial extent of hybridization. ***Short-term (protect):*** Establishment of a permanent barrier and removal of CT hybrids would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): A barrier that includes more downstream habitat followed by WCT expansion would secure this population; however, 2018 surveys were unable to identify a suitable barrier location on USFS or private land. Based on recent demographic surveys Buffalo Creek would support a secured WCT population of 2500 fish >75mm. ***Additional comments:*** This population occupies up to 5.6 miles of stream upstream of the US Forest Service property boundary. Demographic surveys show an average of 14 WCT per 100 meters. Buffalo Creek does not have any connection with Grasshopper Creek because of dewatering for irrigation, which creates an intermittent section of stream; however, no other barriers exist. CT hybrids and RM COT are currently present. Genetic samples collected in 2016 indicate the population downstream of FS Rd. 7351 is hybridized with 0.46% RBT alleles; however, the population in upper Buffalo Creek is genetically unaltered. Two WCT that were found in separate reaches of Upper Buffalo Creek had hybrid alleles at one locus OclRD_Thymo_320Kal. This could be either evidence of hybridization or it could indicate WCT genetic variation. In this case because that locus is also polymorphic in Alkali Creek, the latter interpretation is favored. In 2018 two different genetic samples were collected, one just upstream of USFS Rd. 7351 and one that is a mixture of fish from all four headwater tributaries. These genetic samples have not been analyzed yet.
Cat	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybrid CT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Cat Creek does not have enough habitat to support a WCT population of 2500 fish >75mm; the WCT population is only about 383 fish. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** A cascade near the bottom of this stream appears to be the invasion of EBT and further hybridization from RBT. Rattlesnake Creek is located immediately downstream and flows directly into Kelley Reservoir, because EBT and RBT are abundant in the downstream drainage, ongoing invasion is likely if the cascade is not a true fish barrier. Demographic surveys conducted in 2014 show an average of 14 WCT per 100 meters. This population is an altered population; genetic samples indicated 96.5% WCT and 3.5% RBT. It is unclear how the RBT hybridization occurred, but it suggests that the cascade is not a barrier.
Cottonwood	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Cottonwood Creek is one of six donor streams being used to repopulate the Greenhorn Creek WCT project area (via live fish transfers). Transfers of 61 and 50 WCT from Cottonwood Creek were released into the S.F. of Greenhorn Creek in 2016 and 2017, respectively. ***Short-term (protect):*** The uppermost 0.6 miles of Cottonwood Creek is protected by a natural waterfall that is a 15-foot tall cascade located at 44.93443, -112.46935. Downstream of this natural waterfall/cascade CT hybrids and EBT are abundant. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. Updated demographic surveys indicate that Cottonwood Creek would support a secured population of 2500 fish >75mm. ***Additional comments:*** The unaltered population is comprised of 500-650 fish averaging 187 mm long, occurs in a short reach of stream (0.6 stream miles).
Dyce - EF Dyce - WF Dyce	***Genetic Class:*** Mixed ***On-going projects:*** Demographic and genetic monitoring. Dyce Creek was treated with rotenone in 2010 and 2011, except for the upper East Fork where genetically unaltered WCT remained. Some unaltered fish were transferred to a pond in the West Fork in 2013 and the remainder of the drainage is being allowed to recolonize naturally.

Stream (s)	Population Status and Conservation Needs
	Short-term (protect): Dyce Creek is protected by a culvert fish barrier located at 45.27761 -113.03360, EBT were chemically removed in 2010 and 2011. Updated demographic surveys are needed to reevaluate the success of the current conservation plan. The BLM is currently implementing a cattle grazing plan that mitigates impacts by using a three-year rest rotation where it is used by cattle 2 out of every 3 years. The first year, use is permitted prior to July 1st, the second year it is permitted after July 1st the third year is a rest year and use years cannot exceed thirty days of total use annually. ***Long-term (secure):*** Demographic surveys from 2011 indicate that Dyce Creek could support about 2740 fish once repopulation occurs, which would result in a secured WCT population. ***Additional comments:*** Genetic samples suggest that the trout in this stream should conservatively be considered unaltered WCT. Two different WCT samples in the E.F. of Dyce creek had polymorphic hits at the same loci Occ35. Because it is unclear if these fish are unaltered or altered it is recommended that in the future they are not used to repopulate other WCT populations.
Farlin	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. The highway department installed a concrete box structure with the intention that it could be retro-fitted with some sort of fish barrier that would use the highway berm as a levee. Further reconnaissance is needed to clarify if this is a feasible option for a fish barrier. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75 mm within Farlin Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** The WCT population is relatively small and relegated to the top one-third of the drainage and EBT are abundant in the lower stream stretches. Historic demographic surveys indicate the ratio of WCT to EBT has been 50/50. Farlin Creek has good connectivity to Grasshopper Creek, which has an abundant population of nonnative trout.
French - Trout	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. Demographic surveys of the Rattlesnake drainage indicate a population of 2500 fish >75mm could be secured with this approach. ***Additional comments:*** Hybridization with RBT was documented 23 years ago, in 1994. Genetic samples collected by the USFS on 6/13/1994 showed that there were recent F1 hybrids within the system.
Jake Canyon	***Genetic Class:*** Mixed ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Jake Canyon Creek is protected with a fish barrier (44.97890 -112.46646) that was built in 2016. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Jake Canyon Creek has adequate unaltered WCT (3115) and habitat (4.4 miles) to be considered secured; however, 2017 genetic samples identified low levels of localized RBT hybridization (99.92

Stream (s)	Population Status and Conservation Needs
	% WCT and 0.08% RBT). resulting in a mixed genetic class designation. Removing altered WCT downstream from a designated point with a rotenone treatment would preserve an unaltered and secure population. ***Additional comments:*** Two more genetic samples were collected in 2018 in order to better understand the extent of the hybridization.
Pole - WF Pole	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and nonnative EBT removal would protect this population. Updated demographic surveys and genetic testing are needed to develop conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75 mm within Pole Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Pole Creek is only 4.1 miles in length and does not meet the 5-mile minimum stream length associated with securing a population. In 2004, 23 WCT genetic samples were tested using PINES analysis, which confirmed an unaltered population. Updated demographic and genetic information is needed.
Reservoir	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Establishment of a barrier would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure)*** It may not be feasible to secure a population of 2500 fish >75 mm within Reservoir Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream for WCT expansion is not an option because of intermittent stream flows. ***Additional comments:*** Downstream fish distribution and end of water was documented in 2017 along with genetic samples that reconfirmed unaltered WCT.
Rock	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Grazing practices were changed in 2016 to improve riparian health and mitigate cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more habitat downstream followed by WCT expansion could secure this population. Based on updated demographic surveys this would secure a population of 2500 fish >75 mm within Rock Creek. ***Additional comments:*** Rock Creek from RM 11.4 upstream is located entirely on FWP or BLM land. Downstream one private landowner owns land on Rock Creek (Rebish-Konen). There are two different impoundments located on this productive stream that have good vehicle access to them. More information about these impoundments needs to be collected to understand the feasibility of using one to establish a fish barrier.
Stone - LF Stone - MF Stone - Mine Gulch - Winnipeg	***Genetic Class:*** Mixed ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Stone Creek was previously thought to be protected by an intermittent reach of stream and a downstream barrier. The barrier was thought to be an underground drain tile system that prevented

Stream (s)	Population Status and Conservation Needs
	overland stream connectivity and fish passage. Establishment of a barrier and removal of hybridized CT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Improved road maintenance and drainage management is needed. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion would secure a population of 2500 fish >75mm. ***Additional comments:*** Although results from the latest genetic samples indicated slight hybridization, this population is considered an at-risk conservation population. On 7/23/2014 FWP collected genetic samples that were taken from the bottom end of WCT distribution within Stone Creek. Results showed slight hybridization, (98.8% WCT 1.2% YCT). On 8/8/2017 the BLM collected a 26 fish sample from the Left Fork of Stone Creek above a large open pit talc mine that indicated unaltered WCT. In 2018 BLM collected two other genetic samples within the drainage that have not yet been analyzed. More genetic monitoring is needed to clarify which reaches of stream are unaltered and which are hybridized so that a conservation plan can be developed.
Taylor	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could protect about 7 miles of stream and secure a population of 2500 fish >75mm. ***Additional comments:*** Past BLM genetic monitoring found hybridized cutthroat up to within ¾ of a mile from the headwaters. Genetics taken on 6/27/2012 show that this population is genetically altered (97.4% WCT, 2.6% YCT) and is considered a conservation population.
Teddy	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized cutthroats and nonnative EBT would protect this population. Enhancement of an outlet structure on an already existing impoundment could be used to create a barrier. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. Installation of a barrier could protect up to 7.7 miles of stream and based on the productivity of neighboring streams a project would secure a population of 2500 fish >75mm. ***Additional comments:*** BLM genetic samples collected on 8/29/12 identified an altered population of 94.4% WCT 3.8% RBT 1.5 % YCT. More information is needed to develop a conservation plan for this stream.

Section 2: Red Rock Sub-basin

Overview

Red Rock WCT Status and Threats:

- Number of Conservation populations: 34 (9 unaltered; 5 mixed; 20 altered)
- Populations at risk: 82% (28 of 34)
- Genetically unaltered population at risk: 89% (8 of 9)
- Populations considered protected: 18% (6 of 34)
- Populations considered secured: None
- Significant threats:
  - Brook Trout (EBT): 14 populations
  - Other trout (YCT, RBT, CT hybrids): 26 populations
  - Small population size: 13 populations (< 1,000 fish)
  - Livestock grazing: 33 populations
  - Limited distribution: 18 populations (inhabit < 5 miles of stream)

Table 12. Genetic class and threat status of WCT conservation populations in the Red Rock sub-basin.

Genetic Class	Threat Status of Conservation Populations			
	At-risk	Protected	Secured	**Total**
Unaltered	8	1	0	**9**
Mixed	2	3	0	**5**
Altered	18	2	0	**20**
Total	**28**	**6**	**0**	**34**

Table 13. WCT conservation populations identified in the Red Rock River sub-basin.

