Duck Creek

Wild Eagle Mountain Ranch

Initial Project Assessment

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Executive Summary

Duck Creek is a tributary watershed of the Yellowstone River located near Springdale, Montana. Although no data were available to confirm fish community composition, portions of the watershed apparently support Yellowstone cutthroat trout, one of Montana's native trout, and a species of special concern. This report documents observations on the potential of Duck Creek and East Fork Duck Creek to support resident and migratory Yellowstone cutthroat trout, and provides recommendations to improve existing conditions.

Small stream fisheries are largely dependent on the health and function of their streamside vegetation or riparian areas. Diverse, healthy riparian zones maintain water quality and habitat features critical to fish. Disruption of riparian cover and function is detrimental, resulting in warm water temperatures, streambed sedimentation, and loss of critical pool and channel margin habitat. Assessments focused on the status of riparian vegetation and the associated condition of instream habitat quality and channel stability.

Evaluations of East Fork Duck Creek and Duck Creek identified a range of riparian and stream habitat conditions. Much of East Fork Duck Creek was in excellent shape, although some reaches showed evidence of riparian degradation, which resulted in localized areas of bank erosion. Over use of riparian areas, along with trampling, was a considerable constraint on habitat and water quality on the lowest reach of Duck Creek, resulting in conditions unfavorable to resident or spawning, migratory trout. An invasive, non-native grass species was another observed threat to riparian health on Duck Creek, and was likely inhibiting reproduction of trees and shrubs.

Several options are available to address impaired segments. Development of site-specific grazing management strategies is a broadly applicable solution. Numerous approaches are available in development of a tailored plan, but all control the distribution of livestock within a pasture, promote healthy and vigorous vegetative communities, and provide sufficient rest between periods of grazing. Plan development typically involves technical assistance from rangeland and grazing experts, and incorporates the livestock manager's forage production objectives and other management logistics. Other alternatives include riparian plantings, stabilization of stream banks, and channel restoration. Development of a specific approach is beyond the scope of this preliminary assessment; however, FWP's Yellowstone cutthroat trout restoration biologist will work with interested landowners in development of detailed plans.

A second objective of this assessment was to evaluate the potential for Duck Creek to support a spawning run of Yellowstone cutthroat trout from the Yellowstone River. Yellowstone cutthroat trout are exceptionally rare in this reach of the Yellowstone, with a lack of tributary spawning habitat being a limiting factor. Currently, high levels of sediment on the streambed, and irrigation withdrawals, preclude establishment of a spawning run in Duck Creek. Nonetheless, channel restoration, grazing management, and increasing stream flows through cooperative agreements with irrigators could reverse

these conditions. FWP would then imprint Yellowstone cutthroat trout fry on Duck Creek to jumpstart a spawning run. As Yellowstone cutthroat trout hybridize with rainbow trout, FWP may consider installing a structure at the mouth of Duck Creek, which would allow selective passage of Yellowstone cutthroat trout.

The irrigation canal crossing Duck Creek presents several conservation concerns. Notably, the canal captures most of the flow of Duck Creek, and potentially entrains resident fish. In addition, the diversion structure is likely a barrier to fish moving upstream. Often, fish barriers are desirable in native species conservation as they prevent invasion of competing species such as brook trout, or closely related species such as rainbow trout, which hybridize with Yellowstone cutthroat trout. Solutions to addressing entrainment, dewatering, and fish passage will require additional investigation. Important stakeholders in this effort must include irrigators and the Hunter's Hot Springs Canal Company. FWP has been working on similar projects statewide to promote fish friendly irrigation structures, while protecting water rights.

1.0 Introduction

Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), a species native to Montana, has experienced declines in abundance and distribution throughout its historic range. Seeking to reverse this trend on private lands, the Landowner Incentive Program/Yellowstone Cutthroat Trout project (LIP/YCT) assists private landowners seeking to improve habitat for Yellowstone cutthroat trout on their property. This report, or project assessment, documents preliminary evaluations for potential projects on Duck Creek, a tributary of the Yellowstone River near Springdale, Montana. The objectives of the project assessment are to describe relevant literature and data, describe existing conditions and potential, and provide recommendations to landowners. If landowners agree to proceed with conservation activities, Montana Fish, Wildlife & Parks' Yellowstone cutthroat trout restoration biologist will provide technical, financial, and planning assistance to implement restoration activities on these private lands.

2.0 Project Background

The Duck Creek drainage is a small tributary watershed of the Yellowstone River located near Springdale, Montana (Figure 2-1). The Wild Eagle Mountain Ranch is among the major landowners with holdings throughout the watershed. Most of East Fork Duck Creek's 15 stream miles flow through the Wild Eagle Mountain Ranch, as does a small length of Duck Creek near its confluence with the Yellowstone River. This assessment focuses on these two streams.

On July 2, 2007, FWP's Yellowstone cutthroat trout biologist met with Whitney McMillan, owner of the Wild Eagle Mountain Ranch, to discuss opportunities to promote Yellowstone cutthroat trout on his working cattle ranch. Mr. McMillan has a long history of improving habitat quality on this property, dating back to the 1980s. These efforts have focused largely on the upper reaches of East Fork Duck Creek, and include actions such as increasing quantity and quality of pool habitat, which is naturally limited in this high gradient reach. Mr. McMillan was interested in ideas for promoting Yellowstone cutthroat trout conservation that will be compatible with his agricultural operation and privacy.

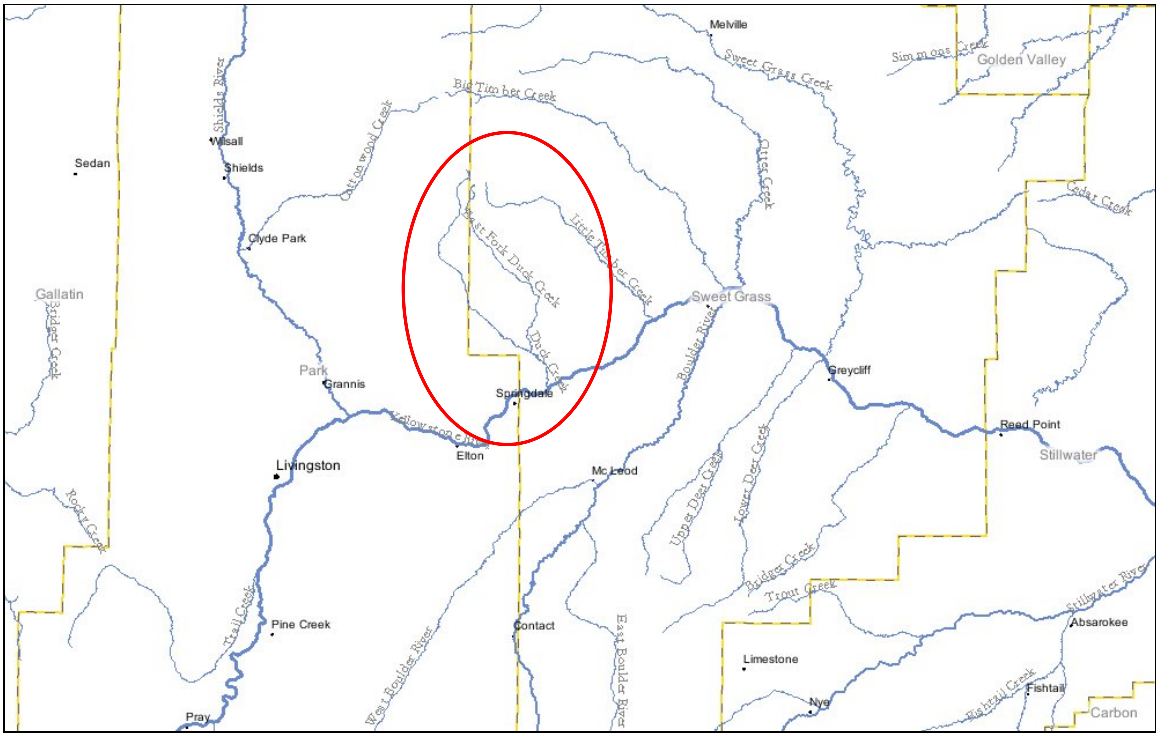

Figure 2-1: Overview of Duck Creek watershed showing its location in the larger watershed.

