

Chapter 6 Arkansas River Basin Plan (Regulation 32)

Exhibit 6-1. Arkansas River Basin Physical Location

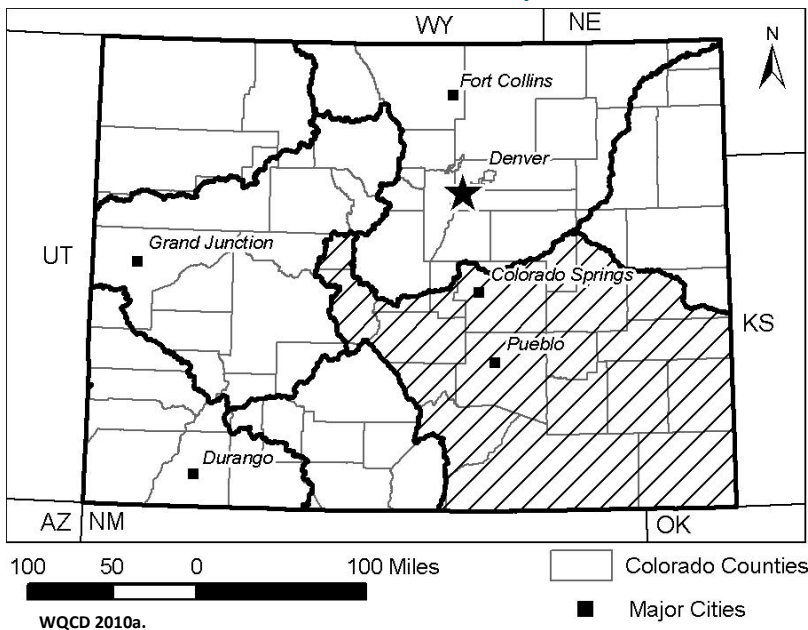


Exhibit 6-2. Arkansas River Basin Summary Statistics

Ecoregions (Level IV):¹	21. Southern Rockies (a-j) 25. High Plains (all) 26. Southwestern Tablelands (e, h, and j)	Surface Area:² Stream Length:³	28,268 square miles 25,592 miles
Threatened and Endangered Species (federal and state):²	Threatened: 12 Endangered: 9 State Species of Concern: 27 Federal Candidate Species: 1	Major Land Cover:²	Grassland and Forest
Counties:	Baca, Bent, Chaffee (portion), Cheyenne (portion), Crowley, Custer, Elbert (portion), El Paso, Fremont, Huerfano, Kiowa, Lake, Las Animas, Lincoln (portion), Otero, Prowers, Pueblo, and Teller (portion)	No. of Assessed Lakes/Reservoirs:^{4,5} Corresponding Acres:	24 60,171
Population:⁶	948,000	No. of Groundwater Aquifers:²	6
Major Population Centers:²	Colorado Springs, Lamar, Las Animas, Leadville, and Pueblo	Approximate Number of Publicly Owned Treatment Works:⁷	159
Water Quality Planning Regions (in total or in part):⁸	4, 6, 7, 13 and 14	Known Primary Water Quality Stressors:⁴	Aluminum, ammonia and nitrate/nitrite, arsenic, cadmium, copper, dissolved oxygen, <i>Escherichia coli</i> , iron, lead, manganese, mercury, pH, selenium, sulfate, temperature, uranium, and zinc

¹ See appendix B for a description of key ecoregional characteristics.

² CWCB 2004.

³ WQCD 2002.

⁴ WQCC 2010b; WQCD 2010a.

⁵ 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.

⁶ CWCB 2010.

⁷ USEPA 2010a, 2010b; WQCD 2010b.

⁸ 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).¹ 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.

6.1 System Description

6.1.1 Location and Physical Setting

The Arkansas River is the sixth-longest river in the United States at approximately 1,460 miles (Kammerer 1990). It is a major tributary to the Mississippi-Missouri system. It begins in Colorado’s central Rocky Mountains and flows generally to the east and southeast through the Great Plains of northern Oklahoma and Kansas and, finally, through Arkansas to the Mississippi River. The mouth of the river is near the town of Napoleon in southeastern Arkansas.

The river is spatially the largest river in Colorado, covering 27% of the state’s surface area, an area of 28,268 square miles. The river begins at Mt. Elbert, which is at 14,433 feet, and its tributaries begin near Leadville, Colorado (Lake County). The river drops to 3,340 feet at the Colorado-Kansas state line, near the town of Holly in Prowers County (CWCB N.d). The altitude change is more than 11,000 feet. A map of the basin showing the Arkansas River and its major tributaries is provided as exhibit 6-3 (at end of chapter).

