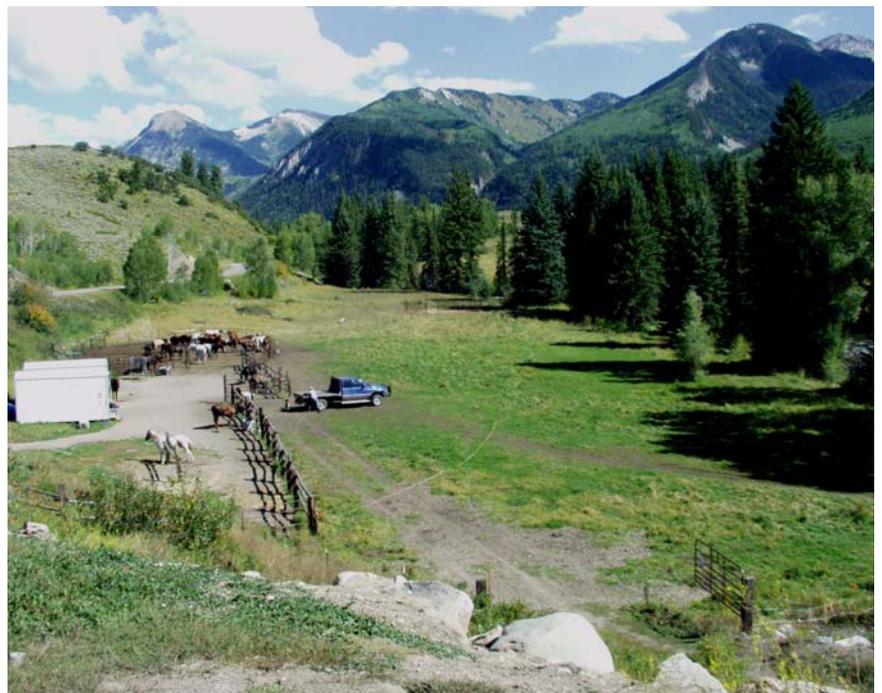


CRYSTAL RIVER, SEGMENT 1

Beaver Lake above Marble to the Base of McClure Pass



Crystal River Segment 1:

Development and recreational pressure threaten stream sustainability. In the photo above beaver activity has created a high quality wetland near the Town of Marble. In the photo below a recreational horse riding operation has resulted in elimination of most of the native riparian vegetation.

6.13.1 Crystal River Segment 1

Number of reaches: 5

Length of segment: 11.23 km

Note: Stream reaches in this segment were delineated by degree and/or type of disturbance, thus one reach may contain one or more stream classes and one or more habitat types.

General description: Crystal River headwaters arise in the Elk Mountains in the White River National Forest at elevations between 11,800 and 12,000 feet. Headwater streams cascade down through steep gorges to the town of Marble, where the gradient suddenly decreases and the valley opens into a wide willow carr. Our assessment begins here just above the town. Surrounding mountains are steep and the watershed is large. Upland habitat is characterized by a mosaic of spruce-fir forests, aspen woodlands and shrublands with each interspersed by various types of herbaceous meadows.

Streams that drain this watershed such as the Crystal, Yule, Carbonate and Lost Creek carry a tremendous amount of energy by the time that they reach the flatter valley where the Town of Marble has been built. When these steep gradient streams suddenly meet the flat valley, energy dissipation occurs rapidly. Channel stability in this transition area requires well vegetated stream banks and floodplain. Currently, abundant beaver activity has resulted in the development of a wide, well-vegetated willow carr just above the Town of Marble but historically, intense mining and related development severely altered the capacity of the channel and riparian zone to absorb and dissipate this energy. Downstream from Marble the stream travels through wide, low gradient valleys interspersed with narrow, steep gorges. Valley floor habitat is characterized by riparian willow carrs dominated by spruce, cottonwood, alder and willow. Habitat in the steeper gorges is characterized by conifer forests on north-facing slopes and conifer mixed with aspen and shrublands on south-facing slopes.

Historically this entire area was dramatically altered by mining operations. The surrounding mountain sides were mined for coal and marble and surrounding spruce-fir forests were logged out. Headwaters of the Crystal were dammed for electricity, stream banks were completely devegetated and riprapped with marble to accommodate the numerous railroads that hauled out ore, marble and coal, and the wide riparian area was built over with ore processing plants, stores and homes. Over time, natural processes have restored much of the mine-damaged landscape but changes to the river channel continue to affect stream dynamics. Although more recent changes to the channel and surrounding floodplain have been minor in comparison, current development nonetheless contributes to stream instability and has had the effect of halting the natural restoration process.

Some of the stream reaches in this segment are stabilizing; others continue to be unstable and degraded due to new or ongoing human disturbances. Current or new human-induced stream impacts result from agricultural, recreational and residential development in riparian areas and along stream banks. Ongoing historic impacts to stream sustainability occur from roads, the railroad grade, townsite impacts, and destabilization of the stream-riparian ecosystem.

Channel condition: Historically, mining and related activities likely destabilized the stream system, which resulted in channel braiding, bank failure and channel widening. In these areas stream structure and velocity/depth regime is simplified. In those areas where the valley narrows and the channel are controlled by bedrock, channel structure is typically stable with a diverse velocity/depth regime. Currently, residential, recreational, and agricultural development in the riparian zone and along stream banks has resulted in channelization, bank destabilization, erosion and ultimately stream imbalance.

Hydrologic alteration: Channel alteration and a reduced amount and extent of beaver activity results in hydrologic alteration throughout the segment. In numerous areas along the segment, downcutting, riprap and erosion inhibits overbanking, which reduces ground water recharge and subsequent base flows. Beaver activity is isolated to a few small areas in the segment. Thus beaver activity has only a small, albeit positive, effect on stream hydrology; where stable dams occur flooding flows are stored in ponds that then slowly release water to supplement base flows.

Riparian habitat: Depending on soil moisture and slope aspect, riparian habitat is characterized by one or more tree species including narrowleaf cottonwood, Colorado blue spruce, Engelmann spruce, subalpine fir, Douglas fir, quaking aspen and thinleaf alder. Each of these tree species is also associated with a characteristic variety of shrubs including Rocky Mountain maple, mountain ash, willow species, twinberry honeysuckle, red-osier dogwood, Wood's rose and gooseberry.

Although much of the riparian habitat has been altered by historic and recent human development, two reaches are noteworthy for their high quality riparian and stream habitat. The first is at the top of the segment just above the Town of Marble. Here beaver activity has created high quality wetland habitat that is characterized by montane willow carr and dominated by thinleaf alder, and willow species, including Drummonds, strappleaf, coyote, whiplash and mountain. These wetlands provide excellent potential for breeding neotropical migrant songbirds and waterfowl. This area is threatened by development and recreational pressure. The other high-quality riparian area is found in a narrow, steep gorge with habitat that is characterized by montane riparian forests. North-facing slopes are dominated by subalpine fir, Engelmann spruce, Colorado blue spruce and thinleaf alder; South-facing slopes are dominated by narrowleaf cottonwood, Douglas fir and aspen. In this reach threats are minimal and wildlife potential is high. Both of these reaches are highlighted in the Conservation Areas of Concern section below.

Wildlife: Wildlife potential in this beautiful mountain valley is greatly diminished by development. Survival for most (>80%) native wildlife in Colorado requires access to stream and riparian habitat at some time during the year. Much of the riparian habitat along this segment of the Crystal has been taken over by human development. Human-dominated habitat is, in essence, lost to many native wildlife species that are sensitive to human disturbance.

The majority of the surrounding uplands are managed by the USFS and much of this land is designated Wilderness Area. However, recreational pressure is high and a legacy of mining with associated roads results in disturbance and habitat alteration that reduce wildlife potential.

Threats and management recommendations: We use the following premises to define threats and identify corresponding management actions that should be taken to remediate threats:

1. To protect and conserve stream resources the ecological processes that support the stream must be preserved.
2. Management strategies should take into consideration the differential potential for disturbance based on stream class, surrounding geology and native riparian ecosystems.

Threats

- Historic stream destabilization from mining and related activities
- Residential development in the riparian zone and on stream banks
- Recreational impacts;
 - Developed campsites along the stream banks and in the riparian zone;
 - Social trails and trampling;
 - Recreational airplane landing strip in a riparian zone;
 - State wildlife fishing ponds dredged and/or dammed in wetland/riparian areas
- Roads
 - Source of excess stream sediment and pollutants
 - Wildlife hazard
- Off-road vehicle use in riparian areas
- Noxious weeds
- Nutrient enrichment

Management Recommendations

- Develop and implement a watershed restoration plan that addresses the historic and current causes of stream destabilization and riparian degradation.
- Work with the County to develop riparian setback guidelines that will protect and conserve the sustainability of the stream ecosystem.
- Work with the USFS to redevelop or close the developed lower Bogan Flats campground; move campsites and picnic areas away from the river; identify and designate appropriate stream access trails; and close social trails.
- Work with the State Wildlife agency to redevelop fish ponds into sustainable wildlife habitat.
- Revegetate road cuts to mitigate erosion and install sediment/pollutant traps
- Install wildlife warning lights that are triggered when wildlife is crossing the road; install “rumble strips” to slow traffic.
- Implement an aggressive weed eradication program.
- Identify nutrient sources and remediate the problem;
- Revegetate stream banks with an effectively wide riparian filtration zone.

Conservation Areas of Concern: We feel that the following Conservation Areas of Concern are, or have the potential to be, especially valuable to wildlife. We have singled out these areas due to current or potential future threats to stream and wildlife values. Some of these areas in the watershed are currently in ecologically sustainable condition; others are not and are in need of management action to restore ecological health. Regardless of the current condition, each area has especially important wildlife potential. Only a few areas in this segment occur where riparian and stream habitat is intact and functional – these should be vigorously protected. These areas include:

CR1-1: At the top of the reach where Yule Creek has its confluence with the Crystal River a large willow carr is sustained by beaver activity. The beaver-willow ecosystem has been essential to stream restoration. This habitat provides excellent songbird breeding habitat and very high wildlife potential. Uncontrolled recreation threatens riparian and stream wildlife values. Appropriately located trails should be identified and hardened; social trails should be closed and revegetated; cars should be prohibited from driving on stream banks; and educational signage should be installed.

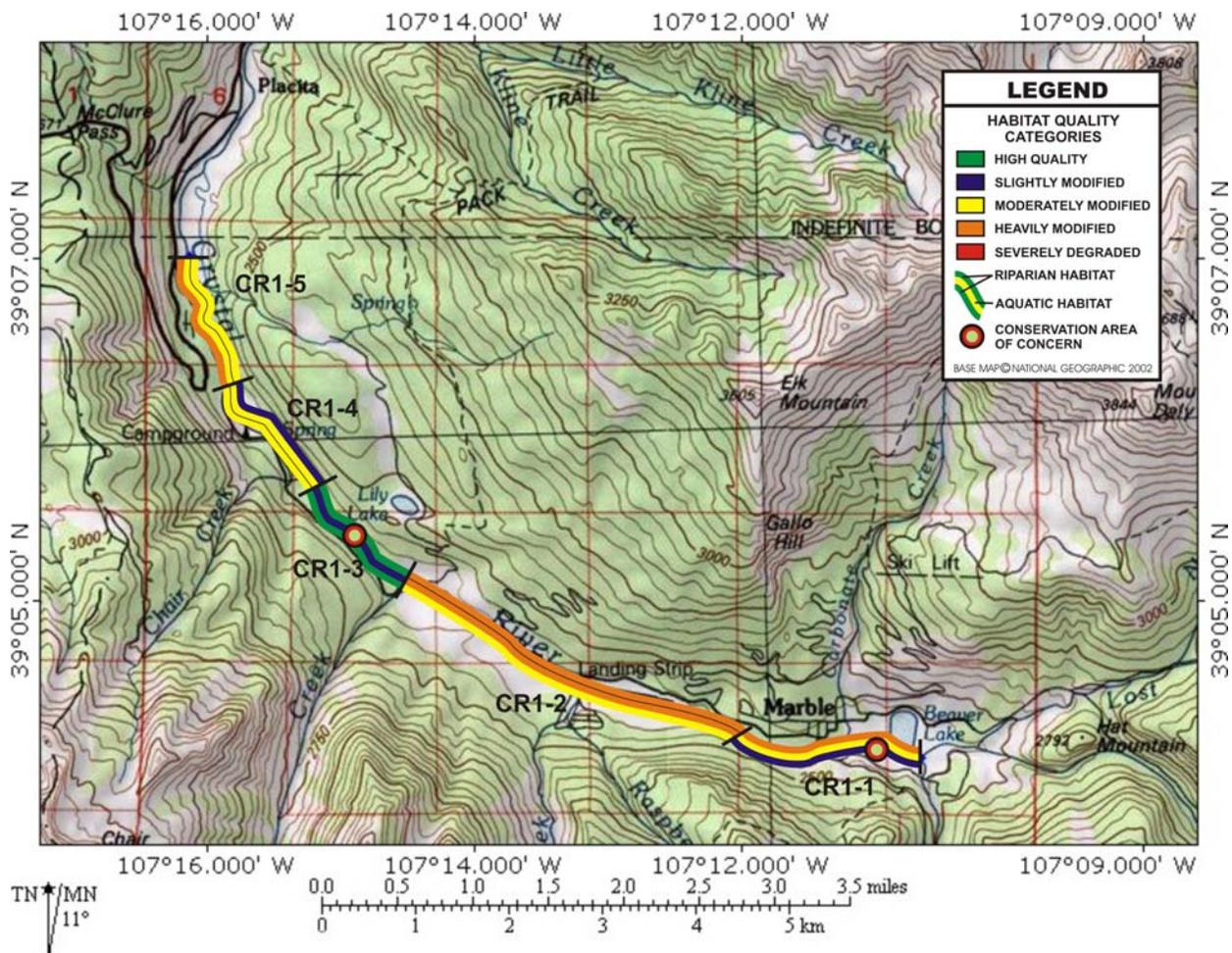
CR1-3: The stream runs through a steep canyon in this reach. Riparian and stream habitat are in very good condition and provide high wildlife potential. Uncontrolled recreation threatens riparian, stream and wildlife values. The downstream end of this reach abuts with a developed campground which is a source of disturbance. This campground, which is currently used only for “group events” should be closed and revegetated. Social trails should be closed and revegetated.



