Assessement of Riparian and Aquatic Habitat with the Coal Creek Watershed, Gunnison County, Colorado.

Prepared for

Coal Creek Watershed Coalition (CCWC)
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Executive Summary

Riparian zones can be defined as the transitional zone or interface between the aquatic area and the terrestrial area with a unique plant community that is often dominated by shrubs such as willow and alder. Alternatively, from a management perspective the riparian zone can be defined as the width of the riparian buffer or a defined distance from a water body that is used to protect the aquatic habitat. Riparian zones, especially those in headwater stream systems such as Coal Creek, are important for wildlife habitat, stream ecology, microclimatic development, migration corridors and for protecting water quality. Also as an important landscape component, riparian zones exchange nutrients and food energy with the associated stream. Additionally, riparian zones are valuable to humans for recreation as well as the reduction of the power of floods. With these definitions, functions and values in mind, we assessed the quality and function of the riparian and stream habitat of Coal Creek, Gunnison County, Colorado in August and September, 2009.

During this assessment, we divided the watershed into "Assessment Segments" of similar riparian and stream quality or similarity of habitat. We focused on both flowing (creeks and streams) and standing water (lakes, ponds and reservoirs) habitats and found that much of the riparian areas of the Coal Creek watershed are in good quality. However, several segments are prioritized for restoration.

The highest priority sites which are described and mapped in the document include:

- The Forest Queen Mine (Assessment Segment 11) is in need of reclamation and stream/riparian restoration.
- The Kebler Lumber Mill/The Ender Lumber Company (TELCO) Mill Site Wetland (Assessment Segment9) needs sawdust removal, trash removal, revegetation plus a restored water flow.
- Coal Creek between Splains Gulch and Irwin Forks (Assessment Segment 6) needs the implementation of roadway Best Management Practices and stream/riparian restoration. Kebler Pass Road is located in the riparian wetland for most of this section.
- The riparian corridor through the Town of Crested Butte (Assessment Segment 3) needs restoration and engineering of the stream/riparian zone to produce a "greenbelt" and to increase human safety.
- Coal Creek on the Crested Butte Land Trust Property near the confluence with the Slate River (Assessment Segment 1) needs changed cattle management or fencing to keep cattle away from the riparian zone. Additionally, the eroded and widened stream needs channel and riparian restoration.
- The lower portion of the watershed needs noxious weed removal and management in the lower portion of the watershed.

- Coke ash piles are eroding and need removal coupled with site revegetation (Assessment Segment 4).

Additionally, there are some lower priority restoration efforts that need to be implemented and these include:

- Engineering of diversion structures to reduce riparian and instream disturbance from repeated maintenance (Assessment Segments 2,3,4,5 and 6).
- The Keystone Mine outflow (Assessment Segment 6) needs riparian restoration and flow management to reduce the erosive forces from major fluctuations in treatment plant discharge.
- Kebler Pass Road (County Road 12) needs the implementation of roadway Best Management Practices to reduce the amount of sediment entering Coal Creek and its riparian zone (multiple segments but with a focus on Assessment Segment 6).
- Mount Emmons Iron Fen outflow (Assessment Segment 15) needs removal of the man-made diversion and restoration of flow and wetlands.
- For aesthetic reasons, the Coal Creek Watershed Coalition (CCWC) should organize a volunteer effort to remove trash that is documented and mapped in this report (various Segments).

Overall, current regulations through the Gunnison County Land Use Regulation and the Town of Crested Butte Watershed Protection District are probably inadequate to protect riparian zones, wetlands, stream habitat and water quality. We recommend that riparian habitat buffers should range from 75 to 300 feet with corrections for land use intensity, wetland category and slope of surrounding landscape. These will help to protect both water quality in Coal Creek and its wildlife habitat.

Connecting riparian and stream habitats throughout the watershed and reducing fragmentation will improve the function of Coal Creek, its downstream rivers and improve the overall health of the watershed. We recommend a coordinated watershed land use planning effort, in addition to the previous water quality based plan (Stantec Consulting, Inc., 2005), to examine the entire watershed and to maintain and restore these as complete systems. This watershed planning effort should be incorporated into the Watershed Restoration plan that the CCWC is developing and the highest priority in this effort is to address are to address the fragmentation caused by the Town of Crested Butte, Kebler Pass Road and the Forest Queen Mine.

Other issues to consider in watershed planning are the restoration of the loss of large woody debris within the riparian zone and stream; and the management of dispersed camping with its impacts in the riparian zone. We recommend allowing large woody debris to remain in the stream and riparian zone unless its presence causes a human hazard and monitoring the quantity of large woody debris to assess whether it is increasing through time as it should be.

The CCWC and the U.S. Forest Service should analyze whether dispersed camping in the riparian zone is causing unnecessary impacts and whether closing the riparian zone to camping would be beneficial. Developing camping areas in upland areas may draw campers away from the riparian zone and help remedy some of these impacts.

Riparian zones are most valuable in headwaters streams, such as Coal Creek, for maintaining water quality both within that stream and in downstream reaches. Thus the management, maintenance and restoration of the headwaters riparian zones within the Coal Creek watershed are important. We hope that this document provides a reference condition to which future changes, both positive and negative, can be measured through an ongoing monitoring and assessment program. We also hope that the assessment and recommendations provided here provide valuable tools to the Coal Creek Watershed Coalition (CCWC) so that they may continue their stewardship to "restore and protect the environmental integrity of the watershed to provide high-quality water for wildlife, aquatic life, and human life."

Contents

Introduction to Riparian Ecology and Functions

Riparian zones are defined in various ways and these definitions are often context specific. In xeric (=drier) regions such as in the Coal Creek watershed, we define the riparian zone as an ecotone (=transitional zone or interface) between the aquatic area and the terrestrial area with a plant community dominated by shrubs such as willow and alder. Additionally, from a management perspective the riparian zone is defined as the width of the riparian buffer or a defined distance from a water body that is used to protect the aquatic habitat.

The riparian vegetation is often unique within a watershed such as Coal Creek and it is visibly different from the surrounding forests, shrublands and grasslands. This vegetation has a variety of functions including providing nutrients and energy in the forms of organic matter from leaf fall, woody material and other organic carbon sources along with other nutrient inputs that are released into the stream. These materials often "drive" the stream's ecology as well as providing habitat and substrate for aquatic animals such as bacteria, fungi, aquatic insects and fishes. The riparian vegetation provides a change in microclimates along the stream such as shading the stream, altering the temperature regime, decreasing wind speed maintaining humidity. All of these vary seasonally as the riparian vegetation changes. The riparian vegetation also contributes to bank stability and help dissipate the energy of moving water to reduce especially during flood events and protects humans and other organisms.

In particular, both large and small woody debris, provides geomorphic structure to the stream. The wood contributes to channel stability, diversifies the instream habitat, forms pools and provides habitat for a variety of species. This habitat is important of organisms seeking refuge for predators, provides a refuge from strong flows, and traps other matter providing additional habitat. Wood provides a food source for the microbial layer growing in the stream (=biofilm) and is used for a carbon and nutrient source. The biofilm then in turn provides a food source for many small macroinvertebrates. Additionally, the wood provides habitat for other macroinvertebrates especially collector-filterers that filter particles from the passing water.

Riparian zones also function as a zone of the transmission of groundwater and upslope water from colluvium, in the case of Coal Creek, into the stream, lake or wetland. In addition, exchanges from the stream to the groundwater in the riparian zone can occur thus ameliorating some of the drastic changes in flow throughout the year, season or day. In this way, riparian zones help maintain water quantity in streams.

These riparian zones act as filters to intercept sediment or nutrients that would enter the stream and otherwise decrease water quality. The sediment can be trapped by the riparian vegetation because the riparian zone has a lower gradient than the surrounding areas and thus reduces the velocity of water flowing over ground. The vegetation also acts as a filter to slow

the water velocity and to trap this sediment. The nutrients, such as phosphorus or nitrogen, or ions and metals from surround land use can be absorbed by the plants through the uptake of riparian groundwater. Thus maintaining riparian vegetation is important to maintaining water quality.

Recently, the high degree to which aquatic habitats and riparian zones interact and are linked has been documented (Polis and others, 2004) and the scientific community has begun understanding how these systems are energetically dependent on each other. The food energy and nutrient transfer between the two systems is considered a "cross ecosystem subsidy" where food energy from each system is supplied to the other. Some studies (Wipfli, 1997) have shown that fishes such as trout depend on terrestrial invertebrates from the riparian and upland zones for as much as 50% of their energy. Additionally, the flow of adult aquatic insects from the stream system feed terrestrial animals such as birds, bats and other insects. Additionally, bears, dippers and minks may also depend heavily on aquatic organisms for food sources. These systems are then linked energetically to other systems further away by the downstream movement of water. Due to this, we can no longer think of these systems as separate systems but as one contiguous entity. These have management implications on how riparian systems are managed affects aquatic systems and vice versa.

Healthy rivers and riparian zones are necessary wildlife habitat and corridors. These systems often comprise less than one percent of the landscape yet are often utilized by a disproportionately high number of wildlife species and perform a disparate number of ecological functions, some of which are described above. These zones across the landscape often function as corridors for wildlife movement and dispersal between larger areas of habitat. Thus, keeping riparian zones intact helps protect biological diversity, allows animal movement, enhances gene flow and provides habitat to animals either outright or during periods of disturbance (Fischer and others, 2000).

Overall, riparian systems have many values including benefits to: water quality and quantity; wildlife and biological diversity; and human quality of life. They reduce pollutants and trap sediment that improves water quality and through the interactions with groundwater they store and release water that supplies flow to the stream. The riparian vegetation also reduces the energy carried by flowing water thus decreasing the impacts of floods. The riparian zones have been considered "keystone nodes" within the landscape where a disproportional amount of wildlife and other biological diversity is dependent upon them (Naiman and others, 2005). Human quality of life is greatly improved by riparian zones because humans use them for activities such as water based recreation and non-motorized transportation plus there are numerous social benefits of recreation in riparian zones such as hiking, running, hunting, skiing, walking and nature observation. In addition, these riparian zones also act as carbon sinks

within the carbon cycle that may help with climate regulation. Therefore, riparian zones are critical to healthy streams, watersheds, and ecosystems as well as providing immeasurable benefits to allow humans to lead quality lives.

Introduction to the Coal Creek Watershed and Riparian Areas

The Coal Creek watershed is predominantly a subalpine spruce-fir forest with drier, primarily south facing slopes being dominated by sagebrush steppe and grasslands. The riparian zones are dominated by willows and alders with some active and abandoned beaver ponds, along with wet meadows. There are many wetland plants in the narrow riparian corridor that are not found in drier soils found upslope. As a result and is typical of most riparian areas, wildlife use of these wetlands is high which contributes to local biodiversity and high plant and animal productivity. The riparian zone is also important for essential functions such as dissipating flood energy and filtering sediment and pollution.

Coal Creek's riparian zone grows on alluvial deposits of silt, sand, gravel, cobbles and boulders while a few sites, especially near the Mount Emmons Iron Fen, have peat. Talus slopes reworked by the river are evident in several places. Rockslides from the construction and maintenance of Kebler Pass Road (County Road 12) impact the riparian zone and Coal Creek itself in many places along the drainage. Kebler Pass Road was constructed in 1880 as the Pioneer Toll Road between Crested Butte and Irwin with the Floresta Branch of the Denver and Rio Grande Railroad being constructed adjacent to Coal Creek in 1893. The riparian impacts of this road and rail construction and maintenance have altered this system for well over a century.