6.1.2 Ecology

The boundaries of the Arkansas River Basin fall within three distinct level III ecoregions (Chapman et al. 2006). Approximately 23% of the basin falls within the Southern Rockies Ecoregion, 59% falls within the Southwestern Tablelands Ecoregion, and 18% falls within the High Plains Ecoregion (exhibit 6-4 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 Arkansas River Basin contains several endangered and threatened species and several species of state concern, as summarized in exhibit 6-5 (at end of chapter). There are 9 federally and/or state-listed endangered species (three fish, three bird, and three mammalian species) and 11 federally and/or state-listed threatened species (three fish, six bird, and two mammalian species, and one plant). An additional plant species is a federal candidate for listing. Finally,

¹ The Integrated Reports are prepared by the WQCD on a biennial basis and are approved by the WQCC as Regulation No. 93: *Colorado’s Section 303(d) List of Impaired Waters and Monitoring and Evaluation List*, 5 CCR 1002-93 (WQCC 2010b; WQCD 2010a).

Colorado has 27 species of concern in the Arkansas River Basin (three fish, four amphibian, eight reptilian, seven bird, and five mammalian species) (CDOW 2010; CWCB 2004).

Exhibit 6-6 (at end of chapter) shows the locations of environmental and recreational uses (i.e., nonconsumptive uses) in the Arkansas River Basin.² The use categories include environmental focus areas, environmental and recreational focus areas, and recreational focus areas (CWCB 2009a). 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 2009a).

6.1.3 Climate

The climate in the Arkansas River Basin is characterized by a high degree of variability; average daily temperatures range from 46 degrees Fahrenheit (°F) in the upper river valley to 55 °F in the lower valley (CWCB 2004). Temperature extremes in the lower valley can range from 0 °F in the winter to 100 °F in the summer (CWCB 2004). Precipitation also varies greatly within the basin. Exhibit 6-7 (at end of chapter) shows a contour (isohyetal) plot of the average annual precipitation throughout the basin. Basin-wide average annual precipitation ranges from less than 10 inches per year in the plains to more than 30 inches per year in the high mountain regions.

6.1.4 Land Ownership and Land Cover/Use

Land ownership in the Arkansas River Basin is predominantly private (70%), followed by the federal government (20%) and the state of Colorado (10%). Exhibit 6-8 (at end of chapter) is a map of land ownership by basin.

Land cover in the Arkansas River Basin is shown in exhibit 6-9 (at end of chapter) and summarized in exhibit 6-10. Grassland and forest are the predominant land cover types in the basin, covering approximately 67% and 13% of the basin, respectively. The grassland areas are concentrated in the central portion of the basin, whereas the forested land is in the western portion (CWCB 2004). The lower elevations of the western portion of the basin are heavily grazed; the low to middle elevations are also grazed but to a lesser extent. The lower basin consists of smooth to slightly irregular plains and contains a high percentage of cropland (Chapman et al. 2006).

Exhibit 6-10. Arkansas River Basin Land Cover Data

Land Cover	Basin-wide		Statewide	
	Area (sq. miles)	Percent of Total	Area (sq. miles)	Percent of Total
Grassland	19,043	67.4%	41,051	39.5%
Forest	3,654	12.9%	29,577	28.4%

² In 2005, the Colorado legislature established the Water for the 21st 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
Planted/cultivated	2,621	9.3%	13,737	13.2%
Shrubland	2,421	8.6%	16,883	16.2%
Developed	219	0.8%	923	0.9%
Barren	213	0.8%	1,219	1.2%
Open water	84	0.3%	590	0.6%
Wetland	13	0.04%	80	0.08%
TOTAL	28,268		104,060	

Source: CWCB 2004.

6.1.5 Demographic and Socioeconomic Conditions

The general socioeconomic conditions of the Arkansas River Basin are characterized by increasing populations in most counties between 2008 and 2050, especially in the counties with urban areas, as well as increasing employment in regional and national service jobs and household basic jobs between 2008 and 2050.

Population growth has increased substantially in the urban areas of the Arkansas River Basin over the past several years, primarily in Colorado Springs and Pueblo, the two most populous cities in the basin. The population in the Arkansas River Basin is projected to increase by about 78% (from 948,000 to 1,688,000) between 2008 and 2050 under medium economic development assumptions. El Paso County is projected to account for much of the basin's population growth (CWCB 2010). Population will remain relatively flat in Baca, Bent, Chafee, Crowley, and Custer counties and the portion of Cheyenne County in the basin during the same period. Exhibit 6-11 (at end of chapter) shows the population projections for the Arkansas River Basin.

The patterns of employment growth in the Arkansas River Basin are similar to those seen at the statewide level. Regional and national service jobs, along with household basic jobs, made up the majority of basic sector employment in 2007. Household basic jobs, tourism jobs, and regional and national service jobs are expected to be the drivers of growth in the basin by 2050.