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Basin (Sage)	3053	Genetically Altered	Genetically tested as 91.3% WCT	9/15/04 USFS, Brammer (15 Indel) 91.3% WCT 5% YCT 3.7% RBT
Bean (Centennial)	4377 3421 2225 696	Genetically Unaltered	Genetically tested as 100% WCT	6/6/12 BLM, Hutchinson (25 SNP) Need to be Analyzed 9/18/06 FWP, Nelson (25 PINES) 100% WCT 10/29/01 FWP, Nelson (54 PINES) Inconclusive 8/27/93 FWP, Oswald (10 Allozymes) 100% WCT
Bear (Centennial)	3415 2226 832	Genetically Unaltered	Genetically tested as 100% WCT	9/19/06 FWP, Nelson (25 PINES) 100% WCT 10/30/01 FWP, Nelson (53 PINES) 100% WCT 8/30/93 FWP, Oswald (10 Allozymes) 99% WCT 0.5% RBT 0.5% YCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Bear (Horse Prairie)	3413 984 983 797	Genetically Altered	Genetically tested as 98.2% WCT	7/25/06 FWP, Nelson (25 PINES) 98.2% WCT 1.5% RBT 0.3% YCT 8/5/94 FWP, Oswald (15 and 25 Allozymes) 99.5% WCT 0.5% YCT 8/9/93 FWP, Oswald (9 Allozymes) 99% WCT 1% YCT
Browns (Horse Prairie)	4886 3298 3273 3217 3216 3215 3078 201	Genetically Unaltered	Genetically tested as 100% WCT	8/22/17 FWP, Jaeger (52 SNP) Both Fish Transfers 100% WCT 8/29/16 FWP, Jaeger (55 SNP) 100% WCT 6/22/06 FWP, Nelson (25PINES) 100% WCT 6/28/05 FWP, Nelson (15 PINES) 100% WCT 5/16/05 FWP, Nelson (30 Allozymes) 100% WCT 8/27/02 USFS, Brammer, Opitz (8, 17 and 65 PINES) 100%WCT 7/1/87 FWP, Shepard (10 Allozymes) 100% WCT
Cabin (Big Sheep)	2124 684	Genetically Altered	Genetically tested as 98% WCT	6/20/00 FWP, Shepard (30 PINES) 98% WCT 2% RBT 8/19/92 USFS, Brammer (10 Allozymes) 97.5% WCT 2.5% RBT
Craver (Medicine Lodge)	4926 3662 2125 548	Genetically Unaltered	Genetically tested as 100% WCT	7/13/17 FWP, Jaeger (25 SNP) 100% WCT 8/16/07 BLM, Hutchinson (25 PINES) 100% WCT 7/19/00 FWP, Shepard (14 PINES) 100% WCT 9/6/91 USFS, Browning (6 Allozymes) 100% WCT
Deadman (Big Sheep)	3233 3227 1158	Genetically Altered	Genetically tested as 93% WCT	7/17/02 USFS, Brammer (25 PINES) 93% WCT 5% RBT 2% YCT 7/15/02 USFS, Brammer (19 PINES) 97% WCT 3% RBT 9/20/86 USFS, Browning (10 Allozymes) 98.3 WCT 1.7% YCT
EF Clover (Centennial) -Above barrier -Below barrier	4449 4364 4363 3174	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT	7/12/12 FWP, Jaeger (10 SNP) 100% WCT 9/27/11 FWP, Jaeger (20 SNP) above waterfall 100% WCT 9/27/11 FWP, Jaeger (15 SNP) below waterfall 95.9% WCT 4.1% RBT 8/7/02 USFS, Brammer (15 PINES) 92% WCT 8% YCT
East (Sage)	3247	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT	10/20/05 BLM, Hutchinson (29 PINES) 23 WCT, 5 WCT x YCT 98% WCT
Jones (Centennial)	2224 695	Genetically Altered	Genetically tested as 96% WCT	8/27/02 FWP, Oswald (10 Allozymes) 100% WCT 10/30/01 FWP, Nelson (25 PINES) 96%WCT 1.4 RBT 2.6% YCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Little Basin (Sage)	796	Genetically Altered	Genetically tested as 92.7% WCT	7/22/93 FWP, Oswald (5 Allozymes) 92.7% WCT 5% RBT 1.3% YCT
Little Sheep - MF Little Sheep - WF Little Sheep	4444 3018 674 582 866	Genetically Altered	Genetically tested as 96.3% WCT	8/2/12 FWP, Jaeger (25 SNP) 96.3% WCT 3.7% YCT 7/7/03 USFS, Brammer (10 PINES) 100% WCT 8/12/92 USFS, Brammer (11 Allozymes) 95.1% WCT 4.9% YCT 10/03/91 USFS, Browning (6 Allozymes) 94% WCT 6% YCT W.F. Little Sheep 9/23/93 USFS, Brammer (8 Allozymes) 96% WCT 4% YCT
Long (Sage) - Cattle	1354	Genetically Altered	Genetically tested as 99.1% WCT	8/24/99 USFS, Brammer (25 PINES) 99.1% WCT 0.9% RBT
Meadow (Big Sheep)	4890 4704 2122 982	Genetically Unaltered	Genetically tested as 100% WCT	8/23/17 FWP, Jaeger (50 SNP) 100% WCT 8/29/16 FWP, Jaeger (155 SNP) 100% WCT 6/4/14 BLM, Hutchinson (25 SNP) 100% WCT
Middle (Centennial)	4362	Genetically Altered	Genetically tested as 97% WCT	9/28/11 FWP, Jaeger (25 SNP) 97% WCT 3% YCT
Middle (Snowline)	2938 1293 579	Genetically Altered	Genetically tested as 97% WCT	8/26/02 FWP, Opitz (23 PINES) 97% WCT 3% YCT 7/23/98 USFS, Browning (8 Allozymes) 100% WCT 10/1/91 USFS, Browning (2 Allozymes) 95.8% WCT 4.2% RBT
Muddy (Big Sheep) - Sourdough - Wilson	???? 4047 683	Mixed	Genetically tested as 98% WCT	8/13/18 FWP Jaeger (25 SNP) Awaiting results 8/5/10 BLM, Hutchinson (25 Indel) 24 WCT, 1 WCT x RBT F1 8/19/92 FWP, Oswald (10 Allozymes) 100% WCT
Nicholia (Big Sheep) - Bear - Cottonwood - Tendoy	3056 472 3232 3231 3230 3229 3228 1254 3210 3208 3207 3191 3190 3189 1256 915	Genetically Altered	Genetically tested as 92.3% WCT	Nicholia Cr. 7/8/02 USFS, Brammer (10 PINES) 92.3% WCT 7.7% RBTxYCT 6/6/90 USFS, Browning (7 Allozymes) 92.3% WCT 7.7% RBTxYCT Bear Cr. 7/8/02 USFS, Brammer (6, 8, 13 PINES) 99% to 87.8% WCT 9/10/97 USFS, Browning (10 Allozymes) 100% WCT Cottonwood Cr. 7/10/02 USFS, Brammer, Opitz (3, 6, 6, 12, 19 PINES) 95% to 98% WCT Tendoy Cr. 9/15/97 USFS, Browning (10 Allozymes) 98.7% WCT 1.3% YCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
NF Divide (Horse Prairie) - SF Divide	3167 3166 2123 677	Genetically Altered	Genetically tested as 94% WCT	6/25/02 USFS, Brammer (25 PINES) 94% WCT 6% YCT 6/25/02 USFS, Brammer (25 PINES) 96% WCT 4% YCT 7/19/00 FWP, Shepard (26 PINES) 100% WCT 8/13/92 FWP, Oswald (10 Allozymes) 98.7% WCT 1.3% YCT
NF Everson (Horse Prairie)	4869 3238 679	Genetically Unaltered	Genetically tested as 100% WCT	6/21/16 FWP, Jaeger (25 SNP) 100% WCT 9/20/05 FWP, Nelson (50 PINES)
Odell (Centennial) - EF Odell - MF Odell -Trib. 1 -Trib. 2	4448 4447 3016 1000 3015 3040	Genetically Altered	Genetically tested as 99.5% WCT	8/14/12 FWP, Jaeger (25 SNP) E.F. Odell 99.5% WCT 0.5% YCT Trib. 2 7/31/02 USFS, Brammer (7 PINES) 100% WCT 7/22/02 USFS, Brammer (10 PINES) 100% WCT Trib. 1 7/23/02 USFS, Brammer (4 PINES) WCT Hybrids 8/17/94 FWP, Oswald (10 Allozymes) 95% WCT 5% YCT
Painter (Horse Prairie)	4888 3225 3224 3223 3222 3079 706	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT	8/22/16 FWP, Jaeger (50 SNP) 8/22/17 FWP, Jaeger (60 SNP) Both Fish Transfers 100% WCT 8/28/02 USFS, Brammer, Opitz (6, 11, 25 PINES) 100% WCT 5/2/05 FWP, Nelson (25 Allozymes) 22 WCT 3 RB 9/4/92 USFS, Brammer (12 Allozymes) 100% WCT
Peet (Centennial)	4442 694	Genetically Unaltered	Genetically tested as 100% WCT	All genetic samples before 2014 are irrelevant because Peet Creek was treated with rotenone that year. Transferred 25 WCT from Bean Cr. In summer of 2016 Transferred 26 WCT from Bear Cr. In summer of 2017 More fish transfers will occur in proceeding years. 7/17/12 FWP, Jaeger (25 SNP) 98.8% WCT 1.2% YCT 8/27/92 FWP, Oswald (10 Allozymes) 87.9% WCT 12.1% YCT
Price (Centennial) - WF Price	4277 4276 4275 3199 3198 3197 3196 3194	Genetically Altered	Genetically tested as > 90% WCT	8/10/11 BLM, Hutchinson (24 SNP) Upper 91.7% WCT (51 SNP) Lower 96.4% WCT (24 SNP) Trib. 97.9% WCT 7/31/02 USFS, Brammer, Opitz (1,2,2,11,12,12 PINES) 98% WCT to 93% WCT 7/30/02 USFS, Brammer, Opitz (5,6,19 PINES) 100% WCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
	3193 3192 3187 3186 3185			
Rape (Horse Prairie)	4868 3246 764	Genetically Altered	Genetically tested as 99.4% WCT	6/20/16 FWP, Jaeger (31 SNP) 99.4% WCT 0.6% RBT 8/12/05 BLM, Hutchinson (25 PINES) 100% WCT 7/20/93 FWP, Oswald (10 Allozymes) 99% WCT 0.5% RBT 0.5% YCT
Rock (Big Sheep)	4931 4732 1225	Genetically Altered	Genetically tested as 95.7 % WCT	7/28/15 FWP, Jaeger (25 SNP) 95.7% WCT 4.3% Admixture 9/15/97 FWP, Oswald (10 Allozymes) WCT? 1 polymorphic RBTxYCT
Sage	4153 1213 1210	Genetically Altered	Genetically tested as 96% WCT	7/29/16 FWP, Jaeger (25 SNP) 96% WCT 1.1% RBT 2.9%YCT 7/13/10 BLM, Hutchinson (24 SNP) 10/2/96 FWP, Oswald (10 Allozymes) 100% WCT
Sawmill (Snowline)	3221 3220 3219 3218 3211 857	Genetically Altered	Genetically tested as 95% WCT	8/14/02 USFS, Brammer (2, 9, 14, 25 PINES) 96% WCT t0 88% WCT 5% to 12% Admixture 9/17/93 USFS, Browning (10 Allozymes) 97.2% WCT 2.8% YCT
SF Everson (Horse Prairie)	4044 799	Genetically Unaltered	Genetically tested as 100% WCT	7/22/10 BLM, Hutchinson (49 Indel) 100% WCT 8/9/93 USFS, Browning (5 Allozymes) 100% WCT
Sheser (Horse Prairie)	3959 1903	Genetically Altered	Genetically tested as 98.3% WCT	8/10/09 BLM, Hutchinson (25 Indel) 98.3% WCT 1.7% RBT 8/10/98 USFS, Kampwerth (10 Allozymes) 100% WCT
Shineberger (Snowline)	3214 3213 3212	Genetically Altered	Genetically tested as 95% WCT	8/14/02 USFS, Brammer (25 PINES) 94% WCT 5%YCT 1% RBT 7/23/98 USFS, Browning (6 Allozymes) 97.5 % WCT 2.5% YCT 9/20/91 USFS, Browning (4 Allozymes) 93.2% WCT 6.8% YCT
Simpson (Big Sheep) - Unamed trib.	4928 4705 3237 3020 685	Genetically Unaltered	Genetically tested as 100% WCT	7/26/17 FWP, Jaeger (25 SNP) 100% WCT 6/1/14 BLM, Hutchinson (25 SNP) 100% WCT 9/22/05 FWP, Nelson (50 PINES) 100% WCT 7/8/04 USFS, Brammer (3 PINES) 100% WCT 8/19/92 FWP, Oswald (10 Allozymes) 100% WCT
Trapper (Horse Prairie)	1154 798	Mixed	Genetic analysis indicating presence of	8/15/96 USGFS, Browning (5 Allozymes) 100% WCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
- NF Frying Pan - SF Fry Pan			both unaltered and hybridized WCT	8/9/93 FWP, Oswald (10 Allozymes) 94.2% WCT 5.8% RBT

Table 14. Characteristics that define threat status of WCT conservation populations in the Red Rock sub-basin.

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Basin	0.7		4 per 100 m (62 fish)	Intermittent flow	State, Private	Limited distribution, small population, no barrier, Brook Trout, hybridization, livestock grazing	At-risk
Bean	2.1	2.1	4 per 100m (186 unaltered fish)	Intermittent flow	BLM, Private	No Barrier, limited distribution, small population, livestock grazing	At-risk
Bear (Centennial)	2.9	2.9	13 per 100 m (612 unaltered fish)	Intermittent flow	BLM, Private	No Barrier, limited distribution, small population, livestock grazing	At-risk
Bear (Horse Prairie)	6.5		6 per 100 m (628 fish)	None	FS, Private	No barrier, Brook Trout, hybridization, livestock grazing	At-risk
Browns	6.5	6.5	25 per 100 m (2615 unaltered fish)	Intermittent flow	FS, Private	No Barrier, hybridization, livestock grazing	At-risk
Cabin	2.8		21 per 100 m (946 fish)	Intermittent flow	BLM, FS, Private	No barrier, limited distribution, hybridization, livestock grazing, heavy siltation	At-risk
Craver	1.4	1.4	3 per 100 m (67 Unaltered Fish)	Perched culvert	BLM, Private	Brook Trout, limited distribution, small population size, livestock grazing	At-risk
Deadman	3		23 per 100m (1110 fish)	None	FS, Private	No barrier, hybridization, limited distribution, livestock grazing	At-risk
EF Clover	1.4	0.5	5 per 100 m (113 fish) (40 unaltered fish)	Cascades	State, Private	Limited distribution, small population, Brook Trout, hybridization, livestock grazing	Protected (above) At-Risk (below)
East	3.3		Unknown	None	BLM, State, Private	No barrier, limited distribution, Brook Trout, hybridization, livestock grazing, heavy siltation	At-risk
Jones	3		Unknown	Intermittent flow	BLM, Private	Livestock grazing, limited distribution, heavy siltation	At-risk
Little Basin	3.8		2 per 100 m (140 fish)	Intermittent flow	BLM, State, Private	No barrier, hybridization, limited distribution, small	At-risk

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
						population, livestock grazing, heavy siltation	
Little Sheep - MF Little Sheep - WF Little Sheep	23.5		28 per 100 m (10,589 fish)	Intermittent flow	FS, BLM, State and Private	No barrier, Brook Trout, hybridization, livestock grazing	At-risk
Long - Cattle	5.5		33 per 100 m (2921 fish)	None	BLM, State	No barrier, Brook Trout, hybridization, livestock grazing, heavy siltation, bank erosion	At-risk
Meadow	4.5	4.5	13 per 100 m (941 unaltered fish)	Intermittent flow	FS, BLM, Private	No barrier, hybridization, limited distribution, livestock grazing, heavy siltation	At- risk
Middle	4.2		5 per 100 m (334 fish)	None	FS, BLM, Private	No barrier, Brook Trout, limited distribution, small population size, livestock grazing, irrigation	At-risk
Middle (Snowline)	0.5		Unknown	Intermittent flow	FS and Private	No barrier, Brook Trout, limited distribution, small population size, hybridization, livestock grazing	At-risk
Muddy - Sourdough - Wilson	10.7		3 per 100 m (518 fish)	Irrigation diversion (6 ft. drop)	BLM, FS, Private	Brown Trout, hybridization, small population, livestock grazing, heavy siltation	Protected
Nicholia - Bear - Cottonwood - Tendoy	19.3		Unknown	None	FS and Private	Hybridization, livestock grazing, irrigation	At-risk
NF Divide - SF Divide	5.8		11 per 100 m (1043 fish)	None	FS and Private	No barrier, hybridization, livestock grazing	At-risk
NF Everson	3.3	3.3	5 per 100 m (266 unaltered fish)	Perched culvert	BLM, Private	Small population size, limited distribution, livestock grazing	Protected
Odell	6.4		20 per 100 m (2073 fish)	None	BLM Wilderness, State, Private	No barrier, hybridization, Brook Trout	At-risk
Painter	9.2	5.5	17 per 100 m (2517 fish)	Perched culvert protects 5.5 miles	FS, Private	None in upper reach; lower threatened by hybridization, livestock grazing	Protected (above barrier)

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
			(1505 unaltered fish)				At-risk (below)
Peet	11.4	11.4	2016-2018 Introduced (99 unaltered fish)	Impoundment	BLM, Private	Livestock grazing, small population, heavy siltation	Protected
Price - WF Price	7.4		Unknown	Intermittent flow	BLM, Private	No barrier, hybridization, livestock grazing	At-risk
Rape	5.3		13 per 100 m (1109 fish)	Levee Impoundment	BLM, State, Private	Hybridization, livestock grazing	Protected
Rock (Big Sheep drainage)	8.8		5 per 100 m (733 fish)	Unknown	FS and Private	No barrier, hybridization, livestock grazing, irrigation	At-risk
Sage	0.7		31 per 100 m (417 fish)	None	State, BLM, Private	Limited distribution, small population, no barrier, Brook Trout, hybridization, livestock grazing, irrigation	At-risk
Sawmill	6.1		Unknown	Unknown	FS, State, Private	No barrier, hybridization, livestock grazing, irrigation	At-risk
SF Everson	2.1	2.1	1 per 100 m (34 unaltered fish)	Intermittent flow	BLM, Private	No barrier, hybridization, limited distribution, small population, livestock grazing	At-risk
Sheser	4		Unknown	Intermittent flow	FS, Private	No barrier, limited distribution, Brook Trout, hybridization, livestock grazing	At-risk
Shineberger	1.8		Unknown	Intermittent flow	FS, Private	No barrier, Brook Trout, limited distribution, hybridization, livestock grazing	At-risk
Simpson - Crystal	5	5	12 per 100 m (966 unaltered fish)	Intermittent flow (Irrigation withdraws)	BLM, FS, Private	No barrier, hybridization, livestock grazing, heavy siltation	At-risk
Trapper - NF Frying Pan - SF Fry Pan	12		11 per 100 m (2091 fish)	Unknown	FS, Private	No barrier, hybridization, Brook Trout, livestock grazing	At-risk

[a] relevant to “mixed” populations where there are genetically unaltered and altered segments of the population that exist in the same stream.
[b] WCT population sizes were calculated by averaging 100 m population estimates from throughout the drainage and extrapolating to the number of river miles occupied.

