

Eagle River Watershed Plan



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Written & Prepared by:

Eagle County & The Eagle River Watershed Council

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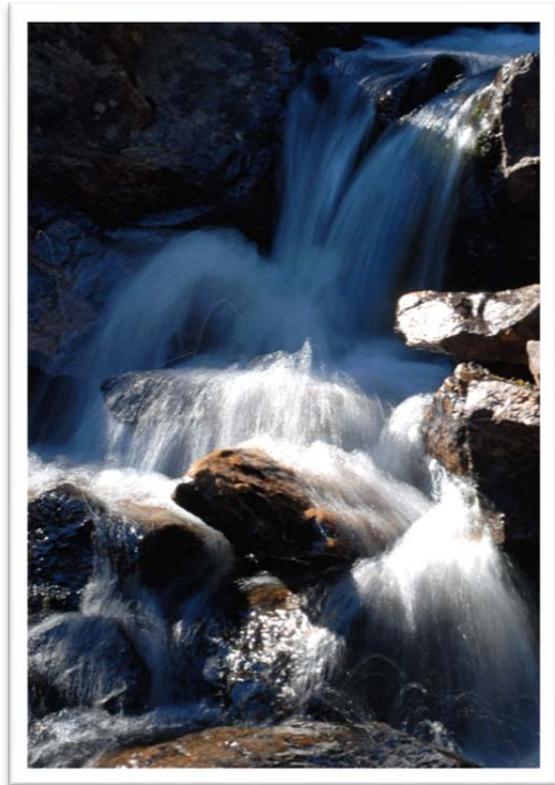
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Executive Summary

Background

The Eagle River Watershed Plan was first adopted in 1996, and provides information, goals, strategies and action items related to water and land management practices in the Eagle River drainage basin. This 2013 document updates and replaces the 1996 plan in its entirety, and while it follows the general layout of that plan, it includes a great deal of new information, and a new chapter that discusses issues and opportunities associated with the Colorado River as it flows through the north western part of the county.



Community input during the planning process for the 2013 Plan update indicated general satisfaction with the condition of streams and rivers in the Eagle River Basin. Fishing was good and even improved in some areas, upper elevation streams continued to exhibit pristine qualities desired by residents and visitors, and efforts to mitigate mining impacts on the upper and middle Eagle River had been largely successful. Significant concerns were voiced, however, on a number of topics, including continued impacts from mining, damage to riparian habitats, increasing demands for water, the lack of adequate in-basin storage, impacts from untreated urban and road runoff, the possibility of climate change and the prospect for future population growth and development.

It was agreed that given the nature of lifestyles and the economy in Eagle County, the loss of healthy aquatic ecosystems in the basin would have negative and far-reaching implications. Participants in the planning process voiced a strong desire for coordinated action, and for more information regarding water supply and demand, water quality, wildlife habitat, recreational impacts, and water related land use practices.

The 2013 Eagle River Watershed Plan is organized around five (5) water related topics (Quantity, Quality, Land Use, Wildlife and Recreation) and has a chapter devoted to the status of the Colorado River. The foundation of the plan is a series of vision statements, developed by a

Partnership Advisory Team (PAT) with the help of interested stakeholders, as follows:

The Vision for watersheds in Eagle County is of:

... A network of clear mountain streams, rivers, lakes and reservoirs that provide good quality water in ample quantity to sustain a healthy aquatic environment and fish population, and dependable water supplies for efficient and conscientious use by humans;

... Open space and native greenbelts along rivers and streams that buffer waterways from human land use impacts, preserve the riparian areas that provide critical wildlife habitat and enhance scenic vistas;

... Land uses arranged and managed in a manner that respects the function of riparian and aquatic ecosystems and complements the scenic character of the waterways;

... Appropriate, non-disruptive and well-designed access points to rivers, streams, lakes and reservoirs for passive and active recreation;

... An appreciation and respect from well-informed residents and guests of the watershed for the extraordinary environmental, social and economic resource that it represents - a resource that is shared by all.

Each Chapter of the Plan provides an overarching goal, a background discussion, and a list of recommended objectives, strategies and actions that can be employed to retain or achieve desired conditions. A summary of each chapter follows.

Water Quantity in the Eagle River Basin

For all practical purposes, the source of water for streams and rivers in Eagle County is snow that accumulates during the winter and then melts, quickly at first in the spring and then with diminishing return during summer and fall. Summer rains also contribute to surface flows for short periods of time. The variability of precipitation, temperature and water runoff from season to season and year to year can be significant, as can river and stream flow amounts.

The health of aquatic and riparian ecosystems is dependent on the amount, timing and variability of stream flows. Seasonal flows fluctuate in cycles that have been established over thousands of years, supporting unique ecosystems and environments that in turn provide habitat for populations of fish, insects, mammals and birds. These aquatic and riparian ecosystems can be fragile in nature, and are subject to impacts from a number of external factors, both natural and man-made.

Through diversions and water use, humans can impact the wellbeing of aquatic and riparian ecosystems. Water is removed from natural channels in varying amounts at different times of the year to support agriculture, domestic uses and recreation. Some diverted water is lost or “consumed”. Most diverted water returns to the river system, sometimes at a lower quality, sometimes at a much later date. These uses (diversions) interact with natural cycles, and can either support or compromise stream and river health. Of particular focus in Eagle County is the water that is not diverted, and is instead left in natural channels to support fishing, boating and other recreational activities, as well as wildlife. These activities and elements contribute to the quality of local lifestyles and the success of the local economy, requiring healthy aquatic ecosystems and some semblance of natural flow regimes in stream channels throughout the year.

There are strong connections between water flow and water quality and habitat for aquatic life in a stream or river system. Changes to the amount and timing of flows, whether by nature or man, can impact water quality and aquatic habitat.

Streams and rivers accommodate a variety of uses in Eagle County, and each use “consumes” different amounts of water. Some water is diverted entirely out of the basin (trans-basin diversion) to serve uses on the eastern slope of the Rockies. Since no water is returned to the basin post use, this diversion is 100% consumptive. In-basin uses include agriculture, domestic uses, and snow making, all of which divert water in differing amounts at different times of the year. Unlike trans-basin diversions, not all water diverted in-basin is consumed. Some agricultural water and most snow making water eventually returns to the river system. With the exception of water used for outdoor irrigation, most domestic water is also returned, albeit after processing at a wastewater treatment facility.

The use of water in Colorado is administered through a water rights system, which allocates various amounts of water to users along a stream or river by legal decree. Those with the most senior rights have the highest priority to use the water; others have more junior rights that may be subject to curtailment in the event of low flows. Instream flow rights have been adjudicated for many segments of local streams as a means to maintain habitat for fish.

In response to the need for additional water at certain times of the year, a number of reservoirs have been constructed within the Eagle River basin. Water from higher spring flows is trapped by these impoundments, and can be released in the late summer and winter to meet downstream flow requirements. The expansion of existing in-basin storage or the construction of new facilities could help efforts to preserve riparian and

aquatic habitats in the face of future growth. These projects can be difficult and expensive to implement, however, and can have the negative impact of reducing flushing and channel maintenance flows during spring and summer runoff.

A changing climate could dramatically influence periods of time when water flows might be deficient to meet ecological needs. Water conservation with an emphasis on reducing the amount of water used for outdoor irrigation will be an essential component of future stream flow management programs.

This plan is premised on the need to manage river and stream flows to assure good water quality and to accommodate competing needs for water in the future, including the need to retain water in the channel for ecological and recreational purposes. Public education and collaboration between stakeholders, service entities and government agencies will be essential to this end.

In response to the identified issues and concerns the following objectives were developed for the 2013 Eagle River Watershed Plan:

1. Manage water storage, water diversions and water releases within the Eagle River watershed in a manner that protects or enhances stream health and recreational uses.
2. Minimize and/or mitigate adverse impacts to stream flows from existing development and future growth.
3. Continue to collect and make available comprehensive water quantity and stream flow information, increasing awareness of the social, ecological and economic importance of maintaining adequate flows in local streams and rivers.
4. Create a collaborative and transparent system of administration, oversight and decision-making between government entities and affected management agencies on matters pertaining to water quantity.

For a more detailed discussion of issues and concerns surrounding the topic of water quantity, please reference pages 11 through 34. Also please note recommended strategies and action items beginning on page 35.

Water Quality in the Eagle River Basin

Eagle County is blessed with water that originates from high elevations in the Central Rocky Mountains of Colorado. Water from melting snow and summer rains flows directly into streams, or seeps into aquifers from which

it is slowly released throughout the year. As a result, and with some exceptions, surface water in the Eagle River watershed is of generally pristine quality in high elevation streams and lakes. As melt water reaches lower elevations, however, it become increasingly impacted by historic disturbances and present day land uses, as well as natural contaminants. Ground water aquifers in tributary basins and in alluvial deposits in the upper and middle reaches of the Eagle River, at the writing of this plan, are also in good to very good condition.

Water quality problems are being monitored within the basin, and the potential exists for continued water quality deterioration in the future. Parameters of concern identified by this plan include metals from historic mining, point and non-point sources of nutrients, untreated urban and transportation corridor runoff, elevated temperatures, sediment loading from both natural and human sources, and pesticides.

For almost a century mining operations at the Eagle Mine impacted the Eagle River below Redcliff. Mining ceased in the early 1980's, but the impacts remain today. While much of the water leaving the Eagle Mine Superfund Site is collected and treated at the Maloit Park facility, remediation is not yet meeting the applicable water quality standards. Metals from numerous point and non-point sources within the mine site continue to impact aquatic life in the Eagle River, and additional cleanup measures needed to meet water quality standards are being investigated.

Excessive sedimentation of riverbeds is also a problem. Black Gore Creek is a high elevation stream above Vail that is impacted by the I-70 travel corridor over Vail Pass. Uncollected traction sand that is spread during the winter to create a safe travel surface is carried into the creek during spring runoff and by summer rains, reducing habitat for aquatic insects (macroinvertebrates) and fish. Significant efforts have been made and are on-going to mitigate these impacts. West of Wolcott, overgrazing has exacerbated erosion from poor soils, resulting in high sediment loads in the Eagle River during spring runoff and following summer rain storms.

There are a number of other chemical contaminants that either exist or have the potential to exist in surface and ground waters. Potential pollutants include but are not limited to pesticides, herbicides and fertilizers from agricultural properties and landscaped areas, petroleum products from impervious areas like roads and parking lots, and nutrients from domestic and on-site wastewater treatment systems and nonpoint sources. There are natural chemical influences as well, as evidenced by the high salt and mineral content of ground water found in western parts of the county.

Land use regulations employed by most towns and the county now require stormwater detention and treatment in urbanized areas, but many developed areas in the county were established prior to the implementation of these rules. Funds are generally lacking for the retrofitting of systems to adequately treat stormwater runoff in older commercial areas and subdivisions, and positively linking sources of very dispersed runoff to aquatic health problems is a difficult task. The presence of healthy riparian vegetation is also closely linked to water quality, and provides a natural treatment buffer for pollutants before water enters a stream or river.

The monitoring and data collection network in the Eagle River basin is one of the most extensive in the region, but continuous work is needed to refine collection techniques and correlate trend data with pollutant sources. A number of stream and river segments in the basin have been identified as impaired or potentially impaired by the State of Colorado. Many stream segments would benefit from the development of water quality improvement plans that could target localized water quality issues and concerns. This plan is premised on the need to manage river and stream flows to assure good water quality in the future as we continue to intensify land uses in existing and new community centers. Public awareness and involvement will be key to the success of future efforts to maintain and/or enhance water quality in Eagle County.

In response to the identified issues and concerns for water quality in the Eagle River, the following objectives were developed for the 2013 Eagle River Watershed Plan:

1. Reduce or eliminate impacts to water quality in aquifers, rivers, streams and lakes from existing land use and future growth.
2. Manage water quality monitoring efforts to provide long-term trend assessments and identify future monitoring needs to address site-specific parameters or areas of concern.
3. Increase awareness of the social, ecological and economic importance of maintaining high quality water in local streams and rivers.

For a more detailed discussion of issues and concerns surrounding the topic of water quality, please reference pages 43 through 58. Also please note recommended strategies and action items beginning on page 58.

Water and Land Use in the Eagle River Basin

The way that land is used to support human activities can have significant impacts on both the quality and quantity of water in a watershed. In Eagle County, the alteration of natural landscapes began in the late 1800's when primitive roads provided access to productive ranch lands, future town sites and rich minerals in the canyon above Minturn. Rail lines, silver mines, irrigated pastures, military training camps, ski areas, an interstate highway, commercial and residential developments, water storage projects, and the installation of miles of underground and above ground infrastructure have since changed the land in Eagle County, affecting both the dynamics and the quality of local water resources.

While mining ceased at the Eagle Mine (Gilman) in the mid 1980's, elevated metal concentrations continue to be a concern in the Eagle River. Significant efforts have been made to clean up contaminated areas, and to collect and treat contaminated water from the mine, but vigilance and additional treatment will continue to be necessary.

Farmers and ranchers divert significant quantities of water from local streams and rivers to flood irrigate crops and pastures. This can reduce flows and significantly impact stream health in tributary streams like Beaver Creek, Lake Creek, Brush Creek and Gypsum Creek. Since the 1970's, many acres of agricultural lands in Eagle County have been urbanized, and old agricultural water rights have been converted to serve new domestic systems. This has improved water flows in some areas, but has created new water flow and water quality challenges in others. Significant agricultural diversions are anticipated to continue on the lower Eagle River and on the Colorado River.

Impacts from urban development within the watershed include increased erosion from disturbed soils, diminished water quality from storm runoff and treated domestic wastewater, lower water flows from diversions and consumptive uses, and the loss of riparian buffers and habitats from building encroachments and recreational activities. Traffic on Interstate 70 has increased dramatically since the 1970's, and the maintenance of multiple lanes of travel over Vail Pass has required the use of de-icing chemicals and thousands of tons of traction sand every year. Vegetation has been impacted by magnesium chloride, and aquatic habitats in nearby Black Gore Creek have been severely altered by deposited sand.

Recreational pursuits in Eagle County include skiing, golfing, fishing, rafting, biking, hiking, horseback riding, and backpacking. Each of these uses can have different impacts on streams and rivers. Given the economic significance of recreation in the Eagle River watershed, a separate chapter has been provided in this plan to discuss related topics.

Activities outside of Eagle County can also affect local watersheds. Large agricultural operations and rapidly growing cities on the Front Range have drawn water for years from western slope sources like the Eagle and Colorado Rivers, and additional diversions are proposed for the future. Land use activities and senior water rights to the west (downstream) of the county can curtail access to water in local streams, rivers and aquifers at certain times of the year.

The pattern of land use and human activities on the landscape is as important a consideration as the types of land uses that are present. Mountain topography results in linear development, with most improvements concentrated along narrow valley floors in immediate proximity to waterways. Impacts to riparian areas and water quality become widespread and more difficult to monitor and remediate.

While disparity still exists between the methods employed by service providers and land use authorities in Eagle County to protect water resources, the significance of these resources to local lifestyles and the local economy is increasingly recognized. Promoting a shared vision for protection and enhancement, and implementing uniform best management practices throughout the watershed will be paramount to insuring sustainable, high quality water resources for the future.

In response to identified issues and concerns regarding land use, the following objectives were developed for the 2013 Eagle River Watershed Plan:

1. Promote land use patterns and site design practices that maximize opportunities for protection and enhancement of water resources.
2. Minimize or mitigate impacts to water resources from historic disturbances and existing developed areas.
3. Avoid, minimize or mitigate impacts to water resources from future land development, including transportation and infrastructure improvements.
4. Integrate recommended actions for water quantity, water quality, recreation, wildlife and education design standards specifically expressed by this plan into other master plans, land use policies and regulations throughout the watershed.

For a more detailed discussion of issues and concerns surrounding the topic of land use, please reference pages 65 through 79. Also, please note recommended strategies and action items beginning on page 79.

Wildlife in the Eagle River Basin

Eagle County was a destination for wildlife viewing, hunting and fishing long before ski resort development began in the 1960's. The County has outstanding wildlife habitat, and today boasts one of the largest elk herds and most sought after mule deer hunting opportunities in the state of Colorado. Streams, rivers, creeks and lakes support healthy populations of trout, both native and introduced. Healthy and abundant wildlife contributes notably to the local economy, creating many jobs, and recent quality-of-life surveys conducted by the Northwest Colorado Council of Governments and Eagle County have indicated the continued importance of wildlife to both residents and visitors.

While the diversity of habitat available for terrestrial wildlife in Eagle County is considerable, the focus of this Watershed Plan is on those areas where shallow ground water supports unique vegetative communities. These "riparian zones" follow and surround streams, rivers and lakes, and support over 250 identified species in the County. They provide movement corridors and critical winter habitat for both deer and elk at lower elevations and they additionally mitigate effects of land use disturbances on water resources by filtering pollutants from runoff. Immensely important, riparian habitats are very limited in extent and are subject to damage from both development and human activities.

Aquatic habitats in Eagle County are equally diverse. Lakes, ponds and marshes host many species, but the focus of this Plan is on those environments created by water that moves in streams and rivers where pools, riffles, and long runs provide homes for fish and macroinvertebrates (insects). Depending on elevation and water quality conditions, cutthroat trout, brook trout, rainbow trout, brown trout, sculpin, dace, suckers and mountain whitefish fill important ecosystem niches in these aquatic habitats. A wide variety of insects are equally important, serving as the primary food source for fish, and also as indicators that can be monitored to identify water quality trends or issues.

Many factors influence the use of riparian and aquatic habitats by animals, birds, insects and fish. Elevation, topography, seasons, the type and density of vegetation, the quality, temperature and speed of water and the presence or lack of connectivity to other habitats are all considerations. Barriers to movement, the loss of solitude, competition from non-native species and disease resultant from stress are increasingly significant factors for species both above and below the water line in the Rocky Mountain west.

While positive trends exist for some wildlife populations in Eagle County, there are concerns for others. A number of species are listed by federal or

state agencies as endangered, threatened, or at risk. Residential and commercial development has resulted in the loss of significant acreages of prime terrestrial/riparian habitat and ecosystem connectivity, and aquatic habitats have also been compromised in some areas. Water quality stressors of concern include metals (from the Eagle Mine), nutrient and sediment loading, elevated temperatures and pollution from urban runoff. As the population grows, so too will the potential for damage to sensitive environments from boating, fishing and other recreational activities. Recent beetle epidemics and persistent drought conditions provide evidence of the impacts from climate change, which could significantly alter both aquatic and terrestrial habitats in the region.

The environmental, social and economic importance of wildlife in a place like Eagle County cannot be overstated. Collaboration in efforts to monitor the health of wildlife populations, to analyze and distribute relevant data, to identify in advance key indicators and trends, and to implement timely and effective management strategies will be essential to the sustainability and health of local wildlife populations. In response to identified issues and concerns for wildlife in Eagle County, the following objectives were developed for the 2013 Eagle River Watershed Plan:

1. Protect, enhance and improve aquatic, riparian and related habitats.
2. Improve opportunities for isolation and minimize stress to wildlife in aquatic, riparian and related habitats.

For a more detailed discussion of issues and concerns surrounding the topic of Wildlife, please reference pages 85 through 101. Also please note recommended strategies and action items beginning on page 101.

River Recreation in the Eagle River Watershed

Since the 1960's, recreation has had an increasingly important role in shaping the economy of Eagle County. The Eagle River and its tributaries support a wide range of water-related recreational activities, including fishing, rafting and kayaking. Other recreational pursuits, like skiing, golfing, hunting and camping, also rely on the presence of healthy streams, rivers, lakes and riparian areas. This Plan identifies a number of ways to responsibly monitor and manage these activities so as to reduce impacts to the quality of local water resources.

Boating is an increasingly popular pursuit by both commercial ventures and private individuals in Eagle County. The Upper Eagle River is generally more popular for whitewater enthusiasts, while the areas below Wolcott

are most popular for fishing. Rafters access the Eagle River at a variety of locations during the spring and early summer, starting at Dowd Junction and ending just west of the Town of Gypsum. Two kayak parks – one on Gore Creek and one on the Eagle River - are available to white water enthusiasts. Regional and national events held at these venues can benefit the local economy by drawing large crowds. The availability of parking, restrooms and other amenities at boating access points varies considerably.

While private boating numbers are not tracked on the Eagle, statistics collected by the BLM and Colorado Outfitters Association show steady growth in commercial rafting despite a relatively short runoff season. Potential impacts from rafting and kayaking include disturbances to riparian zones and the loss of solitude and quiet enjoyment for wildlife and recreational users within river environments.

Colorado Parks and Wildlife (CPW) considers the Eagle River to be a good but limited fishery due to impacts from historic mining, urbanization and late summer warm water temperatures. Gore Creek, while also affected by urbanization, is less impacted by temperature changes, and has had no impact from mining. A Gold Medal fishery designation has been established between its confluence with Red Sandstone Creek and its confluence with the Eagle River.

Private property limits access for fishing at lower elevations in Eagle County, resulting in heavier concentrations of fishermen on those reaches available to the public. Fish can become stressed in these areas from catch and release practices and may be more susceptible to disease, especially during periods of low flows and warmer temperatures.

River and stream recreation places people and pets within fragile riparian habitats. Some access points in Eagle County provide parking, trails, signage, and measures to protect and stabilize stream banks; others do not. Recreational trails, including the Eagle Valley Regional Trail, are frequently located in streamside locations where users can enjoy the vegetation, scenery, wildlife viewing and fishing. Specific criteria can be employed in designing trails to help minimize impacts to riparian and wetland resources, but increased erosion and disturbances to wildlife are sometimes unavoidable.

Water-related recreation in Eagle County is increasingly popular, and strategies should be employed to help assure the availability of high quality experiences for both present and future generations. Boating will require adequate flows during the spring and early summer. Healthy fisheries will require the maintenance of natural flow regimes throughout the year as well as good quality water. A long-term river and stream

access management strategy should be implemented to accommodate future growth while minimizing recreation related impacts. Public education, signage, appropriate regulation, the participation of the business community and interagency and intergovernmental collaboration will be essential to this end.

In response to identified issues and concerns regarding river recreation, the following objectives were developed for the 2013 Eagle River Watershed Plan:

1. Provide safe and appropriate recreational access to streams, rivers and lakes.
2. Monitor recreational impacts, provide public education, and manage recreational activities to assure and sustain the ecological health of streams, rivers, lakes and riparian habitats.

For a more detailed discussion of issues and concerns surrounding the topic of river recreation, please reference pages 105 through 116. Also please note recommended strategies and action items beginning on page 116.

The Colorado River in Eagle County

The Colorado River, which drains the northwestern corner of Eagle County, is a valuable asset to the economy and environmental integrity of the area. Complications in planning for this water resource are numerous, however, especially given upstream and downstream influences that affect river flows within the corridor. Over half of the available water in the Upper Colorado watershed is diverted to supply large agricultural operations and burgeoning populations in the Front Range before the river even crosses the Eagle County line. Concerns for the Eagle County segment include future (upstream) water development and impacts from transportation corridors, agricultural uses, oil and gas development and recreational uses.

Although it is significantly diminished by trans-basin diversions near its headwaters in Grand County, the Colorado River is relatively free flowing through Eagle County. It retains many of its natural attributes, supporting riparian and aquatic habitats similar to those found at lower elevations on the Eagle River. The fishery is comprised of both cold water species (trout, whitefish and sculpin) and warm water species (native and non-native suckers, chub and dace). While some stocking of whirling disease resistance rainbows may be required in the future, the river is presently managed as a wild trout water, with populations sustained through natural reproduction.

In July 2011, the Colorado Water Conservation Board appropriated in-stream flow rights for the Colorado River reach in Eagle County. Although junior in priority to most other rights on the river, their establishment will help focus future efforts to restore variable stream flows for both ecological and recreational purposes.

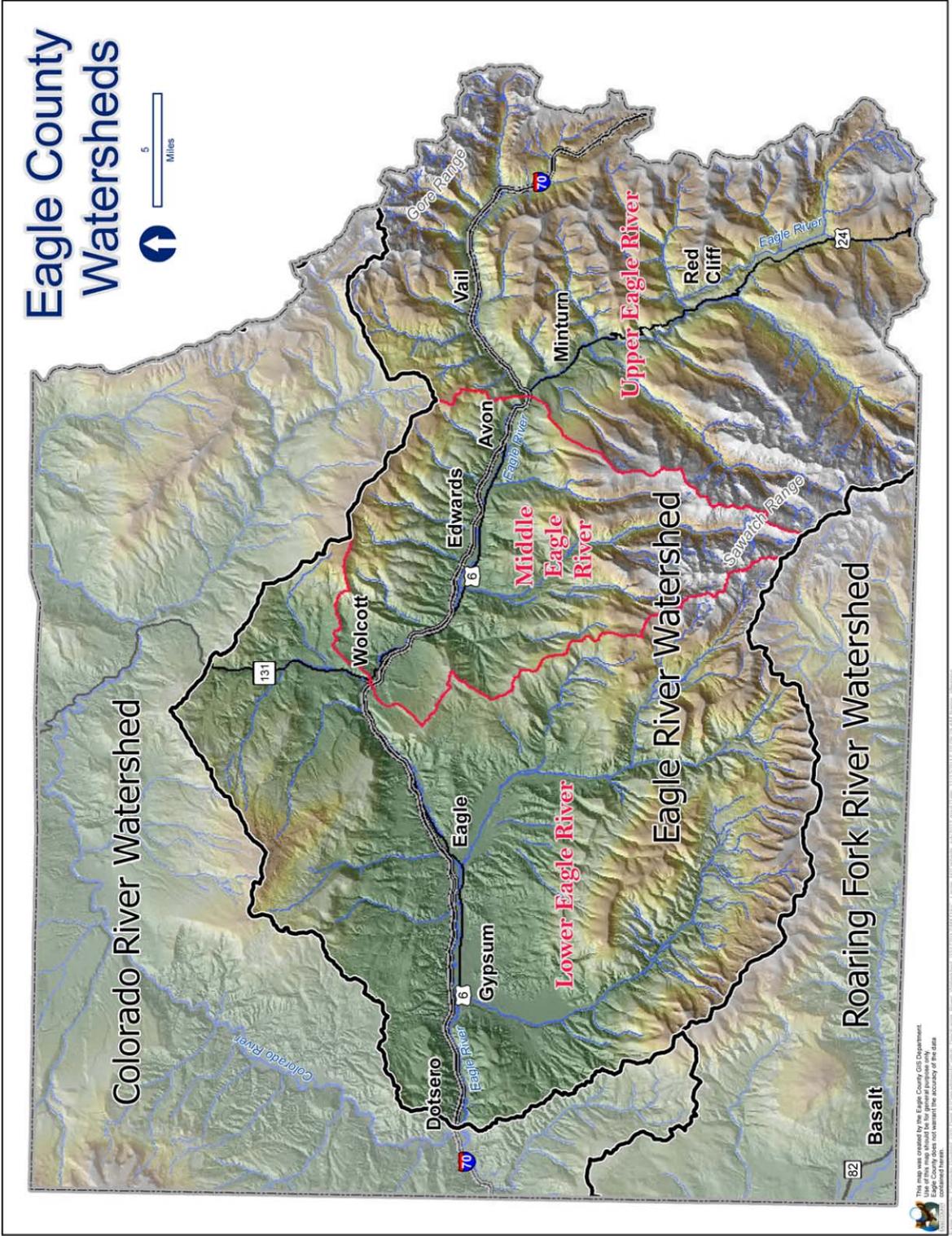
At the writing of this plan, a comprehensive ecological inventory on the Colorado reach in Eagle County is lacking. To improve local knowledge, Colorado State University and the Eagle River Watershed Council along with multiple partners have initiated an inventory and assessment that will address multiple issues and needs along the river corridor. This work will result in targeted management actions that, if implemented, could preserve and enhance the condition of the water resource, including the stabilization of banks and the rehabilitation of riparian and wetland areas.

Given the lack of aquatic and biologic information, this plan identifies only a handful of water quality trends and land use issues for the section of the Colorado River in Eagle County. While recreation impacts are well documented on the reach above State Bridge and into Grand County, little work has been done to assess impacts between State Bridge and Dotsero. It is anticipated that river use by recreationalists will continue to grow. Eagle County has made significant investments to acquire and construct new boat launch sites along the river, and should continue to work closely with the Bureau of Land Management and Colorado Parks and Wildlife officials to monitor and manage future recreation use of the area.

In response to identified issues and concerns regarding the Colorado River, the following objectives were developed for the 2013 Eagle River Watershed Plan:

1. Protect and enhance the values of the Colorado River watershed in Eagle County through coordinated efforts that balance agricultural, recreational and environmental interests.
2. Obtain and utilize the best available water quality and water quantity data to inform resource management agencies and land use decision makers.
3. Strengthen relationships between Eagle County officials and other Colorado River partners to assure success of long term environmental and land use objectives.

For a more detailed discussion of issues and concerns surrounding the topic of Colorado River, please reference pages 121 through 132. Also please note recommended strategies and action items beginning on page 133.



Chapter 1

Introduction



Autumn on the Eagle River, just east of the Town of Eagle (Photo: C. Simonton).

Purpose

The purpose of the Eagle River Watershed Plan is to outline a collaborative local philosophy for protecting and improving water quantity, water quality, wildlife habitat and recreational opportunities, and to promote compatible and complimentary land use strategies, actions and practices. The Plan is primarily focused on defining steps that can be taken to ensure the desirable attributes of the watershed are protected and enhanced as Eagle County continues to grow. It provides a long term vision for the Eagle River and Colorado River in Eagle County, acknowledging:

1. The ecological, economic and recreational values provided by local streams and rivers,
2. The contribution of stream and river corridors to viewsheds, community character, and local lifestyles,
3. The need to clearly define the ecological health of local streams and rivers, and

4. The need to identify causes and sources of impairment in order to determine the best course of restoration action and prevent further degradation as the county continues to grow and develop.

The Eagle River Watershed Plan reflects community based values and objectives, and is intended to be used by local resource managers and governmental entities as a guideline for setting priorities, planning projects, and making development and management decisions. The plan offers a number of recommendations, many of which are dependent on educational efforts by local government, agencies and other interested parties to promote voluntary actions and improved awareness. While not a regulatory document, the Plan does include suggestions for possible policy and/or regulatory revision related to land use and management impacts on water resources. Generally, implementation of regulatory recommendations and suggestions, such as river and creek setbacks, will be up to the discretion of individual jurisdictions and may require tailoring to meet the needs of each community and/or entity.

Geographic Scope of the Plan

The Eagle River Watershed Plan was first adopted in 1996 and provides goals, strategies and action items related to water and land management practices in the Eagle River drainage basin. This 2012 document updates and replaces the 1996 plan in its entirety, and provides a new format and a great deal of new information. The Plan covers the entire Eagle River watershed, which includes all lands draining into the Eagle River, its tributary streams, headwater lakes, reservoirs and other water features. A significant land area of northwestern Eagle County also drains into the Colorado River, and unlike the original 1996 Plan, this document addresses and includes conservation and management strategies for that part of the county. Discussions provided within the chapters of this Plan reflect a growing desire to understand the "big-picture" of how watersheds like the Eagle and the Colorado function and respond to both natural events and human influences.

Those portions of Eagle County that are drained by the Frying Pan and Roaring Fork Rivers are not addressed by this document, but are instead covered by the Roaring Fork Watershed Plan, which is available for viewing and download at www.roaringfork.org/sitepages/pid175.php.

A Common Vision for the Watershed

Through the planning process, a community-based vision emerged for the future of the Eagle River and Colorado River watersheds. While it is difficult to speculate what this region will be like 100 years from now, one can assume that many more people will be relying on local water resources which may or may not be as plentiful or as clean as a result of impacts from growth and fluctuations in climate. The potential for conflicts between users will certainly intensify. The vision for this plan attempts to capture these and other expectations for the future. Statements targeting the long-term protection of the Eagle River and its tributaries as unique natural, recreational, economic and cultural resources were agreed upon during the planning process, and are fundamental to this planning effort.

The Vision for watersheds in Eagle County is of:

... A network of clear mountain streams, rivers, lakes and reservoirs that provide good quality water in ample quantity to sustain a healthy aquatic environment and fish population, and dependable water supplies for efficient and conscientious use by humans;

... Open space and native greenbelts along rivers and streams that buffer waterways from human land use impacts, preserve the riparian areas that provide critical wildlife habitat and enhance scenic vistas;

... Land uses arranged and managed in a manner that respects the function of riparian and aquatic ecosystems and complements the scenic character of the waterways;

... Appropriate, non-disruptive and well-designed access points to rivers, streams, lakes and reservoirs for passive and active recreation;

... An appreciation and respect from well-informed residents and guests of the watershed for the extraordinary environmental, social and economic resource that it represents - a resource that is shared by all.

When appropriate actions are taken, the vision for our watersheds can be achieved. Many elements of this vision are in place currently, but diligence will be required to cope with change and growth. Other elements of the vision need to be developed, and many of these will require teamwork and collaboration. It is essential that citizens in Eagle County come to a common understanding that the rivers and tributaries are a critical component of our quality of lives, and the integrity of the natural environment that supports our economy. Achieving the vision will require the cooperation and commitment of everyone.

Eagle River Watershed Profile

The Eagle River watershed covers a drainage area of approximately 970 square miles and has an average annual water discharge (water yield) of 415,000 acre-feet. Elevations in the watershed range from 6,100 feet at Dotsero to 14,003 feet at the summit of Mount of the Holy Cross. The Eagle River originates near the southeastern border of Eagle County at Tennessee Pass and flows northwest and then west for about 77 miles to its confluence with the Colorado River at Dotsero, 6 miles west of Gypsum (please see Streams and Rivers Base Map on following page)

Homestake, Cross, Gore, Beaver, Lake, Brush and Gypsum Creeks are the largest of the many Eagle River tributary streams, and there are approximately 120 natural lakes and 8 reservoirs in the watershed. The river and its tributary streams supply water to the majority of Eagle County's population, and the majority of the population lives in developed areas immediately adjacent to stream and river channels.

For the purpose of discussion, the Eagle River drainage has been separated into three areas: the Upper Eagle River Basin, the Middle Eagle River Basin and the Lower Eagle River Basin. Approximately 98% of the watershed land area is located in Eagle County. The remaining 2% is located in Pitkin County in the Homestake Reservoir area. Approximately 75% percent of the land in the watershed is public land managed by the U.S. Forest Service and Bureau of Land Management.

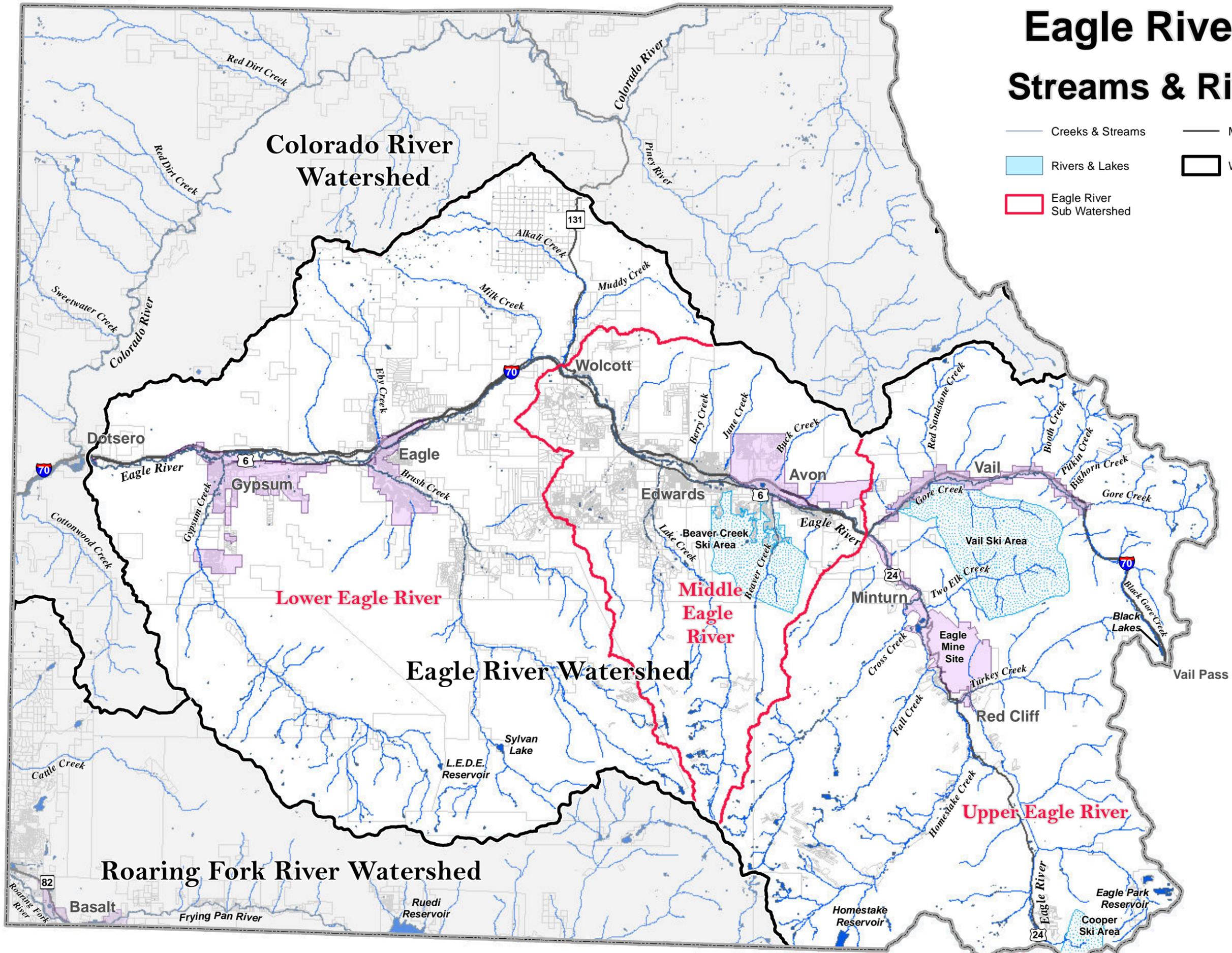
Colorado River Watershed Profile

A sixty-mile reach of the Colorado River is located in Eagle County. Originating in Grand County to the north, the Colorado cascades through Gore Canyon into northern and northwestern Eagle County, eventually merging with the Eagle River at Dotsero. From Dotsero the river flows west out of the county through Glenwood Canyon on its way to the arid landscapes of western Colorado, Utah and Arizona.