Employment in these sectors is anticipated to grow by 193%, 131%, and 117%, respectively. In comparison, employment in other basic sectors (agriculture, mining, manufacturing, and government) will increase by 40% or less over the same period (CWCB 2010). Exhibit 6-12 shows the employment projections for the Arkansas River Basin under a medium growth scenario.

Exhibit 6-12. 2050 Arkansas River Basin Employment Projections, Medium Growth Scenario

Sector	2007	2050
Agribusiness Jobs	13,000	17,300
% of Total Jobs	2.7%	1.9%
Total % Growth	NA	33%
Mining Jobs	900	1,000
% of Total Jobs	0.2%	0.1%
Total % Growth	NA	11%
Manufacturing Jobs	20,100	25,300
% of Total Jobs	4.2%	2.8%
Total % Growth	NA	26%

Sector	2007	2050
Government Jobs	59,200	82,500
% of Total Jobs	12.3%	9.1%
Total % Growth	NA	39%
Regional/National Service Jobs	70,200	152,100
% of Total Jobs	14.6%	16.8%
Total % Growth	NA	117%
Tourism Jobs	23,800	55,000
% of Total Jobs	4.9%	6.1%
Total % Growth	NA	131%
Household Basic Jobs	60,400	176,900
% of Total Jobs	12.6%	19.5%
Total % Growth	NA	193%
Total Basic Jobs	247,600	510,200
% of Total Jobs	51.5%	56.2%
Total % Growth	NA	106%
Resident Service Jobs	233,500	397,700
% of Total Jobs	48.5%	43.8%
Total % Growth	NA	70%
Total Jobs	481,100	907,900
% of Total Jobs	100%	100%
Total % Growth	NA	89%

Source: CWCB 2010.

6.1.6 Water Withdrawals

The Arkansas River has many diverse uses in Colorado, which include recreational, environmental, municipal, and agricultural uses. Compact obligations with Kansas require Colorado to deliver a minimum amount of water to Kansas each year. The basin also exports water to several communities in the Denver metropolitan area. Water reuse is high in the basin, which has raised concern among some residents and officials regarding water quality (CWCB 2009b).

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 6-13 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 Arkansas River Basin to be 2,213.70 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.³ Exhibit 6-13 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 1,861.16 Mgal/d (84%), followed by public supply at 225.86 Mgal/d (10%) and industrial at 73.82 Mgal/d (3%) (USGS 2010).

Exhibit 6-13. Arkansas River Basin Total Water Withdrawals in Colorado, 2005

Withdrawals by Use Category			
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)	1,861.16 (84.07%)	12,354.91	15.06%
Irrigation (golf course)	5.36 (0.24%)	40.64	13.20%
Public Supply ¹	225.86 (10.20%)	864.17	26.14%
Domestic ²	7.53 (0.34%)	34.43	21.86%
Industrial	73.82 (3.33%)	142.44	51.83%
Mining	3.10 (0.14%)	21.42	14.47%
Thermoelectric	36.90 (1.67%)	123.21	29.95%
Totals	2,213.70 (or 2,481.56 thousand acre-feet per year)	13,581.22 (or 15,224.55 thousand acre-feet per year)	16.30%

¹ 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).

² 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.⁴ The projections will provide relevant parties in the state

³ 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).

⁴ 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 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.

with a basis for discussing and addressing the state's future M&I water needs. In this report, the CWCB estimated M&I water demand in the Arkansas River Basin to be at 196,000 acre-feet per year (AFY) (175 Mgal/day) in 2008 and at 349,000 AFY (311 Mgal/day) for 2050 under medium-growth economic assumptions. The water demands are projected to be 320,000 AFY (286 Mgal/day), under medium growth assumptions, if passive conservation is employed (CWCB 2010).⁵

M&I water needs in the Arkansas River Basin are expected to be nearly 1.6 times higher than 2008 levels by the year 2050. The counties with the highest forecasted M&I water demands in the Arkansas River Basin are El Paso, Pueblo, and Fremont counties (CWCB 2010).

Water for self-supplied industrial (SSI) needs for the Arkansas River Basin is all from large industries and thermoelectric facilities in Pueblo County. Large industry demands are expected to hold steady at 49,400 AFY from 2008 to 2050 under low growth to high growth economic scenarios for Pueblo County.

6.1.7 Hydrography and Hydrology

6.1.7.1 Surface Geology

Geology ranging from Precambrian to Quaternary age is exposed in the Arkansas River Basin. In the Mountain Province, Precambrian metamorphic schists and gneisses, intruded by igneous rocks, abound. The Plains Province is dominated by multiple layers of sedimentary rocks, and Quaternary alluvium fills the reaches along the lower Arkansas River (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.⁶

6.1.7.2 Surface Water

The northwestern portion of the Arkansas River Basin consists of steep mountain slopes, some wetlands, glaciated lakes, and high-gradient headwater and perennial streams. The river gushes through the steep valleys of the Rockies, dropping 4,600 feet in 120 miles. The Arkansas River valley widens and flattens markedly at Canon City, Colorado. Just west of Pueblo, Colorado, the Arkansas River enters the High Plains. There, the river has wide, shallow banks. This region has intermittent streams and a few large perennial streams that originate in the mountains (Chapman et al. 2006).