Most of the springs in the watershed are on the south side of Coal Creek. Beaver ponds have also altered long sections of Coal Creek with the fine sediments trapped behind the ponds creating sedge (*Carex spp.)* meadows when the beaver ponds are ultimately abandoned.

Coal Creek starts at about 10,300 feet in the town site of Irwin and runs in a general easterly direction for approximately nine miles. At its origins near the town site of Irwin, Coal Creek has two main forks. One fork is predominantly fed by a transbasin diversion from Irwin Lake while the other fork drains the extensive willow wetlands on the south west facing hillside. A downstream, extensive willow wetland/riparian complex in Irwin has a number of springs and seeps that then add to the flow of Coal Creek. The riparian zone narrows and suffers several types of anthropogenic disturbance as Coal Creek passes the Forest Queen Mine. Downstream of the Forest Queen mine to the Irwin Forks, the creek has an intact and healthy riparian zone.

As Coal Creek nears the confluence with the creek coming from the Ohio Pass area, it again enters an extensive willow riparian wetland that extends south to the abandoned Kebler Lumber Mill/The Ender Lumber Company mill site and just beyond where the topography climbs to Ohio Pass. The lumber mill operated from 1917 to 1929 and its sawdust remnants have become a human produced dry island in a larger wetland complex with a user created shooting range and associated debris. The willow riparian wetlands continue downstream until the valley narrows and steepens with many active beaver ponds throughout this section.

Just above Splains Gulch, Kebler Pass Road is immediately adjacent to Coal Creek that there is effectively no riparian zone on the south side of the creek for most of the stretch. The valley then narrows with an occasional wider stretch that holds beaver ponds downstream of Splains Gulch where the Axtell laccolith impinges on the creek.

Continuing downstream, the outflow of the Mt Emmons Iron Fen created an alluvial fan covered with a sedge wetland. Then, the Coal Creek riparian zone has minimal anthropogenic disturbance until a concentration of human activity around the Crested Butte Town Water supply, the Mount Emmons Water Treatment Plant outflow and road building by the subdivision Trappers Crossing at Wildcat Creek. The eroded slope on the north side of Kebler Pass Road east of the Mt. Emmons Mine access road contributes noticeable sediment to Coal Creek. Recent Best Management Practices for erosion control from the road have been undertaken by Gunnison County and the Coal Creek Watershed Coalition since the field portion of this assessment was complete in September, 2009.

As Coal Creek gets closer to town of Crested Butte areas of human disturbance to the stream and riparian zone due to water abstraction, coke ash piles, weeds and trash increases. Coal Creek then reaches Crested Butte, a town that as of the 2000 census consists of 1,529 residents, 692 households and 253 families. Crested Butte was incorporated in 1880 as a mining town and this town began on the banks and within the riparian zone of Coal Creek. As the creek flows through Crested Butte, the stream has been historically channelized to help reduce the impacts of flooding and allow the town to exist on the historical flood plain. As a result of this channelization and the increase in water velocity the banks and streambed are armored due to scouring flows and a reduction in sediment and organic inputs. This reduces habitat to fish and other aquatic life in these sections of stream. The riparian zone throughout town has been greatly reduced and this riparian zone has lost most its functions.

Downstream from the Town of Crested Butte, the stream approaches it's confluence with the Slate River as it passes through a section of private land that is primarily used for livestock grazing. The gradient of the stream is lower as it reaches the confluence and the streams riparian zone widens and is dominated by a large willow carr (= wet, willow forest). In this

section, there is abundant beaver activity but many of the beaver dams were washed out during the spring of 2008.

The larger tributaries to Coal Creek include Splains Gulch, Elk Creek, Wildcat Creek and Evans Basin. All of the tributaries have healthy riparian zones except for the area around the Standard Mine along Elk Creek. The Standard Mine has been listed as U.S. Environmental Protection Agency Superfund site and is currently being reclaimed and restored, thus it was excluded from this riparian assessment.

There are also a variety of lentic (=standing water) habitats found within the Coal Creek watershed. The Mount Emmons Iron Fen is a wetland complex consisting of forested wetland, sedge fen, and a pond, all underlain by peat enriched with iron oxide (limonite). The unusual geological conditions associated with the Mount Emmons Iron Fen produce a combination of mineral rich waters and a very low pH (~3-4). This rare combination also makes for habitat of the roundleaf sundew (*Drosera rotundifolia*) and two unusual species of dragonfly (*Leucorrhinea hudsonica* and *Somatochlora semicircularis*). These characteristics led to the designation of 75 acres in a State of Colorado Natural Area which provides some degree of protection to this wetland complex and its associated riparian community. The outflow of this fen was altered by the construction of a ditch which diverts the outflow away from it wetlands and into a separate drainage. Since this water drained to a slope above a road that caused slumping, this diversion was constructed to reduce road maintenance costs.

More typical lentic habitats are found at the high elevation lakes of Copley Lake, Green Lake and Lily Lakes that all have associated riparian zones. Additionally, the Crested Butte Town Reservoir is a modified drainage where water from Coal Creek is stored prior to its use by the town and its residents.

In addition to the road, the Town of Crested Butte and the town site of Irwin, there are two other anthropogenic activities that have affected the riparian communities within the Coal Creek watershed. First, the mineral rich geology of the area led to mining in the area with this activity beginning in the 1870's. Much of the original mines were for coal and the major minerals of interest were copper, lead, cadmium, zinc, silver, and gold with a recent discovery of a large deposit of molybdenum. Secondly, water diversions for irrigation and water supply reduce water flow and thus decrease the water table that supports the riparian zones downstream from where the diversion occurs. The major diversions are the Town of Crested Butte Water Supply, the Halazon Ditch, the Spann-Netick Ditch, the McCormick Diversion, the Crested Butte Ditch and the Kapushion Ditch These diversions often remove enough water so that in some years, Coal Creek is dry at the Butte Avenue bridge during the fall.

Other historical activity that could have affected Coal Creek and its riparian systems were historical fires and logging. On page 93 in “Across the San Juan Mountains" by Thomas A. Rickard (1903), he writes about Crested Butte and the horseback ride up the Coal Creek valley in 1902. In his writing he describes the area as “On both sides of the canon the hillslopes were a desolation of burnt timber, a glimpse of that destruction, through careless fires, which is gradually causing the deforestation of Colorado." The resulting sedimentation and impacts to riparian areas could have caused major changes which we may be seeing today such as the minimal amounts of large woody debris.

A wetland survey by David Cooper (1993) mentioned dust as a problem in the Coal Creek watershed. Since that time the Kebler Pass Road between Crested Butte and the Wildcat Bridge has been paved and Gunnison County Road and Bridge crews have used magnesium chloride (MgCl) for dust abatement. Recently discussion has occurred regarding paving or chip sealing more of the Kebler Pass Road which should also help with dust control. During our assessment only minor dust problems were noted and this probably a result of the paving and application of MgCl for dust abatement mentioned above.

Methods

During August and September 2009, we (Kevin Alexander, Wendy Brown and Amy Weinfurter) conducted a field survey of known and accessible aquatic (streams, ponds, wetlands) and riparian habitat within the Coal Creek watershed, Gunnison County, Colorado. These sites included all of Coal Creek from its confluence with the Slate River at the northeast of Crested Butte, CO to the headwaters of Coal Creek near the Irwin Townsite and Ohio Pass. The Coal Creek tributaries of Splain’s Gulch, Wildcat Creek, Evans Basin and the drainage flowing from the Mount Emmons Iron Fen (also known as the Mount Emmons Iron Bog) were also surveyed. This study also included a field survey of the riparian areas around the lentic areas of Copley Lake, Green Lake, Lily Lake, the Crested Butte Town Reservoir and the Mount Emmons Iron Fen. Some areas around the Mount Emmons Mine, private land immediately downstream from the Town of Crested Butte and various remote areas that were assumed to have minimal or no impacts and which would have taken an inordinate amount of time to visit were not field surveyed.

The riparian and aquatic habitats included in this report were assessed using protocols similar to those in Chapter 5 in Barber and others (1999); and Prichard and others (lotic waters 1998, lentic waters 1999). In using these and similar protocols, we assessed the watershed for characteristics such as: Epifaunal Substrate/Available Cover, Substrate Embeddedness,

Velocity/Depth Regime, Sediment Deposition, Channel Flow Status, Channel Alteration, Bank Stability, Frequency of Riffles, Vegetative Protection, Width of Riparian Zone, Age-Diversity of Riparian Vegetation, Appropriate Riparian Soil Moisture Characteristics, Lateral and Vertical Stream Channel Stability, Dominant Riparian Vegetation Type, Watershed Contributions to Stream Degradation, Overall System Hydrology, Riparian Plant Vigor, Presence of Substantial Amounts of Trash and Presence of Known Noxious/Invasive Weeds. These individual criteria were noted on forms represented in Appendices 1 through 3 and functional scores were provided where applicable that range from a low of 0 to a high of 180. Alternatively, some areas were scored using Proper Functioning Criteria (see Prichard an others 1998, 1999 for further definitions) into:

Proper Functioning Condition – when the riparian zone is achieving all of its potential and is performing all of the riparian functions

Functional – At Risk – when the riparian zones are impacted making them susceptible to degradation

Nonfunctional – are clearly not providing their main functions of reducing erosion, improving water quality and dissipating stream energy at high flows.

Prior to the field survey, the participants analyzed representative sites along Coal Creek together and calibrated ourselves to the metrics being used in the Appendices (1-3). When questions arose or critical designations were in question, we then consulted each other and analyzed the sites together. The Colorado Natural Heritage Program (CNHP 2009) field tested Ecological Integrity Assessment protocol for Subalpine-Montane Riparian system that is similar to the ones used by the authors and in a similar habitat. The CNHP found that the biological condition metrics used in the Ecological Integrity Assessment and most similar to the ones used in this study were “robust and reliable” indicators of riparian condition. Additionally, the CNHP found that overall “Ecological Integrity” scores are reliable across users which supports the use of three calibrated observers in this study.

Based on the above criteria, the watershed segments were then analyzed, scored (Appendix 1-3) and characterized as to their “health” and functioning. These watershed segments were photodocumented, points were taken in the field using a Thales ProMark3 GPS unit in WGS 84 and maps were produced that illustrate the various watershed segments and their classification. Impaired areas were then prioritized for restoration based on issues such as the potential impacts of continued or future degradation, feasibility and degree of impairment.

Results

The following are riparian zones in Coal Creek that are divided into areas of similar riparian condition or functional units for analysis. These areas are represented, numbered and color coded on Map 1 and the results of our field discussion listed below follow these numbers and segments. The "Assessment Segments" along the mainstem of Coal Creek are numbered consecutively going upstream from the confluence with the Slate River from segments 1 to 13 with tributaries numbered 13 through 16. Map 2 also represents these areas but they are color coded according to priority of restoration with red being high, yellow moderate and green low priority or no restoration is needed. Also, Cooper (1993) documents the wetlands along some of the sections that are covered here. The Cooper (1993) data is referenced where relevant.