Although heavily influenced by diversions and dams at its headwaters in Grand County, the Colorado River in Eagle County is largely undeveloped. The Bureau of Land Management manages large expanses of rangeland adjacent to the river. Large working ranches represent Eagle County's agricultural heritage, utilizing senior Colorado River water rights to irrigate hundreds of acres of productive pasture.

Eagle River Watershed Streams & Rivers Base Map

-  Creeks & Streams
-  Rivers & Lakes
-  Eagle River Sub Watershed
-  Major Road
-  Watershed Boundary
-  Town Boundary
-  County Boundary



5
Miles

This map was created by the Eagle County GIS Department. Use of this map should be for general purpose only. Eagle County does not warrant the accuracy of the data contained herein.



Residential development is sparse and limited to ranch headquarters and small rural neighborhood areas scattered along the river.

Streams descend from the Eagles Nest, Bull Gulch, Castle Peak and Flattops Wilderness Areas into the Colorado River, and there are several landscapes in proximity that are being considered for new Wilderness or Wild and Scenic designations. Rafting and fishing are popular in those sections of river that are accessible to the public. It is a well-known fact that the northern and northwestern parts of Eagle County host some of the most scenic and sought after recreational destinations in the state.

The Planning Process

Local governments initiated the 1996 Eagle River Watershed Plan after protection of the Eagle River was identified as a top community concern through town and county master planning forums and surveys. The perception among local citizens and community leaders at the time was that the Eagle River and its tributaries were a tremendous asset that had been negatively impacted by development and use in terms of water quality, water quantity, adjacent land use impacts, aesthetic quality, recreation impacts and habitat values. Those concerns continue to be expressed today. Additionally, a number of stream segments in the county have been identified by the State Water Quality Control Division as impaired or potentially impaired due to the presence of metals, sediment, or other contaminants affecting aquatic life.

The decision in 2010 to update the watershed master plan was based on a strong belief in the continued relevance and value of the Plan to Eagle County and its water resource partners, especially given the magnitude of changes that had occurred since adoption of the original Plan in 1996. The process of updating the Plan began with the production of a State of the Rivers Report in 2010. This effort included research and compilation of data regarding water issues on the Eagle River and all of its major tributaries, as well as on the Colorado River. Six public open houses were held in different communities to gather input on important watershed issues. Citizen's at-large, property owners, business owners, rafting, fishing and other special interest groups, government officials and representatives of water and wastewater providers participated in these sessions. The State of the Rivers Report exists as a separate document, and can be found at www.erwc.org.

The Eagle River Watershed Council (ERWC) facilitated both the State of the Rivers Report and the Watershed Plan update process, with assistance from Eagle County planning staff. Work to update the plan began in earnest in January of 2011, utilizing a public process that included a

Partnership Advisory Team (PAT) made up of local water experts, planners, officials and stakeholders. The PAT began reviewing text and information proposed for each chapter of the updated plan. Over the course of numerous meetings, the group discussed water-related topics and strategies, and helped to develop a draft, which was delivered to the Eagle County Planning Commission for preliminary consideration in early 2012.

Additional adjustments were made by the Planning Commission prior to the plan being released for public review. A 30-day public referral period commenced on July 20, 2012. The first official adoption hearing was held on September 5, 2012, followed by additional hearings in October, November, and January. During these meetings all public comments were considered, and additional revisions occurred. Text was finalized and the Eagle County Planning Commission adopted the updated Eagle River Watershed Plan on May 15, 2013.

The Planning Commission would like to acknowledge and thank the Eagle River Watershed Council and members of the Partnership Advisory Team for the expertise, dedication, work and time devoted to the planning process. A complete list of PAT members and other participants is included in Appendix A.

Relationship to Other Plans

The Eagle River Watershed Plan is one of a number of more technically oriented master plan documents that supplement and are considered chapters of the Eagle County Comprehensive Plan. Most planning documents adopted by county and town governments include goals and policies regarding the Eagle River and its tributaries. This Plan works in concert with the provisions of those other plans, providing additional detail on the topic of water, and an updated and expanded lists of strategies and action items. Instances of conflict should be brought to the attention of the Eagle County Planning Commission and other involved regulatory entities.

Master Plans are living documents, and The 2013 Eagle River Watershed Plan should be revised as necessary to reflect the changing needs and priorities of the watershed and its citizens. Emerging threats to water resources should be noted, as should emerging technologies for monitoring and managing water quantities and qualities in river and stream systems. A review of the Plan to confirm its relevancy should be done every ten years or sooner, as determined necessary by involved agencies and stakeholders.

Organization of The Plan & User Guide

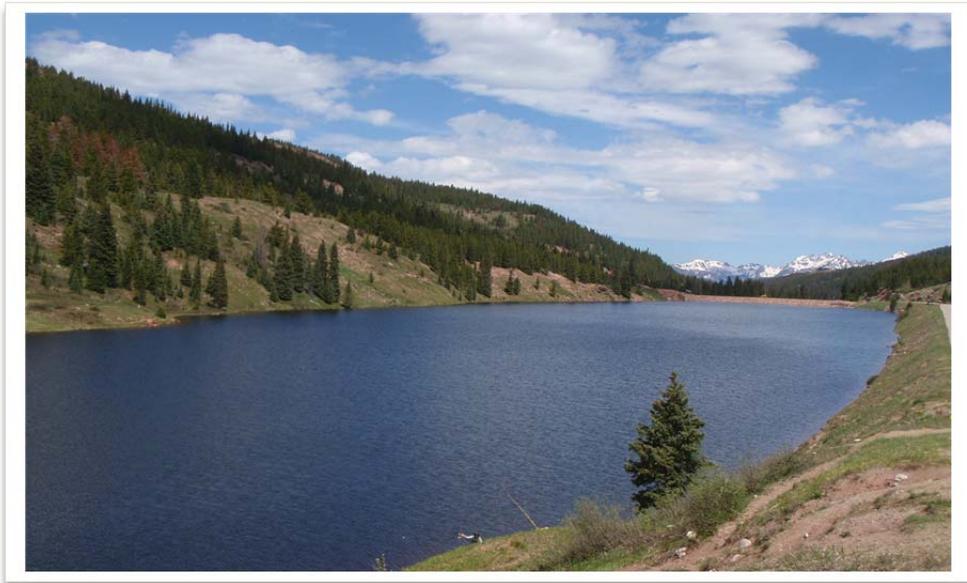
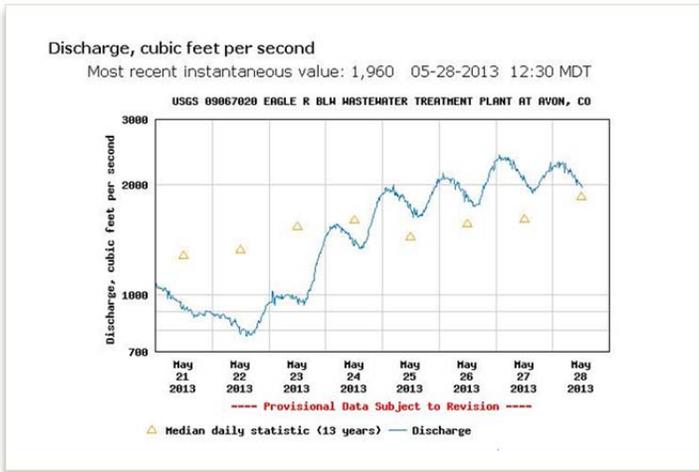
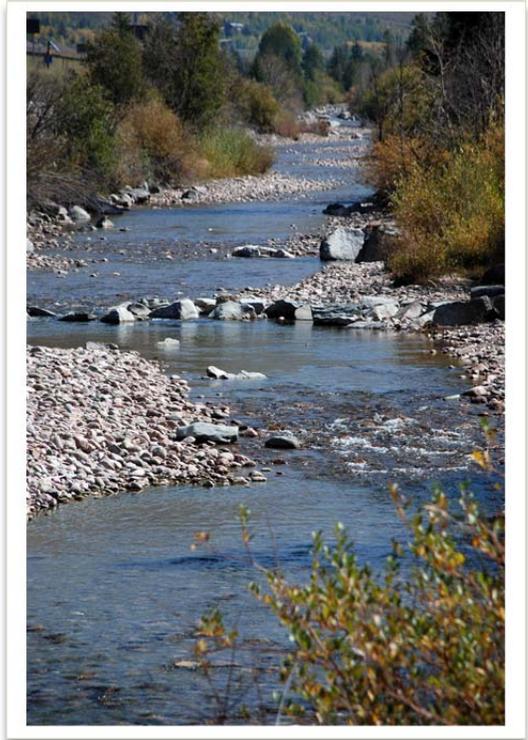
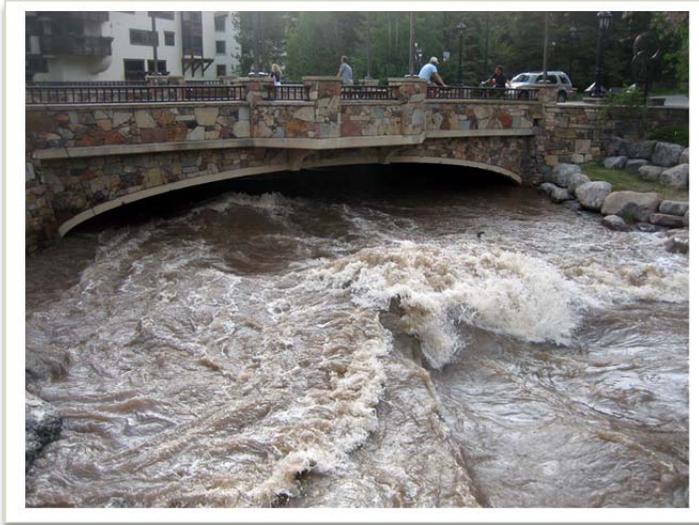
The Eagle River Watershed Plan is organized into chapters, each addressing a specific topic identified through the planning process: Water Quantity, Water Quality, Land Use, Wildlife, Recreation and the Colorado River. Each chapter provides a goal, background information, a number of objectives, and a list of supporting strategies and action items. The conformance of a proposed land use, project, policy or management action to the purposes and intents of this Plan should be determined in part by evaluating the degree to which the proposal aligns with the objectives and utilizes strategies listed.

It is not possible to isolate many of the issues that affect watersheds in Eagle County because of their functional relationship with more than one water topic. For example, water quantity affects water quality; quantity and quality affects wildlife habitat; land use affects quantity, quality and wildlife, and so on. As such, some redundancy is to be expected. Repetition in a master plan is telling, as overlaps between topics can serve to illuminate which concerns or actions are of greatest priority.

Appendices at the end of the document acknowledge process participants, outline modification and update procedures, and provide links to specific studies, educational materials, descriptions of impaired waters, and other references. Please refer to the Table of Contents for more information.



Bald Eagle in spruce tree overlooking Brush Creek (Photo: Mike Metcalf)



Chapter 2

Water Quantity

Eagle River Watershed

Water Quantity Goal: Streams, rivers lakes and reservoirs in the watershed are managed and cared for in a manner that insures adequate amounts of water for domestic, agricultural, recreational and ecological needs to the greatest degree possible at all times of year.

Overview of Water Quantity Issues and Objectives

Several water quantity issues and concerns were identified and discussed during the planning process:

- The need to assess impacts on the watershed from increasing water supply demands.
- The need for flows for rivers and streams in the Eagle River watershed that adequately protect and enhance ecological health and recreational uses.
- The need for uniformly implemented management strategies that protect and enhance instream flows.
- The need for up-to-date water supply information and improved education.
- The need for increased cooperative water and land use planning between water providers and local land use decision makers.

In response to the identified issues and concerns the following objectives were developed

1. Manage water storage, water diversions and water releases within the Eagle River watershed in a manner that protects or enhances stream health and recreational uses.
2. Minimize and/or mitigate adverse impacts to stream flows from existing development and future growth.
3. Continue to collect and make available comprehensive water quantity and stream flow information, increasing awareness of the social, ecological and economic importance of maintaining adequate flows in local streams and rivers.

4. Create a collaborative and transparent system of administration, oversight and decision-making between government entities and affected management agencies on matters pertaining to water quantity.

Background

A Valued but Limited Resource

In Colorado and in other western states, the quantity of water present and available in streams and rivers is an immensely important issue. Competition for water has been intense between water users, like Front Range communities and western slope interests, as well as between western states that share river resources. Where ample water is available, communities, recreation, industry and agriculture have flourished. Where water is limited, considerable effort and money has been devoted to the development of water diversion and storage schemes to support agriculture, urban development and other land uses.



Understanding complex water resource issues requires collaboration and cooperation between water experts, resource management agencies, service providers and other water use stakeholders (Photo: ERWC).

While water rights and trans-basin diversions have always been an issue in Eagle County, development since the 1960's have brought new focus to competing water demands for municipal, agricultural, recreational and environmental purposes. In response to concerns for the condition of the Eagle River, local governments convened the Eagle River Assembly (Assembly Report) in 1994. This group of representatives from the County, Towns, water districts and the holders of out-of-basin water rights was tasked with evaluating local water issues and identifying potential strategies that would 1) improve the condition of the river, and 2) assure adequate water supplies for future needs.

The resulting assessment concluded that flows in the Eagle River were inadequate to meet existing environmental and water supply demands in average years and dryer than average years, principally in late summer and winter months. The report provided detailed explanations of the relationships of trans-basin diversions, in-basin diversions, Colorado water law and various storage and augmentation strategies on flows in the Eagle River. Environmental concerns were based on identified "stream flow deficits" where the amount of water in the stream was not adequate to meet recommended instream flow rights that had been implemented years earlier (CWCB flow rights) for the protection of fish.

The Assembly Report listed and evaluated four water supply strategies for Eagle County:

1. *Take No Action.* Under this strategy, no water management objective would be met. Streamflow deficits and the degradation of aquatic habitats would increase. Plans for additional trans-basin diversions would move forward, and the potential for in-basin domestic water shortages would increase.
2. *Water Conservation and Reuse.* This important aspect of any water supply management plan would reduce but not eliminate river impacts.
3. *Manage Land Use and Growth.* Also important components of a water supply plan, controlling the type and intensity of growth could delay river impacts, but by itself would not be sufficient to protect habitats and assure adequate water supplies.
4. *In-basin Water Storage.* In combination with conservation and growth management, additional in-basin storage would provide water to streams during low flow periods. However, the report noted that even with new storage, growth and additional trans-basin diversions would likely result in low flow periods and aquatic habitat degradation. New reservoirs are not easy to construct, and the feasibility of any new project would need to be evaluated given

the cost, associated environmental impacts and lengthy approval processes.

Even in 1994, the challenges related to sustaining adequate flows for the Eagle River as the County continued to grow appeared substantial.

During the planning process for the 1996 Watershed Plan, it was acknowledged that current rates of growth in Eagle County could not be supported without the eventual degradation of aquatic habitats, recreational experiences, and the aesthetic values provided by the Eagle River and its tributary streams. Planners and water officials referenced the Assembly Report, emphasizing that steps needed to be taken to reduce water demand and/or increase water supply. It was suggested in 1996 that decisions for future growth in the watershed should be based, at least in large part, on water availability. In 2000, the Eagle River Assembly participants revisited the overview of the Eagle River Basin water quality issues and confirmed a general policy objective of adding 7,000 to 10,000 acre-feet of in-basin storage to enhance river conditions while meeting municipal demands for water supply.

Steps have been taken in Eagle County to address the issue of water availability. Water storage within the Eagle River Basin has been substantially increased, and water rights for future proposed trans-basin diversions have been renegotiated. Water delivery systems have been interlinked, several senior irrigation rights have been converted to less consumptive municipal uses, and water conservation guidelines and regulations have been implemented. These improvements and strategies proved invaluable during the drought of 2002, when the Upper Colorado River Basin snowpack was 69 percent of average and the State endured one of the most devastating wildfire season in recorded history.¹ After 2002, Gore Creek, Brush Creek, Abrams Creek and Gypsum Creek were identified as 'water short' by the Colorado Water Trust as a result of extremely low flows and water temperatures that threatened the health of the aquatic ecosystems. The Colorado Division of Wildlife also instituted voluntary fishing restrictions on the lower Eagle that year to protect stressed fish populations.

In 2005, another report was initiated by the Eagle River Watershed Council to develop a scientifically based inventory detailing the condition of the Eagle River. The report developed a set of recommendations to guide future restoration and conservation work, including a prioritized list of seven recommended elements of a comprehensive restoration strategy for the watershed.

Jump forward to 2012, and the process to update the Eagle River Watershed Plan. The Partnership Advisory Team once again tackled the

topic of water quantity, and once again it rose to the surface as the most complex and controversial topic in the plan. The lack of adequate water for municipal, agricultural, recreational and ecological purposes, especially in light of continued growth and the potential for climate change was still a priority issue, especially as the County emerged from a winter (2011-2012) where snowpack levels were lower than those experienced in the drought year of 2002.



A Parshall flume is a device commonly used to measure flows in irrigation ditches near diversion points (Photo: Eagle County).

Stream Flow Measurement

Stream flow can be measured as cubic feet per second (CFS) or as stream discharge measured in acre-feet per year. An acre-foot is approximately the area of a football field covered with one foot of standing water, and is generally considered to be the quantity of water necessary to support up to three households for one year.

Discharge of the Eagle River, as historically measured at a stream gage below Gypsum Creek, averages about 415,000 acre-feet per year. Most of this stream flow occurs in a short period of time in response to melting snowpack. About 75 percent of the average annual flow of the Eagle

River occurs during the three months of May, June, and July. River flows are presently monitored at fifteen (15) different gaging stations located in the Eagle River Basin and operated by the United States Geological Survey (USGS).

Water Rights

In Colorado the ability to use water for a beneficial use is dictated by the "doctrine of prior appropriation". A very simplified explanation of water rights is that water users must acquire water rights to use water for beneficial uses, which include municipal, industrial, recreation, environmental and agricultural uses.

The beneficial use of water is limited to that amount of water that is reasonably efficient to accomplish, without waste, the purpose for which the appropriated water is lawfully made. Water rights have a quantity associated with the right, a priority date (the year the right was decreed) and a period of time or season during which the diversion can take place. Water users with the oldest or most senior water rights have the first priority for water during dry periods when there is not enough water to meet all demands.

The most senior rights and the largest water right holders on the Colorado River are the Shoshone Power Plant and farmers in the Grand Junction area (referred to as the Cameo Call). When the Eagle and Colorado Rivers are low, these water users have the first priority for water usage. This limits how much water can be diverted or used upstream from these locations without augmentation (see *Streamflow Augmentation* on page 27), and can impact water use in the Eagle River during low flow periods.

Instream Flow Water Rights

Colorado's instream flow program was developed in the 1970's with the intent to "preserve the natural environment to a reasonable degree" and maintain flows necessary to sustain aquatic life, i.e. fish.² Although junior to most agricultural and municipal water rights, instream flow rights are noteworthy in Colorado Law, as they establish a water use where the water remains in the natural channel as a "beneficial use". Recommendations for instream flows are typically developed by the Colorado Division of Wildlife and submitted to the Colorado Water Conservation Board (CWCB). The CWCB reviews the instream flow recommendations, conducts a water availability study, and files a notice with the water court of its intent to appropriate water for the instream flow.

Within the Eagle River watershed, instream flow rights exist for 67 separate river and stream reaches, many with different summer and winter rights (see example in Table 1 below). Many of these rights were filed on smaller tributary streams, and only 20 of the 67 rights were filed on sections of streams where gages presently exist that can monitor stream flow. These instream flow appropriations were developed utilizing the R2CROSS method, which is based on the assumption that a discharge sufficient to maintain critical riffle habitat should be sufficient to maintain habitat in pools and runs for most life stages of fish and macroinvertebrates (bugs that live in the river).³

Eagle River Reach	Instream Flow Right (CFS)	
	<i>Summer</i>	<i>Winter</i>
Cross Creek to Gore Creek	50	20
Beaver Creek to Lake Creek	85	35
Lake Creek to Brush Creek	110	45
Brush Creek to Colorado River	130	50

Table 1: CWCB instream flow rights during different times of the year along the mainstem of the Eagle River. Summer is considered May 1 through September 30; winter is considered October 1 through April 30.

The R2CROSS method looks at water depth, wetted perimeter, and average water velocity and can be implemented relatively quickly at a reasonable cost. However, the R2CROSS method may result in instream flow recommendations that are less than or greater than what might actually be necessary to preserve the natural environment to a reasonable degree. As example, fish "kills" have been recorded by the Colorado Division of Wildlife (CDOW) on the Eagle River when flows have appeared to meet CWCB rights. This is likely due to pollutants and/or temperature having a greater effect on fish at times of low flow. There are also instances when flows in streams and rivers drop below CWCB rights with no discernible impacts to larger fish. Impacts to smaller fish and fish eggs during these events may occur, but are very difficult to quantify.⁴

The 2005 Eagle River Inventory and Assessment (ERIA) revisited the methods used to establish minimum in-stream flows in Eagle County. The report found that the methodology was overly simplistic and did not necessarily account for disparate procedures used, and the complexity of variables that influence mountain river systems, including recreation, water quality, land use changes, wastewater dilution and temperature.⁵ The report suggested that in-stream flow rights established using the

R2CROSS method should not be used to determine the potential ecological ramifications of flow modifications in a stream or river reach (see Appendix D).

A more thorough and quantitative means of determining flows needed to sustain aquatic habitat is called the *Instream Flow Incremental Methodology* (IFIM). This methodology looks at a number of variables including water depth, channel geometry, water velocity, and the type of material that covers the stream bottom (substrate). Complex modeling is then used to determine habitat characteristics under different flow scenarios. The IFIM approach is considerably more time consuming and expensive than the R2CROSS method.

The 2005 ERIA recommended that a new in-basin decision-oriented tool comparable to but more comprehensive than the In-stream Flow Incremental Methodology be created to more accurately assess the potential effects of flow alterations on fish habitat and water quality in the Eagle River. Through this effort, key ecological aspects of flow amounts and flow timing as a restoration management strategy for the watershed could be developed.

During the 2012 process to update this watershed plan the topic of in-stream flows was extensively debated. The Partnership Advisory Team solicited opinions from an assortment of resource managers, water providers and water engineering consultants. In the end it was determined that a re-evaluation of established instream flow rights in Eagle County using a new and more science-based approach like IFIM would be impractical and cost prohibitive.

However, it was also acknowledged that an effort to utilize science based approaches to link flow levels at certain times of the year with key ecological processes would unquestionably help stakeholders and policy-makers balance competing interests with a clearer vision of the ecological sensitivity of the river. The use of the IFIM or similar method to establish flow thresholds in locations where flow and habitat conditions are thought to be limiting, or where they may be negatively impacted by new diversions or new consumptive uses, may be very appropriate, and should be strongly considered. This Plan recommends including IFIM or comparable study where individual reaches of rivers or streams are identified as having inadequate flows, or a known impairment related to flows.

Water Diversions

In the Eagle River there are two types of water diversion: trans-basin and in-basin. Both types of diversions are affected by the available water in

any given year, and the water rights that have been appropriated within the basin (see figure 1 below).

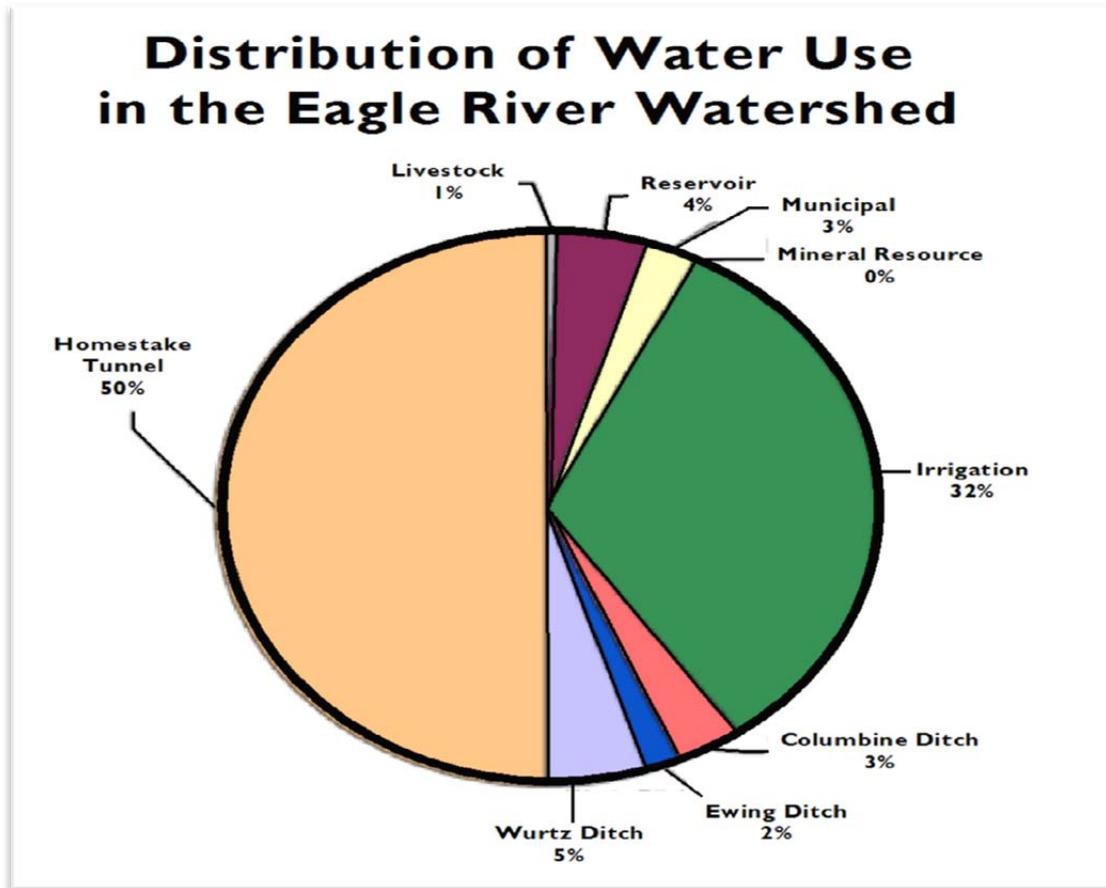


Figure 1: Total distribution of consumptive use for the Eagle River watershed, including transbasin diversions (Source: CSU, 2005).

Trans-basin (or trans-mountain) diversion involves transporting water from one watershed to another via diversion systems. There are four diversions that take water out of the Eagle River watershed and transport it to Front Range cities (please see map on page 23). These diversions include the Wurtz and Ewing Ditches (City of Pueblo), the Columbine Ditch (recently acquired by Aurora and the Climax Molybdenum Company), and the Homestake 1 Project (Cities of Aurora and Colorado Springs). Trans-basin diversions mostly occur during the spring runoff when stream flows are at their highest. Together trans-basin diversions remove approximately 34,000 acre-feet of water from the Eagle River watershed each year (see Table 2 on the following page). They are considered 100% consumptive, as none of the water diverted is ever returned to the watershed of origin.

<i>Name</i>	<i>Stream</i>	<i>10-Year Average</i>
Columbine Ditch	Tennessee Creek	1295.9 Acre-feet
Ewing Ditch	Tennessee Creek	910.4 Acre-feet
Homestake Tunnel	So. Platte via Arkansas	32,687.7 Acre-feet
Wurtz Ditch	Tennessee Creek	2,123.2 Acre-feet

Table 2: Eagle River Watershed Trans-mountain Diversions, Ten-Year Average (Source: Division 5 Water Resources, 2009).

In-basin water use consists of all water uses that divert water from a local stream or river for use within the watershed, or that retain some amount of water in the channel for ecological or recreation purposes. Domestic household use in Gypsum, lawn irrigation in Edwards and snowmaking at Beaver Creek would be examples of in-basin uses that require out of channel diversions. Unlike trans-basin uses, a significant portion of the water diverted in-basin is returned to the Eagle River.

In-basin water use that requires diversion includes the following:

1. *Domestic* water and wastewater providers take water out of the river or aquifers, treat it, provide it for homes, and businesses, treat it again at a waste water treatment facility (typically down river from the diversion), and then return it to the channel. Major domestic diversions and returns within the watershed are summarized in Table 3 on the next page.

The amount of water that is consumed (not returned to the river) by domestic uses varies considerably between communities and also between seasons. The highest levels of domestic diversion in Eagle County occur during the summer, when the percentage of water returned to the river is lowest due to losses from outdoor irrigation.

Water diversions are also high in the winter when tourism peaks. Although natural water flows are low in winter months, a higher percentage of water is returned to streams and rivers in the form of treated effluent.

With domestic diversions there can be a significant depletion in stream flows between the point where water is diverted and the point where it is returned at a wastewater treatment plant. (see Water Quality chapter for discussion). Examples of this would be the towns of Eagle and Gypsum, who divert water high on Brush Creek and Gypsum Creek. After serving the towns, that water is returned to points on the Eagle River many miles below the point of diversion. Table 3 provides a summary of domestic diversions in the watershed.

<u>Town*</u>	<u>Diversion point</u>	<u>Return point</u>
Red Cliff	Turkey Creek	Eagle River below Red Cliff
Minturn	Cross Creek	Eagle River at Avon
Vail**	Gore Creek and wells	Gore Creek in Vail and the Eagle River at Avon
Avon**	Eagle River	Eagle River at Avon
Edwards**	Eagle River and wells	Eagle River at Squaw Creek
Eagle	Brush Creek	Eagle River below Eagle
Gypsum	Gypsum Creek	Eagle River below Gypsum
*Some developed areas are served by individual or group wells, and wastewater is treated through on-site wastewater treatment systems.		
**The Towns of Vail, Avon and Edward have connected domestic water systems, which can be operated to pump water from a variety of diversion locations.		
Table 3: Major domestic diversions and returns		

2. *Snowmaking* usually takes water from the river in October, November and December when flows are relatively low. The water is stored as manmade snow. Approximately 80% of water is returned during the spring melt when flow is high. The rest is lost to evaporation and sublimation (the direct conversion of water from ice to a vapor state). Snowmaking generally results in higher peak flows for a longer duration during spring runoff. The Vail Ski Area diverts water from Gore Creek and the Eagle River for snow making, and the Beaver Creek Ski Area diverts water from the Eagle River. Both ski areas have some amount of on-mountain storage. It is important to note that water rights for snowmaking in Eagle County are generally junior to the CWCB instream flow rights, and that water often must be released from upstream in-basin storage reservoirs to replace snowmaking diversions.

Agricultural users divert water at established head gates and route it through irrigation ditches to grow crops or feed for livestock. Small diversions along irrigation ditches allow water to flood across fields and pastures, although some ranches have installed modern automated sprinkler systems. Return flows to the river can vary significantly depending on soil conditions and the type and quality of the irrigation system but can range up to 50%, with the rest consumed by evaporation, plant use and deep percolation. Flood irrigation that recharges ground water aquifers can be valuable in augmenting late summer/fall flows as these aquifers slowly release water along stream and riverbanks. Numerous irrigation diversion

points, some of them dating back 100 or more years, are located on the Eagle River and its tributary streams. As with domestic diversions, there can be a significant depletion in stream flows between the points where water is diverted for irrigation, and where unused portions return to the river.

3. *Golf Courses* also divert water for irrigation, and often utilize senior agricultural water rights. A well-managed golf course uses water more efficiently, however, resulting in only minor return flows to the stream and river system. Golf course irrigation is generally considered to be 70% to 90% consumptive.

Both trans-mountain and in-basin water diversions are monitored by the Colorado Division of Water Resources Division 5 office. The Eagle River watershed is located in District 37, and active calls and information on diversions and surface water conditions for the district can be viewed at: <http://water.state.co.us/DivisionsOffices/Pages/SelDistWaterCommissioner sDocsAndQLinks.aspx?Div=5&WD=37>.

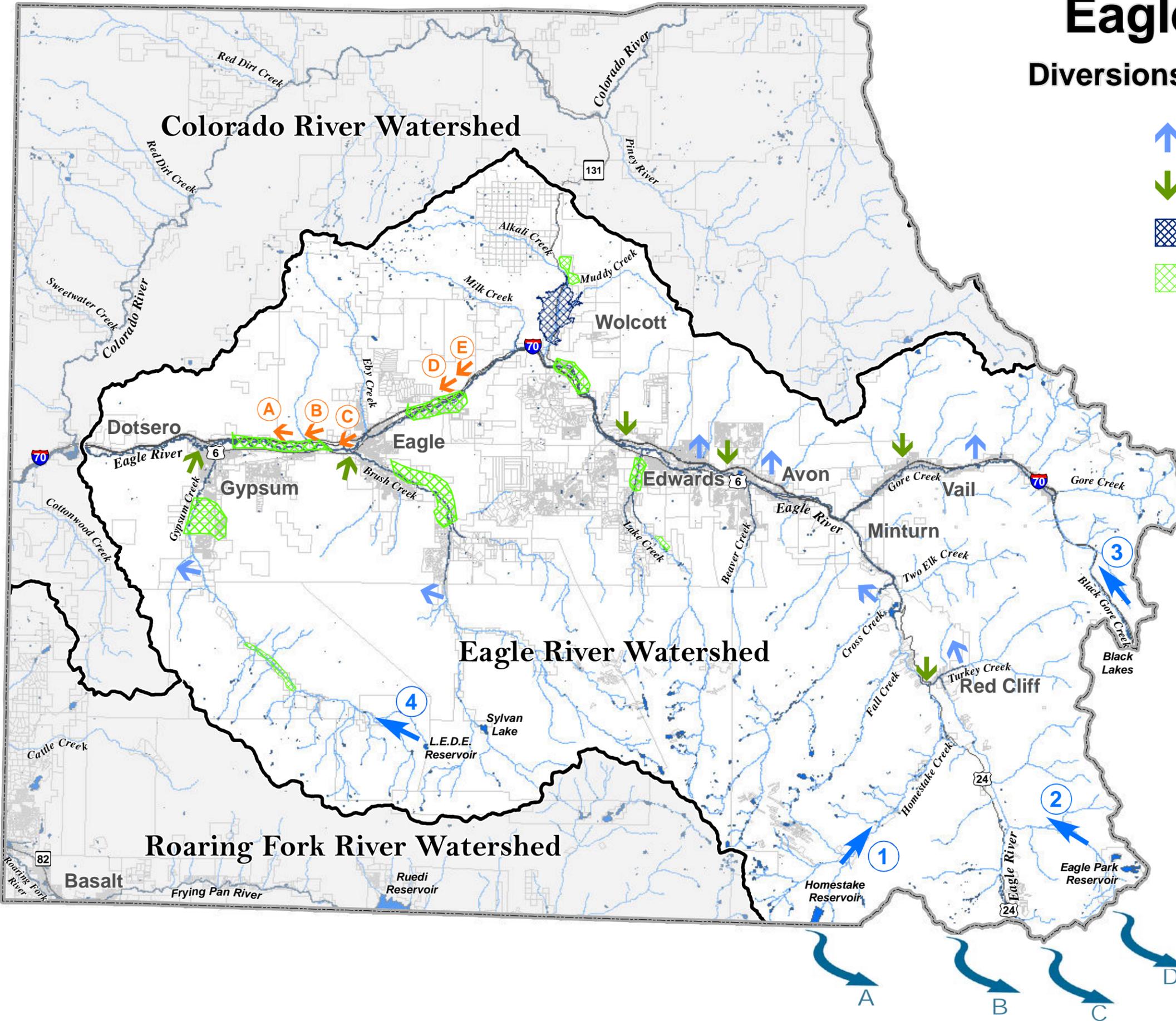
Impacts from Trans-Basin and In-Basin Diversions

Trans-basin diversions can reduce the intensity of spring runoff flows that are important in the maintenance of aquatic habitat. Spring flows flush fine sediments from the channel substrate and provide the high quality gravel beds needed by aquatic insects and fish for reproduction. High flows also maintain riparian communities through flooding of the banks and riparian zones adjacent to the river.⁵ Studies to determine how much of a “flushing” flow is actually needed on the Eagle River to maintain optimal habitat for aquatic life and bank recharge have not been conducted.

While the impacts of trans-basin water diversions in the Eagle River Basin are less than those seen on the Colorado River, the Fraser River, the Blue River and the Roaring Fork River, it is important to note that any water transferred out of the basin is water that is not available to benefit local streams, or to satisfy future local augmentation needs for domestic or environmental benefits. Senior water rights continue to be held by out-of-basin interests, and future requests for additional trans-basin diversions are likely.

Eagle River Watershed

Diversions, Returns, and In-Basin Storage



- Municipal Diversions - Amount Varies
- Municipal Returns - Amount Varies
- Possible Wolcott Reservoir Footprint
- Significant Agricultural Irrigation

Large Agricultural Ditches on the Main Stem of the Eagle River in Acre Feet Diverted

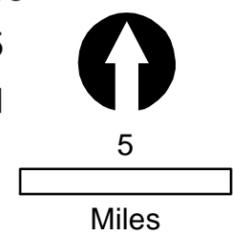
A	CM Stremme & Gates Ditch	4064
B	Schumm #2 Ditch	743
C	Schumm #1 Ditch	782
D	Warren Ditch	2249
E	Hollingsworth Ditch	4110

Trans-basin Diversions in Acre Feet / Year (10 Year Average)

A	Homestake 1	32,700
B	Wurtz Ditch	2120
C	Ewing Ditch	910
D	Columbine Ditch	1295

In-Basin Water Storage Available Firm Yield, Acre Feet

1	Homestake	1500
2	Eagle Park	2088
3	Black Lakes	425
4	LEDE Reservoir	431



This map was created by the Eagle County GIS Department. Use of this map should be for general purpose only. Eagle County does not warrant the accuracy of the data contained herein.

Agreements between Eagle River Basin and Front Range water users have resulted in abandonment of most of the water rights for the Eagle-Piney Project, which would have diverted thousands of acre-feet to Denver each year. Changes to the diversion amounts that would result from a future Eagle Park Conjunctive Use Project have also been negotiated. Local management agencies and stakeholders should remain vigilant to growth trends and water use policies in places like Denver, Aurora and Colorado Springs. Ongoing negotiations and collaboration with Front Range water interests will help to minimize future trans-basin diversion impacts on the Eagle River Basin.

