Colorado River in Eagle County Inventory and Assessment

Report prepared for the
Eagle River Watershed Council

By
Johannes Beeby, M.S.
Brian Bledsoe, Ph.D., P.E.
Kyle Hardie, M.S.

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Colorado State University
Civil and Environmental Engineering
Fort Collins, CO 80523
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Executive Summary

The Colorado River corridor through Eagle County is a unique ecosystem that offers a multitude of valuable resources, services, and amenities. Owing to a largely confined valley surrounded by a relatively arid and mineral-poor landscape, local human influences in the Eagle County portion of the upper Colorado are relatively modest despite direct encroachment by road and railroad corridors. Yet its remote and picturesque setting belies mounting pressures from upstream; namely, the fundamental societal challenge of meeting increasing demands for water supplies while simultaneously providing flows necessary to sustain aquatic and riparian ecosystems. Finding this balance rests squarely upon future water-management decisions throughout the Upper Colorado River basin.

This report describes the results of the Colorado River in Eagle County Inventory and Assessment (CRIA), a joint effort of Colorado State University (CSU) and the Eagle River Watershed Council (ERWC), to assess the current state of the Colorado River corridor within Eagle County. The overarching goals of the project were to: 1) conduct a systematic inventory of channel, riparian, and upland characteristics in the main stem river corridor and 2) use data collected and analyzed during the inventory to assess pertinent parameters and characteristics that affect the ecological integrity, recreational amenities, and aesthetic values of the Eagle County portion of the river. The specific objectives of the inventory and assessment were to:

- Perform an analysis of existing monitoring data and information to assess the status of river corridor. Existing water quality data may be used to “bracket” sources of nonpoint source pollution and to identify the spatial distribution of water quality influences and biological stressors.
- Conduct synoptic field surveys of riparian condition, chemical, physical, and biological water quality, and geomorphic attributes to supplement existing information. The spatial domain of this survey was defined as the Colorado River main stem from Pumphouse to Dotsero.
- Identify and describe candidate rehabilitation projects (structural and non-structural) and link to current issues and likely outcomes based on:
  - field reconnaissance,
  - meetings with watershed stakeholders,
  - meetings with local, state, and federal scientists,
  - Geographic Information System (GIS) inventory and analysis (e.g., riparian conditions, land cover, geomorphic processes, etc.), and
  - scientific assessment.

ES.1 Main Stem Corridor Overview

The study area for this project encompasses the 60-mi main stem corridor of the Colorado River from Pumphouse boat launch downstream to the confluence with the Eagle River. In general, the river is mostly confined by canyon and steep-sided topography.
Pumphouse is located at the bottom of Gore Canyon where the Colorado River runs steeply out from the narrow canyon onto flatter, less confined topography. From here, the river travels through Lower Gore Canyon before Blacktail Creek enters from the north. The river continues downstream where Sheephorn Creek merges from the south before reaching Radium. Below Radium, Red Gorge Canyon offers a steeper decent before mostly flatter water presides until State Bridge. Just upstream of State Bridge, the largest tributary in the study area, the Piney River, enters the Colorado River. Downstream to Rock Creek the river alternates between steep-walled canyon and less confined valley. Areas with wider floodplains in this reach are mainly used for growing hay. Catamount boat launch is located at the junction of Big Alkali Creek and the Colorado River. From Catamount downstream the geologic setting becomes more sedimentary-dominated and the river valley alternates between relatively steep canyon-like sections and flatter yet still confined areas. Land cover within watershed below Pumphouse is 36% evergreen forest, 28% shrub/scrub, 14% grasslands/herbaceous, and 14% deciduous forest. A brief description of nine perennial tributaries is provided below. A more in-depth analysis of tributary water quality and its influence on the main stem are discussed in Chapter 4.

**ES.2 Analysis of Watershed Characteristics**

**ES.2.1 Land Use**

Land use change within the study area has remained relatively modest due to steep topography and aridity. Ranches and irrigated pasture have encroached upon the river floodplain in the wider valley bottoms; however, 65% of the river runs through public land managed by the Bureau of Land Management (BLM). Future opportunities for development along river corridor appear minimal and are primarily focused on opening up recreational opportunities. A recent proposal from Grand County to build a whitewater park upstream of Pumphouse is being reviewed by the BLM and other resource agencies. Currently there are no oil and gas leases within the study area (BLM, 2013a). Most of the area has no known or low potential for gas occurrence except for one medium potential section around Cabin Creek and Big Alkali Creek watersheds (BLM, 2013a).

**ES.2.2 Water Rights**

The first water rights in the Colorado River basin within Eagle County date back to the 1880s when settlers began ranching in the area. The arid land required settlers to divert water by ditch, well, and pump in order to ranch. As of 2005, there were 496 diversion structures within the study area (Colorado Decision Support System (CDSS), 2013). Of these, only 151 have an absolute water right rate greater than 3 cfs. The largest single diversions in the study area occur in the Derby Creek (32 and 29 cfs) and Rock Creek (25 and 22 cfs) watersheds. The most important water rights for maintaining flows in the main stem river are actually located downstream. The water rights held by the Shoshone Power Plant and the “Cameo Call” are two of the oldest held on the Colorado River and make up a large portion of the water in the Colorado River year round. However, the Shoshone rights can be shutoff during runoff and
“relaxed” during times of drought to allow more junior rights held by reservoirs upstream to store water.

An agreement made in 2010 by East Slope and West Slope water providers will guarantee flows in the late summer months to help with recovery of four federally endangered fishes that inhabit a 15-mi reach of the Colorado River near Grand Junction. The four species of fish, Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), humpback chub (*Gila cypha*), and bonytail chub (*Gila elegans*), will benefit from an additional 10,825 AF of water. Initially, water was provided from the Williams Fork and Wolford Mountain Reservoirs which provided the benefit of additional late summer flows to the Colorado River through Eagle County. However, in 2013, two permanent sources, Ruedi and Granby Reservoirs, were designated to each release half of the 10,825 AF of water. Only Granby Reservoir is upstream of the study area; thus, less water will be sent through the area than in previous years under the new operations.

**ES.2.3 Upstream Reservoirs and Diversions**

The Colorado River basin has an extensive history of water storage and diversion. Some diversions are inbasin (the water never leaves the watershed). In contrast, transbasin diversions move water outside of the watershed where it fell as precipitation. Finally, transmountain diversions are transbasin diversions that move water from the West Slope of the state, over the Continental Divide, to the East Slope.

The largest transmountain diversion project in Colorado, the C-BT Project built between 1938 and 1957, originally came about to deliver water from the West Slope to the East Slope primarily for agricultural purposes. Today, 12 reservoirs, 35 mi of tunnel, and 95 mi of canal deliver 213,000 AF of water per year to the East Slope to provide for agricultural and municipal uses.