Mainstem of Coal Creek

Assessment Segment 1: Confluence with the Slate River to the upstream fence on Crested Butte Land Trust (CBLT) property. (Scores: 128/180. Functional at Risk with downward trend)

In this segment the riparian vegetation, primary willows, is removed and major erosion occurring due to overgrazing of the riparian zone (Photograph 1) by cattle as this is evident by the change noticed upstream of the upper boundary fence (Photograph 2). Willows have died, been hedged (tops have been eaten) or mushroomed (lower branches eaten) from domestic livestock grazing. This is causing Coal Creek to widen, braid and increasing the sediment load entering the stream which is covering stream bed habitat. The widening stream also is reducing instream deep water habitat and could be allowing increased stream temperature. These impacts are also reducing the ecological functions of riparian habitats and reducing the aesthetic qualities of this stream section. Additionally, the loss of beaver dams blown out during high water in 2008, may be the result of the widening of the stream in this section making it unsuitable or marginal for beaver activity. The loss of beavers can change the overall functioning of streams as well as altering the hydrology. The impacts from increased sediments in this section are probably negatively impacting the Slate River from the confluence downstream. A similar condition and the loss of beavers were also documented by Cooper (1993).

This section is given a high priority for restoration due to the ongoing dramatic riparian impacts that can be easily remedied. It is recommended that CCWC work with the CBLT and those that possess the grazing rights to either fence cattle away from the riparian zone or manage the cattle in a way to reduce grazing pressure on the riparian zone. Unfortunately, after streams of this type become degraded as this one has, complete restoration of the channel and hydrology is difficult and costly (Rosgen 1996).

Assessment Seqment 2: Crested Butte Land Trust property fenceline upstream to Butte Avenue Bridge. (Scores: 160/180. Proper Functioning Condition).

We did not walk this section since it is private property but we observed it from both the upstream and downstream property boundaries. There is evidence of historical grazing since most of the willows show some "mushrooming" and the alder, cottonwood and herbaceous plants typical of a riparian system in this area are missing. The riparian area is recovering and has reached a functioning condition which gives strong support that a change in grazing management on the CBLT property downstream can allow for the riparian community there to recover. There are additional indications that dewatering by water diversions has reduced flow and groundwater connections with riparian vegetation.

This segment is given a low priority for restoration since it is occurring but recovery of this section needs to recover. Protecting the riparian zone from overgrazing is important and the greatest means of fully restoring this area aside from what is already occurring is to restore the natural flow of Coal Creek. We do recognize that this would be a substantial change in water use and would be impractical; therefore, this section was given a low priority rating for restoration.

Assessment Segment 3: Town of Crested Butte from Butte Avenue Bridge to Kebler Pass Road /Whiterock Bridge. (Scores: 120/180. Functional at Risk to Nonfunctional with no apparent trend).

This section passes through the urban town of Crested Butte (Photographs 3 – 6) where most of the riparian vegetation has been removed and channelization has left any riparian vegetation hydrologically disconnected from groundwater. Additionally the natural floodplain is gone and the channelization of the stream has homogenized the stream bed. Also due to the channelization (Photographs 3 and 4), the stream has loss its natural vertical and horizontal movement. Due to these factors, Coal Creek and its riparian zone has loss most of its ecological functions along with its ability to dissipate the energy of flowing water. The creek has the ability to dissipate most annual floods but a larger flood event could prove catastrophic. Also of note is the thinleaf alder (*Alnus incana* subspecies *tenuifolia*) die-off (Photograph 5) that is occurring through this segment and has been documented elsewhere (Worrall, 2009).

Ideally, restoring the riparian zone through the Town of Crested Butte could provide a corridor for connecting intact riparian areas upstream to those downstream thus increasing animal migrations and reducing some of the stream impairments. This would also restore much of the

ecological functions and provide an added level of human safety. However, with the construction that has occurred in the riparian zone in this stretch, this would be difficult to achieve especially working with such diverse property owners. Additionally, there were several piecemeal studies conducted by the Federal Emergency Management Agency that resulted in some channelization of the streambed and gabion placement to stabilize the banks. For example, channelization above the Old Town Hall contributes to the standing waves on the west side of the building during the high flow events and the resultant safety concerns and repairs. We would recommend that future watershed planning efforts include efforts to have a holistic plan for engineering coupled with restoration of the streambed and riparian zone through town. This could involve the development of some form of "greenbelt" through Crested Butte that could enhance the aesthetic and human values of Coal Creek along this stretch. However, where possible the planting of native trees and shrubs at areas toward each end of Crested Butte would reduce the distance the riparian zone is fragmented as well as enhancing the stream ecology.

Assessment Segment 4: Kebler Pass Road/Whiterock Bridge to Spann-Netick Diversion (Scores: 168/180. Proper Functioning Condition)

This section is near the western edge of the Town of Crested Butte and is paralleled by Kebler Pass Road. The close proximity to town results in a high human use and shows impacts associated with this high use. Kebler Pass Road impinges on the riparian zone with some sediment entering from the roadway (Photograph 7). The Halazon and Spann-Netick diversions are reducing the riparian zone (Photograph 8) due to their construction and maintenance activities along with the loss of water reducing riparian and stream habitat below due to reduced flows and reduced groundwater. Also due to human activities there are a variety of noxious weeds in the riparian zone present along dirt road used for maintenance of the diversions. Weed list includes *Artemisa absinthe*, *Matricaria perforata* (Scentless chamomile), *Linaria vulgaris* (Yellow toadflax), and *Cirsium arvense* (Canada thistle).

Some coke ash piles (Photograph 9) are eroding into stream causing a sediment issue and the piles themselves covering some of the vegetation in the riparian zone. This coke ash is probably a remnant of the 154 coke ovens that were built in 1884 possibly associated with the Jokerville mine and thus has been impacting the riparian zones for well over a century.

We recommend reducing sedimentation coming from road and slope by stabilization these sections and using Best Management Practices for road maintenance. To reduce the impacts from the diversions, water users should consider engineering the diversions to minimize repeated seasonal maintenance which involves instream disturbance as well as impacting the

riparian vegetation. The noxious weeds should removed by hand pulling, spraying, burning or alternatively by goats trained to forage on noxious weeds may alleviate concerns about herbicide use near town or in an area regularly used by residents. The use of this area by residents and visitors with their pets also leaves a noticeable amount of pet feces along the riparian zone which may be causing a fecal coliform issue and also releasing trace amounts of pet medications. Users of this area should be encouraged with signage to remove their pet feces.

Removal of the coke ash pile that is eroding into the stream and impinging on the riparian vegetation should be removed and this can be coordinated with the Colorado Division of Reclamation, Mining and Safety (DRMS). Since this waste is coal based there is severance tax based funding available and the removal can be done in conjunction with other reclamation activities planned for 2010.

These activities are not of immediate concern except for the coke ash removal. However, these other restoration activities should be relatively easy and have low associated costs. The engineering of the diversions structures may be an exception.

Assessment Segment 5: Spann-Netick Diversion to Wildcat Bridge (Score: 149/180 Proper Functioning Condition)

This segment is in healthy condition with minimal impacts. Kebler Pass Road causes sedimentation of Coal creek in many locations along this reach however the implementation of Best Management Practices (BMPs) such as rock check dams, erosion control and revegetation that are proposed for this area could help alleviate this problem. The BMPs associated with the debris flows coming from Kebler Pass Road east of the Keystone Mine site and culvert repair appear to be the most urgent needs.

There are several pipes (Photograph 10) from an emergency, Town of Crested Butte water supply replacement during the winter of 1976-1977 that were left in the riparian zone. These are causing minimal disruption of the riparian zone but a strategic removal of these that would minimize the disturbance of riparian vegetation, possibly scheduled while there is snow, would improve the aesthetics of this area.

Assessment Segment 6: Wildcat Bridge to Town of Crested Butte Water Diversion (Scores: 140/180. Functional at Risk with no apparent trends)

In this segment there is impairment due to major channel homogenization above and below Town of Crested Butte Water Diversion (Photograph 11) where there is a reduction of stream habitat types. Engineering a better diversion structure coupled with restoring the natural stream bed would greatly improve this area. This restoration activity may reduce maintenance costs to the Town of Crested Butte.

In addition to the reduced water flows downstream from the diversion, there is dramatically fluctuating discharge and mineral deposition on creek substrate from the Keystone Mine outflow and the outflow drainage has reduced riparian vegetation. The Keystone Mine outflow also has eroded down the steep drainage from Kebler Pass Road to Coal Creek (Photograph 12). Reducing the repeated, major and rapid flow fluctuations and restoring the riparian vegetation would be beneficial but the erosion caused by the increased flows from the mine discharge would be difficult to restore due to the steep slope, the nature of the water discharged and the erosion that has already occurred.

The outflow from the Town of Crested Butte Reservoir also is eroded similar to the Keystone Mine outflow and in needed of restoration. Attempts should be made to stabilize the slopes and to restore riparian vegetation such as planting willow cuttings.

Assessment Segment 7: Town of Crested Butte Water Diversion to near Splains Road (Scores: 175/180. Proper Functioning Condition).

This section has a riparian corridor that is in excellent health and is one of the highest quality stream sections on Coal Creek. There are some minor impacts from Kebler Pass Road maintenance with its increased sediment load. The implementation of BMPs will help reduce this sediment loading and some of the road maintenance impacts. Paving or chip-sealing Kebler Pass Road would greatly reduce these impacts but may increase other impacts such as increased traffic and more rapid runoff of road waste.

Assessment Segment 8: Splains Road to Irwin Forks (Scores: 150/180. Functional at Risk).

In this segment, the stream gradient is relatively low and the valley widens with a broad riparian corridor. Due to this, Coal Creek has large, natural meanders while Kebler Pass Road passes near the creek and within the riparian zones. With the location of Kebler Pass Road in the riparian zone here it reduces riparian vegetation and the road reduces the natural movements of Coal Creek thus influencing sinuosity and depth regime. Kebler Pass Road maintenance reduces bank stability and increases sedimentation. The fine sediments and small

gravel that enter Coal Creek reduce instream habitat quality (Photograph 13). Additionally the placement of culverts with fast flow and minimal natural streambed features probably limits fish movement between segments (Photograph 13).

Road removal is not a viable option but the use of Best Management Practices or paving to reduce fine sediments entering this section of the stream is recommended. The use of "Bottomless Arch" culverts increases streambed habitat, reduces rapid water flow and may allow for easier fish passage. These impacts are large and the sedimentation affects downstream creek segments thus restoration in this area should be a priority.

Assessment Segment 9: Irwin Forks to Ohio Pass (Score: 160/180. Functional with downward trend except Non-functional at mill site).

This segment is a large wetland and riparian complex that functions as one fork of the headwaters of Coal Creek. The riparian zone in this area is healthy except for Kebler Lumber Mill/The Ender Lumber Company (TELCO) mill sites (Photograph 14 and sites closer to Irwin Forks) which was placed in a wetland and is surrounded by wetland/riparian vegetation. Because this area is covered with remnant saw dust, it is a dry island in the surrounding wetlands. This open, drier area has now been utilized as a user created gun range and target shooting area. This area is receiving heavy use and the trash, including lead bullet fragments, is degrading this area further. Also, there is evidence of dispersed camping in this area.