Table 15. Actions required to maintain conservation populations in the Red Rock sub-basin

Stream (s)	Population Status and Conservation Needs
Basin	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Basin Creek due to lack of fish bearing habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** BLM surveys identify less than 1 mile of habitat occupied by WCT. Hybridized CT, EBT and RM COT were found during 2015 monitoring efforts. Connectivity with Little Basin and Sage Creeks during high water years is the main threat for hybridization or invasion by EBT.
Bean	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Bean Creek upstream of the South Valley Road to the mouth of the canyon has been restored to have sinuosity, riffles and pools of appropriate size. Live fish transfers from Bean Creek are being used to repopulate the Peet Creek WCT project area. In 2016 and 2018, 25 and 23 WCT were transferred to the Peet Creek Reservoir and Peet Creek, respectively. ***Short-term (protect):*** Irrigation withdrawals isolate and dewater the lower 3 miles of Bean Creek and prevent nonnative trout invasion from downstream (Red Rock River). Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Presently, the Bean Creek population cannot be secured (5+ miles of habitat or 2500 fish >75 mm) due to lack of stream habitat and connectivity. The Bean Creek population is adjacent to the Bear Creek population (also genetically unaltered); however, connecting these two systems to allow gene flow is not feasible because of topography and irrigation needs. ***Additional comments:*** This population is small, and abundance is limited by natural low flow regimes.
Bear (Centennial)	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Live fish transfers from Bear Creek are being used to repopulate the Peet Creek WCT project area. In 2017 and 2018, 26 and 25 WCT were transferred to Peet Creek Reservoir and Peet Creek, respectively. ***Short-term (protect):*** Irrigation withdrawals isolate and dewater the lower 3.5 miles of Bear Creek and prevent nonnative trout invasion from downstream (Red Rock River). Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Presently, the Bear Creek population cannot be secured (5+ miles of habitat or 2500 fish >75 mm) due to lack of stream habitat and connectivity. The Bear Creek population is adjacent to the Bean Creek population (also genetically unaltered); however, connecting these two systems to allow genetic flow is not feasible because of topography and irrigation needs. ***Additional comments:*** This population is small, and abundance is limited by natural low flow regimes.
Bear (Horse Prairie)	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): It may not be feasible to secure a population of 2500 fish >75mm within Basin Creek due to lack of fish-bearing habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Genetics were collected from between stream mile 4.2 and 5.2 in 2006, they showed hybridization with both RBT and YCT. These fish were 98.2% WCT, 1.5% RBT and 0.3% YCT.
Browns	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Browns Creek is one of six donor streams being used to repopulate the Greenhorn Creek WCT project area (via live fish transfers). Transfers of 55 and 52 WCT from Browns Creek were released into the N.F. of Greenhorn Creek in 2016 and 2017, respectively. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Short-term (protect):*** This population is isolated by irrigation diversion and flood irrigation practices that dewater and convert a relatively short reach of Browns Creek from stream to wet meadow. Feasibility of alternative isolating mechanisms should be investigated. ***Long-term (secure):*** A barrier placed on lower Browns Creek could secure at least 7 miles of stream that already supports a population of unaltered WCT that exceeds 2500 fish >75 mm. ***Additional comments:*** Browns Creek needs a fish barrier to be considered a secured WCT population. This unaltered WCT population is very diverse when compared to other eastside WCT; its heterozygosity is 192% greater than the average for east side populations.
Cabin	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT followed by WCT expansion would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Cabin Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries like Simpson, Tex and Big Sheep Creeks would significantly increase connectivity and protect 20-30 stream miles. ***Additional comments:*** Meadow and Simpson Creeks are the only two genetically unaltered WCT populations left in the upper Big Sheep Creek basin and could be used to repopulate a larger WCT project area. EBT are not found in the upper Big Sheep Creek basin; the main threat to WCT is hybridization.
Craver	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Annual physical suppression of EBT using backpack electro-fishing. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Modification of an existing pond outlet structure may be the most feasible barrier option. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Craver Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Surveys done in 2017 indicated very low numbers of remaining WCT (< 3 per 100 m); it took three crews an entire day to collect a 25-fish genetic sample. This is the last remaining genetically unaltered population of WCT left in the entire Medicine Lodge watershed.

Stream (s)	Population Status and Conservation Needs
Deadman	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Identification of a possible barrier location has already been completed. Updated demographic and genetic information are needed to determine if a WCT conservation population persists. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A fish barrier at the bottom of this drainage near the confluence with Big Sheep Creek could secure 18 or more stream miles and would include Little Deadman and Pine Creek tributaries. Based on demographic surveys of neighboring streams a project like this would secure 2500 fish >75mm. ***Additional comments:*** Updated information has been collected and will be used to manage this fishery and possibly develop a plan for a future WCT project area. Deadman Creek is a highly productive stream in terms of both size and abundance of trout; protection of only a few miles of stream could secure a robust population.
EF Clover	***Genetic Class:*** Mixed ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** At the headwaters of the E.F of The E.F. of Clover Creek there is a large cascade that protects a genetically unaltered population of about 40 fish that occupy less than ½ mile of stream. EBT and CT hybrids are abundant downstream of this cascade. This population of WCT is primarily located on private property, the genetically unaltered population at the headwaters could be used to repopulate this drainage from the top down.
East	***Genetic Class:*** Mixed ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic monitoring and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Lack of available fish habitat could be the limiting factor to securing a population of 2500 fish >75mm. A barrier that includes more habitat within the upper Sage Creek drainage followed by WCT expansion could secure this population. ***Additional comments:*** At one time, 3800 EBT were physically removed from 0.5 miles of stream, to help this altered WCT population. East Creek is a productive fishery, lack of fish bearing habitat is likely a limiting factor for WCT.
Jones	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic and genetic information are needed to determine if unaltered WCT still persist. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Jones Creek due to lack habitat and connectivity.

Stream (s)	Population Status and Conservation Needs
	Additional comments: Based on surveys conducted by the USFS in 2002, EBT occur with WCT in all but the upper reach of Jones Creek. Like adjacent Bear and Bean Creeks, Jones Creek is isolated from the Red Rock River (via Winslow Creek) and other nonnative species by channel alterations and irrigation withdrawals. This altered population is a small headwater population and the only population data for WCT is from 1982. It is uncertain if WCT still persist due to competition with non-native EBT. Genetic results indicated that the population is 96% WCT 1.4% RBT and 2.6% YCT.
Little Basin	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic monitoring and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Little Basin Creek due to lack of fish bearing habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Lack of suitable habitat for WCT is likely a limiting factor in Little Basin Creek. On 7/22/1993 genetic samples show that these fish are genetically altered (92.7% WCT 5% RBT 1.3% YCT).
Little Sheep - WF Little Sheep	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic monitoring and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** On 8/2/12 genetic samples show that these fish are genetically altered (96.3% WCT 3.7% YCT). These samples were collected from the headwaters of the Middle Fork of Little Sheep Creek.
Long - Cattle	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic monitoring and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Long Creek due to lack of fish bearing habitat and connectivity. A barrier that includes more neighboring tributaries (Beech, Divide, Cattle, Pistol and Sage Creeks) followed by WCT expansion could secure this population. ***Additional comments:*** Long Creek has not been sampled since 1999, at that time surveys revealed this stream supported an abundance of WCT, WCTxRBT hybrids, EBT and RM COT. On 8/24/99 a 25 fish genetic sample showed these hybrids were 99.1% WCT 0.9% RBT.
Meadow	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Meadow Creek is one of six donor streams that is being used to repopulate the Greenhorn Creek WCT project area (via live fish transfers). Transfers of 55 and 50 WCT from Meadow Creek were released into the S.F. of Greenhorn Creek in 2016 and 2017, respectively. ***Short-term (protect):*** Establishment of a barrier would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): It may not be feasible to secure a population of 2500 fish >75mm within the upper Big Sheep Creek basin due to lack of connectivity. A barrier that includes more neighboring tributaries and habitat followed by WCT expansion is not an option due to lack of stream connectivity. ***Additional comments:*** In 2017 demographic monitoring indicated that this stream supports 13 fish per 100 meters. Meadow Creek is one of two streams left that contain a genetically unaltered WCT population within the upper Big Sheep Creek basin, the other being Simpson Creek. This can be attributed to lack of connectivity (irrigation withdraws and intermittent flows) with neighboring streams in the basin.
Middle (Centennial)	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Middle Creek flows into West Creek which maintains < 90% WCT; invasion of these hybrid fish into the upper reaches of Middle Creek is a threat. Riparian habitat could be improved by mitigating cattle grazing impacts. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan for this population. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Middle Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population; however, maintaining an open system is a priority for grayling conservation. ***Additional comments:*** The top (< 1.0 mile) reach of upper Middle Creek appears to be fishless. This reach should be evaluated for potential upstream expansion of the WCT population.
Middle (Snowline)	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Middle Creek due to lack of habitat. A barrier that includes more neighboring tributaries (Big Beaver, W.F. Big Beaver, Poison, Shineberger, Swamp) and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Surveys in the 1990's indicated WCT from river mile 3.3 to 4.6, with genetic samples indicating genetically unaltered WCT at RM 4.6 and genetically altered WCT at 3.3. No WCT were captured in the most recent survey of the stream in 2002 (RM 3.2), though a single WCT was observed. Anecdotal evidence suggests habitat quality is inadequate (at least in the headwaters) to secure WCT in Middle Creek.
Muddy - Sourdough - Wilson	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. A new fish barrier built on private land by replacing an existing irrigation head-gate was documented in August 2018. ***Short-term (protect):*** Muddy Creek is presently protected by a barrier on private land near river mile 2.2. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. In the past, a wooden pin and plank barrier with a 3 ft. drop restricted fish movement upstream. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Muddy Creek due to lack of fish bearing habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population.

Stream (s)	Population Status and Conservation Needs
	Additional comments: A long period of drought prior 2003 may have negatively impacted this population. Consistent bad water years and high levels of sedimentation and erosion are limiting factors for this WCT population. A genetic sample collected on 8/5/2010 revealed 24 unaltered WCT and 1 WCT x RBT F1 first generation hybrid above the barrier between river miles 2.2 and 2.9.
Nicholia - Bear - Cottonwood - Tendoy	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion would secure this population. Barrier placement could secure 15-20 stream miles and a WCT population greater than 2500 fish >75 mm. ***Additional comments:*** The Nicholia Creek system was extensively surveyed by the USFS in the early 2000's. Surveys found a well distributed WCT population with relatively high fish densities on National Forest lands. Identification as "at-risk" is based on < 88% WCT at the mouth of Bear Creek, and their potential to invade less hybridized (upstream) segments of the population. Stocking records indicate 19,800 "CT" (Washoe Park Hatchery) were planted in Nicholia Creek in 1936, and 3,600 "CT" (Bozeman Fish Tech Center) were planted in Nicholia Creek in 1950.
NF Divide (Horse Prairie) - SF Divide	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within N.F. Divide Creek due to lack of habitat. A barrier that includes more neighboring tributaries (Black Canyon, Maiden, Prairie, S.F. Divide) and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Population surveys conducted on the North and South forks of Divide Creek from 1992 through 1994 indicated healthy populations of WCT and RM COT. In 2002 the USFS collected genetic samples in both the North and South forks that indicated hybridization (94% WCT and 6% YCT).
NF Everson	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. N.F. Everson Creek has a culvert barrier that drops 4 ft. onto a concrete splash pad that is located were FS/BLM Rd. 1882 crosses the N.F. Everson Creek. There has been an ongoing EBT removal project on the N.F. Everson Creek since the barrier was constructed. Since June of 2016 no EBT have been observed in N.F. Everson Creek. ***Short-term (protect):*** N.F. Everson Creek is considered protected because of the man-made fish barrier coupled with the successful physical removal of nonnative EBT. Over about 5 years 3800 EBT were removed from N.F. of Everson Creek. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within N.F. Everson Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** On 6/21/16 genetic samples confirmed this population is still genetically unaltered WCT.