3.0 Fisheries Data Review

Pertinent information for the Duck Creek watershed comes from a variety of sources, including FWP's fisheries database and monitoring reports. Another source of information is a draft conservation strategy for Yellowstone cutthroat trout in the Shields River watershed, which will provide the model for Yellowstone cutthroat trout conservation planning throughout Montana. The developing plan emphasizes promoting connectivity, reducing entrainment in irrigation ditches, improving and restoring habitat quality, and conducting studies to improve understanding of the life history strategies of Yellowstone cutthroat trout in Montana's streams. These components of the draft plan informed the approach to field evaluations and development of recommendations.

Review of FWP's database indicates quantitative fish data are lacking for streams in the Duck Creek watershed. In absence of formal fish sampling information, FWP's biologists made professional best judgments on composition of a stream's fishery. Yellowstone cutthroat trout were presumed present but rare in both Duck Creek and East Fork Duck Creek (Table 3-1and Table 3-2). Rainbow trout, brook trout, and brown trout, all introduced species, were potentially common in the basin's waters. Jim Lovell, a stream restoration specialist for Confluence Incorporated, confirmed presence of Yellowstone cutthroat trout in the upper reaches of East Fork Duck Creek, in addition to brown trout. His observations date from the late 1990s.

Table 3-1: Fisheries data available for Duck Creek (Montana Fisheries Information System [MFISH]).

Species	***Scientific Name***	***Abundance***	***Water Use***	***Data Quality***
Brown trout	*Salmo trutta*	common	Year-round resident	No survey, professional judgment
Rainbow trout	*Oncorhynchus mykiss*	common	Year-round resident	No survey, professional judgment
Yellowstone cutthroat trout	*O. clarki bouvieri*	rare	unknown	No survey, professional judgment

Table 3-2: Fisheries data available for East Fork Duck Creek (MFISH)

Species	***Scientific Name***	***Abundance***	***Water Use***	***Data Quality***
Brook trout	*Salvelinus fontalis*	common	Year-round resident	No survey, professional judgment
Yellowstone cutthroat trout	*O. clarki bouvieri*	rare	unknown	No survey, professional judgment

The apparent persistence of Yellowstone cutthroat trout in the Duck Creek drainage sets it apart from other streams downstream of the Shields River watershed. Yellowstone cutthroat trout are increasingly rare proceeding east in tributaries of the Yellowstone River (Figure 3-1). Conserving Yellowstone cutthroat trout in the Duck Creek watershed is a desirable outcome for native species conservation.

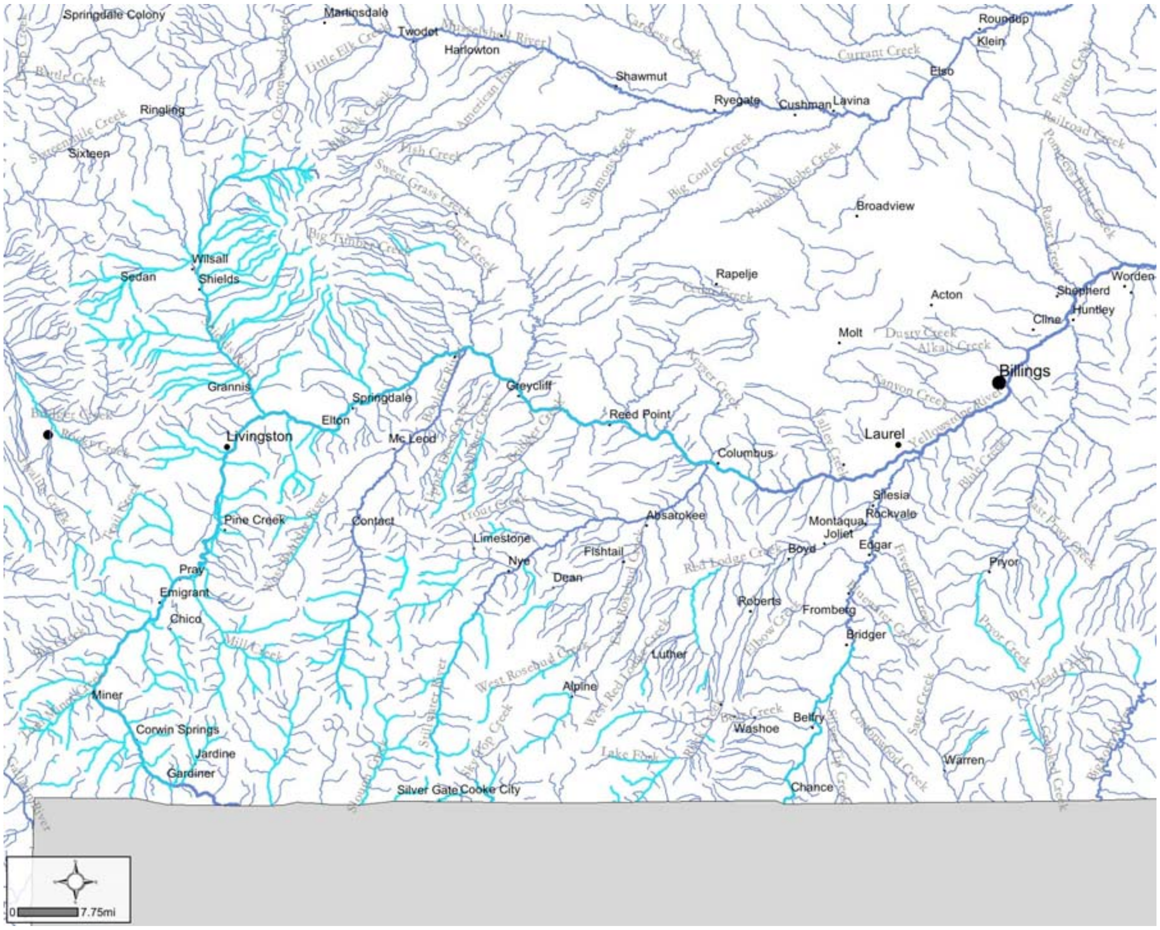

Figure 3-1: Distribution of Yellowstone cutthroat trout in the Yellowstone River watershed. (Streams known or presumed to support Yellowstone cutthroat trout are in aqua).

As a tributary to the Yellowstone River, Duck Creek has potential to provide a spawning area for migrant Yellowstone cutthroat trout. Long-term monitoring in the Yellowstone River has found a decline in the abundance of Yellowstone cutthroat trout, especially from Livingston through Springdale. Sampling efforts over the past five years have found too few Yellowstone cutthroat trout to calculate a population estimate (Opitz 2006). A lack of spawning areas is among the causes of the decline of Yellowstone cutthroat trout.

4.0 Assessments

4.1 Aerial Photo Assessments

Given the spatial extent of the Wild Eagle Mountain Ranch, walking the entire length of stream was infeasible. Instead, aerial imagery from the National Agriculture Imagery Program (NAIP 2005) provided a means to characterize conditions across the landscape, and delineate stream reaches based on apparent riparian condition, stream morphology, and channel stability. The field assessment component involved visiting a subset of reaches identified in the aerial photo assessment, allowing the observer to ground-truth observations made from aerial imagery.

4.1.1 Duck Creek

At its lower end, Duck Creek flows through the Wild Eagle Mountain Ranch from County Road 21 to its confluence with the Yellowstone River (Figure 4-1). The Hunter's Hot Spring Canal flows through this portion of the Wild Eagle Mountain Ranch and intercepts Duck Creek just below County Road 21. Given the potential to restore a spawning run of Yellowstone cutthroat trout in Duck Creek, this relatively small portion of the Wild Eagle Mountain Ranch garnered considerable scrutiny.

Based on aerial imagery and a preliminary field visit, this length of Duck Creek was delineated into two reaches (Figure 4-1). A fence line effect, differences in riparian condition and stream stability relating to pasture management, was apparent in the field (Figure 4-2), resulting in demarcation of these two reaches. Overall, aerial imagery showed a narrow band of widely spaced cottonwoods in both reaches, with no indication of recent cottonwood reproduction. Likewise, herbaceous ground cover was sparse, especially in reach 1 (Figure 4-3). Low vegetative cover has likely contributed to bank erosion, channel widening, and sedimentation.