A more recent addition to the C-BT Project is Windy Gap Reservoir. Built in 1985, Windy Gap Reservoir is a small impoundment (445 AF) used to pump water from the Colorado River, below the confluence with the Fraser River, up to Lake Granby. Windy Gap delivers an average of 48,000 AF/year of water. A new firming project for Windy Gap has been proposed and is currently under review. This would provide an additional 90,000 AF of storage allowing for the Northern Colorado Water Conservancy District (NCWCD) to fully utilize the 90,000 AF/year that can be diverted by Windy Gap. These additional water withdrawals from the Colorado River can have direct impacts on the river downstream of Windy Gap including through the study area. Possible impacts could include reduced flows in general but especially peak flows which could exacerbate sedimentation issues.

Within the Colorado River basin, Denver Water owns and operates two reservoirs and four tunnels that deliver water out of the basin to the Eastern Slope. A proposal put forward by Denver Water to enlarge Gross Reservoir by 72,000 AF is currently under review. Enlarging the reservoir means that Denver Water would be able to divert more water out of the Williams Fork and Fraser River basins. Reducing flows on these two major tributaries to the Colorado River
could possibly impact peak flows and late summer water temperatures downstream including the study area.

**ES.2.4 Hydrology**

The hydrologic regime of the Upper Colorado River is dominated by snowmelt from higher elevations in the watershed. Certain climatic factors that control snowpack influence how the hydrologic regime behaves in any given year. One of the more crucial factors determining the water quantity available to the Colorado River in any year is the peak Snow Water Equivalent (SWE) in the watershed. Six Snow Telemetry (SNOTEL) sites within the Upper Colorado River watershed were analyzed for upward or downward trends in SWE and average air temperature during their period of record. Overall, four of six sites showed a decreasing trend in SWE with two of these being statistically significant. Five of six sites showed an increasing trend in average air temperature and these were all statistically significant. Basing future projections of SWE and temperature on these periods of record is questionable; however, if these trends continue it could mean less overall water for the Colorado River and earlier peak flows which could possibly result in lower and warmer flows in late summer.

Flow alterations within the Upper Colorado River began with the construction of the numerous diversion structures and reservoirs that are present today. The largest diversions exported water out of the watershed. Direct discharge measurements of these diversions were compared for the period between 1961 and 2011. Results indicate that the Moffat, Adams, and Roberts tunnel diversions exported 29% of the total yield at the Colorado River at Kremmling gage (U. S. Geological Survey (USGS) #09058000) (Figure 3.23). The majority of the water rights are diverted during spring runoff, effectively reducing annual peak flows.

The current flow regime within the study area during the post Windy Gap (1985-2013) period shows the annual average peak discharge at the Kremmling gage is approximately 2,240 cfs. The average annual peak flow (1985-2013) for the Colorado River above the confluence with the Eagle River is approximately 3,660 cfs. Tributaries within the study area on average (1985-2013) contribute up to 46% of flows during spring runoff, but tributary inputs decrease to a low of 16% during the summer months. Flow contribution from the Piney River, the largest tributary, peaks in spring runoff at 12% and decreases to an average of 2% in summer.

Changes in streamflow characteristics (magnitude, frequency, duration, timing, rate of change) from pre- to post-development were analyzed using the Indicators of Hydrologic Alteration (IHA) program (Mathews and Richter, 2007). The streamflow gage records at Kremmling date from 1904-1916 and from 1962-2013. The period from 1904-1916 was used streamflow analyses performed in this study as an approximation of pre-diversion and reservoir flows on the Colorado River. The period from 1962-2013 is representative of post-development flows in a period of evolving water operations and management.

The climate between 1905 and 1931 is characterized as a long wet period with brief dry periods in the early teens (McKee et al., 1999). When examining peak flows from the years 1905-1918, the maximum peak flow was 21,500 cfs in 1912 and the minimum peak flow was 6,690 cfs in 1908. The brief dry period in the early teens is most likely referencing the peak flow
of 7,860 cfs in 1913. Although the peak flows may be slightly higher than average conditions due to the long wet period, a peak flow greater than the minimum peak flow of 6,690 cfs from 1905-1918 has only occurred six times between 1962-2013.

The construction of major reservoirs within the watershed has increased minimum flows on the Colorado River. Reservoirs tend to increase base flows on a river due to the storage of water allowing for more flow to be released during what are normally low flow periods. The 1-day, 3-day, 7-day, 30-day, and 90-day minimum flows have all increased post-development by an average of 27%. If the increase in minimum flows is occurring during the low-flow summer months it could help keep water temperatures below the critical threshold for trout. However, post-development median flows during July and August were 43% smaller than the wet pre-development period. Meanwhile, post-development median flows between October and March are 19% larger than pre-development. Therefore, increases in minimum flows due to reservoirs seem to be occurring primarily during the winter months.

Maximum flows on the Colorado River have been substantially altered by transmountain diversions. The 1-day, 3-day, 7-day, 30-day, and 90-day maximum flows have all decreased post-alteration by an average of 74%. The overall hydrograph from the two periods of record breaks flow into different environmental components including large floods (>17,900 cfs), small floods (>11,700 cfs), and high-flow pulses (>1,800 cfs) (Figure 3.26). During the pre-development period, 8 of 14 peak flow events were considered a small flood or larger and the remaining six were high-flow pulses. Applying the same thresholds to the post-development period indicates the occurrence of one small flood, 31 high-flow pulses, and 19 peak events below 1,800 cfs. Comparison of exceedance probabilities for all pre- and post-development flows indicates that flows with an exceedance probability greater than 57% (~700 cfs), post-development flows are on average 51% smaller than pre-development. This reduction in peak flows post-development becomes more apparent when comparing the exceedance probability of flows in June when the peak usually occurs. For all exceedance probability values in June, post-development flow values are on average 78% smaller than pre-development. The durations of these peak flow events have also decreased substantially. The median duration of the pre-development small flood peak flows was 91 days. The median duration of post-development peak high-flow pulses is 12 days. The timing of the peak flow event has also shifted. Pre-development, the average peak flow occurred on June 13. Post-development, the average peak flow occurs on June 2.

**ES.2.5 Riparian Analysis**

Field-based analysis of the riparian corridor was conducted between September 26 and October 2, 2012 and from October 1 to October 4, 2013 while floating the river through the study area. Every instance of accelerated bank erosion or failure, riparian buffer encroachment, or sparsely to unvegetated riprap was documented with photographs and GPS. Sites where riprap banks had vegetation established were not designated as potential restoration sites due to the low feasibility of either eliminating or reducing encroachment by the road or railroad. Russian olive (*Elaeagnus angustifolia*) was also noted but was not a focus of the analysis as Russian olive was widespread from Two Bridges to Dotsero (~35 mi) making eradication
possibly unfeasible. Tamarisk (*Tamarix aphylla*) was documented with GPS; however, the resulting estimates of impacted bank lengths do not represent dense stands as tamarisk was not observed to be continuously established along any banks. Rather, individual plants were spotted either infrequently. Overall, the estimated percentage of impacted riparian area is low at 8%. Most of the riparian impacts stem from human activities on private land. In general, the impacts from these riparian encroachments appear minimal and rehabilitation efforts in these areas, although desirable, provide limited local ecological benefits compared to system wide management efforts (e.g., environmental flows).