To monitor stream flow, numerous USGS stream flow gauges are maintained in the Arkansas River Basin. Exhibit 6-14 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

⁵ 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).

⁶ 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.

historic flows in the basin across a broad spatial scale. As indicated in the exhibit, mean annual flows are highest in the upstream reaches of the Arkansas River near Canon City. The locations of the selected gauges are shown in exhibit 6-15 (at end of chapter); also shown are major surface water diversions and segments with decreased instream flow.

Exhibit 6-14. Arkansas River Basin Summary of Selected USGS Stream Gauges

Site Name	USGS Site Number	Mean Annual Stream Flow (AFY)	Mean Annual Stream Flow (cfs) ¹	Period of Record (years)	Drainage (square miles)
Arkansas at Canon City	07096000	534,289	738	1890-2002	3,117
Fountain Creek at Pueblo	07106500	73,304	101	1922-2002	926
Arkansas at Las Animas	07124000	157,836	218	1939-2002	13,976
Purgatoire near Las Animas	07128500	67,633	93	1922-2002	3,306
Arkansas at Lamar	07133000	135,856	188	1913-2002	18,830

¹ 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/>.

6.1.7.3 Groundwater

Groundwater in the Arkansas River Basin is located within the following aquifers:

- ◆ Alluvial
- ◆ Denver Basin
- ◆ High Plains
- ◆ Raton Basin
- ◆ Dakota-Cheyenne
- ◆ Wet Mountain Valley and Huerfano

Exhibit 6-16 (at end of chapter) shows these aquifers, broken down into three groups: alluvial, bedrock (Raton Basin and Dakota-Cheyenne), and designated basin (High Plains). Also shown in the exhibit is the location of wells in the Arkansas River Basin with a permitted or decreed yield of 500 gallons per minute (gpm) or higher (CGS 2003).

The unconfined alluvial aquifer of the Arkansas River, composed of glacial silts to large boulders, is primarily recharged by surface water infiltration from the river, as well as from many ditches and canals. Irrigation also plays a role in recharging the alluvial aquifer. The depth of water in the lower valley generally ranges between 5 and 30 feet and in the upper valley between 5 and 58 feet. Trends in hydrographs since the 1970s show a general increase in the water table elevation, which can be attributed to irrigation return flows. Irrigation is the major use of the alluvial aquifer groundwater. In Chaffee and Lake Counties, however, public water supply is the primary use of such groundwater (CWCB 2004).

The major aquifers of the Raton Basin include the Raton, Vermejo, and Trinidad formations, and the Cuchara and Poison Canyon formations. Sources of recharge for the aquifers include runoff from the Sangre de Cristo Mountains, precipitation infiltration, and infiltration from streams and lakes. The depth to water generally increases in the aquifers from northwest to southeast, indicating a southeastern direction of groundwater flow. In all areas but the southeast corner of the basin, water can be encountered at less than 200 feet below ground surface (CWCB 2004).

The Dakota-Cheyenne aquifer lies under most of the Arkansas River Basin. The stratigraphy of this unit ranges from well-sorted sandstone to fine-grained shales. The aquifer provides water for irrigation and domestic water supply in the basin. Because of the diversity of the aquifer stratigraphy, well yields can range from around 5 gpm to more than 1,000 gpm (CWCB 2004).

The High Plains aquifer is in the eastern portion of the basin, and the state of Colorado considers it a “Designated Basin.” A designated groundwater basin is one that is not adjacent to a continuously flowing natural stream or a stream that fulfills a surface water right. Such basins are established by the Colorado Groundwater Commission in accordance with section 37-90-106 of the *Colorado Revised Statutes*. The High Plains aquifer is a major source of water for southeast Colorado. Because of this, groundwater withdrawals have exceeded recharge since the early 1960s. The depth of wells generally increases eastward toward the Colorado-Kansas state line, and in the Arkansas River Basin the saturated thickness of the aquifer ranges between zero and 50 feet (CWCB 2004).

6.2 Water Quality Classifications and Standards

In general, water quality classifications and standards information is presented on a basin scale with some additional detail provided for sub-basins.

6.2.1 Sub-Basin Boundaries

As discussed in chapter 3, “Current Statewide Water Quality,” Colorado’s seven major drainage basins have been subdivided 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 data in its biennial 2010 *Integrated Water Quality Monitoring and Assessment Report* (2010 Integrated Report) developed by the WQCD and approved by WQCC. For purposes of this report, the Arkansas River Basin has been subdivided into three sub-basins:⁷

- ◆ **Upper Arkansas:** The Upper Arkansas River Sub-basin is composed of segments from the headwaters of the Arkansas River mainstem to Pueblo Reservoir, as shown in exhibit 6-17 (at end of chapter).