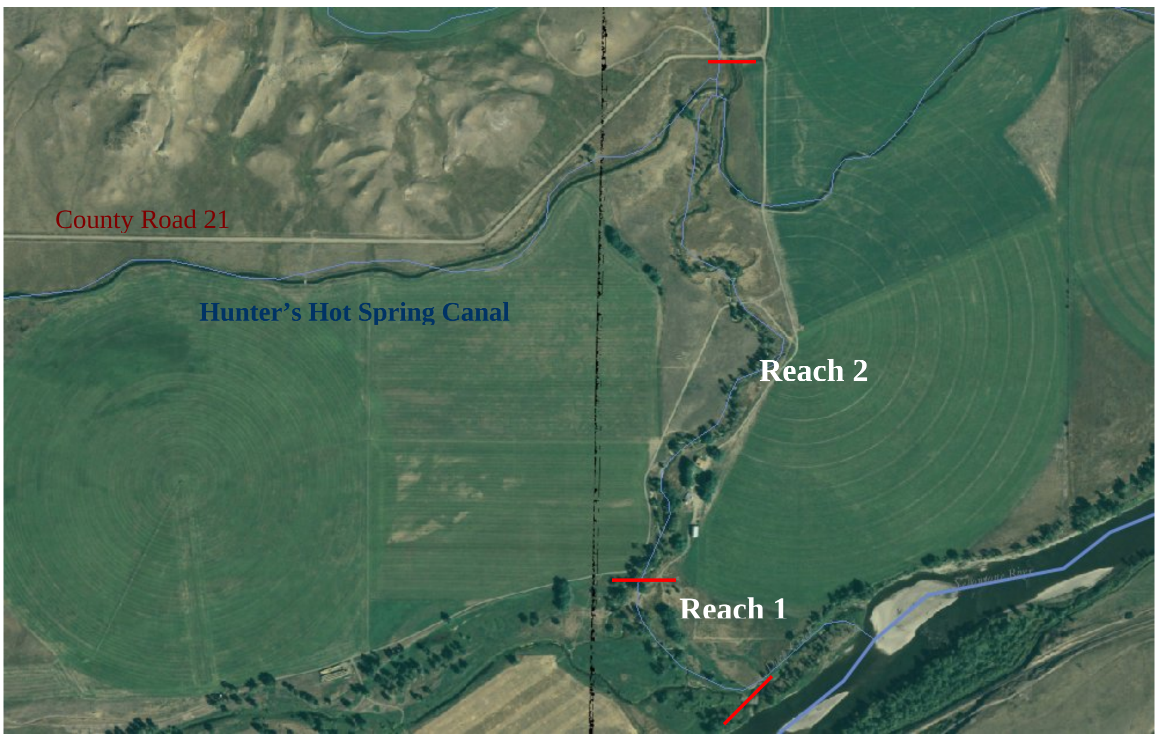

Figure 4-1: Duck Creek flowing through the Wild Eagle Mountain Ranch at its confluence with the Yellowstone River.

Figure 4-2: Fence line forming the boundary between reaches 1 and 2 on Duck Creek. Note tall grass on the upstream side of the fence.

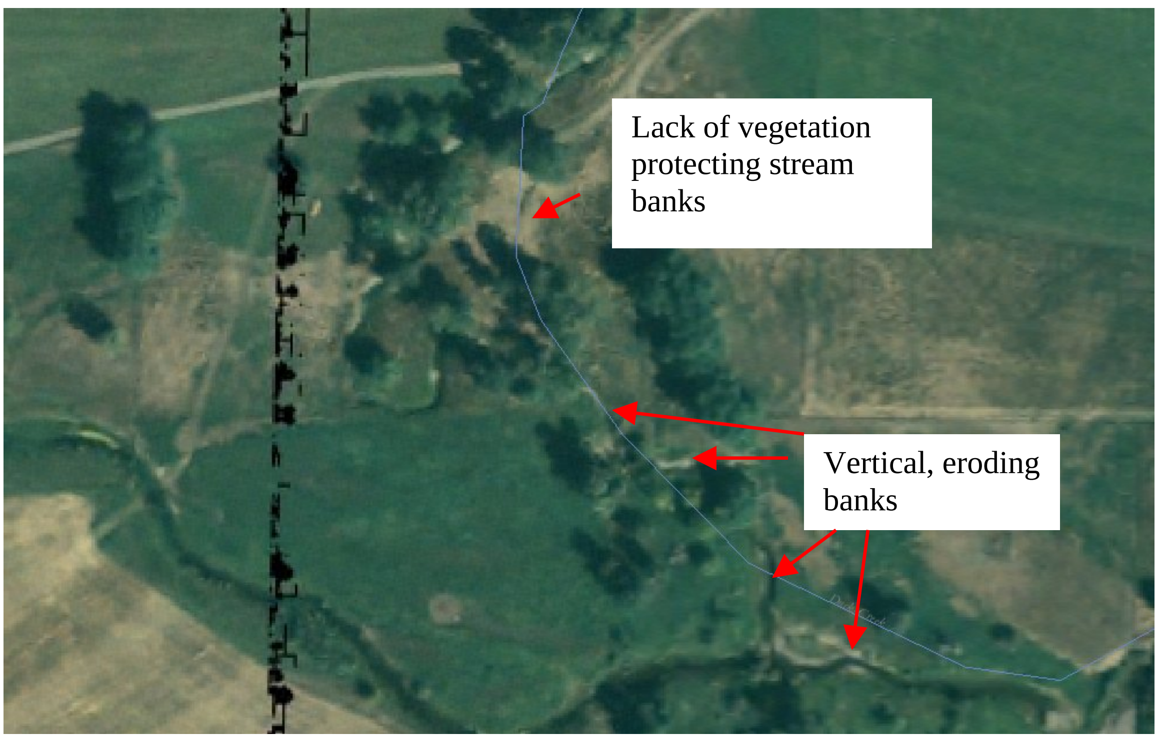

Figure 4-3: Close-up of reach 1 showing sparse herbaceous cover and bank erosion.

4.1.2 East Fork Duck Creek

East Fork Duck Creek flows through ten sections on the Wild Eagle Mountain Ranch. Assessment of aerial imagery indicated a range of riparian and stream channel conditions, with the majority having apparently intact riparian health and function, and stable stream morphology. Nevertheless, review of aerial photos identified several reaches where streamside management or restoration could have a beneficial influence on fisheries.

Beginning at the downstream end of East Fork Duck Creek, the Wild Eagle Mountain Ranch begins in section 26 of T1NR12E (Figure 4-4 and Table 4-1). Four reaches were delineated in this section with riparian condition, evidence of bank erosion, and topographical confinement being the defining features. Low cover of woody vegetation and eroding banks were significant characteristics in reach 1, and these perturbations are likely sources of fine sediment to the system. Woody riparian vegetation also appeared to be limited in reach 2; however, aerial photos did not show obvious areas of eroding banks. Apparent topographic confinement contributed to a narrow bank or riparian vegetation in reach 3, making conditions here natural. Reach 4 opened into a relatively wide floodplain, vegetated with dense stands of woody vegetation, which is consistent with a healthy stream and productive fisheries.

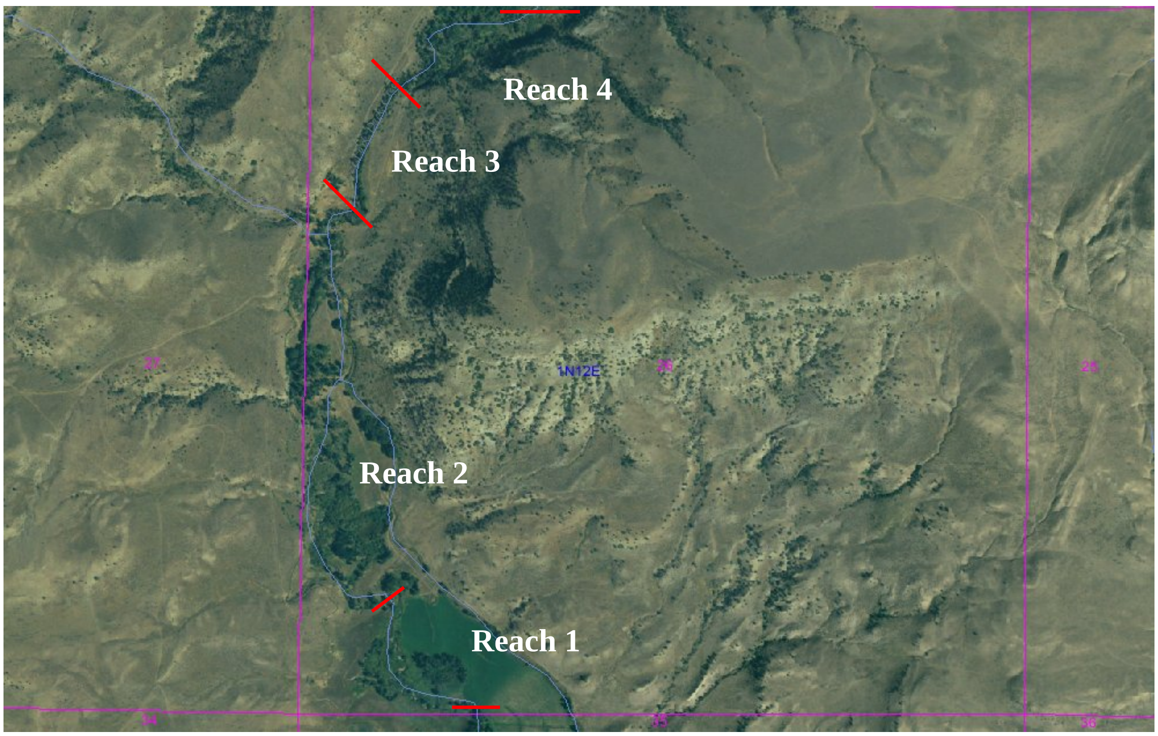

Figure 4-4: Map of T1NR12E Section 26 showing delineated reaches.