**ES.2.6 Water Quality**

Water quality is strongly influenced by interactions with water quantity (streamflow) in the study area. The two primary issues identified in this study are elevated water temperatures, especially during low flows of late summer, and deposition of fine sediment. Water temperatures were recorded in 2012 and 2013 by the Wild and Scenic (W&S) Stakeholder Group at three locations within the study area: 1) State Bridge, 2) Below Red Dirt Creek, and 3) Dotsero. In 2012, the data logger below Red Dirt Creek was buried by sediment and the resulting data were unusable. Hence, the analysis of temperature data performed in this study focused on the more complete data set from 2013.

As expected, results indicate that water temperatures increase moving downstream. In 2013, temperatures at Dotsero were on average ~4°F warmer than at State Bridge (3/29-11/7). Compared to water temperature data from the Colorado River at Kremmling, Dotsero was 3.1°F warmer (3/28-9/30). Between July 1 and September 30, Dotsero was 5.6°F warmer than Kremmling and 6.3°F warmer from July 1 to August 31.

Temperatures for the three sites in the project area were compared to Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Commission (WQCC) standards for Cold Water Tier II Aquatic Life streams. CDPHE WQCC standards exist for two parameters: 1) the DM and 2) the MWAT. During 2013, the most-upstream W&S temperature monitoring site at State Bridge recorded no observations exceeding recommended state standards. At Red Dirt Creek, sedimentation at the probe site rendered a portion of the mid-season data unusable, but generated a viable record overall. During the period from June 29 to July 22, observations exceeded MWAT standards for 4 weeks. In the final week of July, upstream water releases increased and temperature concerns abated; this time period in 2013 also featured plentiful monsoonal moisture in the mountain region, easing diversion pressures and temperatures on many streams across the West Slope. At the Dotsero site, observations exceeded MWAT standards for 4 weeks between June 29 and July 30. DM exceedances also occurred for a shorter period within that time, surpassing the 23.8°C threshold for 8 days from July 15 to 24. Analysis of a limited subset of data from 2012 shows a similar MWAT exceedance for nearly 6 weeks between July 4 and August 15. Taken together, these observations support the conclusion that warm temperatures, associated with low flows, are a continuing concern to aquatic ecosystems in the Eagle County reach of the Colorado River.

Single point water temperatures were collected between September 26 and October 1, 2012 in all perennial tributaries to determine if they were contributing to increases in water
temperature on the main stem. Results indicate that all tributaries were colder than the Colorado River except for Sheephorn Creek which was 1°F warmer (Figure 3.73). Combining these single point measurements with the fact that on average the largest tributary, the Piney River, only contributes 2% of flow to the main stem through the summer months, it appears unlikely that any single tributary, nor the cumulative contribution of all tributaries, would have a substantial effect on main stem warming during the period of observation. Additional analyses described below suggest that elevated temperatures within the study area are primarily a consequence of tributary influences and reservoir operations the upper watershed. Further investigation during the summer months by collecting continuous data from each tributary and in the main stem above and below each tributary, especially in August, is recommended to fully understand the influence of tributaries on main stem temperatures.

A GIS time-series animation was created to explore water temperature dynamics in the Colorado River watershed upstream of the study area. Water temperature and discharge data collected between 2010-2012 by the USGS and Grand County Water Information Network (GCWIN) for many of the tributaries and locations along the main stem were used in this study to develop three GIS animations depicting spatial and temporal temperature patterns. The animations show both the daily maximum temperature and daily average flow. Overall, it appears that the Fraser River is contributing more flow and is substantially warmer than the Colorado River at their confluence. Below the Fraser confluence, water temperatures again become elevated in the Colorado River prior to reaching the Williams Fork. The Williams Fork does appear to substantially decrease water temperatures in the main stem when the flow being released is a substantial portion of the total flow. If the Williams Fork is not contributing enough flow to cool the main stem, temperatures remain elevated and continue to increase upstream of Muddy Creek. Thus, water releases from the Williams Fork Dam appear to play a pivotal role in moderating summer temperatures along the main stem Colorado River.

GIS animations indicate that Muddy Creek temperatures during summer increase substantially between Wolford Mountain Reservoir and its confluence with the Colorado River. This is particularly apparent below the Kremmling Wastewater Treatment Facility. The Blue River appears to normally be substantially colder during summer than the main stem and provide a cooling effect in the main stem, especially when enough flow is being released from Green Mountain Reservoir. The Blue River also appears to play an important role in moderating summer water temperatures through the study area. Hence, it is important to note that with the agreement to allow substitution of water from the Blue River with Muddy Creek, the water temperatures and the consequent influence on the Colorado River main stem may not be the same. If large quantities of water from the Blue River are swapped with Muddy Creek water, this pronounced cooling effect may be diminished.

Turbidity samples were collected from September 26 to October 2, 2012 and from October 1 to October 4, 2013. In general, turbidity increased in a downstream direction. During 2013, a storm dropped 2 to 4 inches of snow throughout the study area. Turbidity was measured in the tributaries during the snowmelt from this event to possibly identify differences in the contribution of fine sediments. The majority of sediment entering the main stem from tributaries undoubtedly occurs during intense summer thunderstorms, but snowmelt may
provide some semblance of a baseline indication. Big Alkali Creek, Red Dirt Creek, and Sweetwater Creek were the most turbid. The Piney River was the least turbid.

**ES.2.7 Sedimentation Above and Below Catamount**

As described above, there is a general shift from a mix of igneous and sedimentary rocks to sedimentary-dominated geologic setting moving downstream. This change becomes most apparent downstream from Two Bridges to Catamount where an appreciable increase in sediment delivery occurs due to increasing numbers of gullies and washes. This increased influx of fine sediment from surrounding hillslopes, gullies, and tributaries continues all the way to Dotsero.

Upstream of Catamount, the geology within the study area is: 36% igneous, 1%, metamorphic, 41% sedimentary, and 22% other rock types. Below Catamount, the geology consists of: 15% igneous, 0% metamorphic, 57% sedimentary, and 27% other. Part of the well-known Universal Soil Loss Equation (USLE) is the K-factor or soil erodibility factor. The higher the K-factor value the higher the soil erodibility. The K-factors for soils within the study area were mapped and the results indicate more readily erodible surfaces downstream of Catamount. The steepness of the surrounding hillslopes also plays a central role in delivering eroded sediment to the river. Therefore, the product of slope and USLE K-factor was mapped to represent the synergistic interaction between slope and soil erodibility. Again, areas with higher erodibility appeared to be more prevalent downstream of Catamount.

With increased sediment delivery occurring downstream of Catamount, a resulting shift in river bed slope, width, or planform might be expected. The bedslope from Pumphouse to Rancho Del Rio, from Rancho Del Rio to Burns, and from Burns to Dotsero have all been estimated at 0.0027 (Miller and Swaim, 2011); however, these slopes are estimated from topographic maps and do not reveal local trends and variations in the longitudinal profile of the river. Detailed longitudinal surveys along the length of the study area are not currently available. Another factor that could potentially change with increased sediment deposition is the frequency and size of mid-channel islands. Above Catamount there were on average 2.4 vegetated islands per mile, while below averaged 2.3. No substantial difference in island frequency is apparent; however, the islands below Catamount tended to be larger and occupy more of the channel. Results from the pebble counts data show that the river bed surface at the cross section located ~1 mi above Dotsero contained substantially more material less than 8 mm and 2 mm as compared to other cross sections. Percent embeddedness was also highest at the two cross sections downstream of Catamount. Percent fines were highest at Radium followed by the two cross sections downstream of Catamount.