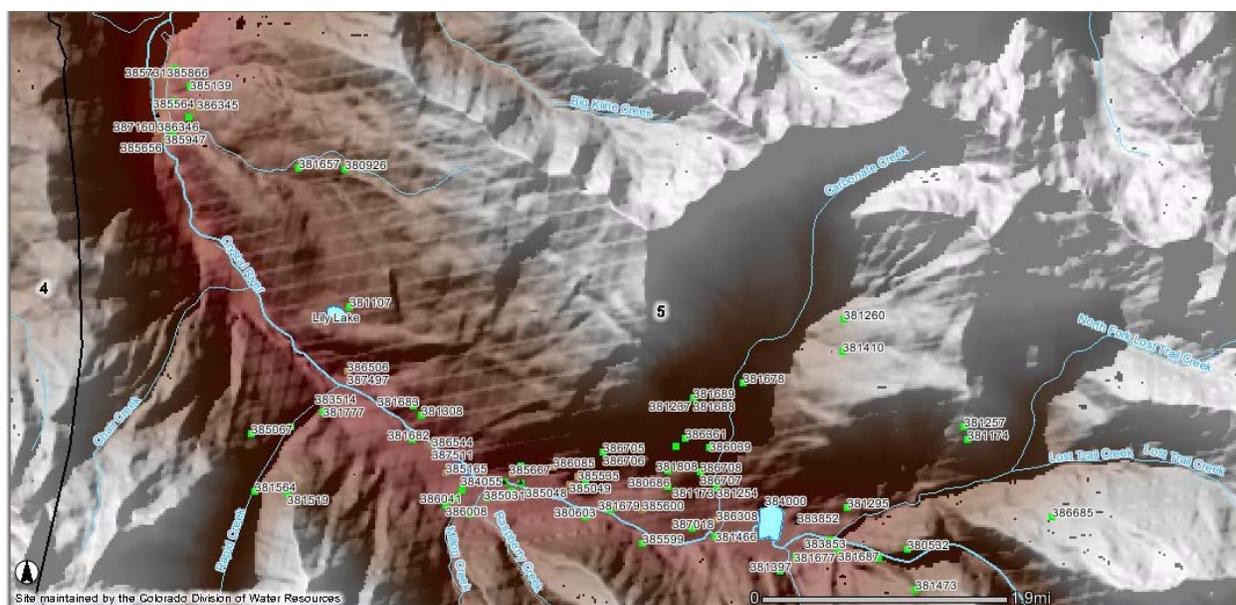
Above: At CR1-1 spring floods recharge the willow carr.

Right: At CR1-3 flooding flows are dissipated by large boulders. Dense riparian vegetation protects stream banks from erosion even during high flows.

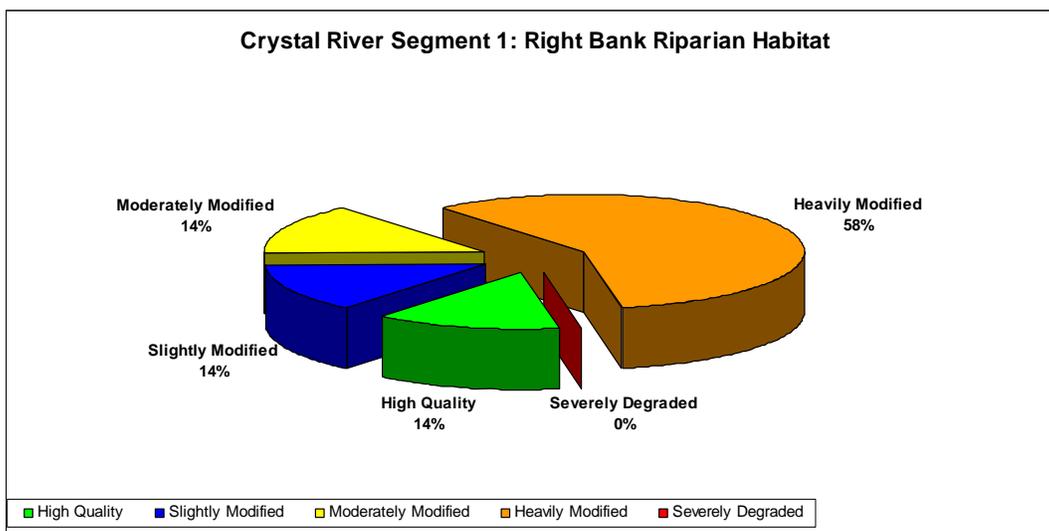
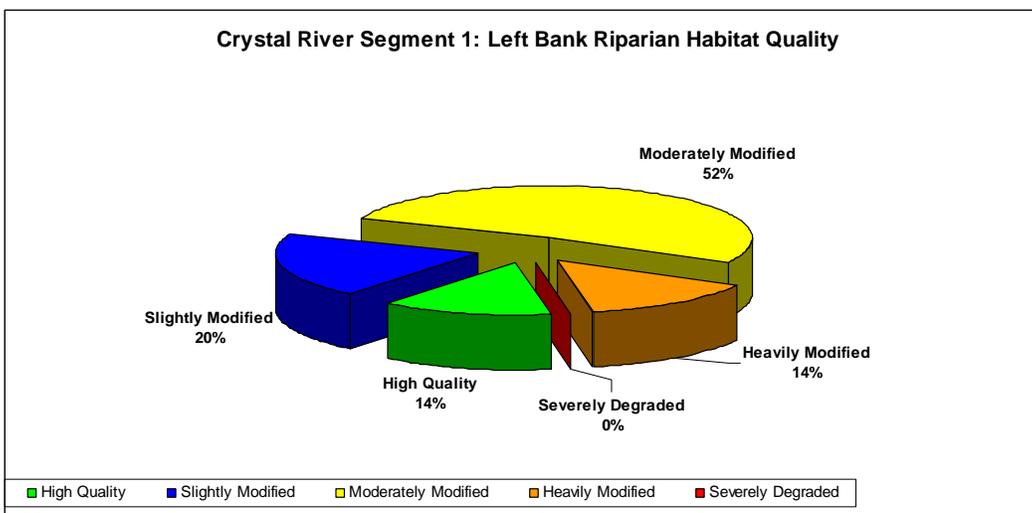
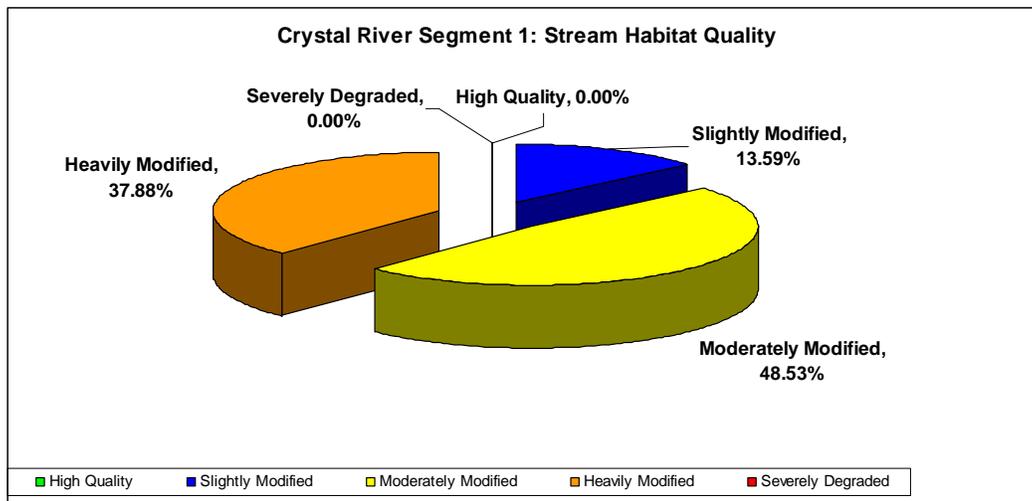




Crystal River Segment 1 assessment results.



Upper Crystal River Watershed: green dots indicate locations of in-stream diversions.



Segment 1, Crystal River: Stream habitat assessment results.
 See appendix for habitat parameters and ranking criteria.

Stream Habitat Parameters	CRI-1 N39 04.092 W107 10.691	CRI-2 N39 04.221 W107 12.041	CRI-3 N39 05.118 W107 14.536	CRI-4 N39 05.654 W107 15.197	CRI-5 N39 06.255 W107 15.812
1. Epifaunal Substrate/Cover (0-20)	15	12	18	15	15
2a. Embeddedness (0-20)	14	14	18	17	18
2b. Pool Substrate Characteristics (0-20)	NA	NA	NA	NA	NA
3a. Velocity/Depth Regime (0-20)	18	15	16	16	16
3b. Pool Variability (0-20)	NA	NA	NA	NA	NA
4. Sediment Deposition (0-20)	13	14	6	15	16
5. Channel Flow Status (0-20)	15	15	16	17	16
6. Channel Alteration (0-20)	13	12	17	15	15
7a. Riffle Frequency (0-20)	17	15	18	16	18
7b. Channel Sinuosity (0-20)	NA	NA	NA	NA	NA
8. Bank Stability (LB: 0-10/RB: 0-10)	8/4	5/3	9/7	5/9	6/5
9. Bank Veg. Protection (LB: 0-10/RB: 0-10)	9/3	5/3	9/8	5/9	5/5
10. Riparian Zone Width (LB: 0-10/RB: 0-10)	9/3	4/4	9/9	5/10	5/5
Reach Total	141	122	161	153	145
Habitat Condition	MM	HM	SM	MM	MM

High Quality: 180-200
Slightly Modified: 160-179
Moderately Modified: 140-159
Heavily Modified: 120-139
Severely Degraded: Below 120

Segment 1, Crystal River: Riparian habitat assessment results.

See appendix for habitat parameters and ranking criteria.

Riparian Habitat Parameters	CR1-1 N39 04.092 W107 10.691	CR1-2 N39 04.221 W107 12.041	CR1-3 N39 05.118 W107 14.536	CR1-4 N39 05.654 W107 15.197	CR1-5 N39 06.255 W107 15.812
1. Stream Incisement (0-8)	6	5	8	6	6
2. Lateral Cutting (0-6)	4	3	6	3	4
3. Stream Balance (0-6)	4	3	4	4	4
4. Sufficient Soil (LB: 0-3/RB: 0-3)	3/1	3/3	3/3	2/3	2/3
5. Stream bank Veg. Composition (LB: 0-6/RB: 0-6)	6/6	6/6	6/6	6/6	6/6
6. Weeds (LB: 0-3/RB: 0-3)	2/2	2/2	2/2	2/2	1/2
7. Disturbance-caused Undesirable Plants (LB: 0-3/RB:0-3)	3/2	2/2	3/3	1/2	0/0
8. Woody Species Establishment & Regeneration (LB: 0-8/RB: 0-8)	8/6	8/4	8/8	6/8	6/6
9. Browse/Utilization of Trees and Shrubs (LB: 0-4/RB: 0-4)	2/2	3/3	4/4	3/3	4/4
10. Veg. Cover in Rip., Floodplain & Stream bank Zone (LB: 0-8/RB: 0-8)	7/2	4/2	8/8	6/8	2/4
11. Riparian Energy Dissipation (LB: 0-6/RB: 0-6)	5/3	4/3	6/6	4/6	4/4
Reach Total (LB/RB)	49/38	44/37	58/58	43/51	39/43
Riparian Habitat Condition	SM/HM	MM/HM	HQ/HQ	MM/SM	HM/MM

High Quality: 55-61

Slightly Modified: 49-54

Moderately Modified: 43-48 scores below 49 indicate riparian/stream habitat that is at risk

Heavily Modified: 37-42

Severely Degraded: <37 scores below 37 indicate riparian/stream habitat that is not sustainable

Crystal River Segment 1, Reach 1.

Habitat Condition: Stream – moderately modified; LB/RB Riparian – slightly modified/heavily modified.
Stream Class (Rosgen) – D3 transitions to B2/B3. **Stream Order** – 3rd. **Reach Length** – 2.28 km.

Summary

Hydrologic considerations

Channel Condition: This reach begins at the upstream end of the Town of Marble where Yule Creek has its confluence with the Crystal River and ends at the downstream end of town. Historic mining-induced alterations to the uplands and the stream channel dramatically changed the channel condition and that of the surrounding floodplain. Over time, much of the historic degradation to the surrounding uplands and riparian zone has been restored by natural processes but channel degradation has not been completely remediated and stream function continues to be affected. Additionally, current development continues to have channel altering effects although these are very minor compared to historic changes.