We recommend this area receive high priority for restoration since impacts here also affects the downstream functioning of Coal Creek. It appears that the ground is saturated below the sawdust and thus removing the sawdust, trash and planting locally harvested wetlands plant seeds could restore this area. A water table and soil study should be done that a wetland can be feasibly established prior to proceeding. Additionally, to make this restoration successful, the area should be temporarily closed to human traffic to allow the plants and hydrology to re-establish. This should involve signage and directing recreational shooters to a nearby, more appropriately planned area outside of wetland habitats.

Assessment Segment 10: Irwin Forks to Forest Queen Mine (Scores: 174/180. Proper Functioning Condition)

This segment is a wide riparian area that is a considerable distance from the road is currently one of the highest quality sections of Coal Creek. It appears healthy and in proper functioning condition however there are is the threat to this section from the Forest Queen Mine and town

site of Irwin should conditions deteriorate in those areas and have downstream impacts. It should be noted that the nuisance alga, *Didymosphenia geminata*, is present in this stream segment.

Assessment Segment 11: Forest Queen Mine vicinity (Scores: 108/180. Non-functional)

This segment is highly impacted (Photograph 15) to the point of being non-functional with the stream channel being moved from its original path and the riparian vegetation is almost completely lacking with the few wetland plants in the area of showing stress due to altered hydrology, mine waste or possibly toxic soils. There are also piles of mine waste that are eroding into Coal Creek and the nuisance alga, *Didymosphenia geminata* covers the stream bed. Also, some of the water has been diverted into ponds in the area.

This is one of the most altered and impacted stream segments in the watershed. Restoration of this segment would involve removing the mine waste, analyzing sediment for toxicity, restoring the original channel, removing the ponds, and replanting riparian vegetation. These restoration costs are probably higher than in other stream segments but the benefits would be great since this is a headwaters zone where riparian function is of high value and there is potential impacts on downstream communities should the condition continue or worsen. Additionally, pond dam failure and sediment release could be a hazard. The Colorado Division of Reclamation, Mining and Safety and federal entities could be a useful partners in this restoration since it is an abandoned mine.

Assessment Segment 12: Irwin Townsite (Scores: 162/180. Proper Functioning Condition)

This segment begins as a transbasin diversion from Lake Irwin and flows through the Townsite of Irwin. There are some minor impacts to riparian zone from the historical construction housing and road crossings within or very near the riparian wetlands. The flow regime is altered from diversion out of Irwin Lake and the nuisance algae, *Didymosphenia geminata,* is present throughout this entire segment.

No restoration is currently recommended but road Best Management Practices and town site planning to remain out of the riparian zone and wetlands is encouraged.

Tributaries

Assessment Segment 13: Evans Basin (Score: Proper Functioning Condition)

This drainage is in near pristine condition with minimal anthropogenic disturbance but a major avalanche slide recently occurred at the head of this drainage. Additionally, there is some evidence of natural mineralization at the surface. The riparian impacts are limited to one road, one trail crossing and potentially historical impacts from logging and fires**.** The only recommendations would be to maintain the natural aspects of this drainage and to minimize sediment impacts from the road and trail crossing.

Assessment Segment 14: Splains Gulch (Score: Proper Functioning Condition)

This drainage has minimal human impacts except for some road crossings and some minimal encroachment of the road into the riparian zone. We would recommend a low priority for Best Management Practices in a few areas of the road crossing but the road is far from the riparian zone throughout most of the drainage

Assessment Segment 15: Mount Emmons Iron Fen Outflow (Score: Functional at Risk with upward trend)

This riparian areas flows out of the Mount Emmons Iron Fen (Photograph 16), across Kebler Pass Road and into Coal Creek. Historically the outflow was channelized (Photograph 17) to divert its flow to the west and down a drainage to prevent it dispersed flow across a slope above Kebler Pass Road. The historical flow pattern caused slumping onto the road and it caused increased road maintenance and safety issues. However, this channelization and relocation of the flow caused a loss of wetlands and riparian communities across a large area and multiple small drainages. Currently, the diversion is clogged by downed trees and the water has recently ceased flowing in lower reaches of the diversion and has returned to areas, including peatlands, of its historical flow. This is naturally restoring the wetlands and riparian zones of its historical drainage but this natural restoration could be assisted by closing the ditch and returning the flow to its natural wetlands and riparian zone.

We recommend that for maintaining wetlands and riparian habitats that this natural restoration continue and the flow not be returned to the diversion. However, the road

maintenance issues will probably be weighed against the benefits of the riparian and wetland restoration.

Assessment Segment 16: Wildcat Creek (Score: Proper Functioning Condition)

This riparian zone has minimal anthropogenic disturbance except for trail crossing used for recreation such as motorcycle and mountain bike riding. There is also substantial amounts of Large Woody Debris indicating a healthy system and may help this creek serve as a reference condition for the watershed. There is some natural erosion into the riparian zone from steep hillsides at regular intervals along the drainage. Occasional sand bars and embedded rocks were a result of the steep drainage and the erosion. We found no sign of degradation from the Trappers Crossing subdivision except for straightening of Wildcat Creek below the culvert and one trash site. Additionally, in this drainage there are some dispersed campsites that are impacting the riparian zone.

No restoration is required at this time but BMPs on the road crossing and potentially installing bottomless arch culverts should be considered. Potentially closing the riparian zone to camping may be considered for land use change.

Lentic Areas

We visited the Mount Emmons Iron Fen (Photograph 16 and 17), Copley Lake (Photograph 18), Green Lake (Photograph 21), Lily Lake (Photograph 19) and the Town of Crested Butte Reservoir. Overall, these all had riparian zones that were in proper functioning condition. There were only some impacts to riparian zones by recreating humans that is causing some erosion, particularly to Green Lake. These impacts are minimal and difficult to regulate so no restoration is recommended at this time but the areas should continue to be monitored for deterioration. The Town of Crested Butte Reservoir had a riparian zone in Proper Functioning Condition except numerous noxious weeds were at the southeast end of the Reservoir. It is recommended that these be controlled by methods that would notinclude the use of herbicides since this is Crested Butte resident's drinking water.

Restoration Priorities.

Overall, the riparian condition of Coal Creek, its tributaries and lakes is in relatively healthy condition. There are some areas in need of restoration and the **highest priority areas** are:

-Forest Queen Mine Reclamation and Stream Restoration (Assessment Segment 11).

-Kebler Lumber Mill/The Ender Lumber Company (TELCO) Mill site Wetland Restoration (Assessment Segment 9).

-Implementation of Best Management Practices along Coal Creek between Splains Gulch and Irwin Forks (Assessment Segment 6).

-Engineering and Design of Riparian Corridor through the Town of Crested Butte (Assessment Segment 3).

-Cattle Management and Stream/Riparian Restoration on Crested Butte Land Trust Property (Assessment Segment 1).

-Coke Ash Removal (Assessment Segment 4).

Of **lower priority** but will still in need of restoration within the Coal Creek are:

-Engineering of Diversions/Ditches to Reduce Riparian and Instream Disturbance from Maintenance (Assessment Segments 2,3,4,5 and 6) with signs describing the diversion and its name.

-Restoration and Flow Management of Keystone Mine Outflow (Assessment Segment 6).

-Best Management Practices and Reduction of Sediment from Road Maintenance (Assessment Segment 6).

-Restoration of the Mount Emmons Iron Fen Outflow (Assessment Segment 15).

In addition to the lists above, noxious weed management and removal is a **high priority** within the watershed and riparian zone in particular. The weeds have the potential to become the dominant species in those areas, displace native riparian plants, reduce biological diversity and reduce the ecological functions and human values of these riparian areas. The Colorado Natural Heritage Program (2009) found, in a watershed within a similar region to the Coal Creek watershed, that the presence and abundance of native vegetation (=absence of non-native and noxious weeds) was a strong predictor of overall riparian quality. The noxious, non-native and/or invasive weeds that were documented during this assessment are primarily located in the vicinity of the Town of Crested Butte and shown on Map 3.

Didymosphenia geminata, a nuisance diatom, is also found in the watershed in background levels but in some area, particularly near the Townsite of Irwin, the levels are covering large areas of the bottom of the stream. In some areas around the world*, D. geminata* has become a major nuisance by covering stream bottoms with thick layers of it stalks which is at the minimum is an aesthetic issue but also some studies have indicated that the productivity of the stream and trout are reduced. Currently, there is no known acceptable means of reducing *D. geminata* abundances to below nuisance levels. We suggest monitoring current research and management issues along with the abundance of *D. geminata* in the watershed to assess if future actions need to be taken.

Of low priority, is the removal of trash within the riparian zone of Coal Creek and tributaries. During our assessment, we noticed several areas where trash occurred. Though none of this trash appeared to be hazardous waste or pose a major risk to water quality or riparian vegetation they are an aesthetic issue that can be removed easily with minimal expense and through the organization of volunteers for a trash removal. These areas of where large amounts of trash (Photograph 20) can be found are shown on Map 4.

Watershed Management Recommendations and Discussion

In general, the riparian area throughout the Coal Creek watershed is generally protected by a 25 foot setback from wetlands for general construction and a 100 foot setback from wetlands for septic systems through the current Gunnison County Land Use Regulations (LUR). There are defined exceptions where these regulations can be modified based on slope or other specific case conditions The Town of Crested Butte has a "Watershed Protection District" that requires a permit for any surface disturbing activity that also follows generally follows LUR stipulations but has some qualitative language preventing riparian or water quality degradation.

There are, however, many studies (see Fischer and others, 2000 for a list) that indicate that the 25 foot setback, as designated in the LUR and generally followed by the "Watershed Protection District" ordinance, is inadequate at protecting water quality. For the sole protection of water quality, studies indicate from 4 meters to 30 meters and the Planner's Guide to Wetland Buffers for Local Governments (Environmental Law Institute 2008) indicate 20 to 175 feet is necessary with corrections for land use intensity, wetland category and slope adjustment. So, the Gunnison County LUR only minimally protects water quality and since water quality maintenance is a concern for the CCWC, then planning for larger buffers from wetland and riparian zones in the Coal Creek watershed should be a priority.

In addition to water quality concerns the CCWC lists "wildlife" as a topic of concern. When wildlife and their habitat (including amphibians, reptiles, birds and mammals) is considered, recommended buffers to riparian zones increases. Of the groups of wildlife needing the greatest buffer zones, the amphibians, reptiles and migratory birds need the greatest zones of protection. These recommendations are often hundreds of meters wide and the Planner's Guide to Wetland Buffers for Local Governments (Environmental Law Institute 2008) indicate that habitat buffers should range from 75 to 300 feet is necessary with corrections for land use intensity, wetland category and slope adjustment. It should also be noted that with the steep slopes on the Coal Creek drainage that the buffer zones for water quality and for habitat are multiplied by up to 1.5. So, the Gunnison County LUR only minimally protects riparian wildlife habitat and if habitat protection and enhancements are a concern for the CCWC, then planning for larger buffers from wetland and riparian zones in the Coal Creek watershed should be a priority similar to water quality protection.