Unlike trans-basin diversions, a significant portion of the water diverted for in-basin uses finds its way back to the river. Losses do occur for water that is diverted for irrigation during the summer, at times when river flows are generally higher. During the winter season, when irrigation uses are not occurring, snowmaking, residential and commercial water diversions can be significant (note the conceptual hydrograph in Figure 2 on the following page). Stream flow amounts are much lower during these months, but the amount of water returned the river (as treated effluent) is much higher. The time lag between diversions and returns for domestic and commercial uses is generally short.⁶ As the number of irrigated agricultural acres has been converted to residential and commercial land uses, the total in-basin consumptive use has likewise decreased, particularly in the upper part of the watershed.

Historically, the low elevation reaches of tributary streams like Lake Creek, Brush Creek and Gypsum Creek were almost completely dried up by late summer agricultural diversions. The condition of these streams has improved as development proposals have transferred agricultural water rights to municipal water providers, and as management strategies have focused more attention on the ecological and recreational benefits of maintaining adequate stream flows.

Stream Flow Deficits

The combination of natural forces, human development, in-basin and out-of-basin diversions, and instream flow rights on a river system creates the potential for water use conflicts, and the need for stream flow management strategies. As consumptive uses increase, so does the likelihood that flows will fall below levels that have been set to protect aquatic habitats at certain times of the year or under certain circumstances. These instances are referred to as instream flow deficits (note the circled areas in Figure 2). In 2005, data from USGS gages was used by the CSU Engineering Research Center to analyze the frequency

of in-stream flow deficits in the watershed as part of the Eagle River Inventory and Assessment project.

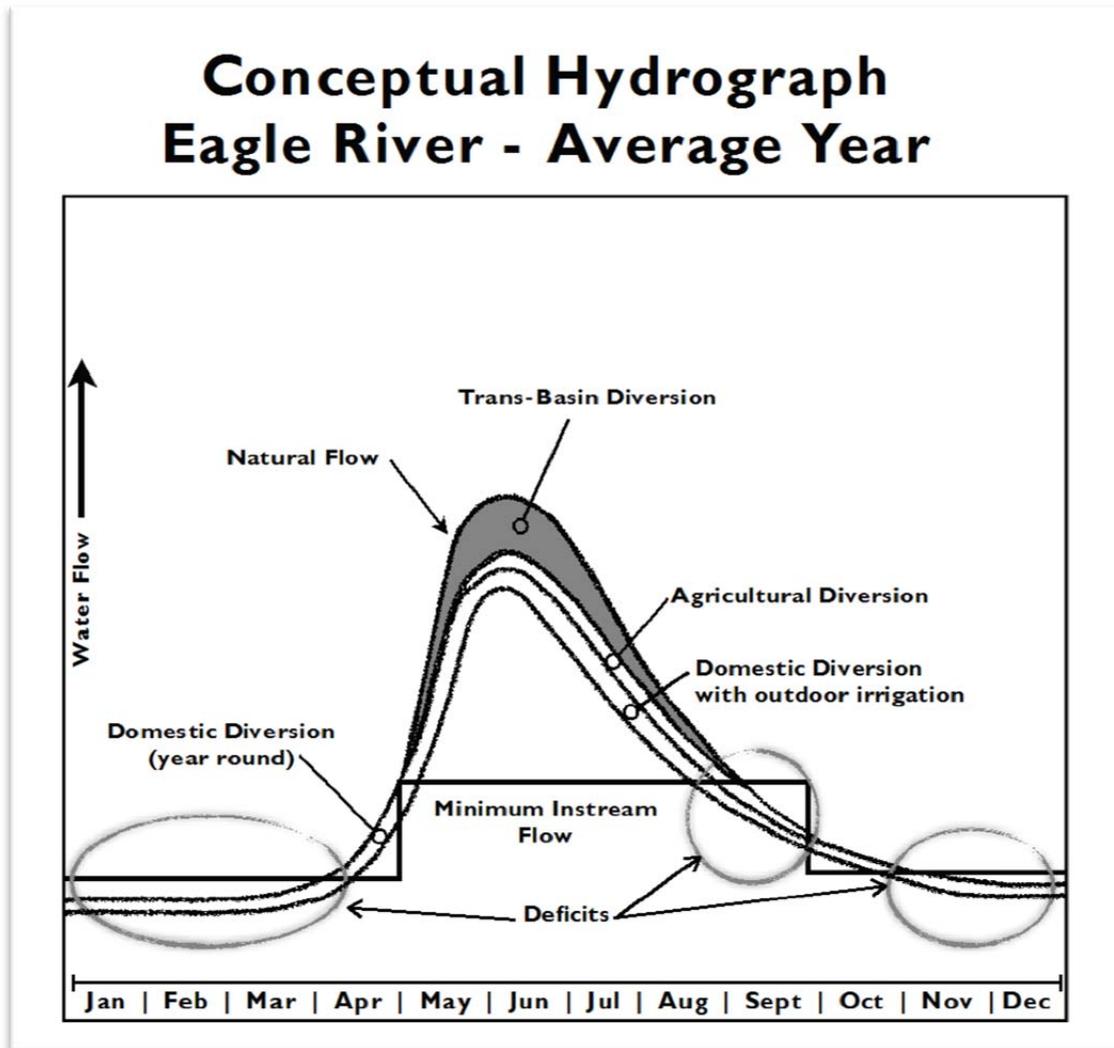
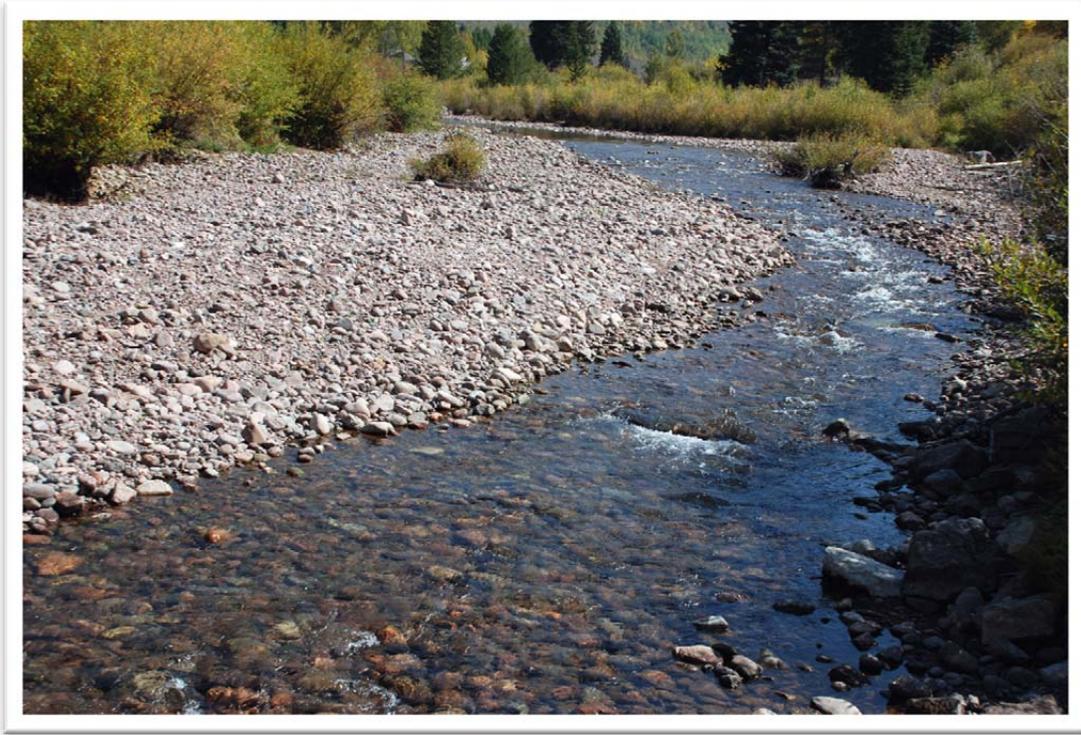


Figure 2: Conceptual flow diagram of the Eagle River in an average year. It is important to note that stream flows can drop below instream flow rights even under natural conditions. Vertical scale and spacing are conceptual only and not intended to reflect specific amounts of water (Source: ERWC).

That study indicated a number of stream segments that were subject to periods when flows were less than CWCB instream rights during the late summer and winter months. Some deficits occurred on stream and river reaches downstream of domestic or agricultural diversion points, which would indicate a likely combination of natural and manmade influences. Other deficits were found on streams that were not subject to any manmade influences, indicating the effect that precipitation,

temperature, wind, and other meteorological events have on natural water storage and runoff levels.



Periods of low flow can dramatically reduce the habitats available to aquatic insects and fish. Shown above is Gore Creek in September of 2012. (Photo: Eagle County)

Regardless of the origin of the deficit, this Plan recommends that stream flow management strategies should be developed on those individual reaches of rivers or streams that have been identified as having inadequate flows or known impairment related to flows.

Stream Flow Augmentation

Colorado water law allows "water augmentation" as a means to replace water used by a "junior" (younger) water right when this junior right would otherwise be out of priority and unable to divert water. An augmentation plan typically replaces (or augments) the amount of water consumed from the stream with water from an available source like a reservoir. By replacing the amount of water consumed, the amount of water available to senior downstream water rights (such as the Shoshone and Cameo water rights on the Colorado River) is maintained.

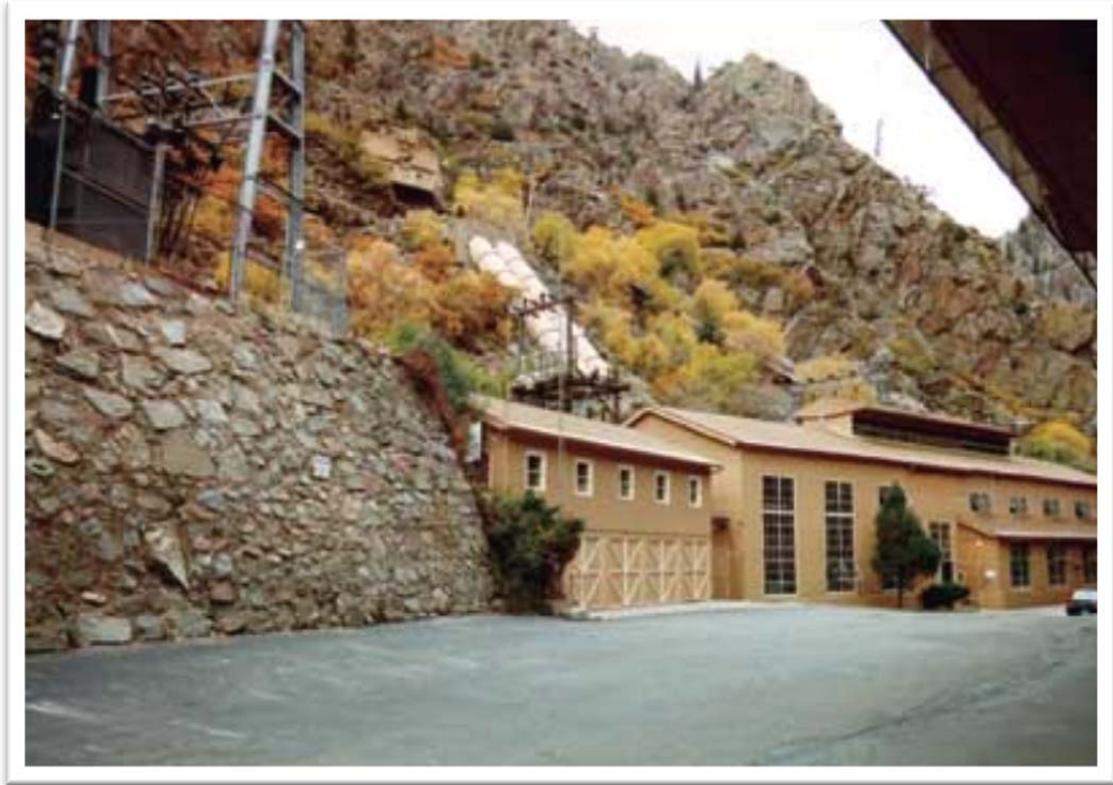
A frequently expressed concern regarding water in Eagle County is that the most senior water right downstream from the Eagle River Basin is the Shoshone Power Plant, which is located on the Colorado River. In those

instances when water in the Colorado was insufficient to meet a Shoshone Call, flows from the Eagle River are necessary to meet that demand, and as such the Shoshone senior right helps to protect local stream flows.

But the fact that Shoshone is located on the Colorado River creates a situation where an entity can apply for a new water right on the Eagle River and purchase augmentation water from Green Mountain Reservoir in Summit County or Wolford Mountain Reservoir in Grand County to meet a Shoshone "call". An augmentation plan using these reservoirs grants the legal right to withdraw water from the Eagle River watershed and "replace it" with water that flows into a different river to meet downstream demands. For a new (junior) water right, an augmentation plan has the potential to reduce flows in the Eagle at non-critical periods.

Fortunately, most water rights in Eagle County that contract water for augmentation from Green Mountain or Wolford Mountain reservoirs are junior to the CWCB's instream flow rights. Several Eagle River Basin water users including the Eagle River Water & Sanitation District, the Upper Eagle Regional Water Authority and Vail Resorts have implemented an operating strategy that utilizes out-of-basin augmentation sources when flows are above established rights for instream flow. During the late summer, fall and winter low flow periods, when the CWCB rights are in priority, augmentation water for users within the aforementioned District and Authority boundaries must come from in-basin sources such as Eagle Park Reservoir, Homestake Reservoir, or Black Lakes. This operating strategy sets a good example for other users in the basin, as it helps to preserve in-basin augmentation sources for critical times of a dry or drought year, such as 2012.

Water storage and water releases from upstream reservoirs can influence both high and low flows of a river system, as well as the timing and variability of stream flows throughout the year. Water released from upstream locations to replace water diverted downstream provides the added benefit of increasing flows between the reservoir and the point where a water deficit is occurring. A number of reservoirs have been constructed in Eagle County to store spring runoff water and release it later in the year for augmentation. Storage reservoirs are often classified by the amount of "firm yield water" they contain, in other words, the amount of water that can actually be released from the facility for use downstream in a dry year or a series of dry years.



Between a rock and a hard place: the Shoshone Power Plant, Glenwood Canyon
(Photo: Colorado River District).

The Eagle River Assembly Report provided an estimate that 3,300 to 4,000 acre-feet of firm yield augmentation water was needed in 1994 to maintain CWCB flow rights. At the writing of this Plan, 4,443 acre-feet of augmentation water has been developed in the basin. As one considers the water use changes that have occurred since 1994, and looks ahead at the certainty of continued growth in Eagle County, the need for additional in-basin storage and augmentation water becomes clearly evident.

In-basin Water Storage

There are six water storage facilities in the Eagle River Basin: Homestake Reservoir, Eagle Park Reservoir, Black Lakes, Nottingham Lake, Sylvan Lake and LEDE Reservoir. These facilities vary considerably in terms of size, yield and in their ability to support multiple uses (viewshed enhancement and recreation as examples).

Table 4 on the next page illustrates the amount of in-basin water augmentation secured by local water entities over the years in order to replace consumptive uses of water diverted from the river system.

Reservoir/Lake (common name)	Available Yield (in acre-feet)	Water available since
Homestake Reservoir	500 AF	2010
Eagle Park	75 AF	2009
Black Lake 1	124 AF	2008
LEDE Reservoir	431 AF	2006
Homestake Reservoir	500 AF	2004
Homestake Reservoir	500 AF	1998
Eagle Park	2013 AF	1999
Black Lake 1	227 AF	1992
Black Lake 2	73 AF	1986
Total	4443 Acre-feet	

Table 4: Eagle River in-basin storage available for augmentation, 2013

In 1994, the Eagle River Assembly identified 10,000 acre-feet as the amount of water that would need to be stored to meet future needs and also enhance aquatic conditions in the Eagle River. As indicated above, there is presently 4,443 acre-feet of water available from the storage facilities within the watershed.

As Eagle County continues to grow, instream flow deficits will likely increase in frequency unless actions are taken to reduce or replace water lost to consumptive uses in the watershed. Avoiding or minimizing additional out-of-basin diversions will help secure water for future storage, and sustain flushing flows in the spring. Service provider operating plans that mandate water conservation, particularly in the area of residential landscaping, can help reduce the demand for treated domestic water. A number of water conservation programs have been developed, and should be periodically reviewed and updated to assure effectiveness. Wherever possible, new storage facilities should be located at higher elevations, thus providing benefit to stream and river segments above downstream points of diversion.

It is important to note that the level of water in reservoirs designed for augmentation can fluctuate considerably, which often conflicts with recreational uses. This can limit the functionality of the facility over time, as recreational or aesthetic uses can serve to alter management decisions regarding water releases. Nottingham Lake is a good example of this; initially developed as an augmentation facility, its value to the community as a recreational lake now competes with the possibility of its being used to supplement flows downstream.

Additional reservoir projects have been identified in Eagle County that, if constructed, could provide additional storage and augmentation. These

include Eagle Park Conjunctive Use (Camp Hale), Wolcott Reservoir and Bolts Lake. For a detailed listing and description of all existing and proposed water storage facilities, please see the Glossary & Water Facts.

Any reservoir proposal would need to be carefully evaluated for both environmental and socio-economic impacts and benefits it provides to the basin of origin, and would be required to comply with applicable Federal, State and local government processes and regulations. New storage facilities would capture early season runoff water, and should be operated in a manner that maintains adequate flushing flows downstream. Any stream flow management strategies developed for the Eagle River Basin must comply with applicable provisions of Colorado Water Law.

In-Basin Water Management

Clearly, managing water for competing needs within the context of existing laws in a place like Eagle County is a multifaceted and complex task. It is not uncommon for incorporated communities to obtain water rights and operate their own water service and treatment systems. The Town of Eagle, Town of Minturn, Town of Gypsum and the Town of Redcliff are examples. In other instances, developers create metropolitan districts to finance and operate water distribution systems to serve their developments. Over time, some of these districts consolidate. Others may delegate their water service responsibilities to larger regional service entities.

In 1984 six entities formed the Upper Eagle Regional Water Authority (Authority), whose board members are representatives of the underlying metropolitan districts and the Town of Avon. These separate operating districts delegated their water service obligations to this umbrella organization. Other entities, like Cordillera and Bachelor Gulch metropolitan districts, also receive water services through contract with the Authority. The Authority in turn contracts with the Eagle River Water & Sanitation District (ERWSD) for operations of its system. The ERWSD has a Board of Directors that is elected at large. Separate water systems operated by the District and the Authority in the eastern end of the county have been connected, and treated water can now be delivered to properties between Vail and Edwards using a variety of piping and pumping systems, all managed by a single service provider.



Eagle Park reservoir, once a mine tailings pond, was remediated and now provides valuable augmentation water for a variety of Eagle River watershed uses (Photo: Ken Neubecker).

Most Towns and service districts employ tiered metering, with higher fees charged for higher rates of water use. Nighttime, odd-day and even-day watering regulations can be used to promote water conservation in the care of landscaped areas. In the instance of severe water shortages, water service providers can prohibit the watering of lawns and gardens and even the washing of cars.

Impacts from Climate Change

Climate change is a near certainty based on the most recent scientific evidence, and will affect the timing, rate and intensity of precipitation and stream flows in the Eagle River watershed (please note figure 4 on the following page). It is projected that by the year 2040 the Upper Colorado and Eagle River basins will suffer a 5 to 8 percent overall stream flow reduction due to climate change, and up to a 17 percent reduction in average annual stream flow by 2070.⁷

In the Eagle River basin, such a reduction could add up to a loss of 70,380 acre-feet of water based on historical annual average flow of 414,000

acre-feet. To put this in perspective, that is more water than currently stored in all reservoirs in-basin.

Generally, in the Eagle River Basin, the effects of climate change could include the following:

- Streamflows during the winter could tend to be somewhat higher than under historical conditions due to warmer temperatures, possibly resulting in some improvements to wintertime fish habitats;
- Less precipitation may occur as snow and more as rain resulting in lower annual streamflow discharges.
- Snowmelt runoff will begin earlier in the spring and end earlier in the summer, resulting in a shorter season for rafting, kayaking, and float fishing.
- The magnitude and duration of peak flows could be decreased, possibly reducing the amount of water available for trans-mountain diversions or local storage under existing water rights.
- The combined impacts of peak flow reductions, trans-mountain diversions, and in-basin storage diversions would reduce flushing flows, possibly resulting in more sediment deposition areas and associated adverse impacts to riparian and aquatic habitat.
- Lower streamflows during the summer and fall could result in more frequent and longer periods of time when stream flows fail to meet CWCB instream flow rights.
- Lower streamflows in the summer and fall could result in higher water temperatures and a reduction in the amount of habitat available for fish.

With these potential changes in mind, water managers may look to encourage water efficiency and increased water supply systems operational flexibility as solutions to accommodate growth while minimizing impacts to streams. This can be accomplished through strategies that might include aggressive conservation measures, and expanded in-basin water storage projects.

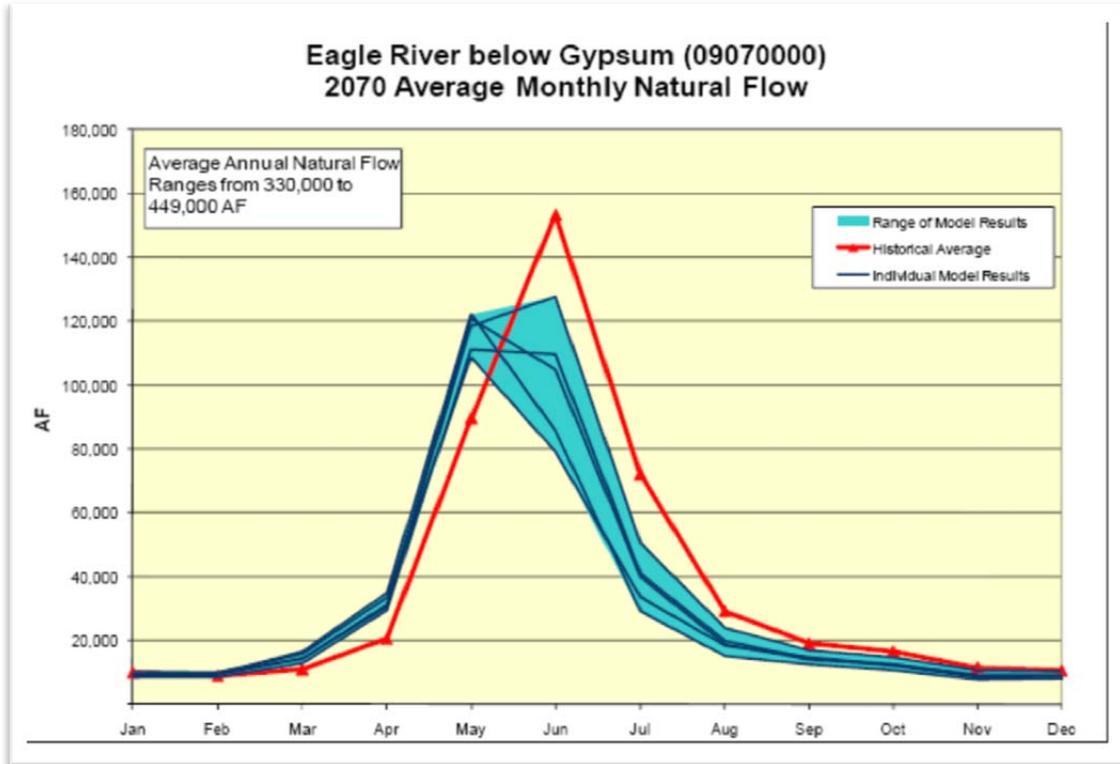


Figure 4: A few degrees of warming could produce a variety of flow results in the Eagle River basin by 2070. Most models indicate an earlier peak runoff of shorter duration yielding less overall water. The red line is the historical average, and all models generate earlier and lower peak runoff, shown in blue and blue shading (Source: CWCB, 2010).

Information on Water Quantity

Hourly information on water flows in the Eagle River is available on the web for USGS gages, a site frequented by river rafters and fishermen, at:

<http://waterwatch.usgs.gov/index.php?m=real&w=gmap®ions=co>.

Selecting the individual gage of interest will redirect you to real time discharge information as well as statistics based on the available period of record for the site. Information on active water diversions (calls) on the river are also available from the Colorado Division of Water Resources at: <http://water.state.co.us/DivisionsOffices/Pages/SelDistWaterCommissionerSDocsAndQLinks.aspx?Div=5&WD=37>.

Water Quantity Goal: Streams, rivers, lakes and reservoirs in the watershed are managed and cared for in a manner that insures adequate amounts of water for domestic, agricultural, recreational and ecological needs at all times of year.

Water Quantity Objectives, Strategies and Actions (items not listed in order of importance or priority)

Objective 2.1: Manage water storage, water diversions and water releases within the Eagle River watershed in a manner that sustains or enhances stream health and recreational uses.

The amount of water flowing in a river or stream at various times of the year is a critical determinant of the health of associated aquatic and riparian habitats. Flushing flows in the spring and adequate flows in the fall and winter months help assure the presence of a viable fishery and the stability of important riparian vegetation. Natural flow patterns in rivers and streams vary considerably from year to year and from season to season. Diversions, consumptive uses and reservoir releases within a watershed can significantly impact natural flow patterns. In some instances, manmade influences on stream flows can be designed and managed to help maintain and even improve aquatic and riparian habitats.

Strategies/Actions:

1. Only approve new storage projects or the expansion of existing storage projects that provide local stream flow augmentation. New storage facilities (excepting new water storage tanks) should bypass sufficient flows or dedicate a portion of the available yield for the maintenance or enhancement of stream health and aquatic habitats as a community/public benefit.
2. Where appropriate, expand existing in-basin storage or water supply operations to provide local stream flow augmentation.
3. Construct new in-basin water storage facilities that contribute to long-term watershed health, and that result in positive impacts to Eagle County's economy and environment. Locate new facilities at higher elevations to benefit stream segments above diversion points.
4. Continue negotiations with trans-mountain diverters, and implement strategies to minimize the impacts of future trans-mountain diversion projects.

5. Ensure that augmentation efforts to supplement flows in one drainage do not negatively impact stream health in an adjacent drainage.
6. Where individual reaches of rivers or streams are identified as impaired or having inadequate flows, craft and implement Streamflow Management Plans that offer creative and cost effective strategies to address ecological, domestic, recreational and agricultural water needs. Streamflow management plans can include:
 - Modeling based on or comparable to the IFIM methodology;
 - Recommendations for desired ecological flows to support natural stream flow variability (low, base, maintenance and flushing flows);
 - Recommendations for other approaches to improving and sustaining the stream or river in question, including water and land conservation techniques or bed and bank enhancements.
7. Co-locate domestic diversion and return points, and otherwise implement strategies to minimize impacts to flows between domestic and agricultural diversion and return points.
8. Periodically review and revise local land use regulations, site development standards, building codes and service provider operating plans to maximize the wise and efficient use of water treated for domestic use.
9. Support the wise and efficient use of raw water for domestic irrigation where practicable to reduce treatment costs and keep water in stream channels between domestic diversion points and raw water diversion points.
10. Support appropriately managed flood irrigation diversions on agricultural properties located above river bottom alluvial deposits to enhance ground water recharge and the resulting late summer return flows.
11. Establish a partnership between Eagle County and the CWCB to develop and incentivize water efficiency improvements and/or new legislation, creating unused water that would then be available for contracting to the CWCB for instream flow purposes.

Objective 2.2: Minimize and/or mitigate adverse impacts to aquatic habitat and stream health from existing development and future growth.

Developed areas in Eagle County utilize water in different ways and at different times of the year. As such, the impact that land use has on river and stream flows varies considerably.

The effect that existing development in Eagle County has on stream flows in most locations is generally well understood. Strategies have been implemented in areas by some water providers to address stream flow deficits at critical times of the year, including use fees and watering restrictions. Some water diversions are augmented by in-basin storage to maintain flows in the stream. In other areas, strategies have not been developed or implemented. Additional efforts are warranted to further reduce impacts from development.

Decisions regarding new development proposals should be based in part on the implementation of strategies, technologies and programs that will avoid or minimize negative impacts to the health and well-being of area streams.

Strategies/Actions:

1. Create and make available a low cost water-auditing program that would provide residential and commercial property owners with an assessment of their water use and suggestions for greater water conservation.
2. Encourage the retrofitting of older homes and businesses with water efficient fixtures and outdoor irrigation systems. Utilize the current EPA Water Sense certification or similar industry standard to ensure that all indoor fixtures and appliances are state of the art. Periodically review and revise local building codes to reflect/reference state of the art technologies.
3. Incentivize the incorporation of xeriscape landscaping principles into existing residential and commercial landscapes areas. Promote the creation of landscaping guidelines and regulations that:
 - *Specify drought tolerant grasses and minimize irrigated turf areas, and*
 - *Restrict the use of non-native, water-hungry plantings, and*
 - *Require automated irrigation systems, and*
 - *Utilize drip irrigation for all trees, shrubs and flowers.*

4. Encourage all water providers in the Eagle river Basin to implement an operating strategy similar to that of the Eagle River Water and Sanitation District, whereby augmentation water must come from in-basin sources when the CWCB rights are in priority.
5. Where not already in place, implement water metering with tiered water use rate schedules in all residential and commercial areas.
6. As opportunities arise, amend applicable regulations, codes, policies and/or guidelines within all government and/or service jurisdictions to require:
 - *Demonstration that legal and physical water is available for any new project, and*
 - *Accurate information regarding water use and consumption for all development and redevelopment proposals, and*
 - *A Water Conservation Plan that specifies indoor and outdoor water conservation measures for all development and redevelopment proposals, and*
 - *Evidence that augmentation plans for any new development or redevelopment will not harm stream health.*
7. Recognizing that stream flows can drop below CWCB instream flow levels under natural conditions, and that this condition may be further compromised by use of water rights senior to the CWCB instream flows, encourage water management strategies and projects that enhance stream flows during times when flows are below CWCB levels. Such efforts should include a combination of new private water trusts, legislation or other creative means to 'loan' water rights to instream flow purposes.
8. Obtain third party plan review assistance to provide objective analysis of water service plans for new development or redevelopment proposals.
9. Continue efforts to map source water and ground water recharge areas. Support the development of source water protection and education plans to minimize threats and increase community awareness and involvement.
10. Monitor Front Range water planning and trans-basin water diversion activities, and assure local representation and participation in regional and state level water planning efforts.

Objective 2.3: Collect and make available comprehensive water quantity and stream flow information. Increase awareness of the social, ecological and economic importance of maintaining adequate flows in local streams and rivers.

The water that flows in streams and rivers in Eagle County is a community asset that is an obvious benchmark of our quality of life. Decisions by government officials and management agencies that affect water flows and the health and wellbeing of aquatic and riparian habitats are enhanced by the availability of up-to-date understandable information, and by a well informed and engaged public.

Residents, business owners and guests can easily adjust water use practices based on good information. Improved knowledge of water quantity issues is very much needed, especially in relation to current and emerging threats to desired flow regimes and the amount of water that is or will be available for domestic, agricultural, ecological and recreational uses. Significant information on water quantity exists, but is not always available in a form that is understandable and/or actionable. Water quantity information should be presented through a variety of media sources that are easily accessible and visible. Data "gaps" should be identified and remedied. Simplifying streamflow information and educating the public on the many roles and risks to local water resources is an objective strongly endorsed by this Plan.

Strategies/Actions:

1. Maintain and continue to fund a comprehensive and reliable river and stream gauging system. Provide sufficient monitoring to accurately assess flow conditions and trends in local streams and rivers.
2. Identify areas where flow data is needed but currently not collected. Target as a priority stream or river reaches that are not gauged where ecological concerns exist. Target as a second priority stream or river reaches that are not gauged that contribute significantly to recreational uses and quality of life activities.
3. Monitor water table data from existing wells, and support the drilling of new wells that would provide information regarding the condition and availability of ground water in the area.
4. Create and make available a comprehensive water quantity and supply report, similar to the *State of the Rivers Report* or the *Eagle River Assembly Report* that tracks water quantity and

water use data, trends or supply concerns in the watershed. Update this report as conditions warrant.

5. Support information systems and educational programs that effectively distribute water quantity information to citizens, guests and decision makers. Develop and/or enhance a published and web based information and education system.

Objective 2.4: Create a collaborative and transparent system of administration, oversight and decision making between government entities and affected management agencies on matters pertaining to water quantity.

The natural course of a stream does not respect jurisdictional boundaries. Historic water law and water agreements in the west are premised largely on the fact that water use in one area has legal priority (or seniority) over water rights in another area, regardless of the water decisions or management strategies that might or might not be employed at different points along the way.

In the Eagle River basin decisions that affect stream flows are made by individual service districts, consolidated service districts (authorities), town governments, county government and other major players like trans-basin diverters, ski area operators and the owners of agricultural properties. Water use in the Gore Creek Valley can impact water treatment decisions in the Town of Eagle. The administration and management of water flows and water diversions represents a complex rubric of interconnected factors and outcomes that in turn requires collaborative decision-making.

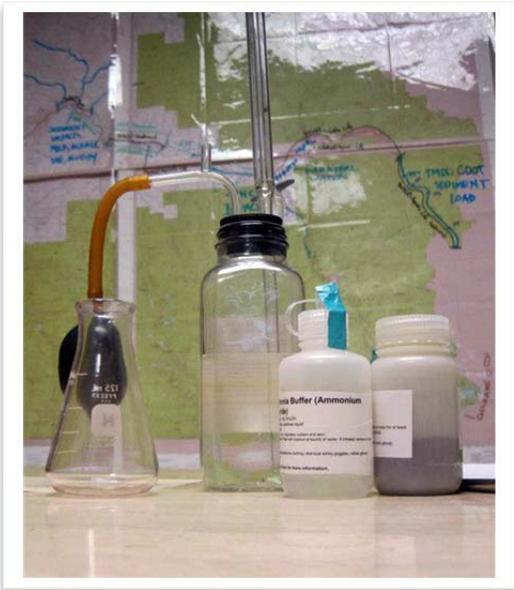
The 1994 Eagle River Assembly provides an excellent example of local and regional water interests coming together to discuss and plan for the future of stream health and water supplies. The consolidation of eight separate water providers in eastern Eagle County to form the Eagle River Water Authority in 1984 represents another noteworthy and successful effort to centralize water supply decision-making. Similar collaborative efforts are supported by the actions of this Plan, as the demands on this limited resource increase.

Strategies/Actions:

1. Assure that all master plans, management plans, operating plans, land use regulations and town ordinances utilized by governing and management entities in the Eagle River basin accurately identify water quantity concerns, and adequately

address and support the need for collaborative water quantity decision making.

2. Develop a cooperative and transparent strategy for informed decision-making between government entities and affected management agencies on matters pertaining to water quantity.
3. Provide opportunity for public input and comment on decisions that affect stream flows and the availability of water for domestic, recreational, and ecological purposes.
4. Continue to work collaboratively with Front Range water interests to insure that trans-basin water development projects are mutually beneficial and adequately mitigate social, economic, ecological and recreational impacts in the Eagle River basin.
5. Where appropriate and beneficial, encourage the consolidation of water and sewer management operations. Conversely, discourage the unnecessary creation or proliferation of new water management entities.



Name	Query Water Quality Data
CO.	Stations: USGS-09064600, USGS-09065500, USGS-09067020
GORE CREEK AT VAIL, COLORADO	Start date: 05-01-2012
MIDDLE CREEK NEAR VAIL, COLORADO	End date: 05-01-2013
GORE CREEK, LOWER MOUNTAIN VIEW, COLORADO	Search Characteristics By: <input checked="" type="radio"/> Name <input type="radio"/> Type
GORE CREEK ABOVE SANDSTONE CREEK, COLORADO	Characteristic Names: <input type="checkbox"/> Uranium-234 and/or uranium-235 and/or uranium-238 <input type="checkbox"/> Vanadium <input type="checkbox"/> Velocity - stream <input checked="" type="checkbox"/> Zinc <input checked="" type="checkbox"/> pH <input type="checkbox"/> pH, lab
RED SANDSTONE CREEK, MINTURN, CO.	Characteristic Types: <input type="checkbox"/> Biological <input type="checkbox"/> Habitat <input type="checkbox"/> Information <input type="checkbox"/> Inorganics, Major, Metals <input type="checkbox"/> Inorganics, Major, Non-metals <input type="checkbox"/> Inorganics, Minor, Metals <input type="checkbox"/> Inorganics, Minor, Non-metals
GORE CREEK NEAR MINTURN, CO.	File Format: Excel(xls)
GORE CREEK AT MINTURN, CO.	<input type="button" value="Submit"/> <input type="button" value="Cancel"/>
BEAVER CREEK AT MINTURN, CO.	
EAGLE RIVER AT MINTURN, CO.	
EAGLE R BLW WA TREATMENT PLANT, CO.	
LAKE CREEK NEAR MINTURN, CO.	
ALKALI CREEK NEAR MINTURN, CO.	
EAGLE RIVER AT PASTE, CO.	

Chapter 3

Water Quality

Eagle River Watershed

Water Quality Goal: Water in the Eagle River and its tributary streams is of the highest quality, providing excellent drinking source water and supporting healthy and self-sustaining trout populations as indicators of a healthy watershed.

Overview of Water Quality Issues and Objectives

Several water quality issues and concerns were identified and discussed during the update process:

- A variety of water quality impairments require future monitoring and restoration to minimize or mitigate impacts.
- Relevant information on the linkage between land use and water is not always available to decision makers.
- The quality of source water for municipal service needs to be protected and maintained.
- Public information and community education programs should effectively communicate water quality conditions and concerns.
- Runoff from travel corridors and growing urban areas is impacting water quality in streams and rivers.

In response to the identified issues and concerns, and in support of the Plan's vision, the following objectives were developed

1. Reduce or eliminate impacts to water quality in aquifers, rivers, streams and lakes from existing land use and future growth.
2. Manage water quality monitoring efforts to provide long-term trend assessments and identify future monitoring needs to address site-specific parameters or areas of concern.
3. Increase awareness of the social, ecological and economic importance of maintaining high quality water in local streams and rivers.

Background

Clean Water

The rivers and streams of the Eagle River watershed are highly valued for their contribution to domestic, recreational, economic, scenic and quality-of-life activities and benefits in Eagle County. While the value of clean water and viable aquatic ecosystems to local communities is generally acknowledged, the path toward conservation and/or restoration of these ecosystems often requires an adaptive management approach due to the changing nature of many water quality influences.