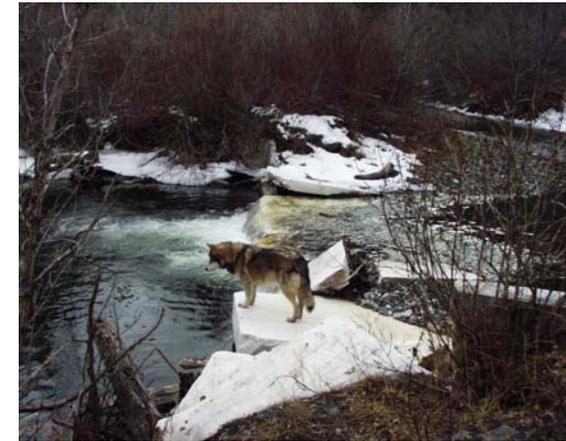
At the top of the reach, the channel starts out as a meandering low-gradient stream and about halfway through the reach, transitions to a slightly steeper more confined channel with a pool-cascade structure. Historic alterations to the channel continue to affect condition and function. The right bank was completely revegetated and riprapped with marble along 40-50% of the reach to accommodate marble mining operations, the railroad grade and townsite development. Current activities are considerably less impactful in scope and degree but nevertheless contribute to channel alteration. A natural lake at the top of the reach that was directly connected to the stream has been dredged and shored up by a levee on two sides to accommodate recreation, and some home/lawn development with accompanying riparian vegetation removal occurs in the riparian zone on the right bank.

The condition of the stream channel at the turn of the century when the marble mining operation was in full swing was, according to historical photographs, severely degraded. Over time, natural processes have greatly improved channel condition but have not yet returned the channel to pre-mining condition. On the upper half of the reach, the stream is braided with numerous unvegetated cobble berms above bank-full height and on the lower half marble riprap continues to prevent the return of natural sinuosity.

Instream heterogeneity: Habitat variety is suboptimal, with the stream dominated by run morphology. Although all four velocity/depth regimes occur, habitat would be improved with greater frequency of deep and shallow pools. A fast-deep regime dominates stream morphology and occurs on 35% of the reach; a fast-shallow regime occurs on 30%; slow-deep on 23%; and slow-shallow on 17%.

Hydrologic Alteration: During spring flooding flows, overbanking occurs yearly although bank-full flows only occur during spring and early summer. A variety of factors contribute to altered stream hydrology including irrigation diversions on the headwaters of the Crystal and channel alteration. Width/depth ratio is inappropriately high throughout the reach. On the upper half of this reach, stream widening and shallowing has resulted from an unstable channel that is braided due to an excessive bedload. On the upper half of the reach, historic channel alterations likely created the current condition that divides the stream into several channels – some which are stable while others are not. These channels are variably filled with water – some are at bank-full but others have exposed substrate.

Beaver activity is essential to the continued restoration of this reach. Beaver activity is abundant and critical to energy dissipation for channel stability, enhances riparian restoration for bank restabilization and increases



Above: Beaver activity has created a wide willow carr that helps stabilize the stream.
Middle: Marble riprap was used to stabilize banks at the confluence of Yule Creek and the Crystal River.
Below: Historic stream and bank degradation continue to affect stream functions.

water storage to help sustain base flows. Riparian zones are returning to a well-vegetated condition that enhances water storage

Stream balance / Erosion – deposition: The channel has evidence of old downcutting that has begun stabilizing with vegetation establishing at the base of failing banks. Also a minimal amount of human-induced lateral erosion occurs on the upper half of the reach where vegetation has been removed and on the lower half where devegetated banks have not been stabilized.

The stream is currently not in balance with the amount of water and sediment in the watershed – but natural restoration is in process. On the upper half of the reach mid-channel cobble bars and large, unvegetated pointbars are common – however, some of the bars are revegetating and some of the mid-channel islands are stable. In addition, excess sedimentation occurs with slight deposition in pools and cobbles and gravel embedded by 25-30%.

Upland contribution to degradation

Historic mining activities dramatically altered upland, riparian and stream ecosystems. Upland recovery is in process but riparian and stream ecosystems are still affected by mining impacts. Current impacts are very minor in comparison but nevertheless contribute to degradation. Upland impacts that affect the river system are primarily focused on home development on unstable upland slopes on the right side of the river.

Vegetation considerations

Riparian Zone: Riparian zone width on the left bank is unimpacted by recent human disturbance on > 90% of the reach. Vegetated width on the upper half of the reach is >50 m while on the lower half the vegetated zone width is typically about 12 m except for where a steep bedrock wall does not allow for vegetation development. On the right bank, human activities have somewhat impacted riparian zone width; zone width on 80% of the upper half of the reach is >50 m but <5 m on 20%; on the lower half of the reach, potential zone width is a naturally narrow 5-10 m due to steep geology but human activities have further reduced that width on 75% of the reach to <5 m.

Habitat on the upper half of the reach is characterized by a montane willow carr. On the lower half of the reach, where the gradient steepens and the riparian zone narrows, a cottonwood-spruce riparian forest characterizes the habitat.

In willow carr habitat on the upper half of the reach, plant species diversity, composition and structural heterogeneity is appropriate and indicates a healthy, sustainable plant community. Structural diversity is high and all age-classes of woody species are well represented. In this upper half of the reach, tree cover occurs only on the periphery of the riparian zone where soil moisture decreases. Tree cover totals 10% and is comprised of 2 layers with each layer dominated by Colorado blue spruce and narrowleaf cottonwood. Shrub cover totals 40% cover and is comprised of 3 layers (shrub cover would be much greater but for at least half of the riparian area being open-water beaver ponds); the upper shrub layer is dominated by thinleaf alder, willow, and narrowleaf cottonwood saplings; the middle layer by willow, twinberry honeysuckle and red-osier dogwood and the lower layer by willow, elderberry and raspberry.

On the lower half of the reach, on the left bank, plant species diversity and habitat structure indicates healthy and sustainable habitat. On the right bank community composition and age class structure is indicative of a habitat that has been disturbed and is in the process of recovery. All age classes of tree species are well represented on the left bank but on the right bank age-classes are dominated by mature and young individuals. Tree cover totals 20% on the left bank and 10% on the right bank and each bank is



Above: Beaver dams store water and create conditions that enable willow carrs to thrive. Mid: Dense vegetation protects banks from erosion during spring flood. Below: Excess bedload is deposited and braids the stream channel.

comprised of three layers however dominant plant species differ from left to right bank. Tree species on the left bank are dominated by Colorado blue spruce and Douglas fir and on the right bank by narrowleaf cottonwood, Colorado blue spruce, Douglas fir, lodgepole pine and quaking aspen. Shrub canopy cover differs between left and right bank with regard to percent cover but is similar with regard to number of layers and dominant shrub species. Shrub canopy cover is comprised of 3 layers on each bank and totals 50% on the left bank and 20% on the right bank. Dominant shrub species in the upper shrub layer include thinleaf alder, willow, Rocky Mountain maple and river birch, in the middle layer by willow, red-osier dogwood and twinberry honeysuckle and in the lower layer by shrubby cinquefoil, common juniper and mountain lover.

Native vegetation protects 90% of the left bank and 60% of the right bank – much of the right bank is riprapped with marble to protect banks from erosion. Although sufficient kinds of plant species occur to stabilize banks and hold onto water, abundance is inadequate to accomplish these functions on the right bank; 85% of the left bank but only 65% of the right bank riparian cover has a stability rating > 6.

Stream bank Stability: The left bank is stable with little evidence of erosion or bank failure. The right bank is moderately stable due to marble riprap along much of the bank. However, 15% of the banks have neither riprap nor appropriate or sufficient vegetation and are eroding.

Floodplain characteristics: On the upper half of the reach, dense riparian vegetation and numerous beaver dams provide adequate means to dissipate energy and trap sediment. On the lower part of the reach, although characteristics such as large rock and woody debris are present, abundance is insufficient to adequately accomplish these functions. Consequently, occasional evidence of surface erosion is present on banks on the right of the stream. Marble riprap occurs along much of the right bank of the reach and, although it protects banks from erosion, it also increases stream energy and erosion potential in the downstream direction.

Weedy and undesirable species: Noxious weeds occur on up to 5% of the riparian area; species include common tansy and curly dock. Undesirable plant species occur on 5-10% of the riparian area; species include planted grasses such as timothy and red top.

Wildlife considerations

Instream: Limits to aquatic wildlife potential occur from substrate and stream bank instability on the right bank. However, potential is increased by beaver activity and the development of riparian vegetation. Cobble and gravel substrate is unembedded but is somewhat unstable and so provides only marginal quality macroinvertebrate habitat. Tree and shrub canopy provides adequate shade to help maintain water temperature and protected habitat for aquatic wildlife. Fish cover is common and includes woody debris, overhanging vegetation and stable undercut banks on the left banks of the stream. In addition, beaver ponds provide numerous deep pools and backwater pools and thick root mats are common.

Riparian: Human disturbance limits wildlife potential on the right bank and at Beaver Lake. Over most of the reach, especially on the left bank, plant species diversity and structural heterogeneity, including vertical diversity and habitat patchiness are high and provide good wildlife potential. Beaver activity has greatly increased habitat diversity thus providing a greater diversity of resources for both aquatic and terrestrial native wildlife.



Blue-winged teal eggs; Willow carr habitat provides excellent potential for a large variety of wildlife. Human trampling can undermine habitat potential and be devastating to nesting birds and mammals.

Management Recommendations:

- Restore riprapped stream banks; remove riprap and revegetate with soil-moisture-appropriate native plant species.
- Revegetate levee at Beaver Lake with native riparian plant species.
- Enhance the hydrologic connection between Beaver Lake and the Crystal River
- Close and revegetate social trails that emanate from the recreation area at Beaver Lake
- Designate and harden an appropriately located recreational trail.
- Install educational signage regarding the importance of staying on the designated trail.
- Establish appropriate development setbacks that include prohibitions regarding riparian vegetation removal.

General Characteristics

Location CR1-1: N39 04.092/W107 10.691; 39 04.221/107 12.041. **Elevation:** 7930'. **Life Zone:** Montane.
Ecosystem: Willow carr/open water beaver ponds/cottonwood-spruce riparian forest.
Watershed Features: predominant surrounding land use – Forest and Residential; local watershed NPS pollution – some potential sources; local watershed erosion – moderate.
Dominant Native Vegetation: Riparian – willow spp., thinleaf alder, Colorado blue spruce, narrowleaf cottonwood. Upland – LB engelmann spruce, sub-alpine fir, aspen, RB aspen lodgepole, ponderosa, cottonwood.
Instream Features: stream width – 14.5 m; stream depth – 0.45 m; canopy cover – 10%; high water mark – 1 m; stream morphology types – riffles 30%, pools 25%, runs 45%; channelized – no; dam present – no.
Large Woody Debris (0 none to 4 abundant): 2 (common).
Dominant Aquatic Vegetation: dominant species – periphyton: estimated abundance – 2 (common).
Water Quality: water odors – normal; water surface oils – none; turbidity – clear.
Sediment/Substrate: odors – normal; oils – absent; deposits – sand; undersides of unembedded stones black – no.
Inorganic Substrate Components %: bedrock 5; boulder 30; cobble 35; gravel 20; sand 10; silt 0; clay 0.
Organic Substrate Components %: detritus (CPOM) 5; muck-mud (FPOM) 5; marl 0.

Assessment Data

EPA Habitat Assessment Score: 141/200.

NRCS Habitat Assessment Score: left bank – 49/61; right bank – 38/61.

Weedy species: common tansy, curly dock, reed canarygrass.

Disturbance-caused undesirable plants: timothy, red-top.

Dominant Native Riparian Vegetative Species:

Trees: Colorado blue spruce, narrowleaf cottonwood, Douglas fir, ponderosa pine, lodgepole pine.

Shrubs: willow spp., thinleaf alder, red-osier dogwood, twinberry honeysuckle, river birch, Rocky Mountain maple, shrubby cinquefoil, common juniper, mountain lover.

Grasses and Forbs: sedge and rush spp., equisetum spp., pink pyrola, aster spp.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Residences - L; Maint. Lawns - L; Roads - L; Bridges/Culverts - L; Sewage Treatment - L; Recreational: Park - M.

Agricultural: Water withdrawal - L.

Stream management: Angling - L; Dredging - L; Channelization - M; Dams - L.

Other Human Influences:

Nutrient enrichment: clear water along entire reach, moderate algal growth, low macrophytes abundance.

Barriers to fish movement: none.

Manure presence: none.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 4/4.

Beaver: beaver sign – common; flow modification – major.

Dominant Land Use – forest & town; forest age class – 25-75.

Proper Functioning Condition: at risk; trending toward sustainable.