As discussed in the "Introduction to Riparian Ecology and Functions," longitudinal connections down the length of a stream and its riparian zone are important for natural ecological function, organism migration and gene flow. The disruption and breaking up of this connection is termed "fragmentation." Throughout the Coal Creek watershed, the riparian zone and stream is potentially fragmented by roads and housing. In watershed planning, the CCWC should consider maintaining stream and riparian areas that are already contiguous such as Assessment Segments 7 and 10 as well as the tributaries. However, where these segments are separated by more intensive land use, efforts should be made to correct these. The Town of Crested Butte represents the greatest degree of fragmentation along the stretch of Coal Creek and the restoration of the creek through Assessment Segment 3 and the potential development of a "greenbelt" could help remedy some of this fragmentation. Additionally, the implementation of BMPs in Assessment Segment 8 along with the remediation and restoration of the areas around the Forest Queen Mine will also be beneficial at reducing fragmentation. A comprehensive series of Best Management Practices should be implemented along the entire drainage to reduce sedimentation from roadways throughout the entire creek.

Also, within planning it should be considered whether camping (Photograph 20) and other high impact recreational activities should be allowed within the riparian zone within Coal Creek or if it should be directed to specific locations to focus impacts rather than having dispersed impacts. The CCWC should consider working with the U.S. Forest Service to discuss whether dispersed camping should be allowed within a given buffer zone of the riparian habitats. Also, the development of campsite specifically located in upland sites away from riparian or wetland zones may be considered to focus recreational use in specific areas where impacts may not be as harmful.

There is a conspicuous absence of large woody debris (=large, downed trees in the riparian zone and stream) throughout much of the watershed, especially when it is compared to other watersheds in the region with less human activity such as West Elk Creek. Within the Coal Creek watershed, Wildcat Creek and Evans Basin have healthy levels of large woody debris and may represent a reference condition. The overall lack of large woody debris may be a historical artifact of the large fires documented by Prichard (1903) or logging practices. If so, then the slow plant growth associated with the cold and dry climate has resulted in the slow recovery of these forests. Since large woody debris is important for stream and riparian habitat then the amount should increase in the stream through time and the riparian and stream habitat should improve as a result. The presence of large woody debris in the stream or riparian zone should not be removed unless it poses a human safety risk. Wildcat Creek and the upper portion of Evans Basin, within the Coal Creek watershed, are examples of streams with adequate large woody debris.

Lastly, the CCWC or others should develop a coordinated effort to continually monitor and assess the quality and health of riparian zone and stream habitats. This could involve rapid assessments of these areas periodically and the compilation of data. This document could serve as a reference condition and then changes, either positive or negative, could then be document with appropriate actions following.

Acknowledgements

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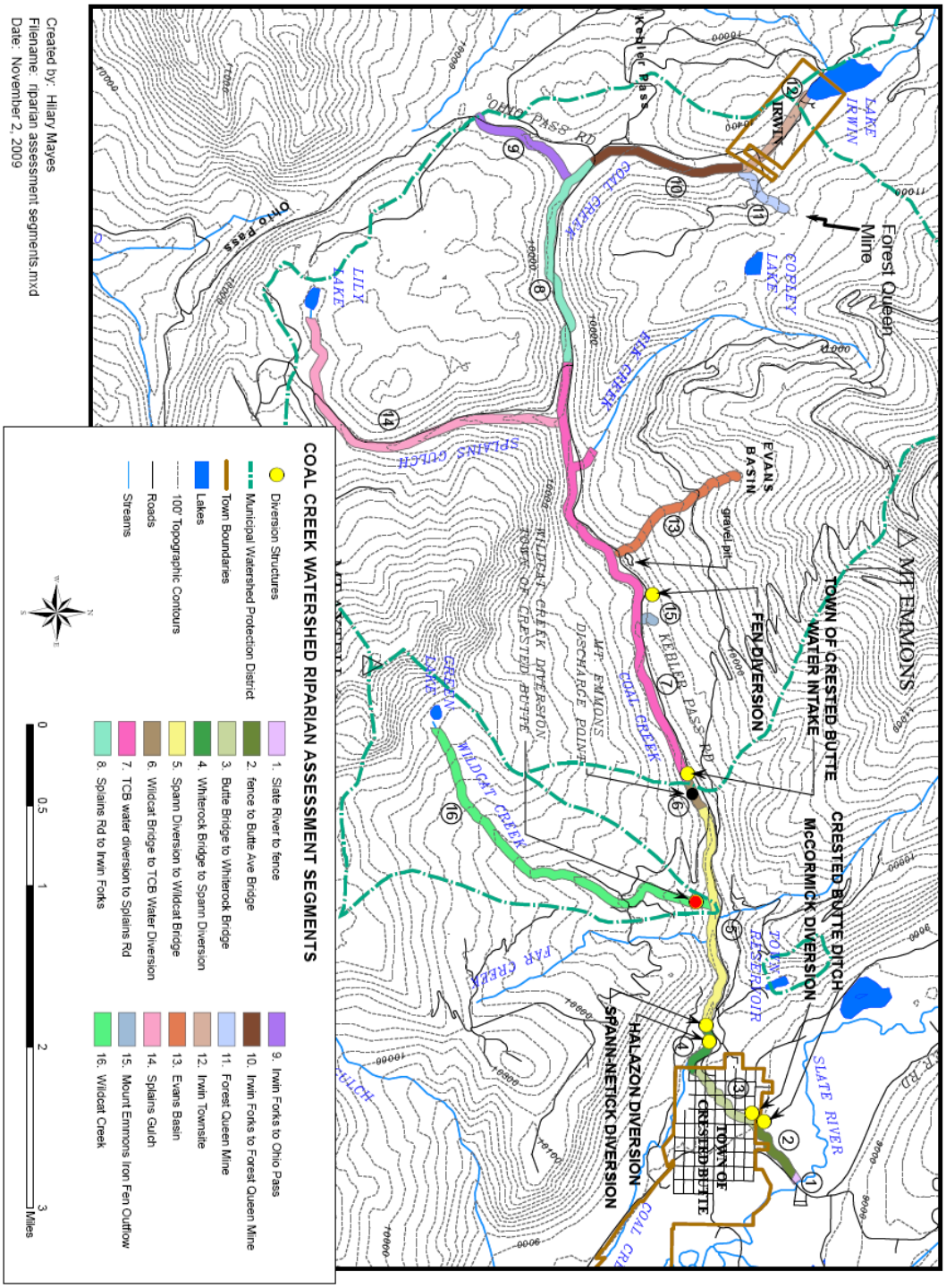
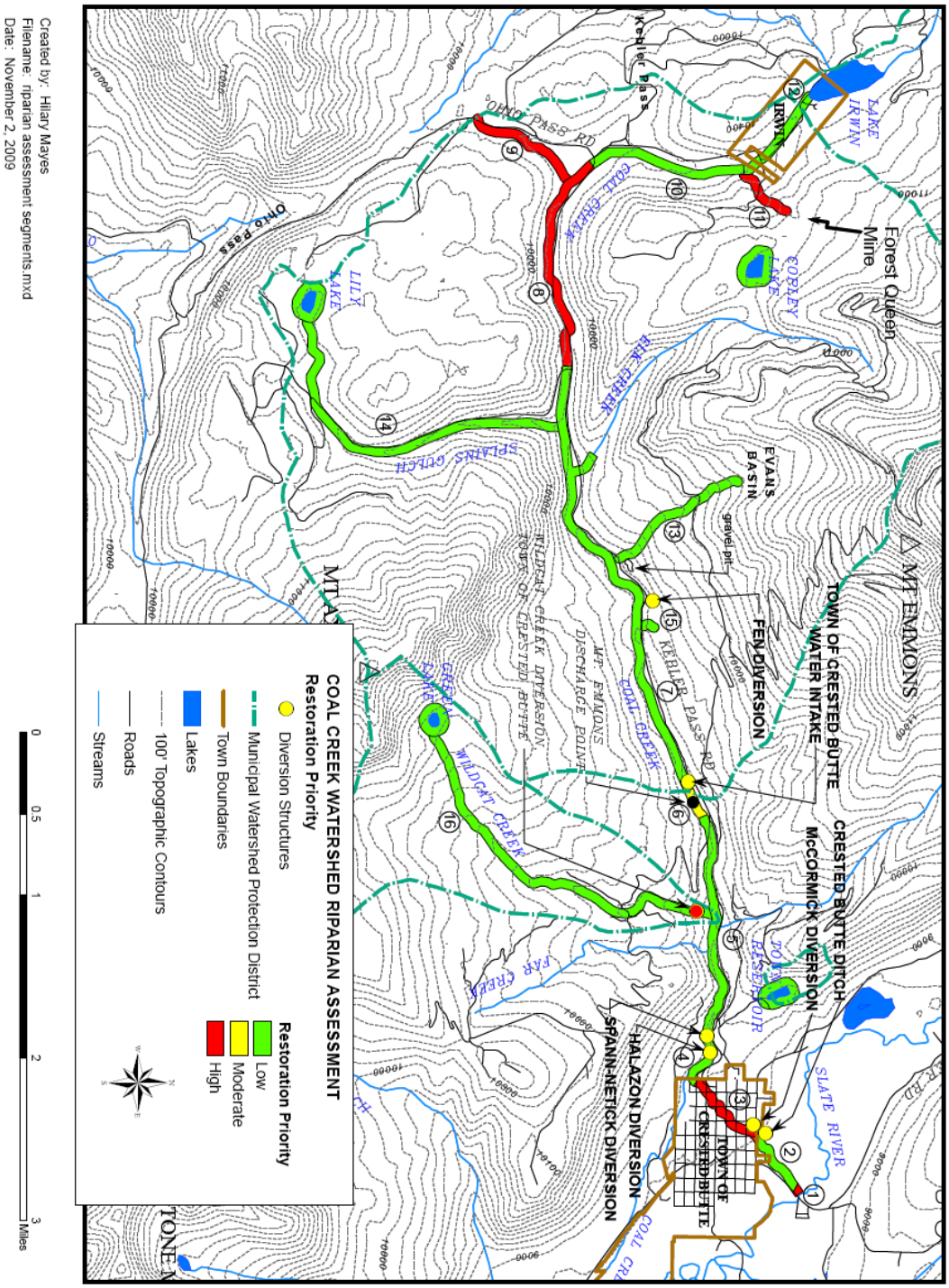
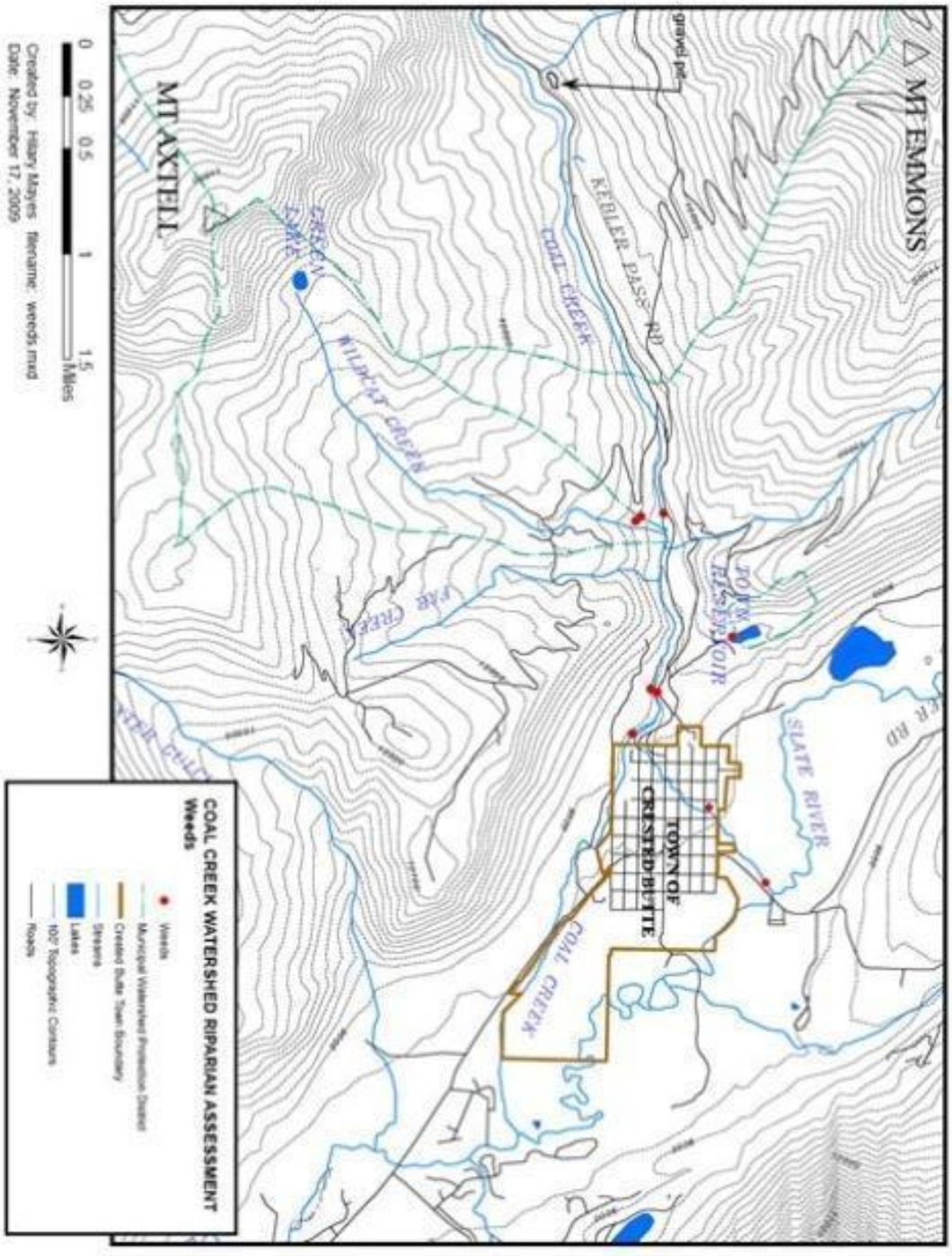
Maps