The photographic evidence along with the apparent increases in: turbidity, soil erodibility, percent bed material less than 8 mm and 2 mm, percent embeddedness, and percent fines below Catamount, provide multiple lines of evidence suggesting that sediment delivery is relatively high in this part of the river corridor. This increase becomes more evident when examining benthic macroinvertebrate data as described in the following section.

**ES.2.8 Macroinvertebrates**
Three macroinvertebrate samples were taken at each riffle site using a 900-cm² Surber sampler with a 500-µm mesh size. Macroinvertebrate data were analyzed for upward or downward trends in density and richness from upstream to downstream. Overall, only the 2012 Total Richness and Ephemeroptera, Plecoptera, and Tricoptera (EPT) Richness trends were significant. Total density appeared to show a downward, although not statistically significant, trend moving downstream in 2012. Total richness increased slightly downstream in 2012 and 2013. EPT density and richness appeared to increase 0.7 mi below Two Bridges (River Mile 21.3). This increasing trend in EPT below Two Bridges runs counter to the notion that increased sediment delivery below Catamount would negatively affect macroinvertebrate density and richness. However, many of the EPT taxa collected in this study have some tolerance of fine sediment.

When considering taxa known to be sediment-tolerant or sediment-intolerant as defined by the Fine Sediment Bioassessment Index (FSBI) (Relyea et al., 2000), there appears to be a more discernable trend occurring. Trends in richness of sediment tolerant taxa and density of sediment intolerant taxa were statistically significant. Sediment-tolerant richness increased downstream and sediment-intolerant richness decreased downstream. Sediment-tolerant density also increased downstream, with a substantial increase occurring at Two Bridges. Sediment-intolerant taxa density again decreased downstream.

Macroinvertebrate taxa collected in the study area that are relatively tolerant of fine sediment include: *Baetis tricaudatus*, *Ephemerella* sp., *Paraleptophlebia* sp., *Tricorythodes explicates*, *Hydroptila* sp., *Heptagenia* sp., *Isoperla* sp., and *Cheumatopsyche* sp. All of these sediment tolerant species showed an increasing trend in density moving downstream but only *Hydroptila* sp. and *Heptagenia* sp. were considered significant. Taxa that are relatively intolerant of fine sediment in the study area include: *Orthocladiinae*, *Chironomini*, *Epeorus* sp., *Cultus* sp., *Lepidostoma* sp., and *Pteronarcyis californica*. These taxa all showed a decrease in density downstream and four of the six trends were significant.

CDPHE WQCC uses the Multi-metric Index (MMI) to assess attainment of aquatic life use standards as required by the Colorado Water Act and defined in the 2010 *Aquatic Life Use Attainment* (CDPHE WQCC, 2010) methodology. Researchers sampled 24 total sites in 2013 and 2014; 24 on the main stem and 14 on tributaries. Streamflow variability prevented resampling of all sites in both years. In addition, low densities at some sites, and low numbers in certain operation taxonomic units prevented MMI calculation for some samples. The MMI was successfully calculated for 16 sites on the Colorado River and 6 tributary sites.

All sites attained state standards in 2012 and 2013, except the 2012 Blacktail Creek sample (Figure 3.104). This site produced a high score the next year, indicating either a wide natural variability to the creek, or potentially some introduced sampling error or outlier condition in the first year. Scores appeared to indicate a slight upward trend from Pumphouse to Dotsero on the main stem, although this was not statistically tested. As compared to state standards, generalized metrics for community assemblages appeared healthy in the project area.

MMI results appear to parallel the previously-reported trends in Total Richness and EPT Richness, which increased slightly in a downstream direction within the project area. Samples
from perennial tributaries exhibit an apparent decreasing trend in the downstream direction, although again this was not statistically tested due to the low sample population. Perennial tributaries in the project area generally feature undeveloped or slightly-impacted headwater reaches, which then flow through areas of diversions and increased ranching including irrigated pasture and hay production, before joining the Colorado. The lower reaches of these creeks tend to have the available bottomland for agricultural use, small residential development, or access road alignment and thus the most potential for stream impacts in terms of dewatering, grazing impacts, and physical alteration. In general, MMI scores indicate the lower reaches of perennial streams are attaining CDPHE WQCC aquatic life use standards, although continued lower-frequency monitoring at a smaller subset of locations may help detect impacts of land use or changing climate/runoff regimes in the region to aquatic communities.

**ES.2.9 Fishes**

Between Pumphouse and Radium, the river is designated as a wild reproducing brown trout fishery. Rainbow trout are present but the population is much smaller than the brown trout. Electrofishing data from 2010-2012 indicate that brown trout biomass is approximately 5 to 14 times greater than rainbow trout (Ewert and Bakich, 2014). All fish were determined to be in good condition due partially to abundant *Pteronarcys californica* larvae as a food source (Ewert, 2013). Electrofishing data from the Colorado Parks and Wildlife (CPW) indicate that brown trout biomass decreases moving downstream. Between 2008 and 2013, the highest biomass occurred at Radium and it decreased at each site downstream.

Electrofishing surveys indicate a transition from a trout-dominated to sucker and chub-dominated water seems downstream of Catamount. Fish count data in 2009 and 2010 indicate that although trout are still established downstream of Catamount, the sucker and chub populations become more prevalent (Figure 3.107). This shift in fish assemblages is likely caused by many factors including increases in water temperature, sediment deposition, and a greater prevalence of homogeneous run and glide habitat compared to upstream of Catamount.

**ES.2.10 Flushing Flows**

The importance of moderate to high streamflows in maintaining aquatic and riparian ecosystems is widely recognized (Poff et al., 1997; Bunn and Arthington, 2002; Annear et al., 2004; Poff and Zimmerman, 2010). Moderate to high flows in Rocky Mountain snowmelt rivers provide several types of amenities, physical processes, and ecological functions.

A flushing flow analysis was performed on the main stem Colorado River to provide a preliminary estimate of flows needed to mobilize the median grain size bed material and surficial deposits of fine sediment at cross sections along the Colorado River through the study area. Sites were chosen along the Colorado River to be representative of a larger portion of the river, yet had to be to allow for data collection across the entire channel. Due to the size and limited wadeability of the Colorado River through the study area, only five sites were chosen as representative and accessible. A systematic point grid frame method was used in combination with a gravelometer to collect substrate data at each site along transects spanning the bankfull channel (Bunte and Abt, 2001). The systematic point grid frame method was used to obtain over
300 pebble count observations with the gravelometer. Transects were placed in riffles as these areas are commonly used to assess the condition of aquatic ecosystems within gravel-bed streams. Substrate samples were taken pre- and post-runoff to quantify changes in bed material composition as a result of the magnitude and duration characteristics of the 2013 snowmelt hydrograph. Resulting grain-size distributions taken pre-runoff were truncated at 2 mm to estimate the $d_{50}$ used in the flushing flow analysis. The substrate data collected before runoff was deemed a more accurate representation of what would possibly be flushed during runoff.