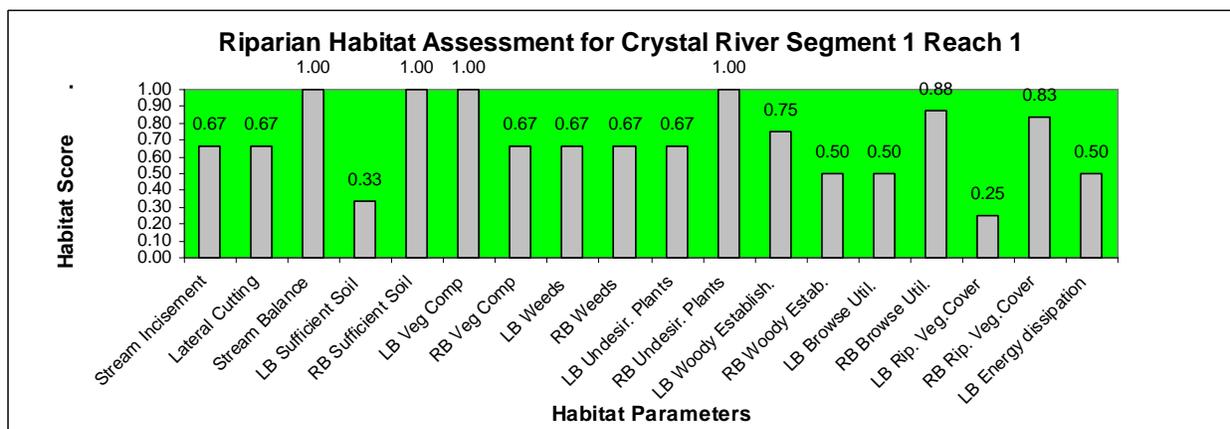
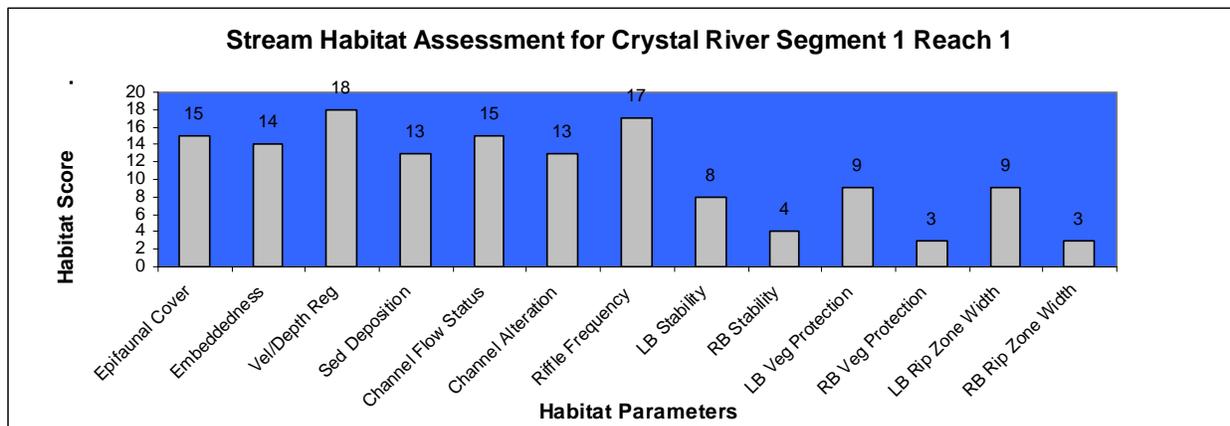
Biological Indicators of Stream and Riparian Condition:

- At the top of the reach benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 42/8/0 indicating good water quality; at the bottom of the reach the ratio was 36/8/0.
- Two American dippers were observed in the survey area indicating the presence of sufficient foraging and nesting resources.
- A survey of the breeding bird community recorded 160 individuals in 24 species for a biodiversity score of 2.571 and an evenness score of 0.507. As indicated by a low evenness score, abundance is not evenly distributed – 90 individuals are in 4 species. More importantly, the presence of bird species such as willow flycatchers, Swainson's thrush, and Scissor-tailed flycatcher indicates good quality riparian habitat.
- At the top of the reach, estimated abundance of periphyton was "1" (rare) and filamentous algae "0" (absent) indicating an appropriately low level of nutrient enrichment; at the bottom of the reach periphyton was "3" (abundant) and filamentous algae was "2" (common) indicating excessive nutrient enrichment.



Left: Even during low-flow season, in beaver ponds water is plentiful; Janis is standing in front of the beaver's winter cache of willow stems.

Right: Stream banks adjacent to the marble mill site have still not recovered from historic degradation.



Crystal River Segment 1, Reach 2.

Habitat Condition: Stream – moderately modified; LB/RB Riparian – moderately modified/heavily modified.
Stream Class (Rosgen) – D3 60%, B2 12%, C3 28%. **Stream Order** – 3rd. **Reach Length** – 4.25 km.

Summary

Hydrologic considerations

A variety of rural development activities impact the stream and riparian condition of this reach, and thereby affect the hydrology.

Channel Condition: A variety of human impacts have altered the condition of the channel. Impacts include: 1) dredging that, in effect, created a levee along 50% of the reach, 2) riparian vegetation removal over 70% of the reach, and 3) roads and bridges. Consequences include channel straightening, loss of overbanking flows, channel braiding, bank instability and erosion.

Instream heterogeneity: Channelizing impacts have reduced the variety of instream habitats. Sinuosity is decreased over the entire reach due to dredging, roads, and vegetation removal for homes and pastures. Riffle and run morphology dominate the reach and pools are rare throughout the reach. Thus, although riffles are frequent, habitat variety is diminished and velocity-depth regimes are unevenly represented. A fast-deep regime occurs on 39% of the reach, fast-shallow on 38%, slow-deep on 11% and slow-shallow on 12%.

Hydrologic Alteration: Width/depth ratio is inappropriately high throughout the reach due to the cumulative effects of instream diversions, channel widening that has resulted from bank instability, and riparian degradation. Bank-full flows likely occur regularly but, due to levees on the upper part of the reach and downcutting on the lower part of the reach, overbanking flows likely occur only in very high flow years and then only in a very few areas of the reach where levees and downcutting do not occur.

Human-induced impacts have decreased the functional width of the riparian zone throughout the reach on both banks. Ground water recharge has certainly been diminished by a reduction in overbanking, which then results in decreased base flows in the dry season.

Stream balance / Erosion – deposition: The stream channel is neither horizontally nor vertically stable. Lateral erosion occurs throughout the reach and downcutting is apparent in the upper and lower parts of the reach. Consequently the stream is not in balance with the amount of water and sediment supplied by the watershed. On the upper 60% of the reach, the stream is braiding and throughout the reach sedimentation is excessive. Deposition of new gravel and sand occurs on old and new pointbars, deposition in pools is prevalent and cobbles and gravel are 30-40% embedded on the upper and lower parts of the reach.

Upland contribution to degradation

Rural and agricultural development includes homes, pastures, stables, a grass airfield, a commercial campground and a road cut within 50 m of the stream along parts of the reach. Pastures and home development has typically resulted in the conversion of native habitat to planted grasses. Road and road cut increase pollutant-laden runoff. Cumulative impacts from these developments contribute to stream degradation by altering the hydrologic regime and contributing to excessive nutrient and pollutant inputs.

Vegetation considerations

Riparian Zone: Human activities have impacted the riparian zone on each bank a great deal. On 18% of the left bank very little riparian vegetation remains due to home development with lawns “to the edge” and a commercial campsite where all vegetation has been removed; on 27% of the left bank the



Above: Large deposits of cobble braid the stream channel.

Middle: Stream straightening and riprapped banks eliminate wildlife habitat.

Below: Riparian habitat has been removed and replaced with pastures.

riparian zone is <5m due to pastures; on 12% the riparian zone is naturally very narrow due to steep banks; and on 48% of the left bank, the functional riparian zone width is at potential width of >20m. On the right bank 63% of the riparian zone is <5m wide. Impacts include a landing strip with adjacent car-campsites and pastures that have altered the riparian zone so that very little riparian vegetation remains. On 6% of the right bank, road impacts reduce an already narrow riparian zone from 5 m to 2-3 m wide. In these degraded riparian areas tree and shrub cover is reduced, age-class distribution of trees and shrubs has been altered, and habitat complexity is diminished. Consequences of these impacts include reduced habitat resiliency and decreased wildlife potential.

Riparian habitat is in good condition on 48% of the left bank and 25% of the right bank. In these areas native plant species diversity and vertical complexity is high, horizontal patchiness creates a mosaic of habitats and all age-classes of desirable woody species are present and well distributed. These areas of the reach provide good wildlife potential and enhance ecosystem sustainability.

A Colorado blue spruce-cottonwood-willow-alder riparian forest characterizes the riparian habitat on the upper 60% of the reach. Left bank habitat is in good condition compared to the right bank habitat which is indicative of disturbance. Vegetation cover differs between left and right bank with regard to percent tree and shrub cover and age-class distribution but is similar with regard to dominant species and number of tree and shrub layers. Age-class distribution on the left bank is fairly even with all age-classes of trees and shrubs well represented. On the right banks age-classes are dominated by younger-aged trees and middle-aged shrubs. Tree canopy has a total cover of 40% on the left and 20% on the right bank with each of the three tree layers dominated by Colorado blue spruce and narrowleaf cottonwood.

Shrub canopy has a total cover of 50% on the left bank and 20% on the right bank. Each of the three shrub layers are dominated by similar species, including spruce and cottonwood saplings, willow species, thinleaf alder, river birch, and red-osier dogwood. Age-class distribution of the shrub canopy differs between left and right bank with the left bank having a fairly even distribution of age classes and the right bank dominated by mostly middle-aged individuals.

In the middle 10% of the reach the stream enters a steep narrow canyon where the habitat on the north-facing left bank is characterized by a spruce-Douglas fir-cottonwood-willow-alder riparian forest and on the south-facing right bank by a similar plant community but that also includes trees and shrubs that are tolerant of drier soil such as Ponderosa pine, Rocky mountain juniper, serviceberry, chokecherry and rabbitbrush. On both banks age-classes of woody plant species are fairly well distributed, thus enhancing vertical complexity. Plant species composition on the left bank is appropriate for the landscape but on the right bank is altered by a road cut. The road cut has resulted in reduced tree and shrub cover thereby altering environmental conditions which likely contributes to drier soils.

In this middle part of the reach tree cover on the left bank totals 30% and is comprised of three layers. Plant species composition is similar in each layer and is dominated by blue spruce, Douglas fir and narrowleaf cottonwood. Tree cover on the right bank totals 20% and is comprised of three layers. Plant species composition is similar in each layer and is dominated by blue spruce, narrowleaf cottonwood, ponderosa pine, and Rocky Mountain juniper. Shrub canopy cover totals 15% on the left and 10% on the right bank and is comprised of three layers on each bank. Plant species assemblage differs between left and right bank. On the left bank the upper shrub layer is dominated by cottonwood, blue spruce and fir saplings, the



Above: The riparian zone has been cleared and replaced with a grass landing strip.

Middle: Road-based gravel and sediment washes directly into the stream

Below: Nutrients from this horse corral move into the stream, mostly unfiltered, due to the removal of riparian vegetation.

middle layer by willow species and thinleaf alder and the lower layer by Wood's rose and twinberry honeysuckle. On the right bank the upper shrub layer is dominated by cottonwood, spruce and fir saplings, the middle layer is dominated by willow species, thinleaf alder, chokecherry and serviceberry, and the lower layer by Wood's rose, snowberry, common juniper, rabbitbrush and mountain gooseberry.

On the lower 30% of the reach the canyon opens up and the stream gradient decreases. Riparian habitat on both sides of the stream is similar and on both sides has been greatly altered by agricultural and recreational development. Plant community composition is similar to that in the upper part of the reach but the cover percentage of trees and shrubs has been reduced. Age-classes of trees are indicative of a disturbed habitat. Plant species diversity and habitat structure are reduced.

Tree cover is comprised of three layers on each bank and totals 10% on the left and 15% on the right bank. Tree cover on the left bank is dominated by blue spruce in each layer. On the right bank each layer of the tree canopy is dominated by blue spruce, narrowleaf cottonwood, and Douglas fir. Shrub cover is comprised of three layers and totals 15% on each bank. Shrub species are similar on each bank with the upper layer dominated by willow species, thinleaf alder and cottonwood and spruce saplings, the middle layer by red-osier dogwood, thinleaf alder and twinberry honeysuckle, and the lower layer by Wood's rose, gooseberry, and shrubby cinquefoil.

Overall, native vegetation protects 50% of the left bank but <50% of the right bank. Disruption is obvious with bare patches of soil and closely cropped vegetation common. Although sufficient kinds of riparian vegetation is present to stabilize banks and hold onto water, abundance and distribution is insufficient to accomplish these functions; 65% of the left bank but <55% of the right bank riparian plant cover has a stability rating >6.

Stream bank Stability: Condition of the stream banks on the left bank is unstable with erosion occurring on 40-50% of the left bank. On the right, 60% of the stream banks are eroding with frequent "raw" areas occurring along straight sections and bends.

Floodplain characteristics: Due to human activities, riparian attributes that are essential for energy dissipation and sediment trapping, although present, are insufficient in abundance to accomplish these functions. Riparian vegetation has been removed or severely degraded over much of the reach and channel dredging has simplified stream structure thereby removing instream features that dissipate energy.

Weedy and undesirable species: Throughout the reach noxious weeds are common and include toadflax, yellow and white sweetclover, oxeye daisy, and St. Johnswort. Undesirable plant species are abundant and include pasture grasses and Kentucky bluegrass.

Wildlife considerations

Instream: Factors limiting aquatic wildlife potential include hydrologic alteration including excessively low base flows, habitat simplification, reduced canopy cover and excessive sedimentation and embeddedness. Consequently, essential habitat characteristics that provide resources for aquatic wildlife are missing or reduced including deep pools, overhanging vegetation, undercut banks and backwater pools. Some habitat resources are present including woody debris and riffles, and provide important cover and forage.