Water quality in the Eagle River and its tributaries generally meets or exceeds state water quality standards. Some problem areas exist, however, and are the result of both natural and human causes. Citizen commentary during public meetings in 2010 and several recent studies conducted by the USGS and the Eagle River Water and Sanitation District indicate that surface water quality and biological health degradation in local streams and rivers remain a matter of concern.¹ Water chemistry and biological samples are collected regularly by a number of water providers and other entities to monitor conditions related to water quality and biological health.

Groundwater is connected to surface waters, and has the potential to be susceptible to land use impacts and contamination. In the Eagle Valley, many groundwater sources are considered to be “young”, meaning that water which originated as snowmelt or precipitation finds its way from the stream to wells within about nine years on average.² It is therefore important to understand how surface water impacts could affect groundwater quality throughout the watershed.

This Plan identifies water quality issues as currently understood, and provides actions and strategies for responding to these issues. Protecting and improving water quality in streams and rivers across the watershed will require ongoing attention to emerging conditions and trends, and effective relationships between stakeholders to identify and execute necessary monitoring and/or remedial actions.

Key Water Quality Issues

Water quality parameters of concern in the Eagle River watershed include metals loading from historic mining activities, nutrient loading from point and non-point sources, temperature and habitat degradation due to water diversions and other hydrologic modifications, loss of riparian habitat, sediment loading from natural and man-made sources, urban runoff and road maintenance, and pesticide loading associated with lawn and tree care, weed management and agricultural practices.

Impaired or threatened stream reaches within the Eagle River watershed have been identified by the Colorado Department of Public Health and Environment (CDPHE) in accordance with Section 303(d) of the Clean Water Act. Appendix C of this Plan includes the 2012 “303(d) list” of these stream segments and the water quality impacts map displays the general location of these stream reaches. Water bodies included on the 303(d) list, referred to as “water quality limited segments”, do not meet water quality standards set by the State of Colorado.

The potential for ground water contamination in developed areas is also a concern, as is the loss of riparian area buffers. Climate change, deepening droughts and changes in the timing of spring runoff events may increasingly contribute to water quality issues in future years. As of the adoption of this Plan, no concerns have been identified regarding the quality of ground water within aquifers tapped for domestic and agricultural uses.

Metals

Persistent water quality degradation caused by metals draining from the Eagle Mine area between Red Cliff and Minturn is a primary water quality concern in the upper Eagle River watershed upstream of Edwards. Portions of the Eagle River below the Eagle Mine and lower Cross Creek are currently on the 303(d) list for zinc and copper metals impairment. Sample results for cadmium, copper and zinc concentrations frequently exceed standards in the Eagle River above Rock Creek and near Tigiwon Road from mid-March through April. This is a period when elevated zinc concentrations have historically impacted the fishery. Intermittent mid-winter runoff, mine water pipeline and containment failures, seeps and Eagle Mine Wastewater Treatment Plant spills also create peak metals loading events that can go undetected.

“The total production of all [Battle Mountain] districts from 1870 (when production began) to 1900 was \$7,884,925. In 1900, the first zinc was shipped, a sign pointing to the future when this would become the largest zinc producing area of the state.”

“[Mine owners] waited until 1900 to get the Newhouse Tunnel started. It went into the canyon wall a short distance above the railroad at Belden and directly below the Iron Mask Mine. By May 4 [of that year], it had progressed seven hundred of its intended three thousand feet.”

“The mines were getting deeper, and we find some owners complaining about having to pump water.”

(Excerpts from “Early Days on the Eagle”, Knight and Hammock, 1965)



Contaminated soils at the Eagle Mine remain exposed to weathering and erosion almost 30 years after the mine ceased operations. (Photo: Eagle County).

Lead, cadmium, arsenic, iron, zinc, copper and manganese are present in the Eagle Mine area, and are a concern to public water suppliers. Metals impact drinking water treatment processes due to their reaction with chemicals used for disinfection, such as chlorine. When metals “consume” disinfectants, the potential for public health risk is raised.

Higher concentrations of metals released from the Eagle Mine area during warm winter days or during early run off can be especially problematic to domestic treatment plant processes.

Over the objections of Eagle River basin stakeholders, revised copper and zinc standards were adopted for the Eagle River below Belden by the Colorado Water Quality Control Commission in June of 2008. As a result, water quality standards in the

EAGLE MINE IMPACTS

“Sculpin are an excellent indicator of zinc levels. They only existed above Redcliff and below Wolcott before cleanup efforts at the mine began in the 1980’s. It wasn’t until 1999 that Sculpin were found near Arrowhead in Edwards and at a sampling site above Belden. While zinc contamination still exists, mine cleanup efforts have had a positive effect downstream.”

Bill Andree, Colorado Division of
Wildlife

mine reach are now less stringent and no longer protective of rainbow trout or sculpin, and are only partially protective of brown trout.



Old wood cribbings suspended above the river will eventually fail at the Eagle Mine below Gilman (Belden Site). Concrete walls were recently constructed along the railroad tracks to reduce potential impacts. (Photo: ERWC).

Metals contamination persists in the Eagle River and continues to be a concern in the mine-affected stream reaches. In 2009, a focused feasibility study (FFS) was undertaken by CBS Operations Inc. (CBS), the responsible party for the Eagle Mine cleanup, at the direction of the US Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (CDHPE). The purpose of the FFS is to 1) develop and evaluate additional or enhanced remedial alternatives for the Eagle Mine Superfund Site to achieve compliance; 2) identify additional work needed to repair and maintain existing remedial components; and 3) develop updated Environmental Monitoring and Inspection, Operations & Maintenance Plans. At the adoption of this Plan, the FFS was still being reviewed and refined by EPA and CBS.

Mandated remediation of the Eagle Mine Superfund Site has made notable improvements to river segments below the mine as evidenced by increases in the population of brown trout and significant decreasing

trends for dissolved metals concentrations. Projects including the consolidation and capping of mine tailings (waste), and the operation of a mine waste water treatment plant near Maloit Park have all reduced metals pollution impacts to the Eagle River. Also, the shoring of unstable wood cribbing that hold back tons of metals laden waste rock in the Belden area has reduced the potential of future metals pollution from that source.



The notorious Sculpin (Photo: Bill Heicher)

Frequent water quality sampling is needed at a greater number of Eagle River monitoring locations impacted by the Eagle Mine from March through April, and during warm winter periods, to fully characterize water quality and the response of brown trout to fluctuating metals concentrations. Local groups like the Eagle River Watershed Council and service providers like the Upper Eagle Regional Water Authority continue to lobby for the implementation of additional cleanup measures at the Eagle Mine site with the hope that the newly adopted water quality standards can be achieved. Additional cleanup activities in conjunction with new development at the south end of Minturn (Battle Mountain) may also occur in the future.



Algae growing in Brush Creek is likely related to elevated nutrient levels in the stream.
(Photo: Bill Heicher)

Nutrients

Nutrient (i.e. nitrogen and phosphorus) additions to stream ecosystems can promote algal blooms, alter species composition, reduce water clarity, elevate pH, reduce dissolved oxygen concentrations, and contribute nutrient loads in streams, and include treated wastewater discharges, fertilizers and runoff from landscaped areas, stormwater discharges, on-site wastewater system discharges and eroding soils.

Nutrient concentrations are relatively low in the Eagle River upstream of the Gore Creek confluence and progressively increase to their highest levels near Wolcott and downstream to Gypsum. These changes can be attributed to inputs as Gore Creek and the Eagle River flow through the developed areas of Vail, Eagle-Vail, Avon, and Edwards, receiving inflows from storm runoff and tributary watersheds.³

Natural bank and hill-slope erosion can also result in significant phosphorous loading to the stream. Much of the erosion that impacts lower elevation Eagle River segments originates from the Milk, Alkali and

Ute Creek drainages.⁴ This is an important consideration when evaluating elevated nutrient concentrations in the lower Eagle River watershed.

Temperature

Water temperature is a critical ecological factor that is linked to many variables in a watershed. During late summer afternoon stream temperatures can be elevated in the Middle and Lower Eagle River, especially downstream of Edwards. Temperatures naturally increase during this period as a result of direct solar radiation, warm air temperatures, diminished water volumes and slower water velocities.

The duration of elevated temperatures, when combined with other water quality factors such as metals loading and recreational impacts like catch-and-release fishing, can increase the susceptibility of fish to diseases such as furunculosis; large brown trout being especially vulnerable.⁵ In the 1990's, several fish kills were recorded on the Eagle River between Edwards and Gypsum in part because of high water temperatures.⁶ Temperature is directly related to the solubility of oxygen in water, and higher temperatures can reduce the oxygen available for fish. Generally speaking, temperatures above 24 degrees Celsius (75 degrees Fahrenheit) are considered stressful for trout.⁷

The maintenance, protection and enhancement of riparian zones is a recommended action of this Plan to increase shade and reduce impacts from warm temperatures, particularly in the Lower Eagle.

Temperature °C (°F)	Saturated Dissolved Oxygen (ppm)
0 (32)	14.62
5 (41)	12.80
10 (50)	11.33
15 (59)	10.15
25 (77)	8.38
30 (86)	7.63

Table 4: Solubility of oxygen as a function of water temperature (Source: CSU, 2005).

Sediment

Sediment can enter streams and rivers by way of both natural and man-made sources. The Milk, Alkali and Ute Creek drainages (see Water Quality Impacts Map) in the Lower Eagle consist of poorly vegetated and highly erodible shales and clays. These drainages are estimated to contribute 2,600 tons of salts (including phosphorous) through natural sediment deposition to the Eagle River each year.⁸

Man-made sources include soil erosion from drainage features, agricultural lands, ski areas, resource extraction and construction sites, and wintertime road sanding. Excessive sedimentation degrades the quality of aquatic habitat.

Annual winter maintenance of I-70 requires the application of between 6,000 and 30,000 tons of traction sand to provide safe travel conditions between the Town of Vail and the top of Vail Pass.⁹ Much of this traction sand is carried downslope and into valley-bottom streams and wetlands by snowmelt and storm runoff. This sediment is either deposited in thick layers within riparian zones or it winds up at the bottom of slow-moving pools in the stream.

Black Gore Creek has persistent problems related to traction sand, failing culverts, accelerated erosion and maintenance activities along Interstate 70 on Vail Pass. Sediment loading has resulted in detrimental changes to habitats that support aquatic macroinvertebrate (insect) communities, smothered streamside vegetation, and system-wide channel changes in Black Gore Creek.¹⁰ There is increasing concern that sediment impacts could soon migrate into the main Gore Creek channel.

In 2002, the Colorado Water Quality Control Commission added Black Gore Creek to the State's list of impaired waters for sediment. That same year, the Colorado Department of Transportation (CDOT) developed a Sediment Control Action Plan (SCAP) for Black Gore Creek. The SCAP is a planning document that includes relevant background information, an evaluation of I-70 sediment sources, volume estimates, hydraulic/drainage analysis, and maintenance practices to develop a source control strategy.

Absent adequate funding, the SCAP has only been implemented partially and opportunistically as CDOT, the Eagle River Watershed Council, the Town of Vail, the Eagle River Water and Sanitation District and others have allocated money and obtained grants. Progress has been made. Since 2003, and in cooperation with the Town of Vail and the U.S. Forest Service, the Eagle River Watershed Council has coordinated annual streambed sediment and macroinvertebrate monitoring and reporting of Black Gore Creek conditions. According to the 2005 *Eagle River Inventory and Assessment*, over \$4 million had been invested at that time in sediment remediation projects.

Even if the SCAP were fully funded and implemented, it does not address the 20+ years of sediment that has accumulated in the valley bottom. Those sediments, if not addressed, will continue to flush downstream. As a critical task for measuring the progress of Black Gore Creek toward attainment of sediment reduction goals and water quality standard

attainment, sediment control efforts and monitoring should continue indefinitely.



Sediment control structures like these installed on I-70 above Black Gore Creek include an underground vault that traps sand. Using special equipment, CDOT crews periodically vacuum these vaults, preventing sand from reaching the stream. (Photo: ERWC).

Pesticides

For the purposes of this Plan, the term “pesticide” refers to herbicides, fungicides, and insecticides. Concern is growing regarding the widespread use of these chemical agents to control weeds, protect against the Mountain Pine Beetle, Spruce Bud Worm, Pine Needle Scale, and Aspen Scale, and to control the growth of aquatic vegetation and algae in lakes and ponds. Inappropriate application of pesticides by homeowners, landscapers, municipalities, and businesses in areas adjacent to streams and rivers can lead to their transport (via wind drift, leaf litter, improper disposal of cuttings and runoff) into local waterways.

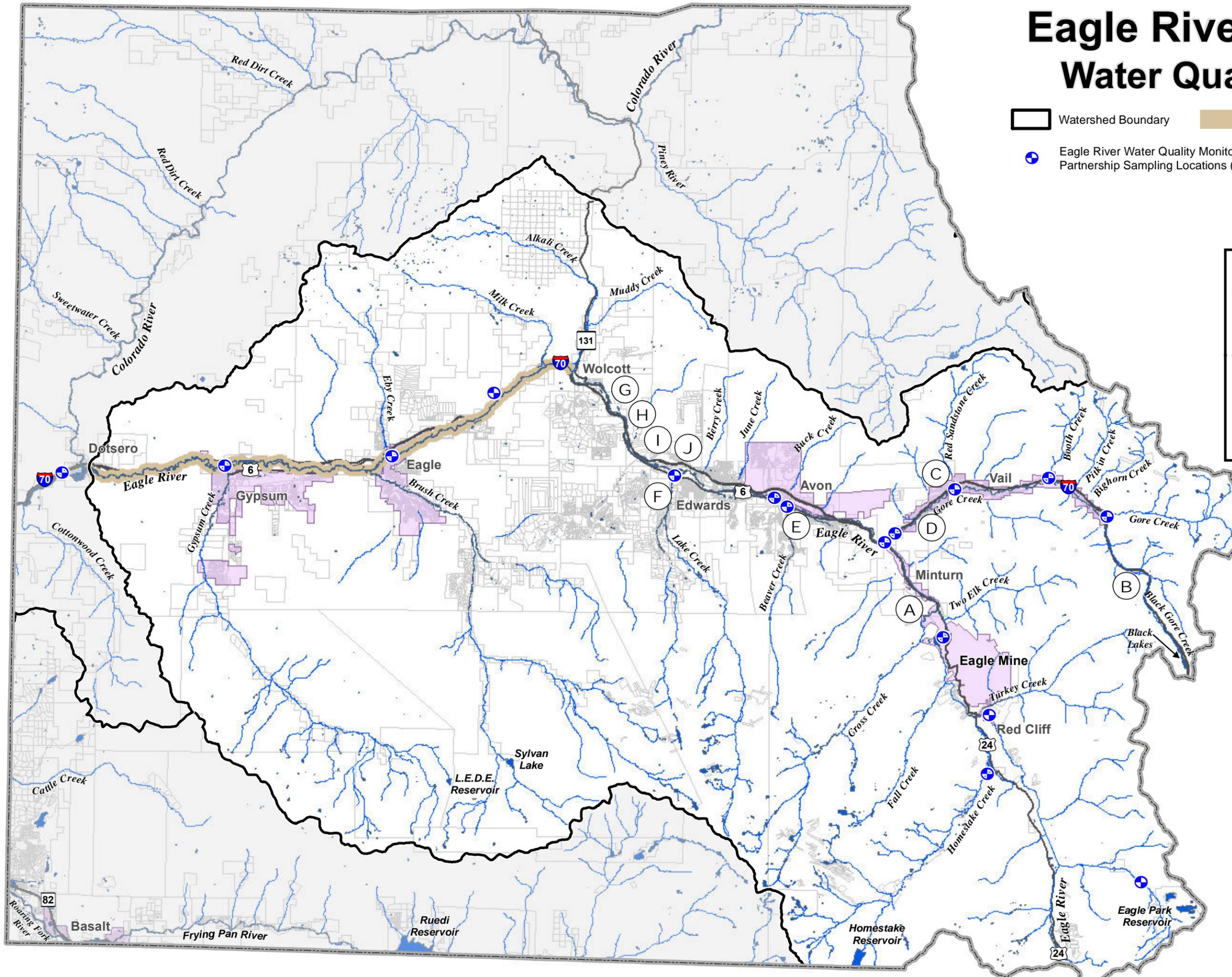
Eagle River Watershed Water Quality Impacts

-  Watershed Boundary
-  Natural Sediment Impact
-  Town Boundary
-  Eagle River Water Quality Monitoring Partnership Sampling Locations (Approximate)
-  Major Road

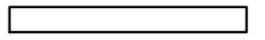
Impaired Segments

River and stream segments listed as "impaired" or identified by the State for "monitoring and evaluation" in accordance with Section 303 (d) of the Clean Water Act. For additional detail please see Appendix D

- A Eagle River, Eagle River Mine influence
- B Black Gore Creek
- C Lower Red Sandstone Creek
- D Gore Creek, main stem
- E Lower Beaver Creek
- F Lake Creek, main stem
- G, H, I & J Eagle River, Gore Creek to Rube Creek



5



Miles

This map was created by the Eagle County GIS Department. Use of this map should be for general purpose only. Eagle County does not warrant the accuracy of the data contained herein.



Many of these pesticides are highly toxic, and it is likely that they have a detrimental effect on macroinvertebrate communities in aquatic environments. Management of the use of pesticides is especially important in urban and residential developments like those along Gore Creek, where riparian areas have been compromised and landscaping activities occur immediately adjacent to the stream. These concerns may highlight the need for a comprehensive integrated pesticide use management plan for the watershed.

Contaminants of Emerging Concern (CECs)

Minor amounts of residual pharmaceutical products, personal care products and other household chemicals are now being detected in Colorado streams and rivers, and are emerging as a concern due to the potential risk of harm posed to human health and the environment. Studies have shown that these contaminants can accumulate in organic matter in streambeds and that they have the potential to disrupt endocrine (hormonal) levels in fish.¹¹ In 2006, a team from CU Boulder conducted a study on brown trout exposed to Vail Wastewater Treatment Facility effluent. The study concluded that at that time there were no impacts associated with endocrine disrupting compounds in Gore Creek.

The EPA is working to better understand the potential impacts of CECs. Given expectations for future growth, periodic monitoring of emerging contaminants downstream from wastewater treatment facilities in the Eagle River basin is warranted.

Aquatic Life Degradation

The State of Colorado has recently developed a multi-metric index (MMI) bio-assessment tool designed to detect the presence of environmental stress based on the biologic condition of aquatic macroinvertebrate communities. MMI scores, and results from other relevant studies performed in the Eagle River watershed, indicate that biological health conditions of Gore Creek and portions of the Eagle River are stressed or impaired as a result of habitat degradation and diminished water quality (Appendix C provides a listing of local stream segments with aquatic life use impairment).

In response to these findings, a Gore Creek Water Quality Improvement Plan (WQIP) is being developed. The WQIP will be designed to guide the planning and implementation of measures to reduce contaminants and improve water quality as indicated by macroinvertebrate community metrics. Gore Creek was selected as a model watershed to implement this first phase planning effort because of its highly valued recreation and

aesthetic contributions and its designation as Gold Medal fishing from Red Sandstone Creek to the Eagle River. This Plan recommends developing water quality improvement plans elsewhere in the watershed where biological health is found to be impaired, stressed, and/or degraded (please see the *Water Quality Management* section for details).

Surface and Ground Water Quality Monitoring

Numerous entities collect water quality data in the Eagle River watershed. In 2012, the USGS, USFS, CDOT, CDPHE, Eagle River Water and Sanitation District, Upper Eagle Regional Water Authority, Eagle Park Reservoir Company, Town of Vail, Eagle River Watershed Council, Adam's Rib Ranch, Town of Gypsum, CBS, several golf courses, and the Eagle River Watershed Monitoring and Assessment Program partners actively collected water quality and biological data from sites across the watershed.



Many community members volunteer their time to monitor water quality conditions, such as these Riverwatch testers (Photo: ERWC).

In total, this monitoring network has created an excellent baseline for water quality monitoring and trends assessments. However, data

collection schedules and methods frequently vary between entities and create barriers for direct data comparisons. This Plan recommends a central coordinating program to ensure all monitoring efforts are coordinated and cost effective.

Water quality data collection programs could be expanded to include additional measurement locations and several real-time water-quality monitoring stations. Additional sites are needed on several tributary streams where impacts are occurring or are anticipated. High frequency or real-time monitoring of water quality characteristics will greatly assist efforts to link observed water quality conditions to stressors that are difficult to characterize when sampling is infrequent (e.g. water quality impact from stormwater discharges). Sampling in groundwater recharge areas that are vulnerable to surface activity and contamination, using existing wells, also provides valuable data to local agencies.

Collection of water quality data at a greater number of sites across the watershed will provide an opportunity to "zero-in" on problem areas. The selection of additional monitoring sites should be guided by a thorough assessment of data gaps, by specific questions regarding the source of an observed impairment, and/or by a long-term monitoring plan.

Surface and Ground Water Quality Management

Eagle County and local communities would benefit from the development of water quality improvement plans, like the one proposed for Gore Creek, to address land use effects on water quality impairment within their jurisdictional boundaries. This action could involve the creation of a model stormwater management plan that each community customizes to meet localized issues.

Water Quality Improvement Plans can identify specific measures and strategies to reduce point and nonpoint source pollution, including but not limited to the following:

- Implementation of stormwater and urban drainage Best Management Practices (BMPs);
- Stream habitat and riparian improvement and protection projects;
- Community educational programs;
- Infrastructure maintenance programs;
- Ongoing monitoring and data collection plans to support improvements and refinements to the WQIP;
- Ongoing monitoring to evaluate effectiveness of water quality improvement efforts;
- Institutional arrangements for program implementation; and
- Identification of funding sources for program implementation.

The development of WQIP's where necessary is consistent with recommendations of this Plan, the *2005 Eagle River Inventory and Assessment* and the *2002 NWCCOG Regional Water Quality Management Plan*.

Public Education

The public should be informed about water quality issues in the watershed, how different land use practices impact water quality, and what individuals can do to protect or enhance water quality. Maintenance of public support for water quality data collection efforts requires frequent and effective communication with community members. Outreach should make water quality conditions and trends relevant and interesting to a non-technical audience. Information should be available and accessible to property owners, business owners, service providers, land managers, and elected and appointed officials.

The Eagle River Watershed Council (ERWC) currently hosts monthly, televised *Water Wise Wednesday* events at locations throughout the watershed. These events serve to provide the public with water-related education through presentations from local and regional experts. Other public education approaches that should be considered include a periodic newspaper column series that highlights water education topics, and TV spots, brochures in hotel rooms, periodic presentations to decision makers, etc.

Water Quality Goal: Water in the Eagle River and its tributary streams is of the highest quality, providing excellent drinking source water and supporting healthy ecosystems and self-sustaining trout populations as indicators of a healthy watershed.

Water Quality Objectives, Strategies and Actions (items not listed in order of importance or priority)

Objective 3.1: Reduce or eliminate impacts to water quality in aquifers, rivers, streams and lakes from existing land use and future growth.

Current and historic activities and disturbances, urban growth and other land uses associated with Eagle County's tourism-based economy have

significantly impacted water quality in the watershed. The close proximity of roadways and developed areas to streams and rivers compounds water quality impacts. Urban and suburban development increases impervious surfaces and the amount of pollutants delivered to water bodies through stormwater runoff. Riparian disturbances from road and utility crossings and building encroachments diminish the ability of natural systems to slow and treat urban runoff. Over time, these changes collectively cause stress to river ecosystems.

Strategies/Actions:

1. Agency mandated restoration projects like those on Black Gore Creek or the Eagle Mine reach of the Eagle River should be supported and carefully monitored to ensure they achieve water quality goals.
2. As opportunities arise, amend applicable regulations, codes, policies and/or guidelines to assure parks, landscaped areas and open spaces are designed and positioned to protect riparian areas and to provide opportunities for passive and/or active treatment of urban runoff.
3. Draft and implement a watershed strategy to manage, protect and restore riparian corridors and natural buffer areas as growth occurs. Enforce adequate setbacks from streams, wetlands and riparian habitats within which disturbances should be minimized. Support efforts to develop and incorporate model standards for the protection of stream and river corridors in the Eagle River watershed.
4. Inventory and promote the reintroduction of vegetative buffers, and the retrofit installation of adequate urban runoff and stormwater control facilities within community centers and along major roadways. Assure adequate maintenance of buffer zones and drainage facilities, and regularly monitor short term and long-term erosion and runoff control measures for effectiveness.
5. Work with CDOT, Eagle County officials and metropolitan district workers to implement road maintenance and snow storage activities that minimize impacts to water quality.
6. Inventory and evaluate existing industrial, manufacturing and resource extraction sites for opportunities to improve stormwater management. Similarly, evaluate large parking lots and outdoor storage areas.
7. As opportunities arise, amend applicable regulations, codes, policies and/or guidelines to assure adequate drainage and

stormwater treatment for all development proposals and transportation corridor designs. Incorporate the following approaches:

- In those areas where riparian zones are narrow or steep, engineered structures should be utilized to remove petroleum products, sediment and other contaminants.
 - Where riparian areas have buffering capacity, they should be protected, and should be utilized in combination with engineering solutions to treat storm water discharges.
 - Plans should address life cycle costs and responsibilities for maintaining stormwater treatment features and facilities in perpetuity.
8. Promote compatible land use practices and management activities on municipal, county, state and federal lands to protect and enhance water resources. Adjust and/or refine regulatory tools to minimize impacts from both dispersed and developed recreational activities and sites. Also, develop regulatory tools in advance of possible oil and gas exploration within the Eagle River and Colorado River watersheds.
 9. Maximize the dilution of watershed contaminants by maintaining adequate flows in streams and rivers. Where individual reaches of rivers or streams are identified as impaired or having inadequate flows, craft and implement Streamflow Management Plans (Please see Chapter 2 for more detail).
 10. Support efforts by CDOT and local stakeholder groups to improve and protect water quality in Black Gore Creek on the west side of Vail Pass.
 11. Identify, support and implement effective pollution reduction strategies for streams and river segments impacted by the Eagle Mine. Work with the Town of Minturn to devise and enforce additional Eagle Mine clean up measures concurrent to the development of the Battle Mountain project. Continue to stress the need for additional cleanup measures and improved operation and maintenance to the EPA, CDPHE and CBS.
 12. Avoid the alteration of river or stream channels except in those instances where work is required for channel stabilization, aquatic habitat improvement, recreation access improvements or irrigation structures. Strategically program and coordinate any in-channel activities to minimize impacts on water quality.
 13. Avoid new road or trail alignments that encroach unnecessarily on riparian areas. Where roads must span streams and rivers, provide

- an alignment perpendicular to the flow path to minimize disturbances.
14. Avoid placing underground utilities in riparian areas or flood plains. Where utilities must cross streams and rivers, provide an alignment perpendicular to the flow path to minimize disturbances. Support maintenance procedures designed to identify and repair leaks in sanitary sewer lines.
 15. Direct new development to areas that can be served by domestic water and wastewater systems, and avoid the proliferation of onsite wastewater treatment systems (OWTS). Where OWTS are necessary, incorporate best installation, maintenance and monitoring technologies.
 16. Assure recreational river access points are designed, located and maintained to minimize erosion and stream bank degradation.
 17. Support service plan amendments and/or wastewater treatment plant improvements designed to maintain or enhance water quality in local streams and rivers.
 18. Draft and Implement a watershed strategy for addressing nutrient enrichment in areas where reductions would be beneficial to support water quality standards and improve aesthetics.
 19. Support the development of source water protection plans within the watershed, and implement identified best management practices.
 20. Draft and implement comprehensive water quality improvement plans, as described in this plan, where biological health is found to be impaired, stressed, and/or degraded.
 21. Develop comprehensive pesticide management plans for urbanized stream and river corridor areas.

OBJECTIVE 3.2: Manage water quality monitoring efforts to provide long-term trend assessments and focus any future monitoring efforts on site-specific parameters or areas of concern.

Maintaining water quality monitoring programs requires a coordinated effort in the watershed, and should continue to be supported by local partners and stakeholders. Creating long-term actions that support and

broaden the scope of water quality monitoring and data collection efforts will have a positive impact on decisions that affect water quality.

Strategies/Actions:

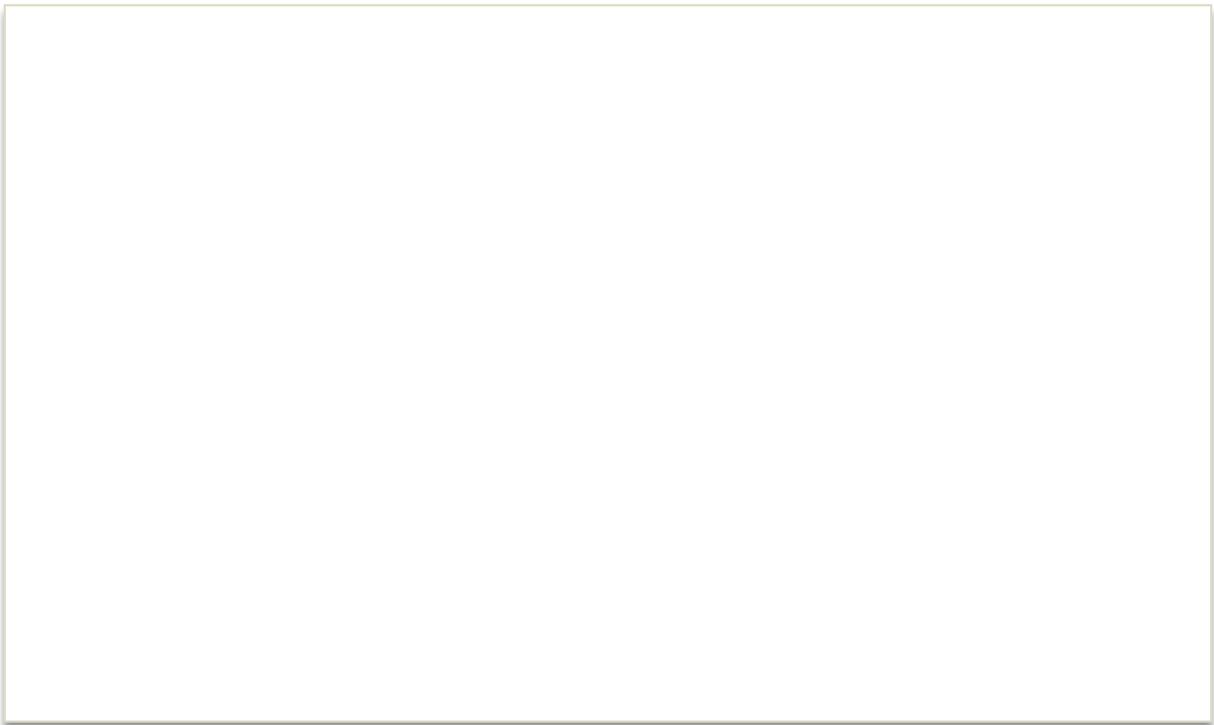
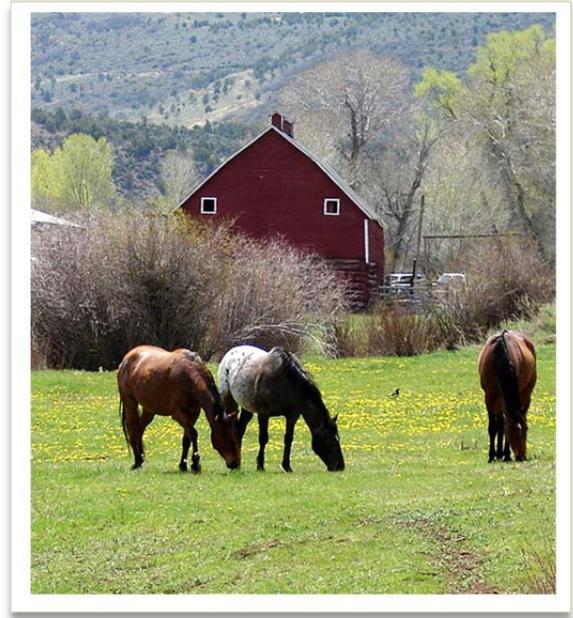
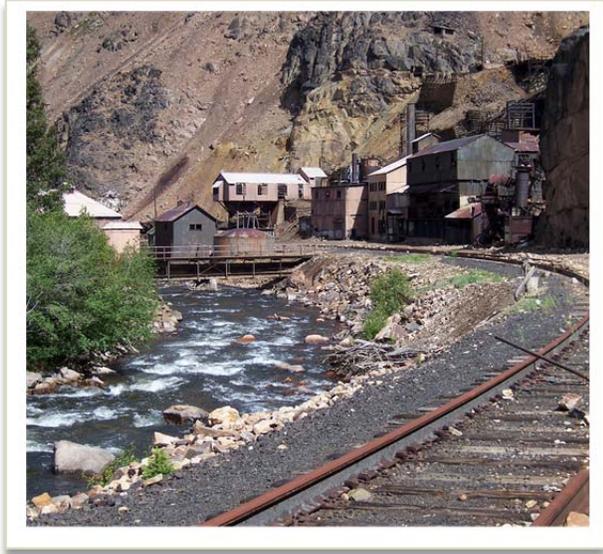
1. Focus water quality data collection efforts with greater frequency at a greater number of sites (including groundwater sampling) based on trends or parameters of concern. Include tributaries where development or disturbances may be impacting water quality.
2. Expand the Eagle River Watershed Monitoring and Assessment Program (ERWMAP) to coordinate monitoring and assessment activities, provide timely data interpretation and technical assistance to stakeholders, identify data gaps, and suggest actions to remedy identified impairments.
3. Utilize the monitoring framework provided by the National Water Quality Monitoring Council to develop a long-term monitoring plan and guide water quality data collection.
4. Support and participate in the work of agencies and organizations that monitor water quality in streams, rivers and ground-water aquifers. Assure conformance with applicable provisions of NWCCOG Regional Water Quality Management Plan (Section 208 of the Clean Water Act).
5. Increase the frequency of water quality monitoring on the Eagle River at and below the Eagle Mine Site during spring runoff and perform additional monitoring checks during occasional warm winter periods to capture all possible metals loading events.
6. Establish a reporting system that frequently transmits water quality conditions and trends to planners and policy makers at the district, municipal, county, and regional levels. Streamline data collection efforts where practical, minimize redundancy, and ensure that data is properly documented to reduce the risk of misinterpretation. Provide public access to local water quality data.
7. Support/develop remedial actions and programs to improve water quality and biological health conditions on stream and river sections listed as impaired by the State of Colorado. Monitor water quality for the presence of/ impacts from emerging contaminants as warranted.

OBJECTIVE 3.3: Increase awareness of the social, ecological and economic importance of maintaining high quality water in local streams and rivers.

Water quality trends are important to local decision makers and citizens. Communicating this information to residents and guests to foster public support for watershed health is a constant challenge that requires active participation by interest groups, management agencies and local governments.

Strategies/Actions:

1. Improve collaboration, documentation, and information sharing practices between stakeholders to streamline data collection efforts where practical, minimize redundancy, and ensure that data is properly documented to reduce the risk of misinterpretation.
2. Encourage development of source water protection plans for each water provider, generally following the State of Colorado's Source Water Assessment and Protection (SWAP) program approach
3. Support technical information sharing programs that report water quality conditions and trends to planners and policy makers at the district, municipal, county, and regional levels.
4. Use resource inventory, trend analysis and restoration plans to implement restoration, conservation and enhancement projects that benefit water quality and increase public awareness of the importance of healthy rivers and streams.
5. Develop and fund public information systems that utilize numerous media sources to maintain and enhance public awareness regarding water quality issues. Include reports that link specific economic and environmental benefits derived from the maintenance of good water quality (treatment costs, business opportunities, healthy wildlife, etc.)
6. Support and encourage curriculum programming in local schools and at Colorado Mountain College that enhance understanding of local water quality issues.
7. Support the efforts of special interest groups and government agencies to provide frequent river and stream related activities, volunteer opportunities and educational sessions.



Chapter 4

Land Use

Eagle River Watershed

Land Use Goal: Land uses in Eagle County are located, designed, occupied and operated in a manner that minimizes impacts to water quality and water quantity in the Eagle River and its tributary streams.

Overview of Land Use Issues and Objectives

Several land use issues and concerns were identified and discussed during the planning process:

- The possibility of approving more development than the water supply can accommodate, even with in-basin water storage.
- A lack of consistent management and monitoring approaches to treat urban runoff.
- Continued development encroachments on riparian buffers and wetlands.
- Lack of uniform strategies to protect open space near and within developed areas to protect water quality and riparian buffers.
- Lack of uniform strategies to preserve and protect undeveloped community buffers that contain streams, rivers and riparian zones.
- The need for increased coordination and planning between governments and agencies to address watershed issues.

In response to the identified issues and concerns, and in support of the goals for the Plan, the following objectives were developed:

1. Promote land use patterns and site design practices that maximize opportunities for protection and enhancement of water resources.
2. Minimize or mitigate impacts to water resources from historic disturbances and existing developed areas.
3. Avoid, minimize or mitigate impacts to water resources from future land development, including transportation and infrastructure improvements.

4. Integrate recommended actions for water quantity, water quality, recreation, wildlife and education design standards specifically expressed by this plan into other master plans, land use policies and regulations throughout the watershed.

Background

Historic Land Use Patterns and Population Growth

Beginning in the late 1800's, successful mining and agricultural operations resulted in the growth of small towns in Eagle County. Redcliff, Gilman, Minturn, Wolcott and Eagle were the area's first communities. Growth was slow to non-existent for decades, until ski area development and the construction of I-70 put Eagle County on the map as a recreational destination of international renown in the 1970's. Explosive land development followed, with new towns and housing developments rapidly filling areas once home to open meadows and grazing sheep. This was especially true in eastern portions of the County. The Town of Vail soon filled the Gore Creek Valley, Avon incorporated, and the communities of Beaver Creek and Edwards were born.

Development pressure and high real estate values pushed affordable residential housing west, resulting in significant growth in the towns of Eagle and Gypsum. In the decade from 1990 to 2000, Eagle County's population grew from 21,928 to 41,659 permanent residents, representing an almost 50 percent increase. The 2010 census reported a population of 52,197, with the majority living along the Eagle River and major tributaries like Gore, Lake, Brush and Gypsum Creeks.

