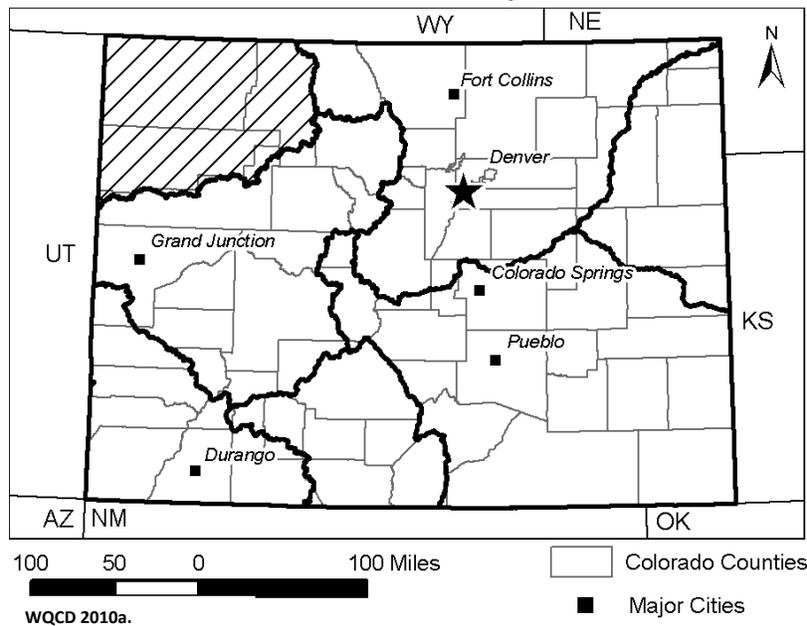


# Chapter 8 Green River Basin Plan (Regulation Nos. 33 and 37)

**Exhibit 8-1. Green River Basin Physical Location**



**Exhibit 8-2. Green River Basin Summary Statistics**

<b>Ecoregions (Level IV):</b> <sup>1</sup>	18. Wyoming Basin (a, d-e) 20. Colorado Plateaus (b-c, e-f) 21. Southern Rockies (a-g)	<b>Surface Area:</b> <sup>2</sup> <b>Stream Length:</b> <sup>3</sup>	10,528 square miles 13,796 miles
<b>Threatened and Endangered Species (federal and state):</b> <sup>2</sup>	Threatened: 9 Endangered: 10 State Species of Concern: 15 Federal Candidate Species: 2	<b>Major Land Cover:</b> <sup>2</sup>	Forest and Shrubland
<b>Counties:</b>	Garfield (portion), Moffat, Rio Blanco, and Routt	<b>No. of Assessed Lakes/Reservoirs:</b> <sup>4,5</sup> <b>Corresponding Acres:</b>	22 22,251
<b>Population:</b> <sup>6</sup>	45,000	<b>No. of Groundwater Aquifers:</b> <sup>2</sup>	7
<b>Major Population Centers:</b> <sup>2</sup>	Steamboat Springs and Craig	<b>Approximate No. of Publicly Owned Treatment Works:</b> <sup>7</sup>	32
<b>Water Quality Planning Regions (in total or in part):</b> <sup>8</sup>	11	<b>Known Primary Water Quality Stressors:</b> <sup>4</sup>	Copper, dissolved oxygen, <i>Escherichia coli</i> , iron (dissolved), iron (Trec), lead, manganese, mercury, pH, sediment, selenium, temperature, and zinc

<sup>1</sup> See appendix B for a description of key ecoregional characteristics.

<sup>2</sup> CWCB 2004.

<sup>3</sup> WQCD 2002.

<sup>4</sup> WQCC 2010c, WQCD 2010a.

<sup>5</sup> The number of lakes/reservoirs and the corresponding acres only include the lakes that have been assessed by the Water Quality Control Division and do not reflect all of the lakes/reservoirs present in the basin.

<sup>6</sup> CWCB 2010.

<sup>7</sup> USEPA 2010a, 2010c; WQCD 2010b.

<sup>8</sup> See exhibit 2-2 in chapter 2 for the names of the Water Quality Planning Regions and counties covered.

*This basin chapter and the SWQMP as a whole are primarily water quality documents. They are based on readily available, peer reviewed water quality information, particularly the 2010 Integrated Water Quality Monitoring and Assessment Report (2010 Integrated Report or Clean Water Act (CWA) section 305(b) report).<sup>1</sup> Both the Water Quality Control Commission (WQCC) and the Water Quality Control Division (WQCD) are aware of many other water quality data sources. Organizations and other parties with water quality data are encouraged to get involved in “calls for data” for the biennially completed CWA section 305(b) reports. The data sources that are used in forthcoming CWA section 305(b) reports will subsequently be used in future iterations of the SWQMP. Other key water quality regulations and policies used in the chapter are tabulated in Appendix A.*

## 8.1 System Description

### 8.1.1 Location and Physical Setting

The Green River Basin covers roughly 10,500 square miles in northwest Colorado and south Central Wyoming. The Yampa River collects water from roughly 8,000 square miles with the headwaters located west of the Continental Divide in the White River Plateau. In the state of Colorado, the Yampa River flows through the town of Yampa, past Steamboat Springs, and then heads west past Craig. The Little Snake River joins the Yampa River 5 miles before entering Dinosaur National Monument. Within the Dinosaur National Monument area, the Yampa River flows into the Green River about 5 miles from the Colorado-Utah state line (CWCB 2004).

The White River, which is part of the Green River Basin, flows from its headwaters in the Flat Tops Wilderness Area west to the town of Buford. It then flows past Meeker and parallels Highway 64 to the Utah state line. Elevations in the Green River Basin range from 12,200 feet in the Sierra Madre range to 5,100 feet at the confluence of the Yampa and Green Rivers at Echo Park within Dinosaur National Monument (CWCB 2004). A map of the basin showing the Green River and its major tributaries is provided as exhibit 8-3 (at end of chapter).

### 8.1.2 Ecology

The boundaries of the Green River Basin fall within three distinct level III ecoregions: 38.3% of the basin falls within the Colorado Plateaus Ecoregion; 31.7% falls within the Southern Rockies Ecoregion; and 30% falls within the Wyoming Basin Ecoregion (exhibit 8-4 at end of chapter). Key characteristics of these and the more specific level IV ecoregions, such as physical characteristics, elevation, land cover, climate, geology, and soil types, are provided in appendix B.

The Green River Basin contains several endangered and threatened species and several species of state concern, as summarized in exhibit 8-5 at end of chapter. There are 10 federal- and/or state-listed endangered species (four fish, two bird, and four mammalian species) and nine

---

<sup>1</sup> The Integrated Reports are prepared by the WQCD on a biennial basis and are approved by the WQCD as Regulation 93: *Colorado's Section 303(d) List of Impaired Waters and Monitoring and Evaluation List*, 5 CCR 1002-93 (WQCC 2010c; WQCD 2010a).

federal- and/or state-listed threatened species (two fish, two bird, one mammalian and four plant species). An additional two plant species are federal candidates for listing. Finally, Colorado has 15 species of concern in the Green River Basin (two fish, one amphibian, two reptilian, eight bird, and two mammalian species) (CDOW 2010; CWCB 2004).

Exhibit 8-6 (at end of chapter) shows the locations of environmental and recreational uses (i.e., nonconsumptive uses) in the Green River Basin.<sup>2</sup> The use categories include environmental focus areas, environmental and recreational focus areas, and recreational focus areas (CWCB 2009). The nonconsumptive uses shown are only meant to provide information on environmental and recreational uses in the basin and not to dictate future actions or impact any water rights (CWCB 2009).

### 8.1.3 Climate

The climate in the Green River Basin is characterized by cool, dry summers and cold winters. Average July temperatures range from 62 degrees Fahrenheit (°F) in Steamboat Springs to 73 °F in Dinosaur, and average January temperatures range from 15 °F in Steamboat Springs to 21 °F in Dinosaur (CWCB 2004). Precipitation also varies greatly within the basin. Exhibit 8-7 at end of chapter shows a contour (isohyetal) plot of the average annual precipitation throughout the basin. The western edge of the basin averages between 7 and 17 inches of precipitation annually, while the far eastern edge near the Continental Divide averages anywhere between 39 and 63 inches (CWCB 2004).

### 8.1.4 Land Ownership and Land Cover/Use

The federal government is the primary land owner in the Green River Basin (60%). Other land owner categories in the basin are private (35%) and state (5%). Exhibit 8-8 at end of chapter provides a map of land ownership by basin.

Land cover in the Green River Basin is shown in exhibit 8-9 (at end of chapter) and is summarized in exhibit 8-10 below. Shrubland and forest are the predominant land cover types in the basin, each covering approximately 42% of the basin. Livestock, grazing, and recreation are the predominant land uses in the basin. Much of the land near the towns of Craig, Hayden, Steamboat Springs, Yampa, and Meeker is dedicated to agricultural uses. The mountains are densely covered by forest. In addition Steamboat Springs is home to a destination ski resort. The valley and plateaus are mostly covered with shrubland and dotted with forests (CWCB 2004).

**Exhibit 8-10. Green River Basin Land Cover**

Land Cover	Basin-wide		Statewide	
	Area (sq. miles)	Percent of Total	Area (sq. miles)	Percent of Total

<sup>2</sup> In 2005, the Colorado legislature established the Water for the 21<sup>st</sup> Century Act, which established an Interbasin Compact Process that provides a permanent forum for broad-based water discussions in the state. The law created two new structures: the Interbasin Compact Committee (IBCC) and the Basin Roundtables. As part of the IBCC, the Basin Roundtables are required to complete basin-wide needs assessments; an assessment of consumptive water needs and an assessment of nonconsumptive water needs. In 2009, the Colorado Water Conservation Board released a draft report entitled, *Nonconsumptive Needs Assessment Focus Mapping*. The focus mapping described in the report is part of the Basin Roundtables' assessment of nonconsumptive water needs.

Land Cover	Basin-wide		Statewide	
	Area (sq. miles)	Percent of Total	Area (sq. miles)	Percent of Total
Grassland	1,289	12.2%	41,051	39.5%
Forest	4,372	41.5%	29,577	28.4%
Planted/cultivated	320	3.0%	13,737	13.2%
Shrubland	4,411	41.9%	16,883	16.2%
Developed	15	0.2%	923	0.9%
Barren	99	0.9%	1,219	1.2%
Open water	19	0.2%	590	0.6%
Wetland	3	0.03%	80	0.08%
<b>TOTAL</b>	<b>10,528</b>		<b>104,060</b>	

Source: CWCB 2004.

Significant coal and oil shale reserves exist in the Green River Basin. Although coal has been mined in the Yampa River Valley for more than 80 years, coal resources remain substantial. An estimated 29 billion tons of coal reserves are present in the Yampa River Valley. Yampa River Valley coal is used by utilities throughout the country and also burned locally in the Craig and Hayden power plants (CWCB 2004).