Stream (s)	Population Status and Conservation Needs
Odell	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. ***Long-term (secure):*** A barrier near the mouth of Odell Canyon followed by downstream expansion of WCT would secure this population. Based on demographic surveys Odell Creek would support a secured population greater than 2500 fish >75 mm. ***Additional comments:*** During the summer of 2012 FWP conducted drainage wide population monitoring to characterize the fishery in upper Odell Creek. Genetic testing revealed that only altered WCT remain in the drainage. A potential location for barrier construction was identified and population surveys were completed.
Painter	***Genetic Class:*** Mixed ***On-going projects:*** Demographic and genetic monitoring. Painter Creek is one of six donor streams being used to repopulate the Greenhorn Creek WCT project area (via live fish transfers). Transfers of 50 and 60 WCT from Painter Creek were released into the N.F. of Greenhorn Creek in 2016 and 2017, respectively. ***Short-term (protect):*** Painter Creek is considered protected because of a man-made culvert fish barrier that was installed around 2008. Riparian habitat could be improved by mitigating cattle grazing. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. Based on 2016 demographic surveys there are about 1505 unaltered WCT above the barrier. A barrier that includes more habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** The barrier is located at N 45.10801 W -113.25527 about 0.2 miles upstream of the USFS boundary.
Peet	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Peet Creek is a WCT restoration project area that is presently being repopulated from Bean and Bear Creeks (via live fish transfers). Peet Creek was treated with rotenone in 2013 and 2014 to remove hybridized CT. Transfers of 25 and 26 genetically unaltered fish were released into the upper Peet Creek pond from Bean and Bear Creeks in 2016 and 2017, respectively. In 2018, 23 Bean Cr. and 25 Bear Cr. genetically unaltered WCT were released into Peet Creek About ½ mile upstream of the pond. ***Short-term (protect):*** Peet Creek is considered protected because of two barriers within the project area; both are impoundments (ponds). A small number of hybridized CT were not killed during the treatment in the upper half of the E.F. Peet Creek. These fish are being physically removed using backpack electrofishing, they have not had a successful spawn and appear to be aging out. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Peet Creek will be considered a secured population once it has reached the criteria of 2500 fish >75mm. ***Additional comments:*** 11.4 stream miles were treated upstream from an already existing fish barrier located at 44.60338 -112.05934. Historically, both donor streams (Bean and Bear Creeks) have been negatively affected by consecutive years of low flows. Based on demographic surveys it was decided to only take around 25 WCT from each stream annually for repopulating efforts.

Stream (s)	Population Status and Conservation Needs
Price - WF Price	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Price Creek due to lack of habitat and connectivity. A barrier that includes more habitat downstream followed by WCT expansion could secure a population of 2500 fish >75 mm. ***Additional comments:*** Genetic results from 2011 indicated that this population is genetically altered with a higher percentage of hybridization occurring in the upper end of Price Creek located near a small private land inholding.
Rape	***Genetic Class:*** Genetically Altered ***On-going projects:*** None. ***Short-term (protect):*** Rape Creek is protected by an impoundment (pond) and updated information and documentation of this barrier are needed. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Rape Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. The estimated population for 6.4 miles of stream is about 1306 total fish. ***Additional comments:*** Genetic samples collected on 6/20/16 revealed that this population is genetically altered (99.4% WCT and 0.6% RBT).
Rock (Big Sheep)	***Genetic Class:*** Genetically Altered ***On-going:*** None. ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Rock Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat within the upper Big Sheep Creek drainage followed by WCT expansion could secure this population. ***Additional comments:*** FWP collected a 25 fish genetic sample on 7/28/15, results show an altered population consisting of 96.9% WCT 0.4% RBT and 2.7% YCT. Rock Creek is diverted overland in multiple locations to flood irrigate hay fields before reconnecting with Nicholia Creek, which would explain the hybridization within the last 15 years.
Sage	***Genetic Class:*** Genetically Altered ***On-going projects:*** None. ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Sage Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries (Beech, Divide, Cattle, Long, Pistol) followed by WCT expansion would secure this population.

Stream (s)	Population Status and Conservation Needs
	Additional comments: FWP collected genetic samples on 7/29/16 and results showed an altered population of 96% WCT 1.1% RBT 2.9% YCT. Tributaries within the Sage Creek basin are productive fisheries in terms of trout per river mile. Based on multiple genetic samples all WCT populations within the greater Sage Creek basin appear to be genetically altered.
Sawmill	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Sawmill Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Species presence and habitat quality in the lower 5 miles of Sawmill Creek is unknown, although Little Beaver Creek maintains < 90% WCT and should be considered a hybridization threat. Historical records show "CT" were stocked in Big Beaver Creek (within the Sawmill/Junction drainage) in 1950 (n=6120 from Bozeman Tech Center).
SF Everson	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Establishment of a barrier would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within S.F. Everson Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** It is clear there is no connectivity downstream with Everson Creek during most years. Lack of water and available habitat are the main limiting factors for this very small population of genetically unaltered WCT (1 fish per 100 m, about 34 fish).
Sheser	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan for this population. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Sheser Creek due to lack of habitat. A barrier that includes more neighboring tributaries (Bear, Frying Pan, Trapper Creeks) followed by WCT expansion would secure this population. ***Additional comments:*** The tributaries of Trail creek are all genetically altered populations with some of them remaining >90% WCT. It is unclear where these genetic separations take place due to good connectivity throughout the greater Trail Creek drainage.

Stream (s)	Population Status and Conservation Needs
Shineberger	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Shineberger Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Shineberger Creek has only been surveyed on FS lands at the headwaters of the drainage. The 2002 surveys found WCT to be rare to common in about 1 mile of stream. Only hybridized WCT have been captured in Shineberger, no other non-native salmonids have been found.
Simpson - Unnamed trib.	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Establishment of a barrier would protect this population. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Simpson Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries and protects more habitat downstream for WCT could secure this population. ***Additional comments:*** Simpson Creek is one of two streams left that contain a genetically unaltered WCT population in the upper Big Sheep Creek basin, the other being Meadow Creek. This can be attributed to lack of connectivity (irrigation withdrawals and intermittent flows) between neighboring streams.
Trapper - NF Frying Pan - SF Fry Pan	***Genetic Class:*** Mixed ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Trapper Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** The tributaries of Trail creek are all genetically altered populations with some of them remaining >90% WCT conservation populations. It is unclear where these genetic separations take place due to good connectivity throughout the greater Trail Creek drainage.

Section 3: Ruby Sub-basin

Overview

Ruby WCT Status and Threats:

- Number of Conservation populations: 18 (2 unaltered, 1 mixed, 15 altered)
- Populations at risk: 89% (16 of 18)
- Genetically unaltered population at risk: 0% (0 of 2)
- Populations considered protected: 11% (2 of 18)
- Populations considered secured: None
- Significant threats:
    - Brook Trout (EBT): 4 populations
    - Other trout (YCT, RBT, CT, hybrids): 16 populations
    - Small population size: 8 populations (<1,000 fish)
    - Livestock grazing: 13 populations, but likely higher
    - Limited distribution: 11 populations (inhabit <5 miles of stream)

Table 16. Genetic class and threat status of WCT conservation populations in the Ruby sub-basin.

Genetic Class	Threat Status of Conservation Populations			
	At-risk	Protected	Secured	**Total**
Unaltered	0	2	0	**2**
Mixed	1	0	0	**1**
Altered	15	0	0	**15**
Total	**16**	**2**	**0**	**18**

Table 17. WCT conservation populations identified in the Ruby River sub-basin.

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Basin (Ruby R.)	3053	Genetically Altered	Genetically tested as 91.3% WCT	9/15/04 USFS, Brammer (15 PINES) 91.3% WCT 5% YCT 3.7% RBT
California (Ruby R.)	1237 703	Genetically Altered	Genetically tested as 95.3% WCT	8/18/97 USFS, Brammer (8 Allozymes) 100% WCT 9/2/92 USFS, Browning (15 Allozymes) 95.3% WCT 4.7%YCT
Coal (Ruby R.)	4562 3058 3057 223	Genetically Altered	Genetically tested as 93.2% WCT	7/23/12 USFS, Watschke (31 SNP) 93.2% WCT 4.4% YCT 2.4% RBT 9/29/04 USFS, Brammer (15 PINES) 100% WCT 9/22/04 FWP, Brammer (10 PINES) WCTxRBTxYCT 8/19/87 FWP, Shepard (19 Allozymes) 88.4% WCT 9% RBT 2.6% YCT
Corral (Ruby R.) - NF Coral	 3054 467	Genetically Altered	Genetically tested as 91% WCT	8/17/04 USFS, Brammer (10 PINES) 91% WCT 7% RBT 2% YCT 10/11/90 USFS, Brammer (12 Allozymes) 91% WCT 7% RBT 2% YCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Cottonwood (Ruby R.) - Lower Geyser - Upper Geyser	 4561 4560 3044 1055	Genetically Altered	Genetically tested as 93.4% WCT	7/12/11 USFS, Watschke (13, 29 SNP) 93.4% WCT 1.6% RBT 5% YCT 8/12/04 USFS, Brammer (18 PINES) WCTxRBT 6/9/90 USFS, Browning (16 Allozymes) 100% WCT
Divide (Ruby R.)	399 222	Genetically Altered	Genetically tested as 92% WCT	7/20/90 USFS, Browning (7 Allozymes) 92% WCT 8% YCT 8/18/87 FWP, Shepard (11 Allozymes) 90.9% WCT 9.1% RBT
Greenhorn - Dark Hollow - Meadow Fork - NF Greenhorn - SF Greenhorn	4440 4439 4438 4045 3444 3409 3408 3407 3059 3010 1097 1019	Genetically Unaltered	Removed hybrids and non-native fish with (Rotenone)	All genetic samples before 2014 are irrelevant because Greenhorn Creek was treated with rotenone that year. Salvaged unaltered WCT from Dark Hollow and Meadow Fork GU WCT live fish Transfers 2016-17 104 Brays Canyon Creek 145 Jack Creek 110 Painter Creek 107 Browns Creek 111 Cottonwood Creek 105 Meadow Creek WCT Transfer total: 682
Harris (California)	4739 4378 4365 3416 704	Genetically Altered	Genetically tested as 99.4% WCT	7/8/14 USFS, Watschke (25 SNP) 99.4% WCT 0.6% YCT 7/2/12 BLM, Hutchinson (24 SNP) WCTxYCT 5/22/12 BLM, Hutchinson (25 SNP) 97.9% WCT 2.1% RBT 7/14/06 BLM, Hutchinson (25 Indel) 100% WCT 9/2/92 USFS, Brammer (10 Allozymes) 100% WCT
Idaho (Ruby R.)	4304 4237 3014 1140 1044 1024	Genetically Altered	Genetically tested as 94.8% WCT	9/11/11 BLM, Hutchinson (20, 41 SNP) 99% WCT to 94.8% WCT 5.2% 10 1% Admixture 9/14/04 USFS, Brammer (10 PINES) 100% WCT 9/15/95 USFS, Browning (9 Allozymes) 100% WCT 10/14/94 USFS, Browning (10 Allozymes) 100% WCT 9/20/94 FWP, Oswald (9 Allozymes) 76.8% WCT 13.9% RBT 2.8% YCT
Indian (Leonard Slough) - NF Indian - SF Indian	1101 794	Genetically Altered	Genetically tested as 96.3% WCT	9/12/95 USFS, Browning (10 Allozymes) 96.3% WCT 3.7% YCT 8/5/93 USFS, Browning (2 Allozymes) 99% WCT 1% YCT
Jack (Ruby R.)	4887 4274 3013	Genetically Unaltered	Genetically tested as 100% WCT	8/22/18 FWP, Jaeger (49 SNP) 100% WCT 8/22/17 FWP, Jaeger (49 SNP) 100% WCT 8/17/16 FWP, Jaeger (49 SNP) 100% WCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Mill Gulch (Granite)	719	Genetically Altered	Genetically tested as 94.4% WCT	9/16/92 USFS, Brammer (6 Allozymes) 94.4% WCT 5.6% RBT
Nugget (Wisconsin)	785	Genetically Altered	Genetically tested as 91.4% WCT	8/3/93 USFS, Browning (7 Allozymes) 91.4% WCT 8.6% RBT
Peterson (Ruby R.)	4446 1094	Genetically Altered	Genetically tested as 95% WCT	7/10/12 FWP, Jaeger (25 SNP) 95% WCT 5% RBT 8/13/91 USFS, Browning (12 Allozymes) 100% WCT
Ramshorn (Ruby R.) - Currant - NF Ramshorn - SF Ramshorn	4927 4738 509 508	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT	7/11/17 FWP, Jaeger (25 SNP) 100% WCT 7/6/16 FWP, Jaeger (85 SNP) 40 SNP above culvert, top 1 km: 100% WCT 20 SNP 0.5 mi. above culvert: WCT slightly hybridized 25 SNP below culvert: 97.2% WCT 2.8% RBT 8/13/91 USFS, Browning (12 Allozymes) 100% WCT 8/13/91 USFS, Browning (12 Allozymes) 11 WCT 1 RBT
Robb (Ruby R.) - The Notch	596	Genetically Altered	Genetically tested as 98.1% WCT	11/1/91 USFS, Brammer (7 Allozymes) 98.1% WCT 1.9% RBT
Sweetwater (Ruby R.) - NF Sweetwater - WF Sweetwater	4731 4445 1098 1020 1016	Genetically Altered	Genetically tested as 97.2% WCT	7/22/14 FWP, Jaeger (50 SNP) 97.2% WCT 2.8% RBT 7/9/12 FWP, Jaeger (25 SNP) 99.8% WCT 0.2% RBT 8/17/95 FWP, Oswald (15 Allozymes) 87.2% WCT 12.8% RBT 9/14/94 FWP, Oswald (10 Allozymes) WCT? 1 polymorphic RBT or YCT 9/8/94 FWP, Oswald (10 Allozymes) 100% WCT
Wisconsin (Jacobs Slough)	724	Genetically Altered	Genetically tested as 97.5% WCT	9/24/92 USFS, Brammer (14 Allozymes) 97.5% WCT 2.5% YCT

Table 18. Characteristics that define threat status of WCT conservation populations in the Ruby sub-basin.