⁷ 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.

- ◆ **Middle Arkansas:** The Middle Arkansas River Sub-basin is composed of segments from the inlet of the Pueblo Reservoir to a point immediately above the river's confluence with Fountain Creek, as shown in exhibit 6-18 (at end of chapter). The Middle Arkansas River Sub-basin consists of only about 12 miles of the Arkansas River mainstem, including Pueblo Reservoir. The tributary drainage areas of the Arkansas River included within this sub-basin, however, are quite large and extend into the headwaters areas of Fountain Creek to the north and the Huerfano and Cucharas rivers to the south.
- ◆ **Lower Arkansas:** The Lower Arkansas River Sub-basin is composed of segments from the river's confluence with Fountain Creek in Pueblo to the state line at the Colorado/Kansas border, a distance of about 151 miles (exhibit 6-19 at end of chapter). At its broadest point in the north at Limon, Colorado, to the south at Branson, Colorado, the Lower Arkansas River Sub-basin is over 160 miles wide.

6.2.2 Surface Water

6.2.2.1 Use Classifications

The Arkansas River Basin contains a total of 95 segments covering approximately 21,913 stream miles and approximately 60,171 lake acres. The WQCC has specified the classified uses for each of these segments in Regulation No. 32: *Classifications and Numeric Standards for the Arkansas River Basin* (5 CCR 1002-32) (WQCC 2010a). These uses are summarized in exhibit 6-20 (at end of chapter) by sub-basin. Segment-level data are presented at the sub-basin level in exhibits 6-21, 6-22, and 6-23 (at end of chapter). These exhibits show that WQCC has classified most of the stream segments in the Arkansas River Basin with the uses of agriculture (97%) and existing recreation (91%). These are followed by water supply (59%) and aquatic life cold water 1 (49%). The stream miles associated with these uses are presented in exhibit 6-24.

Exhibit 6-24. Number of Streams and Stream Miles by Classified Use

Classified Uses	Number of Streams	Stream Miles	Percent of Total Stream Miles (n=21,913 miles)
Agriculture	92	21,655	99%
Existing Recreational Uses	86	11,114	51%
Water Supply	56	4,419	20%
Aquatic Life Cold 1	47	6,181	28%
Aquatic Life Warm 2	26	13,704	63%
Aquatic Life Warm 1	11	1,405	6%
Aquatic Life Cold 2	8	566	3%
Not Suitable for Recreation	7	10,793	49%
Potential Recreational Uses	1	0	0%
Total Streams	95	21,913	--

Source: WQCC 2010b; WQCD 2010a.

WQCC has classified the majority of lake segments in the Arkansas River Basin with agricultural uses (100%), existing recreational uses (92%), and water supply (67%). The lake acres associated with these uses are summarized in exhibit 6-25.

Exhibit 6-25. Number of Lakes and Lake Acres by Classified Use

Classified Uses	Number of Lakes	Lake Acres	Percent of Total Lake Acres (n=60,171 acres)
Agriculture	24	60,171	100%
Existing Recreational Uses	22	49,096	82%
Water Supply	16	38,590	64%
Aquatic Life Cold 1	12	10,460	17%
Aquatic Life Warm 2	7	12,242	20%
Aquatic Life Warm 1	4	37,375	62%
Aquatic Life Cold 2	1	94	0.2%
Not Suitable for Recreation	1	11,060	18%
Potential Recreational Uses	1	14	0.02%
Total Lakes:	24	60,171	--

Source: WQCC 2010b; WQCD 2010a.

6.2.2.2 Designations

As further shown in exhibits 6-20 through 6-23 (at end of chapter), the WQCC has designated a total of three stream segments as *Outstanding Waters* (one in the Upper Sub-basin and two in the Lower Sub-basin). The WQCC has designated a total of 28 segments as *Use Protected* (3 in the Upper, 10 in the Middle, and 15 in the Lower sub-basins). The meaning of these two designations is provided in section 2.1.3.3 of chapter 2, “Water Quality Planning and Management in Colorado.”

6.2.2.3 Standards

Numeric standards for the Arkansas River Basin are provided in the “Stream Classifications and Water Quality Standards” table attached to Regulation No. 32. Because new standards are often developed and existing standards are periodically revised, the standards are not summarized here. Readers should consult the actual regulations for specific details; they are available at <http://www.cdphe.state.co.us/regulations/wqccregs>.

6.2.3 Lakes

6.2.3.1 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, 5 are in the Arkansas River Basin, and specifically in the Lower Sub-basin. (See exhibit 6-26.)