### 8.1.5 Demographic and Socioeconomic Conditions

Population growth has increased substantially in the urban areas of the Green River Basin over the past several years, primarily in Steamboat Springs and Craig, which are the two most populous cities in the basin. The population in the Green River Basin is projected to increase by about 160% between 2008 and 2050 under medium economic development assumptions, from 45,000 to 117,000. Routt and Rio Blanco Counties are projected to account for much of the basin's population growth (exhibit 8-11 at end of chapter). Population will remain relatively flat in Moffat County during the same period (CWCB 2010).

As shown in exhibit 8-12, residential service and tourism jobs were the leading employment sectors in the Green River Basin in 2007, followed by regional and national service jobs. By 2050, regional and national service jobs are expected to become the leading sector, surpassing tourism, with mining and tourism about equal for second place. Mining and regional and national service jobs are expected to be the drivers of growth in the basin. Employment is anticipated to grow over 400% and 157% in the two sectors, respectively, between 2007 and 2050. Total jobs are expected to increase in the basin by 141% over the same period (CWCB 2010).

**Exhibit 8-12. Green River Basin 2050 Employment Projections, Medium Growth Scenario**

Sector	2007	2050
<b>Agribusiness Jobs</b>	1,700	3,000
% of Total Jobs	5.2%	3.8%
Total % Growth	NA	76%
<b>Mining Jobs</b>	2,100	11,300
% of Total Jobs	6.4%	14.2%
Total % Growth	NA	438%

Sector	2007	2050
<b>Manufacturing Jobs</b>	250	410
% of Total Jobs	0.8%	0.5%
Total % Growth	NA	64%
<b>Government Jobs</b>	1,000	1,500
% of Total Jobs	3.0%	1.9%
Total % Growth	NA	50%
<b>Regional/National Service Jobs</b>	5,100	13,100
% of Total Jobs	15.5%	16.5%
Total % Growth	NA	157%
<b>Tourism Jobs</b>	7,600	11,300
% of Total Jobs	23.0%	14.2%
Total % Growth	NA	49%
<b>Household Basic Jobs</b>	2,200	3,500
% of Total Jobs	6.7%	4.4%
Total % Growth	NA	49%
<b>Total Basic Jobs</b>	20,200	44,200
% of Total Jobs	6.7%	4.4%
Total % Growth	NA	119%
<b>Resident Service Jobs</b>	12,800	35,100
% of Total Jobs	38.8%	44.2%
Total % Growth	NA	174%
<b>Total Jobs</b>	33,000	79,400
% of Total Jobs	100%	100%
Total % Growth	NA	141%

Source: CWCB 2010.

In 1996, the Yampa River Valley mines produced about 15 million tons of coal representing approximately 60% of all Colorado coal production. The average annual rate of coal production in the Yampa River Valley increased nearly 8% from 1955 to 1996. The potential for energy resource development in the basin might pose a threat to water quality in the future. Presently, only coal mining and limited soda ash extraction operations in the basin are active (CWCB 2004).

### 8.1.6 Water Withdrawals

Water quantity and quality issues are intertwined, particularly in arid western states where water can be scarce (CFWE 2003). Water quantity issues tend to be more contentious than quality issues. Water rights are protected under Colorado's constitution and several state statutes, including the Colorado Water Quality Control Act. Colorado water law establishes water use rights for a variety of purposes including farming, drinking, manufacturing, recreation, protection of the environment, and all of the use categories listed in exhibit 8-13 below (CFWE 2003). Public and private entities involved in watershed protection in Colorado have grown to appreciate that the two worlds of water quality and quantity are inexplicably linked and are working together more frequently to combat water quality/quantity problems.

In 2005, the U.S. Geological Survey (USGS), in cooperation with the Colorado Water Conservation Board (CWCB), estimated total surface water and groundwater use in the Green River Basin to be 599.75 million gallons per day (Mgal/d). Use was estimated for the following categories: irrigation for crops, irrigation for golf courses, public supply, domestic, industrial, livestock, mining, and thermoelectric.<sup>3</sup> Exhibit 8-13 shows the total water withdrawals in the basin and the state as a whole for these categories. The predominant uses of water in the basin were for agriculture at 556.55 Mgal/d (93%), followed by thermoelectric at 15.33 Mgal/d (3%) and mining at 11.63 Mgal/d (2%)

**Exhibit 8-13. Green River Basin Total Water Withdrawals, 2005**

Use Category	Withdrawals by Use Category		
	Withdrawals (Mgal/d) (Percent of Total Basin Withdrawals)	Total Withdrawals All of Colorado (Mgal/d)	Withdrawals in Arkansas River Basin as Percent of Total Withdrawals in State
Agriculture (crop irrigation & livestock)	556.55 (92.80%)	12,354.91	4.50%
Irrigation (golf course)	1.96 (0.33%)	40.64	4.82%
Public Supply <sup>1</sup>	7.37 (1.23%)	864.17	0.85%
Domestic <sup>2</sup>	1.57 (0.26%)	34.43	4.56%
Industrial	5.34 (0.89%)	142.44	3.75%
Mining	11.63 (1.94%)	21.42	54.30%
Thermoelectric	15.33 (2.56%)	123.21	12.44%
<b>Totals</b>	<b>599.75</b> (or 672.32 thousand acre- feet per year)	<b>13,581.22</b> (or 15,224.55 thousand acre-feet per year)	<b>4.42%</b>

<sup>1</sup> The term “public supply” is water supplied by a publicly or privately owned water system for public distribution, sometimes also known as a “municipal-supply system” or “community water system” (CWS). Any water system that serves drinking water to at least 25 people for at least 60 days of the calendar year or has at least 15 service connections is considered a public supply system. In addition to providing water to domestic customers, CWSs also deliver water to commercial, industrial, and thermoelectric power users (USGS 2010).

<sup>2</sup> The term “domestic” refers to water used for household purposes, such as washing clothes, cleaning dishes, drinking, food preparation, bathing, flushing toilets, and watering lawns and gardens that are not served by public-supply systems (USGS 2010).

Source: USGS 2010.

The CWCB recently completed a projection of municipal and industrial (M&I) surface water use needs to the year 2050 for the state.<sup>4</sup> The projections will provide relevant parties in the state

<sup>3</sup> The term “public supply” refers to “community water systems” as that term is defined under the federal Safe Drinking Water Act. Community water systems (CWSs) are any water system that serves drinking water to at least 25 people for at least 60 days of the calendar year or has at least 15 service connections. In addition to providing water to domestic customers, CWSs also deliver water to commercial, industrial, and thermoelectric power users. The term “domestic” refers to the portion of the population not served by a “public supply” (USGS 2010).

<sup>4</sup> In 2003, the Colorado General Assembly authorized the CWCB to implement the Statewide Water Supply Initiative (SWSI), an 18-month basin-by-basin investigation of the state’s existing and future water needs. As part of that effort, the CWCB assembled water users (farmers, ranchers, municipalities, industrial users, recreationalists, and environmentalists) to plan for the future. That effort resulted in the completion of the *Statewide Water Supply*

with a basis for discussing and addressing the state's future M&I water needs. In this report, the CWCB estimated that M&I water demand in the Green River Basin will more than double over the next 40 years, with water demand increasing from 12,000 acre-feet per year (AFY) (10.7 Mgal/day) in 2008 to 31,000 AFY (27.65 Mgal/day) by 2050 under medium growth economic assumptions. If passive conservation is employed, the water demand for 2050 is projected to be 30,000 AFY under medium growth assumptions.<sup>5</sup> Routt County is estimated to have the largest M&I demands in the Green River Basin at 6,000 AFY (CWCB 2010).

The largest self-supplied industrial (SSI) water demand in the basin is for thermoelectric power at 20,200 AFY in 2008. However, for the 2050 projection under high economic assumptions, the water demand for oil shale is expected to nearly equal thermoelectric power at 41,800 AFY and 44,000 AFY respectively. The Green River Basin is the only basin in the state where SSI water needs exceed M&I water needs, with SSI water needs at 28,590 AFY and M&I water needs at 12,000 AFY in 2008 (CWCB 2010). SSI water needs are expected to remain higher than M&I water needs through 2050 under all projected scenarios (low, medium, and high growth assumptions).

## 8.1.7 Hydrography and Hydrology

### 8.1.7.1 Surface Geology

Geology in the Green River Basin consists of Precambrian-age metamorphic rocks extensively intruded by granitic rocks and quartzite. These rocks are exposed in the central parts of the mountain uplifts. Overlying these rocks are sedimentary rocks of Paleozoic, Mesozoic, and Cenozoic age with a net thickness of 25,000 feet (CWCB 2004). It should also be noted that soils derived from the various shallow geologies and deposited materials are a prime consideration in water quality planning.<sup>6</sup>

### 8.1.7.2 Surface Water

The Green River Basin is comprised of the Yampa and White Rivers, the principal Colorado tributaries to the Green River. The Yampa and the White Rivers are among the least developed rivers in Colorado. WQCD considers the natural quality of the waters to be good, especially in the high mountain headwaters located in the Flat Top Wilderness Area (WQCD 2002).

---

*Initiative* Phase I Report in November 2004 and a Phase II report in November 2007. Both reports focus on all water uses, not just M&I. Since that time, the CWCB has undertaken another investigation to project M&I surface water use needs to the year 2050 for the state. The result of that investigation is reported in the document *State of Colorado 2050 Municipal and Industrial Water Use Projections*, dated July 2010. The report is part of the Basin Roundtables' assessment of consumptive water needs in the state as required by the Water for the 21st Century Act, which was passed by the Colorado legislature in 2005.

<sup>5</sup> Passive conservation accounts for retrofits of existing housing and commercial construction with high-efficiency toilets, clothes washers, dishwashers, etc. as implementation of the baseline efficiency standards established under the 1992 National Energy Policy Act take place (CWCB 2010).

<sup>6</sup> Soil variations occur on a local and regional scale and should be taken into consideration when addressing water quality problems. Information on soil conditions can be found through the Natural Resources Conservation Service (NRCS) Web Soil Survey at <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>. The website can be used to access soil maps and soil descriptions, interpretations, and characteristics. The information can be used at a relatively broad scale as well as on a site-specific basis.

To monitor stream flow, numerous USGS stream flow gauges are maintained in the Green River Basin. Exhibit 8-14 summarizes the mean annual stream flow, period of record, and drainage area for five drainages, all of which were recently selected by the CWCB to summarize historic flows in the basin across a broad spatial scale. As indicated in the exhibit, mean annual flows are highest in the Yampa River near the town of Maybell and in the White River near the town of Meeker. The locations of the selected gauges are shown in exhibit 8-15 at end of chapter. Also shown are major surface water diversions and segments with decreased instream flow.