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Basin	1.8		47 per 100 m (1274 fish)	None	FS	No barrier, hybridization, limited distribution, livestock grazing	At-risk
California	4.8		Unknown	None	BLM, FS, Private	Small population, no barrier, Brook Trout, hybridization, livestock grazing, irrigation	At-risk
Coal	2.1		32 per 100 m (1087 fish)	None	FS	No barrier, hybridization, limited distribution, small population size, livestock grazing, heavy siltation, bank erosion	At-risk
Corral - NF Corral	5.8		24 per 100 m (2240 fish)	None	FS	No barrier, hybridization, livestock grazing, heavy siltation, bank erosion	At-risk
Cottonwood - Geyser	5.6		Unknown	None	FS	No barrier, hybridization, livestock grazing, heavy siltation	At-risk
Divide	2.6		Unknown	None	FS	No barrier, hybridization, limited distribution, livestock grazing, heavy siltation	At-risk
Greenhorn - Dark Hollow - Meadow Fork - NF Greenhorn - SF Greenhorn	26.1	26.1	2016-17 Introduced (682 unaltered fish)	Concrete Man-made Barrier	FS, BLM, Private	Small population size	Protected
Harris	5.7		1 per 100 m (57 fish)	None	BLM, FS, Private	Limited distribution, small population, no barrier, Brook Trout, hybridization, livestock grazing, poor habitat conditions due to placer mining, irrigation	At-risk
Idaho	5.9		8 per 100 m (712 fish)	None	BLM, State, FS	Limited distribution, small population, no barrier, Brook Trout, hybridization, livestock grazing	At-risk
Indian - NF Indian - SF Indian	16.1 Limited Information		Unknown	Unknown	BLM, FS, Private	No barrier, Brook Trout, hybridization, livestock grazing,	At-risk

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Jack	3.3	3.3	15 per 100 m (797 unaltered fish)	Wooden man-made Barrier	BLM, Private	Small population size, poor habitat conditions, livestock grazing	Protected
Mill Gulch	4.2		Unknown	Unknown	BLM, FS	No barrier, Brook Trout, hybridization, livestock grazing,	At-risk
Nugget	3.7		Unknown	None	BLM, FS, Private	No barrier, Brook Trout, hybridization, livestock grazing,	At-risk
Peterson	3.4		11 per 100 m (580 fish)	None	State, Private	No barrier, Brook Trout, hybridization, livestock grazing, heavy siltation	At-risk
Ramshorn - NF Ramshorn	2.6	0.9	12 per 100 m (492 fish) (170 unaltered fish)	None	BLM, FS, Private	No barrier, Brook Trout, hybridization, livestock grazing, poor habitat conditions due to placer mining, irrigation	At-risk
Robb - The Notch	11.4 Limited Information		5 per 100 m (963 fish)	None	FS, State, Private,	No barrier, Brook Trout, livestock grazing, hybridization, heavy siltation, bank erosion	At-risk
Sweetwater - NF Sweetwater - WF Sweetwater	1.3		10 per 100 m (203 fish)	None	State, Private	No barrier, Brook Trout, hybridization, livestock grazing, heavy siltation, bank erosion	At-risk
Wisconsin	3.9		Unknown	None	FS, Private	No barrier, Brook Trout, hybridization, livestock grazing	At-risk

[a] relevant to "mixed" populations where there are genetically unaltered and altered segments of the population that exist in the same stream.
[b] WCT population sizes were calculated by averaging 100 m population estimates from throughout the drainage and extrapolating to the number of river miles occupied.

Table 19. Actions required to maintain conservation populations in the Ruby sub-basin

Stream (s)	Population Status and Conservation Needs
Basin	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Basin Creek due to lack of fish bearing habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** 8,500 "CT" were stocked in Basin Creek in 1931, which could explain why the upper Ruby River is a hybrid swarm. The upper Ruby River drainage (including Basin, Coal, Corral, Cottonwood and Divide creeks) is part of fluvial Arctic grayling (AG) restoration area. Any WCT recovery efforts, particularly barrier construction, would require coordination with AG recovery efforts.
California	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within California Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries (Harris, Quaking Aspen and Wakefield Creeks) followed by WCT expansion would secure this population. ***Additional information:*** BLM population surveys conducted in 2016 revealed low abundances of WCT that appeared to be hybridized WCT. California Creek has likely become an altered population of WCT since 1997 (20 years ago). High densities of EBT were observed in the upper half of the drainage in 2016.
Coal	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Coal Creek due to lack of fish bearing habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** 10,200 "CT" were reported to be stocked in 'Coal Creek' in 1931, this could explain why the upper Ruby River is basically a hybrid swarm. The upper Ruby River drainage (including Basin, Coal, Corral, Cottonwood and Divide Creeks) is part of a fluvial AG restoration area. Any WCT recovery efforts, particularly barrier construction, would require coordination with AG recovery efforts.
Corral - NF Coral	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): It may not be feasible to secure a population of 2500 fish >75mm within Corral Creek due to lack of fish bearing habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** 10,200 "CT" were reported to be stocked in 'Corral Creek' in 1931. The reported stocking location could also be referencing a section of the Ruby River, which could explain why the upper Ruby River is a hybrid swarm. The upper Ruby River drainage (including Basin, Coal, Corral, Cottonwood and Divide Creeks) is part of a fluvial AG restoration area. Any WCT recovery efforts, particularly barrier construction, would require coordination with grayling recovery efforts.
Cottonwood - Geyser	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Cottonwood Creek due to lack of fish bearing habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** On 7/12/11 the USFS collected two different groups of genetic samples. The results showed that this population is altered at 93.4% WCT 1.6% RBT 5% YCT. 32,900 "CT" were stocked in Cottonwood Creek in 1931 and 1932, which could explain why the upper Ruby River is a hybrid swarm.
Divide	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Divide Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** Recent genetic samples were inconclusive regarding the percent hybridization in the population and genetically "Altered" status was based on samples collected in 1990. The upper Ruby River drainage (including Basin, Coal, Corral, Cottonwood and Divide Creeks) is part of a fluvial AG restoration area. Any WCT recovery efforts, particularly barrier construction, would require coordination with grayling recovery efforts.
Greenhorn - Dark Hollow - Meadow Fork - NF Greenhorn - SF Greenhorn	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Greenhorn Creek was treated with rotenone in 2013 and 2014, except for upper Dark Hollow Creek where genetically unaltered WCT remained. In 2015 eDNA sampling every 250 meters followed by backpack electrofishing were used to verify treatment success. Genetically unaltered fish were transferred from 6 different streams to 7 locations throughout the project area during 2016, 2017 and 2018. WCT donor populations include: 104 Brays Canyon, 107 Browns, 145 Jack and 110 Painter creeks fish in the N.F. of Greenhorn Creek; 111 Cottonwood and 105 Meadow creeks fish in the S.F. of Greenhorn Creek. To date a total of 682 genetically unaltered WCT have been transferred into the Greenhorn WCT project area. ***Short-term (protect):*** A man-made concrete barrier was constructed in 2013 on DNRC land that provides protection upstream of the confluence of the South and North Forks of Greenhorn Creek. ***Long-term (secure):*** About 26.1 stream miles were treated upstream from the barrier (45.11120 -112.05934). This habitat has been made available for genetically unaltered WCT. Greenhorn Creek will become secured

Stream (s)	Population Status and Conservation Needs
	once it reaches the population criteria of 2500 fish >75mm following successful natural reproduction of translocated fish. ***Additional information:*** Genetically unaltered WCT from Dark Hollow and the Meadow Fork of Greenhorn Creek were salvaged during the 2013-14 rotenone fish removals. WCT from donor streams were captured, VI Tagged and held instream until genetic results confirmed unaltered status, and were then transferred into the Greenhorn WCT project area.
Harris	***Genetic Class:*** Genetically Altered ***On-going projects:*** Conifers were placed in the floodplain to reduce riparian use by livestock. ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Harris Creek due to lack of habitat. A barrier that includes more neighboring tributaries (California, Quaking Aspen) and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** Genetic samples collected on 7/8/14 by the USFS revealed that this population is altered at 99.4% WCT 0.6% YCT into the headwaters of Harris Creek.
Idaho	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Idaho Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** Genetic samples collected by the BLM on 9/11/11 (25 SNP) revealed that the Idaho Creek population is altered at 94.8% WCT 5.2 % RBT.
Indian - NF Indian - SF Indian	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Indian Creek due to lack of habitat. A barrier that includes more neighboring tributaries (N.F. and S.F. Indian) and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** A single population survey was completed at RM 8.9 in 1994. EBT (n=42) and WCT (n=15) were captured in the survey. Multiple lakes in the headwaters of the Indian Creek system should be evaluated for species present. In 1946 and 1947 over 37,000 RBT and 4,900 "CT" trout were stocked in the Indian Creek drainage.
Jack	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Jack Creek is one of six donor streams being used to repopulate the Greenhorn Creek WCT project area (via live fish transfers). Transfers of 47, 49 and 49 WCT (145 total) from Jack Creek were released into the Meadow and North forks of Greenhorn Creek in 2016, 2017 and 2018. Riparian habitat could be improved by mitigating cattle grazing impacts.

Stream (s)	Population Status and Conservation Needs
	Short-term (protect): Jack Creek is presently considered to be protected with a man-made fish barrier that was built in 2016, which is located on state land (45.15614, -112.12882). The barrier protects about 6 miles of stream, 3.3 miles of which are occupied by genetically unaltered WCT. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It is not possible to secure a population of 2500 fish >75mm within Jack Creek due to lack of habitat and connectivity. This population is presently estimated at 797 total fish. ***Additional information:*** Historically, intermittent stream flow has protected 3.8 miles of habitat from hybridization and nonnative trout. Jack Creek is one of two genetically unaltered WCT populations left in the Ruby River sub-basin the other being Ramshorn Creek.
Mill Gulch	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Mill Gulch due to lack habitat and connectivity. A barrier that includes more neighboring tributaries (Downey, Dulea, Granite, E.F. Granite, Gibbs) followed by WCT expansion would secure this population. ***Additional information:*** Six WCT collected at river mile 5 for genetic analysis in 1992 indicated 94% WCT. In 1948 5,000 RBT were stocked into Mill Gulch.
Nugget	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Nugget Creek due to lack habitat and connectivity. A barrier that includes more neighboring tributaries (Noble Fork, Wisconsin) followed by WCT expansion would secure this population. ***Additional information:*** In 1991, a survey at the stream mouth found only WCT. In 1995, a survey in the mid reaches of the stream also found only WCT. There are no stocking records for Nugget Creek; however, between the 1930's and 1950's the Wisconsin Creek drainage was stocked with large numbers of RBT, YCT, and "CT". All the lakes in this drainage should be sampled to identify fish species presence/absence.
Peterson	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It is not possible to secure a population of 2500 fish >75mm within Peterson Creek due to lack of habitat because it flows directly into Ruby Reservoir. ***Additional information:*** On 7/10/12 FWP collected genetic samples (25 SNP) that showed an altered population of 95% WCT 5% RBTxYCT admixture.

Stream (s)	Population Status and Conservation Needs
Ramshorn - Currant - NF Ramshorn	***Genetic Class:*** Mixed ***On-going projects:*** Demographic and genetic monitoring. In 2017 a barrier (45.45732 -112.01191) was established by modifying the culvert on USFS road 159 to protect unaltered WCT in the upper 0.9 miles of stream. Extensive drainage-wide field surveys were conducted by multiple agencies (BLM, FWP, USFS) during July 2016 and July 2017. Removal of non-natives from12 miles of Ramshorn Creek is planned. ***Short-term (protect):*** Ramshorn Creek is protected by a man-made wooden barrier (45.40951 -112.12399) that was built in the Fall of 2018. This barrier protects about 13 miles of stream and includes Current and N.F. Ramshorn Creek tributaries. Removal of hybridized CT and nonnative EBT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. Treatment of Ramshorn Creek is planned for the 2019 field season. ***Long-term (secure):*** Genetic samples collected in 2016 and 2017 identified an unaltered population of WCT in the headwaters of Ramshorn Creek (170 estimated fish). Genetically unaltered WCT would be salvaged in the headwaters from RM 12.3 upstream and then used as a source population to repopulate the rest of the WCT project area. Future genetic rescue may be needed to improve heterozygosity of the remaining unaltered WCT (He = 0.003, -100% of eastside WCT average He). Once WCT expansion and repopulation is completed Ramshorn Creek will be secured with a population of 2500 fish >75mm. ***Additional information:*** Between 1946 and 1951 Ramshorn Creek was stocked with 9,700 "CT", 4,750 RBT, and 4,800 Yellowstone CT.
Robb - The Notch	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Robb Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** Genetic samples collected by the USFS on 11/1/91 from just 7 fish showed an altered population of 98.1% 1.9% RBT. Stocking records indicate 12,880 "CT" (1946) and 8,700 RBT (1951) have been stocked in the Robb Creek system.
Sweetwater - NF Sweetwater - WF Sweetwater	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Sweetwater Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** 2013 genetic results showed a 99.8% WCT 0.2% RBT population. 2014 genetic samples showed a slightly higher hybridized population at 97.2% WCT 2.8% RBT. 4,500 RBT were stocked in Sweetwater Creek in 1950.

Stream (s)	Population Status and Conservation Needs
Wisconsin	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Wisconsin Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** A genetic sample of 14 fish was collected from the stream in 1992, it revealed an altered population (97.5% WCT and 2.5% YCT). Large numbers of RBT were stocked into lakes (Crystal, Jackson, Sunrise, Twin Lakes) in the headwaters of the Wisconsin Creek. All the lakes in this drainage were sampled in 2018, fish species and natural reproduction were documented.

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Appendix 1: WCT Conservation Actions

The individual sub-basin sections of this assessment identify specific threats and conservation actions. The effect of each threat on WCT and how they are mitigated by each conservation action are described in more detail in Table 20.

Table 20. Threats, their effects on WCT, and how they are mitigated by conservation actions.