In many ways, Eagle County along Gore Creek and the Eagle River from Vail to Gypsum has become an urbanized corridor. Agricultural properties continue to shrink between growing nodes of community activity. Towns, neighborhoods and industrial sites in Eagle County have been developed in close proximity to streams and rivers, which intensifies the effects of development on water quality. Limited developable land has resulted in uncommonly high property values in resort communities like Vail and Avon, which has resulted in significant pressure to develop within sensitive riparian areas.

Agricultural or ranching lands along the Eagle River and its tributaries remain at risk of development, although the pressure is less now than it was during the explosive population growth of the 1990's. Preserving undeveloped and agricultural lands that still serve as "community buffers" is increasingly seen as a strategy that can help protect natural resources and maintain many of the area's quality of life attributes.

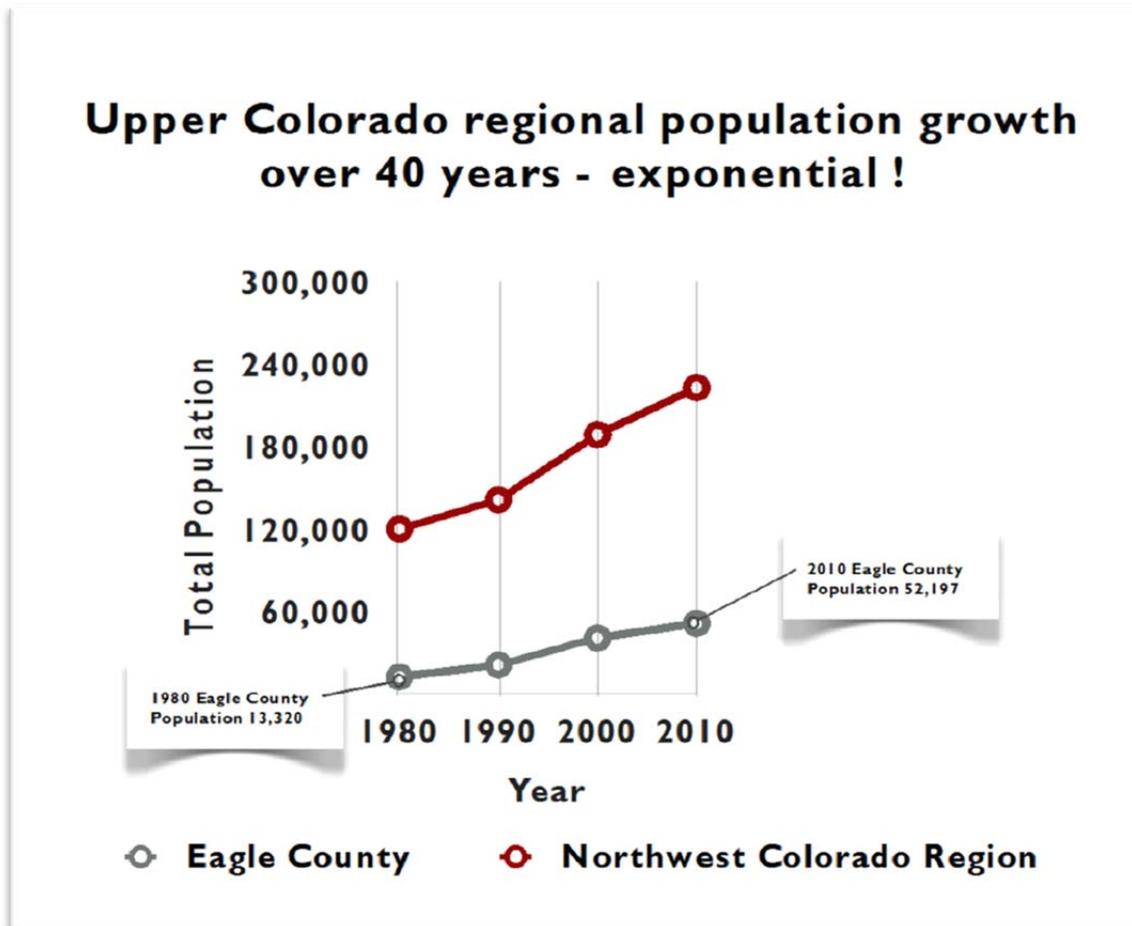


Figure 5: Eagle County lead the region in population growth for well over a decade, dramatically affecting the land use pattern of the area (Source: Land Planning Collaborative).

Perceptions, Expectations and Water Use

People can have unrealistic expectations of water availability in an arid mountain environment where streamflows are derived largely from mountain snowpack. In Eagle County, water features and riparian areas are prominent elements in iconic viewsheds. Irrigated ranch lands in the valley floors are typically lush and green. Golf courses are common, and high quality water is readily available in most areas through a modern infrastructure delivery system. Local lifestyles depend on the availability of significant quantities of water for skiing, golfing, rafting and fishing. All of this gives the impression of a relatively wet climate.

The reality is that most of Eagle County is classified as semiarid, with an average annual precipitation of 22.40 inches in Vail, and 10.88 inches in Gypsum. Without ample winter snows, streams and rivers can quickly shrink

during warm summer months to levels that are highly susceptible to impacts from temperature, foreign contaminants and recreational activities. This greatly increases the potential for stress on the area's coldwater aquatic environments. In 2002, winter precipitation provided only 60% of the normal snowpack. Water use was curtailed that summer and fishing restrictions were imposed. The 2012 winter season was even worse, with reported snowpack levels ranging between 7% and 15% at the end of May.

The perception that there is ample water in Eagle County can result in liberal attitudes toward water use by both full and part-time residents. For example, large amounts of water are often devoted to maintaining non-native ornamental plants and/or expansive bluegrass lawns in residential neighborhoods where xeric approaches would be more appropriate. This is especially true at drier elevations within the watershed.

People also expect the river environments that they experience in a place like Eagle County to be resilient to development pressure, fluctuations in precipitation patterns and changes in the landscape. Understanding the fragile nature and susceptibility of local water systems to natural and man-made influences is critical as local governments and service providers attempt to accommodate additional growth in the face of probable climate change impacts.

Impacts of Land Use on the Watershed

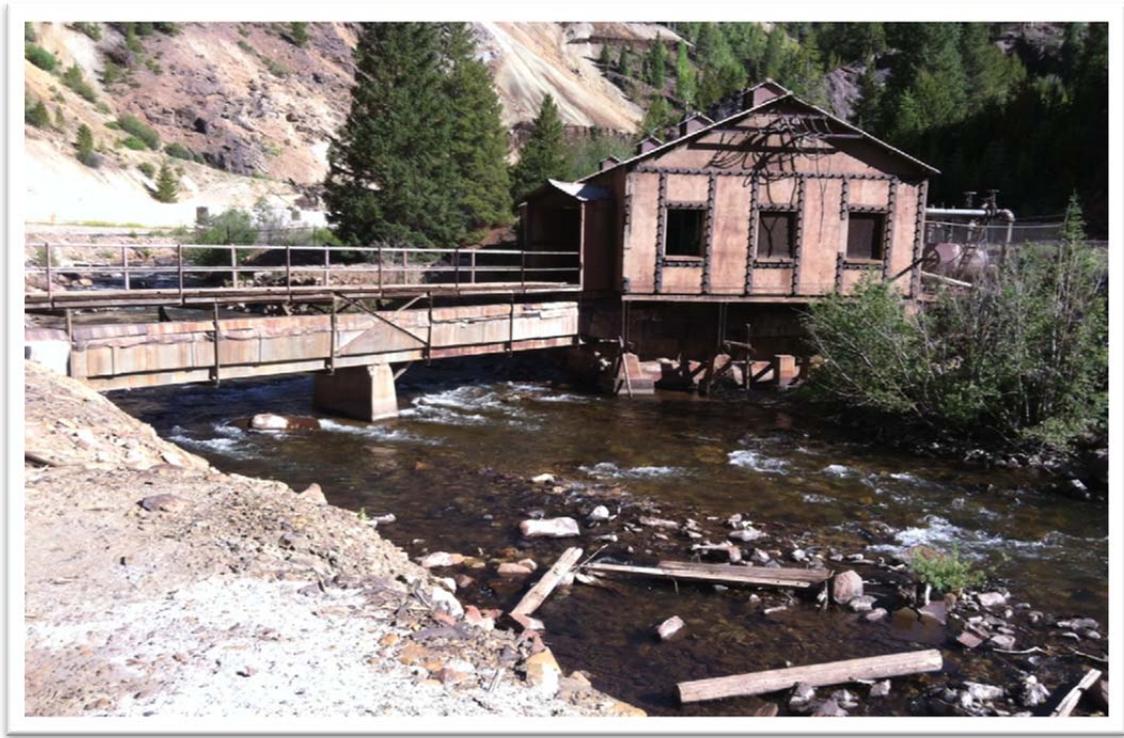
Land use development patterns are major determinants of the overall health and condition of the Eagle River watershed. Lands that are not appropriately buffered from drainage features or streams have degraded the quality of the watershed through additions of chemical, inorganic and organic substances from direct sources such as mines, and indirect sources such as urban run-off.

Agriculture has a long history in Eagle County, and associated land uses can impact riparian and aquatic habitats in a number of ways. Given the great deal of water that is required to cover pastures and fields in the traditional style of flood irrigation, agricultural diversions can severely deplete a stream or river below the diversion point. A significant amount of this water can find its way to ground water aquifers, which can have a positive effect in the late summer when it seeps back into streams, enhancing low flows.

Agricultural operations are in large part exempt from local land use regulations, and it is not uncommon for travel routes, structures, corrals and work areas on ranches to be located in close proximity to riparian habitats. Streams are typically not fenced, and livestock can directly

damage wetland and riparian areas increasing the potential for bank erosion and sediment in the stream.

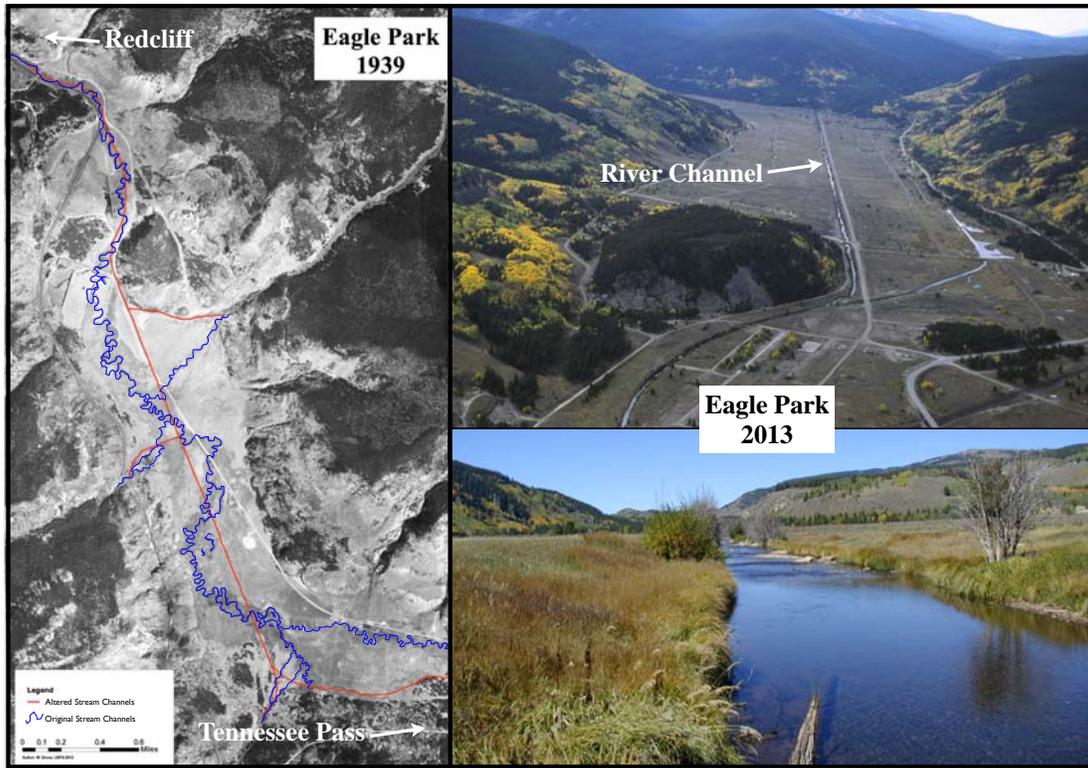
The Eagle Mine at Gilman is one example of a land use that has forever lowered the water quality of a large reach of the Eagle River. In another example, the channelization of the Upper Eagle through the Pando area



Ground disturbance, mine seepage and abandoned mine workings at Belden (below the Eagle Mine at Gilman) have greatly impacted the Eagle River (Photo: ERWC).

as a result of the construction of the 10th Mountain Division's Camp Hale training facility significantly impacted riparian habitats and the productivity of the fishery on that reach of the river. Industrial uses, mining uses and activities that repeatedly disturb significant areas of land or that modify natural drainage features are considered incompatible with efforts to maintain rivers and streams in a sustainable healthy condition.

Commercial and residential land use results in direct impacts to aquatic ecosystems as well as riparian areas. Town centers are typically located in river bottom areas where they can be best served by utilities and transportation improvements. Housing developments frequently end up directly adjacent to riparian areas, often with inadequate buffers or setbacks from these sensitive lands. The desire by property owners for improved views and/or better access to the water often results in "landscape improvements" that can significantly diminish the functionality of streamside habitats.



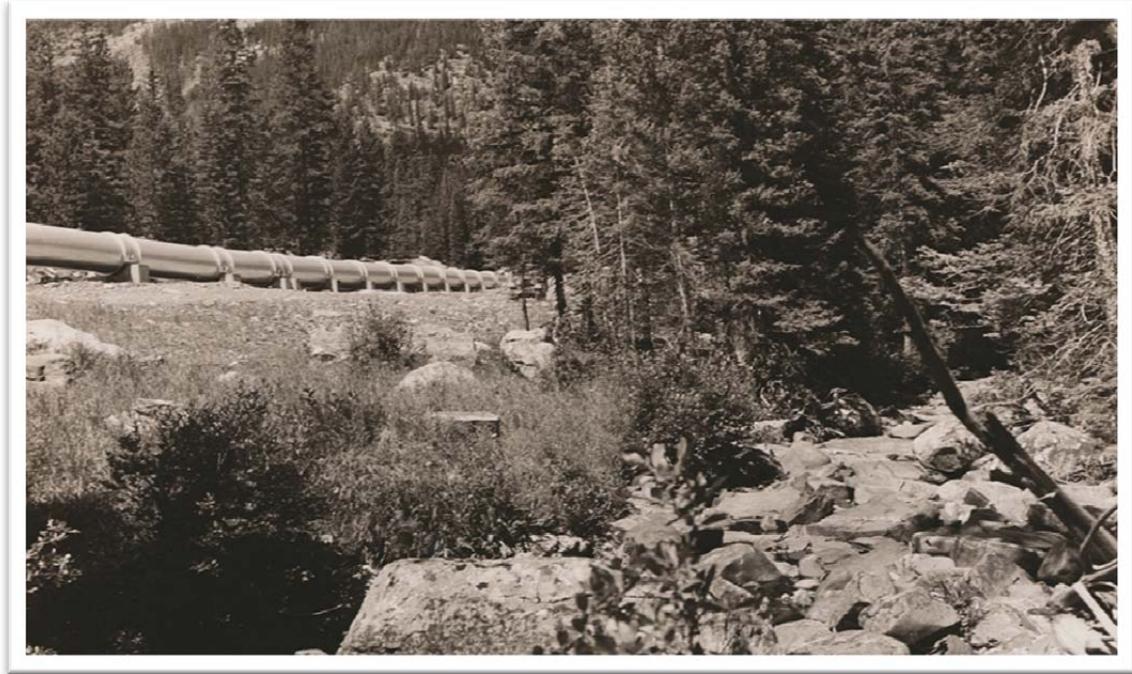
Eagle Park, the site of Camp Hale, before and after the dramatic straightening of the Eagle River. The picture on photo on the left, pre-Camp Hale construction, shows where the natural stream course (blue line) was altered and put into a drainage ditch (red line) to drain wetlands and make way for the training facility. (Source: USFS/ERWC).

Development introduces impervious surfaces in the form of roads, trails, parking lots and rooftops. Over 35 miles of the travel lanes for I-70 and US Highway 6 west of Dowd Junction lie with 600 feet of the Eagle River. Another 22 miles of I-70 and its frontage roads are similarly close to Gore Creek and Black Gore Creek through Vail and over Vail Pass. Parking lots associated with retail centers and multifamily structures are frequently located near streams and rivers. Storm water rapidly drains from these surfaces, carrying a variety of pollutants into local waterways.

Water diverted for municipal uses is returned in varying quantities and in varying conditions to the channel of origin, in most instances resulting in lower water quality. Flows are diminished between diversion points and return points. In Eagle County, winter tourism can result in significant quantities of water being diverted as clean water and returned as treated wastewater at a time when stream flows are very low.

Water is also diverted out of the basin to serve land uses in other parts of the state. These diversions normally take place during the spring and

summer. As evidenced by operations associated with the Homestake Reservoir, entire streams can be dried up by trans-basin diversion projects.



Taken in the early 1970's near Homestake Reservoir, this photo shows a dry streambed adjacent to one of the many diversion pipes that convey water that has been diverted from streams in the area. (Photo: Peter Runyon)

Manufacturing plants and gravel pits are often located on valley floors in proximity to major transportation routes and resource deposits. These uses, as well as other uses that introduce sediment or pollutants in stormwater runoff can increase the potential for significant damage to riparian areas and water quality in rivers and streams. Other development impacts include, but are not limited to:

- Degraded water quality from agricultural, non-point and urban runoff.
- The removal of wetlands and riparian buffer zones that help clean storm runoff.
- Diminished historical natural peak flushing flows as a result of increased trans-mountain diversions, in-basin storage and early season irrigation diversions.
- Increases in nutrients to the river as a result of stormwater runoff and domestic wastewater discharges.

- Diminished recharge of ground water as a result of fewer irrigated pastures and increased impervious surfaces like parking lots and roads.
- Increased use of the river and riparian resources for recreation activities, often resulting in trampled vegetation, litter, lack of solitude and wildlife disturbances.

A development pattern of suburban type growth with scattered retail locations and sprawling single-family homes on larger lots is strongly discouraged by this plan. Conversely, the consolidation of development and services into efficiently designed community centers that both integrate and protect buffer zones and sensitive lands along rivers and streams is strongly encouraged. The inclusion of parks and natural open space areas within communities and the preservation of undeveloped expanses of land in between community centers will be essential to efforts to preserve and protect water resources as the County continues to grow.

Impacts of a Resort Economy on the Watershed

The activities and seasonal fluctuations in population that result from a resort economy like that found in Eagle County can have a dramatic effect on water resources. As example, golf is popular at mountain resorts, and the eleven golf courses in Eagle County remain busy during summer months. Significant quantities of water are used to maintain fairways and greens. The use of highly efficient irrigation systems represents a change from the historic flood irrigation practices employed on many of these same lands, resulting in the loss of late season releases of stored ground water to the stream and river system. Other recreational activities like hunting, mountain biking, fishing, rafting, trail running and camping tend to increase in areas where popular year-round resorts exist, which can result in increased impacts to water resources.

Man-made snow is increasingly critical to the profitability (and durability) of the ski season, and both Vail and Beaver Creek draw tens of thousands of gallons of water from Gore Creek and the Eagle River each year to support snowmaking operations. This water is diverted at a time when local stream flows are naturally low, which requires the release of water from upstream reservoirs to meet minimum streamflow rights.

Water and sewer infrastructure in resort communities like Vail, Avon and Beaver Creek are constructed to a level typically found in larger urban areas in order to accommodate influxes of visitors at popular times of the year. Impacts to water resources are magnified during peak visitation



Ski resorts like Vail and Beaver Creek can accommodate tens of thousands of tourists at any given time, requiring domestic water and wastewater services and infrastructure akin to small cities. (Photo: Eagle County).

periods. During busy winter holidays the Gore Creek Valley can host over 90,000 people and Beaver Creek and Avon are similarly busy.¹ Treated effluent often comprises up to 40% of the stream flow in the Eagle River during winter months when tourist lodging is at capacity.²

Common Goals, Inconsistent Regulations

Each jurisdiction within the County has responded differently to the river over the years as demonstrated by the type of adjacent land uses that have been permitted, the number and type of river or creek side amenities that have been provided, and the amount of riparian area or buffer zone that has been preserved. Steadily, the river system is gaining more recognition as a community asset and more attention is being focused on what types of adjacent land uses are appropriate, what type of amenities should be allowed, and how much effort should be made to preserve sensitive lands. Additionally, river related activities are increasingly important to the local economy, supporting many businesses and bringing significant sporting events to the area.

A common and unifying element found in each of the Town master plans and the County master plans is the identification of the Eagle River and its

major tributaries as community assets that should be protected. Advisory team members identified inconsistency, however, between Town and County stream setbacks and riparian area definitions during the planning process. Please note related information provided in Figure 6 below.

Given the nature and sensitivity of the area’s water resources, it will be increasingly important for communities to demonstrate a shared vision, and to implement consistent approaches regarding the utilization and protection of local streams and rivers. Land use patterns that have evolved over the last fifty years require more water quality monitoring coordination and urban runoff water quality improvement plans to avoid or fully mitigate development impacts. Larger populations place higher demands on water providers, wastewater treatment plants, non-point runoff treatment facilities and access points to river and stream recreation areas.

Municipality or County	Riparian Area Defined?	Stream setback
Redcliff	No	0' or floodplain
Minturn	No	30' from high water mark
Vail	No	50' from centerline of stream
Avon	No	30' from high water mark
Eagle	No	50' from high water mark
Gypsum	No	0' or floodplain
Eagle County	Yes	75' from high water mark

Figure 6: Local area minimum stream setbacks vary as expected, however riparian areas remained poorly defined outside of the suggested 1996 ERWP definition, and consistency in regulation and protection of these limited areas remains elusive (Source: Land Planning Collaborative).

All jurisdictions participating in this Watershed Plan update should periodically review and update policy documents (master plans) and land use regulations (zoning and subdivision codes) to achieve greater consistency in their approach to water resource protection.

Setbacks to water resources are inherently different in form and function than other site development setbacks, which are typically driven by requirements for access, safety, utilities or the need for light and air. While the value of riparian areas for wildlife habitat and water quality treatment is clearly evident, riparian zones in the context of stream setbacks remain largely undefined by the majority of land use authorities, and the range of variability in the purposes and goals of stream setback regulations remains poorly articulated. This poses a significant threat to the quality of riparian areas and water resources in proximity to development and infrastructure improvements.

This plan provides a definition of riparian zone (See Glossary) that should be incorporated by all jurisdictions in master plans and land use regulations. Site-specific riparian analysis and final site designs that appropriately integrate concerns for the protection of water quality, wildlife habitat and open space should be required by all involved jurisdictions.

Managing Impacts from Land Use Activities

As population growth in Eagle County continues to change the landscape, provisions for effective stormwater and non-point or urban runoff management should become increasingly mandatory, and should be included in the responsibilities of any service provider associated with a new development proposal. Even older runoff facilities may be greatly improved in many cases through better site design and installation of modern treatment strategies. This plan recommends retrofitting deficient urban runoff treatment systems as part of a comprehensive strategy to reduce existing land use impacts on water quality.

As regulatory discharge requirements are unlikely to be imposed by State or Federal agencies on Eagle County due to a relatively small permanent population, the formation of a consolidated stormwater utility district(s) countywide would be a positive step toward improving existing infrastructure and monitoring strategies. Periodically testing runoff during storm events to better understand the impacts to water chemistry in local streams and rivers will be key in establishing justifications for the design and installation of new runoff control measures.

Restoration of functional riparian zones and wetlands where they have been removed or damaged provides direct benefits to water quality and wildlife habitat, and improves the experiences of those seeking the river environment for recreation. Future development should provide strategically located open space that protects and enhances riparian

areas and/or that provides opportunity for storm water management or filtering as a high priority of site design.

The Riparian Zone

"The riparian zone is defined as the banks and adjacent vegetation influenced by the high water table. Plant types associated with the riparian zone include but are not limited to cottonwoods, willows, alders, aspens and chokecherry. The presence or absence of these plants does not always indicate a riparian community... conversely, a few characteristic plants may not indicate a true riparian community. For this reason, on-site analysis is needed to help make this determination."

**-1996 Eagle River
Watershed Plan**

Continuing efforts to control and/or minimize impacts from road sand on Vail Pass should be strongly supported, and transportation agencies and water quality stakeholders should continue to work collaboratively to identify opportunities for the better management and treatment of runoff from existing and proposed roads and parking lots throughout the basin.

Future Land Use and Land Use Patterns

Securing permanent, undeveloped open space along rivers, tributaries and other significant water features preserves wetlands and riparian areas that act as buffers to water quality impacts of development. The protection of riparian lands should remain a high open space acquisition priority, and recreation access should be carefully monitored and managed these areas.

The quality of water resources would benefit from retaining properly managed agricultural operations and ranch lands. Traditional flood irrigation charges ground water aquifers in close proximity to natural waterways. Slow releases of this water can supplement late fall and early winter stream flows. Well-managed ranches also provide opportunity for wildlife to access and move along riparian corridors with little stress. In many (but not all) areas, historic ranching has resulted in many miles of remarkably well-preserved riverbank and riparian areas.



Young volunteers work on assembling willow wattles to prevent future erosion on restored stream banks of the Eagle River near Edwards (Photo: ERWC).

The water rights associated with many of the county's remaining agricultural properties are senior, and keeping those senior rights in-basin affords future protection of stream flows when downstream needs are greatest. This Plan recommends the development of a consumptive use credit program for irrigators to make historical consumptive use credits available for contracting to the CWCB for instream flow purposes.

Applying a more vertical urban growth form where higher density residential uses are located within or in very close proximity to commercial and retail centers allows for more efficient and better serviced surface drainage systems, water delivery systems and waste water treatment systems. It also lessens the per-capita amount of water needed for outdoor watering. While pressure on sensitive riparian zones in urban settings can be considerable, fences, trails, durable surfaces and other "design features" can be used to direct access to areas that are specifically designed and managed for human activity.



The Town of Gypsum Eagle River Area Plan illustrates a variety of planning principles that can be applied to create water friendly growth patterns along valley floors (Source: EDAW/AECOM, 2009).

Communities in Eagle County rely on water that originates on public lands (BLM, USFS and State properties). While generally maintained in a natural and stable condition, these public lands can be subject to intense recreational, grazing and industrial development impacts. Oil and gas exploration and certain kinds of ski area upgrades on public lands are examples of projects that have potentially significant impacts on water resources but that may not be subject to a full land use development review process. The impacts from these types of uses should be minimized through the implementation of established best management practices.

Land Use Goal: Land uses in Eagle County are located, designed, occupied and operated in a manner that minimizes impacts to water quality and water quantity in the Eagle River and its tributary streams.

Land Use Objectives, Strategies and Actions (items not listed in order of importance or priority)

Objective 4.1: Promote land use patterns and site design practices that maximize opportunities for protection and enhancement of water resources.

The location, type and intensity of land use can have a dramatic effect on the quality of water resources, and on the types of management strategies that should be employed to retain or enhance those resources.

Strategies/Actions:

1. Encourage higher density, compact development patterns and growth within communities where water consumption, wastewater treatment and urban runoff can be more effectively managed.
2. Promote a uniform and effective approach to define riparian ecosystems, and to establish adequate riparian setbacks and buffers.
3. Preserve permanent open space in proximity to streams, rivers and riparian zones.
4. Encourage appropriately managed agricultural uses around and between existing community centers. Support beneficial irrigation practices and work with ranchers to avoid activities or disturbances that damage riparian areas.
5. Amend applicable regulations, codes, policies and/or guidelines to assure parks, landscaped areas and open spaces are designed and positioned to protect riparian areas and to provide opportunities for passive and/or active treatment of urban runoff.
6. Promote recreational access improvements that facilitate enjoyment of stream and river corridors in a manner that minimizes impacts to riparian habitats. Reference the recreation chapter for related information.

Objective 4.2: Minimize or mitigate impacts to water resources from historic disturbances and existing developed areas.

Efforts should be made to repair historic damages, and to improve the relationship of developed areas to nearby water resources as development evolves over time. Many areas are only partially built out, and many more will be subject to redevelopment as they approach the functional life expectancy of their structures and infrastructure. There is ample opportunity to reestablish riparian buffers and to introduce or improve runoff control measures to further mitigate negative impacts to streams and rivers.

Strategies/Actions:

1. Continue efforts to monitor and mitigate impacts from historic mining along the Eagle River between Redcliff and Minturn. Develop and implement additional site-specific restoration or water treatment plans, require appropriate diligence to state and federal cleanup requirements and assure the establishment of long-term maintenance responsibilities by involved landowners and/or developers.
2. Support efforts to restore high quality aquatic and riparian ecosystems in areas where they were altered or removed by transportation improvements, army training facilities like Camp Hale or other historic land uses.
3. Promote the reintroduction of vegetative buffers and riparian habitats within existing towns and community centers. Work with local authorities to assign responsibility for the monitoring and maintenance of stream and river corridor lands within existing developed areas. Consider the benefits of utilizing unbiased third party agencies for monitoring and oversight.
4. Support efforts to upgrade urban runoff and stormwater control facilities along existing roadways and in existing developed areas.
5. Encourage or require retrofits to existing household and commercial water fixtures and irrigation systems to improve water conservation.
6. Work with CDOT, Eagle County officials and metropolitan district workers to implement road maintenance and snow storage activities that minimize impacts to water quality.
7. Evaluate existing industrial, manufacturing and resource extraction sites for opportunities to improve storm water management. Similarly evaluate large parking lots and outdoor storage areas.

8. Monitor and mitigate impacts from existing recreational uses and access points on streams and rivers.
9. With particular attention to smaller projects that may not be subject to permitting, avoid construction or maintenance activities that require instream disturbances during spawning, or at times when aquatic habitat stress factors are high as determined by Colorado Parks and Wildlife officials.

Objective 4.3: Avoid, minimize, or fully mitigate impacts to water resources from future land development, including transportation and infrastructure improvements.

Future land development decisions should incorporate input from all water management agencies and stakeholders to insure the quality and sustainability of local and regional water resources. The public decision making process should be as transparent as possible, utilizing the best available data, and emphasizing cooperative and collaborative work to create consistent policy and regulatory tools.

Strategies/Actions:

1. Evaluate the effectiveness of and periodically update Land Use Regulations and design guidelines intended to protect riparian areas and the quality of water resources.
2. For new development projects, place open space corridors along streams and rivers into public ownership and management in perpetuity.
3. Preserve community buffers in a natural or well-maintained agricultural pasture condition, and promote significant setbacks from stream and river corridors in these areas.
4. Regulate the use of light fixtures along rivers and streams to avoid impacts to wildlife habitat from fugitive light.
5. Avoid impacts to riparian areas and stream and river channels from the installation buried utility lines, roads, trails and other infrastructure. Where it is necessary to cross a stream or river, provide alignments as perpendicular to the flow path as possible to minimize the area of disturbance. Regularly maintain and monitor all utility pipes and manholes to prevent leaks and/or the infiltration of fresh water.
6. Encourage gravel retrieval along the Eagle River or tributary valleys in areas where development is anticipated per locally adopted master plans. Avoid impacts to water quality and riparian areas

- from resource extraction operations. Ensure adequate post mining reclamation and encourage environmentally compatible post mining land use.
7. Configure new residential lots to avoid ownership of riparian zones and stream channels by individual homeowners. Locate habitable structures far enough from riparian vegetation to avoid impacts to trees and shrubs resultant from wildfire mitigation requirements.
 8. For new development, assure that responsibility for the monitoring and maintenance of stream and river corridor lands has been assigned. Consider the benefits of utilizing unbiased third party agencies for monitoring and oversight.
 9. Where insufficient, and as opportunities arise, amend applicable regulations, codes, policies and/or guidelines to require the installation of effective stormwater control and treatment systems for all developed areas and along all new or expanded transportation corridors. Life cycle costs of installing, monitoring and maintaining stormwater and urban runoff control facilities should be considered for all development proposals.
 10. Monitor future mining and industry development potential in Eagle County, and ensure that any exploratory or expanded resource activity on public and private lands does not degrade ecological and water quality conditions or domestic water supplies.
 11. Refer new development or redevelopment applications to local water service providers and otherwise insure the availability of legal "wet water" to offset anticipated consumptive uses.
 12. Promote compatible land use practices and management activities on public lands that protect and enhance water resources. Develop and/or refine regulatory tools to minimize impacts from ski area upgrades and the possibility of oil and gas exploration on public lands.

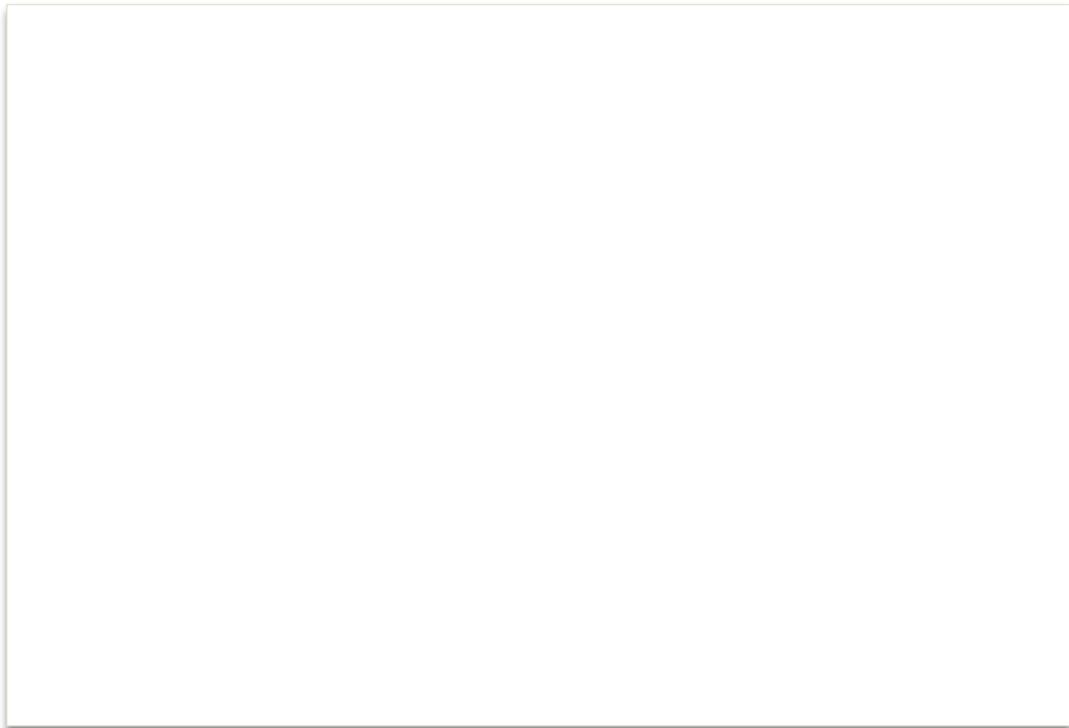
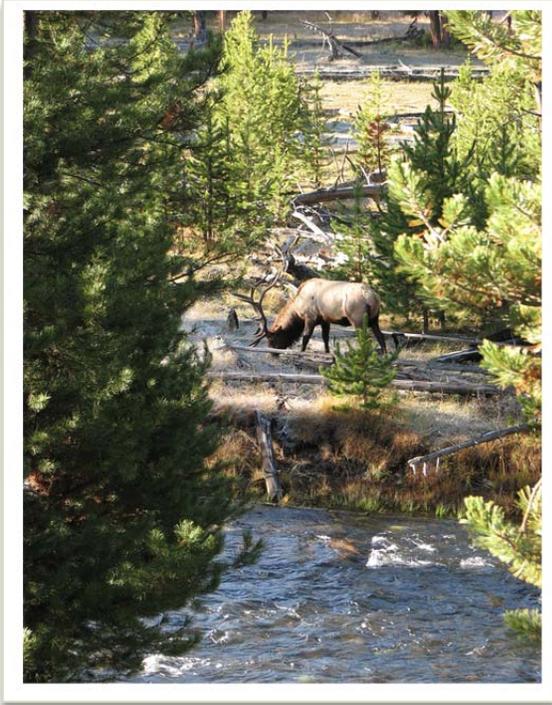
Objective 4.4: Integrate recommended actions for water quantity, water quality, recreation and wildlife specifically expressed by this plan into other master plans, land use policies and regulations throughout the watershed.

Land use decisions have the potential to impact every aspect of watershed health. Incorporating the recommended actions of this Plan into other master plan documents utilized by government entities, service districts, land management agencies and resource management

professionals will advance education and collaboration on the topic of water, and will better assure the protection water resources from negative impacts of future growth.

Strategies/Actions:

1. Encourage collaborative master planning, project coordination, monitoring efforts, management efforts and the sharing of information on a regional basis between all agencies and jurisdictions engaged in water quality monitoring and water use management.
2. Promote the use of and provide easy access to the contents of this Watershed Plan through town, county, service district and management agency web sites. Support efforts and activities designed to inform and enhance local knowledge of water supply and water quality issues.



Chapter 5

Water and Wildlife

Eagle River Watershed

Water and Wildlife Goal: Fish and other wildlife benefit from high quality water flowing in sufficient amounts in local streams and rivers. High quality interconnected riparian and aquatic habitats that are protected and buffered from human activity insure sustainable healthy wildlife populations.

Overview of Wildlife Issues and Objectives

Several wildlife issues and concerns were identified and discussed during the planning process:

- Existing minimum instream flow rights may not fully address the ecological needs of a quality aquatic habitat.
- Some areas of the watershed have poor water quality due to pollutants (urban runoff, metals, etc.) and sediment.
- Some areas of the watershed have riparian habitat that has been removed or degraded.
- There is diminished solitude and increased stress to wildlife from human activities in riparian zones.
- There is an increasing risk for disease to fish and the spread of undesirable aquatic nuisance species.
- There is a lack of suitable management strategies to monitor and mitigate recreation impacts on aquatic and riparian habitats.

In response to the identified issues and concerns, and in support of the goals for the Plan, the following objectives were developed:

1. Protect, enhance and improve aquatic, riparian and related habitats
2. Improve opportunities for solitude and minimize stress to wildlife in aquatic, riparian and related habitats.