**Exhibit 8-14. Green River Basin Summary of Selected USGS Stream Gauges**

Site Name	USGS Site Number	Mean Annual Stream Flow (AFY)	Mean Annual Stream Flow (cfs) <sup>1</sup>	Period of Record (years)	Drainage (square miles)
Yampa River at Steamboat Springs	09239500	336,638	465	1910-2002	604
Yampa River near Maybell	09251000	1,134,945	1,568	1916-2002	3,410
Little Snake River near Lily	09260000	417,948	577	1921-2002	3,730
North Fork White River at Buford	09303000	229,899	318	1952-2001	259
White River near Meeker	09304500	451,554	624	1909-2002	755

<sup>1</sup> cfs = cubic feet per second.

Source: CWCB 2004.

In addition, it should be noted that mountain snowpack can have significant impacts and can cause variations in surface water quality and quantity on an annual basis. The Natural Resources Conservation Service (NRCS) Snow Survey Program provides mountain snowpack data and streamflow forecasts for the western United States. Common applications of snow survey data include water supply management, flood control, climate modeling, recreation, and conservation planning. Additional information on the NRCS snow survey program can be found at <http://www.co.nrcs.usda.gov/snow/>.

### 8.1.7.3 Groundwater

Groundwater in the Green River Basin overlays three separate groundwater basins: the Piceance Basin, the Sand Wash Basin, and the Eagle Basin. Aquifers located within these basins include the following:

- ◆ Upper Piceance Basin
- ◆ Mahogany confining unit
- ◆ Lower Piceance Basin
- ◆ Basal confining unit
- ◆ Wasatch-Fort Union
- ◆ Weber Sandstone
- ◆ Maroon and Minturn Formation

Exhibit 8-16 at end of chapter is an outline of the aquifers, broken down into two groups: alluvial and bedrock. All of the aquifers listed above are bedrock aquifers. Also shown in the exhibit is

the location of wells in the Green River Basin with a permitted or decreed yield of 500 gallons per minute (gpm) or higher (CWCB 2004 and CGS 2003).

The majority of the White River Sub-basin overlies the Piceance Basin. This groundwater basin contains four primary layers or aquifers: Upper Piceance Basin, Mahogany confining unit, Lower Piceance Basin, and Basal confining unit (CWCB 2004 and CGS 2003).

Within the Upper Yampa River Sub-basin, the upper portions of the Yampa River and the Little Snake River overlie the Sand Wash Basin. The confined Tertiary aquifer system (Wasatch-Fort Union aquifer) is the uppermost regional aquifer in the Sand Wash Basin. From the limited data available, this aquifer is estimated to range from less than 1,000 to more than 4,000 feet thick (CWCB 2004 and CGS 2003).

The Eagle Basin, located in the southern portion of Rio Blanco County, is comprised primarily of sandstone aquifers including the Weber Sandstone and Maroon and Minturn Formations. These aquifers are underlain by the Eagle Valley confining unit (CWCB 2004 and CGS 2003).

## 8.2 Water Quality Classifications and Standards

In general, water quality classifications and standards information are presented on a basin scale with some additional detail provided for sub-basins as described in the next subsection.

### 8.2.1 Sub-Basin Boundaries

As discussed in chapter 3, “Current Statewide Water Quality,” Colorado’s seven major drainage basins have been sub-divided into sub-basins as a means to present data at somewhat smaller scales throughout this document. The sub-basins are aggregations of the various stream segments on which the WQCD provides assessment in its biennial *Integrated Water Quality Monitoring and Assessment Report*. For purposes of this report, the Green River Basin has been sub-divided into three sub-basins.<sup>7</sup> These include the following:

- ◆ **Upper Yampa River:** The Upper Yampa River Sub-basin is composed of segments from the headwaters of the Yampa River mainstem to the National Forest boundary, as shown in exhibit 8-17 at end of chapter.
- ◆ **Lower Yampa/Green River:** The Lower Yampa/Green River Sub-basin is composed of segments from the lower portion of the Yampa River from Elkhead Creek at the National Forest boundary to the Colorado/Wyoming border, as shown in exhibit 8-18 at end of chapter. The Lower Yampa/Green River Sub-basin also includes the entirety of the Green River and its tributaries.

---

<sup>7</sup> The WQCD identifies different sub-basins in its biennial Integrated Water Quality Reports than those provided in this document. The SWQMP aggregates water quality segments into larger sub-basins than those in the Integrated Reports simply because the resources available for this first iteration of the SWQMP did not allow for analyzing the data at finer scales.

- ♦ **White River:** The White River Sub-basin is composed of segments from the White River and all its tributaries within Flat Tops Wilderness Area to the Colorado/Utah border, as shown in exhibit 8-19 at end of chapter.

## 8.2.2 Surface Water

### 8.2.2.1 Use Classifications

The Green River Basin contains a total of 100 waterbody segments covering approximately 13,796 stream miles. The WQCC has specified the classified uses for each of these segments in Regulation No. 33: *Classifications and Numeric Standards for the Upper Colorado River Basin and North Platte River* (5 CCR 1002-33) and Regulation No. 37: *Classifications and Numeric Standards for the Lower Colorado River Basin* (5 CCR 1002-37) (WQCC 2010a and WQCC 2010b). In terms of sub-basins, Regulation No. 33 covers the Upper Yampa River Sub-basin, while Regulation No. 37 covers the Lower Yampa/Green River and the White River Sub-basins. The classified uses are summarized in exhibit 8-20 (at end of chapter). Segment-level data is presented in exhibits 8-21 through 8-23 (at end of chapter).

The WQCC has classified all segments in the Green River Basin for agriculture. It has classified 58% of the segments for aquatic life cold water 1, 57% for water supply, and 48% for existing recreation. The proportion of segments for the remaining use categories are 24% for potential recreation, 21% for recreation not suitable, 20% for aquatic life warm water 2, 13% for both aquatic life cold water 2 aquatic life warm water 1, and 10% for recreation undetermined. The stream miles associated with these uses are shown in exhibit 8-24.

**Exhibit 8-24. Number of Streams and Stream Miles by Classified Use**

Classified Uses	No. Streams	Stream Miles	Percent of Total Stream Miles (n=13,796 miles)
Agriculture	100	13,796	100%
Not Suitable Recreational Uses <sup>1</sup>	21	5,794	42%
Aquatic Life Warm 2	20	5,224	38%
Existing Recreational Uses <sup>1</sup>	48	4,656	34%
Aquatic Life Cold 1	54	4,658	34%
Water Supply	57	4,723	34%
Potential Recreational Uses <sup>1</sup>	24	3,426	25%
Aquatic Life Cold 2	13	1,984	14%
Aquatic Life Warm 1	13	1,931	14%
Undetermined Recreational Uses <sup>1</sup>	10	68	0.5%
<b>Total Streams</b>	<b>100</b>	<b>13,796</b>	--

<sup>1</sup> Some segments in this basin have different recreational uses depending on the time of year (existing, not suitable, potential, and undetermined). This exhibit reflects all of the classified uses for all segments in the basin even if some are only applicable at certain times of the year.

Sources: WQCC 2010a, 2010b; WQCD 2010a.

In its latest assessment cycle, the WQCD presented information for 22 lakes in the Green River Basin<sup>8</sup>. These 22 lakes total approximately 22,251 lake acres. The percentage of total assessed lake acres associated with the various classified uses are shown in exhibit 8-25.

**Exhibit 8-25. Number of Lakes/Reservoirs and Corresponding Acres by Classified Use**

Classified Uses	No. Lakes	Lake Acres	Percent of Total Lake Acres (N=22,250.81 acres)
Agriculture	22	22,250.81	100%
Existing Recreational Uses <sup>1</sup>	12	21,624.91	97%
Aquatic Life Cold 1	14	20,255.01	91%
Water Supply	15	21,352.91	96%
Aquatic Life Cold 2	1	Acres not available	--
Aquatic Life Warm 1	7	1,995.80	9%
Undetermined Recreational Uses <sup>1</sup>	9	625.90	3%
Potential Recreational Uses <sup>1</sup>	1	Acres not available	--
<b>Total Lakes:</b>	<b>22</b>	<b>22,250.81</b>	<b>--</b>

<sup>1</sup> Some segments in this basin have different recreational uses depending on the time of year (existing, not suitable, potential, and undetermined). This exhibit reflects all of the classified uses for all segments in the basin even if some are only applicable at certain times of the year.

Sources: WQCC 2010a, 2010b; WQCD 2010a.

### 8.2.2.2 Designations

As further shown in exhibits 8-21 through 8-23 (at end of chapter), the WQCC has designated a total of six segments as *Outstanding Waters* (two in the Upper Yampa River Sub-basin, two in the Lower Yampa/Green River Sub-Basin, and two in the White River Sub-basin). The WQCC has designated a total of eight segments as *Use Protected* (two in the Upper Yampa River Sub-basin, five in the Lower Yampa/Green River Sub-basin, and one in the White River Sub-basin). The meaning of these two designations is provided in section 2.2.3.1 of chapter 2, “Water Quality Planning and Management in Colorado.”

### 8.2.2.3 Standards

Numeric standards for the Green River Basin are provided in the “Stream Classifications and Water Quality Standards” table attached to Regulation No. 33 for the Upper Yampa River Sub-basin and Regulation No. 37 for the Lower Yampa/Green River and White River Sub-basins. Because new standards are often developed and existing standards are periodically revised, the standards are not summarized here. For specific details, readers should consult the actual regulations, which are available at <http://www.cdphe.state.co.us/regulations/wqccregs>.

<sup>8</sup> Lakes are presented in WQCC’s surface water quality classifications and standards regulations in several ways. A lake may be present alone as its own segment, as a combination of several lakes grouped into a segment, or as part of a segment that includes streams, lakes, and wetlands. The WQCD presented only those lakes/reservoirs it assessed during its latest monitoring cycle in appendix B of the 2010 Integrated Report. The entire universe of lakes/reservoirs in the state is not explicitly denoted in the WQCC regulations, nor are the lakes/reservoirs fully denoted in WQCD’s biennial Integrated Reports. Each biennial cycle, the WQCD assesses and presents information for only a subset of lakes/reservoirs in the state.

## 8.2.3 Lakes

### 8.2.3.1 Trophic Status

From July 2007 to July 2009, the WQCD monitored a total of 50 lakes and reservoirs across the state to evaluate their trophic status and to assess whether they were attaining their respective water quality standards. Of the 50 lakes and reservoirs assessed, seven are in the Green River Basin, specifically in the Upper Yampa River and White River Sub-basins. (See exhibit 8-26.)