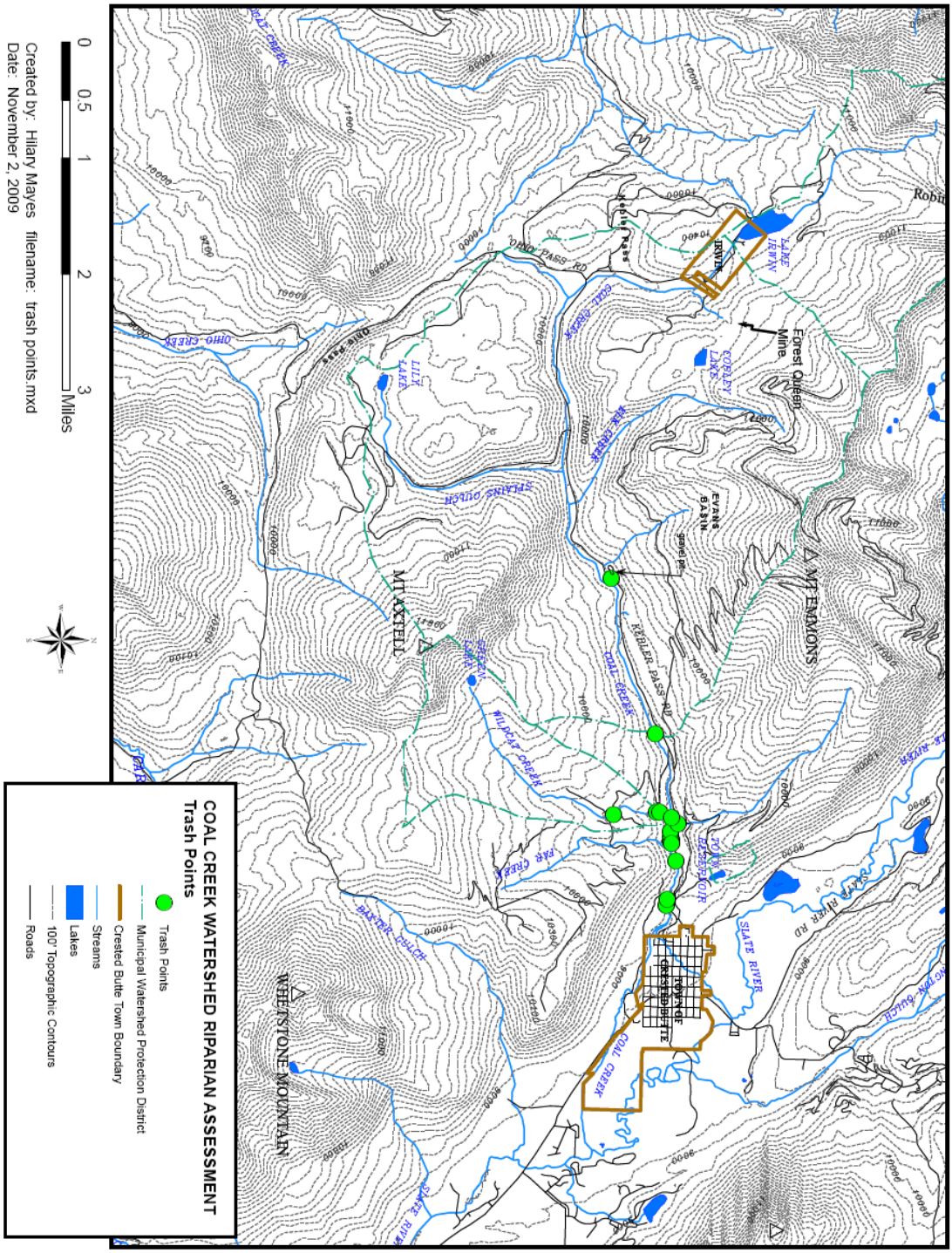
Map 1. Map of the Coal Creek watershed with the assessment segments used in this report numbered and color coded.



Map 2. Map of the Coal Creek watershed with the assessment segments prioritized for restoration priority.

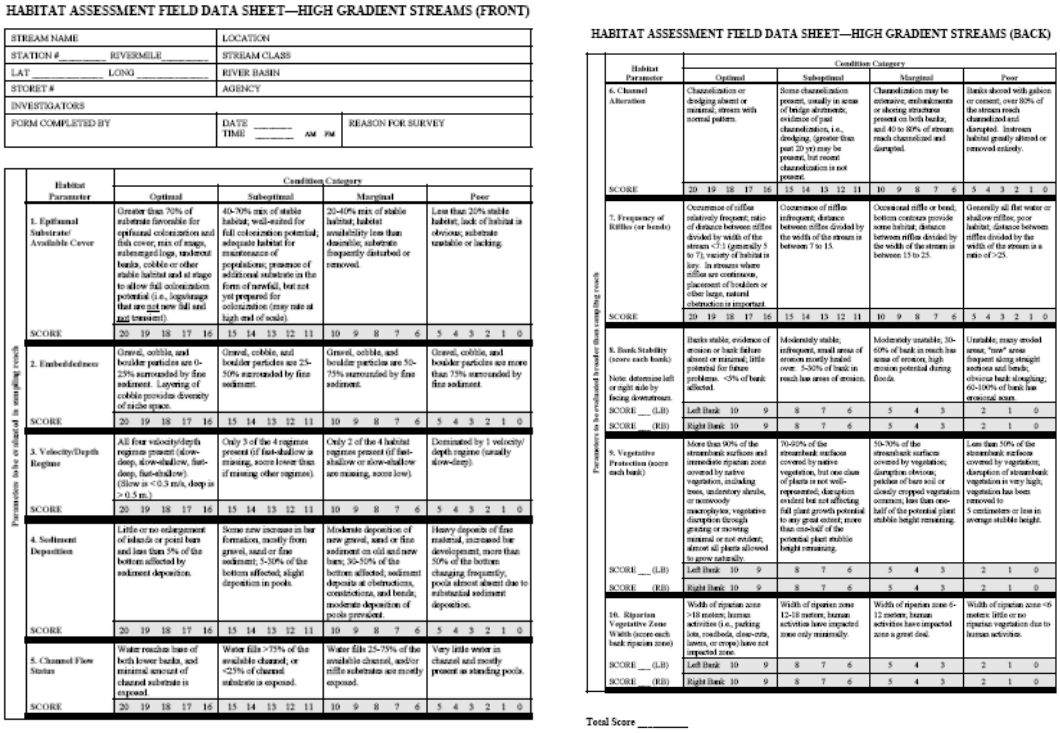


Map 3. Map of the portion of the Coal Creek watershed showing the locations of noxious and invasive weeds that were documented in this riparian assessment.



Map 4. Map of the Coal Creek watershed with the location of large concentrations of trash indicated by green circles.

Appendices



HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION
STATION #_____ RIVERMILE_____	STREAM CLASS
LAT _____ LONG _____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE _____ TIME _____ AM PM / REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is <0.3 m/s, deep is >0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

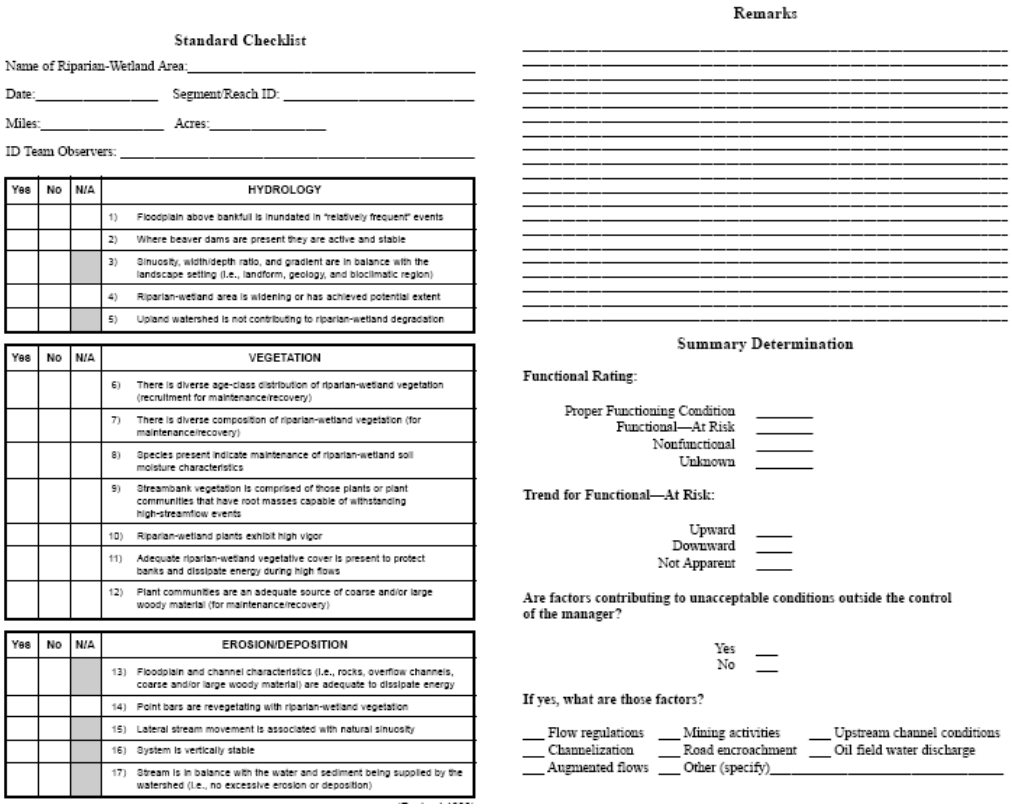
HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score _____

Appendix 1. Data sheets from Barber and others, 1999 used in assessment segment analysis for flowing water sections.