Threat	Effect	Mitigation
Nonnative trout	**Rainbow and Yellowstone cutthroat trout:** hybridization resulting in the permanent alteration of a conservation population's genome. May lead to outbreeding depression, and appearance and behavioral changes. **Brook Trout:** competition and displacement of WCT by EBT, particularly young-of-the-year, is associated with reduced distribution, abundance, and loss of WCT populations. **Brown trout**: not currently common in streams occupied by WCT conservation populations; however, they have the potential of competition and predation interactions with WCT.	**Suppression and eradication of nonnative trout:** removal of nonnative trout using piscicides, electrofishing or other method is necessary to protect and secure conservation populations. **Piscicides** (rotenone and antimycin) are essential tools to remove nonnative trout from large complex streams where mechanical removal techniques are ineffective. Piscicides would be a primary removal technique for expansion of current populations, and to provide areas to establish new populations. **Electrofishing:** multiple-pass electrofishing is a suitable method to remove nonnative trout that occupy the same stream reaches as WCT in very specific instances. The technique will be a primary tool to protect exiting populations but is best suited for relatively small streams with minimal habitat complexity. **Protection with fish migration barriers:** barriers are necessary to prevent new or continued invasion of nonnative trout into streams or reaches occupied by conservation populations. A variety of barrier types are available depending on availability of funding, site accessibility, and channel size and type and size; these include small dams, culverts, and modifications of natural stream features.
Reduced distribution and abundance	**Populations of < 2,500 fish are more prone to loss of genetic variability and demographic stochasticity.** Over the long-term, reduced abundance can lead to direct genetic problems, or reduce the ability of populations to adapt to changing environments. Small isolated populations are also more vulnerable to extreme environmental events and the influence of nonnative trout.	**Expanding the abundance and distribution** of conservation populations to include, where possible, >2,500 fish and 5 miles of occupied habitat is the primary method to secure long-term persistence. Abundance increases will typically occur with removal of nonnative trout within a population, expanding distribution downstream to reaches not currently occupied (typically by removal of nonnative trout), and habitat improvement efforts.
Spatial Isolation	**Loss of connectivity:** Habitat changes, loss of migratory life forms, and placement of migratory barriers have resulted in a loss of connectivity among conservation populations. Lack of connectivity results in reduced gene-flow and demographic support between populations and prevents recolonization of a	**Genetic rescue/supplementation** (i.e., infusion of outside genes from a few individuals to reduce inbreeding depression and increase fitness) may be necessary in smaller populations where opportunities do not exist to increase their abundance.

	stream if local extinction occurs. In the short-term, spatial isolation provides protection for conservation populations, but long-term management must address isolation consequences.	**Establishment of new larger WCT populations** is necessary to significantly increase the distribution of WCT.
Stream/ riparian habitat condition	**Degraded stream and riparian habitats** can result in a reduced number of fishes occupying a stream or reach, and potentially increase the likelihood of nonnative trout invasion, particularly EBT. The consequences of these were described above.	**Restoration of proper stream and riparian function** will generally lead to increases in abundance, distribution, and resiliency to natural disturbance. Some impacts may be addressed with relatively simple actions; for example, riparian exclosure fences to project from livestock grazing impacts. Other impacts like chronic de-watering due irrigation and historic placer mining may require costly and complicated restoration efforts.

Appendix 2: Westslope Cutthroat Trout Status Assessment Field Packet

Form 1. Westslope Cutthroat Data Collection Protocol

Consistency in data collection is the foundation of this assessment and allows accurate description of present status and comparison within and among WCT populations through time. Accurately describing each conservation population is also essential to future project prioritization, repopulation, and expansion. Data collection must follow established protocols and methodologies and include all common minimums specified by established data sheets to be included in this status assessment. Failure to follow these methods or collect all information will likely result in return trips and/or collected data being discarded. To assess status of putative conservation populations:

1) Look for and document barriers to fish passage using an FWP Barrier Data Collection Form.

- Focus searches on confined, high gradient canyon sections where natural waterfalls or cascades may form, road crossings, irrigation infrastructure, impoundments, and reaches of natural or anthropogenically influenced intermittent flow.
- Physical barriers generally have at least 6 feet of drop and local conditions (i.e., gradient, substrate, velocity, etc.) may also combine to result in functional isolation. If you are unsure, document any potential isolating mechanisms as fish barriers.
- Potential fish barriers should be documented as such by completing all fields of the FWP Barrier Form (Form 2) and by taking accompanying photos.
- Record barrier location by specifying longitude and latitude using decimal degrees.
- Potential isolating mechanisms should be validated as fish barriers with demographic and genetic population surveys above and below the putative barrier.
- This information will be directly used to define threat status.

2) Identify the distribution (stream miles) of the WCT population.

- Locate the downstream distribution of WCT by electro-fishing presence/absence survey and record the GPS location in decimal degrees. Professional judgement is not an acceptable substitute.
- Locate the upstream distribution of WCT by electro-fishing presence/absence survey and record the GPS location in decimal degrees. Professional judgement is not an acceptable substitute.
- This information will be used to describe threat status, distribution, and abundance.

3) Complete 100-meter depletion estimate(s) using an FWP Electrofishing Data Form.

- Select 100-meter electrofishing sections that are representative of the habitat types where most of the population occurs. Each section should include at least seven of each habitat unit.
- If habitat quality or quantity varies among stream reaches complete a depletion estimate in each reach.
- Measure section length using a GPS odometer or track log and record the top and bottom of the section in decimal degrees.
- Collect and record all header information on the FWP data sheet (Form 3) using a GPS and a water quality meter before you begin backpack electrofishing.
- If a stream is overly wide or deep or has many fish use block nets.
- Adjust the backpack electro-fisher settings based on water conductivity to sample effectively and avoid causing fish injuries.
- A good starting point within the assessment area (i.e., conductivities 100-300 µS) is 300 volts and 20 Hz.
- In higher conductivities use lower voltages and in lower conductivities use higher voltages.
- Adjust voltage and frequency depending on electrofishing efficiency but avoid using more than 600 volts or 30 Hz unless conductivities are very low.

- Try to net all fish, including YOY's. Use extreme care with juvenile fish to ensure they survive the sampling event.
- Capture as many fish as possible on the first pass (preferably 25-50 fish).
- Equal effort (shocking time) should be used on each electrofishing pass, try to slow down on your 2nd and 3rd passes.
- Each time you electro-fish another pass within a section it is less likely to capture fish that have already been missed on previous passes. Conducting more than three passes is not recommended.
- If you capture less than 50% of the fish you captured on the previous pass, the depletion is done.
- This information will be used to calculate population density and size.

4) Collect a minimum of 25 fin clip samples for genetic testing.

- Pre-fill 1-2 ml screw cap vials with 95% **non-denatured** ethanol. Non-denatured ethanol is available at a University Chem Store or online from a variety of companies. Vials available at Fisher Scientific www.fishersci.com Catalog # 02-862-557
- Labels for individual fish can be placed inside or outside the vial. Use an "ethanol safe" pen for labeling the vials on the outside of the tube. Fisher brand Marking Pens will not smear when subjected to water or alcohol. www.fishersci.com, Catalog # S32179. It is best to use pencil on small pieces of paper for vials labeled on the interior. If this is a population study, there is no need to label the individual fish.
- Spread samples out among all age/size classes captured.
- Avoid sampling more than 5 young of the year (YOY's).
- Collect genetic samples throughout the stream's population distribution area; do not collect all samples from a single 100 m depletion section.
- Use nail clippers or scissors for collecting the fin sample. Caudal or pelvic fin clips are preferred.
- The size of the fin clip should be approximately 1-2 times the size of a paper hole punch.
- Place the fin directly into the vial with ethanol. Screw the cap on tightly, and place in a Ziploc bag with the Fish Sample Collection Form (Form 4) for each population.
- It is a good idea to have a few extra vials filled and ready to go (without labels) as a backup in case a vial gets spilled. Carry extra labels or have an ethanol safe pen available to label the vial accordingly.
- Store the fin samples at room temperature.
- Samples should be shipped to:

  University of Montana
  Conservation Genetics Lab
  32 Campus Drive
  DBS - HS 104
  Missoula, MT 59812
  ATTN: Sally Painter

- Questions can be directed to:
  lab phone 406 243 6749 (Sally Painter or Angela Lodmell)
  email: sally.painter@umontana.edu or Angela.Lodmell3@mso.umt.edu

- These samples will be used to assign genetic class.

Form 2. Fish Barrier Documentation Sheet

MONTANA FISH, WILDLIFE AND PARKS BARRIER DATA COLLECTION FORM

Waterbody Name:______________________________**Barrier Location Description :**__________________________________

Lat/Long(up) (Decimal Degrees NAD83)**:**________________/________________**Lat/Long**(down)________________/________________

Date___/____/____ **Observers:**______________________**Name of feature**(e.g. Joe Creek Falls)**:**___________________________

Blockage direction: ❐upstream ❐downstream ❐both ❐unknown

Reason: ❐velocity barrier ❐physical impediment ❐lack of suitable habitat

Origin: ❐manmade ❐natural ❐unknown **Persistence:** ❐permanent ❐temporary or seasonal ❐unknown

Barrier Type: ❐culvert ❐beaver dam ❐concrete dam ❐debris dam ❐earthen dam ❐water diversion (screened? Y/N) ❐cascade ❐waterfall ❐bedrock ❐poor water quality ❐insufficient flow ❐degraded stream and/or riparian habitat ❐ fish culture facility ❐ utility crossing

Barrier height (m):_____________ **Barrier width** (m):_______________ **Barrier length** (m):___________________________
Stream Discharge (cfs):___________ Estimated or Measured? Circle one **Stream wetted width** (m):________
Percent of stream channel obstructed(%):_______________ **Plunge-pool present:** ❐No ❐Yes Pool depth (m)_____
Barrier Gradient (rise/run):_____________ **Velocity top** (m/s):_______________ **Velocity tail** (m/s):_______________

Barrier materials: ❐bedrock ❐rock/boulders ❐metal ❐wood ❐debris ❐soil ❐other____________________________

Fishway present? Y/N **Fishway functioning?** Y/N / Unknown **Fishway Comment:**_____________________________

Fishway type:❐denil ❐step-pool ❐bypass channel ❐vertical slot ❐ ❐other____________

❐installed for conservation purposes **install date:**___/___/___**removal date:**___/___/___ **project name:**_______________

Owner of barrier (if applicable or known)____

Management actions associated with barrier (check all that apply): ❐maintain barrier into perpetuity
❐temporarily maintain ❐modify to allow for limited passage ❐remove
❐strengthen or fortify ❐fish sampling needed - revisit ❐ none ❐ unknown

Species affected by barrier (use numbers from lookup tables to add information, if known and where appropriate)**:**

Species	Blockage extent*	Life stage affected**	Is the feature a barrier to fish migration or movement?	Barrier position◆	Barrier significance+
			❐definitely ❐probably ❐possibly ❐unlikely		
			❐definitely ❐probably ❐possibly ❐unlikely		
			❐definitely ❐probably ❐possibly ❐unlikely		
			❐definitely ❐probably ❐possibly ❐unlikely		
			❐definitely ❐probably ❐possibly ❐unlikely		
			❐definitely ❐probably ❐possibly ❐unlikely		

* **Blockage extent:** 1-Complete, 2-Partial, 3-Intermittent depending on flow, 4-unknown
** **Life stage lookup:** 1- ALL life history stages, 2-juvenile, 3-adult, 4-unknown

◆ **Barrier position lookup:**
1. upstream from current distribution
2. defines upstream end of distribution
3. within current distribution
4. defines downstream end of distribution
5. downstream from current distribution
6. unknown

+ **Barrier significance lookup:**
1. prevents introgression
2. prevents ingress of competing species
3. migration barrier
4. temporarily prevents introgression or ingress of competing species
5. confines population to small area of usable habitat
6. limits or precludes opportunity for refounding
7. limits expression of life history characteristics
8. historically significant
9. unknown

Photo Number(s):____________________________**Other Comments:** ____
____

Barriers Form, Version 3 - Last Updated 09/24/2014

Form 3. Montana FWP Electrofishing Form (Front and Back)

MONTANA FISH, WILDLIFE AND PARKS ELECTROFISHING DATA FORM

Water Name:________________ Section________________ Date ____/____/____

Observers:________________ Purpose________________ Page:_____of ______

Gear: ☐boat ☐boom ☐mobile ☐backpack ☐bank ☐crawdad ☐other__________ Trip Type:☐M☐R Pass# or run#_________

Rectifying Unit: Name:______________ model:____________ Volts: ________ Amps:_________ Shock Time:_________secs

Shocked:☐left bank ☐right bank ☐middle ☐All % Sect. Sampled: __________ Sect. Length:________ Sect. Width:__________

Lat/Long: UP____________/______________ DOWN ____________/______________ Time:Start ____:____ end____:____

Turbidity ______ ☐NTU ☐cm ☐m ☐disk ☐tube ☐meter Time: ____:____ Cond._______ µs Time: ____:____

Water Temp.____° __Time____:____ Discharge __________☐CFS ☐CMS ☐Meas.☐Est.☐USGS____________ Time: ____:____

Fish Measurement Units: L ________W_________ Mark location and type:_____________

	Sp.	L	W	M/C		TAG/ MISC.	Sp.	L	W	M/C		TAG/ MISC.
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												

Did you look for any other: Fish? ☐Yes ☐No Herptiles? ☐Yes ☐No Other spp. ____________________☐Yes ☐No

Sp.____________# obs.__________☐est. Life stage ________Length range:_______to _______Wt range:________to ________

Sp.____________# obs.__________☐est. Life stage ________Length range:_______to _______Wt range:________to ________

Comments:____

____

____Updated 04/05/12 50fishJaeger

DATA FORM INSTRUCTIONS

Water Name: e.g., Blackfoot River **Section:** e.g.: Johnsrud , if it is a new section use stream name and distance upstream from mouth **Date** MM/DD/YYYY

Observers: Name of crew, first & last names or initials-fill out completely when entering in database **Page:** Current page **of** Total # of pages

Purpose: e.g., long-term monitoring (e.g., historic section), experimental (one time), research (related to a project that may last one or more years), pilot study (may be repeated), sub-sampling (work conducted within a long-term monitoring reach), presence/ absence, genetic sample collection, or "other"

Gear: ☐**boom** ☐**mobile** =anode type ☐boat ☐bkpack ☐bank ☐crawdad e.g., tote barge **Trip Type:** ☐**M**= Marking Run ☐**R** = Recapture M and R are only checked if conducting a mark/ recapture estimate **Pass #** could be pass# or run #,e.g., 1st marking run, or 1st pass of depletion estimate

Volts: Average or range **Amps:** Average or range **Shock Time:** From rectifying unit, time of entire survey **secs**

Sect. Length: Length of entire survey section. Include units (m, km, miles) **Sect. Width:** Wetted width, either average or range, include units

Lat/Long: UP_. DOWN_. Up- & down-stream bounds State standard is NAD 83, decimal degrees **Time: Start** e.g., 07:15 **end** 16:46 (total time of the survey, 24 hr)

Turbidity ____ ☐**NTU** ☐**cm** ☐**disk** ☐**tube** ☐**meter Time:** ____:____ (24 hour) **Cond.**________ **µs Time:** ____:____ (24 hour)

Water Temp.____° C or F **Time**____:____ (24 hr) **Discharge** ____☐**CFS** ☐**CMS** (cubic feet per second or cubic meters per second) ☐Meas.☐Est.- describes how discharge was obtained ☐USGS write usgs station name or number here if applicable **Time:** ____:____ (24 hr)

Meas. Units: L __**W**__ unit of measurement for fish (mm, inches, grams, kg, lbs) **Mark location and type:** e.g., upper caudal clip

	Sp.	L	W	M/C		TAG/ MISC.	NOTES	Sp.	L	W	M/C		TAG/ MISC.	NOTES
1														

Sp= species: Use FWP official abbreviations or codes only (see below, also found in Fisheries Little Blue Book). Only use unspecified codes or abbreviations if species cannot be determined, **L**= length (also note method of length e.g., Fork Length or Total Length), **W**= weight, **M/C**= Mark (1) or Unmarked (0) Blank, **TAG**= tag number or color and number. This field could also be used for anything else,
The blank, "Tag" or "Notes" fields can be used for anything, e.g., Hook Scar, genetic samples, mortality, otolith removed, etc... They are user defined.