The *trophic state* is a means of classifying lakes based on their level of biological productivity (especially algae) and nutrient status. Commonly used indicators of nutrient status and productivity include the amount of algae as measured by chlorophyll *a*, water transparency as measured by Secchi disk depth, and in-lake epilimnetic total phosphorus concentration. WQCD broadly defines the various *trophic states* for the purposes of its analyses as follows:

- ◆ **Oligotrophic.** Lakes with few available nutrients and a low level of biological productivity. They are characterized by clear water, and they often support cold-water fish species.
- ◆ **Mesotrophic.** Lakes with moderate nutrient levels and biological productivity between oligotrophic and eutrophic. These lakes usually support warm-water fish species.
- ◆ **Eutrophic.** Lakes with high nutrient levels and a high level of productivity. These lakes typically support only warm-water fish species.
- ◆ **Hypereutrophic.** Lakes in an advanced eutrophic state.

**Exhibit 8-26. Green River Basin, Trophic Status of Lakes and Reservoirs  
as Measured by WQCD During the Period 2007 to 2009**

Lake	Lake Avery (Big Beaver)	Elkhead Reservoir	Kenney Reservoir	Pearl	Rio Blanco Reservoir	Stagecoach Reservoir	Steamboat Lake
Segment ID No.	COLCWH25	COUCYA02	COLCWH12	COUCYA02	COLCWH11	COUCYA02	COUCYA02
Elevation (feet)	6989	6306	5350	8054	5760	7210	8031
Surface Acres	300	400	600	167	383	780	1053
Chlorophyll <i>a</i> (µg/L)	2.08	1.56	1.90	0.99	2.70	6.00	14.93
Chlorophyll Trophic Status Index <sup>1</sup>	38	35	37	30	40	48	57
Secchi Depth (meters)	3.40	1.60	2.57	4.80	1.18	350	4.00
Estimated Trophic Status	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic	Mesotrophic	Mesotrophic	Eutrophic
Year Monitored	2008	2008	2007	2008	2007	2007, 2008	2007

<sup>1</sup> Chlorophyll Trophic Status Index (TSI) quantifies the relationship between lake clarity measured in terms of Secchi disk transparency and algal biomass measured in terms of chlorophyll *a*. Lakes with the following TSI values are estimated to have the following trophic status: TSI 0-40, Oligotrophic; TSI 41-50, Mesotrophic; TSI 51-70, Eutrophic; and TSI greater than 70, Hypereutrophic.

Sources: WQCD 2010a.

As shown in exhibit 8-26, of the seven assessed lakes/reservoirs in the Green River Basin, four are oligotrophic, two are mesotrophic, and one is eutrophic.

### 8.2.3.2 Fish Tissue Studies

As part of its overall monitoring efforts, the WQCD also investigates fish tissues for the presence of contaminants that can be harmful to humans if ingested. The WQCD uses the monitoring data to issue fish consumption advisories (FCAs) to the public as warranted. During the period July 2007 to July 2009, the WQCD evaluated fish tissues from more than 112 waterbodies. Of this number, six waterbodies were assessed in the Green River Basin (two in the Upper Yampa River Sub-basin, one in the Lower Yampa/Green River Sub-basin, and two in the White River Sub-basin) for mercury, selenium, and arsenic. Two FCAs were issued to Catamount Reservoir and Elkhead Reservoir included in this assessment effort. Exhibit 8-27 lists the lakes/reservoirs and fish species evaluated in the Green River Basin.

**Exhibit 8-27. Green River Basin Lakes and Reservoirs Assessed for Mercury, Selenium, and Arsenic During the Period 2007 to 2009**

Lake	Species tested
Catamount Reservoir (COUCYA02b)	Northern Pike
Elkhead Reservoir (COUCYA02b)	Largemouth Bass, Smallmouth Bass, Northern Pike, and Black Crappie
Rio Blanco Reservoir ((COLCWH11)	Black Crappie, Yellow Perch, Bluegill, and Largemouth Bass
Stagecoach Reservoir (COUCYA02b)	Northern Pike and Walleye
Trapper Lake (COLCWH01)	Brook Trout
Williams Fork Reservoir (COLCLY29)	Northern Pike

Sources: WQCD 2010a.

The WQCD chose to test for the presence of mercury, selenium, and arsenic in fish tissue because of the harmful human health effects that can occur if these parameters are ingested. In particular, mercury adversely affects wildlife and humans, especially children and women of childbearing age. It is also the leading cause of impairment in the nation's estuaries and lakes. Mercury was cited in nearly 80% of FCAs reported by the states in the 2000 National Listing of Fish and Wildlife Advisories. Although arsenic generally bio-accumulates in fish in its less toxic organic form, human exposure is still harmful. The U.S. Department of Health and Human Services (DHHS) has determined that arsenic is a known carcinogen, and human exposure can occur by ingesting water, soil, or air contaminated by the substance. Selenium is an essential dietary element that prevents damage to tissues by oxygen. When consumed in amounts higher than the recommended daily allowance, however, it is toxic to both humans and animals, and excessive ingestion or exposure should be minimized (WQCD 2005).

Any waterbody that is issued an FCA is listed on the state's CWA section 303(d) list of impaired waters with aquatic life impairment. Total maximum daily loads (TMDLs) must be completed for all impairments. As a result of the monitoring between 2007 and 2009, the WQCD issued two FCAs for mercury: one in the Catamount Reservoir and another in the Elkhead Reservoirs

(exhibit 8-28). The 2010 Integrated Report identifies the two reservoirs as impaired for mercury, meaning that TMDLs must be prepared (WQCC 2010c and WQCD 2010a).

**Exhibit 8-28. Green River Basin Lakes and Reservoirs in Which a Fish Consumption Advisory (FCA) Has Been Issued**

Lake/Reservoir	Pollutant	Species tested	Year FCA issued
Catamount Reservoir (COUCYA02b)	Mercury	Northern Pike	2009
Elkhead Reservoir (COUCYA02b)	Mercury	Largemouth Bass, Smallmouth Bass, Northern Pike, and Black Crappie	2009

Sources: WQCD 2009a, 2009b, 2010c, 2010a.

## 8.2.4 Wetlands

A map of Green River Basin wetlands is included as exhibit 8-29 (at end of chapter). The wetlands are those included in the U.S. Fish and Wildlife Service's (USFWS's) National Wetlands Inventory, the database the USFWS uses to periodically report to Congress on the status and trends of the nation's wetlands. Colorado's Natural Heritage Program and other entities are involved in more fully identifying and characterizing Colorado's wetlands. This information will be added when completed to future iterations of the SWQMP.

At the state level, the Green River Basin lies within an area supported by the Colorado Division of Wildlife's (CDOW's) Yampa/White River Wetland Focus Area Committee.<sup>9</sup> The Committee has identified the wetland area within the Yampa/White River Wetland Focus Area using the Colorado National Heritage Program's (CNHP) *Statewide Wetlands Classification and Characterization Final Report*. These wetland areas are listed in exhibit 8-30 and are generally distinguished by vegetation and soil types. The Committee's conservation concerns for these wetland types are also noted in exhibit 8-30.

**Exhibit 8-30. Wetland Types Identified by CDOW Yampa/White River Wetland Focus Area Committee**

Wetland Area	Location Description	Conservation Concerns
Upper Little Snake	From National Forest boundary to Baggs, Wyoming	Lack of woody vegetation, understory degradation, irrigation/water diversion, livestock management impact, channel widening
Lower Little Snake	From Baggs, Wyoming to confluence with Yampa River	Excessive stream bank erosion, understory degradation, non-native plant species invasion, heavy sediment load, loss of seasonally flooded wetlands, livestock management, impact water and/or soil quality degradation, channel down-cutting, channel widening
Elk River	From Forest Service boundary to confluence with Yampa River	Land fragmentation, understory degradation, non-native plant species invasion, floodplain development, channel widening
Upper Yampa River	From West Steamboat Springs to Forest Service boundaries	Land fragmentation, lack of woody vegetation, floodplain development, loss of seasonally flooded wetlands, bank hardening, berming and channelization, recreation impact, water and/or soil quality degradation, impoundment, increase water consumption, change in hydrograph, channel widening

<sup>9</sup> CDOW created the Wetlands Wildlife Conservation Program (WWCP) to focus on preserving, restoring, enhancing, and creating wetlands throughout the state. This program focuses on (1) protecting the role of wetlands in Colorado as important feeding, breeding, migratory, and brooding habitat for water birds, and (2) providing recreational uses, such as hunting, fishing, and bird watching, through wetlands (CDOW 2008). The CDOW has created 11 focus area committees under the WWCP. The committees provide a mechanism through which conservationists can share information on local wetlands, discuss wetland needs, and generate ideas for wetland protection and restoration projects.

Wetland Area	Location Description	Conservation Concerns
Mid-Yampa River	From West Steamboat to Elkhead Creek	Land fragmentation, excessive stream bank erosion, lack of woody vegetation, understory degradation, non-native plant species invasion, floodplain development, increase water consumption, channel widening
Lower Yampa River	From Elkhead Creek to Green River	Excessive stream bank erosion, lack of woody vegetation, understory degradation, non-native plant species invasion, heavy sediment load, irrigation/water diversion, livestock management, impact change in hydrograph
Williams Fork	From Forest Service boundary to confluence with Yampa River	Excessive stream bank erosion, lack of woody vegetation, understory degradation, non-native plant species invasion, livestock management impact
Elkhead Creek	From Forest Service boundary to confluence with Yampa River	Excessive stream bank erosion, lack of woody vegetation, understory degradation, non-native plant species invasion, heavy sediment load, loss of seasonally flooded wetlands, livestock management impact, impoundment, change in hydrograph, channel down-cutting
Fortification Creek	From Forest Service boundary to confluence with Yampa River	Excessive stream bank erosion, lack of woody vegetation, understory degradation, heavy sediment load, bank hardening berming and channelization, irrigation/water diversion, livestock management impact, channel down-cutting
Green River	Within Moffat County	Lack of woody vegetation, non-native plant species invasion, loss of seasonally flooded wetlands, livestock management impact, impoundment, change in hydrograph, channel down-cutting
White River	Forest Service boundary to Agency Park	Land fragmentation, heavy sediment load, channel widening
Lower White River	Agency Park to state line	Excessive stream bank erosion, understory degradation, non-native plant species invasion, heavy sediment load, livestock management impact, recreation impact, channel widening
Piceance/Yellow Creek	Not available	Lack of woody vegetation, understory degradation, non-native plant species invasion, irrigation/water diversion, livestock management, impact water and/or soil quality degradation, impoundment, channel down-cutting
Douglas Creek	From Douglas Pass to the confluence with White River at Rangely	Lack of woody vegetation, understory degradation, non-native plant species invasion, heavy sediment load, floodplain development, loss of seasonally flooded wetlands, livestock management impact, channel down-cutting
USFS Land	Not available	Heavy sediment load, livestock management impact, recreation impact

Source: Yampa/White River Wetland Focus Area Committee 2004.