Table 4-1: Summary of observations for reaches delineated in the aerial photo assessment for East Fork Duck Creek.

Legal Description	*Reach*	*Potential Impairments*	*Dominant Vegetation*	*Potential reference reach?*	*Comments*
T1NR12ES26	1	Eroding banks, riparian degradation	Herbaceous	No	Point bar development
T1NR12ES26	2	Riparian degradation	Herbaceous	No	Unnamed tributary entering within this reach
T1NR12ES26	3	None	Cottonwoods	Yes	Reach is topographically confined
T1NR12ES26	4	None	Shrubs/cottonwoods	Yes	Relatively wide floodplain
T1NR12ES23	5	None	Shrubs/cottonwoods	Yes	Relatively wide floodplain
T1NR12ES23	6	None	Shrubs/cottonwoods	Yes	Topographically confined
T1NR12ES23	7	Riparian degradation	Herbaceous	No	
T1NR12ES14	8	Eroding banks, riparian degradation	Herbaceous	No	
T1NR12ES14	9	Eroding banks, riparian degradation	Shrubs/cottonwoods	No	
T1NR12ES14	10	Riparian degradation	Shrubs/cottonwoods	No	
T1NR12ES11	11	None	Shrubs/cottonwoods	Yes	
T1NR12ES10	12	None	Shrubs/cottonwoods	Yes	Channel appears to be in good condition
T1NR12ES3	13	None	Shrubs/cottonwoods	Yes	Channel stable
T1NR12ES4	14	None	Shrubs/cottonwoods	Yes	Pond present
T2NR12ES33	15	None	Shrubs/cottonwoods	Yes	
T2NR12ES32	16	None	Shrubs/cottonwoods	Yes	
T2NR12ES29	17	None	Shrubs/cottonwoods	Yes	

Differences in topographic confinement and riparian condition were the delineative features in section 23 (Figure 4-5 and Table 4-1). Reaches 5 and 6 varied in terms of floodplain width; however, both had dense cover of woody riparian species. The aerial image suggested reduced recruitment (reproduction) of woody vegetation in reach 7. Overall, these results suggest relatively minor changes in land management may be beneficial to stream health.

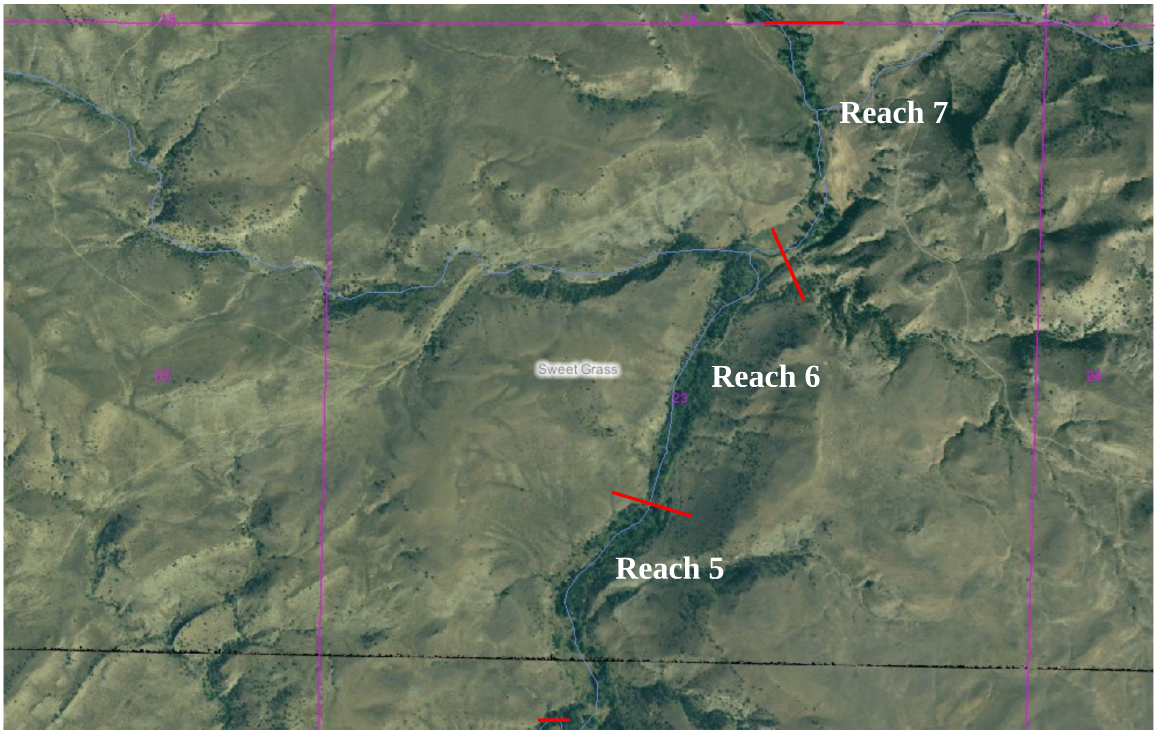

Figure 4-5: Map of T1NR12E Section 23 showing delineated reaches

The next section proceeding upstream is 14. Three reaches were delineated within this section with reduced cover of woody riparian vegetation and eroding banks being observable impairments (Table 4-1 and Figure 4-6). Eroding banks in reaches 8 and 9 appear to be significant contributors of fine sediment to the Duck Creek watershed and may be appropriate candidates for restoration.