Background

Riparian Habitats and Terrestrial Species

The area and vegetation influenced and supported by the water table adjacent to a stream or river is known as the riparian zone or riparian ecosystem. Where the stream banks in an area are steep the riparian zone can be quite narrow; where the topography is flat it can be quite wide, extending tens to hundreds of feet on either side of the main channel. Riparian zones are typically identified by the types of “water loving” plants that are present.

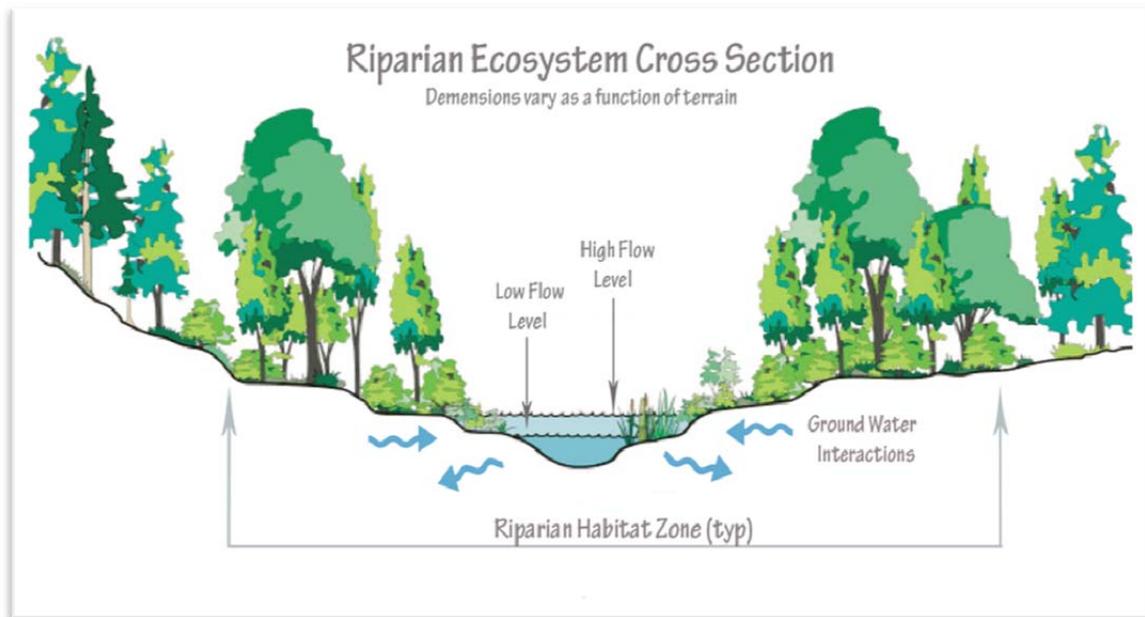


Figure 7: Riparian Zones vary in width and quality depending upon location, topography and the seasonal influence of water. This Plan provides a functional definition for riparian zone (see glossary) that should be broadly adopted by all jurisdictions in Eagle County (Source: U.S. Forest Service, Riparian Restoration manual, 2004).

Riparian ecosystems comprise less than 3% of the total land area of Colorado but represent the most valuable wildlife habitat in terms of numbers and variety of species.¹ Of the State's approximately 1,000 species of wildlife, over 500 utilize or occupy riparian habitats for some part of the year.² The riparian areas along the Eagle River and its tributaries provide important movement corridors, breeding, nesting, fawning, calving and foraging areas. Some species of wildlife use the riparian area year-round.



Thick streamside vegetation provides cover for young fawns “bedded down” while mom is away foraging for food (Photo: Eagle County).

Other wildlife may use riparian areas seasonally for migrating, breeding, rearing their young, foraging for food or shelter. Elk and deer usually calve and fawn within 400 feet of free flowing water.³ Birds like the Great Blue Heron and raptors such as Bald Eagle, Golden Eagle and Kingfishers use riparian areas for wintering, roosting, and/or hunting. A recent Colorado Division of Wildlife inventory indicated that at least 250 species in Eagle County are currently utilizing riparian ecosystems. Observed species include mule deer, elk, bear, lion, moose, Greater Sandhill Cranes, White Pelicans, Trumpeter Swans, Whooping Cranes, Blue Herons, Ibis, snowshoe hare, coyote, lynx, skunks, raccoons, otter, beaver, mink, fox, weasel, marmots, rabbits, squirrels, muskrats, geese, egrets, grebes, ducks and many species of songbirds. A complete list of wildlife using the watershed wetland and riparian areas is available at Division of Wildlife website:

<http://wildlife.state.co.us/LandWater/WetlandsProgram/>

Riparian areas serve a variety of functions including water storage, aquifer-recharge, stream bank protection, pollutant filtering, and floodwater absorption. These areas are frequently visited and used for many recreational activities as well (i.e. fishing, boating, wildlife viewing, picnicking, hiking, etc.). Disturbances in and around these fragile

ecosystems can result in the direct loss of usable habitat, the disruption of movement corridors and production areas, and the fragmentation of associated wildlife populations.



Mule deer depend on available winter range and access to riparian zones for cover and food, like here along Brush Creek during the rut (Photo: B. Heicher).

Given its size, the Eagle River is a fairly unique river in that there are no major water storage projects along its mainstem or on its tributaries. The exception to this would be the large diversion reservoir located at the head of Homestake Creek that is operated by the cities of Aurora and Colorado Springs. There are a number of smaller reservoirs on tributary streams, including Eagle Park, Black Lakes, Sylvan Lake and L.E.D.E. (described in detail in the glossary). Wildlife species in the Eagle River basin benefit from hundreds of miles of generally well-connected and healthy riparian habitats, especially in the higher elevation areas of the watershed that have seen little disturbance or damage from human activity.

At lower elevations riparian habitats are often associated with critical wildlife winter range, and their importance increases dramatically. Unfortunately, in Eagle County, so does the potential for land use disturbance. Beginning in the Pando (Camp Hale) area and moving downstream, riparian areas adjacent to the Eagle River have been

disturbed and/or manipulated by mining, agricultural activities, municipal diversions, transportation improvements (rail and road) and land development. Riparian zones along tributary streams at lower elevations have been similarly impacted. As example, the benefits to wildlife from riparian areas along lower Gore Creek, Beaver Creek, Lake Creek, Brush Creek and Gypsum Creek have been, in some areas, significantly diminished.



Many riparian habitats have been damaged by land use activities at lower elevations in Eagle County. This riparian zone was part of a riverbank restoration project on the Eagle River to reclaim an area where vegetation had been removed. (Photo: ERWC).

Since adoption of the first ERWP in 1996 the popularity of hunting, fishing and wildlife watching in Eagle County has remained strong. In 2007, a "Quality of Place" survey was commissioned by Eagle County to identify and quantify the primary components of our natural and built environment affecting resident's quality of life. Four in five residents felt that protecting wildlife should be a priority of Eagle County.

The economic impacts of maintaining healthy wildlife habitats are considerable as well. In 2008 a study found that Eagle County ranked 8th of all 64 Colorado counties for total economic impacts from wildlife, with

over \$67,000,000 in expenditures from both residents and non-residents.⁴ That same year, wildlife associated activities provided over 900 local jobs.



The presence and abundance of certain types of aquatic insects like the May Fly shown above can be used to assess stream health (Photo: Society for Freshwater Science, 2012).

Aquatic Habitat and Fish

There are a great variety of aquatic habitats found within the streams, rivers, lakes, ponds and wetlands of Eagle County. Each of these underwater environments exhibits unique characteristics and each is uniquely resilient or susceptible to impacts from external sources. This plan is generally focused on the health of streams and rivers, where aquatic organisms rely on (or contend with) moving water. Mountain streams typically consist of a mix of pools, riffles, rapids and runs, and each of these sub-habitats supports a variety of bacteria, algae, worms, crustaceans, insects, fish and plants. Some of these organisms are highly specialized, and are found only in one habitat type; others are more widespread. Some species move between different habitats within a stream, river or lake to live and to reproduce. Many aquatic species are interdependent upon one another, as local trout are clearly dependent on the presence and life cycles of aquatic insects as a reliable source of food. Importantly, aquatic organisms in streams and rivers are accepted indicators of water quality. The presence, diversity and condition of types

of macroinvertebrates (insects), fish, periphyton (algae), macrophytes (plants) and other aquatic organisms provide important information about the biological health of aquatic ecosystems.



Brook trout are common in the clear waters of high elevation streams in Eagle County (Photo: C. Simonton).

The quality of aquatic habitats depends on the speed, depth, temperature, clarity and chemical composition of the water, as well as the nature of the stream channel and the type of cover that is available to insects and fish. Many bacteria and insects rely on habitats within and below the visual bottom of streams and rivers, where moving water delivers oxygen and nutrients to the small spaces found between rocks, gravels, sands and mud. Aquatic habitats are self-sustaining and self-restoring under normal conditions, but they can be negatively impacted, sometimes for long periods of time, by both natural and man-made influences.

Brown and rainbow trout are introduced (non-native) recreational fish species that have dominated local streams and rivers for decades. Other native fish found in the Eagle River include sculpin, speckled dace, and bluehead and flannelmouth sucker; and non-native species include mountain whitefish, white suckers and longnose suckers. Rainbow trout were once prevalent, but have recently declined in the river due to diminished water quality and their susceptibility to whirling disease. The

bluehead and flannelmouth suckers are also believed to be declining due to habitat loss, flow manipulation, and hybridization with non-native suckers.⁵

Brook trout (another popular introduced species) and cutthroat trout dominate high elevation lakes and streams. Brook trout and Colorado River cutthroat trout provide unique recreational fishing opportunities in remote areas. Colorado River Cutthroats are identified as state species of special concern, and have been petitioned as threatened under the Endangered Species Act.

In Eagle County, sensitive aquatic habitats have been impaired in several areas, including the upper Eagle River, certain reaches of Gore Creek and lower sections of Lake Creek. Reduced insect populations in these areas may be attributable to a number of factors including mining impacts, urban runoff, sedimentation, development encroachment, the use of pesticides, and/or diminished natural flows.

Wildlife at Risk

Approximately 75% of the terrestrial, aquatic and avian (bird) species found in the Colorado River basin, of which the Eagle River watershed is a part, are listed by either federal or state agencies as endangered, threatened, or at risk.⁶ Development has encroached on many stream corridors, and increased recreation has reduced solitude and habitat for wildlife. Through the years, growth and infrastructure improvements have resulted in the loss of significant acreages of riparian and terrestrial habitat. It is estimated that during periods of high growth 1.7% of the available mule deer range in Colorado was eliminated each year.⁷ In Eagle County, up to 40% of mule deer winter range has been lost to development. While no new studies update these statistics, it is evident that many miles of riparian corridors in the County either no longer exist or no longer function as viable wildlife habitat due to disturbances or encroachments. Also, most of the residential growth occurring since the 1996 ERWP has developed in critical winter habitat for mule deer, particularly lower in the watershed (near Eagle and Gypsum).

Impacts to Wildlife from Water Quality

Chapter 3 detailed water quality stressors present in the Eagle River watershed, and discussed problems associated with nutrient loading, metals, water diversions (low flows), sediment loading and urban runoff. Of those stressors listed, three appear to limit the quality and productivity of the Eagle River fishery: low flows, excessive sedimentation and heavy metals.⁸

Trout are a coldwater fish species, and if they cannot find thermal refuges during warm temperature periods, they become susceptible to infections and disease, including common water molds or more serious pathogens like those that cause Furunculosis. During the past twenty years the Eagle River has experienced occasional fish die-offs or "fish kills" during the low flow periods in the late summer. After a dry winter and summer in 2001/2002, the CDOW requested fishermen voluntarily curtail all activity on the middle and lower Eagle River reaches to reduce stress to fish that were being exposed to high water temperatures. In the summer of 2012, the CPW again requested the public only consider fishing the Eagle River during periods of cool temperature.

Excessive sedimentation during spring snowmelt run-off, after heavy summer rain events, or as a result of construction can impact aquatic habitats in the Eagle River. Siltation covers potential spawning areas and can smother incubating eggs and emerging fry, preventing successful reproduction of wild trout. Sediment also fills in habitat that is occupied by aquatic invertebrates, thus decreasing fish food resources.

Milk, Muddy, Alkali and Ute Creek capture runoff from areas where highly erosive soils and sparsely vegetated slopes are common. Large amounts of sediment produced by these naturally erosive areas periodically impact the Eagle River downstream of the Wolcott area. Sedimentation from winter road sanding operations in close proximity to streams is also a concern. Road sand has significantly impaired Black Gore Creek on the west side of Vail Pass and to a lesser degree the Gore Creek main channel east of Vail.

Persistent water quality degradation caused by metals loading in the Eagle Mine area between Red Cliff and Minturn is the primary water quality concern in the Upper Eagle River watershed. Portions of the Eagle River and Cross Creek are impaired by zinc and copper for aquatic life use as defined by the State.

The toxicity of zinc exposure varies from fish species to fish species, with sculpin considered most sensitive and brown and brook trout considered more resistant. By way of comparison, brook trout can survive in zinc concentrations greater than 500 parts per billion while sculpin require zinc levels less than about 20 parts per billion. Importantly, extended exposures to zinc and other metals in the water are more detrimental to fish than high concentration levels at any single point in time.

Remediation of the Eagle Mine Superfund Site began in 1984, and has made notable progress as evidenced by improvements in the population



The Eagle River below its confluence with Milk Creek following a summer thunderstorm (Photo: Eagle County).

of brown trout and significant decreasing trends for zinc, cadmium, copper and manganese concentrations in the Eagle River from Belden to Minturn. (<http://www.erwceaglemine.org/>) Even so, metals contamination persists, limiting brown trout numbers and growth rates and excluding more sensitive species like native sculpin and rainbow trout in the mine-affected stream reaches. Further metals loading reductions are needed to improve fishery habitats in the mainstem of the Eagle River.⁹

Streams impacted by urbanization are often characterized by macroinvertebrate populations with low diversity, limited numbers and/or high numbers of certain pollutant tolerant species.¹⁰ In Gore Creek, stressors related to riparian zone degradation, impacts of impervious cover and urban runoff and pollutants associated with land-use activities are considered by local water quality experts as the primary causes of limited macroinvertebrate diversity and associated concerns for the biologic health of the stream.



As part of the remediation plan for the Eagle Mine, contaminated water is piped to Maloit Park near Minturn where it is treated before being released into the Eagle River (Photo: Eagle County).

Impacts to Wildlife from Water Quantity

Chapter 2 provides a detailed discussion of the variability of flows that occur in the Eagle River watershed from both natural and man-made influences. These variations can have both positive and negative effects on wildlife. Flushing flows during spring runoff maintain the quality of aquatic habitats by scouring sediment from gravel habitat needed by aquatic insects and fish for reproduction. Seasonal high flows also create new habitats and introduce food for invertebrate insects in the form of woody debris and organic materials.

During spring runoff, water saturates riparian habitats and recharges ground water aquifers in proximity to streams, rivers and lakes. Exceptionally high flows, however, can damage aquatic habitats and negatively impact fish and insect populations. The spring of 2010 provides a recent example in Eagle County, when a period of hot weather in late May accelerated snow melt, resulting in a surge of unusually high runoff



Fish shocking volunteers and CPW staff regularly monitor fish populations downstream of the Eagle Mine area (Photo: ERWC).

volume in the Eagle River. High flows of this nature have been observed to remove entire age classes of fish from impacted river segments. These events can impact aquatic populations for many years. Erratic flows during spring runoff may become more frequent as a result of climate change (please see additional discussion in Water Quantity Chapter).

In the event that new reservoirs are constructed in the Eagle River drainage, spring runoff will be used to fill them, which will result in lower 'peak' flushing flows. Homestake Creek below Homestake reservoir is currently impacted in this manner. While this may not be a significant factor in the Eagle River basin at this point in time, future diversions and new or expanded water storage facilities may have an effect on the quality of the area's aquatic habitats.

Low stream flows that occur in late summer and last through the winter also impact aquatic habitats. Low flows in the summer can result in elevated water temperatures, reducing the amount of dissolved oxygen available to fish and insects. When flows are low there is less dilution of contaminants that enter the stream, the amount of habitat and cover is

reduced, and fish become concentrated in pools where they are more susceptible to angling pressure, stress and disease. The impacts from an extraordinary low flow event can persist in a stream or river for many years.

Understanding and managing for the desired range of water necessary to support a healthy aquatic habitat in streams and rivers provides long-term benefits to the watershed. Additional flow at certain times of year in impaired sections may benefit the river by providing adequate fish habitat and diluting natural and manmade pollutants. Where area streams or rivers are identified as impaired for aquatic health, further study of the flow characteristics is recommended as an action of this Plan.

Impacts to Wildlife from Disease and Nuisance Species

The introduction and spread of disease and undesirable aquatic nuisance species is a potential limiting factor for trout. Whirling disease and didymo ("rock snot") are present in the watershed, and can be spread by humans on wading boots, boats, and construction equipment. Rainbows are most susceptible to whirling disease, which causes skeletal deformation and neurological damage in young fish. Brook trout and cutthroat trout are also susceptible to whirling disease. Downstream of Edwards near the confluence of Lake Creek and the Eagle River, the river widens and flattens and has a substrate embedded with fine sediment that support tubifex worms – an intermediate host associated with whirling disease. The restoration project recently completed in this reach will hopefully improve sediment movement and reduce the occurrence of disease.

Furunculosis was implicated in fish kills during low flow periods in the Eagle River in 1987, and possibly in 2002. The spread of the disease was likely triggered by a variety of stressors, including high water temperatures and concentrated pollutants. Brown trout are more sensitive to the disease than rainbows. Furunculosis is relatively uncommon in natural flowing waters, and the Eagle River outbreak in 1987 was the first to be encountered in Colorado in over a decade. Stress from angling can increase the potential for outbreaks.

Education programs, regulations that require decontamination of boating and fishing equipment, and stocking programs that introduce disease resistant strains of fish into the watershed can help reduce impacts of disease and aquatic nuisance species. Information on preventative measures can be found on websites of the state wildlife and recreation agency or national campaigns like the Protect Your Waters Initiative (<http://www.protectyourwaters.net>).

Impacts to Wildlife from In-stream Barriers

Natural barriers like waterfalls or man-made barriers like elevated culvert outfalls can be either detrimental or beneficial. Barriers in the wrong location can isolate fish populations and limit genetic diversity. They can also prevent access to seasonal habitat for spawning or to areas providing refuge from summer heat or winter ice. However, barriers may also prevent the spread of disease or nuisance organisms. They have been used successfully in Eagle County to isolate and protect native cutthroat populations from predatory non-native fish, whirling disease, and hybridization with introduced trout. Other potential invasive species include the Zebra and Quagga mussels and the Rusty Crayfish. While these mussels and crayfish are reported to have spread to our region of the Upper Colorado, they have not yet been reported in the Eagle River basin.

Impacts to Wildlife from Land Use

As detailed in Chapter 4, significant acreages of riparian and terrestrial habitat have been lost at lower elevations in Eagle County as a result of agriculture, urban development, resort development and transportation improvements. Farming and ranching has impacted large acreages near streams and rivers. Roads and rail lines require efficient alignments that often utilize land within and immediately adjacent to riparian zones. Urban centers and residential neighborhoods are built in river bottom areas where they can be best served by utilities and transportation improvements. Direct losses to riparian habitats occur when reservoirs are built, and trans-basin and in-basin diversions can indirectly impact aquatic and riparian habitats downstream from diversion points.

In certain instances land use activities can benefit aquatic ecosystems. Flood irrigation from agriculture can recharge ground water aquifers that then release filtered water from shallow springs, supplementing low flows in the late summer and fall. Augmentation water released from reservoirs can also enhance stream flows above downstream diversion points.

Future development, however, may continue to compromise the quality and connectivity of the riparian habitat in Eagle County. Development impacts to wildlife are sometimes unavoidable, but habitat improvement projects and targeted mitigation funds like those established as part of the approval of the Eagle Ranch development on Brush Creek can be implemented to preserve or enhance sensitive stream and river habitats. Throughout the Eagle River basin, measures are needed to maintain the health and long-term viability of local wildlife and fishery populations, and to support the economic contributions made from wildlife watching, hunting, and fishing.



Agricultural land located between Eagle and Gypsum. Note that riparian vegetation has been removed to allow pastures to extend all the way to the river (Photo: Google Earth).

The Colorado Department of Transportation recognizes that the proximity of its roads to water resources requires special management, and has extensively studied the issues surrounding ecosystem connectivity – both aquatic and terrestrial - across the state. Several advisory committees have been formed to design appropriate mitigation strategies in conjunction with expected redevelopment of the I-70 mountain corridor (<http://i70mtncorridorcss.com/>).

Impacts to Wildlife from Recreation

The popularity of hunting and fishing in Eagle County brings thousands of visitors to the area every year, and contributes significantly to the local economy. Most residents list access to outdoor recreational activities as one of the top reasons they choose to live here. This strong focus on outdoor activities and lifestyles can result in significant recreation impacts to wildlife and wildlife habitats in riparian and aquatic environments. Those impacts include soil compaction, loss of vegetative cover, loss of



Major transportation corridors like Interstate 70 and railroad lines are frequently located in close proximity to streams and rivers. Black Gore Creek, as shown above, has been heavily impacted by unmitigated traction sanding operations on Vail Pass (Photo: ERWC).

solitude, increased erosion, trash and fecal waste, and disruptions from pets and noise. Recreational paths are frequently located within the attractive environments of a stream or river corridor. Fishermen wade through and disrupt river and stream bottoms where insects live and fish spawn, and invasive species can be introduced to an aquatic system from boats and fishing boots.

Gore Creek is currently rated as a "Gold Medal" fishery below its confluence with Red Sandstone Creek. "Gold Medal" infers a stream with outstanding recreational fishing value that supports a standing stock of trout of at least 60 pounds per acre, and contains an average of at least 12 quality trout (fish ≥ 14 inches) per acre. The Eagle River fishery has recovered well from the days of metals contamination, and tributary streams and high mountain lakes remain very popular fishing destinations.

Current fishing regulations restrict harvest to two trout on the mainstem of the Eagle River (visit <http://wildlife.state.co.us/Fishing/Pages/Fishing.aspx> for CPW regulations). Based on law enforcement statistics, overharvest is not yet a concern on the Eagle River. However, multiple capture of

individual fish and physical damage or stress associated with repeated or prolonged handling by fisherman is a concern.

Managing human use in critical habitats during critical times of the year (e.g. seasonal closures on areas being used by elk for calving, closures for trout spawning areas, etc.) is important to protect wildlife. CPW can advise private land regulators and the managers of public lands about the areas of concern and the actions that could be implemented through signs, physical closures, and regular monitoring.

Extensions of wildlife closures to federal lands would greatly benefit wildlife in some cases, as would providing an appropriately dimensioned vegetative "buffer zone" between land development, human activities and wildlife habitats. Conservation easements or perpetual agreements with governing agencies can be implemented to affect this outcome. Eagle County and agencies like the CPW, BLM and USFS should consistently monitor the widespread impacts of developed and dispersed recreation on aquatic and other wildlife species.

Impacts to Wildlife from Climate Change

Climate Change is a variable that is not fully understood that has potential to significantly alter streamflow dynamics and aquatic and terrestrial habitats in Eagle County. As the planet warms, it is anticipated that winter snowpack may diminish, and that runoff events will occur for shorter durations at earlier times of the year. Overall yearly precipitation amounts may change and the health of forested areas could be significantly impacted (the recent beetle epidemic a possible case in point). In recent years, increased dryness in areas west of Colorado have resulted in dust being deposited on the snow by mid-winter wind events. This has increased the rate of spring and summer melting, which creates longer periods of low flow in the summer and fall months. Changes to precipitation and the nature of runoff events and stream flows as a result of climate changes will negatively impact the quality of aquatic, riparian and terrestrial wildlife habitats throughout the region. The potential effects of climate change on water availability are also discussed in the Water Quantity chapter.

Water and Wildlife Goal: Fish and other wildlife benefit from high quality water flowing in sufficient amounts in local streams and rivers. High quality interconnected riparian and aquatic habitats that are protected and buffered from human activity insure sustainable healthy wildlife populations.

Wildlife Objectives, Strategies and Actions (items not listed in order of importance or priority)

Objective 5.1: Protect, enhance and improve aquatic, riparian and related habitats.

Connectivity of healthy and varied habitats (aquatic, riparian and terrestrial) benefits a large variety of wildlife. Wildlife habitat associated with streams and rivers is fair to good in the area, however, without a concerted effort to protect and adequately buffer stream and river corridors, wildlife populations will be negatively affected.

Strategies/Actions:

1. Implement stream buffer standards that better manage the urban interface to aquatic and riparian zones. Require a river or creek "buffer zone" where vegetation and soil must remain undisturbed to protect habitats and mitigate storm water impacts. Enhancement of the native vegetation should occur if historic use has degraded the riparian habitat. Work with private developers to design developments that have the least impacts on the riparian habitat (such as clustering housing) and set aside riparian areas as open space. Implement restoration and improvement projects that benefit aquatic, riparian and terrestrial areas.
2. Recognizing that stream flows can drop below CWCB instream flow levels under natural conditions and that this condition may be further compromised by use of water rights senior to the CWCB instream flows, encourage water management strategies and projects that enhance stream flows during times when flows are below CWCB levels.
3. Where individual reaches of rivers or streams are identified as impaired or having inadequate flows, craft and implement Streamflow Management Plans that offer creative and cost effective strategies to address ecological, domestic, recreational and agricultural water needs. Stream management plans can include:

- Modeling based on or comparable to the IFIM methodology;
 - Recommendations for desired ecological flows to support natural stream flow variability (low, base, maintenance and flushing flows);
 - Recommendations for other approaches to improving and sustaining the stream or river in question, including water and land conservation techniques or bed and bank enhancements.
4. Maintain support for existing water quality monitoring and assessment programs and coordination of data collection efforts (Water Quality 3.2.2, 3.2.3 and 3.2.4).
 5. Draft and implement water quality improvement plans, where necessary (Water Quality 3.1.20).
 6. Implement sediment control and habitat and biological recovery targets for Black Gore Creek (Water Quality 3.1.10).
 7. Support best pollution reduction strategies and biological recovery targets for the Eagle Mine cleanup (Water Quality 3.1.11).
 8. Support collaborative efforts between private stakeholders and public organizations and agencies involved in river channel restoration projects.
 9. Use wildlife mitigation funds or other funding mechanisms to protect and purchase habitat and enhance degraded habitat in the watershed.
 10. Support CDOT Context Sensitive Solutions initiatives to correct issues of connectivity and avoid, mitigate or enhance impacts to aquatic, riparian and terrestrial habitat.

Objective 5.2: Improve opportunities for isolation and minimize stress to wildlife in aquatic, riparian and related habitats.

Growth and development in Eagle County has increased stress to wildlife in a number of ways, including increased human presence in remote areas. Providing sufficient monitoring, limiting access in some areas and working to improve overall education and awareness can help to reduce stress to aquatic and terrestrial wildlife.

Strategies/Actions:

1. Manage recreational access, provide buffer zones between human activity and sensitive lands and monitor the function of critical wildlife areas associated with streams and rivers.
2. Promote solitude for wildlife within targeted reaches of riparian corridors. Human access and activity would be limited or precluded in

these areas. Restrictions for critical areas may require partial or complete closure for a specified period of time (e.g. May 1 to June 1 or from 3 p.m. to 5 p.m. daily) to all or some types of use. Insure adequate enforcement of area wildlife habitat closures.

3. Maintain or enhance water quality in all rivers and streams (see applicable strategies in Chapter 3, *Water Quality*).
4. Work with the Colorado Parks and Wildlife to monitor and avoid impacts to aquatic habitats from disease and nuisance species.
5. Create a standard definition of riparian zone in the watershed and work to incorporate that definition into the land use regulations employed by all jurisdictions. Balance the need for stream and river access with the need to protect sensitive riparian environments.
6. Provide information and incentives to encourage owners of residential properties with stream or river frontage to maintain or enhance the condition of riparian habitats on their land.
7. Work with ranchers to maintain the solitude and quality of riparian habitats and wildlife connectivity on agricultural properties. Ranchers should use best management practices to allow livestock to obtain water without impacting riparian areas. Work with the BLM, USFS, Eagle County Conservation District and the NRCS to inventory, monitor and promote riparian restoration on agricultural lands.
8. Coordinate with state, national and local agencies to maintain non-fragmented interconnected wildlife habitat. Provide connectivity in the form of undeveloped corridors, community buffers, golf courses, landscaped areas, and safe road crossing facilities between upland wildlife habitats and riparian zones. Require the implementation of ecosystem connectivity measures through the development approval process.
9. Support open space acquisitions that result in the preservation of quality of aquatic and riparian habitats.
10. Monitor fish populations for signs of stress and implement fishing advisories and regulations accordingly.
11. Promote educational programs directed at protecting wildlife habitat, reducing stress on fish and avoiding the spread of disease and aquatic nuisance species.

Chapter 6

River Recreation

Eagle River Watershed

River Recreation Goal: Water related recreational activities and associated businesses thrive in Eagle County in a manner that respects the quality of water resources and riparian habitats, and contributes positively to our high quality of life and resort tourism economy.

Overview of Recreation Issues and Objectives

Several river recreation issues and concerns were identified and discussed during the planning process:

- Increased recreation pressure on stream and river corridors and access points.
- Inventory and monitoring of ecological impacts from recreation. Inconsistent monitoring and maintenance of existing access sites, including informal access points.
- Assuring and maintaining a high quality recreational experience within stream and river corridors.
- Protection of water based recreational activities and high flows for boating and economic importance of river recreation.

In response to the identified issues and concerns the following objectives were developed:

1. Provide safe and appropriate recreational access to streams, rivers and lakes.
2. Monitor recreational impacts, provide public education, and manage recreational activities to assure and sustain the ecological health of streams, rivers, lakes and riparian habitats.

Background

A River Runs Through Us

The Eagle River and its tributaries support a wide range of recreational activities, and the number of residents and visitors taking advantage of

these opportunities has increased dramatically since 1996. Fishing, rafting, and kayaking are the most popular water related pursuits. Walking, biking, wildlife viewing, camping, hunting, cross-country and downhill skiing, golf, snowmobiling, jeeping, and horseback riding are also very popular. As much as these activities rely on the presence of healthy streams, rivers, lakes and riparian areas, they can also negatively impact the quality of these resources.

Access

The Eagle River and major tributaries like Homestake Creek, Gore Creek, Lake Creek, Brush Creek, and Gypsum Creek experience the most use of all the waterways in the watershed, and access conditions are varied. Many access points are provided for fishing only, while others have been improved for raft and boat put in and take out with limited parking. Some access is provided at parks where picnic tables and bathrooms are available, and several access points in Vail and Edwards are ADA accessible.

Access points are also provided at points along the regional trail system, but these generally do not provide formal parking or picnic areas. Most boat ramp areas provide trashcans, and some have restroom facilities. There are many access points where rivers and creeks flow through public lands. Two kayak parks are available to white water enthusiasts and are described later in this chapter under the topic of boating.

Paved recreational trails have been constructed in more developed areas, and provide access to riparian or riparian/upland zones for those more interested in exercising, sightseeing or wildlife watching. The location of these trails in sensitive areas represents a tradeoff between heightened user experience along the riverside and potential negative impacts to the riparian zone. The topic of recreational trails is also covered in greater detail later in this chapter.

The Eagle River Inventory and Assessment conducted by CSU in 2005 suggested a new long-term access plan for low impact recreation be implemented for the Eagle River Basin. That same year, Eagle County hired River Restoration, Inc. to inventory the status of river and stream access and recreational opportunities in the watershed. The resulting Eagle River Recreation Enhancement Plan (2006) provided a number of recommendations, ranging from boating hazard improvement projects to an organized approach for access that would facilitate public use and enjoyment while preserving the integrity of the river environment. The plan advocated developing high use access points at certain (strategic) distances along the river, maintaining low impact, dispersed uses in between these points as much as possible. Community centers would be

an obvious location for some of these higher use sites, which might or might not include a boat launch area and/or a whitewater park.

A number of sites have been developed to accommodate higher use in the basin, both within towns and also in unincorporated areas. The development of new access points, where necessary, can be accomplished through direct acquisition of riverside property, the negotiation of public access easements or through the development review and approval process. The creation of new access points, including ADA access where possible, should conform to established best management practices and design criteria, and should include provisions for long term oversight and maintenance. Approval of new access points should follow a process that includes participation by affected land management agencies, government officials, property owners or other stakeholder groups, as needed. A consistent sign program should be part of any basin-wide access plan.

Fishing

Fishing enhances our outdoor lifestyle in Eagle County. Virtually all streams and lakes in the watershed support fish, and very good fishing can be found in close proximity to community centers and residential areas. Fly-fishing is particularly popular, and involves wading into the water to access the best casting positions. Access points for fishing can be limited in lower reaches where streams and rivers flow through private properties. Those reaches that are available can become crowded at times, and riverbanks can be damaged by frequent visitation. Fish in these areas may become susceptible to disease from frequent stress and handling.

As previously noted in the Wildlife chapter, Colorado Parks and Wildlife (CPW) considers the Eagle River to be a good but not excellent fishery because of mining and urban impacts and warmer temperatures that become common in the late summer and early fall. For this reason some of the management strategies used on "Gold Medal" fisheries are not appropriate for the Eagle River. Gore Creek is not similarly impacted, however, and has been designated as a Gold Medal fishery between its confluence with Red Sandstone Creek and its confluence with the Eagle River.

Fly and lure-only regulations were imposed many years ago on the Eagle River to help maintain healthy fish populations, and catch and release fishing became a common practice, both as a matter of fishing ethics and also because of health concerns (metals contaminated fish) associated with water quality impacts from the Eagle Mine.



Fly-fishing places recreationalists in direct contact with aquatic and riparian ecosystems (Photo: Eagle County).

In 2008, the CPW released a report titled *the Economic Impacts of Hunting, Fishing and Wildlife Watching in Colorado*, which provided the most up to date economic impact projections of fishing revenue on a County level. According to the research, the total economic impact of fishing in Eagle County was \$38,820,000 (including direct and secondary expenditures such as lodging, transportation, clothing, dining and equipment). Of the 64 counties in Colorado, Eagle County ranks as the 8th highest in total economic benefit from hunting and fishing activity combined, including the generation of over 900 jobs related to recreation expenditures.¹

Boating

A second very popular form of recreation that places users in direct contact with riparian zones and local waterways is boating. The Eagle River and Gore Creek are the only drainages large enough for this activity, although a down-river kayak event was held on Lower Homestake Creek during the Teva Games. Boating only occurs during the spring runoff months, and while boaters access significant reaches of the stream during a float trip, riparian and stream bottom impacts are

generally limited to put-in and take-out areas. In Colorado, property laws prohibit a boater from stepping foot on privately owned riverbank or river bottom.



Commercial rafting companies offer runs through the Edwards area on the Eagle River during spring runoff (Photo: C. Simonton).

The number of boats on the Eagle River has increased dramatically over the past 16 years. Much of this use is devoted to fishing, and areas where fish were once isolated from pressure can now be subject to significant traffic during the rafting months of May, June and July. Private rafts with frames set up for fishing are seen in increasing numbers throughout the county, and there are few times during the spring when views of the Eagle River below Edwards do not include one or more fishing rafts.

At the writing of this Plan, rafters typically access the Eagle River at the following locations:

- Dowd Junction, across from the USFS Ranger Station
- Bob the Bridge in the Town of Avon, at the Beaver Creek pump house
- Lake Creek Village, adjacent to the Edwards Waste Water Treatment Plant

- The BLM Day Use Area, 2 miles west of Wolcott
- The Town of Eagle Information Center and Park
- The Eagle County Fairgrounds below the Fishing is Fun Bridge
- The BLM Campground just west of the Town of Gypsum

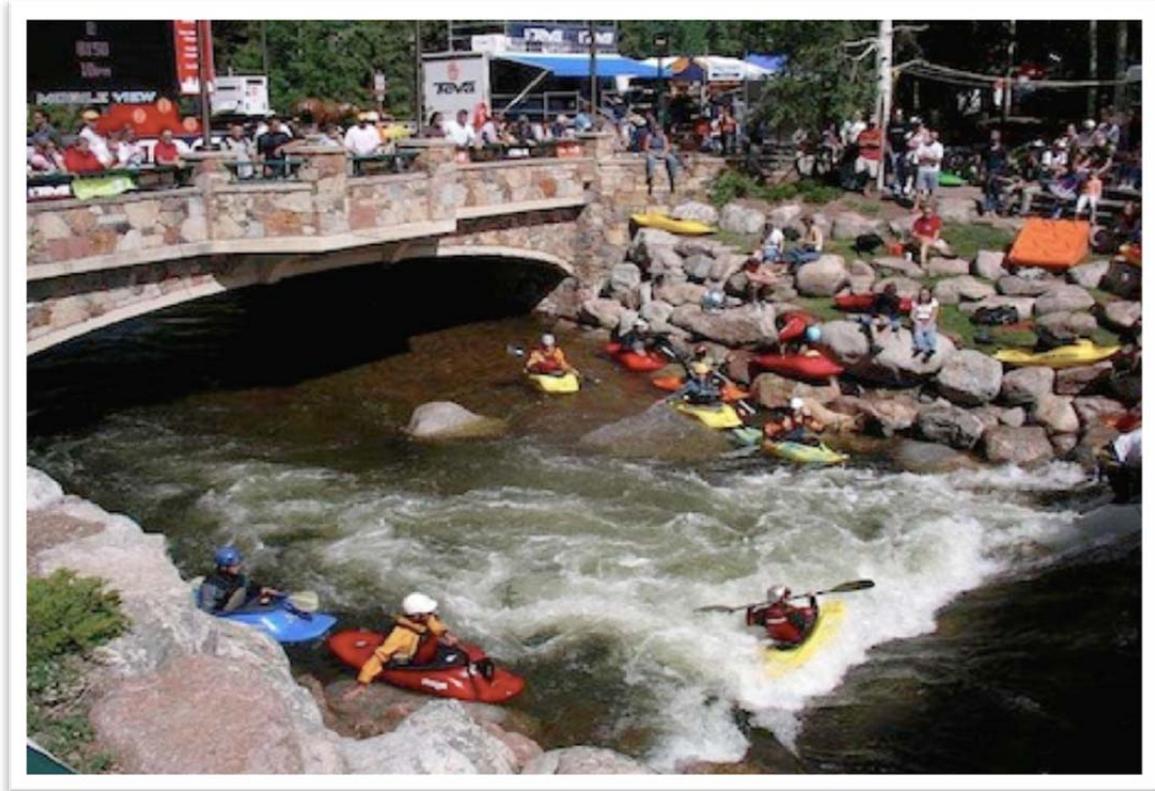
River bank improvements, parking, and other amenities vary considerably between the sites listed above. Only four of the locations provide trailer access to the water's edge. A new boat ramp is contemplated at the Rare Duck Open Space property located approximately four miles west of Gypsum, and improvements are proposed at the Town of Eagle Information Center site. Boaters would also benefit from a new ramp below Dowd Chutes, a take-out above Trestle Rapid at Wolcott, and a new launch site in the Town of Gypsum.