## 8.2.5 Groundwater

### 8.2.5.1 Interim Narrative Standard

The Interim Narrative Standard found in section 41.5(C)(6)(b)(i) of Regulation No. 41: *The Basic Standards for Groundwater* (5 CCR 1002-41) (WQCC 2009) is applicable to all groundwater for which the WQCC has not already assigned standards, with the exception of those groundwaters where the total dissolved solids are equal to or exceed 10,000 milligrams per liter (mg/L). The Interim Narrative Standard is independent of and in addition to the statewide groundwater standards for radioactive materials and organic pollutants.

Until such time as use classifications and numeric standards are adopted for groundwater on a site-specific basis, the following standards apply for each parameter at whichever of the following levels is the least restrictive:

- ◆ Existing ambient quality as of January 31, 1994, or
- ◆ That quality which meets the most stringent criteria set forth in Tables 1 through 4 of Regulation No. 41: *The Basic Standards for Groundwater*.

The four tables from Regulation No. 41: *The Basic Standards for Ground Water* can be viewed online at <http://www.cdphe.state.co.us/regulations/wqccregs> for the following classified uses: Table 1: Domestic Water Supply - Human Health Standards; Table 2: Domestic Water Supply - Drinking Water Standards; Table 3: Agricultural Standards; and Table 4: Total Dissolved Solids Water Quality Standards.

### 8.2.5.2 Site-Specific Classifications and Standards

The WQCC has established five site-specific groundwater classifications for the Green River Basin, as summarized in exhibit 8-31. Exhibits 8-32 to 8-35 (at end of chapter) illustrate the classified areas.<sup>10</sup> Of the five site-specific groundwater classifications and standards, three are in the White River Sub-basin and two are in the Lower Yampa/Green River Sub-Basin.

**Exhibit 8-31. Green River Basin Site-Specific Groundwater Classifications and Standards**

Site	Specified Area <sup>1,2</sup>	Classifications for Confined and Unconfined Groundwater	Are Groundwater Quality Standards in Tables 1–4 Applicable? <sup>3</sup>
<b>Upper Yampa River Sub-Basin</b>			
None	--	--	--
<b>Lower Yampa/Green River Sub-Basin</b>			
Oil and Gas Fields of Northern Moffat County	See exhibit 8-32	Limited Use Quality	No
<b>White River Sub-Basin</b>			
Town of Meeker Wellfield, Rio Blanco County	See exhibit 8-33	Domestic Use Quality and Agricultural Use Quality	Yes
Rangely Oil and Gas Fields of Rio Blanco County	See exhibit 8-34	Limited Use Quality	No
Oil and Gas Field of Rio Blanco County	See exhibit 8-35	Limited Use Quality	No

<sup>1</sup> Specified areas pertain to confined and unconfined groundwaters within the saturated zones.

<sup>2</sup> Maps displayed in these exhibits are pulled directly from Regulation No. 42: *Site-Specific Water Quality Classification and Standards for Ground Water* (WQCC 2006b).

<sup>3</sup> The groundwater quality standards included in tables 1 to 4 of Regulation No. 41: *The Basic Standards for Groundwater* are assigned to all confined and unconfined groundwater in the specified area.

Source: WQCC 2006b.

### 8.2.5.3 Groundwater Quality

The Green River Basin overlays three separate groundwater basins: the Piceance Basin, the Sand Wash Basin, and the Eagle Basin. Exhibit 8-16 (at end of chapter) shows these significant aquifers along with the alluvial aquifers. Wells with decreed or permitted yields greater than or equal to 500 gpm are also displayed (CWCB 2004).

#### *Alluvial Aquifers*

The alluvium in the Yampa River Sub-basin typically consists of unconsolidated deposits of clay, silt sand and gravel. The saturated thickness of the Yampa River alluvium ranges from 10-100 feet. In the tributary valleys, the saturated portion of the alluvium is generally less than 20

<sup>10</sup> Maps displayed in these exhibits are pulled directly from Regulation No. 42: *Site-Specific Water Quality Classification and Standards for Ground Water* (WQCC 2006b).

feet thick and may be absent altogether where streams cross hard resistant bedrock, such as sandstone (CGS 2003). See Exhibit 3-16 at end of chapter 3 for map showing the distribution of alluvial deposits in Colorado.

Alluvial groundwater in the Yampa River Sub-basin is generally a calcium and sodium bicarbonate type when the alluvium is derived from the erosion of sandstone or granitic material. Representative total dissolved solids (TDS) concentrations are shown in exhibit 8-36 below.

**Exhibit 8-36. Representative Total Dissolved Solids (TDS) Concentrations in Water from Yampa River Sub-Basin Alluvial Wells**

Location of Samples	TDS Concentrations (mg/L)
South of Steamboat Springs	105
Northeast of Steamboat Springs	156-244
Elk River	270
East of Fortification Creek	255-1,140
Craig	2,750
Maybell	409

Source: CGS 2003.

The White River Sub-basin alluvium consists of silty sand and rounded gravel and cobbles derived from the eastern mountains. In the Meeker area the depth of alluvium ranges from 112-140 feet. The majority of alluvial wells are concentrated east and west of the town of Meeker. Water quality information for the White River alluvium is sparse. In the eastern upgradient part of the basin, the alluvial water is a calcium bicarbonate type, while in the western part of the basin the water becomes a sodium bicarbonate type. TDS concentrations range from 200-2,500 milligrams per liter (mg/L) (CGS 2003).

### **Piceance Basin**

The majority of the White River Sub-basin overlies the Piceance Groundwater Basin. The basin contains four primary layers: Upper Piceance Basin aquifer, Mahogany confining unit, Lower Piceance Basin aquifer, and a Basal confining unit. The Piceance structural basin encompasses portions of Moffat, Rio Blanco, Garfield, Mesa, Pitkin, Delta, Gunnison and Montrose Counties. It is an elongated structural depression trending northwest to southeast and is more than 100 miles long by 60 miles wide. The largest portion is in Moffat County at 4,751 square miles and the smallest portion is in Pitkin County at 973 square miles. The saturated Tertiary rocks of the Piceance basin are divided into two aquifer units, the upper and lower Piceance basin aquifers, which are separated by a confining unit known as the Mahogany zone. The Mahogany formation is the principal oil shale mining zone. The thickness of the upper and lower aquifers average 600 and 900 feet, respectively (CGS 2003). See Exhibit 3-17 at end of chapter 3 for map showing the Colorado's major sedimentary rock aquifers and aquifer systems.

The upper aquifer gains in TDS as groundwater moves from the upland recharge areas to the discharge areas, which are typically springs above the Mahogany confining layer. In the upper aquifer unit dissolved solids increase from about 500 mg/L to 1,000 mg/L. The chemical water classification is diverse ranging from calcium carbonate to sodium carbonate water. In the lower

aquifer unit the TDS concentration increases from 1,000 to 10,000 mg/L along the basin flow paths. Waters greater than 1,000 mg/L of dissolved solids are generally unsuitable for domestic potable supplies. The water in the lower aquifer is classified as a sodium-carbonate type and is influenced by the dissolution of calcite, dolomite, anchorite and halite (CGS 2003).

Many lower tributaries in the Piceance Creek Basin, located in the central portion of the White River Sub-basin in Rio Blanco County, exhibit poor quality due primarily to the streams being fed by groundwater in contact with oil shale. These streams have exceedingly high concentrations of dissolved solids, sulfates, and other minerals associated with oil shale (CWCB 2004).

### **Sand Wash Basin**

The Sand Wash Basin encompasses 4,760 square miles, including the northeastern half of Moffat County, the western two thirds of Routt County and the northeastern tip of Rio Blanco County. The upper portion of the Yampa River and the Little Snake River (a Yampa tributary) overlie the Sand Wash Basin (CGS 2003). See the exhibit at end of chapter 3 for map showing the Colorado's major sedimentary rock aquifers and aquifer systems.

The confined Tertiary Wasatch-Fort Union aquifer is the uppermost regional aquifer in the Sand Wash Basin. The Wasatch zone of the aquifer ranges from less than 1,000 to more than 4,000 feet thick. The Fort Union zone underlies the Wasatch aquifer and ranges from 1,000 to 3,000 feet in thickness. Since there is no confining layer between these two formations, they are considered one aquifer unit. The thickness of the Wasatch-Fort Union aquifer approaches 7,000 feet in the center of the basin. The Colorado Division of Water Resources well permit database indicates that there are 2,157 bedrock wells in the Sand Wash Basin (CGS 2003).

The TDS concentrations near the recharge areas of the Wasatch zone are less than 500 mg/L, but TDS concentrations increase down the flow paths along the hydraulic gradient toward the Little Snake River. As groundwater moves toward the center of the basin it becomes briny, greater than 35,000 mg/L in TDS (CGS 2003).

### **Eagle Basin**

The portion of the Eagle Basin that is within the White River Sub-basin is located in the southern portion of Rio Blanco County. It underlies the headwaters of the North and South Forks of the White River. The Eagle Basin is comprised primarily of sandstone aquifers including the Weber Sandstone (tan and grayish-white quartz sandstone), the laterally equivalent Maroon formation (maroon, reddish-brown and red quartzitic sandstone) and the underlying Minturn formation (buff, grey-green and brown sandstone). The Eagle Valley Evaporite confining unit underlies these aquifers. In total, the Eagle Basin underlies approximately 1,500 square miles in north central Colorado along the western flank of the Continental Divide (CGS 2003). See the exhibit at end of chapter 3 for map showing the Colorado's major sedimentary rock aquifers and aquifer systems.

Groundwater quality of the Eagle Basin aquifer is extremely variable and dependent upon any connectivity to the Eagle Valley Evaporite rocks underlying the Minturn formation. Beneath the evaporite rocks, which are confining units, lie the carbonate rock sequences including the

Leadville Limestone, Gilman Sandstone and Dyer Dolomite. The water quality within the Eagle basin aquifers is shown in Exhibit 8-37.

**Exhibit 8-37. Water Quality Characteristics of the Eagle Basin**

Hydrogeologic Unit	Total Dissolved Solids (mg/L)	Sodium + Potassium (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Bicarbonate as HCO <sub>3</sub> (mg/L)
Maroon Formation	1,820	574	524	356	534
Eagle Valley Evaporite	10,660 – 10,720	3,760 – 3,830	459 - 495	5,580 – 5,680	399 - 449
Leadville Limestone	18,500- 22,000	6,262 – 7,560	1,120 – 2,450	9,370 – 11,000	424 - 790

Source: CGS 2003.