The point grid frame method was also used in conjunction with a bucket viewer to collect presence of fines, algae, and coarse substrate data. Embeddedness data were collected at each site by measuring the average depth of the largest substrate above and below the layer of fine material surrounding the rock. Fifteen rocks within the wetted boundary were measured at each site. Both embeddedness and presence of fines data were also collected pre- and post-runoff.

The peak flows in 2013 did not mobilize coarse sediment at any of the study sites. Marginal removal of surface veneers of fines from the channel center may have occurred at two sites but did not occur at the other three study locations. Preliminary estimates of flushing flows necessary for coarse substrate mobilization at a few accessible riffles generally exceed 12,000 cfs. Preliminary analyses also suggest that removal of surficial veneers of fine sediment could potentially be achievable at flows in the vicinity of 4,000 to 8,000 cfs, especially in the upstream reaches of the study area.

**ES.3 Projects and Strategies for Conservation**

**ES.3.1 Ecosystem-scale Projects**

**ES.3.1.1 Environmental Flow Management in the Upper Colorado River**

Aquatic life communities and terrestrial riparian communities in the Upper Colorado River corridor have developed life-history strategies built around the natural flow regime of a snow-fed, mountain river system. Alterations of the timing and magnitude of key hydrologic events (especially peak runoff and flow recession) by water-management activities outside the project area produce important changes to the river corridor. Unmitigated sedimentation degrades aquatic habitat conditions in the lower reaches, and high summertime temperature regimes potentially affect cold-water stream communities. The state’s Water Court decreed minimum in-stream flow (ISF) rights for the project reach in 2013, providing some amount of protection to the Upper Colorado ecosystem against management-driven extreme low-flow events in summer and fall. While minimum flow protection supplies an important component of environmental flows in the Upper Colorado, habitat maintenance flows are an equally important component.

Available fishery and macroinvertebrate data indicate aquatic life community health changes in a downstream direction, with a decrease in sediment-intolerant taxa and an increase
in sediment-tolerant taxa. Analyses and empirical evidence provided by the CRIA identifies fine sedimentation and temperature as two primary influences on aquatic conditions. The river is unable to frequently provide habitat maintenance flows that flush accumulated fine sediment downstream due to man-made changes in the flow regime, and reservoir management may exacerbate summertime temperature concerns. Coordinated diversion and reservoir release actions by upstream water resource managers hold the potential to alleviate these ecosystem stressors in the project area. However, numerous existing and potential water-management agreements create a difficult political and regulatory arena in which to effect these vital restoration actions. Future storage and water-management activities in the Colorado Basin currently identified in the State Water Plan hold potential to further exacerbate the altered flow regime issues within the project area. For example, increased diversions from the Fraser River as part of the Moffat Firming Project and potential changes in release schedules tied to a proposed Wolcott Reservoir could both have direct and negative implications for flushing flows in the Upper Colorado area.

The CRIA provides preliminary flushing flow (habitat maintenance flows) estimates for the project reach from Pumphouse to Dotsero using five cross sections. Establishing additional cross sections, especially in the region from Catamount down, will refine these estimates. Additional substrate sampling before and after different spring runoff volumes can provide empirical evidence to support these estimates and reduce potential error. Flushing flow estimates may serve as the basis for flow regime targets for regional water managers, providing the scientific foundation for negotiation of coordinated reservoir actions upstream. A rational future goal would be to include a periodic flushing flow regime in statewide water-management agreements between Colorado River stakeholders to properly sustain ecosystem processes in the river reaches between Kremmling and Glenwood Canyon. The Upper Colorado W&S Stakeholder Group maintains a Channel Maintenance Work Group that is currently working towards consensus on this important issue. It is recommended that ERWC establish and promote a partnership with this Work Group for future monitoring and policy implementation activities surrounding flushing flows in the project area. Table ES.1 outlines goals, tasks, and initiation time frames for flushing flow activities; and Table ES.2 lists recommended flushing flow monitoring and additional sites.
Table ES.1 – Flushing flow activities.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Task</th>
<th>Time Frame to Initiate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide empirical evidence of flushing flows.</td>
<td>• Re-sample substrate data after 2014 runoff and additional flow years for evidence of substrate mobilization.</td>
<td>• Immediate; post-runoff 2014 (2014 is currently a high-runoff year)</td>
</tr>
</tbody>
</table>
| Close estimation error on flushing flow estimates throughout project reach. | • Establish additional cross sections, especially between Catamount and Sweetwater Creek. | • Low flow  
• Late summer/fall 2014 – 2015 |
| Institutionalize flushing flows within the policy framework for river management. | • Using best available scientific evidence, convene appropriate stakeholders (water rights holders, State Engineer, transmountain diversion (TMD) operators, reservoir operators, etc.) for collaborative negotiation of flow regime targets.  
• Write flushing flow schedules into operational policies and compacts that determine Upper Colorado flow regimes. Language used in the 2014 Grand County Mitigation and Enhancement Coordination Plan (Grand County, 2014) can serve as a template. | • After appropriate evidence and analysis is complete  
• 2015+ |

Table ES.2 – Recommended flushing flow monitoring and additional sites.

<table>
<thead>
<tr>
<th>Cross Sections and Substrate Monitoring Sites</th>
<th>Task/Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current sites:</td>
<td></td>
</tr>
<tr>
<td>Pumphouse</td>
<td>Re-sample substrate in 2014</td>
</tr>
<tr>
<td>Radium</td>
<td>Re-sample substrate in 2014</td>
</tr>
<tr>
<td>Above Catamount</td>
<td>Re-sample substrate in 2014</td>
</tr>
<tr>
<td>Above Sweetwater</td>
<td>Re-sample substrate in 2014</td>
</tr>
<tr>
<td>Above Dotsero</td>
<td>Re-sample substrate in 2014</td>
</tr>
<tr>
<td>Additional recommended sites (approximate locations):</td>
<td></td>
</tr>
<tr>
<td>State Bridge area</td>
<td>Establish cross section, sample substrate, and model flows</td>
</tr>
<tr>
<td>Derby Creek area</td>
<td>Establish cross section, sample substrate, and model flows</td>
</tr>
<tr>
<td>Red Dirt Creek area</td>
<td>Establish cross section, sample substrate, and model flows</td>
</tr>
</tbody>
</table>

ES.3.1.2 Temperature Management

CPW, BLM, and the W&S Stakeholder Group all conduct stream temperature monitoring on the Upper Colorado. Analysis in the CRIA of publicly-available data from the GCWIN identified exceedances of CDPHE WQCC temperature standards for the river above Dotsero in 2012 and 2013, and near Red Dirt Creek in 2013. This preliminary analysis suggests that temperature issues for the lower project reach may be a consistent issue and warrant continued monitoring and investigation. The W&S Stakeholder Group and Trout Unlimited (TU) identified these issues in 2013 as well, pursuing voluntary stakeholder-initiated mitigation activities with water managers to alleviate late-summer temperature increases. Additional temperature monitoring over a range of water years at existing or additional sites will provide a fuller picture.
of the geographical and temporal nature of temperature issues in the project area. Continued exceedances may indicate a designation of 303(d) impairment for the reach is appropriate; however, such a designation warrants careful consideration, as it may either help or hinder negotiation of management alternatives among stakeholders and resource managers.