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. The 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 6-26. Arkansas River Basin Trophic Status of Lakes and Reservoirs
as Measured by the WQCD during the Period 2007 to 2009**

Lake	Adobe Creek	Henry	Holbrook	John Martin	Meredith
Segment ID No.	COARLA10	COARLA12	COARLA10	COARLA11	COARLA12
Elevation (feet)	4,128	4,312	4,164	3,783	4,100
Surface Acres	5,147	1,350	537	11,647	3,700
Chlorophyll <i>a</i> (micrograms per liter [µg/L])	15.56	10.14	11.2	6.6	47.83
Chlorophyll Trophic Status Index ¹	57	53	54	49	69
Secchi Depth (meters)	0.58	0.37	0.9	0.66	0.32
Estimated Trophic Status	Eutrophic	Eutrophic	Eutrophic	Mesotrophic	Eutrophic
Year Monitored	2008	2008	2008	2008	2008

¹ 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.

Source: WQCD 2010a.

6.2.3.2 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, four were assessed in the Arkansas River Basin (one in the Upper Sub-Basin and three in the Lower Sub-Basin) for mercury, selenium and arsenic. One FCA was issued to Trinidad Reservoir as a result of this assessment effort. Exhibit 6-27 lists the lakes and reservoirs and the fish species evaluated in the Arkansas Basin.

**Exhibit 6-27. Arkansas River Basin Lakes and Reservoirs Assessed for
Mercury, Selenium, and Arsenic During the Period 2007 to 2009**

Lake/Reservoir (Segment ID No.)	Species Tested
DeWeese Reservoir (COARUA 15)	Smallmouth bass

Lake/Reservoir (Segment ID No.)	Species Tested
Adobe Creek Reservoir (COARLA 10)	Black crappie, channel catfish, saugeye, wiper, and white bass
Neenoshe Reservoir (COARLA 10)	Saugeye
Trinidad Reservoir (COARLA 5b)	Black crappie, channel catfish, walleye, yellow perch, and wiper

Source: WQCC 2010b; 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 may 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).

Between 1993 and 2010, the WQCD issued an FCA for mercury for four waterbodies and one FCA for tetrachloroethylene (PCE) in the Arkansas River Basin (exhibit 6-28).

Exhibit 6-28. Arkansas River Basin Lakes and Reservoirs for Which an FCA Has Been Issued

Lake (Segment ID No.)	Pollutant	Species tested	Year FCA issued
Brush Hollow Reservoir (COARUA 27)	Mercury	Walleye	2006
Teller Reservoir (COARUA 14b)	Mercury	Northern pike, largemouth bass, bullhead, crappie, and channel catfish	¹
Horseshoe Lake (COARMA 16)	Mercury	Smallmouth bass and sauger	2007
Trinidad Reservoir (COARLA5b)	Mercury	Walleye	2007
Willow Springs Ponds (COARFO 7a)	Tetrachloroethylene (PCE)	Largemouth bass, western white sucker, and European rudd	2007

¹ Samples were run prior to the reservoir's being drained in 2002. The reservoir has not been refilled.

Sources: WQCC 2010b; WQCD 2005, 2006a, 2007a, 2007b, 2007c, and 2010a.

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. The WQCD has not yet completed or had TMDLs approved for the lakes issued FCAs in recent years. The Division has assigned a high priority to completing TMDLs for mercury for Brush Hollow Reservoir, Horseshoe Lake, and Trinidad Reservoir. The WQCD has not assigned a priority to TMDL development for mercury for the Teller Reservoir because it was drained in 2002. In addition to mercury, Brush Hollow Reservoir is also impaired due to pH. Willow Springs Ponds is impaired due to PCE. The WQCD has identified the probable source of

the elevated PCE in the Willow Springs Ponds as contaminated groundwater. The Division considers the development of a TMDL for PCE a medium priority (WQCC 2010b and WQCD 2010a).

6.2.4 Wetlands

The Arkansas River Basin is supported by the Colorado Division of Wildlife (CDOW) Prairie Wetland Focus Area Committee.⁸ The Committee has identified the wetland types within the Prairie Wetland Focus Area using the Colorado National Heritage Program’s “Statewide Wetlands Classification and Characterization Final Report.” These wetland types are listed in exhibit 6-29 and are generally distinguished by vegetation and soil types. The Committee’s conservation concerns for these wetland types are also noted in exhibit 6-29.

Exhibit 6-29. Wetland Types Identified by CDOW Prairie Wetland Focus Area Committee

Wetland Type	Conservation Concerns
Submerged Aquatic Wetland	To be determined
Emergent Marsh	To be determined
Wet Meadow	To be determined
Riverine Wetlands/Riparian Areas	Loss or change of hydrology, fragmentation of corridors, invasion of exotic species, and lack of cottonwood regeneration
Warm Water Seeps, Springs, and Sloughs	Hydrologic alteration as a result of water development causing sloughs to become choked with silt and vegetation, thus diminishing habitat value
Playa Lakes	Sedimentation, pesticide and fertilizer runoff, excess nutrients and/or contaminants from feedlot effluent, oil field water dumping, altered grazing, hydrologic alterations and water use regimes
Artificial Wetlands and Shallow-water Impoundments	Trampling of food plants desirable to birds and high water turbidity

Source: Prairie and Wetlands Focus Area Committee 2004.