## 8.3 Surface Water Quality Stressors and Sources

This section of the Green River Basin Plan summarizes data provided in the 2010 Integrated Report developed by the WQCD and approved by the WQCC. It is important to note that the data on water quality impairments and pollutant sources, as well as segments listed for further monitoring and evaluation, are based on information that is available to the WQCD today. Moreover, the data are limited to those parameters for which assessments are performed.

### 8.3.1 Impairments

Exhibits 8-38 and 8-39 (at end of chapter) provide a summary of the impairments for stream and lake/reservoir segments, respectively, in the Green River Basin. A map of these impairments is provided as exhibit 8-40 (at end of chapter).

As shown in exhibit 8-38, the WQCD identified nine impaired stream segments in the Green River Basin during its latest monitoring cycle, which represents 9% and 3% of the total segments and stream miles in the basin, respectively. Selenium is causing impairments in a total of four segments. Sediment and iron are causing impairments in two segments each, and *Escherichia coli* (*E. coli*) is causing impairment in one segment.

The 2010 Integrated Report identified one lake and reservoir segments as impaired (exhibit 8-39 at end of chapter). This segment represents 5% of the total assessed lakes and 64% of total assessed lake acres, respectively. Mercury is the cause of the impairment. Sub-basin details are provided in exhibits 8-41 to 8-44 (at end of chapter).

### 8.3.2 Segments Listed for Further Monitoring and Evaluation

During each monitoring cycle, the WQCD typically identifies parameters with elevated concentrations in some segments within a basin. The sample results or other factors are such that the WQCD is unable to make a determination as to whether the classified use in question is being attained. These segments are subsequently placed on the state's Monitoring and Evaluation (M&E) List. In its latest monitoring cycle, the WQCD identified 22 of the 100 segments in the Green River Basin (22%) with elevated concentrations of one parameter or more. Selenium, zinc, *E. coli*, copper, and iron (total recoverable) were identified in more than one sub-basin, while

manganese, dissolved oxygen, dissolved iron, mercury, lead, sediment, and pH were identified in only one sub-basin. See exhibits 8-45 to 8-48 at end of chapter for sub-basin details.

### 8.3.3 Known Sources of Stressors

Exhibit 8-49 provides a synopsis of the identified sources of stressors to the Green River Basin based on parameters causing impairments per the 2010 Integrated Report. The information is presented for each sub-basin and for the basin as a whole. Note that similar but even more detailed information is provided in exhibits 8-41 to 8-44 (at end of chapter). The Green River Basin has a total of 10 impaired waterbody segments that require development of a TMDL. Selenium accounts for greatest number of impaired segments with four, followed by sediment and iron with two segments each.

**Exhibit 8-49. Green River Basin Summary of Stressors for Impaired Waterbodies<sup>1</sup>**

Sub-Basin and Watershed	Number of Impaired Segments	Impairment	Number of Affected Segments	Source of Pollutants	Number of Affected Segments	Number of Affected Segments by TMDL Priority Development Status		
						Low	Med	High
<b>Upper Yampa Sub-Basin</b>								
Upper Yampa	6	Sediment	1	Unknown	1	1	0	0
		<i>E. coli</i>	1	Mining	1	0	0	1
		Selenium	2	Unknown	2	2	0	0
		Iron	1	Not assessed <sup>2</sup>	1	1	0	0
		Mercury	1	Not assessed	1	0	0	1
		<b>Subtotal</b>	<b>6</b>	<b>Total No. TMDLs</b>	<b>6</b>	<b>4</b>	<b>0</b>	<b>2</b>
<b>Lower Yampa/Green River Sub-Basin</b>								
Lower Yampa/Green	2	Selenium	1	Unknown	1	1	0	0
		Iron	1	Unknown	1	0	0	1
		<b>Subtotal</b>	<b>2</b>	<b>Total No. TMDLs</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>1</b>
<b>White River Sub-Basin</b>								
White	2	Selenium	1	Unknown	1	1	0	0
		Sediment	1	Unknown	1	1	0	0
		<b>Subtotal</b>	<b>2</b>	<b>Total No. TMDLs</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>0</b>
<b>Basin-wide Totals</b>								
Green River Basin	10	Selenium	4	Unknown	4	4	0	0
		Sediment	2	Unknown	2	2	0	0
		Iron	2	Not assessed	1	1	0	0
				Unknown	1	0	0	1
		<i>E. coli</i>	1	Mining	1	0	0	1
		Mercury	1	Not assessed	1	0	0	1
		<b>Total</b>	<b>10</b>	<b>Total No. TMDLs</b>	<b>10</b>	<b>7</b>	<b>0</b>	<b>3</b>

<sup>1</sup>The term "waterbodies" is used because the regulations identify some segments as containing streams, lakes, wetlands, or some combination thereof. In other instances, the regulations identify some segments as "lake-only." In this exhibit, all relevant segments are shown.

<sup>2</sup>"Not Assessed" indicates that if a single designated use is not assessed within the segment, then the whole segment is entered into the EPA Assessment Database as not assessed.

Sources: WQCC 2010c; WQCD 2010a, appendices A to D.

## 8.4 TMDLs as Water Protection Strategies

### 8.4.1 TMDL Basics

As noted previously in chapter 2, “Water Quality Management and Planning in Colorado,” CWA section 303(d) requires states to periodically submit to EPA a list of waterbodies that are impaired, meaning that the segment is not meeting the standards for its assigned use classification. The list of impaired waterbodies is referred to as the CWA section 303(d) list. The WQCD prepares the list in conjunction with its biennial Integrated Reports. The WQCC approves and adopts the list as Regulation No. 93: *Colorado’s Section 303(d) List of Impaired Waters and Monitoring and Evaluation List* (5 CCR 1002-93) (WQCC 2010c).

TMDLs must be developed for waterbodies on the CWA section 303(d) list. A TMDL is the maximum amount of a pollutant that a waterbody can receive and still maintain water quality standards. The TMDL is the sum of the waste load allocation (WLA), which is the load from point source discharges; the load allocation (LA), which is the load attributed to natural background and/or nonpoint sources; and a margin of safety (MOS).

#### TMDL Equation

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS}$$

An important aspect of the TMDL development process includes the identification of the sources of pollutants causing impairments in the waterbody. Both point sources and nonpoint sources are identified.

### 8.4.2 TMDLs Required to be Developed

Exhibit 8-50 summarizes the number of TMDLs that must be developed based on the waterbodies (streams and lake-only segments) included on the 2010 CWA section 303(d) list, which is also encompassed in the 2010 Integrated Report. The first section of the exhibit shows that a total of 10 impairments occurred in 10 distinct waterbody segments for the basin as a whole. The Upper Yampa River Sub-Basin requires the greatest number of TMDLs to be developed (six total). The WQCD has assigned a high priority to developing 3 of the 10 TMDLs (30%). The remaining TMDLs are listed as low priorities for development.

The sections that follow in exhibit 8-50 show the same information presented for the basin for each of the sub-basins. The Upper Yampa River Sub-basin has the greatest number of impaired segments at six segments. These numbers represent 60% of the total 10 impaired segments in the basin. The Upper South Platte has the greatest number of affected stream segments of the sub-basins, yet the Lower Yampa/Green River Sub-basin has the greatest number of affected stream miles (208 versus 183 miles). The Upper Yampa River Sub-basin has the only impaired lake in the Green River Basin. A thorough review of exhibit 8-50 and exhibits 8-38 to 8-44 (at end of chapter) will provide readers with a better appreciation of nuances such as these.

**Exhibit 8-50. Green River Basin Summary of Impairments, Affected Waterbody Segments, and TMDL Priority Development Status**

Basin-wide	Total Number of Distinct Segments Impaired <sup>1</sup>	Affected Stream Segments		Affected Lake-Only Segments		Impairment	Number of Impaired Segments by Pollutant <sup>1</sup>	Number of Affected Segments and TMDL Priority Status by Pollutant		
		No. (n=100)	Miles (n=13,796)	No. (n=22)	Acres (n=22,251)			Low	Medium	High
	10	9	481	1	14,311	Selenium	4	4	0	0
					Sediment	2	2	0	0	
					Iron	2	1	0	1	
					<i>E. coli</i>	1	0	0	1	
					Mercury	1	0	0	1	
					<b>Total No. TMDLs to Be Developed</b>	<b>10</b>	<b>7</b>	<b>0</b>	<b>3</b>	
Impaired Segments as Percent of Total Segments and Miles/Acres in Basin		9%	3%	5%	64%	Affected Segments as Percent of TMDL Priority Status		70%	0%	30%

Upper Yampa River Sub-Basin	Total Number of Distinct Segments Impaired <sup>1</sup>	Affected Stream Segments		Affected Lake-Only Segments		Impairment	Number of Impaired Segments by Pollutant <sup>1</sup>	Number of Affected Segments and TMDL Priority Status by Pollutant		
		No. (n=25)	Miles (n=2,443)	No. (n=2)	Acres (n=18,440)			Low	Medium	High
	6	5	183	1	14,311	Selenium	2	2	0	0
					Sediment	1	1	0	0	
					Iron	1	1	0	0	
					<i>E. coli</i>	1	0	0	1	
					Mercury	1	0	0	1	
					<b>Total No. TMDLs to Be Developed</b>	<b>6</b>	<b>4</b>	<b>0</b>	<b>2</b>	
Impaired Segments as Percent of Total Segments and Miles/Acres in Sub-Basin		20%	7%	50%	78%	Affected Segments as Percent of TMDL Priority Status		67%	0%	33%

Lower Yampa/Green River Sub-Basin	Total Number of Distinct Segments Impaired <sup>1</sup>	Affected Stream Segments		Affected Lake-Only Segments		Impairment	Number of Impaired Segments by Pollutant <sup>1</sup>	Number of Affected Segments and TMDL Priority Status by Pollutant		
		No. (n=42)	Miles (n=6,285)	No. (n=11)	Acres (n=998)			Low	Medium	High
	2	2	208	0	0	Selenium	1	1	0	0
					Iron	1	0	0	1	
					<b>Total No. TMDLs to Be Developed</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>1</b>	
Impaired Segments as Percent of Total Segments and Miles/Acres in Sub-Basin		5%	3%	0%	0%	Affected Segments as Percent of TMDL Priority Status		50%	0%	50%

White River Sub-Basin	Total Number of Distinct Segments Impaired <sup>1</sup>	Affected Stream Segments		Affected Lake-Only Segments		Impairment	Number of Impaired Segments by Pollutant <sup>1</sup>	Number of Affected Segments and TMDL Priority Status by Pollutant		
		No. (n=33)	Miles (n=5,069)	No. (n=9)	Acres (n=2,813)			Low	Medium	High

White River Sub-Basin	Total Number of Distinct Segments Impaired <sup>1</sup>	Affected Stream Segments		Affected Lake-Only Segments		Impairment	Number of Impaired Segments by Pollutant <sup>1</sup>	Number of Affected Segments And TMDL Priority Status by Pollutant		
		No. (n=33)	Miles (n=5,069)	No. (n=9)	Acres (n=2,813)			Low	Medium	High
	2	2	92	0	0	Selenium	1	1	0	0
					Sediment	1	1	0	0	
					<b>Total No. TMDLs to Be Developed</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>0</b>	
<b>Impaired Segments as Percent of Total Segments and Miles/Acres in Sub-Basin</b>		<b>6%</b>	<b>2%</b>	<b>0%</b>	<b>0%</b>	<b>Affected Segments as Percent of TMDL Priority Status</b>	<b>100%</b>	<b>0%</b>	<b>0%</b>	

<sup>1</sup>When the total number of TMDLs to be developed is greater than the total number of distinct segments impaired, it typically means that one or more of the impaired individual segments is impaired by more than one pollutant. When the total number of TMDLs to be developed is less than the total number of distinct segments impaired, it typically means that one or more individual segments were identified as impaired in a previous CWA section 303(d) listing cycle. However, the segments showed in the latest monitoring cycle that they are not meeting the standard(s) for one or more assigned use classifications.