Standard Checklist

Name of Riparian-Wetland Area:_____

Date:_____ Segment/Reach ID: _____

Miles:_____ Acres:_____

ID Team Observers: _____

Yes	No	N/A	HYDROLOGY
			1) Floodplain above bankfull is inundated in "relatively frequent" events
			2) Where beaver dams are present they are active and stable
			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
			4) Riparian-wetland area is widening or has achieved potential extent
			5) Upland watershed is not contributing to riparian-wetland degradation

Yes	No	N/A	VEGETATION
			6) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)
			7) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery)
			8) Species present indicate maintenance of riparian-wetland soil moisture characteristics
			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high-streamflow events
			10) Riparian-wetland plants exhibit high vigor
			11) Adequate riparian-wetland vegetative cover is present to protect banks and dissipate energy during high flows
			12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)

Yes	No	N/A	EROSION/DEPOSITION
			13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy
			14) Point bars are revegetating with riparian-wetland vegetation
			15) Lateral stream movement is associated with natural sinuosity
			16) System is vertically stable
			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks

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Summary Determination

Functional Rating:

Proper Functioning Condition _____
Functional—At Risk _____
Nonfunctional _____
Unknown _____

Trend for Functional—At Risk:

Upward ____
Downward ____
Not Apparent ____

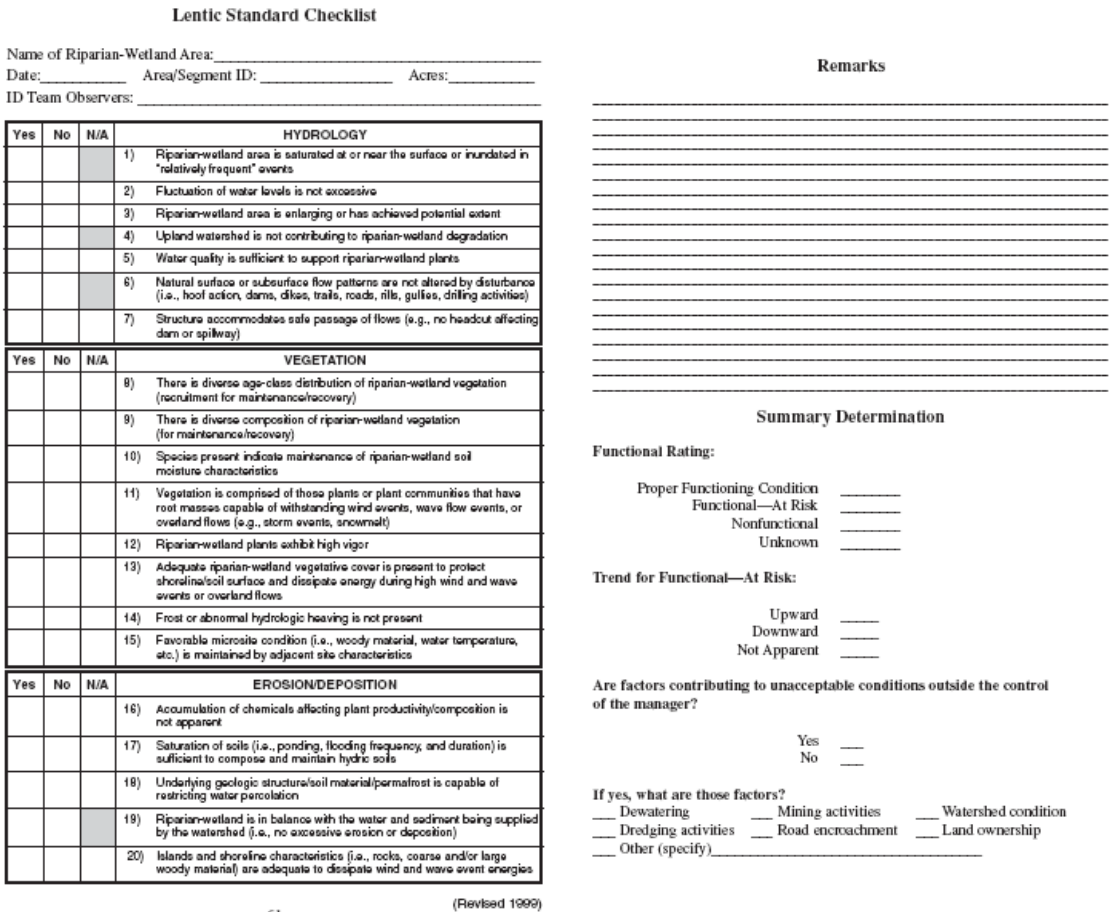
Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No ___

If yes, what are those factors?

___ Flow regulations ___ Mining activities ___ Upstream channel conditions
___ Channelization ___ Road encroachment ___ Oil field water discharge
___ Augmented flows ___ Other (specify)_____

Appendix 2. Data sheets from Richard and others, 1998 used in assessment segment analysis for flowing water sections.



Lentic Standard Checklist

Name of Riparian-Wetland Area:_____
Date:_____ Area/Segment ID: _____ Acres:_____
ID Team Observers: _____

Yes	No	N/A	HYDROLOGY
			1) Riparian-wetland area is saturated at or near the surface or inundated in "relatively frequent" events
			2) Fluctuation of water levels is not excessive
			3) Riparian-wetland area is enlarging or has achieved potential extent
			4) Upland watershed is not contributing to riparian-wetland degradation
			5) Water quality is sufficient to support riparian-wetland plants
			6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)

Yes	No	N/A	VEGETATION
			8) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)
			9) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery)
			10) Species present indicate maintenance of riparian-wetland soil moisture characteristics
			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
			12) Riparian-wetland plants exhibit high vigor
			13) Adequate riparian-wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
			14) Frost or abnormal hydrologic heaving is not present
			15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics

Yes	No	N/A	EROSION/DEPOSITION
			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
			19) Riparian-wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
			20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

(Revised 1999)

Remarks

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Summary Determination

Functional Rating:

Proper Functioning Condition _____
Functional—At Risk _____
Nonfunctional _____
Unknown _____

Trend for Functional—At Risk:

Upward _____
Downward _____
Not Apparent _____

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No ___

If yes, what are those factors?

___ Dewatering ___ Mining activities ___ Watershed condition
___ Dredging activities ___ Road encroachment ___ Land ownership
___ Other (specify)_____

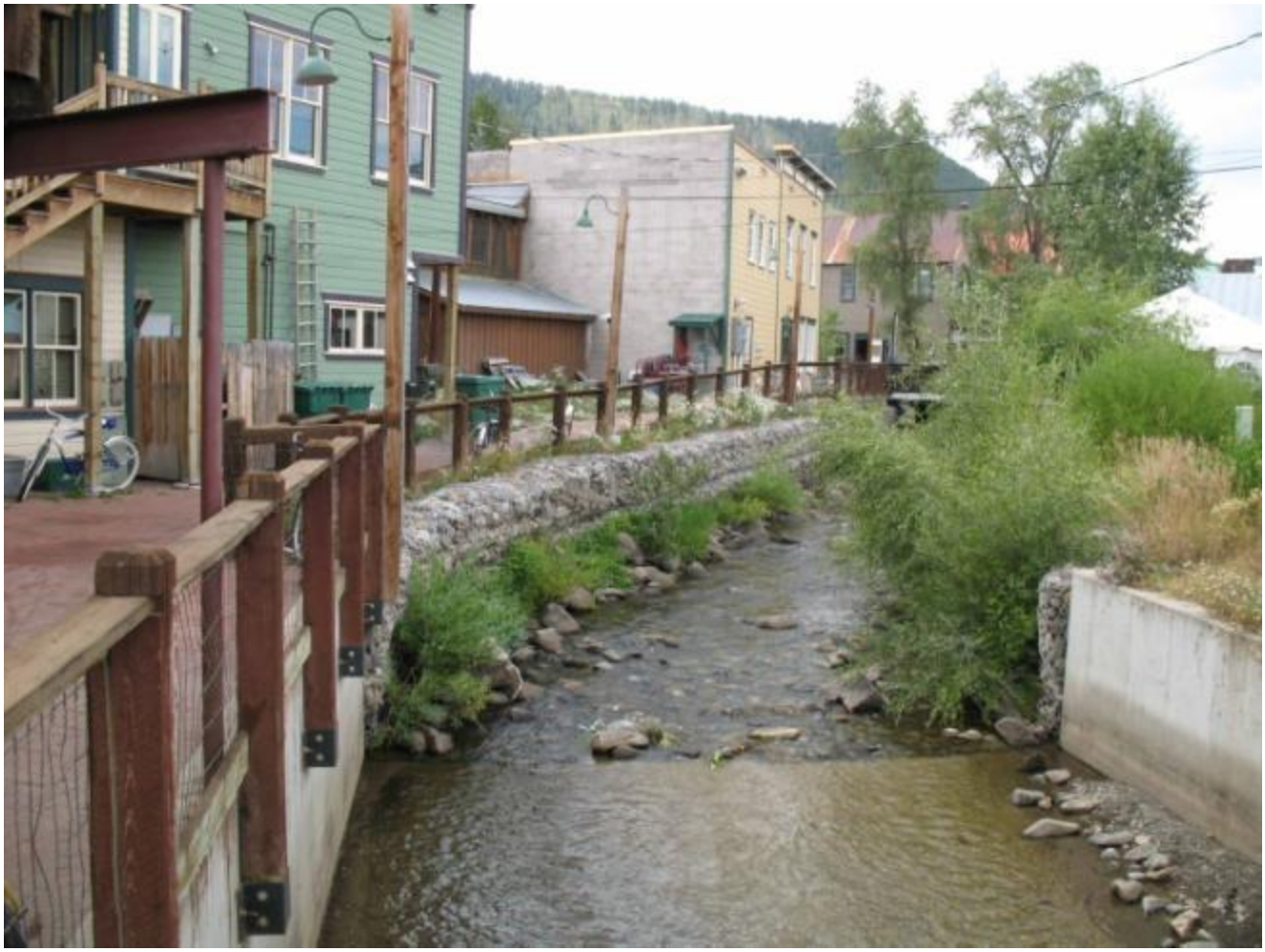
Appendix 3. Data sheets from Richard and others, 1999 used in assessment segment analysis for standing water sections.

Photographs

Photograph 1. Photograph taken August 2009 of Coal Creek above the confluence with the Slate River looking upstream in Assessment Segment 1. Note the streambank erosion and the lack of riparian vegetation.

Photograph 2. Photograph taken August 2009 of Coal Creek looking at the fenceline boundary between Assessment Segment 1 (left) and Assessment Segment 2 (right). Note the streambank erosion and the lack of riparian vegetation on the left and the recovering riparian vegetation on the right. Also, note the grazed zone on the right side of the fence where grazing by domestic livestock occurs through the fence.