A map of Arkansas River Basin wetlands is included as exhibit 6-30 (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.

6.2.5 Groundwater

6.2.5.1 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

⁸ CDOW created the Wetlands Wildlife Conservation Program (WWCP) to focus on preserving, restoring, enhancing, and creating wetlands throughout the state. This program particularly focuses on (1) protecting the role of wetlands in Colorado as important feeding, breeding, migratory, and brooding habitat for waterbirds 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.

groundwater for which WQCC has not already assigned standards, with the exception of those groundwaters where the total dissolved solids (TDS) 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 Groundwater* may 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.

6.2.5.2 Site-Specific Classifications and Standards

The WQCC has established several site-specific groundwater classifications for the Arkansas River Basin, as summarized in exhibit 6-31. Maps of the classified areas are provided as exhibits 6-32 to 6-38 (at the end of the chapter).⁹ These exhibits are cross-referenced in exhibit 6-31. Of the eight site-specific groundwater classifications and standards, seven are in the Lower Arkansas River Sub-basin and one is in the Upper Sub-basin.

Exhibit 6-31. Arkansas River Basin Site-Specific Groundwater Classifications and Standards

Site	Specified Area ^{1,2}	Classifications for Confined and Unconfined Groundwater	Are Groundwater Quality Standards in Tables 1–4 Applicable? ³
Upper Arkansas River Sub-basin			
Park Center Water District Wellfield, Fremont County	See exhibit 6-32	Domestic Use Quality	Yes
Middle Arkansas River Sub-basin			
None.	--	--	--
Lower Arkansas River Sub-basin			
Crowley County Water System Wellfield, Crowley County	See exhibit 6-33	Domestic Use Quality and Agricultural Use Quality	Yes
City of Fountain, Security Water and Sanitation District, Stratmoor Hills Water District, and Widefield Homes Water Company Wellfields, El Paso County	See exhibit 6-34	Domestic Use Quality and Agricultural Use Quality	Yes
City of La Junta Wellfield, Otero County	See exhibit 6-35	Domestic Use Quality and Agricultural Use Quality	Yes
City of Lamar Wellfield, Prowers County	See exhibit 6-36	Domestic Use Quality and	Yes

⁹ Maps displayed in these exhibits are pulled directly from Regulation No. 42: *Site-Specific Water Quality Classification and Standards for Ground Water* (WQCC 2006).

Site	Specified Area ^{1,2}	Classifications for Confined and Unconfined Groundwater	Are Groundwater Quality Standards in Tables 1–4 Applicable? ³
		Agricultural Use Quality	
Town of Las Animas Wellfield, Bent County	Map not located	Domestic Use Quality and Agricultural Use Quality	Yes
Town of Springfield Wellfield, Baca County	See exhibit 6-37	Domestic Use Quality and Agricultural Use Quality	Yes
Upper Black Squirrel Creek Alluvial Aquifer, El Paso County	See exhibit 6-38	Domestic Use Quality and Agricultural Use Quality	Yes

¹ Specified areas pertain to confined and unconfined groundwaters within the saturated zones.

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

³ 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 2006.

6.2.5.3 Groundwater Quality

The Colorado Ground Water Protection Program (CGWPP) evaluated a network of 20 monitoring wells in the Arkansas River Valley during 2004 and 2005. CGWPP found the median nitrate-nitrogen concentration to be 2.04 parts per million (ppm); only one well had greater than 10.0 ppm. The third quartile was at 7.3 ppm. Overall, the CGWPP concluded that elevated nitrate levels in the Arkansas River alluvial aquifer are not a concern given that the sampling network spans from just east of Pueblo, Colorado, all the way to Holly, Colorado.

The CGWPP evaluated 19 wells in the network in 2008. The results of this 2008 evaluation are presented in exhibit 6-39. Compared to the 2004–2005 evaluation, CGWPP found the median nitrate concentration to be about two times higher, while it found the third quartile to be only slightly higher. The key difference in the distribution of nitrate concentration in the alluvial aquifer between 2005 and 2008 is the increase in the number of wells with nitrate-nitrogen concentrations above the U.S. Environmental Protection Agency (EPA) drinking water standard of 10 mg/L, east of Lamar, Colorado.