Sources: WQCC 2010c; WQCD 2010a, appendices A to D.

### 8.4.3 TMDLs Completed to Date

During any given assessment cycle, segments for which a TMDL has already been developed are likely to be identified as impaired. This indicates that the TMDL has not yet been implemented or the benefits of TMDL implementation have yet to be realized. To date, the WQCD has not had to develop TMDLs for segments in the Green River Basin.

### 8.4.4 TMDL Implementation Strategies

Although no TMDLs have been completed in the Green River Basin to date, the WQCD recognizes that many other entities have undertaken or are planning activities that will contribute to improvements in water quality in the basin. In addition, WQCD appreciates that the development and implementation of strategies is best undertaken in partnership with local and other stakeholders in the watersheds and basins of issue. Readers interested in understanding the array of potential strategies that could be employed in a watershed should consult chapter 4 of this document, “Strategies for Addressing Water Quality Problems” and appendix E.

## 8.5 Planned Point Source Treatment Upgrades

As shown in exhibit 8-51, there are a total of 32 public and private point source dischargers in the Green River Basin<sup>11</sup>. Of this number, 19 (59%) are in the Upper Yampa Sub-basin, 6 (19%) are in the Lower Yampa/Green Sub-basin, and 7 (22%) are in the White Sub-basin. The point source dischargers are located in four counties. The counties with the greatest number of point source dischargers are Routt with 18 (56%), Moffat with 8 (25%), Rio Blanco with 5 (16%), and Garfield with 1 (3%).

**Exhibit 8-51. Green River Basin Summary of Point Sources by County**

<sup>11</sup> Point source dischargers only include those reported in the Clean Watershed Needs Survey 2008 database (USEPA 2010a), the USEPA ECHO database accessed June 24, 2010 (USEPA 2010d), and the Water Pollution Control Revolving Fund annual Intended Use Plan (WQCD 2010b).

Sub-Basin	Applicable Counties	No. of Point Sources by County
<b>Upper Yampa</b>	Moffat	1
	Routt	18
<b>Total Upper Yampa Sub-Basin</b> <i>(as % Total in Basin)</i>		<b>19</b> (59%)
<b>Lower Yampa/Green</b>	Moffat	6
<b>Total Lower Yampa/Green Sub-Basin</b> <i>(as % Total in Basin)</i>		<b>6</b> (19%)
<b>White</b>	Garfield	1
	Moffat	1
	Rio Blanco	5
<b>Total White Sub-Basin</b> <i>(as % Total in Basin)</i>		<b>7</b> (22%)
<b>Basin-wide</b>	Garfield	1
	Moffat	8
	Rio Blanco	5
	Routt	18
<b>Total All Counties</b>		<b>4</b> <b>32</b>

Sources: USEPA 2010a and 2010d; WQCD 2010b.

Congress authorized the Clean Water State Revolving Fund (CWSRF; called the Water Pollution Control Revolving Fund, or WPCRF, in Colorado) when amending the CWA in 1987. The purpose of the CWSRF is to help provide financial assistance to governmental agencies for the construction of projects that are listed in the state's annual Intended Use Plans (IUPs). The Project Eligibility List included in the IUPs is made up of projects for construction of publicly owned treatment works and projects/activities eligible for assistance under CWA sections 319 and 320. The Colorado IUP Project Eligibility List is comprised of the following six categories: (1) Category 1 includes those projects that improve or benefit public health or that will remediate a public health hazard; (2) Category 2 includes those projects that enable an entity to achieve permit compliance; (3) Category 3 includes those projects that contribute to the prevention of a public health hazard, enable an entity to maintain permit compliance, or enables an entity to address a possible future effluent limit or emerging issue; (4) Category 4 includes those projects that implement a watershed/nonpoint source management plan; (5) Category 5 includes those projects that implement a source water protection plan; and (6) Category 6 includes those projects that sought funding only under the American Recovery and Reinvestment Act of 2009 and that were not already on the state's Project Eligibility List as of January 1, 2009. For the purposes of the SWQMP, projects in categories 1 through 3 were labeled as wastewater treatment facility projects; projects in category 4 were labeled as nonpoint source projects or stormwater projects; and projects in category 5 were labeled as source water protection projects. Finally, projects in category 6 were labeled as wastewater treatment facility, nonpoint source, stormwater, or source water protection depending on the nature of the project (WQCD 2010b).

A total of 16 planned treatment projects were identified for point source facilities in the Green River Basin.<sup>12</sup> Exhibit 8-52 provides a summary of the project types by sub-basin and includes the number of projects, the estimated costs of the project, and the population expected to benefit. The two project types include (1) wastewater treatment facility and (2) stormwater. Of the 16 projects, 15 are for wastewater treatment related and 1 is a stormwater project (6%).

**Exhibit 8-52. Green River Basin Summary of Scheduled Point Source Improvements**

Project Type	Sub-Basin	No. of Projects	Estimated Cost of Projects <sup>1</sup>	Population Expected to Benefit from Projects	No. of Projects Reporting Population Data
Wastewater Treatment Facility	All	15	\$46,178,571	27,844	100%
Stormwater	All	1	\$1,350,000	6,000	100%
<b>Total All Projects</b>		<b>16</b>	<b>\$47,528,571</b>	<b>33,844</b>	

<sup>1</sup> Dollar amounts listed are those reported in WPCRF project applications only, as reported in the IUP. They likely are not inclusive of all projects that may be occurring in the basin.

Sources: USEPA 2010a, 2010d; WQCD 2010b.

The total estimated cost of the 16 projects in the Green River Basin is \$47,528,571. Of this number, wastewater treatment facility improvements account for 97% or \$46,178,571. Stormwater projects account for 3% or \$1,350,000. Exhibits 8-53 to 8-55 (at end of chapter) provide additional details. In addition to project information, these exhibits also summarize NPDES permit information. It should be noted that funding gaps exist nationwide in the CWSRF for wastewater treatment projects.<sup>13</sup> Total funding has also not increased significantly under section 319 in spite of nonpoint sources being the leading source of water pollution nationwide.

## 8.6 Nonpoint Source Management

This section of the basin plans typically provides a summary of CWA section 319 projects identified as taking place in the basin over the past 5 years. No such projects were identified for the Green River Basin.

<sup>12</sup> Projects identified include only those on the state's IUP. Therefore, the list is not likely inclusive of all projects that may be occurring in the basin.

<sup>13</sup> It is well recognized that the nation's infrastructure is aging and that the funds to replace this infrastructure are severely lacking. EPA recently completed its 2008 Report to Congress summarizing the results of its Clean Watersheds Needs Survey. The report presents a comprehensive analysis of capital investments necessary to meet the nation's wastewater and stormwater treatment and collection needs over the next 20 years. The report documents a total need of \$299.1 billion as of January 1, 2008. This total includes capital needs for publicly owned wastewater treatment pipes and treatment facilities (\$192.2 billion), combined sewer overflow correction (\$63.6 billion), and stormwater management (\$42.3 billion) (USEPA 2010b).

## References

### Text and Table/Figure References

- CDOW (Colorado Division of Wildlife). 2008. *Strategic Plan for the Wetland Wildlife Conservation Program*. Colorado Department of Natural Resources, Colorado Division of Wildlife, Denver, Colorado.
- CDOW. 2010. Species of concern. <<http://wildlife.state.co.us/WildlifeSpecies/SpeciesofConcern>>. Accessed August 9, 2010.
- CFWE (Colorado Foundation for Water Education). 2003. *Citizen's Guide to Colorado Water Quality Protection*. Colorado Foundation for Water Education, Denver, Colorado.
- CGS (Colorado Geological Survey). 2003. *Ground Water Atlas of Colorado*. Special Publication 53. Colorado Department of Natural Resources, Division of Minerals and Geology, Colorado Geological Survey, Denver, Colorado.
- CWCB. 2004. *Statewide Water Supply Initiative*. Colorado Department of Natural Resources, Colorado Water Conservation Board, Denver, Colorado.
- CWCB. 2009. *Nonconsumptive Needs Assessment Focus Mapping*. Colorado Department of Natural Resources, Colorado Water Conservation Board, Denver, Colorado.
- CWCB. 2010. *State of Colorado 2050 Municipal and Industrial Water Use Projections*. Colorado Department of Natural Resources, Colorado Water Conservation Board, Denver, Colorado.
- DOLA (Department of Local Affairs). Population Totals for Colorado Counties. <[http://dola.colorado.gov/dlg/demog/pop\\_cnty\\_estimates.html](http://dola.colorado.gov/dlg/demog/pop_cnty_estimates.html)>. Accessed on January 20, 2011. Colorado Department of Local Affairs, Division of Local Government, Denver, Colorado.
- USEPA. 2010a. Clean Watershed Needs Survey 2008 data. <<http://www.epa.gov/cwns/>>. Accessed June 28, 2010.
- USEPA. 2010b. *Clean Watershed Needs Survey: 2008 Report to Congress*. EPA-832-R-10-002. U.S. Environmental Protection Agency, Washington, D.C.
- USEPA. 2010c. *Grants Reporting Tracking System*. <<http://iaspub.epa.gov/pls/grts/f?p=110:199:1611870697608659::NO:::>>. Accessed August 4, 2010.
- USEPA. 2010d. NPDES facility attribute information. <<http://www.epa.gov/echo/index.html>>. Accessed June 24, 2010.