While private boating numbers are not presently tracked, statistics for the last 10 years also show steady growth in commercial rafting of the Eagle River. Much of this is generated by local businesses, but fishing outfitters are increasingly known to travel with their boats from surrounding counties to fish the Eagle. The BLM and Colorado River Outfitters Association (CROA) monitor commercial "user days" which are defined as a paying guest on a river for any part of a day. A report issued by CROA in 2010 found a 3.4% increase in commercial user days on the Eagle River during the boating season, with an almost equal split in commercial use of the Upper Eagle (Dowd Chutes) and the Lower Eagle (Edwards to Wolcott).

Kayaking is generally not a commercial venture, and private kayaking numbers are not tracked. There are some great kayaking runs on the Eagle River, however, and it is logical to assume that as the local population grows, so too will the numbers of kayakers. Kayaks are lightweight and easy to carry, and kayakers are not restricted to developed boat launches for access to the river. Impacts to stream banks and riparian areas from kayak use are generally light. Boaters often know a great deal about somewhat hidden access and egress points, and sometimes utilize private properties through handshake agreements. Local rafting companies or kayak shops should be consulted for current information on kayak access points.

There are two kayak parks in the watershed, where constructed river features allow boaters to 'play' in the river without having to float to a downstream take-out. The Vail whitewater park on Gore Creek at the International Bridge in Vail Village has an inflatable bladder system that changes the shape of the river bottom in relationship to high flows in order to maintain a 'fun' wave for kayakers and stand up paddle boards. Spectator viewing is very good, and this site has become the mainstay location for an annual kayak competition.

The Avon 350 foot long whitewater park on the Eagle River at Bob the Bridge was constructed with spectator seating on the river edge, access from the paved recreational trail system, and three water features offering beginning, intermediate and advanced paddling opportunities depending on flow conditions.



Vail Whitewater Park on Gore Creek, home of annual kayak competition each summer (Photo: ERWC).

Whitewater parks are an important part of local summer recreation that positively benefit our local economy and demonstrate the importance of natural flow regimes and peak flows. The use of Avon and Vail's whitewater parks is growing yearly, and other towns like Eagle and Gypsum may consider adding white water parks in coming years. Specific features, including foot paths, spectator viewing areas, boulder placements and other bank stabilization measures should be included in the design of new whitewater parks. Concentrated boating activities impact aquatic and riparian habitats, and the process for the approval of any new park should include consultation with local Colorado Parks and Wildlife officials.

The former TEVA Mountain Games, which center around the kayaking and whitewater events, was estimated to have brought 40,000 visitors to Vail and have a total economic impact of \$3.9 million dollars in 2009.² The

economic impact of commercial rafting can also be estimated using the results of a 2010 survey done by CROA. The study estimates \$115 was spent on average by each person per raft day. Including total spending such as lodging, transportation, clothing, and dining, an estimated \$830,903 was spent by people rafting on the Eagle River in 2010. Rafting revenues statewide have seen a dip of 7% from peak user days in 2007, due in large part to the national recession. ³

Recreational Trails

Recreational trails built for walking, running or biking are frequently located in riverside locations. These trails are typically paved, and require considerable engineering grading and cost to construct. Paved trail systems provide surfaces suitable for both road and mountain bikes, and provide connectivity to numerous other recreation opportunities, including developed parks, playgrounds, and side trails. Paved recreation trails along streams and rivers also connect neighborhoods to important social destinations like commercial retail centers, schools and community buildings. Eagle County is constructing a paved regional trail that will eventually connect the top of Vail Pass to Glenwood Canyon. This fully connected paved trail system between Summit, Eagle, Garfield and Pitkin Counties will be constructed in close proximity to streams and rivers in a number of areas as a result of topography and existing development. At the writing of this plan, over fifty percent of Eagle County's regional trail has been completed.

Trail alignments next to streams and rivers provide a cooler environment, beautiful scenery and excellent opportunities for wildlife viewing. However, paved trails within riparian corridors can also result in additional "renegade" trails being formed, and human activities sometimes damage riparian vegetation, disturb sensitive habitats and introduce trash and waste.

Eagle County maintains a regional trails plan which has specific design criteria aimed at avoiding or mitigating impacts to riparian and wetland resources. The Eagle County Regional Trails Plan is viewable online at http://www.eaglecounty.us/Trails/Eagle_Valley_Regional_Trails_Plan/).

Topography frequently necessitates the location of backcountry hiking trails next to streams and wetland areas. The popularity of certain trails and establishment of renegade or non-system trails and short cuts causes erosion and damage to sensitive riparian areas. High elevation lakes are seeing increased usage and the need for new fire rings and tent sites, many of which become located too close to water resources.



Regional and local paved trails often provide access to other types of trail systems, like the miles of mountain biking and hiking trails throughout the Brush Creek valley (Photo: mountainbikeeagle.com).

Backcountry camping in Eagle County draws visitors from around the world, and as visitation grows increased management will be necessary to prevent damage to sensitive areas.

Quality of Experience and Dispersed Recreation

To a large degree, the feeling and perception of solitude is an essential aspect of many Eagle County recreational experiences. This is particularly true for fishing, hiking, wildlife viewing, rafting, and kayaking. Resource damage, over-handling of fish and crowding on stream and river recreation sites are issues that can detract from the quality of water related recreational experiences. The Eagle River corridor from Minturn to Gypsum has become increasingly urban, particularly in the Vail to Edwards and Eagle to Gypsum areas. This increases the potential for riparian impacts, and decreases opportunities for quiet reflection and solitude.

The relatively brief window of opportunity for commercial and private boaters to get on the river during higher flows can cause congestion at

put-in and take-out areas, and can also create the perception of crowding on the river itself. Rafters frequently desire to stretch their legs or fish from shore during their float trip, and this activity must occur at the limited areas where riverbanks are not privately owned – areas where wade fishermen will already be present.

Conflicts between recreational uses along the river are minimal at this time, especially since most rafting and kayaking occurs in the early summer when the river is too high to be available to wade fishermen. Inevitably, though, as use by all river based recreational activities becomes increasingly focused into limited areas so will the potential for conflicts that detract from the quality of experience.

Managed Access

The health and sustainability of fishery resources presents a complex and multifaceted rubric that requires frequent study and analysis. While overcrowding has not become an issue yet, management strategies, including the possibility of implementing permit or user fee systems, will become increasingly important to assure high quality fishing experiences remain available for both rafters and wade fishermen.

Oversight and management of access points is generally inconsistent throughout the watershed. Signage, vegetative exclusions to protect riparian zones, and improved surfaces and drainage at existing boating access points can help mitigate impacts on the fishery from recreation. Recreational trails constructed in proximity to rivers and streams corridors should be designed to minimize potential impacts to stream banks and wildlife habitat. The closure and re-vegetation of non-system trails and campsites on public lands is one method employed by the BLM and USFS to lessen the impact of dispersed recreation on river resources.

Stricter fishing regulations may be required in some areas. Some portions of the Eagle River may need such designations as “artificial flies and lures only”, while allowing bait and spin fishing in other areas. The Arrowhead CPW lease currently has an “artificial flies and lures only” designation. The CPW may also need to improve enforcement of regulations designed to protect or enhance fishery quality. New areas that become available for recreation to the public, like lower Brush Creek through Eagle Ranch, should be closely monitored to assess cumulative recreation impacts.

Creating detailed up to date river recreation and access maps can help to promote safety and understanding of the river and tributaries, protect riparian and other sensitive environmental areas, and direct users to areas designed to accommodate access. River recreation maps should include, but are not limited to:

- River and stream access points and parking areas
- Locations of reaches suitable for boating
- Significant rapids and/or navigation hazards
- Promotion and explanations of river ethics
- Identification and treatment of sensitive environmental areas including bilingual translation as needed

Public education and managed access improvements alone will not guarantee a high quality and sustainable aquatic habitat. Recreation has become more widespread as a result of community growth and adverse impacts to water quality and riparian habitats have increased. Continued monitoring and reporting of riparian and fishery conditions will assist CPW management in making sound decisions related to the protection of river habitats. Studies on recreation impacts could include creel census, user surveys, fish counts, habitat inventories, etc. Results of this monitoring can be made public at presentations like Waterwise Wednesdays hosted by the ERWC, or on a web site.

Administration and Oversight

Currently, there is no comprehensive plan or program that ensures management or long-term maintenance of existing access points on the river, particularly in unincorporated areas. Entities involved with or capable of managing river access and the quality of the river experience should work collaboratively to better monitor and control access throughout the basin. Periodic stakeholder meetings should be conducted. The designation of a management agent or agents for various access points, especially on lands in unincorporated areas, could be helpful. Commercial guides can actively participate in maintenance activities, and can regularly report access conditions to land managers.

Restrictions to and permitting of private use and commercial outfitter use may become necessary. Private users could also be required to work within a permit system to control amount of use and ensure an appropriate level of river ethics education. Commercial outfitters could be tasked with the management and policing of various boat launch areas, and other locations where they might frequently stop to allow guests to stretch or fish. A "fee for use" could be implemented for all users that could help fund management programs. Regulatory revisions or actions of any type should be carefully considered and should not be implemented without sound justification and appropriate agency and public involvement.

The Eagle River Watershed Council is one entity that can assist in monitoring and managing recreation impacts. This non-profit group founded in 2004 can also play a key role in planning and supervising volunteer efforts to rehabilitate overused recreation areas along streams like Homestake Creek. Municipal governments have jurisdiction over many high use recreational areas, and should be included as plans and strategies are updated to provide quality activities while protecting water resources. Public land and natural resource management agencies like the USFS, BLM and the CPW obviously play an important role on federal or state lands, and/or in backcountry areas. In some instances, boating and fishing access points can be managed by commercial rafting and fishing companies and entities like Eagle Valley Trout Unlimited.

River Recreation Goal: Water related recreational activities and associated businesses thrive in Eagle County in a manner that respects the quality of water resources and riparian habitats, and contributes positively to our high quality of life and resort tourism economy.

River Recreation Objectives, Strategies and Actions (items not listed in order of importance or priority)

Objective 6.1: Provide safe and appropriate recreational access to streams, rivers and lakes.

Well-designed access points on the Eagle River and its tributary streams are necessary to accommodate the variety of recreational activities enjoyed by residents and visitors to Eagle County. Access sites should be located and designed to assure functionality, and to guarantee the long-term protection of natural ecosystems and environments within the basin. Plans for new access points, or improvements to existing sites, should follow a basin-wide low impact recreational strategy, employing basic design criteria consistent with recommendations of the 2006 *Eagle River Recreation Enhancement Plan* and the intents and purposes of this Watershed Plan.

Strategies/Actions:

1. Establish a collaborative program to evaluate conditions and implement improvement and/or maintenance projects for all existing public access points.

2. Where determined necessary and appropriate, create new public access points.
3. Eliminate and/or strongly discourage the use of inappropriate or illegal river and stream access points. Develop site specific reclamation plans to restore damaged riparian areas and riverbanks to a natural and stable condition.
4. Encourage the establishment of well-maintained higher use access sites at the beginning/end of defined river and stream "reaches", and work to avoid concentrated access impacts at locations in between.
5. Where compatible, promote the installation of new and appropriately engineered and amenitized whitewater parks.
6. Provide adequate parking and safe pedestrian routes at boat ramps and popular fishing access points.
7. Provide appropriately designed and managed restroom facilities at higher use access sites.
8. Design and maintain all access sites to avoid impacts to riparian areas and water quality. Minimize impacts from channel work and bank stability projects by employing appropriate de-watering, sediment control and revegetation strategies. Avoid footpath alignments along rivers and streams that negatively impact sensitive wetlands or riparian habitats.
9. Where appropriate, encourage the creation of access easements or lease arrangements for walking access across private properties.
10. Design road bridge embankments to accommodate foot passage by recreationalists (and wildlife).
11. Design recreational trails to avoid unnecessary impacts to riparian corridors (consult the Eagle County Regional Trails Plan for design criteria). Where practical and appropriate, create river and stream access points that connect to the paved recreational trail systems.
12. Consider the construction of ramps and other improvements that would allow river visitation and fishing by physically handicapped recreationalists.

Objective 6.2: Monitor recreational impacts, provide public education, and manage recreational activities to assure and sustain the ecological health of streams, rivers, lakes and riparian habitats.

Regular monitoring of recreational impacts and management of recreational uses are key elements in providing quality experiences and protecting sensitive fishery and riparian habitats. Looking forward, visible maintenance activities, site controls and readily available information regarding uses, impacts and regulations will help to shape public opinion and public expectations for high quality river and stream recreational opportunities.

Strategies/Actions:

1. Maintain river recreation access maps for public in easily accessible locations like fishing shops, motel lobbies and the web.
2. Provide appropriate regulatory, informational and educational signage at boat ramp and fishing access points. Work to establish a uniform and easily recognizable "brand" and appearance for river access signage throughout the watershed.
3. Monitor the health and vitality of fish populations in local streams, rivers and lakes and make information available to the public.
4. Enforce existing and implement new boating and fishing regulations, access restrictions and/or habitat improvement projects where necessary to ensure the long-term viability of fishery resources.
5. Monitor impacts to riverbanks and riparian vegetation at river access sites. Install signs, modify trail alignments or implement temporary or permanent closures to mitigate damages. Implement measures to minimize impacts to riparian areas and wildlife from domestic pets.
6. Limit camping to officially designated sites along the Eagle River and tributary streams. Support efforts by the CPW, the BLM and the USFS to enforce regulations designed to protect the quality of stream and river related recreational activities in backcountry areas and throughout the watershed.
7. At access points where management does not exist, establish long term care and maintenance responsibilities by a qualified agency or entity. Promote cooperative arrangements between government agencies, towns, commercial entities and other stakeholder groups to monitor, control and adequately manage river access sites.
8. Consider a river use permit and/or fee program to minimize impacts from overcrowding, and to generate funds for on-going river access management and maintenance. Consider dial-a-clock or other

systems at boat ramps to help separate boat launch times, improving river floating experiences.

9. Monitor floatable reaches of Gore Creek and the Eagle River for navigation hazards and implement appropriate corrective actions to ensure safe boat passage. Avoid structural improvements in stream and river corridors that would create new hazards.
10. Promote fish stocking at lakes and ponds near community centers to enhance fishing opportunities on lands that are more easily managed and less susceptible to damage.



Chapter 7

Colorado River

Colorado River Goal: The Colorado River is conserved and restored in a way that positively reflects our community values, carefully balancing public access and recreation, agriculture, land use and water supply needs of the State and basin.

Overview of Colorado River Issues and Objectives

The 1996 Eagle River Watershed Plan did not include a discussion of the Colorado River, which drains the northwestern corner of Eagle County. This watershed corridor is a valuable asset of increasing importance to local lifestyles, the local economy and the overall environmental integrity of the region, and it is appropriate that the updated watershed plan be expanded to cover this drainage. Several issues and concerns were identified and discussed during the planning process:

- Lack of coordinated planning between governments and agencies to address watershed issues.
- Lack of a comprehensive baseline inventory and assessment, including water quality data, to establish ecological restoration and conservation priorities.
- Complications of water resource planning given upstream and downstream influences that affect that portion of the river that flows through Eagle County.
- Concerns about future water development, ranch and agriculture conversion to other land uses, and other competing interests.
- The potential for overuse by recreationalists and subsequent impacts both on and off the river.
- Risks to the river environment from railroad corridor activities.
- The lack of local familiarity, and local stakeholder engagement.
- Impacts from flow manipulation, sedimentation and salt.

In response to the identified issues and concerns, and in support of the goals for the Plan, the following objectives were developed:

1. Protect and enhance the values of the Colorado River watershed in Eagle County through coordinated efforts that balance agricultural, recreational and environmental interests.
2. Obtain and utilize the best available water quality and water quantity data to inform resource management agencies and land use decision makers.
3. Strengthen relationships between Eagle County officials and other Colorado River partners to assure success of long term environmental and land use objectives.

Background

The Upper Colorado River headwaters originate in Grand County and encompass a large area of 1,869 square miles. The watershed includes parts of Routt, Eagle and Garfield Counties.

As it passes through Eagle County the corridor is typified by spectacular scenic vistas, large ranches and scattered residential and recreational sites and trailheads. Steep canyon walls and unique rock formations combine with irrigated pastures to frame the river as it flows through semi-arid lands on its way to Glenwood Canyon. The river represents one of the state's most important ecological, recreational, agricultural, and economic resources, and plays a critical role in linking together multiple conservation values of Colorado's mountain landscape, including critical wildlife habitat, significant wetlands and riparian areas, working farms and ranches, scenic open space and river recreation like rafting and fly fishing.

The Colorado River below Glenwood Springs is impacted by agricultural diversions, like those in the Grand Junction area, and large in-channel reservoirs like Lake Powell and Lake Mead in Utah and Arizona. In contrast, and with the exception of reservoirs and trans-basin diversions near its headwaters, the Upper Colorado River is relatively free flowing and retains many of its natural attributes despite significantly diminished flows.

The Colorado River Conservation and Restoration Projects (CORCP) inventory and assessment will address multiple issues and needs arising from the lack of a comprehensive ecological inventory for the Eagle County reach of the Colorado River. The lack of an ecological baseline and recommended management and restoration strategy on this reach of river jeopardizes environmental, recreation and consumptive uses due to a dearth of knowledge of existing water quality, aquatic habitat conditions and riparian habitat conditions of the river on both public and private lands.

The CORCP will identify the variety of potential conflicts that exist between Colorado River stakeholders. For instance, the BLM has simultaneously recognized "Outstanding Resource Values" associated with recreational float boating, fishing and wildlife viewing while the same agency's 2012 draft *Resource Management Plan* identifies land along the reach as having "medium potential" for oil and gas leasing. The Eagle County Conservation District has targeted this area as a streambank management zone, while the Colorado River Outfitters Association has identified significant future capacity for increased commercial boating on the reach from State Bridge to Glenwood Springs. Eagle County has recently acquired several open space parcels to improve recreational access to the river.

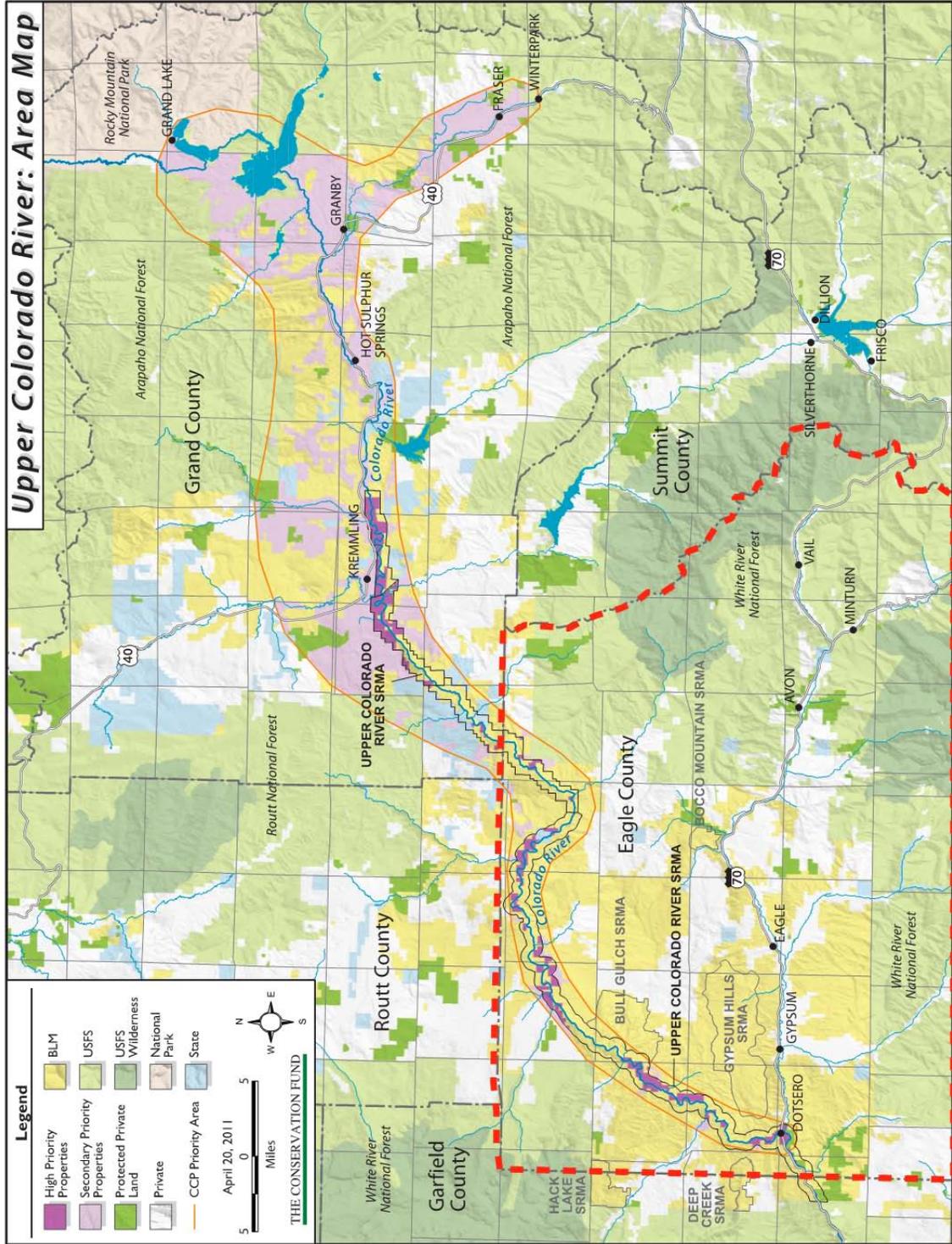
Pairing results of the CORCP baseline inventory with both upstream and downstream information and management plans for the river (including Grand County and the Middle Colorado River Partnership) has the potential to better manage and address future non-consumptive and consumptive water use and related activities on public and private land, and to preserve and enhance the Colorado River through the work of multiple jurisdictions, agencies and organizations.

Water Quantity

Given future demands and the nature of trans-basin diversion operations upstream in the Grand Lake area, maintaining sufficient flow regimes in the Colorado River through Eagle County is a significant concern for the future. While the senior water rights that exist at Shoshone in Glenwood Canyon and further downstream at Cameo in Grand Junction provide some guarantee that minimal flow levels will be sustained, the flushing flows that are essential to the maintenance of high quality aquatic and riparian habitats, and to the attraction of the corridor to recreationalists, continue to be threatened.

In July 2011, the Colorado Water Conservation Board (CWCB) unanimously approved a motion to appropriate in-stream flow rights for the Colorado River in both Eagle and Grand Counties. In-stream flow rights, though junior to established municipal and agricultural water rights, provide at least some measurable protection to river flows. Although scientific study conducted by Eagle County as part of the submittal process for instream flow rights points to the necessity of even greater minimum flows than those approved by the CWCB, the establishment of these flows should be viewed as a significant action in preserving aquatic habitat and recreational potential. As opportunities arise, Eagle County

Upper Colorado River: Area Map





Late fall on the Colorado River, a time when river flows can be boosted by the groundwater stored from summer flood irrigation on many agricultural properties (Photo: Eagle County).

should work with Colorado River water rights stakeholders to implement strategies that would increase stream flows for recreational and ecological purposes, as recommended by this Plan.

An agreement of historic proportions was also reached in 2011 between Denver Water, Grand County, Summit County, Eagle County, the Colorado River District, the ski industry and other main stem Colorado River basin water interests. The proposed "Colorado River Cooperative Agreement", five years in the making between 35 stakeholders, will remove opposition to Denver Water's Moffat Collection System Project in exchange for environmental enhancements and financial incentives to various entities on the West Slope, including opportunities for Denver Water to manage flows for the benefit of the environment in Grand County. Importantly, the Shoshone hydroelectric power plant in Glenwood Canyon – whose historic 1905 non-consumptive water right has acted as a de facto minimum in-stream flow right – is part of the package of protections being offered in this agreement. A complete copy of the agreement and press release is available at <http://www.crwcd.org/>.

In early 2012, Eagle County became the first entity to sign the Colorado River Cooperative Agreement, which is expected to be fully executed by the end of 2013. Eagle County is party to the agreement as a result of the possible Wolcott reservoir, which could require piping water from the confluence of the Piney and Colorado River in addition to filling the reservoir from the Eagle River. Water from a reservoir at Wolcott would be released into the Eagle River to augment reduced flows on the Colorado River caused by additional trans-basin diversions upstream in Grand and Summit Counties.

While there could be some local benefits of the reservoir to the Eagle River below Wolcott, upstream reaches of the Colorado River could be further dewatered, negatively affecting river corridor values. A full copy of the Wolcott feasibility study is available at http://www.crwcd.org/page_5.

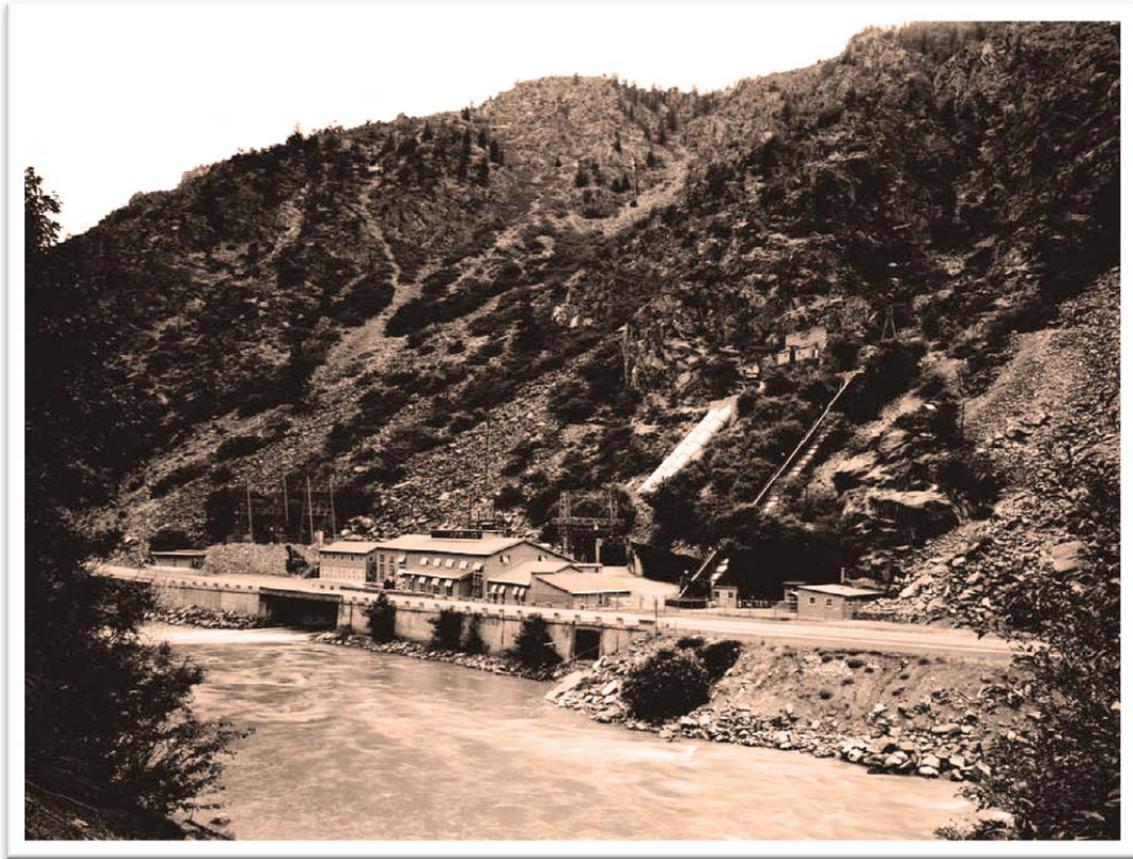
Water Quality

A NWCCOG report in 2002 indicated that water quality issues on the segment of the Colorado River in Eagle County would most likely be associated with upstream trans-mountain water diversions (flow manipulation) and sediment and solids loading from non-point sources. In their work to update this Plan, members of the Partnership Advisory Team echoed these assumptions and added the possibility of water quality impacts from transportation corridor activities, recreational uses and agricultural uses within the corridor.

Water quality monitoring has been conducted at two sites on the Colorado River in Eagle County, one at State Bridge and the other near Dotsero. Testing at the State Bridge site in 2008 indicated generally dilute water of good quality with low dissolved solids, nutrients and metals concentrations. Below State Bridge, the river becomes more susceptible to sediment and dissolved solids, prompting the Eagle County Soil Conservation District to designate this segment of the river a "stream bank erosion management area". Projects like the recently completed bank stabilization of East Red Dirt Creek are intended to reduce the potential for erosion and improve water quality conditions.

While testing by the USGS near Dotsero indicates generally higher amounts of sediment and other contaminants than found upstream at State Bridge, water quality is still good, with high dissolved oxygen levels and low amounts of dissolved solids and nutrients.

The Grand County Water Information Network (GCWIN) has been collecting information since 2010 on a variety of water quality parameters, including pH, turbidity, nutrient levels, conductivity and temperature.



The historic Shoshone Power Plant built in 1909 - one of the earliest hydroelectric plants on the Colorado River - depends on the available flow of a river for its source of power rather than on stored water of a reservoir (Photo: www.historic-structures.com).

Samples are gathered monthly from May to October, and include a site at Pumphouse, which is located just north of the Eagle County line. This information could be useful in determining trends for water quality in the Colorado as it flows through Eagle County. Data from these efforts can be viewed at <http://www.gcwin.org/our-programs/monitoring.html>.

Land Use

With the exception some large ranching operations north and west of Burns, private lands are limited along the Colorado River in Eagle County. Smaller agricultural operations are scattered along the river bottom, as are small pockets of single-family homes. Significant expanses of public land separate these isolated areas of human activity. The Colorado River Road follows the river closely in many areas, sharing available space with the tracks of the Union Pacific Railway that parallel the river for its entire length. Recreational uses impact certain sections of the river more than others, as further detailed in this chapter.



Sampling for the prevalence of aquatic macroinvertebrates (bugs that live in the river) is a technique often used to determine localized water quality issues (Photo: ERWC).

Recent BLM resource management plans indicate the possibility of oil and gas exploration along the Colorado River. While not considered an immediate threat to the corridor in Eagle County, mineral and resource extraction activities such as hard rock mining and oil and gas exploration should be strongly discouraged, as they may result in impacts that are inconsistent with the goals and objectives of this plan.

Community values of the corridor include scenic vistas, agriculture, and preserving the quality of recreation and tourism, all of which are incompatible with the impacts that industrial scale resource extraction activities could bring to the area. Conservation efforts on agricultural and public range are a key factor in riparian areas within the Colorado River watershed. Working with ranch managers, landowners, BLM, USFS and local stakeholder groups like the ERWC and Eagle County Soil Conservation District, Eagle County can incentivize and implement strategies to repair damaged or degraded riparian zones on public and private lands.



Bottomlands along the river support ranching activities, and accommodate road and railway easements. The 1,000-acre Colorado River Ranch north of Dotsero has recently been protected with a conservation easement (Photo: C. Simonton).

Recreation

The eight-mile reach of the Colorado River from the Grand County line to State Bridge (Gore canyon is in Grand County) is heavily used by rafters and fishermen. This section is located within a BLM Special Recreation Management Area. In 2010, over 65,000 recreationalists registered at the three access points monitored by the BLM and available for rafting put in and take out (Rancho Del Rio, Yarmony Bridge and State Bridge). Another heavily utilized rafting access site that affects this reach begins at Pump House, which is located just north of Eagle County in Grand County.

In contrast, the approximately forty-five mile reach of the river below State Bridge and above Sweetwater receives very little recreational rafting use due mainly to the lack of public access points that allow reasonable float distances. The established put in and take out points along the river in this reach include State Bridge, Catamount, Pinball Point, Cottonwood Island, Lyon's Gulch and Dotsero. Not all of these provide trailer access to the water, and the distances between them range from too short to too long. Of these access points, the Cottonwood to Dostero reach sees the majority of rafting traffic during summer months.

Within the Colorado River corridor there are also numerous points of access to public lands, most significantly the Flat Tops Wilderness area. Recreationalists utilize areas like Deep Creek, Sweetwater Lake, Derby Creek Road and the entrance to the Bull Gulch Wilderness Study Area to reach unique settings for hiking, camping, fishing, biking, hunting, four-wheel driving and snowmobiling. Popular activities along the main stem of the river itself are generally limited to floating, wade fishing, hunting and camping.



The Colorado River in Eagle County, particularly above State Bridge, is a popular destination for both commercial outfitters and private boaters (Photo: C. Simonton).

At the writing of this plan the BLM is working to finalize its new Resource Management Plan. A number of alternative management approaches are being considered for the RMP that could influence the types and intensities of use that would be allowed along the Colorado River Corridor. Key concerns identified by the ERWC of the draft Resource Management Plan include the increased possibility of oil and gas exploration and leasing, and the lack of regular management presence of the BLM staff to address increased recreation use on the river.

The lack of recreational access in the corridor has also recently drawn the attention of Eagle County officials. In 2011 and 2012, the County worked with the BLM to acquire river front properties along the Colorado using its

open space fund to construct new public boating access points between State Bridge and Dotsero. Increasing public enjoyment of this underutilized section of the river is an important goal for the County, as it will further incentivize the preservation of river flows and other recreational attributes of the area.

The increasing popularity of recreation on the Colorado River in Eagle County will place additional pressures on sensitive riparian habitats. There are sites along the river popular for camping, and beaches and grassy banks that are popular as stopping points for rafters and kayakers. Riparian vegetation can become trampled, trash and waste disposal can become an issue, and the quality of wildlife habitat can be compromised. Land management agencies and recreation stakeholder groups should work together to monitor impacts to riparian areas, and to implement strategies designed to minimize impacts from these activities to the river environment. Recreation activities should be closely monitored and managed and have local stewardship and enforcement presence.

Wildlife

Riparian and aquatic habitats along the Colorado River are similar to those found in the Eagle River Watershed, although they reflect a lower elevation and drier climate, and a warmer average water temperature. The Colorado River through Eagle County is comprised of river habitat that can either be classified as either canyon-bound or meandering. The habitat in these distinguishable reaches influences the local fish populations.

In Eagle County, the Colorado River fishery is comprised of both cold-water fish species (trout, whitefish, sculpin) and warm-water fish species (native and non-native suckers, chub, and dace).

In the canyon-bound reaches, fish habitat is characterized by steeper gradient, large substrate, and higher velocity waters punctuated by deep pools. These reaches are dominated by adult trout and whitefish, which prefer these areas to feed and inhabit most of the year. On the other hand, the meandering reaches provide spawning and rearing habitat for trout and whitefish reproduction due to presence of spawning gravels, fry and juvenile refuge from predators is available, and slightly warmer temperatures promoting fast growth for young fish. The meander river reaches also provide habitat for native non-game fishes like flannelmouth and bluehead suckers, and roundtail chub.

The lower reach of Colorado River in Eagle County near Dotsero has been observed to be particularly good reproductive habitat for rainbow trout, mountain whitefish, and flannelmouth sucker. Sculpin are abundant in the

cooler, faster waters and provide excellent forage for trout, while dace can be found in the meandering reaches, providing forage for trout during cooler months that encompass their reproductive periods. The occasional cutthroat trout may also be found in the Colorado River in Eagle County, most likely exploring the river from tributary streams that contain populations of this native trout.

Colorado Parks and Wildlife has managed the fishery in the Colorado River in Eagle County primarily as a Wild Trout Water. This means that the fishery has been sustained by wild reproduced trout, particularly rainbow and brown trout. However, since the introduction of the whirling disease, the rainbow trout fishery has severely declined and has caused a need for supplemental stocking of rainbow trout. Recent stocking efforts of the CPW of a strain of rainbow trout that have developed a resistance to whirling disease should reestablish a wild rainbow fishery in this section of river.



The Colorado River near Derby junction – unspoiled natural beauty in a rural setting (Photo: K. Neubecker).

Colorado River Goal: The Colorado River is conserved and restored in a way that positively reflects our community values, carefully balancing public access and recreation, agriculture, land use and water supply needs of the State and basin.

Colorado River Objectives, Strategies and Actions (items not listed in order of importance or priority)

Objective 7.1: Protect and enhance the natural values of the Colorado River watershed in Eagle County through coordinated efforts that balance agricultural, recreational and environmental interests.

Growth in the popularity of the Colorado River Corridor as a recreational destination and in the demand for Colorado River water both upstream and downstream from Eagle County is a significant management consideration. Successful conservation of the natural values of the river will require a balancing act of interests, monitoring, restoration work, collaboration and good planning and communication. In order for any restoration or rehabilitation work on the Eagle County reach of the Colorado River to have lasting value, it will be important to recognize upstream and downstream influences and proactively identify future threats and opportunities on the river. The Red Dirt Creek restoration project administered by USFS and CDOW with the assistance of ERWC volunteers in 2010 is a good example of such a coordinated effort.

Strategies/Actions:

1. Support efforts to restore and/or enhance damaged riparian resources within the drainage basin.
2. Provide consistent guidance to federal agencies through their permitting and management plan updates to avoid impacts from mineral and resource extraction activities.
3. Regularly monitor recreation impacts on the Colorado River.
4. Only approve new storage projects or the expansion of existing storage projects that provide local stream flow augmentation. New storage facilities (excepting new water storage tanks) should bypass sufficient flows or dedicate a portion of the available yield for the maintenance or enhancement of stream health and aquatic habitats as a community/public benefit.
5. Ensure that augmentation efforts to supplement flows in one drainage do not negatively impact stream health in an adjacent drainage.