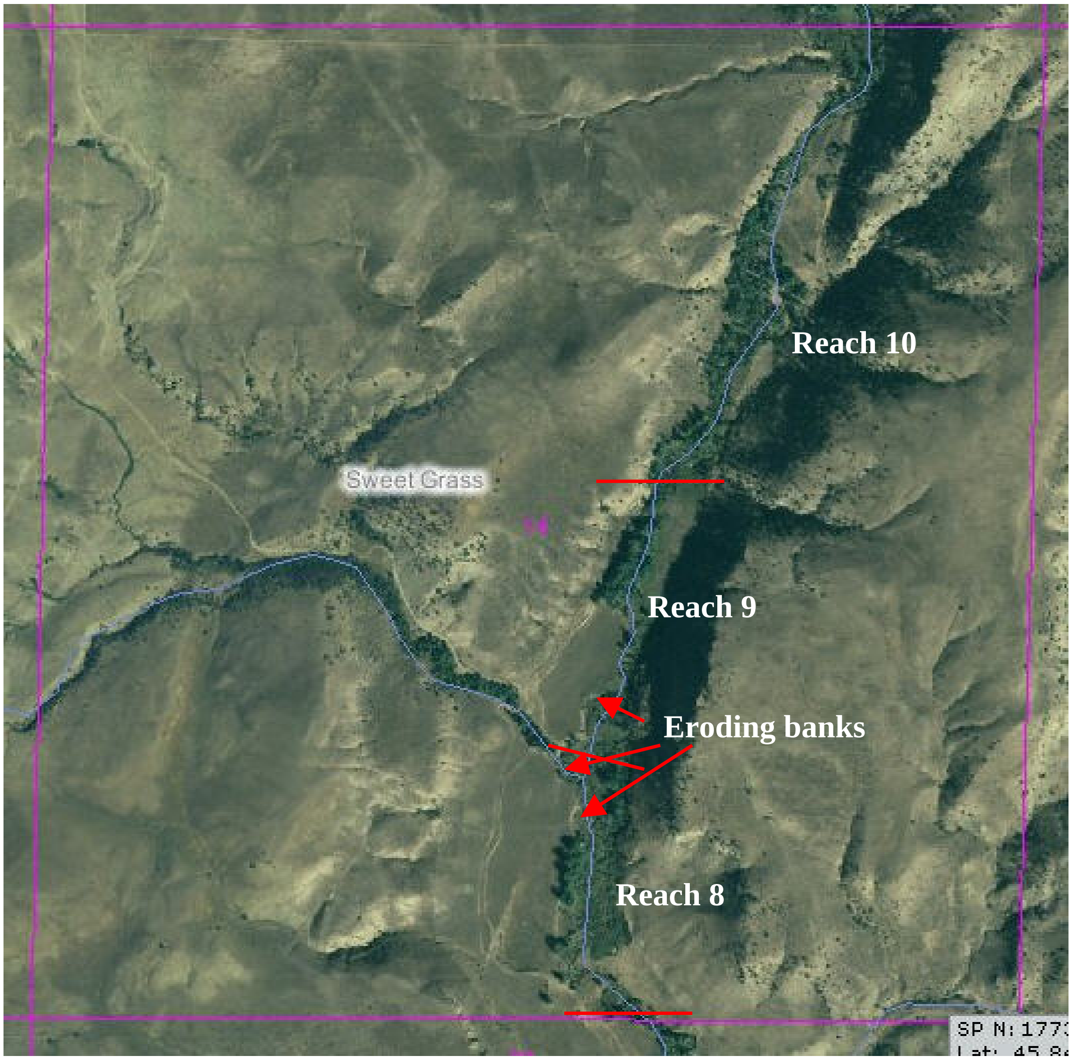

Figure 4-6: Map of T1NR12E Section 14 showing delineated reaches

Upstream of section 14, the remainder of East Fork Duck Creek appeared to be in excellent condition. Woody species dominated the riparian area and no areas of eroding bank were observable (Table 4-1). Aerial imagery of section 11 is representative of these conditions, showing well vegetative floodplain with mixed-aged stands of riparian woody species (Figure 4-7).

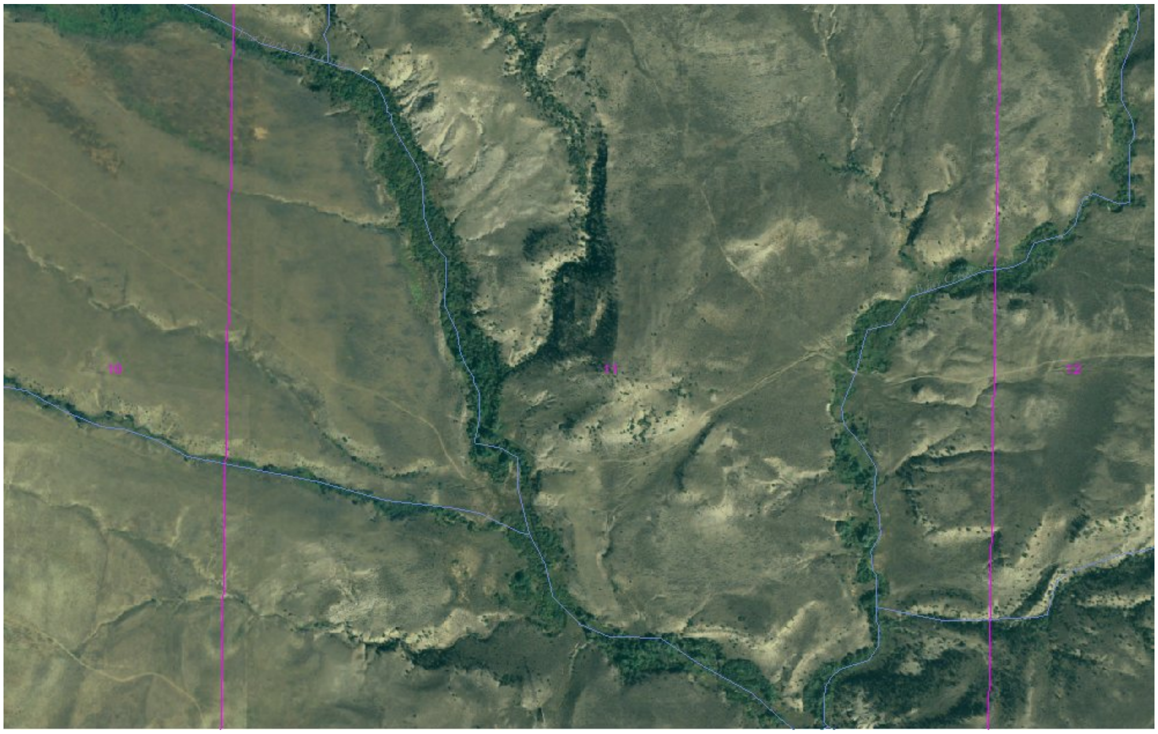

Figure 4-7: Map of T1NR12E Section 14 as an example of excellent riparian conditions and stable channel morphology typical of the upper reaches of East Fork Duck Creek.

4.2 Field Assessments

On July 17, 2007, Yellowstone cutthroat trout biologist, Carol Endicott, visited the Duck Creek watershed with the objective of identifying limitations to fish, especially native Yellowstone cutthroat trout, and potential projects to conserve and enhance native fish in the drainage. The aerial photo assessment allowed selection of reaches representing the potential range of conditions in the Duck Creek watershed. Additional observations included evaluations of fish passage at roads and irrigation diversions.

4.2.1 Duck Creek

Field observations identified several factors with significant potential to limit fish in Duck Creek at the lower end of the Wild Eagle Mountain Ranch. Reach 1 (Figure 4-1) showed the greatest impairment of all areas evaluated, with current conditions contributing to water quality and habitat degradation. Eroding banks were prevalent in reach 1, resulting in increased loading of fine sediment (Figure 4-8). Likewise, bank erosion has lead to a widening of the stream channel, which has reduced the sediment transport capacity, resulting in accumulation of fine sediment on the streambed (Figure 4-9). Wide, shallow channels lacking riparian shading tend towards warm temperatures during summer months. Water temperature on July 17, 2007 was 77°F, which is lethal to coldwater fishes such as Yellowstone cutthroat trout.

Figure 4-8: Example of an eroding stream bank in reach 1 of Duck Creek.

Figure 4-9: Reduced sediment transport capability in the overly wide and shallow streambed, which is exacerbated by calving of eroding stream banks.

Disruption of the functional attributes of riparian vegetation, combined with bank trampling, is the primary problem in this reach. Under current management, livestock have reduced or eliminated the herbaceous understory (Figure 4-10), which protects banks and filters sediment and nutrients. Similarly, browse pressure on woody species from livestock, and wildlife, has resulted in no observable reproduction of this important vegetative type in this reach. Promoting recruitment of woody species should be a management priority, as the remaining shrubs and trees are decadent and will be gone within years. A lack of riparian shrubs and trees reduces habitat suitability for fish and a host of terrestrial wildlife species. Likewise, loss of riparian trees and shrubs is detrimental to livestock operations as cows rely on these plants for shade in the summer and protection in the winter.

Figure 4-10: Bare ground associated with current livestock management on reach 1 of Duck Creek.

Habitat features for fish were severely limited in reach 1. Pools were rare and of low quality. Accumulation of fine sediment on the streambed was at levels that will preclude reproduction of trout. Correspondingly, fine sediment limits food organisms for fish, as these typically reside in the spaces or interstices between gravel particles.

Reach 2 on Duck Creek had lower livestock grazing pressure than reach 1; however, several problems persisted in this reach. Notably, riparian community composition was impaired. Ideally, the riparian community of this stream should be a mixed-aged stand of riparian shrubs and trees, with a diverse understory of grasses and forbs. A decadent gallery of cottonwoods occupied the narrow riparian strip and smooth brome (*Bromus inermus*) forms a monoculture underneath (Figure 4-11).

Figure 4-11: Typical view of the riparian area in reach 2 of Duck Creek showing the mature cottonwood gallery and understory dominated by smooth brome.

Although an important forage species for livestock, dominance by smooth brome is undesirable in riparian areas. Smooth brome is an aggressive, non-native grass that effectively excludes other species. Although this reach does not receive the degree of grazing pressure experienced by reach 1, persistence of its cottonwood forest is equally in jeopardy because of smooth brome. Similar to reach 1, no recruitment of woody species was observed in reach 2.

Channel conditions were also unfavorable for fisheries in reach 2. Much of the channel was wide and shallow, resulting in impaired sediment transport capabilities (Figure 4-12). Pools were rare and of poor quality. Although less pronounced as in reach 1, eroding banks were present in reach 2 (Figure 4-13) and contributed to sediment delivery and channel widening.