Riparian: Human disturbance and habitat simplification reduces wildlife potential by eliminating nesting, foraging and cover resources for



Above: The stream is widening, shallowing and braiding due to bank instability.

Middle: Land use has altered riparian habitat and resulted in destabilized banks.

Below: Eroding banks have resulted in a wider stream channel and excess bedload.

many native wildlife species. Browse is somewhat high on selective plant species. Red-osier dogwood and twinberry honeysuckle has 5-10% of available second year and older stems browsed. Reduction in available forage due to habitat alteration may put undue pressure on remaining resources.

Management Recommendations:

- Restore beaver to this reach of stream.
- Increase stream heterogeneity; create deep pools with large woody debris such as root wads and downed logs.
- Deconstruct the levee on the upper part of the reach to allow overbanking flows.
- Stabilize banks with appropriate native vegetation.
- Establish development setbacks to prevent riparian vegetation alteration and building in the riparian zone.
- Revegetate the road cut on the middle part of the reach.
- To help prevent excess nutrients from horse pastures from entering the stream and to enhance riparian functions restore a functional-width riparian zone on the upper and lower parts of the reach.

General Characteristics

Location CR1- 2: N39 04.221/W107 12.041; 39 05.118/107 14.536.

Elevation: 7865'. **Life Zone:** Montane. **Ecosystem:** cottonwood-conifer-willow-alder forest.

Watershed Features: predominant surrounding land use – Forest, Residential, Pasture; local watershed NPS pollution – obvious sources; local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – Colorado blue spruce, narrowleaf cottonwood, willow spp., thinleaf alder, red-osier dogwood. Upland – LB engelmann spruce- sub-alpine fir, aspen, RB Douglas fir forest, Aspen groves, Rocky Mountain juniper- sage-oak woodland..

Instream Features: stream width – 26 m; stream depth – 0.32 m; canopy cover – 10%; high water mark – 0.60 m; stream morphology types – riffles 40%, pools 10%, runs 50%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 2 (common).

Dominant Aquatic Vegetation: dominant species – periphyton: estimated abundance – 2 (common).

Water Quality: water odors – normal; water surface oils – none; turbidity – clear.

Sediment/Substrate: odors – normal; oils – absent; deposits – sand; undersides of unembedded stones black – no.

Inorganic Substrate Components %: bedrock 1; boulder 25; cobble 44; gravel 15; sand 15; silt 0; clay 0.

Organic Substrate Components %: detritus (CPOM) 5; muck-mud (FPOM) 5; marl 0.

Assessment Data

EPA Habitat Assessment Score: 122/200.

NRCS Habitat Assessment Score: left bank – 44/61; right bank – 37/61.

Weedy species: toadflax, reed canarygrass, white and yellow sweetclover, oxeye daisy, common mullein, St. Johnswort.

Disturbance-caused undesirable plants: Kentucky bluegrass, red-top, pasture grasses.

Dominant Native Riparian Vegetative Species:

Trees: Colorado blue spruce, narrowleaf cottonwood, Douglas fir, Ponderosa pine, lodgepole pine, Rocky Mountain juniper.

Shrubs: willow spp. (exigua, monticola, bebbiana), thinleaf alder, red-osier dogwood, twinberry honeysuckle, river birch Wood's rose, gooseberry.

Grasses and Forbs: snowberry, common juniper, rabbitbrush, chokecherry, serviceberry.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Residences - L; Maint. Lawns - L; Pipes, drains - L; Roads - M; Bridges/Culverts - L.

Recreational: Campground - L; hiking trails - L.

Agricultural: Pasture - H; Livestock use - H; Water withdrawal - M.

Stream management: Angling - L; Dredging - M; Channelization - M; Water fluctuation - H.

Other Human Influences:

Nutrient enrichment: fairly clear or slightly greenish, moderate algal growth on stream substrates.

Barriers to fish movement: none.

Manure presence: Evidence of livestock access to riparian zone, extensive amount of manure on banks.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 3/3.

Beaver: beaver sign – rare; flow modification – none.

Dominant Land Use – forest, rural; forest age class – 25-75.

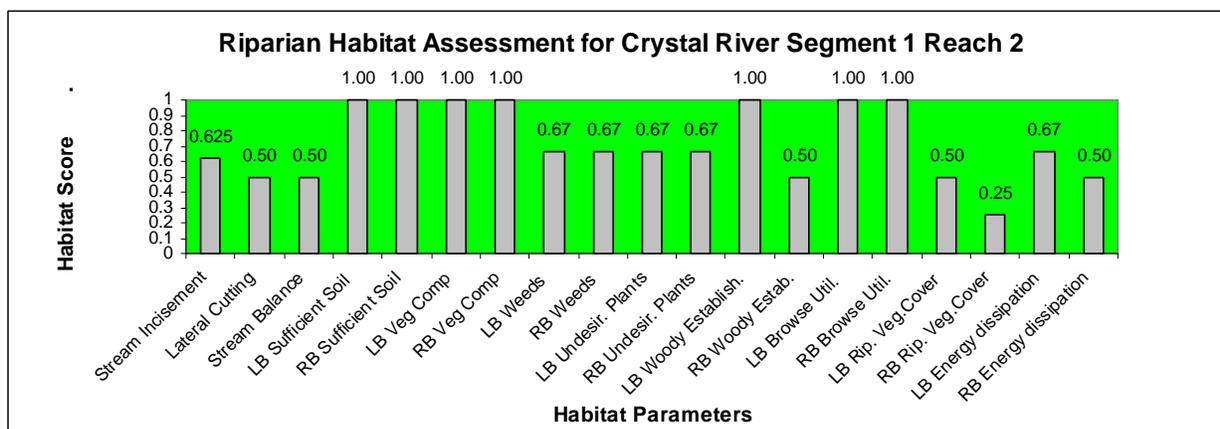
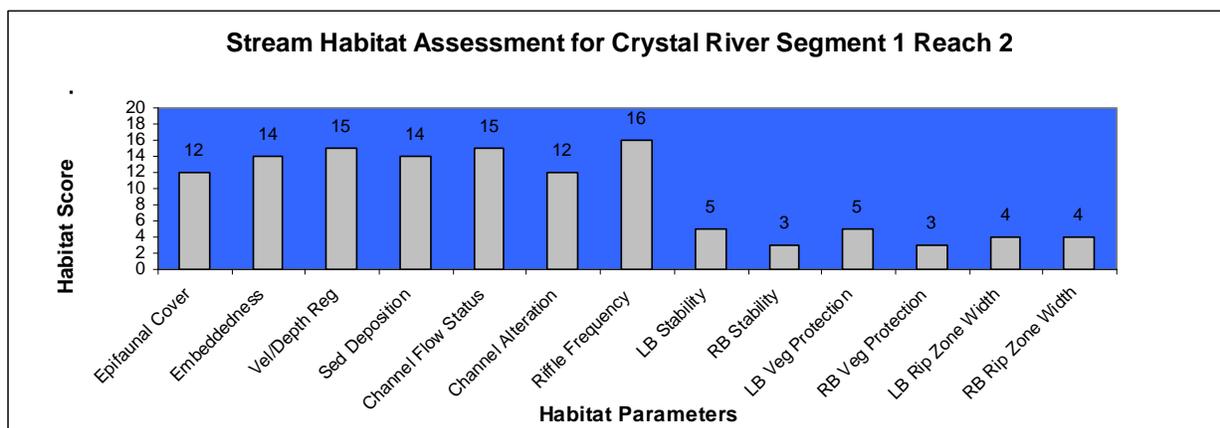
Functional Rating: at risk, trending downward without appropriate restoration.

Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals at the top of the reach was 43/3/0, 50/7/0 midway, and 50/24/0 at the bottom of the reach. Ratios at the top compared to the bottom indicate a potential source of water quality impairment at the bottom of the reach.
- Two American dippers were observed in the survey area at the top of the reach. None were observed elsewhere in the reach. Low dipper abundance indicates habitat impairment.
- A survey of the breeding bird community recorded 80 individuals in 24 species for a biodiversity score of 2.828 and an evenness score of 0.645.
- Estimated abundance of periphyton at the top and middle of the reach was “1” (rare) and filamentous algae “0” indicating appropriate nutrient levels. At the bottom of the reach, abundance of periphyton and filamentous algae were both “2” (common) indicating increased and excessive nutrient enrichment.



At base flow wildlife habitat is reduced due to channel widening and stream shallowing.



Crystal River Segment 1, Reach 3.

Habitat Condition: Stream – slightly modified; LB/RB Riparian – high quality/high quality.
Stream Class (Rosgen) – B2. Stream Order – 3rd. Reach Length – 1.5 km.

Summary

Hydrologic considerations

Channel Condition: The stream enters a steep and narrow canyon that is largely unimpacted by human alteration. A small area at top of the reach equaling <5% of the reach is channelized by the road and a bridge. At the bottom 5% of the reach a small trail on the left bank has some minimal impact on riparian vegetation resulting in a small amount of bank failure. The remaining 90% of the channel has a natural pattern.

Instream heterogeneity: Habitat variety is high. A cascading stream structure characterizes this reach. Although this structure has resulted in few riffles a highly diverse habitat has developed. Numerous large boulders dissipate energy from fast-flowing deep water to create large deep pools, and on the downstream end of the pools flows fast, shallow water. Therefore, all four velocity-depth regimes are represented, though not with an even representation; a fast-deep regime dominates on 40% of the reach, fast-shallow on 30%, slow-deep on 20% and slow-shallow on 10%. Sinuosity is appropriate for the stream class and contributes to heterogeneity.

Hydrologic Alteration: Although no diversions occur in this reach, numerous upstream diversions on the Crystal and on tributary streams and upstream channelizing impacts contribute to an altered hydrologic regime. Consequences include an inappropriately high width/depth ratio (27/1) and lower than expected base flows that result in 20-25% of channel substrate exposed. Bank-full flows occur yearly and the flood plain is regularly inundated. However, because the riparian area is very narrow and soils are shallow, ground water storage is minor and discharge plays only a small role in maintaining base flows. Beaver sign was rare and there was no flow modification from their activity.

Stream balance / Erosion – deposition: The channel is stable. Neither active downcutting nor excessive lateral cutting occurs. However, the stream is not in balance with the sediment and water supplied by the watershed. Excess sediment initiates from degraded upstream reaches and in this reach from steep naturally unstable slopes which are a source of excess sediment during high flows, runoff and precipitation events. Excess sediment, in combination with dewatering, results in excess deposition that affects 50% of the stream bottom.

Upland contribution to degradation

Grazing that occurs on upland meadows and forested areas impacts the entire watershed by altering vegetation structure and plant species composition, thereby degrading soils and altering the hydrologic regime.

Vegetation considerations

Riparian Zone: The riparian zone is naturally narrow, 5-10 m wide, in this steep-walled canyon. Human activities have impacted the zone only minimally at the top 5% and bottom 5% of the reach. Thus a functional riparian zone is present and up to potential on 90% of the reach. Plant species diversity and structural complexity is appropriate for the landscape. All age-classes of desirable woody species are present and well represented. Vertical structure is complex and habitat patchiness is high.

Because this stream segment trends east-west through a steep canyon, left and right stream banks have different aspects, the left bank is north-facing and the right bank is south-facing, and consequently have different plant assemblages. The plant community on the left bank is more moisture-loving while the community on the right bank includes species that more tolerant of drier soil conditions.



Above: At the top of the reach the stream enters a narrow, steep canyon.
Below: Steep canyon walls are densely vegetated and stable and stream morphology is diverse.

Tree cover on the left bank totals 40% cover and is comprised of three layers; the upper layer is dominated by Colorado blue and Engelmann spruce, the middle layer by blue and Engelmann spruce, subalpine fir, and narrowleaf cottonwood, the lower layer by blue and Engelmann spruce, subalpine fir and quaking aspen. Tree cover on the right bank totals 30% cover and is comprised of three layers with 10% cover in each layer; the upper layer is dominated by blue spruce, the middle and lower layers are dominated by narrowleaf cottonwood, blue and Engelmann spruce, Douglas fir and aspen.

Left bank shrub cover totals 25% and is comprised of three layers; the upper shrub layer is dominated by spruce and fir saplings, thinleaf alder, and Rocky Mountain maple, the middle and lower layers are dominated by thinleaf alder, red-osier dogwood, twinberry honeysuckle and montane willow and also in the lower layer Ribes species and thimbleberry. Right bank shrub cover is comprised of three layers and totals 30% with 10% cover in each layer; the upper layer is dominated by cottonwood, fir and spruce saplings, thinleaf alder, and mountain ash; the middle layer is dominated by thinleaf alder, red-osier dogwood, twinberry honeysuckle, montane willow, chokecherry and serviceberry; and the bottom layer is dominated by Wood's rose, twinberry honeysuckle, raspberry, snowberry and serviceberry.

On the left bank >90% and on the right bank 80-90% of the stream bank surfaces and riparian zone are covered by native vegetation. Some disruption occurs on both banks at the top and bottom 5% of the reach due to human trampling with additional disturbance on the right bank due to steep, naturally eroding slopes. Sufficient kinds of bank-stabilizing vegetation occur on both banks to prevent erosion and hold onto water and, except for the naturally eroding area on the right bank, occur with sufficient abundance to accomplish these functions; >85% of the riparian canopy cover has a stability rating > 6.