Future flow depletions and/or climate change will potentially exacerbate summer temperature extremes in the Upper Colorado River corridor. Since elevated temperatures appear to be controlled by interactions with major tributaries and reservoirs in the upstream watershed, it is recommended that future water-management decisions upstream of the study area be considered in terms of potential system-level temperature effects. It is strongly recommended that the influence of water management and reservoir operations on downstream temperatures be explicitly included in management agreements between Colorado River stakeholders to conserve critical ecosystem processes in the river reaches between Kremmling and Glenwood Canyon. The Upper Colorado W&S Stakeholder Group maintains a Monitoring Work Group that is currently working towards consensus on managing this important issue. ERWC is encouraged to establish and promote a closer working partnership with this group for future monitoring and policy implementation activities surrounding temperature issues in the project area.

**ES.3.2 Regional-scale Projects**

**ES.3.2.1 Invasive Species**

Tamarisk occurs along the river corridor in sparse amounts, making it an ideal candidate for eradication before further establishment. Concerted efforts to cut and spray tamarisk communities from Bond to Dotsero will hinder the ability of communities to disperse further upstream or entrench at existing locations. As this area is likely approaching the natural climate boundary for most tamarisk species, the probability of success is positively weighted. Invasive species is a programmatic mandate for BLM resource managers as well as county governments in Colorado; thus, a streamlined planning and approval process would be anticipated for these activities on BLM-managed land within the river corridor. An agency partnership with the ERWC on this effort will both strengthen stakeholder relations and serve as a nexus for short-term community volunteer engagement. Russian olive also occurs downstream of Bond, however, the degree of community establishment is much greater than tamarisk and will likely prove harder to manage. Russian olive is notoriously difficult to remove, often involving mechanical extraction of the entire root system with large equipment. Russian olive in areas with multiple or high conservation values may still be worthy to consider for control or removal. Current contact information for invasive plant management is reported in Table ES.3.
Table ES.3 – Area contacts for invasive plant management.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
| BLM             | Project area: State Bridge – Dotsero  
Hydrologist/Geologist: Paulin Adams  
Colorado River Valley Field Office  
Telephone: (970) 876-9071  
E-mail: padams@blm.gov |
| Eagle County    | Scott Griffin  
Eagle County Noxious Weed Control  
Telephone: (970) 328-3553  
Fax: (970) 328-8788 |

ES.3.2.2 Native Fish Conservation and Reclamation Strategy

Colorado River cutthroat trout (Blue Lineage) and as-yet-to-be-named Green Lineage cutthroat trout exist in a small number of perennial tributaries to the main stem Colorado River in the project area. The Blue Lineage cutthroat is a species of special concern in the state and a BLM, State of Colorado, and U. S. Forest Service (USFS) Region 2 sensitive species. Green Lineage cutthroats are currently treated as federally threatened, although recent genetic research in the state has initiated a review of species status and management. Regardless of current uncertainties surrounding Green Lineage fish, populations as a whole occupy a fraction of historical range and face the same difficult pressures as Blue Lineage fish. The last century has brought large reductions in overall habitat range and loss of genetics through hybridization with non-native trout species. Non-natives introduced for sport aggressively out-compete cutthroats for habitat in the limited number of suitable Colorado streams, threatening viability statewide and throughout the central Rocky Mountains.

Out of hundreds of miles of perennial streams in the project area, including tributaries to the Piney River, only six streams are currently known to support native cutthroat (White River National Forest (WRNF), 2014). Other tributaries may still hold populations of indeterminate lineage and purity. Taken together, these subwatersheds of the Upper Colorado represent a potentially viable sanctuary region for cutthroat conservation and preservation; a region of headwater streams with some agricultural pressure; but partly free of heavy development, habitat loss, and legacy impacts from forestry, mining, and urbanization that degrade other watersheds in the Colorado River basin. These fisheries represent a unique, under-appreciated, and under-valued asset of the Upper Colorado region. A locally-pushed, unified strategy for their protection and enhancement could help ensure a sustainable and resilient stronghold for these populations in the face of statewide human and natural pressures that increasingly threaten their long-term survival prospects.

In 2006, the state wildlife agencies of Colorado, Utah, and Wyoming adopted a joint Conservation Strategy for Colorado River Cutthroat Trout (CRCT) to address threats to the species and preemptively avoid a potential Endangered Species Act listing (CRCT Coordination Team, 2006). The CRIA project area nests within the Colorado Headwaters Geographic Management Unit for that document. One significant tributary hosts a conservation population of Green Lineage fish and has already received limited attention by WRNF and
EWRC for habitat improvement projects. Conservation populations are “naturally reproducing and recruiting populations of native cutthroat trout that managed to preserve the historical genome and/or unique genetic, ecological, and/or behavioral characteristics;” in general, they are more than 90% genetically pure (CRCT Coordination Team, 2006).

Populations of Green lineage in nearest-neighbor stream systems in Upper Colorado perennial tributaries could potentially qualify as ‘metapopulations’ under the interstate/interagency management strategy, although more data may be necessary to fully understand regional population genetics. Metapopulations are “geographically distinct yet genetically interconnected. If individual localized populations go extinct, they can be refounded by surrounding populations” (CRCT Coordination Team, 2006). A unified strategy for protection, habitat improvement, and stream range reclamation in the Upper Colorado region could proactively protect broodstocks, small populations, and spawning fish, creating a sustainable genetic sanctuary for cutthroat in the Pumphouse-Dotsero region.

This report does not recommend a single project, but rather, suggests investing in the development of a unified conservation strategy among local area partners including ERWC, CPW, WRNF, Colorado River Valley Field Office (CRVFO) / Kremmling Field Office (KFO) BLM, local hunting/fishing outfitters, and other potential partnerships such as Colorado Headwaters Chapter of Trout Unlimited (CO TU), Colorado Mountain Club (CMC), Walking Mountains, etc. At its core, this unified conservation strategy could be a down-scaled version of the interstate/interagency framework laid out in the 2006 Conservation Strategy. It would nest within the greater multi-agency/multi-state effort, but be guided by local-to-regional organizational partnerships (Table ES.4). Strategy implementation could utilize a suite of stream and reach-specific tools including habitat protection and enhancement (both riparian and in stream); non-native species removal; physical migration barriers and other engineered solutions; ISF and water rights acquisition; and where both appropriate and having a high probability of success, reclamation (re-introduction). Implementation strategies would vary reach to reach based on feasibility, probability of success, and land ownership situations.

Table ES.4 – Native fish conservation goals and tasks.