Figure 4-12: Accumulation of fine sediment in reach 2 on Duck Creek.

Figure 4-13: Example of an eroding bank on reach 2 of Duck Creek.

The Hunter's Hot Springs Canal has several ramifications for fisheries. This ditch intercepts Duck Creek, resulting in an unimpeded potential to capture fish moving downstream from Duck Creek (Figure 4-14), and forms a barrier to fish moving upstream (Figure 4-15). In addition, on July 17, 2007, this structure captured most of Duck

Creek's flow, resulting in low stream flows in Duck Creek on the Wild Eagle Mountain Ranch.

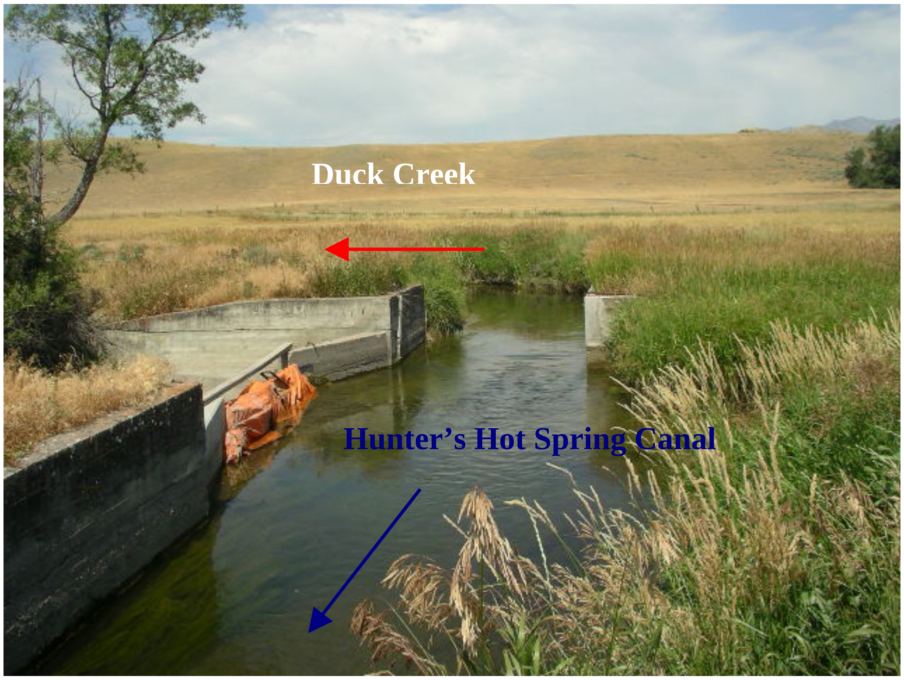

Figure 4-14: Confluence of Hunter's Hot Spring Canal and Duck Creek.

Figure 4-15: Front view of the diversion structure at the confluence of Duck Creek and the Hunter's Hot Spring Canal.

As the Hunter's Hot Springs Canal intercepts nearly all of Duck Creek's water, dewatering is another major constraint on fisheries in lower Duck Creek on the Wild

Eagle Mountain Ranch. Nonetheless, as a gaining reach, a length of stream receiving groundwater, this section had more water than could be accounted for by incoming surface flows. Likely sources of groundwater include irrigation return flows from nearby irrigation and connectivity with the Yellowstone River's alluvial aquifer. Contribution of groundwater is promising for both resident and migratory fish, as it tends to be cool, even during summer months. Therefore, with improved shading from riparian vegetation, and a narrower and deeper channel, lower Duck Creek may provide suitable habitat for trout, even during the warm summer months.

4.2.2 East Fork Duck Creek

Road access to East Fork Duck Creek is limited, so field observations concentrated on accessible portions of stream, which corresponded to reach 14 in T1NR12E. Field assessments confirmed results of the aerial photo survey, which suggested most of East Fork Duck Creek has excellent riparian condition and function, and a correspondingly intact fish habitat. The riparian zone consisted of mixed-aged stands of cottonwoods, willows, and other riparian shrubs (Figure 4-16). The stream channel was stable and possessed pools and habitat features such as boulders and overhanging vegetation, which promote a healthy fishery.

Figure 4-16: Typical view of non-impaired reach of East Fork Duck Creek.

4.3 Water Rights

Andy Brummond, water rights specialist for FWP, conducted a preliminary investigation of water rights on Duck Creek (Appendix A). Essentially, his report indicates the Wild Eagle Mountain Ranch is a senior water rights holder in the drainage, and points of diversion for these rights are near the mouth of Duck Creek. Mr. Brummond identified

Duck Creek as an excellent candidate to increase instream flows through water leasing, while maintaining current levels of irrigated forage crop production.

5.0 Conclusions and Recommendations

5.1 Riparian and Instream Habitat

Results of field assessments and aerial photo evaluations indicate a range of conditions exist on Duck Creek and East Fork Duck Creek. The majority of East Fork Duck Creek, especially at higher elevations, appears to be in proper functioning condition with healthy, intact riparian vegetation, and a stable stream channel providing high quality habitat. Nonetheless, some reaches showed evidence of impairment, including degraded riparian health and function, eroding banks, and channel alterations. These reaches would benefit from implementation of a grazing management plant and, in some cases, bank stabilization, and stream restoration.

Several impairments were evident on Duck Creek, which limit resident and migratory trout. Livestock grazing in the lowest section had substantially reduced vegetative cover, resulting in bank erosion and channel widening. These alterations have substantially limited habitat quality for fish with a lack of pools and cover. Water quality is likewise impaired with high levels of fine sediment and nutrients, and warm summer temperatures.

Numerous options are available to reverse current conditions on East Fork Duck and Duck creeks, including implementation of compatible grazing management strategies, riparian plantings, mechanical restoration of instream habitat, and bank stabilization. Managing livestock along stream margins, and implementing agricultural best management practices to limit their impact on vegetation and banks, is a broadly applicable approach that will increase vegetative cover and diversity along these streams. The NRCS and DNRC have developed a list of agricultural BMPs with potential applicability to ranching operations such as the Wild Eagle Mountain Ranch (Table 5-1). The recommendation is to develop site-specific grazing management plans, in partnership with range and grazing specialists, and the livestock manager. The objective of the plan is to protect vegetation and stream banks, while meeting the livestock’s forage consumption and water requirements. Of course, the plan must also be compatible with the producer’s operation and ability to implement the strategy.

Table 5-1: Grazing BMPs to promote riparian health and function (DNRC 1999 and NRCS 2001)

BMP and Management Techniques
Create riparian buffer exclosures through fencing.
Design a grazing management plan and determine the intensity, frequency, duration, and season of grazing to promote desirable plant communities and productivity of key forage species.
Maintain adequate vegetative cover to prevent accelerated soil erosion, protect stream banks, and filter sediments. Set target grazing use levels to maintain both herbaceous and woody plants. No grazing unit should be grazed for more than half the growing season of key species.
Ensure adequate residual vegetative cover and re-growth and rest periods. Periodically rest or defer riparian pastures during the critical growth period of plant species.
Distribute livestock to promote dispersion and decomposition of manure and to prevent the delivery of manure to water sources.
Establish riparian buffer strips of sufficient width and plant composition to filter and take up nutrients and sediment from concentrated animal feeding operations.
Alternate a location's season of use from year to year. Early spring use can cause trampling and compaction damage when soils and stream banks are wet. If possible, develop riparian pastures to be managed as a separate unit through fencing.
Provide off-site high quality water sources.
Periodically rotate feed and mineral sites.
Place salt and minerals in uplands, away from water sources (ideally ¼ mile from water to encourage upland grazing).
Keep salt in troughs and locate salt and minerals in areas where soils are less susceptible to wind or water erosion.
Monitor livestock forage use and adjust strategy accordingly.
Create hardened stream crossings.
Encourage the growth of woody species (willow, alder, etc.) along the stream bank, which will limit animal access to the stream and provide root support to the bank.

Options to stabilize eroding banks vary with severity of the bank erosion and the potential for natural recovery. Some banks may heal with reduced pressure from livestock grazing, in conjunction with conservation plantings. Alternatively, some banks may benefit from mechanical stabilization such as is displayed in Figure 5-1. This "soft" approach to bank stabilization capitalizes on the stabilizing function of riparian vegetation, along with a stable bank geometry. Concomitant with this approach should be a livestock grazing strategy that protects recovery banks and allows for establishment of healthy riparian vegetation.