Stream bank Stability: Evidence of erosion on the left bank is minimal and there is little potential for future problems as long as recreational impacts do not increase. The right bank is moderately stable; naturally unstable geology on 15% of the reach prevents the establishment of vegetation with consequent ongoing erosion.

Floodplain characteristics: instream and floodplain characteristics on both sides of the stream are adequate to dissipate energy and capture sediment; large boulders are abundant, and dense stream bank vegetation and large woody debris are common.

Weedy and undesirable species: Noxious weeds are common and occur on up to 5% of the riparian area. Weedy species include oxeye daisy and reed canarygrass. Although reed canarygrass provides good bank stability it degrades habitat for native wildlife; most natives do not use canarygrass for nesting or foraging and it outcompetes native plants that are important resources for wildlife. Very few undesirable plants are present – those that occur include pasture grasses and Kentucky bluegrass.

Wildlife considerations

Instream: Limits to aquatic wildlife occur due to lower than expected base flows and excess sedimentation. Other essential habitat factors provide good wildlife potential: canopy cover is 20-30 %, invertebrate habitat is abundant, riffles are small but frequent, submerged logs and leaf packs occur, and cobbles are unembedded and layered. Fish cover is also abundant and diverse and includes stable undercut banks, numerous deep pools, large woody debris, overhanging vegetation and backwater pools.

Riparian: Human disturbance is infrequent and together with a diverse plant community that is structurally complex provides excellent wildlife potential. Due to the abundance and diversity of foraging resources, although elk and deer sign was abundant, browse was light with 0-5% of available second year and older stems browsed.

Diversity of the breeding songbird community was appropriate for the habitat type and included species that are sensitive to disturbance including Hammond's flycatcher and golden-crowned kinglet.



Natural bank instability introduces excess sediment to the stream during spring runoff.

Management Recommendation:

- Threats to this reach come from dewatering and the potential of increased recreational use; currently, because of healthy, undisturbed riparian vegetation, steep slopes are stable and stream habitat is sustainable – increased human use and commensurate vegetation trampling would easily and rapidly destabilize stream banks resulting in bank erosion and stream degradation.
- Maintain the current low level of human recreational use; close and revegetate the small social trails that are present on the top and bottom of the reach.
- Restore a natural hydrologic regime with sufficient instream flows during the late summer and early fall.

General Characteristics

Location CR1-3: N39 05.118/W107 14.536; 39 05.654/107 15.197.

Elevation: 7690'. **Life Zone:** Montane. **Ecosystem:** spruce-fir-cottonwood riparian forest

Watershed Features: predominant surrounding land use – Forest; local watershed NPS pollution – some potential sources; local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – Colorado blue spruce, Engelmann spruce, narrowleaf cottonwood, thinleaf alder, Rocky Mountain maple, red-osier dogwood, twinberry honeysuckle, thimbleberry. Upland – LB blue and Engelmann spruce, sub-alpine fir, RB Douglas fir, Ponderosa pine, quaking aspen.

Instream Features: stream width – 18.5 m; stream depth – 0.70 m; canopy cover – 30%; high water mark – 0.70 m; stream morphology types – riffles 30%, pools 30%, runs 40%; channelized – no; dam present – no.

Large Woody Debris (0 none to 4 abundant): 2 (common).

Dominant Aquatic Vegetation: dominant species – periphyton; estimated abundance – 2 (common).

Water Quality: water odors – normal; water surface oils – none; turbidity – clear.

Sediment/Substrate: odors – normal; oils – absent; deposits – sand; undersides of unembedded stones black – no.

Inorganic Substrate Components %: bedrock 10; boulder 30; cobble 30; gravel 20; sand 10; silt 0; clay 0.

Organic Substrate Components %: detritus (CPOM) <5; muck-mud (FPOM) 0; marl 0.

Assessment Data

EPA Habitat Assessment Score: 161/200.

NRCS Habitat Assessment Score: left bank – 58/61; right bank – 58/61.

Weedy species: reed canarygrass, oxeye daisy.

Disturbance-caused undesirable plants: Kentucky bluegrass, pasture grasses.

Dominant Native Riparian Vegetative Species:

Trees: Colorado blue spruce, Engelmann spruce, subalpine fir, Douglas fir, narrowleaf cottonwood, quaking aspen.

Shrubs: thinleaf alder, willow spp., mountain ash, Rocky Mountain maple, red-osier dogwood, twinberry honeysuckle, gooseberry, serviceberry, chokecherry, snowberry, raspberry, common juniper, mountain lover.

Grasses and Forbs: equisetum spp., sedge and rush spp., cowbane, pink pyrola, pyrola picta, ranunculus spp., northern bedstraw, aster spp., sweet cicely, baneberry, self-heal.



Above: During spring floods, boulders dissipate energy and healthy native vegetation prevents bank erosion.

Left: During base flow conditions the pools created by numerous large boulders provide essential deep, slow water habitat.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Roads - L; Bridges/Culverts - L.

Recreational: Hiking trails - L

Agricultural: NA

Stream management: Angling - L; Channelization - L.

Other Human Influences:

Nutrient enrichment: clear water along entire reach, little algal growth, low macrophytes abundance.

Barriers to fish movement: none.

Manure presence (evaluated only if livestock or human waste discharges are present): none.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 4/4.

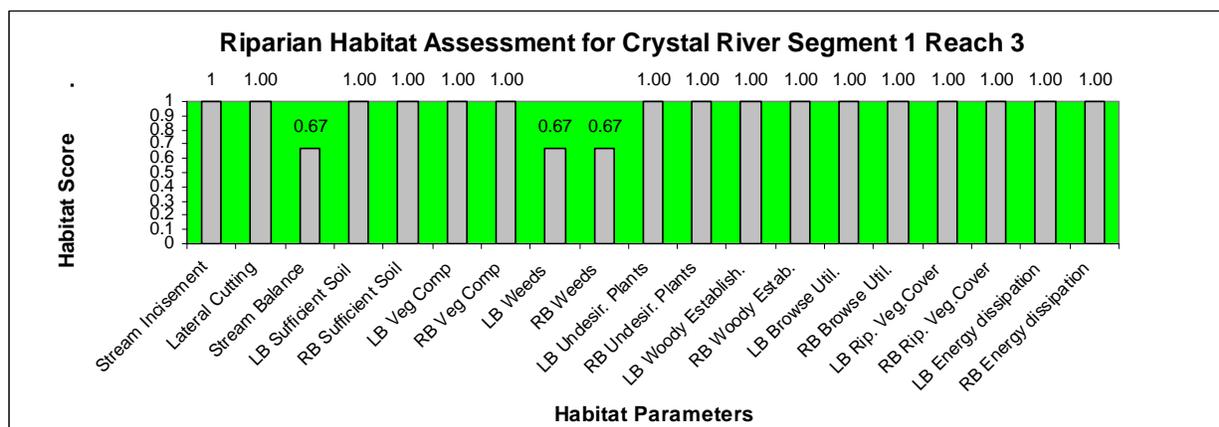
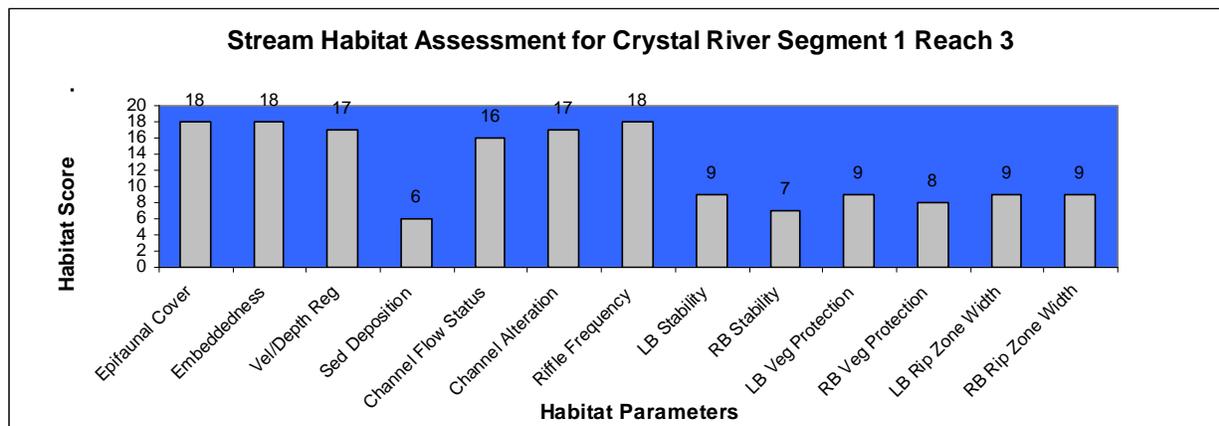
Beaver: beaver sign – rare; flow modification – none.

Dominant Land Use – forest; forest age class – >75.

Functional Rating: sustainable.

Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 54/37/0 indicating good water quality.
- Two American dippers were observed in the survey area indicating the presence of sufficient foraging and nesting resources.
- A survey of the breeding bird community recorded 40 individuals in 13 species for a biodiversity score of 2.293 and an evenness score of 0.622. Given the narrow riparian zone and consequently reduced riparian area bird abundance and richness is appropriate for the landscape.
- Estimated abundance of periphyton was “2” (common) and filamentous algae “1” (rare) indicating appropriate levels of nutrient enrichment.



Crystal River Segment 1, Reach 4.

Habitat Condition: Stream – moderately modified; LB/RB Riparian – moderately modified/slightly modified.
Stream Class (Rosgen) – C3/C2. **Stream Order** – 3rd. **Reach Length** – 1.55 km.

Summary

Hydrologic considerations

At the top of this reach the stream enters a wide valley where the stream gradient decreases. Current human impacts to the stream ecosystem are recreation-related. The upper half of the reach is a low-use campground while the lower half is a high-use campground. Human-induced vegetation alterations, associated with campground activities, threaten stream and riparian sustainability.

Channel Condition: On 35% of the left bank, trampling and removal of riparian vegetation has resulted in bank erosion with consequent alteration to channel shape. Impacts to the right bank are indirect and emanate from left bank degradation. The upper half of the reach is less impacted by vegetation degradation than the lower half; bank instability and consequent alteration of channel shape occurs on 20% of left bank at the upper campground and 50% of the left bank at the lower campground. As a consequence of vegetation destruction, areas of the stream bank on the lower campground have been ripped in an attempt to stabilize eroding banks. Additionally, an improperly installed drop structure on the lower half of the reach is resulting in lateral bank erosion.

Mid-channel islands are numerous throughout the reach and make a positive contribution to channel condition by increasing channel structural heterogeneity. Islands are typically well-vegetated and stable with a diversity of species and multiple layers of native vegetation.

Instream heterogeneity: Sinuosity is on the low side, but within the parameters for the landscape and setting, with consequent decreases in stream structural heterogeneity. Also, stream heterogeneity decreases in the downstream direction. Throughout the reach, a riffle-run morphology dominates, but on the upper half of the reach greater instream diversity is created by numerous large boulders, large woody debris, and a higher frequency of pools. On the lower half of the reach, these characteristics are reduced, thereby contributing to a reduction in the variety of instream habitat. Consequently, although all four velocity/depth regimes occur they are not evenly represented: a fast-deep regime occurs on 30% of both the upper and lower half of the reach; a fast-shallow regime occurs on 40% of the upper and 50% of the lower part of the reach; a slow-deep regime occurs on 20% of the upper and 10% of the lower part of the reach; and a slow-shallow regime occurs on 10% of both upper and lower parts of the reach. Velocity/depth regime characteristics indicate habitat simplification on the lower part of the reach adjacent to the lower campground.

Hydrologic Alteration: Width/depth ratio is inappropriately high during late season base flows. Bank-full flows occur yearly but floodplain inundation occurs on only on the 70% of the left bank where down cutting does not prevent access to the floodplain. Down cut areas correspond to developed campground sites. On the right bank overbanking flows occur over the entire reach.

On 70% of the left bank and 100% of the right bank riparian vegetated width improves infiltration and ground water recharge, which then helps sustain late season base flows. Beaver sign was rare and there was no flow modification from their activities.

Stream balance / Erosion – deposition: At the upper campground old downcutting that has begun stabilizing is apparent. Lateral erosion continues to occur on the left bank where ongoing trampling destroys vegetation. At the lower campground, large areas of vegetation destruction have resulted in an unstable channel where bank failure is common and the channel is actively



Above: The top of the reach during spring flood – native vegetation stabilizes banks.

Middle: Overbanking on the right bank during spring flood dissipates energy and recharges ground water.

Lower: Destruction of understory vegetation at the lower campground has resulted in severely eroded banks.

eroding. Stream banks are eroding and large trees are falling into the stream where riparian shrubs and forbs have been eliminated thereby resulting in channel widening and straightening.

Eroding banks in combination with late-season dewatering have created an imbalanced stream reach where there is an insufficient amount of water to move an excessive amount of sediment. Thus, as bank failure increases in the downstream direction, sedimentation effects increase. At the upper campground there is little enlargement of pointbars or islands and <10% deposition in pools; at the lower campground we observed new increases in pointbar formation and >10% deposition in pools.

Upland contribution to degradation

Grazing of surrounding uplands has altered plant community assemblage and degraded soils. The road to Marble fragments the landscape and is a barrier to deer and elk that must move between riparian to upland habitat. High numbers of road killed deer and elk has resulted.