Photograph 3. Photograph taken August 2009 looking upstream along Coal Creek in the Town of Crested Butte from the Totem Pole Park bridge. Note the channelization of the creek with gabions and concrete and the resulting reduced riparian zone.

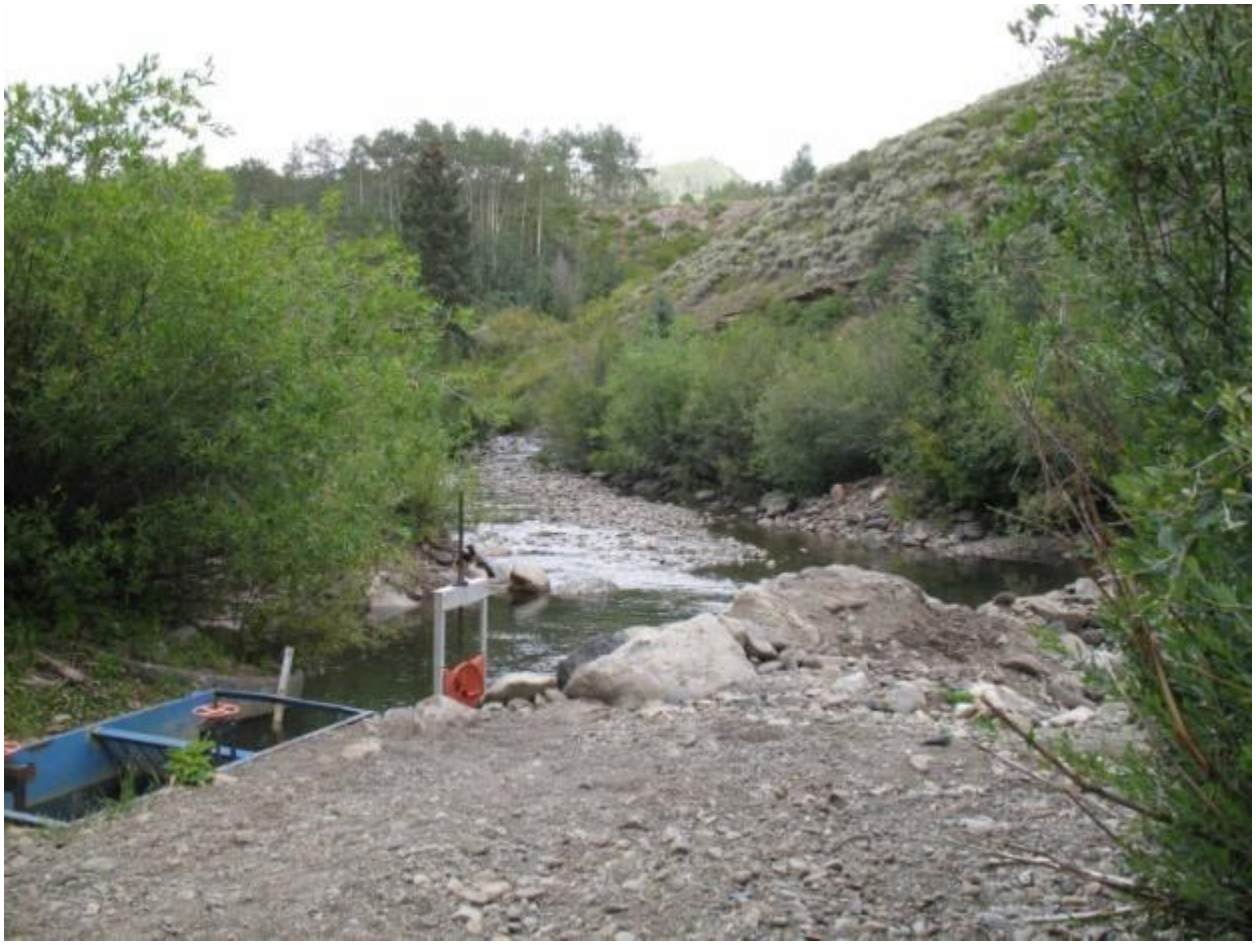


Photograph 4. Photograph taken August 2009 looking upstream along Coal Creek in the Town of Crested Butte behind the Eldo. Note the channelization of the creek and the reduced riparian zone. Also, willows are colonizing the gabions.

Photograph 5. Photograph taken August 2009 looking downstream along Coal Creek in the Town of Crested Butte near Whiterock Bridge. Note the channelization of the creek and the reduced riparian zone on river right. Also note the dying Alders (*Alnus tenuifolia*) on river left.

Photograph 6. Photograph taken August 2009 looking across Coal Creek in the Town of Crested Butte near Third Avenue. Note the channelization of the creek, berming to reduce flooding and the disturbance from diversion maintenance.

Photograph 7. Photograph taken Fall 2009 looking northeast from Coal Creek along Kebler Pass Road. Note the erosion and sediment entering the road as well as the road impinging on the riparian vegetation. Crested Butte Mountain is in the background.

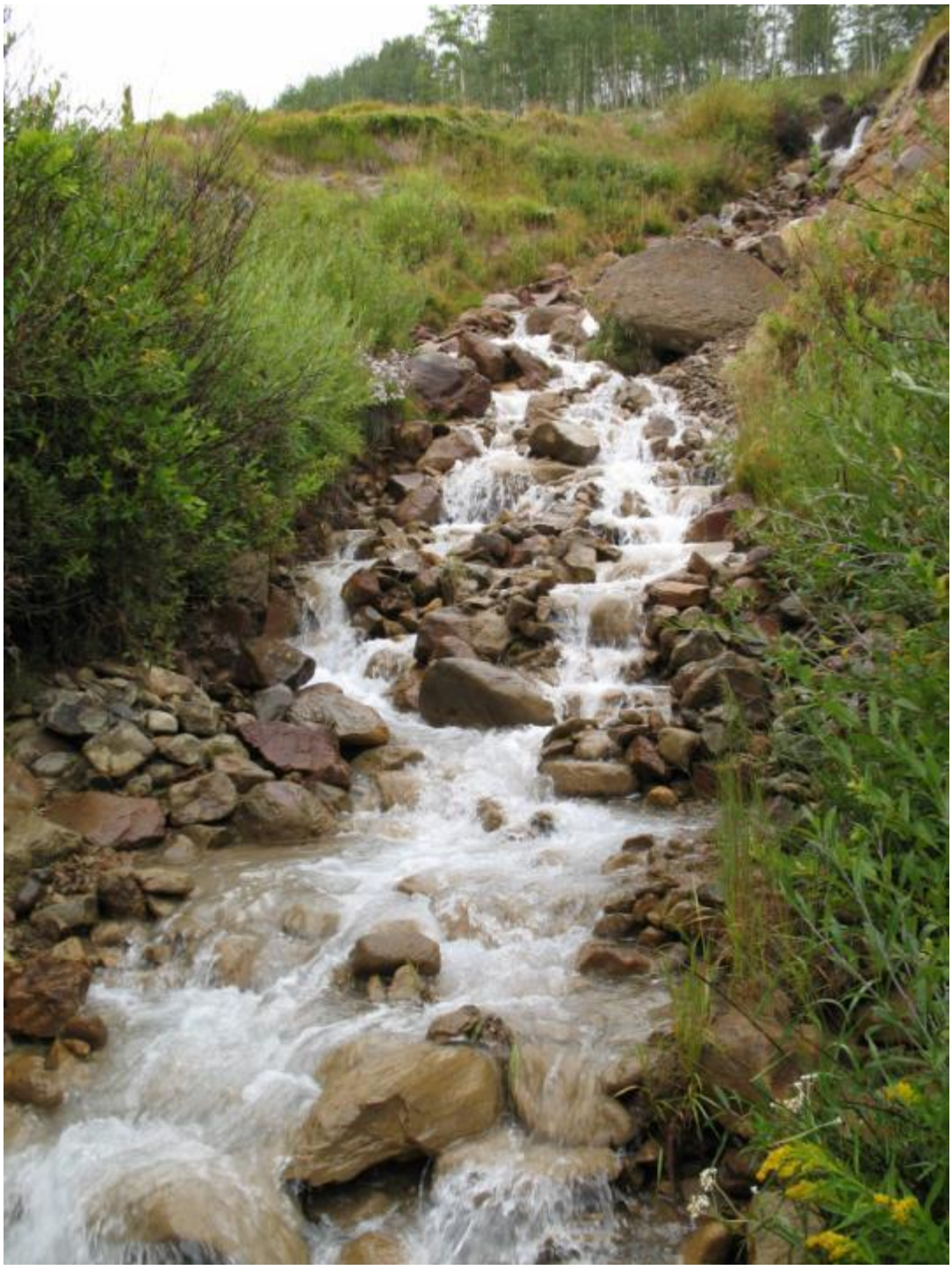


Photograph 8. Photograph taken Fall 2009 looking upstream from Coal Creek from the Halazon Ditch. Note the disturbance to riparian vegetation and the disruption of the streambed from maintenance of the diversion structure.

Photograph 9. Photograph taken Fall 2009 looking into Coal Creek with a coke ash pile eroding into Coal Creek.

Photograph 10. Photograph taken Fall 2009 in the riparian zone of Coal Creek near Wildcat Creek showing pipes remaining from an emergency water pipe replacement in 1976.

Photograph 11. Photograph taken Fall 2009 in Coal Creek looking upstream towards (top) the Town of Crested Butte Water Diversion and looking upstream from above the diversion (bottom). Note the associated debris in the top photograph and the homogenization of the substrate in the bottom photograph.



Photograph 12. Photograph taken Fall 2009 from Coal Creek looking upstream to the Keystone Mine outflow. Note the precipitate on the rocks and the lack of diverse sizes of sediment indicating erosion from rapid fluctuations in flow coupled with reduced sediment inflow.

Photograph 13. Photograph taken Fall 2009 from Coal Creek looking downstream from Splains Road. Note Kebler Pass Road impinging on the wetlands on the left hand side of the photograph, the culvert on the lower left hand corner of the photograph and the turbid water with sediment from road maintenance.

Photograph 14. Photograph taken Fall 2009 at the Kebler Lumber Mill/The Ender Lumber Company (TELCO) mill site that is surrounded by wetland vegetation and hydrology. Wendy Brown is taking GPS reading and note the trash left behind by recreational shooters.

Photograph 15. Photograph taken Fall 2009 of Coal Creek at the Forest Queen Mine Site. Note the altered stream path, the lack of riparian vegetation and the mine waste in the creek and riparian zone.

Photograph 16. Photograph taken Fall 2009 of Mount Emmons Iron fen pond from the pond outlfow.

Photograph 17. Photograph taken Fall 2009 of Mount Emmons Iron fen pond diversion that diverts water away from the wetlands and riparian zone towards a different drainage.

Photograph 18. Photograph taken Fall 2009 of Copley Lake.

Photograph 19. Photograph taken Fall 2009 of Lily Lake.

Photograph 20. Photographs taken Fall 2009 of representative trash found in Coal Creek and its riparian zone.

Photograph 21. Photograph taken Fall 2009 of Green Lake. Notice the bare ground under the tallest tree towards the left and other bare spots to the left due to heavy recreational use of the riparian zone.