<table>
<thead>
<tr>
<th>Goals</th>
<th>Tasks</th>
<th>Time Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gage interest and coalition building.</td>
<td>• <strong>Concept development.</strong> Stakeholder engagement (ERWC, CPW, WRNF, BLM, other nongovernmental organizations (NGOs), and appropriate private parties).</td>
<td>2014</td>
</tr>
<tr>
<td>Identify available conservation options.</td>
<td>• <strong>Feasibility assessment.</strong> Fully review available fishery data, identify inter-agency management goals, objectives, and responsibilities. Determine property ownership and access status, initiate National Environmental Policy Act (NEPA), and other agency-required processes.</td>
<td>Fall 2014 – 2015</td>
</tr>
<tr>
<td>Begin active strategy implementation and fieldwork.</td>
<td>• <strong>Strategy implementation.</strong> Utilize suite of available tools to actively protect and enhance cutthroat in Upper Colorado region.</td>
<td>2015 – 2025</td>
</tr>
</tbody>
</table>
ES.3.3 Local-scale Projects

ES.3.3.1 Riparian Buffer and Plantings

Functional riparian buffers generally persist in the project area, except where interrupted by localized land-management activities such as agricultural and residential mowing, or removed by significant physical alteration such as railroad construction directly bordering the river. For the main stem Colorado River, work conducted for the CRIA indicates that hydrologic alteration and localized sedimentation driven by water-management activities outside the project area are the primary controllers of aquatic ecosystem conditions. In general, actions targeting riparian improvement are unlikely to provide significant changes or improvements to main stem water-quality condition and aquatic communities. Where riparian improvement activities coincide with additional conservation values or special areas of concern, revegetation projects may still prove worthwhile due to the other resource values they support. Examples include river parcels with identified conservation easements, or segments with identified habitats for species of concern such as river otter. In general, short-scale reaches with outstanding wildlife, recreational, or other conservation values may be well-served by vegetation-oriented projects. In certain cases, landowners engaged in riparian restoration on Sage grouse habitat may receive certain technical assistance, planning, and other benefits from the Natural Resources Conservation Service (NRCS). Sage grouse habitat mapped by the NRCS tends to concentrate in northern Eagle County, on the south side of the river above Burns in the Big Alkali Creek watershed, and to a limited degree in the upper Cabin Creek watershed. Conservation-minded riparian management practices in these areas may have synergistic benefits for both native fish in perennial streams and landowner credits for grouse habitat preservation.

Tributaries. In select perennial tributaries with existing valuable native fish populations, additional riparian improvement projects can provide measureable benefits to aquatic habitat in the project area. One example is Red Dirt Creek, where existing vegetation and road-corridor work by the ERWC, WRNF, and CPW has sought to improve conditions for the conservation population of cutthroat, and potentially decrease sediment load to the Colorado River. Potential locations for reach-scale riparian improvement projects include the Colorado River Ranch, Red Dirt Creek, high-visibility recreational visitor ‘portals’ like the boat ramps and picnic areas at Lyons Gulch, Cottonwood, and Catamount. Sheeporn Creek has already been the focus of previous restoration; in 2001 NRCS initiated a bank-stability project on Piney Peak Ranch, in the lower reaches which border the Radium State Wildlife Area (SWA). As these downstream reaches are CPW-administered, publicly-accessible fishing segments, additional attention to stream stability, temperatures, and sediment delivery from upstream land use may be a worthwhile endeavor to ensure a sustainable and productive sport fishery in this high-use area.

Private lands. Private lands with degraded riparian conditions on the main stem tend to concentrate in the Bond-McCoy and Red Dirt Creek-Dotsero reaches (Figure ES.1), although the aerial extent of mowing and hayfield encroachment, and grazing impacts comprises only 4.1% of the 62-mi project area. A limited education/outreach campaign with landowners may generate voluntary efforts to refrain from mowing or otherwise developing riparian zones further. Emphasis for property owners could be placed on the improved bank stability and sediment...
retention characteristics of native vegetation over shallow turf grasses, in order to increase stakeholder buy-in to riparian projects on private lands. Geographic emphasis can be placed on corridors that are anticipated to receive more public use in the near future, such as the area near the Colorado River Ranch and downstream to other large parcels like the Roundup River Ranch (Figure ES.2). New and improved public river access at locations like Red Dirt Creek and Horse Creek are anticipated to increase recreational float boating and fishing use in these areas. Improving riparian conditions can provide examples of model land stewardship, as well as provide localized improvements to streamside habitat such as increased bank complexity, woody debris, and thermal refugia for aquatic life. Before implementing riparian improvement strategies in these areas, additional landowner education and outreach is necessary to generate support and local buy-in/ownership of conservation issues by residents, and to avoid the perception by landowners that unnecessary conservation projects are thrust upon them by top-down management planning.

Figure ES.1 – In the corridor from Red Dirt Creek to Dotsero, many private lands maintain little or no riparian buffer, potentially exacerbating bank erosion and limiting local-scale habitat for animal communities dependent on the riparian zone. An outreach campaign and guidance/support on riparian stewardship for riverside landowners can help improve this issue in the reach, which is experiencing increased recreational use from float boaters and fishermen due to access improvements by Eagle County.
Figure ES.2 – Upper Colorado region issues and potential projects.
Agency lands. BLM staff at the CRVFO has identified the Colorado River at the entrance to Glenwood Canyon as a location of interest for larger-scale riparian restoration, including reconnection of the river to floodplain areas and re-establishing of cottonwood-willow communities (Table ES.5). Increased water-based recreational use between the Dotsero put-in and Bair Ranch rest area by tubers and standup paddleboarders has produced a large jump in visitor use and social impacts to the river corridor in the last 5+ years. This area is also potentially degraded from past land use management activities, legacy impacts from highway construction, and hydrologic impacts of Shoshone Dam downstream including delta formation and sedimentation in the reservoir backwaters. Bank and floodplain re-contouring and other localized physical improvements, followed by revegetation to reestablish healthy and functional riparian communities such as willow-cottonwood to this high-visibility portal to Glenwood Canyon and the Upper Colorado area surrounding Dotsero. Table ES.6 outlines goals, tasks, and initiation time frames for riparian improvement. Current contact information for riparian projects is reported in Table ES.7.

Table ES.5 – Local riparian improvement opportunities.

<table>
<thead>
<tr>
<th>Site</th>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado River Ranch-Dotsero corridor</td>
<td>Riparian improvement, private lands</td>
</tr>
<tr>
<td>Radium area</td>
<td>Riparian improvement, private lands</td>
</tr>
<tr>
<td>Glenwood Canyon entrance</td>
<td>Floodplain reconnection, revegetation, and willow-cottonwood restoration</td>
</tr>
</tbody>
</table>