Vegetation considerations

Riparian Zone: Potential width on each bank on 80% of the reach is 20-30 m. Due to geology, 20% of the reach has a naturally narrow riparian zone width of 1-2 m but these areas are stabilized with dense native vegetation that covers the steep banks. At the upper campground the riparian zone is at potential width on all but 20% of the left bank where campground activities and a few social trails have eliminated or degraded vegetation. At the lower campground, riparian width on the left bank has been reduced by human recreational activities. There is little or no vegetation on 40-50% of the campground area due to trampling, vegetation cutting and habitat degradation. On the right bank of the entire reach, which is mostly inaccessible, >90% of the riparian zone is up to potential vegetated width.

Plant community species composition, habitat structural complexity and age class distribution is mostly unimpacted by human activities on the right bank. On the left bank, percent cover, habitat structure and age class distribution are altered by campground-related activities, especially at the lower campground, though alterations to the upper campground remain apparent. Overall tree and shrub canopy cover has been reduced by the elimination or reduction of younger and middle aged trees and shrubs. In the campground, disturbance-tolerant/loving shrubs and forbs are more abundant than those less tolerant species. Consequently habitat structure and community composition on the left bank has been simplified and differs from the (relatively) undisturbed habitat conditions on the right bank.

Although similar tree and shrub species dominate on each bank differences occur with regard to percentages of each plant species due to amount of human-disturbance and due to slope aspect. The left bank is northwest facing and the right bank south-east. Although the valley is fairly wide and the riparian zone does not have a steep slope, different aspects result in differences in soil moisture that result in a somewhat different plant community assemblage on left and right banks. Most impactful are human-induced changes to the habitat, which has resulted in large changes to plant community composition and structure on the left bank.

Throughout the reach tree cover is comprised of three layers. On the upper campground, tree cover totals 25% on the left and 30% on the right bank. On each bank the upper tree layer is dominated by blue and Engelmann spruce; the mid layer by blue and Engelmann spruce, narrowleaf cottonwood, subalpine fir and Douglas fir and the lower tree layer by cottonwood, Douglas fir, subalpine fir and narrowleaf cottonwood.

On the lower campground dominant tree species are similar to those in the upper campground but percent cover and age-class distribution on the left bank differs from the left bank of the upper campground. Tree cover on the left bank totals 15% and 25% on the right bank.

Throughout the reach, shrub cover is comprised of three layers. Similar species occur on each bank but individual species percentages vary with campground disturbance and slope aspect. Shrub cover on the upper campground totals 40% on the left and 30% on the right bank; on the lower campground shrub cover totals 15% on



Above: Riparian habitat on most of the upper campground is in excellent condition.
Below: On the lower campground, unmanaged camping and vandalism has destroyed trees and degraded riparian habitat.

the left and 30% on the right bank. The upper shrub layer is dominated by willow species, thinleaf alder and saplings, the mid layer by willow species, red-osier dogwood, twinberry honeysuckle, bog birch, serviceberry and Rocky Mountain maple and the lower layer by Wood's rose, thimbleberry, mountain gooseberry, common juniper, and Gambel oak. Herbaceous cover is higher at the lower campground compared to the entire remainder of the reach due to a dense cover of planted grasses including Kentucky bluegrass.

Overall, 70% of the left bank and 90% of the right bank are covered by native vegetation. On the left bank patches of bare soil and trampled vegetation are common. Although sufficient kinds of soil-stabilizing plant species are present on each bank to prevent erosion and hold onto water, abundance and distribution is insufficient on the left bank to enable these functions; on the left bank 75-85% and on the right bank >90% of the riparian canopy cover has a stability rating > 6.

Stream bank Stability: Stream banks on the left are moderately unstable with 30% of the reach having areas of erosion. Stream banks on the right are moderately stable with 20% of banks having areas of erosion.

Floodplain characteristics: Although characteristics that provide energy dissipation and sediment trapping functions are present, such as large boulders and dense riparian vegetation, there are long portions of the reach where these characteristics are absent. Consequently the quantity of these characteristics is inadequate to accomplish these functions.

Weedy and undesirable species: Noxious weeds are present on up to 5% of the riparian area on each bank. Weedy species include oxeye daisy, houndstongue, yellow sweetclover and Canada thistle. Undesirable plant species occur on 10-15% of the left and 5-10% of the right bank; species include orchard grass, smooth brome, and Kentucky bluegrass.

Wildlife considerations

Instream: Riparian and bank conditions on the right bank provide good fish cover and invertebrate habitat; canopy cover is high, and overhanging vegetation, stable undercut banks and backwater pools are common. However, left bank degradation and channelizing impacts have simplified stream habitat and reduced wildlife potential. In the lower part of the reach adjacent to the campground, deep pools are infrequent, backwater pools and stable, undercut banks are uncommon and canopy cover is reduced.

Numerous mid-channel islands improve aquatic and terrestrial wildlife potential. For aquatic wildlife, these well-vegetated islands enhance habitat diversity. Overhanging vegetation and undercut banks are increased, and on mid-channel islands, there are more pools on the downstream end, and riffles on the upstream end.

Riparian: Outside of the campground areas and their zone of influence, riparian habitat provides good wildlife potential, especially on the right bank. Vegetation structure is complex, foraging and nesting resources are diverse and there is little human disturbance. On the lower half of the reach wildlife potential is reduced by habitat simplification and human disturbance. Human disturbance influences and degrades habitat for sensitive wildlife species well beyond the campground perimeter. Habitat simplification reduces the abundance and diversity of available resources thus also reducing wildlife potential.

Elk and deer browse is light, 5-25% of available second year and older stems are browsed. This level of browse probably does not impact plant vigor or habitat sustainability.



Above: Mid-channel islands improve instream morphologic diversity.
Below: Vegetation removal has resulted in bank erosion and consequent stream straightening and reduced instream diversity.

Management Recommendations:

- Campground impacts threaten the health and sustainability of this reach.
- Close and revegetate the upper campground.
- On the lower campground:
 - Move campsites at least 25 m away from stream banks.
 - Identify and harden access trails to the stream.
 - Close and revegetate social trails in the campground and along stream banks.
 - Revegetate stream banks at the campgrounds.
 - Install educational signage regarding the importance of riparian habitat, responsible campground behaviors and the damage done by “axing trees” - numerous large trees have been cut for firewood and vandalized with axes.
- Restore beaver to enhance habitat diversity and base flows.
- Institute and enforce traffic speed control measures along the road to Marble.
- Redesign and install a new drop structure to halt current lateral erosion.

General Characteristics

Location CR1-4: N39 05.654/W107 15.197; 39 06.255/107 15.812.

Elevation: 7600'. **Life Zone:** Montane. **Ecosystem:** Conifer-cottonwood-willow-dogwood forest/willow carr.

Watershed Features: predominant surrounding land use – forest; Local watershed NPS pollution – some potential sources; Local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – Colorado blue spruce, Engelmann spruce, subalpine fir, Douglas fir, thinleaf alder, willow spp., red-osier dogwood, twinberry honeysuckle,. Upland – spruce-fir forest, aspen forest, montane shrubland.

Instream Features: stream width – 29.5 m; stream depth – 0.90 m; canopy cover – 15%; high water mark – 0.30 m; stream morphology types – riffles 40%, pools 20%, runs 40%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 2 (common).

Dominant Aquatic Vegetation: dominant species – periphyton: estimated abundance – 1 (rare).

Water Quality: water odors – normal; water surface oils – none; turbidity – clear.

Sediment/Substrate: odors – normal; oils – absent; deposits – marble dust; undersides of stones black – no.

Inorganic Substrate Components %: bedrock 0; boulder 30; cobble 40; gravel 15; sand 10; silt 5; clay 0.

Organic Substrate Components %: detritus (CPOM) 10; muck-mud (FPOM) 5; marl 0.

Assessment Data

EPA Habitat Assessment Score: 155/200.

NRCS Habitat Assessment Score: left bank – 43/61; right bank – 49/61.

Weedy species: oxeye daisy, Canada thistle, yellow sweetclover.

Disturbance-caused undesirable plants: dandelion, orchard grass, Kentucky bluegrass, smooth brome.

Dominant Native Riparian Vegetative Species:

Trees: Colorado blue spruce, Engelmann spruce, subalpine fir, Douglas fir, narrowleaf cottonwood, quaking aspen, ponderosa pine.

Shrubs: willow spp., thinleaf alder, river birch, red-osier dogwood, twinberry honeysuckle, bog birch, Rocky Mountain maple, common juniper, shrubby cinquefoil, Wood's rose, gooseberry, Colorado currant, thimbleberry, serviceberry, buffaloberry, snowberry.

Grasses and Forbs: sedge and rush spp., equisetum spp., self-heal, false solomonseal, aster spp., kinnikinnick, golden glow, gentian spp., solidago spp.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Roads - L.

Recreational: Hiking trails -H; Campground - H; vandalism - H.

Agricultural: NA.

Stream management: Angling - L; Channelization - L

Other Human Influences:

Nutrient enrichment: clear water along entire reach, little algal growth, low macrophyte abundance.

Barriers to fish movement: drop structure >1 foot within reach.

Manure presence: none.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 4/4.

Beaver: beaver sign – rare; flow modification – none.

Dominant Land Use – forest; forest age class 25-75 years.

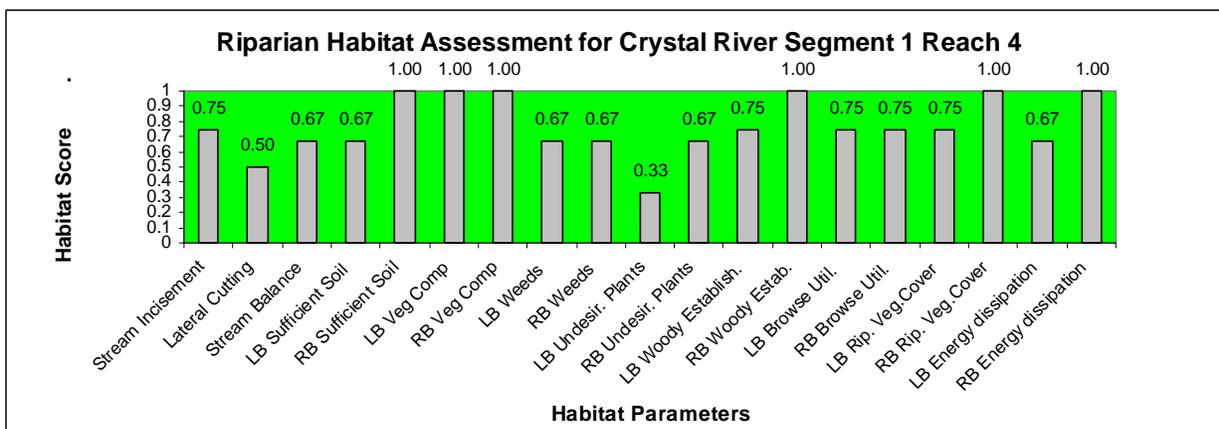
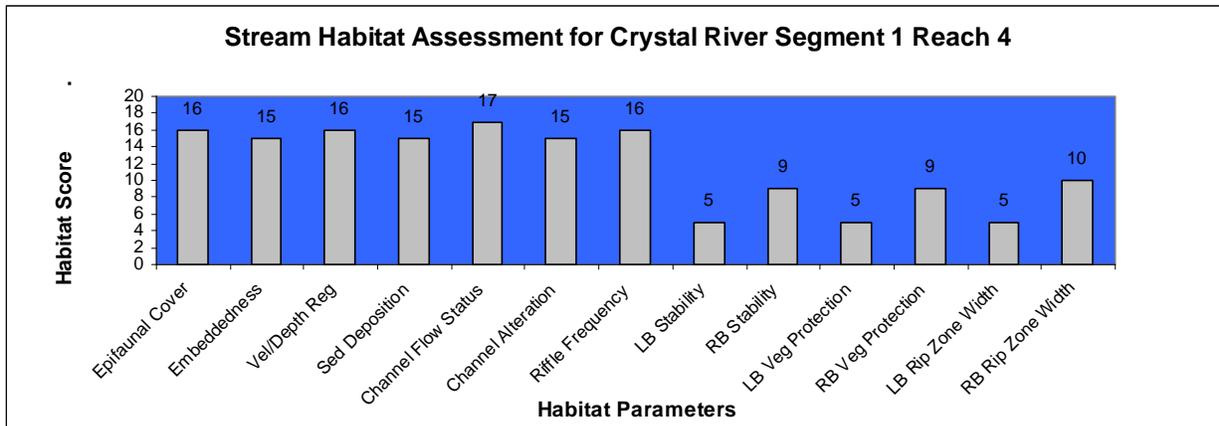
Functional Rating: at risk, trend depends on campground management and restoration.

Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 26/17/0 at the upper campground and 26/9/0 at the lower campground indicating good water quality throughout.
- No American dippers were observed in the survey area indicating the absence of an essential resource and habitat impairment.
- Breeding bird surveys in the upper and lower campgrounds recorded 85 individuals in 23 species for a biodiversity score of 2.909 and an evenness score of 0.655. In the lower campground survey results recorded 41 individuals in 17 species for a biodiversity score of 2.608 and an evenness score of 0.702. Surveys were conducted in similar habitat types in each reach. Results indicate habitat impairment and the presence of limiting factors in the lower campground that likely include vegetation degradation and high levels of human disturbance.
- Estimated abundance of periphyton and filamentous algae were each “1” (rare) indicating appropriate levels of nutrient enrichment.