CODE	NAME	ABBR	CODE	NAME	ABBR	CODE	NAME	ABBR	CODE	NAME	ABBR
000	No Fish Caught	NO FISH	033	Northern Pikeminnow	N PMN	066	Yellow Bullhead	YL BH	119	Trout / Salmon (unknown salmonid)	TR SAL
001	Rainbow Trout	RB	034	Goldeye	GE	071	Brook Stickleback	BR SB	120	Rainbow Trout X Golden Trout Hybrid	RBxGT
002	Cutthroat Trout (unknown cutthroat sub. sp.)	CT	035	Utah Chub	GILA	072	White Bass	W BS	121	Upper Missouri Cutthroat	UMCT
003	Brook Trout	EB	036	Freshwater Drum	DRUM	073	Smallmouth Bass	SMB	122	Native Rainbow Trout	NRB
004	Brown Trout	LL	037	Minnow (unknown cyprinid)	MN	074	Bluegill	BG	123	Cutthroat Trout X Golden Trout Hybrid	CTxGT
005	Bull Trout	BULL	038	Shortnose Gar	GAR	075	Pumpkinseed	PUMP	124	Brook Trout X Bull Trout Hybrid	EBxBULL
006	Lake Trout	LT	039	Longnose Dace	LN DC	076	Green Sunfish	G SUN	125	Cisco	CIS
007	Golden Trout	GT	040	Buffalo (unspecified)	BUFF	077	Black Crappie	BL CR	126	Atlantic Salmon	AL SAL
008	Kokanee	KOK	041	Redbelly / Finescale Dace	NRB/F DC	078	White Crappie	WH CR	130	Mottled Sculpin	M COT
009	Coho Salmon	SS	042	Brassy Minnow	BR MN	079	Rock Bass	R BS	131	Slimy Sculpin (unspecified)	SL COT
010	Arctic Grayling	GR	043	Western Silvery / Plains Minnow	WS/P MN	081	Sauger	SGR	132	Torrent Sculpin	T COT
011	Rainbow X Cutthroat Hybrid	RBxCT	044	Flathead Chub	FH CH	082	Walleye	WE	133	Shorthead Sculpin	SH COT
012	Westslope Cutthroat Trout	WCT	045	Lake Chub	LK CH	083	Iowa Darter	IOWA	134	Spoonhead Sculpin	SP COT
013	Yellowstone Cutthroat Trout	YCT	046	Sturgeon Chub	ST CH	085	Mountain Whitefish	MWF	135	Rocky Mountain Sculpin	RM COT
014	Whitefish (unspecified)	WF	047	Emerald Shiner	EM SH	086	Pygmy Whitefish	PWF	136	Clark Fork Sculpin	CF COT
015	Lake Whitefish	L WF	048	Sand Shiner	SD SH	087	Chinook Salmon	CK SAL	137	Columbia Slimy Sculpin	CSL COT
016	Sculpin (unspecified)	COT	049	Redside Shiner	RS SH	088	Splake (brook trout x lake trout)	SPLK	140	Western Silvery Minnow	WS MN
017	Largemouth Bass	LMB	050	Creek Chub	CR CH	089	Salmon (unspecified)	SAL	141	Plains Minnow	PL MN
018	Bass (unspecified)	BASS	051	Pearl Dace	P DC	090	White Sturgeon	W STRG	142	Finescale Dace	FC DC
019	Sunfish (unk. centrarchid)	SUN	052	Fathead Minnow	FH MN	091	Pallid Sturgeon	P STRG	143	Northern Redbelly Dace	NRB DC
020	Yellow Perch	YP	053	Golden Shiner	G SH	092	Shovelnose Sturgeon	S STRG	144	Peamouth X N Pikeminnow	PEAxNPMN
021	Crappie (unspecified)	CR	054	Sicklefin Chub	SF CH	099	Rainbow Smelt	RB SM	145	Spottail Shiner	SP SH
022	Sauger / Walleye	SAWE	055	River Carpsucker	RC SU	100	Trout-perch	TR PR	146	Peamouth X Redside Shiner Hybrid	PEAxRSSH
023	Nothern Pike	NP	056	Longnose Sucker	LN SU	103	Plains Killifish	PKF	147	Redbelly Dace X Finescale Dace Hybrid	NRBxFCDC
024	Channel Catfish	C CAT	057	White Sucker	W SU	106	Mosquitofish	MQF	148	Northern Pike X Muskie Hybrid	NPxMK
025	Bullhead	BLHD	058	Largescale Sucker	LS SU	108	Sailfin Molly	SFM	149	Sauger X Walleye Hybrid	SGRxWE
026	Burbot	LING	059	Blue Sucker	B SU	109	Shortfin Molly	SHM	150	Golden Trout X Rainbow X Cutthroat Trout Hybrid	GTxRBxCT
027	Sturgeon	STRG	060	Bigmouth Buffalo	BM BUF	110	Rainbow X Westslope Cutthroat Hybrid	RBxWCT	152	Sunfish Hybrid	SUN HY
028	Paddlefish	PF	061	Smallmouth Buffalo	SM BUF	111	Rainbow X Yellowstone Cutthroat Hybrid	RBxYCT	153	Central Mudminnnow	CM MN
029	Peamouth	PEA	062	Shorthead Redhorse	SH RH	112	Variable Platy	VPF	154	Brook Trout X Brown Trout Hybrid	EBxLL
030	Goldfish	GDF	063	Mountain Sucker	MT SU	113	Rainbow X Yellowstone X Westslope Cutthroat	RBYCTWCT	155	Striped Bass	ST BS
031	Sucker (unknown catostomid)	SU	064	Stonecat	S CAT	115	Green Swordtail	GST	156	Gizzard Shad	GZ SHAD
032	Common Carp	CARP	065	Black Bullhead	BL BH	118	Trout (unspecified)	TRT	800	Survey Site Dry	DRY

Did you look for any other Fish? ☐**Yes** ☐**No Herptiles?** ☐**Yes** ☐**No Other spp.** Example: benthic macroinvertebrates ☐**Yes** ☐**No**

Sp.______**# obs.**______☐**est.** check this box if it is an estimate, otherwise it will be considered a "count", could also be qualitative e.g., common.

Life stage Examples: egg, tadpole, metamorphosed frog, larvae, etc... **Length range:** _______**to** _______**Wt**= Weight range: ________**to** ________

Comments: This is a place to record any other sampling event details, notes or observations

Form 4. Genetic Sample Submission Form

Agency: ______________________ Region:_____

Collector: ______________________Phone:______________

Collection Date:___/___/______Target Date: ___/___/______

Hydro unit/Basin:______________________________________

Stream/Lake Name:___________________________________

Purpose for Analysis: Hybridization
Other (specify below or call lab)

Type of Analysis Requested:
(circle one) DNA (fin clips)

Comments:

Suspected Species: ________________

Contact: ______________________ ____________

Number of Fish: __________________

Sample Location:

Longitudinal Sample? ☐ Specify Units_____
Begin______________End_______________

TRS ¼ ¼ : ____

and/or

Lat/Long:____

and/or

River Mile:____

and/or

UTM: Zone___:

x____

y____

Funding source__________________________________

Samples should be shipped to:

University of Montana
Conservation Genetics Lab
32 Campus Drive
DBS - HS 104
Missoula, MT 59812
ATTN: Sally Painter

Questions can be directed to:
lab phone (406) 243-6749 (Sally Painter or Angela Lodmell)
email: sally.painter@umontana.edu or Angela.Lodmell3@mso.umt.edu

If these are rush samples, you must notify the lab before the samples are shipped and the samples must be shipped over night post.

All **samples submitted** to the University of Montana Conservation Genetics Lab **become the property of the University of Montana and will be disposed of using appropriate biosecurity**, unless other arrangements are made in writing prior to submission. Additional fees will apply. The laboratory and the University of Montana are not responsible for improperly submitted samples, mislabeled or inappropriately stored samples.

Appendix 3: Potential WCT Donor Streams

Restoration projects will be re-founded using transfer of live wild fish from genetically unaltered WCT populations within the assessment area such that the donor populations are not adversely affected. To avoid impacts and maximize genetic diversity no more than 20% < 75mm and no more than 10% of >75 mm fish in the donor population should be transferred, 2) transfer should occur over at least two years, 3) fish should be collected from throughout the donor stream, and 4) multiple age classes should be selected. Up to 50 fish may be moved from a donor population each year. All populations used as donors will have genetic samples collected and analyzed prior to transfer and comply with FWP wild fish transfer and fish health policies. The number of fish transferred from a given population will be determined based on the most recent population surveys and project goals. Candidate WCT populations within the assessment area and the results of recent surveys that inform their suitability as donors are described below in Table 21.

Table 21. Demographic, genetic, fish health, and AIS sampling results from potential WCT donor streams.

WCT Donor Stream	Pop. Est. (Year)	Threat Status	Genetic Class	Most Recent Genetics Sample (Sample #)	Most Recent Fish Health Sample (result)	Most Recent AIS Sample (+/-)
Brays Canyon Creek	1559 (2018)	Protected	Unaltered	8/14/2017 (4891)	7/18/2016 (-)	NA
Buffalo Creek	2140*/1261 (2018)	At-Risk	Mixed	8/21/2018 (Awaiting Results)	NA	NA
Cottonwood Creek	4039*/521 (2017)	At-Risk	Mixed	8/23/2017 (4889)	7/26/2016 (+ M. cerebralis)	NA
Jake Canyon Creek	3298* (2018)	Secured	Mixed	8/22/2018 (Awaiting Results)	7/24/2017 (-)	NA
Reservoir Creek	767 (2017)	At-Risk	Unaltered	7/27/2017 (4925)	NA	NA
Stone Creek	2060* (2018)	At-Risk	Mixed	7/17/2018 (Awaiting Results)	4/1/2005 (+ R. salmoninarum)	NA
Bear Creek (Cent.)	612 (2018)	At-Risk	Unaltered	9/19/2006 (3415)	NA	NA
Browns Creek	2615 (2017)	At-Risk	Unaltered	8/22/2017 (4886)	7/19/2016 (-)	NA
Meadow Creek	941 (2017)	At-Risk	Unaltered	8/23/2017 (4890)	7/76/2016 (-) * henneguya sp. spores detected in heads	NA
Painter Creek	1505 (2017)	Protected	Mixed	8/22/2017 (4888)	7/19/2016 (-)	NA
Simpson Creek	966 (2017)	At-Risk	Unaltered	7/26/2017 (4928)	NA	NA
Jack Creek	797 (2018)	Protected	Unaltered	8/22/2017 (4887)	NA	NA

* Represents estimates that include mixed populations (genetically unaltered and altered WCT within the same stream.

Appendix 4: FWP Wild Fish Transfer Policy

All transfers of WCT must be approved by the FWP Fisheries Division Administrator and conform with the FWP Wild Fish Transfer Policy. Decisions regarding wild fish transfers will be made at quarterly (January, April, June, October) Aquatic Health Advisory Committee meetings. To be considered, a project must have a completed FWP Wild Fish Transfer Form and all applicable fish health and AIS testing completed prior to the meeting. Disease and AIS testing may take up to 12 months to complete; advance planning is needed and expected.

The FWP Wild Fish Transfer Policy and Wild Fish Transfer Form are included on the following page and should be read in detail before considering a transfer.

POLICY
MONTANA FISH, WILDLIFE & PARKS
FISHERIES BUREAU

ISSUED 4/18/96	REVISED 4/18/12
APPROVED BY: Bruce Rich, Fisheries Bureau Chief	

TITLE: WILD FISH TRANSFER POLICY

SUBJECT: FISH STOCKING

PURPOSE:
This policy has been prepared to ensure that movement of wild fish by Montana Fish, Wildlife and Parks (FWP) personnel is compatible with overall stewardship of Montana's fishery resources.

RELATED STATE STATUTES/ADMINISTRATIVE RULES:
87-5-713

GENERAL:
The procedures associated with this policy are intended to prevent the transfer of fish pathogens and aquatic invasive species when moving fish for management purposes.

POLICY:
This policy, along with its standard operating procedures, will apply to all wild fish transfers (including eggs) within the State by FWP personnel. Employees of other agencies and entities who need to move fish within the State must work through the appropriate fisheries management staff and must follow the same procedures.

All wild fish transfers need to be approved by the Fish Health Committee (FHC), Aquatic Invasive Species (AIS) Coordinator, Regional Fisheries Manager, Fisheries Management Section Supervisor and Fisheries Bureau Chief. The role of the FHC is an advisory Board to make recommendations to the Fisheries Bureau Chief on fish transfers. The intent of this policy is to ensure that the risks of moving fish pathogens or aquatic invasive species are evaluated and minimized.

Testing Requirements.
Oversight of FWP's disease testing procedures is the responsibility of the fish health committee and the State Fish Health Coordinator. FWP's AIS Coordinator is responsible for oversight of the AIS program and conducts AIS inspections.

It is FWP's policy that all live fish movements will be preceded by both a fish health inspection and an aquatic invasive species inspection, as detailed by FWP fish health policy. A standard sample size for a fish health inspection is 60 fish of the target species to be moved. An aquatic invasive species inspection must by conducted by AIS program personnel when water temperatures are above 50° F. AIS inspections are not required for transfers of eggs. Deviations from these standards will be considered by the fish health committee on a case-by-case basis. Guidelines that will be used by the fish health committee to help determine the number and frequency of required tests on donor populations can be found in Appendix A.