Table ES.6 – Riparian improvement goals and tasks.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Task</th>
<th>Time Frame to Initiate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generate landowner buy-in to riparian stewardship and improvement.</td>
<td>Focused landowner outreach and education campaign to avoid the perception of an outsider-imposed conservation mandate.</td>
<td>2014 – 2015</td>
</tr>
<tr>
<td></td>
<td>Determine interest level, cooperative partners, and available locations</td>
<td></td>
</tr>
<tr>
<td>Identify priority improvement areas within Red Dirt Creek-Dotsero corridor.</td>
<td>Prioritize areas by landowner access, riparian condition, and revegetation feasibility.</td>
<td>2014 – 2015</td>
</tr>
<tr>
<td></td>
<td>Produce a planning or guidance document</td>
<td></td>
</tr>
<tr>
<td>Partner with residents, Eagle County, and relevant agencies to implement riparian improvement.</td>
<td>Help landowners design and implement BMPs for riparian buffering and mowing/grazing restrictions on streambanks.</td>
<td>2015+</td>
</tr>
<tr>
<td></td>
<td>Utilize volunteer base and partnerships to re-vegetate impacted areas</td>
<td></td>
</tr>
</tbody>
</table>
### Table ES.7 – Area contacts for riparian projects.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
| BLM                              | Hydrologist/Geologist: Pauline Adams  
Colorado River Valley Field Office  
Telephone: (970) 876-9071  
E-mail: padams@blm.gov             |
| Eagle County Conservation District | District Manager: Audra Meyers  
PO Box 360  
Eagle, CO 81631  
Telephone: (970) 230-0844          |
| Colorado NRCS                    | District Conservationist: Derek Wiley  
Glenwood Springs Field Office (Eagle County)  
258 Center Drive  
Glenwood Springs, CO 81601-2539  
Telephone: (970) 945-5494  
Fax: (970) 945-0837                |

### ES.3.3.2 Visitor Portal Enhancement

Physical improvement or maintenance of high-use visitor portals addresses recreational values in the project area (Table ES.8). These can include improving boat ramp conditions for sustainable long-term use; or other engineering projects around these areas involving re-grading, drainage work, and revegetation and visitor use pattern management.

### Table ES.8 – Visitor portal improvement projects.

<table>
<thead>
<tr>
<th>Location</th>
<th>Work Needed</th>
<th>Purpose</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Dirt Creek</td>
<td>Continued stabilization of boating access point and vehicle access road.</td>
<td>Long-term physical site stability</td>
<td>Eagle County Open Space</td>
</tr>
<tr>
<td>Yarmony Bridge</td>
<td>Used as unofficial put-in below Rancho del Rio, eroding ramp and parking issues.</td>
<td>High visibility/recreation value and visitor portal</td>
<td>None currently</td>
</tr>
<tr>
<td>Others as needed</td>
<td>Update inventory on existing status, user numbers, and work needed at multi-agency boat ramps and riverside recreational amenities.</td>
<td>Various</td>
<td>BLM, Eagle County, CPW</td>
</tr>
</tbody>
</table>

### ES.3.3.3 Education and Outreach Projects

**State Bridge river access: Outdoor classroom and interpretive station.** In addition to research and projects, ERWC is mandated to advocate for the health of the Eagle and Upper Colorado Rivers via public education and outreach. The State Bridge area is a key access to the Upper Colorado River corridor for thousands of local and out-of-area visitors yearly, arriving both by I-70/Wolcott, the Steamboat area to the north, and Grand County via the Trough Road. Eagle County invested significant resources in improved river access here in 2012, and the State Bridge music center and BLM campground continue to serve as a social focal point for thousands of recreational users including float boaters, fishermen, and others. This portal is a...
high-visibility, high-use, and high-quality location for public engagement by ERWC and organizational partners like Walking Mountains Science Center, Eagle County, and BLM. A small river interpretive station at the access site can provide visitors a welcoming overview of the Upper Colorado region, including conservation issues and threats, recreation amenities, and wildlife resources. In addition to these river access site items, coupling additional amenities such as a short interpretive trail/walking classroom towards the Piney River confluence (below the existing road cut) and a small outdoor classroom or primitive amphitheater seating setup, could provide the physical setting for reoccurring outreach/education activities by ERWC and partners like Walking Mountains Science Center.

**Dotsero-Glenwood area river cleanup.** In recent years, the advent of several commercial tubing businesses in the Vail and Glenwood area and the large increase in Stand Up Paddleboarding (SUPing) on state rivers have both significantly increased recreational river use on the reach from Dotsero landing to Bair Ranch. The river is generally calm, deeper, and devoid of major rapids through this area, making it ideal for these uses. With increased social use comes increased resource pressure, as well as a desire for a clean natural setting for optimum visitor experiences. Large metal debris from legacy land uses, as well as occasional litter from recreational users, currently detract from scenic values on this reach and could be addressed with a minimum amount of work. A partnership between ERWC and area businesses that utilize this stretch for a yearly, bi-yearly, or as-needed cleanup effort would ensure the resource retains the high-quality experience that visitors to the area expect, and that underpins the region’s tourism and recreation-based economy.

**ES.4 Conclusions**

When considering the results from the inventory and assessment of the Eagle County portion of the Colorado River corridor, there appear to be certain factors that control the ecological condition of the river corridor. Generally speaking, land use within the river corridor has changed modestly since the first arrival of European settlers. Homes have been built and irrigated hay fields have been established along areas with wider floodplains, but the lack of mineral and oil or gas resources have kept hydrologic and water-quality impacts from local land use change to a minimum. Future land use change is likely to remain minimal due to the arid and steep setting of the river corridor. However, rehabilitation of the riparian area along these private lands could provide localized ecological benefit to the river corridor.

The railroad and road are the two biggest encroachments upon the river corridor. Paralleling the river throughout the entire study area, the railroad and road have impacted the river corridor by: reducing riparian habitat, disrupting connectivity between surrounding terrestrial habitats and the river for wildlife, acting as a pathway for invasive species, reducing wood inputs to the river, and replacing natural banks with riprap that remain sparsely vegetated. However, the removal of either the road and/or railroad from the river corridor is impractical and socially unacceptable. Despite this, sections of the river corridor still harbor one of the most intact riparian areas on the Colorado River within the state including rare plant assemblages.
Future threats to the riparian area include greater establishment of invasive species, future hypothetical high-speed rail plans which may further encroach upon the river, and decreased frequency and duration of flows inundating the riparian area to maintain ecological health.

Overall, the most significant current threats to the ecological condition of the Colorado River are elevated water temperatures above the known thermal tolerance of trout, and interactions between fine sediment loading and the available environmental maintenance flows. All of these issues can be attributed to water quantity and flow regime. Beyond the water rights held by the Shoshone Water Plant and Cameo Call group downstream, the magnitude, frequency, and duration of environmental flows are controlled completely by the upstream watershed. Given uncertainty in future water demands and climate, ensuring the provision of future flows necessary to keep water temperatures below critical levels, flush deposited fine sediments, and mobilize the substrate for rejuvenation of habitats in the river bed becomes the utmost priority. Water-management decisions in the upstream watershed may directly affect the Eagle County portion of the Colorado River and should be monitored closely. Preliminary estimates of flushing flows necessary for coarse substrate mobilization at a few accessible riffles generally exceed 12,000 cfs. Preliminary analyses also suggest that removal of surficial veneers of fine sediment could potentially be achievable at flows in the vicinity of 4,000 to 8,000 cfs, especially in the upstream reaches of the study area. Continued monitoring of the capacity of the current flow regime to flush the system is recommended to allow water managers to make informed decisions in the future. Finally, it is important to manage this portion of the Colorado River as an inseparable unit of the entire upstream watershed system that ultimately determines its fate.