Standing at the top of the reach looking downstream: Diverse and undisturbed habitat on the right bank provides excellent wildlife potential.



Crystal River Segment 1, Reach 5.

Habitat Condition: Stream – moderately modified; LB/RB Riparian – heavily modified/moderately modified.
Stream Class (Rosgen) – B3/B2. **Stream Order** – 3rd. **Reach Length** – 1.61.

Summary

Hydrologic considerations: The stream enters a narrow canyon where the gradient steepens and the channel is naturally entrenched. Steep canyon walls on each bank result in a naturally narrow riparian zone. Both historic and current human activities have altered the condition of the stream channel.

Channel Condition: On the left bank of the stream, a historic railroad grade has been converted into a paved road. Railroad grade/road cut induced bank instability occurs on 15% of the left bank. Home development, in combination with road cut effects, impacts an additional 55% of the left bank. On the right bank, home development impacts 60% of the stream channel and riparian zone.

Impacts to the channel from railroad/road and home development include channel straightening, reduced flow diversity, riparian vegetation destruction and increased stream energy due to marble riprapped banks and vegetation degradation.

Instream heterogeneity: Instream habitat variety is decreased by road- and home-induced channelizing effects. On 75% of the reach, stream morphology is completely dominated by riffles and runs. Deep pools only occur on 25% of the reach where the stream has a steeper gradient that has enabled the development of a pool-cascade structure. In these steeper sections, deep pools have formed behind boulders and shallow pools occur along the edge of the stream. Thus, all four velocity/depth regimes occur, though not with an even representation; a fast-deep regime occurs on 45% of the reach, fast-shallow on 35%, slow-deep on 12% and slow-shallow on 8%.

Hydrologic Alteration: During the late summer, width/depth ratio is excessively high resulting in approximately 20% of the channel substrate being exposed. However, with spring runoff, bank-full flows and flood plain inundation occur regularly. During the late summer, upstream diversions and diversions on tributary streams likely impact flow status in the Crystal River contributing to excessively decreased late season base flows. Ground water storage function on the naturally narrow riparian zone has been further reduced by road and housing development. Beaver sign was rare and there were no beaver dams to modify flows or store water.

Stream balance / Erosion – deposition: The channel has evidence of old downcutting that has begun stabilizing. Narrow pointbars are redeveloping and revegetating at the base of steep eroding slopes that were devegetated and destabilized by the railroad grade and road cut.

Lateral erosion is occurring on both banks in areas where homes are built to the edge of the stream bank and where riparian vegetation has been removed, typically in conjunction with home or pasture development.

Stream balance has been disturbed by the cumulative impacts of excessive lateral erosion, road-based gravel and sediment that move into the stream unfiltered by riparian vegetation and upstream and tributary diversions that dewater the stream. Consequences include sediment deposition that is somewhat excessive with slight deposition in pools, and 10-15% of the stream bottom affected.

Upland contribution to degradation

Highway 133 contributes excess sediment and road-based pollutants to the stream and fragments wildlife habitat. Home development has increased impermeable surfaces and decreased infiltration, landscaped exteriors contribute fertilizers and pesticides to runoff, and the housing development creates a barrier to wildlife migrations.



Above: Riparian habitat is in good condition on 30-40% of the reach.

Below: The historic railroad grade and current road cut destroyed riparian vegetation and degrades stream banks.

Vegetation considerations

Riparian Zone: A naturally narrow riparian zone has been further reduced by road cut-induced bank destabilization and home and vegetation alteration within the zone. Potential riparian zone width is typically 6-12 meters; this width has been reduced to <6 m on 60% of each bank.

On 70% of the left bank and 60% of the right bank, riparian habitat has been degraded by the road cut, home development or pastures. Typically, in these developed areas, most large trees remain, most shrubs and younger aged trees have been removed, and native forbs have been replaced with Kentucky bluegrass or pasture grasses. A few homeowners have allowed native trees and shrubs to return. Consequences from riparian alteration include a reduction in native plant species diversity, habitat complexity and ecosystem resilience.

In the remaining natural areas, plant species diversity and habitat complexity is appropriate for the landscape with a good distribution of all age-classes of desirable woody riparian plant species present. Differences in stream bank aspect result in natural differences in plant community composition so that although many of the same species occur on each bank they are present in different percentages; the left bank is north-facing and selects for more moisture-loving plants while the right bank is south-facing with more drought-tolerant species. In undisturbed areas, riparian benches, although relatively narrow, provide good wildlife habitat and supply riparian functions such as bank stabilization, sediment trapping and energy dissipation.

Tree cover on the left bank totals 30% cover and is comprised of three layers. The upper tree layer is dominated by Colorado blue spruce with both the mid and lower tree layers dominated by narrowleaf cottonwood, blue spruce and subalpine fir. Tree cover on the right bank totals 25% cover and is also comprised of 3 layers. The upper layer is dominated by blue spruce and Douglas fir with both the middle and lower layer dominated by narrowleaf cottonwood, blue spruce and Douglas fir.

Shrub cover on each bank totaled 20% and is comprised of three layers. The upper shrub layer is dominated by willow species and Rocky Mountain maple on the left bank and willow species and thinleaf alder on the right bank. The mid layer is dominated by coyote willow and twinberry honeysuckle on the left bank and twinberry and red-osier dogwood on the right bank. The lower layer is dominated by mountain gooseberry and twinberry on the left bank and Wood's rose and dogwood on the right bank.

Native vegetation protects 50-70% of the stream bank surfaces and immediate riparian zone. Disruption is obvious and there are numerous patches of bare soil and closely cropped vegetation. Both banks are adversely affected by the road cut and by houses, lawns and pastures that are the proximate causes for the excessive amount of ongoing lateral erosion.

Stream bank Stability: The left bank is moderately stable due to marble riprap – unfortunately one negative aspect of riprapping banks includes increasing stream energy in the downstream direction and in the direction of the opposite bank, thereby increasing erosion elsewhere. The right bank is moderately unstable with 30% of the banks in the reach having areas of erosion and high erosion potential during floods.

Floodplain characteristics: Although characteristics that provide energy dissipation and sediment trapping are present, quantity is insufficient to adequately accomplish these functions. Although an abundance of large boulders in the channel help dissipate energy, other important characteristics, such as riparian vegetation, are degraded and banks that have been riprapped serve to increase energy in the downstream direction. Sediment trapping functions are also diminished due to vegetation removal at road cuts and at home developments where lawns replace riparian vegetation and where banks have been shored with riprap.

Weedy and undesirable species: Noxious weeds are extensively distributed over the entire reach with over 10% of the riparian area inundated. Weedy species include oxeye daisy, Canada thistle, common tansy, black medic, yellow sweetclover, houndstongue and reed canarygrass. Undesirable plant species occur on over 15% of the riparian area; species include smooth brome, orchard grass, Kentucky bluegrass and Timothy grass.



Above: Some homeowners have opted to allow natural vegetation restoration to occur.

Below: Removal of riparian shrubs and forbs typifies development along this reach and has resulted in bank erosion.

Wildlife considerations

Instream: Wildlife potential is limited by excessively reduced base flows, reduced canopy cover and suboptimal invertebrate and fish habitat. Aquatic wildlife potential is enhanced by an abundance of boulders, and stable cobble and gravel, which create deep pools (boulders), riffles (cobble) and spawning habitat (gravel). However this potential is undermined by bank and riparian vegetation degradation; overhanging vegetation is reduced, stable undercut banks and large woody debris are rare, and there are no backwater pools or root mats. Additionally, road-based gravel washes into the stream at unvegetated areas and is filling pools.

Riparian: Less than half of the riparian habitat is in good condition and able to support native wildlife communities. Habitat simplification has occurred with the removal of much of the understory. Vegetation alteration also eliminates protective cover, forage and nest sites. Human disturbance permeates well beyond the perimeter of development to impact a greater area. Thus wildlife is limited by a decrease in habitat and by disturbance that creates in stress to sensitive species.

Browsing by deer is light but noticeable but probably does not negatively affect plant vigor. Selective browsing on native grasses and shrubs is about 5% of available second year and older stems

Management Recommendations:

- Revegetate road cuts with appropriate native vegetation and install sedimentation prevention measures.
- Establish riparian setbacks of at least 50 m that prevent building in the riparian zone or altering riparian vegetation.
- Restore riparian vegetation where lawns and homes encroach into the riparian zone and onto stream banks.
- As indicated by aquatic vegetation, nutrient levels are excessive; determine and mitigate the source(s) of excessive stream nutrients.



Mosses are important and effective bank stabilizers that are easily destroyed by human trampling.

General Characteristics

Location CR1-5: N39 06.255/W107 15.812; 39 07.004/107 16.145. **Elevation:** 7550'. **Life Zone:** Montane.

Ecosystem: Conifer-cottonwood-alder-willow-dogwood forest/lawn/pasture.

Watershed Features: predominant surrounding land use – Forest and Residential; local watershed NPS pollution – obvious sources; local watershed erosion – moderate.

Dominant Native Vegetation: Riparian – LB Colorado blue spruce, subalpine fir, thinleaf alder, willow; RB Douglas fir, blue spruce, thinleaf alder, red-osier dogwood, twinberry honeysuckle,. Upland – Douglas fir forest-aspen forest-oak shrubland.

Instream Features: stream width – 19 m; stream depth – 1m; canopy cover – 15%; high water mark – 1.6 m; stream morphology types – riffles 35%, pools 20%, runs 45%; channelized – yes; dam present – no.

Large Woody Debris (0 none to 4 abundant): 1 (rare).

Dominant Aquatic Vegetation: periphyton and filamentous algae: estimated abundance – 2 (common).

Water Quality: water odors – normal; water surface oils – none; turbidity – clear.

Sediment/Substrate: odors – normal; oils – absent; deposits – sand & road-based gravel; undersides of unembedded stones black – no.

Inorganic Substrate Components %: bedrock 0; boulder 30; cobble 30; gravel 25; sand 15; silt 0; clay 0.

Organic Substrate Components %: detritus (CPOM) 5; muck-mud (FPOM) 5; marl 0.

Assessment Data

EPA Habitat Assessment Score: 145/200.

NRCS Habitat Assessment Score: left bank – 39/61; right bank – 43/61.

Weedy species: oxeye daisy, Canada thistle, common tansy, reed canarygrass, black medic, yellow sweetclover, houndstongue.

Disturbance-caused undesirable plants: smooth brome, orchard grass, Kentucky bluegrass, timothy.

Dominant Native Riparian Vegetative Species:

Trees: Colorado blue spruce, narrowleaf cottonwood, subalpine fir, Douglas fir.

Shrubs: willow spp. (beaked, whiplash, strapleaf, coyote), red-osier dogwood, twinberry honeysuckle, Rocky Mountain maple, thinleaf alder, mountain gooseberry, Wood's rose.

Grasses and Forbs: sedge and rush spp., equisetum spp., cowbane, pink pyrola, ranunculus spp., northern bedstraw, aster spp., sweet cicely, baneberry, self-heal, monkey flower.

Watershed Activities and Disturbances Observed (intensity – low, moderate, heavy):

Residential: Residences - M; Maint. Lawns - M; Roads - M.

Recreational: NA.

Agricultural: Pasture - L; Water withdrawal - L

Stream management: Angling - L; Channelization - L; Water fluctuation - M.

Other Human Influences:

Nutrient enrichment: fairly clear or slightly greenish, moderate algal growth on stream substrates.

Barriers to fish movement: none.

Manure presence: evidence of livestock access to riparian zone.

Site Characteristics:

Waterbody character (5-1 pristine to disturbed/appealing to unappealing): 3/3.

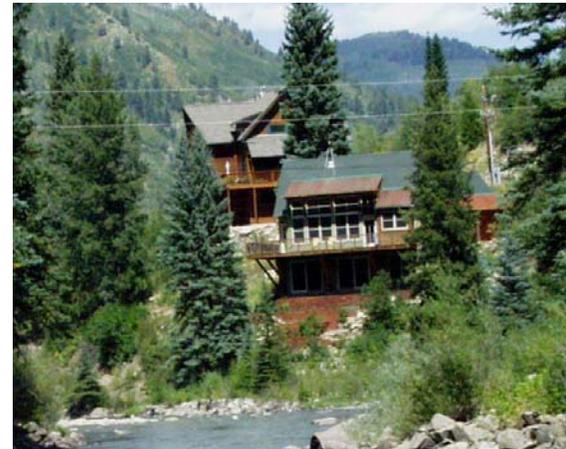
Beaver: beaver sign – rare; flow modification – none.

Dominant Land Use – forest & rural; forest age class – 25-75.

Functional Rating: risk, trend depends on riparian restoration and management.

Biological Indicators of Stream and Riparian Condition:

- Benthic macroinvertebrate community ratio of pollution intolerant to facultative to tolerant individuals was 47/53/0 indicating potentially impaired water quality.
- One American dipper was observed in the survey area.
- A survey of the breeding bird community recorded 54 individuals in 17 species for a biodiversity score of 2.576 and an evenness score of 0.646.
- Estimated abundance of periphyton was “2” (common) and of filamentous was “2”. This sudden increase in abundance of both periphyton and filamentous algae when compared to the previous upstream reach indicates excessive nutrient enrichment.



Building in the riparian zone and on the stream bank has reduced riparian functions and degraded stream habitat.



Runoff, laden with road-based pollutants, including sediment, is carried directly into the stream, unfiltered, due to the lack of riparian vegetation.