6. Establish a partnership between Eagle County and the CWCB to develop and incentivize water efficiency improvements and/or new legislation, creating unused water that would then be available for contracting to the CWCB for instream flow purposes.
7. Support open space acquisitions that result in the preservation of quality riparian habitats.
8. Retain and encourage appropriately managed agricultural uses along the Colorado River in Eagle County. Support appropriate irrigation practices and work with ranchers to avoid activities or disturbances that damage riparian areas.
9. Recognizing that stream flows can drop below CWCB instream flow levels under natural conditions, and that this condition may be further compromised by use of water rights senior to the CWCB instream flows, encourage water management strategies and projects that enhance stream flows during times when flows are below CWCB levels. Such efforts should include a combination of new private water trusts, legislation or other creative means to 'loan' water rights to instream flow purposes.
10. Where appropriate, expand existing in-basin storage or water supply operations to provide local stream flow augmentation.
11. Construct new in-basin water storage facilities that contribute to long-term watershed health, and that result in positive impacts to Eagle County's economy and environment. Locate new facilities at higher elevations to benefit stream segments above diversion points.
12. Maximize the dilution of watershed contaminants by maintaining adequate flows in streams and rivers. Where individual reaches of rivers or streams are identified as impaired or having inadequate flows, craft and implement Streamflow Management Plans (Please see Chapter 2 for more detail).
13. Support and implement sediment control plans along transportation corridors, on construction sites, on agricultural properties and for resource extraction projects. Regularly monitor short term and long term erosion and sediment control plans for effectiveness.
14. Work with the Forest Service and BLM to monitor and mitigate water quality impacts from grazing and recreational activities on public lands.
15. Avoid the alteration of river or stream channels except in those instances where work is required for channel stabilization, aquatic habitat improvement, recreation access improvements or irrigation

structures. Strategically program and coordinate any in-channel activities to minimize impacts on water quality.

16. In the event that new residential lots are approved, configure lot lines to avoid ownership of riparian zones and stream channels by individual homeowners. Locate habitable structures far enough from riparian vegetation to avoid impacts to trees and shrubs resultant from wildfire mitigation requirements.
17. Avoid the installation of onsite wastewater treatment systems (OWTS) in close proximity to rivers and streams, and where installed incorporate best design, maintenance and monitoring technologies.
18. Monitor fish for signs of stress and implement fishing restrictions/regulations accordingly. Balance the need for stream and river access with the need to protect sensitive riparian environments.
19. Work with ranchers to maintain the solitude and quality of riparian habitats and wildlife connectivity on agricultural properties. Encourage the use of best management practices to allow livestock to obtain water with minimum impact to riparian areas. Work with the CPW, BLM, USFS, Eagle County Conservation District and the NRCS to inventory, monitor and promote riparian restoration on agricultural lands.
20. Manage recreational access, provide buffer zones between human activity and sensitive lands and monitor the function of critical wildlife areas associated with streams and rivers.

Objective 7.2: Strengthen relationships between Eagle County officials and other Colorado River partners to assure success of long term environmental and land use objectives.

Focusing just on the Eagle County reach of the Colorado River will not necessarily guarantee success of the objectives and strategies of this plan. Eagle County should consistently communicate with other Colorado River partners.

Strategies/Actions:

1. Work cooperatively with agencies and stakeholders upstream and downstream of the Eagle County reach of the Colorado River to protect and positively enhance the resource.
2. Recognize upstream and downstream influences on the Colorado River, and coordinate efforts with partners engaged in protecting the resource.

3. Continue negotiations with trans-mountain diverters, and implement strategies to minimize the impacts of future trans-mountain diversion projects.
4. Promote compatible land use practices and management activities on public lands that protect and enhance water resources.
5. Promote educational programs directed at protecting wildlife habitat, reducing stress on fish and avoiding the spread of disease and aquatic nuisance species.
6. Coordinate with state, national and local agencies to maintain non-fragmented interconnected wildlife habitat. Consider the importance of ecosystem connectivity measures, especially those that connect upland areas with riparian habitats, during development review and approval processes.
7. Provide information and incentives to encourage owners of residential properties with stream or river frontage to maintain or enhance the condition of riparian habitats on their land.
8. Support collaborative efforts between private stakeholders and public organizations and agencies involved in river channel restoration projects.
9. Encourage collaborative master planning, project coordination, monitoring efforts, management efforts and the sharing of information on a regional basis between all agencies and jurisdictions engaged in water quality monitoring and water use management.
10. Promote the use of and provide easy access to the contents of this Watershed Plan through town, county, service district and management agency web sites. Support efforts and activities designed to inform and enhance local knowledge of water supply and water quality issues.
11. At access points where management does not exist, establish long term care and maintenance responsibilities by a qualified agency or entity. Promote cooperative arrangements between government agencies, towns, commercial entities and other stakeholder groups to monitor, control and adequately manage river access sites.
12. Encourage the establishment of well-maintained higher use access sites at the beginning/end of defined river and stream "reaches", and work to avoid concentrated access impacts at locations in between.

Objective 7.3: Obtain and utilize the best available data to inform resource management agencies and land use decision makers.

While considerable information is available for the Colorado, a comprehensive baseline of the river's ecological condition and potential restoration projects has not been completed. Water quality data is limited and monitoring of the river has only occurred above Eagle County in Grand County and at Dotsero by the USGS. Data efforts should be focused on better monitoring and the collection of data useful to inform water policy decisions.

Strategies/Actions:

1. Complete the baseline inventory and assessment for the Colorado River reach in Eagle County.
2. Use resource inventory, trend analysis and restoration plans to implement restoration, conservation and enhancement projects that benefit water quality and increase public awareness of the importance of healthy rivers and streams.
3. Support the efforts of special interest groups and government agencies to provide frequent river and stream related activities, volunteer opportunities and educational sessions.
4. Improve collaboration, documentation, and information sharing practices between stakeholders to streamline data collection efforts where practical, minimize redundancy, and ensure that data is properly documented to reduce the risk of misinterpretation.
5. Focus water quality data collection efforts with greater frequency at a greater number of sites based on trends or parameters of concern. Include tributaries where development or disturbances may be impacted water quality.
6. Support and participate in the work of agencies and organizations that monitor water quality in streams, rivers and ground-water aquifers. Assure conformance with applicable provisions of NWCCOG Regional Water Quality Management Plan (208 Plan).
7. Assure that water quality data and trends analysis is available to all stakeholders and interest groups. Streamline data collection efforts where practical, minimize redundancy, and ensure that data is properly documented to reduce the risk of misinterpretation.
8. Work with the Colorado Parks and Wildlife to monitor and avoid impacts to aquatic habitats from disease and nuisance species.

9. Monitor the health and vitality of fish populations in local streams, rivers and lakes and make information available to the public.
10. Where individual reaches of rivers or streams are identified as impaired or having inadequate flows, craft and implement Streamflow Management Plans that offer creative and cost effective strategies to address ecological, domestic, recreational and agricultural water needs. Stream management plans can include:
 - Modeling based on or comparable to the IFIM methodology;
 - Recommendations for desired ecological flows to support natural stream flow variability (low, base, maintenance and flushing flows);
 - Recommendations for other approaches to improving and sustaining the stream or river in question, including water and land conservation techniques or bed and bank enhancements.
11. Implement objectives, recommended actions and best management practices and strategies where applicable to the Colorado River and supported by this plan.

Continuing Education

In combination with Goals, Objectives and recommended Strategies and Actions in this Plan, these web links provide guidance to citizens interested in watershed management practices and continuing education:

River/Creekfront and Wildlife BMP's

<http://water.epa.gov/type/wetlands/index.cfm>

(US EPA wetlands information homepage)

<http://cwcb.state.co.us/technical-resources/floodplain-stormwater-criteria-manual/Pages/main.aspx> (CWCB guidelines for floodplain practices)

<http://purl.access.gpo.gov/GPO/LPS92173>

(USDA riparian buffer design guidelines for water quality and wildlife habitat function on agricultural lands, 2008)

<http://www.co.nrcs.usda.gov/programs/eqip/eqip.html>

(NRCS Colorado Environmental Quality Incentive Program)

<http://coloradoriparian.org/GreenLine/index.php>

(Newsletter of the Colorado Riparian Association)

<http://www.coloradocattle.org/ranchinglegacyprogram.aspx>

(Colorado Cattleman's Association information to equip ranchers to be innovative leaders in management and conservation)

<http://www.glci.org/>

(Grazing Lands Conservation Initiative association education on best management conservation strategies for agriculture)

<http://coloradoacd.org/>

(Colorado Association of Conservation Districts)

<http://wildlife.state.co.us/LandWater/ResourcesTips/Pages/ResourcesTips.aspx>

(Colorado Division of Wildlife recommended land use practices)

Water Conservation BMP's

<http://www.cwi.colostate.edu/>

(Colorado Water Initiative from CSU extension education and information)

<http://www.epa.gov/WaterSense>

(EPA water sense website information)

<http://www.erwsd.org/wise-use>

(Eagle River Water & Sanitation District information on indoor and outdoors water conservation)

<http://coloradowaterwise.org/Default.aspx?pagelid=645757>

(Links from Colorado Water Wise to a number of Xeriscape resources)

<http://www.sare.org/>

(Sustainable Agriculture Research & Education links to water conservation strategies for agriculture)

Water Quality BMP's

<http://www.nrdc.org/water/pollution/storm/chap12.asp>

(Low impact development specific practices)

<http://www.epa.gov/oaintmnt/stormwater/actions.htm>

(List of EPA recommended practices and example projects including retrofits)

<http://www.lowimpactdevelopment.org/links.htm>

(NGO created in 1998 with expansive set of links to LID practices and providers)

<http://www.lid-stormwater.net/>

(NGO with expansive set of links and educational materials for water managers)

<http://npscolorado.com/stormwtr.htm>

(Nonpoint Source Colorado)

Recreation Access BMP's

www.nps.gov/ncrc/programs/rtca/helpfultools/launchguide.pdf

(National Park Service comprehensive guide to site access analysis and construction BMP's)

<http://www.americanwhitewater.org/content/Stewardship/view/>

(American Whitewater's River Stewardship Toolkit with river access BMP's)

http://www.blm.gov/co/st/en/BLM_Information/directory/northwest_district/crvfo.html

(BLM Colorado River valley office contact information for riverside practices)

<http://www.imba.com/resources/conservation>

(International Mountain Biking Association BMP's for habit friendly trail practices)

<http://www.croa.org/>

(Colorado River Outfitters Association – potential future riverside bmp's)

Local Resources:

<http://www.erwc.org>

(Eagle River Watershed Council – volunteer projects and general education)

<http://www.crwcd.org>

(Colorado River District – news from the Upper Colorado watershed and Statewide)

<http://www.erwc.org/index.php/resources/publications/>

(Eagle River Watershed Council publications page – comprehensive set of links to studies on the Eagle River watershed)

Glossary

The following definitions are offered to assist the reader in understanding the terms, phrases and names encountered in this Master Plan document. Written for the layperson, they are not intended to represent legal definitions under Colorado water law.

Acre-foot (Feet): The volume of water required to cover one acre of land to a depth of one foot. An acre-foot is equal to 325,825 gallons, the approximate amount of water required to support three family households for one year.

Adjudication The judicial process through which the existence of a water right is confirmed by court decree.

Aquatic Habitat: Underwater habitat available for use by fish, insects and other aquatic species.

Appropriation Doctrine (Appropriation): The system of water law primarily used in the western United States under which: 1) The right to water is acquired by diverting water and applying it to a beneficial use; and 2) the right to water use developed earlier in time is superior to a right developed later in time.

Augmentation: To supplement flows in a stream or river with additional water from a natural or man-made source. Summer rains can be said to “augment” stream flows, but augmentation more commonly refers to water being released from a reservoir. An augmentation plan typically replaces the amount of water consumed by a junior water right, such that the amount of water available to senior downstream water rights is not diminished. (See C.R.S. 37-92-103 for definition of Augmentation Plan under State Statute)

Bank Recharge: During high flow events, refers to water moving from a stream or river channel into the adjacent subsurface geology (the stream bank), recharging ground water systems.

Beetle Epidemic: A severe outbreak of pine beetles that, since 1996, has impacted more than 4 million acres of timber in northern Colorado and southeastern Wyoming. Beetles that are able to burrow into the bark introduce a fungus that kills the tree within a year.

Beneficial Use: The application of water necessary to accomplish the purpose of the appropriation, without waste. Some common types of beneficial use are agriculture, municipal, wildlife, recreation and mining.

Best Management Practices (BMP's): Practices that are technically and economically feasible and for which significant water conservation or water quality benefits can be achieved.

Black Gore Creek Steering Committee (BGSC): A group of concerned stakeholders formed to meet and discuss the issues facing Black Gore Creek as a result of I-70 operations on Vail Pass. Members include the Colorado Department of Transportation, Eagle County, Eagle River Water & Sanitation District, Eagle

River Watershed Council, River Restoration.org, Town of Vail, and US Forest Service.

Call: A request for water from an owner of a senior water right that forces users upstream with more junior water rights to cease or diminish their diversions, or provide augmentation for their diversions, thus providing the requested amount of water downstream.

Camp Hale: The training facility for the 10th Mountain Division that was constructed in the large glacial valley known as “Pando” or “Eagle Park” in 1942. Located in the Upper Eagle River basin between Redcliff and Leadville, the construction of Camp Hale relocated and channelized the Eagle River over a five mile reach, resulting in the loss of hundreds of acres of riparian and wetland areas and a variety of ecological functions due to the loss of natural meanders.

Climate Change: A significant change in the measures of climate, including changes in temperature, precipitation or wind patterns, lasting for an extended period of time.

Colorado Water Quality Control Commission (CWQCC): The administrative agency responsible for developing specific state water quality policies in a manner that implements the broader policies set forth by the legislature in the Colorado Water Quality Control Act. The Commission adopts water quality classifications and standards for all surface and ground waters of the state, and develops regulations aimed at achieving compliance with those classification and standards.

Colorado Water Conservation Board (CWCB): A state agency created to provide policy direction on water issues, governed by a 15 member board that is appointed by the Governor.

Conjunctive Use: The combined use of groundwater and surface water in a managed and deliberate fashion. Ground water aquifers can be extensive in some areas, and in the right geologic setting can be replenished annually by the infiltration of surplus surface water. During dry years, the use of ground water to satisfy diversion demands helps to conserve surface water flows.

Consumptive Use: That amount of water diverted from a stream or river and put to use that is not returned to the stream or river.

Contaminants of Emerging Concern Pharmaceutical products, personal care products and household chemicals that may slip past modern wastewater treatment efforts, negatively impacting water quality and aquatic life in local streams and rivers.

Cubic Foot per Second (cfs): A rate of stream flow equal to one cubic foot of water (7.5 gallons) moving past a point every second. One cfs flowing for one day is the equivalent of approximately two acre-feet of water.

De-icing Chemical A chemical compound like magnesium chloride that when applied to a road surface prevents the formation of ice at temperatures below the freezing point.

Depletion: A decline in the flow level in a stream, or in the amount of ground water available in an aquifer, as a result of stream diversion or well pumping. Depletion impacts may be limited in extent or reach, or may influence large areas or long segments of a river system.

Domestic Water: Water treated at a domestic water treatment plant that is used for commercial or household purposes, including outdoor irrigation.

Erosive Soils: Soils prone to erosion due to slow permeability, rapid surface runoff and minimal vegetative cover.

Dust on Snow: A phenomenon where dust carried by the wind is deposited onto Colorado's mountain snowpacks, dramatically increasing snowmelt rates and snowmelt runoff intensities. Clean snow reflects as much as 98% of sunlight, but dust-contaminated snow absorbs as much as 40-50% of the incoming solar energy.

Eagle River Assembly: A consortium of local governments, in-basin water districts and out-of-basin water users that completed an Eagle River Basin study in 1994 in an effort to identify strategies to provide adequate water for future in-basin and out-of-basin use while simultaneously identifying strategies to improve the condition of aquatic habitat and water quality in the river system.

Eagle River Inventory and Assessment: A comprehensive report completed in 2005 as a joint effort by the Eagle River Watershed Council and Colorado State University to assess the state of the Eagle River watershed from a basin-wide ecological perspective and to prioritize potential restoration activities to improve the integrity of the river system.

Eagle River Water and Sanitation District: A water and wastewater service provider responsible for the public water systems and wastewater treatment system for the Towns of Vail, Avon, Edwards, and other developed areas in eastern Eagle County.

Eagle River Watershed Council: A non-profit organization that advocates for the health and conservation of the Upper Colorado and Eagle River basins through the support and administration of research projects, educational efforts and stream rehabilitation projects.

Eagle Valley Regional Trail: A cross-county paved recreational trail that upon completion will provide an uninterrupted route for recreationalists from the top of Vail Pass to the entrance to Glenwood Canyon

Ecosystem: A biological community of interacting plants and organisms and the physical environments that support them.

Effluent: Water discharged after use, for example water used by residential households that is treated and released back to the river system.

Flow deficit: Refers to periods of the year when the amount of water in a stream or river falls below the levels established by adjudicated minimum stream flow rights.

Flow Regime: A term used to describe the dynamic characteristics of the flow in a natural stream or river and the changes that typically occur to that flow throughout the calendar year.

Flushing Flows: Peaks in the natural flow regime that occur during spring runoff and heavy rainfall. Flushing flows remove accumulated sediments and debris, and are necessary to maintain the ecological integrity of a stream. The characteristics that comprise an effective flushing flow event are unique to every stream.

Gold Medal Fishery: Waters that have been designated by the Colorado Wildlife Commission as being able to produce 60 pounds of trout and at least 12 fourteen inch or larger trout per acre.

Ground Water: Water located below the surface of the earth. Shallow ground water aquifers can be more readily impacted by conditions at the surface than deep water aquifers.

In-Basin Water Diversion: The diversion of water from streams of rivers within the Eagle River Basin for use within the basin. Most of the water diverted in-basin is returned (in some cases after a considerable period of time) to the river system.

Indicator Species: An organism whose presence, absence or abundance reflects a specific environmental condition within an ecosystem.

Junior Water Right: A water right that has a more recent decree date than an older or more senior right. Often used to describe water rights claimed after minimum stream flow rights were adjudicated in the Eagle River or Colorado River basins.

Maloit Park Treatment Facility: A wastewater treatment facility located south of Minturn that is specially designed to treat water released from the Eagle Mine, removing contaminants and harmful metals before releasing that water back to the river.

Metals Loading The process by which metal contaminants like lead, zinc, iron and copper are introduced into a natural waterway like the Eagle River, commonly measured in pounds per day.

Macroinvertebrate Insects that live in streams, rivers, wetlands and lakes that are without backbone and that can be seen by the naked eye.

Minimum instream Flow (or instream flow right): Based on recommendations from the Division of Parks and Wildlife, the amount of stream flow in a stream or river necessary to maintain natural resource values such as fish habitat, recreation or water quality, preserving the natural environment to a reasonable degree (See C.R.S. 37-92-102(3)). A decreed instream flow water right can only be held by the Colorado Water Conservation Board (CWCB right).

Non-Point Source Pollution: A source of pollution that has a diffuse origin and entrance point to the stream. Sediment-laden water leaving a construction site at numerous locations or oil and grease washing off roads and into adjacent streams or rivers would be examples.

Northwest Colorado Council of Governments (NWCCOG): An association of county and municipal governments formed to address issues of regional concern or significance. NWCCOG serves 28 member jurisdictions in a 5-county region of northwest Colorado, including Eagle County.

Nutrient Loading The process by which nitrogen and phosphorous are added to a natural waterway from either natural or manmade sources, commonly measured in weight over a defined period (ex. tons per year).

NWCCOG Regional Water Quality Management Plan (208 Plan): A water quality management plan for the NWCCOG Region, which includes the Eagle River and Upper Colorado watersheds, in compliance with Section 208 of the Clean Water Act.

Onsite Wastewater Treatment System (OWTS): An engineered system designed to collect and treat sewage originating from one lot, or a small number of individual lots. Not to be confused with a domestic treatment system, onsite wastewater treatment systems collect solids in a tank and disperse the remaining effluent underground, relying on natural processes to remove contaminants from the wastewater.

Peak Flows The highest flows observed in a stream or river at a given location. In Eagle County, peak flows from spring runoff typically occur in late May or early June.

Pesticide/herbicide: A pesticide is any substance use to kill, repel, or control certain forms of plant or animal life considered to be pests. Pesticides can include herbicides (for treating vegetation), insecticides (for treating insects), fungicides (for treating mold and mildew), and disinfectants (for treating the spread of bacteria).

Point Source Pollution: Contaminants that enter a stream or river system from a discreet source such as a drainage culvert, storm water collection system outlet or municipal wastewater treatment discharge point.

Raw Water: Untreated surface or ground water typically used for irrigation purposes on golf courses or in developed areas.

Reach: A specific stream or river segment, often identified on the basis of biological and physical characteristics, but which may also be identified on the basis of recreational attributes.

Return Flow: Water returned to the stream after being diverted and used for some "beneficial" use such as irrigation, snowmaking or domestic purposes. Return flows usually occur downstream of the point of diversion.

Riparian buffer The vegetated area near a stream, waterway or wetland (see "riparian zone") which can mitigate impacts from adjacent land uses. Riparian buffers separate land uses, enhance viewsheds, and if wide enough help to absorb and filter runoff from adjacent urban areas.

Riparian Zone or Riparian Habitat: Areas adjacent to a stream or river where cottonwoods, willows, alders, dogwood, chokecherry Blue Spruce, and other species that require a high water table are able to grow. Riparian zones provide

shade, maintain water temperatures, slow and store floodwaters, increase groundwater infiltration (bank recharge), and provide habitat and movement corridors for insects, mammals and birds. These sensitive lands are increasingly popular as destinations, but can be negatively impacted by access improvements and human visitation.

Sedimentation The deposition of sand and other fine particles on the bottom of a stream or river in areas where slower velocities lessen the ability of the stream or river to transport the material.

Sediment loading The process by which sediment is added to a stream or river from either natural or manmade sources. Sediment is solid inorganic material that is carried either in suspension (wash load) or as heavier material that moves along the bottom of the stream or river (bed load).

Senior water right A water right that has been established early in the history of a watershed, and which therefore carries a high priority for use during dry (lower flow) periods. Often used to describe water rights claimed before minimum stream flow rights were adjudicated in the Eagle River or Colorado River basins.

Sensitive Areas or Lands: Land or water areas that are limited in extent, prone to damage if not protected and which contribute to the quality of scenic viewsheds, critical wildlife habitat and ecosystem integrity. Riparian zones, natural hazard areas, steep slopes, areas containing rare or endangered species or lands supporting significant stands of native vegetation are examples.

Service (Water) Provider: A governmental or quasi-governmental agency which operates and maintains domestic water and wastewater treatment and delivery systems. May also refer to businesses for hire that periodically empty and maintain on-site wastewater treatment systems (OWTS).

Setback: That area between a water feature and a land use, structure or activity which is intended to remain in a natural and undisturbed condition. Defined in Eagle County as 75 feet from the high water line or the boundary of the 100 year floodplain, whichever is greater at a given location. Please note additional detail in Eagle County Land Use Regulations, Section 3-340.C.6.

Shoshone Call/Demand: The water that is required for operations at the Shoshone Hydroelectric Facility on the Colorado River in Glenwood Canyon. One of the most senior water rights on the Colorado, the Shoshone call limits upstream diversions (or requires augmentation for diversions) on the Eagle River and the Upper Colorado River during low-flow periods of the year.

Storm Water: Water that is generated from precipitation events or snowmelt that is not absorbed by the ground and that can carry contaminants collected from the surfaces over which it travels.

Storm Water Detention: Engineered systems designed to slow, control and clean storm water discharges in order to lessen the potential for flooding and in order to prevent harmful pollutants from entering local surface waters.

Stream Gage: A measuring device located on the edge of a stream or river which collects information and records data related to flows and/or water quality at that specific location.

Superfund Site: A federally designated area that is part of the national environmental program to address abandoned hazardous waste sites, allowing federal and state officials to clean up such sites and compel responsible parties to perform cleanups or reimburse the government for cleanup and long-term protectiveness of the cleanup remedy.

Surface Water: Sources of water such as lakes, reservoirs, rivers and streams found on the earth's surface. Surface water responds in a reasonably short period of time to precipitation and snow melt events.

303(d) Impaired Waters: Reaches of streams or rivers that fail to meet State water quality standards that have been placed on a list in accordance with Section 303(d) of the Clean Water Act. The Act requires local jurisdictions to establish priority rankings for waters on the list, and to develop management plans for these waters.

Trans-Basin Diversion (or Out-of-Basin Diversion): The diversion of water from one basin or watershed for use at locations in a separate basin or watershed. Trans-basin diversions are considered a 100% consumptive use because no water is returned to the source water basin.

Tributary Stream/basin: A tributary is generally regarded as a smaller stream, ground water or surface water drainage system which connects to and "feeds" a larger stream or river system. Under Colorado law, all surface and groundwater, the withdrawal of which would affect the rate or direction of flow of a surface stream or river within 100 years, is considered to be tributary to that stream or river.

Upper Eagle Regional Water Authority: A local government with a six member board of directors including the metropolitan districts (service providers) of Arrowhead, Beaver Creek, Berry Creek, Eagle Vail, Edwards and the Town of Avon.

Urban Runoff Storm water (see definition above) that originates from lands where intensive residential and commercial development and/or the construction of roads and parking lots has created large expanses of impervious surfaces, and from which storm water would be expected to carry elevated amounts of sediment, trash and chemical pollutants.

Watershed: A geographic area in which all water drains to a common point or outlet. A watershed is also referred to as a drainage basin.

Water Right: The legal right to use a specified amount of water in accordance with its "priority" or year of decree (first in time, first in right).

Water discharge or water yield, firm yield: The amount of runoff that bypasses a gaging station at the terminal end of a drainage basin like the Eagle River basin, averaged over wet, normal and dry years. Water yield figures are used to

determine the amount of water that would be available for use on a reliable basis, assuming a specified level of risk, during a critically dry period.

Wetlands: Areas that are inundated or saturated by surface or ground water for long enough periods of the year to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs, and frequently support adjacent riparian habitats.

Xeric Landscaping Also called Xeriscape, refers the use of native or indigenous plant materials and specialized irrigation systems and practices that in combination minimize the amount of water used in outdoor landscaping. The term 'xeriscape' was copyrighted by Denver Water in 1981.

Water Conversion Table

1 acre-foot = 43,560 cubic feet or 325,581 gallons of water

1 cubic foot per second (cfs) = 450 gallons per minute, or 646,320 gallons per day

Appendix A – Plan Acknowledgments

Eagle County Planning Commission

Patricia Hammon	Craig Snowdon	Kelly Miller
Greg Moffet	Vern Brock	Pedro Campos
Bill Heicher	Tim Carpenter	

Eagle River Watershed Council

Melissa MacDonald, Executive Director
Tambi Katieb, Director of Policy & Planning
Seth Mason, Water Program Director

Eagle County Staff

Cliff Simonton, Senior Planner	Bob Narracci, Planning Manager
Ray Merry, Environmental Health	Karen Sepp, Administrative Technician
Scott Fleming, GIS Mapping	

Board of County Commissioners

Jon Stavney, Chair, *District 2*
Sara Fisher, Commissioner, *District 3*
Jill Hunsaker Ryan, Commissioner, *District 1*

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Justin Hildreth – Town of Avon
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Katie Langdon – Eagle County Conservation District
Scott Jones – Eagle County Conservation District, Colorado River Ranch
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Karla Ware – Natural Resource Conservation Service

Appendix B - Plan Modifications and Updates

The Eagle River Watershed Plan is a living document that should be reviewed periodically by the County and affected agencies and entities to assure the continued appropriateness and applicability of the data and strategies contained therein.

Minor Modifications may be necessary over time. These are defined as changes to the document which do not require extensive analysis or community or stakeholder involvement. Minor modifications typically take the form of technical corrections to maps, charts or diagrams, the insertion of new technical data, or factual updates to the supporting text.

The Goals and Objectives provided by this Plan are foundational elements, and should not be subject to change except at those times when the Plan is being formally updated (see below). Changes to Strategies and Actions, however, may be considered under the Minor Modification process, so long as the suggested change:

- 1) reduces the probability of a misinterpretation or misunderstanding, or
- 2) enhances the probability that the targeted objective will be met, and
- 3) remains consistent with the Vision and overall purpose and intents of the document.

Proposals for Minor Modifications may be submitted by County Staff, government agencies, water service providers or other water interest groups. Proposals for Minor Modifications will be reviewed and approved or denied by the Eagle County Planning Commission at a regularly scheduled and properly noticed public hearing.

The Eagle River Watershed Plan should be updated every 10 to 15 years, or as necessary to respond to changed conditions. Upon approval from the Planning Commission, an update to the Watershed Plan shall involve a full public planning process, as described in Chapter 1.

Appendix C – Colorado’s Section of 303(D) Eagle River Watershed Impaired Waters & Monitoring and Evaluation Lists

The Clean Water Act requires that the State compile a list of those waters for which the basic effluent limitations are not stringent enough to implement water quality standards, and thus require Total Maximum Daily Load (TMDL) allocations. The Eagle River has seven segments listed on the 2012 303(d) list and an additional seven segments on the Monitoring and Evaluation list.

Segment	Description	Colorado’s Monitoring & Evaluation Parameter(s)	Impairment	Priority
COUCE A05c	Eagle River, Martin Creek to Gore Creek		Cd	H
COUCE A06	Tributaries to Eagle River, Belden to Lake Creek, except specific segments / Black Gore Creek adjacent to I-70 portion		Sediment	H
COUCE A06	Tributaries to Eagle River, Belden to Lake Creek, except specific segments / Mainstem of Lake Creek from below the confluence with East and West Lake Creek to the mouth		Aquatic Life (Provisional)	L
COUCE A06	Tributaries to Eagle River, Belden to Lake Creek, except specific segments / Beaver Creek from confluence with Wayne Creek to Mouth	Aquatic Life		
COUCE A06	Tributaries to Eagle River, Belden to Lake Creek, except specific segments /	Aquatic Life		

	Red Sandstone Creek from USFS Boundary to north side I-70 Frontage Road			
COUCE A06	Tributaries to Eagle River, Belden to Lake Creek, except specific segments / Red Sandstone Creek from north side I-70 Frontage Road to confluence with Gore Creek		Aquatic Life (Provisional)	L
COUCE A08	Mainstem of Gore Creek from the confluence with Black Gore Creek to the confluence with the Eagle River.		Aquatic Life (provisional)	L
COUCE A09a	Mainstem of the Eagle River from Gore Creek to a point immediately below the confluence with Rube Creek. / From Berry Creek to confluence with Ute Creek	Temperature		
COUCE A09a	Mainstem of the Eagle River from Gore Creek to a point immediately below the confluence with Rube Creek / From Ute Creek to confluence with Rube Creek		Temperature	L
COUCE A09a	Mainstem of the Eagle River from Gore Creek to a point immediately below the confluence with Rube Creek./ Eagle River from confluence with Berry Creek to confluence with Squaw Creek	Aquatic Life	Sediment	H
COUCE A09a	Mainstem of the Eagle River from Gore Creek to a point immediately below the confluence with Rube Creek / Eagle River from Gore Creek to confluence with Berry Creek and from Squaw Creek to confluence with Rube	Sediment		

	Creek			
COUCE A10a	All tributaries to the Eagle River from Lake Creek to the Colorado River / Eby Creek Portion	Se		

Appendix D – Multi-Criterion Decision Analysis (MCDA) Ranking Approach for Potential Restoration Projects

The *2005 Eagle River Inventory and Assessment* details the multi-criterion decision analysis (MCDA) ranking approach which was used to prioritize restoration projects for the Eagle River and Colorado River watersheds. The following is a brief summary of that approach:

- A.** Potential projects are identified and then screened against four basic criteria:
- 1) *Can the project be implemented without posing a significant risk to public health and safety?*
 - 2) *Will the project be compliant with applicable laws?*
 - 3) *Is the project technically feasible from an engineering perspective?*
 - 4) *Is the project consistent with the mission of the Eagle River Watershed Council?*
- B.** Projects that meet all four of the above criteria are then ranked using a multi-tiered scoring process that focused on four categorical topics:*
- 1) Ecology *Will there be preservation or enhancement of:*
 - *Hydrologic conditions*
 - *Habitat and/or geomorphic conditions*
 - *Riparian functions*
 - *Aquatic biology*
 - *Water quality*
 - *Broader ecosystem benefits*
 - 2) Watershed strategy *Does the project enhance opportunities for:*
 - *The leveraging of other watershed projects*
 - *Volunteer involvement*
 - *Fundraising*
 - *Visibility*
 - 3) Practicality *What is the potential for:*
 - *Complex legal or permitting issues*
 - *Complex ownership issues*
 - *Technical difficulties*
 - *Negative impacts to public health and safety*
 - 4) Socioeconomics *Will the project enhance or benefit:*
 - *The local economic base*
 - *Educational opportunities*
 - *Recreational opportunities*
 - *Historic preservation*

* Cost is also an important component, but is evaluated using a different metric for each potential project.

- C.** Each of the criteria listed for the topics above are further broken into component parts and each part is then assigned a ranking from -1 to +1, where -1 indicates high probability of negative impacts, 0 indicates little or no change, and +1 indicate high probability of positive impacts resulting from the proposed project. (See Appendix L of the 2005 Eagle River Inventory and Assessment for further detail). These rankings are further weighted relative to knowledge of watershed characteristics and stakeholder feedback, resulting in a final score for each proposal.

Appendix E – Recent and on-going Eagle River and Colorado River Restoration and Enhancement Projects

(Note: Not all of the projects listed below were the result of the 2005 MCDA analysis. For additional information, please reference the Eagle River Watershed Council web site)

Eagle Park Reservoir Enlargement

Managed by the Eagle Park Reservoir Company, this project was completed in 2009 and increased the effective capacity of this important augmentation reservoir by 153 acre feet.

Black Lakes Enlargement and Cleaning

Several projects have recently been completed at Black Lakes at the head of Black Gore Creek. Improvements at the outlet of the upper lake in the summer of 2008 increased its capacity to 125 acre feet. The lower lake was drained in 2011 so that accumulated sediments could be removed. The work for these projects was completed under the direction of the Eagle River Water and Sanitation District.

Black Gore Creek Restoration Project (Vail Pass Traction Sand Mitigation)

Significant progress has been made on this multi-year project which seeks to mitigate stream health damage caused by traction sand migration from Interstate 70 into Black Gore Creek. Many culverts have been repaired, and highway drainage features have been improved. A large in-channel catch basin, called the Basin of Last Resort, was cleaned of accumulated sediments in the fall of 2009 and will need to be cleaned again in 2014. Partners in this effort include CDOT, USFS, Town of Vail, Eagle County, Black Gore Creek Steering Committee, and the Eagle River Watershed Council.

Gore Creek Water Quality Improvement Plan

The Town of Vail together with the Eagle River Watershed Council, Eagle County and Eagle River Water and Sanitation District is working to identify and remedy water quality issues in Gore Creek, which has been listed by the State as impaired for aquatic life. The resulting Water Quality Improvement Plan document, due to be completed in 2013, could serve as a template for similar efforts on other stream and river segments in the County.

Eagle Mine Superfund Site Mitigation (Gilman/Belden Reach)

This perpetual project involves water quality and fish health monitoring at a number of sites downstream from the Eagle Mine Superfund site. A number of local, state, and federal agencies are involved. Data, trend analysis and other findings are compiled and distributed annually.

Eagle River Restoration Project (Minturn Reach)

Completed the summer of 2004, this project utilized money from the Natural Resource Damage Fund (money made available via the restoration of the Eagle

Mine Superfund site) to improve channel and riparian characteristics in the section of the Eagle River that passes through Minturn. The project was coordinated by the Town of Minturn.

Eagle River Restoration Project (Edwards Reach)

Completed in 2012 this project targeted a 1.6 mile section of the Eagle River below Edwards that required channel work and riparian enhancements to repair historic damage and improve aquatic habitat. Championed by the Eagle River Watershed Council, the project has involved hundreds of volunteers and has provided many hands-on learning experiences for local students.

Eagle River Water Quality Monitoring

The Eagle River Watershed Council works to assemble water data collected by numerous agencies and entities in Eagle County, providing a repository of information regarding the area's rivers and streams. The project includes analysis of methodologies and data collection practices, and includes targeted community outreach activities.

USFS projects (with ERWC volunteers and grant funding):

- **Piney River Dispersed Camping Restoration**
Completed in 2010, volunteers with USFS decommissioned and revegetated a number of user-created camping sites that were located too close to the Piney River below Piney Lake.
- **Homestake Creek Dispersed Camping Restoration**
Similar to the work on the Piney, workers removed and restored a number of camping sites that were too close to Homestake Creek in 2011.
- **Red Dirt Creek Restoration**
Initiated in 2010, this project involves stream bank restoration and stabilization on the east fork of Red Dirt Creek, which flows into the Colorado River below Burns. The stream has been negatively impacted by historic grazing. Additional work such as creation of alternative sources of water for livestock (water savers), revegetation and road eradication is planned for 2013. Trout Unlimited is also participating on this project.
- **Camp Hale Eagle River Channel Restoration**
A multi-year project, the Forest Service is teaming with the National Forest Foundation to address the channelization of Eagle River that occurred in 1942 when the Army developed a training facility in the Pando Valley above Redcliff. Work will involve returning segments of the river to a more natural sinuous alignment, expanding adjacent wetlands and riparian habitats, mitigating noxious weeds and preserving select historic and recreational elements in the area.

Brush Creek Habitat Restoration Project

Initiated by the Eagle Ranch Wildlife Mitigation Committee and the Town of Eagle with support from Colorado Parks and Wildlife, this project stabilized stream banks and modified channel and riparian characteristics in lower Brush Creek to improve trout habitat.

L.E.D.E Reservoir Acquisition and Enlargement Project

The Town of Gypsum has developed plans for the enlargement of LEDE Reservoir which is located above the Town on a tributary to Gypsum Creek. This project will provide augmentation water, and is slated to begin in 2014.

Colorado River Inventory and Assessment

The Eagle River Watershed Council is partnering with CSU and other stakeholders to inventory and assess the ecological condition of the Colorado River corridor as it flows through Eagle County. Baseline information will be established and recommendations for protection measures and a prioritized list of restoration projects will result.

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