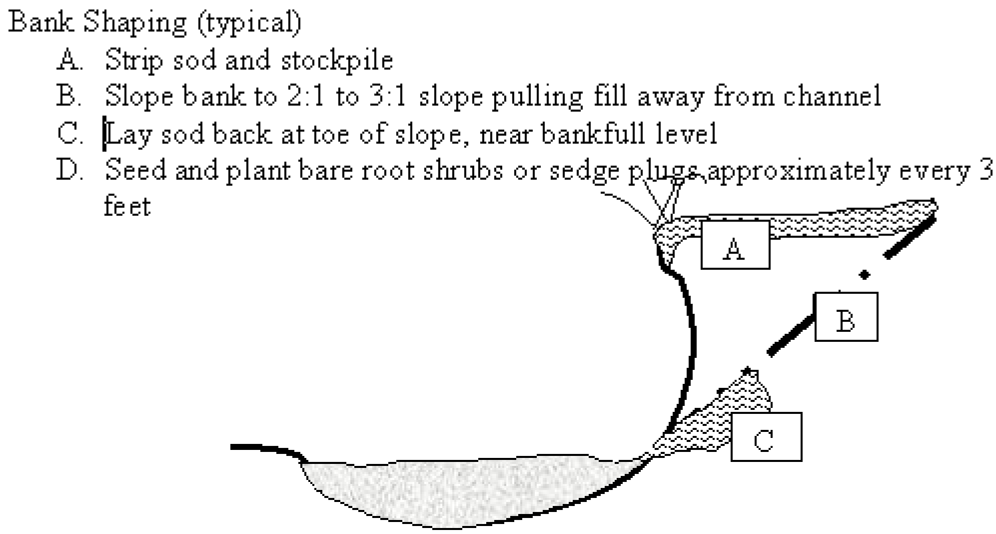

Figure 5-1: Conceptual approach to stabilizing vertical eroding banks.

Mechanical restoration of instream habitat is another option to improve fish habitat in Duck Creek. Excavation of pools, channel narrowing, and in some cases, increasing the length of the channel by constructing meanders are among the available actions to restore habitat quality and sediment transport ability. These approaches are potentially the most expensive options; however, the benefit of increased recruitment of Yellowstone cutthroat trout to the Yellowstone River may justify the expense.

5.2 Irrigation Infrastructure and Instream Flows

Hunter's Hot Springs Canal has several influences on Duck Creek's fishery. The structure is a probable barrier to fish moving upstream, and has potential to capture fish moving downstream, resulting in a loss of fish in the system. Likewise, the pin and plank diversion structure currently diverts the majority of the flow, which results in chronic dewatering in the lowest mile of this stream.

Throughout Montana, FWP is working with irrigators and ditch companies to modify or replace irrigation structures to make them more fish friendly. Several options exist for the structure on Duck Creek. In cases similar to this diversion, removing the existing structure, and siphoning the ditch under the stream, has been an option that restores a functioning stream channel, while ensuring delivery of ditch flows to irrigators. Alternatively, installation of a fish ladder that permits fish to pass over the barrier is a possibility. On the other hand, the existing structure may be beneficial in blocking invasion on non-native trout that may compete or hybridize with Yellowstone cutthroat trout. Additional investigation is needed to determine the appropriate course of action.

Installation of a fish screen that prevents loss of fish down the canal is another option for this site. Given the amount of water conveyed by the canal, this may entail substantial alterations to the existing structure. Evaluation of the extent to which this ditch entrains fish is needed to justify the expense of screen construction. Of course, the ditch company would need to be a full partner in this process and involved in all decision-making.

Hunter's Hot Springs Canal results in pronounced dewatering of the lower mile of Duck Creek. The remaining flows, which are augmented by groundwater, provide insufficient habitat for a healthy resident fishery, or for Yellowstone River migrants. Numerous solutions exist for promoting adequate instream flows to support the fish in Duck Creek such as leasing water rights, modifying the irrigation structure to allow better control of diverted flow amounts, and increasing irrigation efficiency to decrease the quantity of water needed. FWP frequently works in partnership with irrigators to devise solutions that benefit fish and are compatible with irrigator's needs and water rights.

5.3 Fisheries Investigations

As noted in 3.0 Fisheries Data Review, no formal investigation of fish populations has occurred in the Duck Creek watershed. Given its potential to support pure Yellowstone cutthroat trout, FWP has considerable interest in filling these data gaps by sampling fish at key locations, determining species composition, and evaluating genetics of Yellowstone cutthroat trout in the basin. The resulting data will inform the approach to conserving Yellowstone cutthroat trout in the basin.

5.4 Establishment of a Yellowstone Cutthroat Trout Spawning Run in Duck Creek

In Montana, stream dwelling Yellowstone cutthroat trout have two primary life-history strategies. Small stream resident fish spend their entire lives within tributary watersheds, while migrant fish reside in the Yellowstone River, but return to their natal streams to spawn. Both the resident and migrant forms are becoming increasingly rare. Yellowstone cutthroat trout conservation planning includes provisions to conserve, restore, and enhance both strategies.

Establishment of a spawning run of Yellowstone cutthroat trout in lower Duck Creek will be contingent on restoration of habitat, reduction in fine sediment on streambed surfaces, and maintenance of sufficient stream flows to inundate redds and convey emerging fry to the Yellowstone River. FWP would imprint fry on Duck Creek using remote site incubators. Upon sexual maturity, these fish would return to Duck Creek and establish a self-perpetuating spawning run.

Appendix A: Water Rights Memo

Memorandum

To: Carol Endicott

From: Andy Brummond

Date: August 1, 2007

Subject: Wild Eagle Mountain Ranch LLC – Duck Creek Water Rights

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Wild Eagle Mountain Ranch LLC shares the oldest water right priority date of July 2, 1881 on Duck Creek with Engwis Investment Co. LP. Wild Eagle's right is for 1.56 cfs and irrigation of 155 acres. The Engwis July 2, 1881 right is also for 1.56 cfs and for irrigation of 300 acres. I reviewed water rights for Duck Creek and the East and West Forks of Duck Creek. The Wild Eagle July 2, 1881 is senior in to priority to all water rights on the forks of Duck Creek. The attached spreadsheet shows the water rights in order or priority with those owned by Wild Eagle shown in red.

Wild Eagle owns several properties on Duck Creek and the East Fork of Duck Creek. The property at the mouth is associated with 4 water rights listing Duck Creek as the source. Wild Eagle owns one other water right for 1 cfs from Duck Creek with a relatively old 1884 priority date. The other two Duck Creek water rights are more junior in priority. Duck Creek and its Forks appear to have been historically decreed by the District Court. Likely water shortages created the need for the water rights to be adjudicated.

I reviewed the DNRC water rights abstracts for Wild Eagle's Duck Creek water rights. I also have reviewed the 1950 Sweet Grass County Water Resources Survey as well as 1950, 1976 and 2005 aerial photos for the area. Based on all of these resources it appears that the water rights were historically diverted from three locations on Duck Creek at least to of which were upstream of the Hunters Hot Springs Canal. However, it appears that all water used from Duck Creek by Wild Eagle is now diverted into the Hunters Hot Springs Canal where it is pumped to the sprinkler systems. The Hunter Hot Springs Canal also supplies Yellowstone River water to the same irrigated lands served by Wild Eagle's Duck Creek rights.

Any changes to the diversion structure on the Hunter Hot Springs Canal that intercepts Duck Creek would need to be approved by the Hunter Hot Springs Canal Co., Engwis Investment Co. LP, as well as Wild Eagle Mountain Ranch LLC.