Procedures
The attached wild fish transfer approval form is to be completed and approved by the fish health committee prior to any transfer of wild fish by fisheries management personnel. This form, along with information described in the appendices, is intended to collect necessary information needed to evaluate wild fish transfer proposals and also ensures that a centralized record of all wild fish transfers is maintained by FWP.

Note: Fish moved relatively short distances and placed in areas where they would normally have free access to are exempt from this policy. Examples would be fish entrained in irrigation ditches and dewatered streams that are being salvaged. Only regional approval is necessary for these fish movements. In order to maintain a record of these transfers, post-transfer reporting requirements must be met by submitting: a wild fish transfer form and a record of all fish (species and number) moved to the fish health coordinator, and a planting ticket to the fisheries section administrative assistant.

Wild fish transfers of non-salmonid fish, occurring in the Eastern Fishing District (portions of Regions 4 and 5 and all of Regions 6 and 7) will comply with the following modified procedures.

1) **All live fish movements will be preceded by both a fish health inspection and an aquatic invasive species inspection of the source body of water, as detailed by FWP fish health policy**.

2) **If the wild fish transfer satisfies all of the following criteria, no approval is required by the Fish Health Committee and the Regional Fish Manager is free to authorize the transfer**:

    a) Fish Health Inspection report of the donor species in question is free of pathogens or pathogens found are deemed by the Fish Health Committee to be low/no risk organisms.

    b) An aquatic invasive species inspection has been completed and no significant organisms have been detected, as determined by the AIS Coordinator.

    c) The Wild Fish Transfer proposal is intra-regional and no wild salmonids are present in the donor or recipient waters.

    d) MEPA requirements are met

    e) Copy of the WFT form is sent to the Fish Health Coordinator for filing

    f) Post transfer reporting requirements must be met by submitting a record of all fish (species, number) moved should be sent to the Fish Health Coordinator for filing.

    g) Planting ticket must be sent to the Fisheries Section Administrative Assistant.

Transfer proposals should be submitted well in advance of the planned transfer date. Depending on the transfer, disease and AIS testing may take up to 12 months to complete, as provided by FWP Fish Health Policy. It is the responsibility of applicants to plan accordingly and allow sufficient time for disease and AIS testing and the review process.

APPENDIX A
Guidelines for Determining the Number and Frequency of Fish Health and AIS Inspections

Any time fish or eggs are moved from one location to another, there is a risk of moving undesirable organisms along with them. Fish health and AIS inspections are tools that we have to help manage those risks. In order to use those tools most effectively, we must understand both the benefits of having the information they provide, as well as their inherent limitations. An inspection is somewhat of a snapshot in time that gives us a better feel for what organisms may be present in a body of water. It is important to recognize that the presence of organisms, as well as our ability to detect them, is a dynamic process that can and does change over time. From a general standpoint, inspections have historically been considered valid for up to one year. From a practical standpoint, they are only good until a new harmful organism is introduced into that water. There are a variety of characteristics, or risk factors that can impact the chances that harmful organisms are introduced into a body of water and could be subsequently be spread along with the transfer of fish. These characteristics are numerous and will vary greatly between different water bodies.

In order to more fully understand and mitigate the risks of moving potentially harmful organisms in these fish transfers, it is prudent to consider some of these characteristics, in addition to just conducting inspections, when evaluating wild fish transfer proposals.

These factors include (in no particular order):

- species composition
- presence of salmonids
- species being moved
- size of the water body
- relative proximity to other water bodies
- water source (ie. perenniel or intermittent stream, run-off, etc.)
- connectivity to other waters
- proximity of water body to urban areas
- amount of angling pressure
- angler demographics (resident vs. non-resident)
- use of live bait
- level of boat use
- distance between donor and recipient waters
- fish health and AIS testing history

These characteristics will be used to rank the various water bodies based on their relative level of risk of containing and spreading harmful organisms. Since annual sampling of all fish sources is not practical, guidelines are offered as to the frequency of sampling of the various categories. As a very rough guideline, three levels of risk should be considered.

High risk waters

- Would require annual fish health and AIS sampling
- Characteristics – larger size, close to population centers or heavy angler use, especially non-resident anglers, heavy boat traffic, open system that connects to other water bodies.
- Examples – Tongue River Reservoir, Ft Peck Reservoir, Nelson Reservoir and Fresno Reservoir

Medium risk waters

- Would require testing every 2-3 years
- Characteristics – smaller to medium size, somewhat isolate but still receive moderate boat traffic and angler use,
- Examples – South Sandstone Reservoir, Cow Creek Reservoir

Low risk waters

- Would require testing every 4-5 years
- Characteristics – small, isolated ponds, no salmonids present, relatively low angler use, little or no boat traffic, fairly close proximity to receiving water.
- Examples – characteristic of ponds generally found in the Eastern Fishing District.

These Water Body Risk Criteria are guidelines. This will be a subjective process and the ability to identify and quantify these characteristics will, at times, be challenging. However, we would be remiss to not consider them in the decision making process. Various waters will possess combinations of the aforementioned characteristics and it will be difficult to assess the relative risks between them. Regional fisheries personnel will be relied on to provide data and knowledge relating to the various water bodies involved in order to facilitate discussion and make decisions.

FWP policy stipulates that no fish will be moved from sources that have not been tested for fish pathogens and aquatic nuisance species. This information is intended to be discussed by the fish health committee when an application for fish transfer is made in order to provide important feedback to regional personnel for use in planning future wild fish transfers as well as determining any additional precautions that may be necessary, as outlined in Appendix B.

APPENDIX B
Protocols and Guidelines for Wild Fish Transfers

It is recognized that there are additional precautions that can be taken to further reduce the likelihood of moving unwanted organisms while moving wild fish for management purposes. Due to the endless variations in circumstance surrounding these transfers, such as locations, equipment, personnel, etc., it is difficult to develop a one-size-fits-all protocol. The use of pathogen free water is a requirement on all transfers, and additional suggested measures should be taken when it is practical to do so.

Required Measure

Water supply –Pathogen-free water obtained from closed water supplies such as springs or wells must be used for hauling fish. Surface waters from the donor source must not be utilized. Water from any State fish hatchery should be considered an optimal source. Use municipal water supplies with caution as they usually contain chlorine. When approved by the Regional Fisheries Manager, water from the receiving water may be used for hauling fish.

Suggested Measures

Use of hatchery equipment – The use of hatchery equipment to conduct wild fish transfers poses additional risks of bringing harmful organisms into the State hatchery system and is strongly discouraged. The use of hatchery trucks for hauling wild fish is at the discretion of individual hatchery managers.

Care of equipment – All equipment used to conduct wild fish transfers should be thoroughly cleaned and dried between uses. If complete drying is not possible, chemical disinfection such as bleach, quaternary ammonias, Virkon Aquatic™, etc. should be a priority. Please contact the fish health lab for specific information or to procure disinfectants.

WILD FISH TRANSFER FORM

Montana Fish, Wildlife & Parks

A wild fish transfer form must be completed for each request to transfer any fish from any water in Montana to another water in Montana

Mail completed form to:
Fish Health Lab
Montana Fish, Wildlife and Parks
4801 Giant Springs Road
Great Falls, MT 59403

Date: ______________________________

I. Stocking Request

Species: ______________________________

Number and size to be stocked: ______________________________

Stocking objective: ______________________________

Proposed collection method and date: ______________________________

Will hatchery system equipment be involved in transfer? ______________________________

_______ Yes _______ No If yes, describe equipment and hatchery role:

II. Collection Site

Name of Water: ______________________________

Region: ______________________ County: ______________________

Legal Description: ______________________________

Water Code: ______________________ Drainage: ______________________

Fish species composition: ______________________________

Describe any know disease or parasite concerns: ______________________________

Have fish been collected and transferred from this water before? ______________________________

III. Stocking Site

Name of Water: ______________________________

Region: ______________________ County: ______________________

Legal Description: ______________________________

Water Code: ______________________ Drainage: ______________________

Fish species composition: ______________________________

Describe any known disease or parasite concerns: ______________________

Has the proposed species been stocked in this water before? _______ Yes _______ No

IV. Summary of Transfer Type

Species	Salmonids Present in donor water?	Salmonids present in receiving water?
_______ Salmonid	_____ Yes	_____ Yes
_______ Non-salmonid	_____ No	_____ No

Are donor and receiving water within the same region? _____ Yes _____ No

Is an EA required? (if yes, attach to form) _____ Yes _____ No _____

Date of last fish health inspection: ______________________

Date of last Aquatic Invasive Species inspection: ______________________

Will proposed transfer impact any species of special concern of threatened/endangered species?
(if yes, describe impacts and submit form for Division approval) _____ Yes _____ No

V. Approval

Project Biologist ______________________

Area Management Biologist: ______________________

Regional Fisheries Manager: ______________________

State Fish Health Coordinator: ______________________

Aquatic Invasive Species Coordinator: ______________________

Fish Management Bureau Chief: ______________________

____

Date Received: ____________ WFT No: ______________________

Appendix 5: WCT Transfer Protocol

The following protocols were developed to maximize survival of wild WCT being transferred from donor populations to restoration projects. These protocols should be followed for any wild fish transfer. Prior to transferring live fish ensure that FWP has approved the transfer and all applicable fish health and AIS sampling has been completed.

Equipment needed:

- Cooler with four aerators firmly attached
- Extra D cell batteries
- Extra aerators with hardware to attach/remove
- Two ratchet straps per cooler
- Ice bags
- Large internal frame packs
- O_2 tank
- O_2 tank hoses
- Electrical tape
- Heavy duty garbage bags
- Milk Cans with aerators
- Thermometer or multimeter

<u>Instructions for packing fish with O_2:</u>

1) Put one garbage bag inside another one
2) Put in external frame pack
3) Add about four gallons of water
4) Measure stream temperature
5) Add ice to reduce temperature to 6-8 C (43-47 F) <u>but by no more than 5 C total</u>
6) Put no more than 25 fish in the bag
7) Attach a tube to the nipple on the regulator of the O_2 tank
8) Turn on O_2 tank (handle at the top of the tank)
9) Insert the tube in the bags and work all air out by holding the top tightly
10) Turn the O_2 regulator on and inflate bag to the top of the pack
11) Turn off O_2 tank
12) Hold bag tightly closed and remove tube
13) Tie bag top in knot, double tag end on its self, wrap tightly with electrical tape

<u>Instructions for moving fish in coolers:</u>

1) Add water to cooler and test all aerators
2) Add water to a milk can in case of spills in transit
2) Measure stream temperature
3) Add ice to reduce temperature to 6-8 C (43-47 F) <u>but by no more than 5 C total</u>
4) Put no more than 50 fish in the cooler
5) Strap cooler shut with at least two straps and strap into back of truck
6) Check water temperatures and levels every hour
7) When arriving at release site, slowly acclimate fish to new water by removing part of a bucket from cooler and replacing with recipient stream water.
8) **<u>Do not dump any water from donor stream into the recipient stream.</u>**

Appendix 6: Unaltered WCT Heterozygosity (He) Table

The mean and standard deviation of average expected heterozygosity (He) for this set of populations are 0.036 and 0.024, respectively. Populations with He that is below 1 standard deviation of the mean (0.012) will be considered as potential candidates for genetic rescue. At this time two populations, Bear and Ramshorn creeks, are below this threshold. Genetic rescue plans (i.e., donor source, number of fish transferred, duration, etc.) will be developed on a case-by-case basis.

Table 22. Average expected heterozygosity (He) estimated from 93 SNP loci in 30 samples of what appear to be non-hybridized Westslope Cutthroat Trout collected east of the Continental Divide (A. Whitely, unpublished data).

Unaltered WCT He in Beaverhead, Red Rock, and Ruby Sub-basins

Stream	He	% of Avg. He (0.036)	Sample Number	# Fish in Recent Sample (Total Samples Collected)
Alkali	0.048	+33%	4874	25 (50)
Bean	0.022	-39%	4808	25 (114)
Bear	0.007	-81%	4809	25 (88)
Brays Canyon	0.021	-42%	4891	50 (240)
Browns	0.105	+192%	4886	52 (237)
Buffalo	0.035	-3%	4876	25 (25)
Cottonwood	0.018	-50%	4889	50 (298)
Craver	0.033	-8%	4926	25 (70)
EF Clover	0.059	+64%	4449	10 (10)
Jack	0.024	-33%	4887	49 171)
Meadow	0.049	+36	4890	50 (165)
NF Everson	0.033	-8%	4869	28 (81)
Painter	0.065	+81%	4888	60 (197)
Ramshorn	0.003	-100%	4927	25 (97)
Reservoir	0.022	-42%	4925	25 (106)
SF Everson	0.023	-36%	4870	27 (81)
Simpson	0.030	-16%	4928	25 (117)
Stone	0.047	+31%	4930	26 (26)

Appendix 7: WCT Conservation Population Genetic Monitoring Schedule

WCT conservation populations, especially those classified as at-risk, should be resurveyed and genetic class confirmed or updated every 10 years. The genetic monitoring schedule for the assessment area is described in Table 23. In 2019, 675 samples should be collected from 27 populations, which will cost $27,000 ($40/sample).

Table 23. Genetic monitoring schedule for conservation populations within the assessment area.

2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Farlin	Dyce	EF Clover	Taylor		Cat	Long	Alkali	Brays	Muddy
French	SF Everson	Middle (R. R.)	Teddy		Rock (Bvhd.)	Rock (R. R.)	NF Everson	Cottonwood (BH)	Buffalo
Pole		Price	Bean		Stone	Sage	Rape	Jake Canyon	Jack
Basin (R.R.)		Cottonwood (Ruby)	Little Sheep		Harris			Reservoir	
Bear (R.R.)		Idaho	Odell		Sweetwater			Browns	
Bear (R.R.)			Peet					Craver	
Cabin			Coal					Meadow	
Deadman			Greenhorn					Painter	
East			Peterson					Simpson	
Jones								Ramshorn	
Little Basin									
Middle (R.R.)									
Nicholia									
NF Divide									
Sawmill									
Sheser									
Shineberger									
Trapper									
Basin (Ruby)									
California									
Corral									
Divide									
Indian									
Mill									
Nugget									
Robb									
Wisconsin									