- USGS (U.S. Geological Survey). 2010. *Estimated Withdrawals and Use of Water in Colorado, 2005: Scientific Investigations Report 2010–5002*. U.S. Department of the Interior, U.S. Geological Survey, Reston, Virginia.
- WQCC (Water Quality Control Commission). 2006a. *Colorado Water Quality Management and Drinking Water Protection Handbook*. Commission Policy #98-2. Colorado Department of Public Health and Environment, Water Quality Control Commission, Denver, Colorado.
- WQCC. 2006b. Regulation No. 42: *Site-Specific Water Quality Classifications and Standards for Groundwater*. 5 CCR 1002-42. Colorado Department of Public Health and Environment, Water Quality Control Commission, Denver, Colorado.
- WQCC. 2009. Regulation No. 41: *The Basic Standards for Ground Water*. 5 CCR 1002-41. Colorado Department of Public Health and Environment, Water Quality Control Commission, Denver, Colorado.
- WQCC. 2010a. Regulation No. 33: *Classifications and Numeric Standards for Upper Colorado River Basin and North Platte River (Planning Region 12)*. 5 CCR 1002-33. Colorado Department of Public Health and Environment, Water Quality Control Commission, Denver, Colorado.
- WQCC. 2010b. Regulation No. 37: *Classifications and Numeric Standards for Lower Colorado River Basin*. 5 CCR 1002-37. Colorado Department of Public Health and Environment, Water Quality Control Commission, Denver, Colorado.
- WQCC. 2010c. Regulation No. 93: *Colorado’s Section 303(d) List of Impaired Waters and Monitoring and Evaluation List*. 5 CCR 1002-93. Colorado Department of Public Health and Environment, Water Quality Control Commission, Denver, Colorado.
- WQCD (Water Quality Control Division). 2002. *Integrated Water Quality Monitoring and Assessment Report*. Colorado Department of Public Health and Environment, Water Quality Control Division, Denver, Colorado.
- WQCD. 2005. *Quality Assurance Project Plan and Sampling Analysis and Assessment Plan for Fish Tissue Surveys for the State of Colorado*. Colorado Department of Public Health and Environment, Water Quality Control Division, Denver, Colorado.
- WQCD. 2008. *Integrated Water Quality Monitoring and Assessment Report*. Colorado Department of Public Health and Environment, Water Quality Control Division, Denver, Colorado.
- WQCD. 2009a. *Catamount Lake Attention Anglers*. (Posted Announcement). Colorado Department of Public Health and Environment, Denver, Colorado.

WQCD. 2009b. *Elkhead Reservoir Attention Anglers*. (Posted Announcement). Colorado Department of Public Health and Environment, Denver, Colorado.

WQCD. 2010a. *Integrated Water Quality Monitoring and Assessment Report*. Colorado Department of Public Health and Environment, Water Quality Control Division, Denver, Colorado.

WQCD. 2010b. *State of Colorado Water Pollution Control Revolving Fund and State Domestic Wastewater Treatment Grant Intended Use Plan*. Colorado Department of Public Health and Environment, Water Quality Control Division, Denver, Colorado

Yampa/White River Wetland Focus Area Committee. 2004. *Yampa/White River Wetland Focus Area Strategy*. Prepared with the assistance of Vital Resources, Steamboat Springs, Colorado.

## Map References

### Exhibit 8-1. Green River Basin Physical Location

WQCD (Water Quality Control Division). 2010a. CDPHE 2010 305(b) Basin Classifications. Shape\hucs\12digit\hydrologic\_units\wbdhu12\_a\_co\_Clip.shp. Acquired March 16, 2010.

### Exhibit 8-3. Green River Basin and Major Tributaries

ESRI (Environmental Systems Research Institute, Inc.). 2008. U.S. and Canada City Points. \ESRI\cities.sdc. Accessed April 5, 2010.

ESRI (Environmental Systems Research Institute, Inc.). 2008. U.S. and Canada Street Cartographic. \ESRI\streets.sdc. Accessed April 5, 2010.

ESRI (Environmental Systems Research Institute, Inc.). 2008. U.S. Counties. \ESRI\counties.sdc. Accessed April 5, 2010.

ESRI (Environmental Systems Research Institute, Inc.). 2008. U.S. National Atlas Water Feature Lines. \ESRI\hydroIn\_Clip\_to\_CO.shp. Accessed April 5, 2010.

ESRI (Environmental Systems Research Institute, Inc.). 2008. U.S. States and Canada Provinces. \ESRI\states.sdc. Accessed April 5, 2010.

USEPA (U.S. Environmental Protection Agency). 2010. 2010 EPA-approved National Hydrography Database (NHD) Stream Segmentation co\_2010\_305b\_draft\_str\_021410.shp and 2010 EPA-approved National Hydrography Database (NHD) Waterbody Segmentation co\_2010\_305b\_draft\_wb\_021410.shp. Acquired from Water Quality Control Division on March 16, 2010.

WQCD (Water Quality Control Division). 2010a. CDPHE 2010 305(b) Basin Classifications. Shape\hucs\12digit\hydrologic\_units\wbdhu12\_a\_co\_Clip.shp. Acquired from Water Quality Control Division March 16, 2010.

**Exhibit 8-4. Green River Basin Level III Ecoregions**

CEC (North American Commission for Environmental Cooperation). 2006.

<[http://www.cec.org/Page.asp?PageID=122&ContentID=1329&SiteNodeID=498&BL\\_ExpandID](http://www.cec.org/Page.asp?PageID=122&ContentID=1329&SiteNodeID=498&BL_ExpandID)>. Published by the U.S. Environmental Protection Agency, Washington, District of Columbia. Accessed April 2, 2010.

**Exhibit 8-6. Green River Basin Nonconsumptive Needs Assessment**

CWCB (Colorado Water Conservation Board). 2009a. *Nonconsumptive Needs Assessment Focus Mapping*. Colorado Department of Natural Resources, Colorado Water Conservation Board, Denver, Colorado.

**Exhibit 8-7. Green River Basin Precipitation**

CWCB. 2004. *Statewide Water Supply Initiative*. Colorado Department of Natural Resources, Colorado Water Conservation Board, Denver, Colorado.

**Exhibit 8-8. Green River Basin Land Ownership**

CDO (Colorado Division of Wildlife). 2003. Public Access Properties.

NDIS\_CDO\CDOPublicAccessProperties\CDOPublicAccessProperties.shp.  
Accessed May 18, 2010.

CSLB (Colorado State Land Board). 2009. Colorado State Land Ownership. CO State Land Board\slb\_surface\_ed\_032210a.shp. Accessed May 11, 2010.

USGS (U.S. Geological Survey). 2005. National Atlas of the United States (Federal Lands). NATIONALATLAS\lands\federal\fedlanp020.shp and NATIONALATLAS\lands\indian\indlanp020.shp. Accessed April 17, 2010.

**Exhibit 8-9. Green River Basin Land Cover**

USFWS (U.S. Fish and Wildlife Service). 2009. National Wetlands Inventory.

<<http://www.fws.gov/wetlands/data/DataDownload.html>>. Accessed June 14, 2010.

USGS. 2001. National Land Cover Database. <<http://www.mrlc.gov/>>. Accessed April 2, 2010.

**Exhibit 8-15. Green River Basin Key Diversions and Streamflow Gauges**

CWCB. 2004. *Statewide Water Supply Initiative*. Colorado Department of Natural Resources, Colorado Water Conservation Board, Denver, Colorado.

**Exhibit 8-16. Green River Basin Wells and Aquifers**

CWCB. 2004. *Statewide Water Supply Initiative*. Colorado Department of Natural Resources, Colorado Water Conservation Board, Denver, Colorado.

**Exhibit 8-17. Upper Yampa River Sub-Basin Classified Waterbody Segments**

WQCD. 2010a. CDPHE 2010 305(b) Basin Classifications.

Shape\hucs\12digit\hydrologic\_units\wbdu12\_a\_co\_Clip.shp. Acquired March 16, 2010.

USEPA. 2010. 2010 EPA-approved National Hydrography Database (NHD) Stream Segmentation co\_2010\_305b\_draft\_str\_021410.shp and 2010 EPA-approved National Hydrography Database (NHD) Waterbody Segmentation

co\_2010\_305b\_draft\_wb\_021410.shp. Acquired from Water Quality Control Division on March 16, 2010.

#### **Exhibit 8-18. Lower Yampa/Green River Sub-Basin Classified Waterbody Segments**

WQCD. 2010a. CDPHE 2010 305(b) Basin Classifications.

Shape\hucs\12digit\hydrologic\_units\wbdhu12\_a\_co\_Clip.shp. Acquired March 16, 2010.

USEPA. 2010. 2010 EPA-approved National Hydrography Database (NHD) Stream Segmentation co\_2010\_305b\_draft\_str\_021410.shp and 2010 EPA-approved National Hydrography Database (NHD) Waterbody Segmentation co\_2010\_305b\_draft\_wb\_021410.shp. Acquired from the Colorado Water Quality Control Division on March 16, 2010.

#### **Exhibit 8-19. White River Sub-Basin Classified Waterbody Segments**

WQCD. 2010a. CDPHE 2010 305(b) Basin Classifications.

Shape\hucs\12digit\hydrologic\_units\wbdhu12\_a\_co\_Clip.shp. Acquired March 16, 2010.

USEPA. 2010. 2010 EPA-approved National Hydrography Database (NHD) Stream Segmentation co\_2010\_305b\_draft\_str\_021410.shp and 2010 EPA-approved National Hydrography Database (NHD) Waterbody Segmentation co\_2010\_305b\_draft\_wb\_021410.shp. Acquired from Water Quality Control Division on March 16, 2010.

#### **Exhibit 8-29. Green River Basin Wetlands**

USFWS (U.S. Fish and Wildlife Service). 2009. National Wetlands Inventory.

<<http://www.fws.gov/wetlands/data/DataDownload.html>>. Accessed June 14, 2010.

#### **Exhibit 8-40. Green River Basin Impaired Waterbody Segments**

USEPA. 2010. 2010 EPA-approved National Hydrography Database (NHD) Stream Segmentation co\_2010\_305b\_draft\_str\_021410.shp and 2010 EPA-approved National Hydrography Database (NHD) Waterbody Segmentation co\_2010\_305b\_draft\_wb\_021410.shp. Acquired from Water Quality Control Division March 16, 2010.

WQCD. 2010a. CDPHE 2010 305(b) Basin Classifications.

Shape\hucs\12digit\hydrologic\_units\wbdhu12\_a\_co\_Clip.shp. Acquired March 16, 2010.

WQCD. 2010b. CDPHE 2010 303(d) Listings By Regulation and Basin

Shape\303D\_LISTING\REG\_33\_EXPORT.shp,  
Shape\2010\_303\_ME\COUC\lakes\COUC\_impaired\_lakes.shp,  
Shape\2010\_303\_ME\COLC\COLC\_impaired\_str.shp, and  
Shape\2010\_303\_ME\COLC\lakes\COLC\_impaired\_lakes.shp. Acquired from the Water Quality Control Division on March 16, 2010.