Given the old priority of Wild Eagle's Duck Creek water right, it offers a good potential for restoring flow to Duck Creek through a water lease. This old priority date could be used to draw water down to the mouth of Duck Creek past junior priority water users if necessary. Depending on the available water supply in the Hunter Hot Springs Canal, Yellowstone River water could be used to replace and/or supplement the Duck Creek water. It may be possible for Wild Eagle to maintain its existing production while at the same time re-watering lower Duck Creek. As with any changes to the diversion, a successful flow restoration would need the cooperation and involvement of Hunter Hot Springs Canal Co. and Engwis Investment Co. LP.

wrnumber	owner	enfprioritydate	srcname	maxflwrt	flwrtunt	countyid	tr	secno	qsection
43B 34012 00	ENGWIS INVESTMENT CO LP	18810702	DUCK CREEK	1.56	CFS	SG	1S12E	12	NESENE
43B 193514 00	WILD EAGLE MOUNTAIN RANCH LLC	18810702	DUCK CREEK	1.56	CFS	SG	1S12E	12	NESENE
43B 180112 00	CRAZY MOUNTAIN CATTLE CO	18831009	DUCK CREEK. WEST FORK	2.5	CFS	SG	1N12E	35	SWNWSW
43B 192254 00	ROCK CREEK RANCH I LTD	18831009	DUCK CREEK. WEST FORK	2.5	CFS	SG	1N12E	34	NWNESE
43B 179745 00	CRAZY MOUNTAIN CATTLE CO	18840421	DUCK CREEK. WEST FORK	2.13	CFS	SG	1N12E	35	SWNWSW
43B 193511 00	WILD EAGLE MOUNTAIN RANCH LLC	18840421	DUCK CREEK	1	CFS	SG	1S12E	12	SENENE
43B 124065 00	WILD EAGLE MOUNTAIN RANCH LLC	18840501	DUCK CREEK. EAST FORK	112	GPM	SG	1N12E	26	NWNWSW
43B 180116 00	CRAZY MOUNTAIN CATTLE CO	18840501	DUCK CREEK. EAST FORK	1.25	CFS	SG	1N12E	35	SWNESW
43B 192252 00	ROCK CREEK RANCH I LTD	18840501	DUCK CREEK. EAST FORK	1	CFS	SG	1N12E	35	SWSENW
43B 192252 00		18840501	DUCK CREEK. EAST FORK	1	CFS	SG	1N12E	26	NWNWSW
43B 180115 00	CRAZY MOUNTAIN CATTLE CO	18860601	DUCK CREEK. EAST FORK	1.6	CFS	SG	1N12E	35	SWNESW
43B 192251 00	ROCK CREEK RANCH I LTD	18860601	DUCK CREEK. EAST FORK	1.6	CFS	SG	1N12E	35	SWSENW
						SG	1N12E	26	NWNWSW
43B 124063 00	WILD EAGLE MOUNTAIN RANCH LLC	18870325	DUCK CREEK. EAST FORK	3.75	CFS	SG	1N12E	14	SWSWNE
43B 180113 00	CRAZY MOUNTAIN CATTLE CO	18880601	DUCK CREEK. EAST FORK	1.35	CFS	SG	1N12E	35	SWNESW
43B 192248 00	ROCK CREEK RANCH I LTD	18880601	DUCK CREEK. EAST FORK	1.6	CFS	SG	1N12E	35	SWSENW
						SG	1N12E	26	NWNWSW
43B 192247 00	ROCK CREEK RANCH I LTD	18900801	DUCK CREEK. WEST FORK	2.13	CFS	SG	1N12E	28	SESWSE
						SG	1N12E	28	SESESE
						SG	1N12E	34	SWNWNW
43B 14387 00	ROCK CREEK RANCH I LTD	18910915	DUCK CREEK. WEST FORK	3.75	CFS	PA	2N11E	26	NWNWNW
43B 114668 00	ROCK CREEK RANCH I LTD	18910915	DUCK CREEK. WEST FORK	3.75	CFS	PA	2N11E	26	NWNWNW
43B 192196 00	ROCK CREEK RANCH I LTD	18950501	DUCK CREEK. WEST FORK	426	GPM	SG	1N12E	29	SENWNE
	REICH FAMILY PARTNERSHIP								
43B 20822 00	HOFFMAN DONALD	18950610	DUCK CREEK. WEST FORK	3.12	CFS	PA	2N11E	1	SESWSW
	HOFFMAN MYRTLE A								
43B 40471 00	PHILIP MORRIS INC	18950610	DUCK CREEK. WEST FORK	6.25	CFS	PA	2N11E	1	SESWSW
43B 193150 00	GROBLER WERNER H	18950610	DUCK CREEK. WEST FORK	3.12	CFS	PA	2N11E	1	SESWSW
	GROBLER BARBARA								
43B 14400 00	ROCK CREEK RANCH I LTD	18960601	DUCK CREEK. WEST FORK	3.5	CFS	PA	2N11E	26	NWNWNW
43B 114667 00	ROCK CREEK RANCH I LTD	18960601	DUCK CREEK. WEST FORK	3.5	CFS	PA	2N11E	26	NWNWNW
43B 180108 00	CRAZY MOUNTAIN CATTLE CO	18990501	DUCK CREEK. WEST FORK	7.5	CFS	SG	1N12E	35	SWNWSW
43B 124064 00	WILD EAGLE MOUNTAIN RANCH LLC	19030701	DUCK CREEK. EAST FORK	336.6	GPM	SG	1N12E	26	NWNWSW
43B 180114 00	CRAZY MOUNTAIN CATTLE CO	19050501	DUCK CREEK. EAST FORK	1.5	CFS	SG	1N12E	35	SWNESW
43B 14388 00	ROCK CREEK RANCH I LTD	19050630	DUCK CREEK. WEST FORK	4	CFS	PA	2N11E	26	NWNWNW
43B 193513 00	WILD EAGLE MOUNTAIN RANCH LLC	19100428	DUCK CREEK	3.13	CFS	SG	1S12E	12	SENENE
43B 34011 00	ENGWIS INVESTMENT CO LP	19100428	DUCK CREEK	6	CFS	SG	1S12E	12	NESENE
43B 193512 00	WILD EAGLE MOUNTAIN RANCH LLC	19100428	DUCK CREEK	3.13	CFS	SG	1S12E	1	SESESE
43B 14389 00	ROCK CREEK RANCH I LTD	19100510	UNNAMED TRIBUTARY OF UNNAMED	2	CFS	PA	2N11E	36	NWSWSW
43B 180110 00	CRAZY MOUNTAIN CATTLE CO	19111231	DUCK CREEK. EAST FORK	3.75	CFS	SG	1N12E	35	SWNESW
43B 114670 00	ROCK CREEK RANCH I LTD	19121130	DUCK CREEK. WEST FORK	15	CFS	PA	2N11E	27	NESESE
43B 41766 00	WILD EAGLE MOUNTAIN RANCH LLC	19150528	DUCK CREEK. EAST FORK	5.25	CFS	SG	2N12E	29	NENESW
43B 41762 00	WILD EAGLE MOUNTAIN RANCH LLC	19150814	DUCK CREEK. EAST FORK	3.75	CFS	SG	2N12E	33	NESWSW
43B 180109 00	CRAZY MOUNTAIN CATTLE CO	19171231	DUCK CREEK. EAST FORK	7.5	CFS	SG	1N12E	35	SWNWSW
43B 186945 00	HUNTER HOT SPRINGS CANAL CO	19191231	DUCK CREEK	37.5	CFS	PA	1S12E	12	NESENE
43B 14399 00	ROCK CREEK RANCH I LTD	19191231	DUCK CREEK. WEST FORK	11.25	CFS	PA	2N11E	26	NWNWNW
43B 179907 00	CRAZY MOUNTAIN CATTLE CO	19191231	DUCK CREEK. WEST FORK	1.5	CFS	SG	1N12E	35	SWNWSW
43B 192237 00	ROCK CREEK RANCH I LTD	19191231	DUCK CREEK. EAST FORK	7.5	CFS	SG	1N12E	27	SESENE
43B 192239 00	ROCK CREEK RANCH I LTD	19191231	DUCK CREEK. EAST FORK	2.65	CFS	SG	1N12E	35	SWSENW
43B 192242 00	ROCK CREEK RANCH I LTD	19191231	DUCK CREEK. WEST FORK	1.88	CFS	SG	1N12E	34	NWNESE
43B 192243 00	ROCK CREEK RANCH I LTD	19191231	DUCK CREEK. WEST FORK	5.01	CFS	SG	1N12E	28	SESESE
						SG	1N12E	34	SWNWNW
43B 192245 00	ROCK CREEK RANCH I LTD	19191231	DUCK CREEK. EAST FORK	1.88	CFS	SG	1N12E	35	SWNESW
43B 192246 00	ROCK CREEK RANCH I LTD	19191231	DUCK CREEK. EAST FORK	3.13	CFS	SG	1N12E	26	NWNWSW
43B 192249 00	ROCK CREEK RANCH I LTD	19191231	DUCK CREEK. WEST FORK	3.75	CFS	SG	1N12E	28	SESWSE
43B 192249 00		19191231	DUCK CREEK. WEST FORK	3.75	CFS	SG	1N12E	28	SESESE
43B 192249 00		19191231	DUCK CREEK. WEST FORK	3.75	CFS	SG	1N12E	34	SWNWNW
43B 68 00	WILD EAGLE MOUNTAIN RANCH LLC	1.97308E+11	DUCK CREEK. EAST FORK			SG	2N12E	29	SWNWNESW