Exhibit 6-39. Results for Selected Water Quality Parameters Collected from Monitoring Wells in the Arkansas Valley Network in 2008

Monitoring Wells (n=19)	Nitrate-N	Sulfate	Sodium	Boron	Chloride	Selenium	TDS ¹	SAR ²
----- ppm or mg/L -----								
Mean	5.7	946	253	0.5	85	0.022	2164	3.3
Median	4.1	827	165	0.35	56	0.019	1953	2.5
Standard Deviation	5.6	475	188	0.41	72	0.015	1081	2
Minimum	BDL ³	94	21	0.06	8	BDL	386	0.6
Quartile 25%	1.0	605	134	0.22	45	0.012	1441	2
Quartile 75%	7.7	1362	411	0.64	102	0.031	3206	4.9
Maximum	20.5	1731	655	1.35	306	0.047	3957	7.7

¹ TDS = total dissolved solids (lab-calculated).

² SAR = sodium absorption ratio.

³ BDL = below detection limit.

Source: WQCC 2010b; WQCD 2010a.

6.3 Surface Water Quality Stressors and Sources

This section of the Arkansas River Basin Plan summarizes data provided in the 2010 Integrated Report. 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 WQCD today. Moreover, the data are limited to those parameters for which assessments are performed.

6.3.1 Impairments

Exhibits 6-40 and 6-41 (at end of chapter) provide a summary of the impairments for stream segments and lake/reservoir segments, respectively, in the Arkansas River Basin. A map showing all impaired waterbody segments for the Arkansas River Basin is provided as exhibit 6-42 (at end of chapter). Exhibits 6-43 to 6-48 (at end of chapter) provide this information for each of the sub-basins.

During the 2010 assessment cycle, the WQCD identified 11 impairments in the Upper Arkansas River Sub-basin, 6 in the Middle Arkansas River Sub-basin, and 14 in the Lower Arkansas River Sub-basin for a total of 31 impaired segments (exhibit 6-40). The impaired stream segments constitute approximately 14% of the total stream miles in the basin (1% in the upper, 1% in the middle, and 12% in the lower). Selenium is the predominant parameter causing impairments in the basin overall, in a total of 17 segments. It is followed by *E. coli* in seven segments and iron in four segments. An additional eight lake segments were identified as impaired during the 2010 assessment cycle (2 in the Upper Arkansas, 1 in the Middle Arkansas, and 5 in the Lower Arkansas River Sub-basin). Mercury and selenium are the predominant parameters causing the impairments in lake segments in three segments each in the basin. Each of the impairments noted in exhibits 6-40 and 6-41 requires completion of a TMDL.

6.3.2 Segments Listed for Further Monitoring and Evaluation

During each monitoring cycle, WQCD typically identifies parameters with elevated concentrations in some segments within a basin. The sample results or other factors are such that WQCD is unable to make a determination as to whether the classified uses in question are being attained. These segments are subsequently placed on the state's Monitoring and Evaluation (M&E) List for further monitoring and evaluation. In its latest monitoring cycle, the WQCD identified 10 (11%) of the 95 combined stream and lake/reservoir segments in the Arkansas River Basin with elevated concentrations of one parameter or more. A summary of this information is presented in exhibit 6-49 (at end of chapter). The Division identified copper, zinc, and sediment in more than one sub-basin, while it identified the other parameters (arsenic, mercury, nitrite, pH, selenium, and uranium) in only one sub-basin. See exhibits 6-50 to 6-52 (at end of chapter) for sub-basin details.

6.3.3 Known Sources of Stressors

Exhibit 6-53 provides a synopsis of the identified sources of stressors to the Arkansas 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 6-43 to 6-48 (at end of chapter). The Arkansas River

Basin has a total of 39 impaired waterbody segments that required development of a TMDL. Selenium accounts for the greatest number of impaired segments with 20, followed by *E.coli* with 7 segments.

Exhibit 6-53. Arkansas River Basin, Summary of Stressors for Impaired Waterbodies¹

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
Upper Arkansas Sub-Basin								
Upper Arkansas	13	Dissolved oxygen	3	Unknown	2	0	0	2
				Not assessed ²	1	0	0	1
		Cadmium	1	Unknown	1	0	1	0
		Lead	1	Unknown	1	0	1	0
		Zinc	1	Unknown	1	0	1	0
		Copper	1	Not assessed	1	0	0	1
		pH	1	Not assessed	1	0	0	1
		Mercury	1	Unknown	1	0	0	1
		Subtotal	9	Total No. TMDLs	9	0	3	6
Middle Arkansas River Sub-Basin								
Middle Arkansas	7	Selenium	5	Unknown	5	4	0	1
		<i>E. coli</i>	1	Unknown	1	0	0	1
		Iron	1	Unknown	1	1	0	0
		Zinc	1	Unknown	1	0	0	1
		Uranium	1	Unknown	1	0	0	1
		Mercury	1	Unknown	1	0	0	1
				Subtotal	10	Total No. TMDLs	10	5
Lower Arkansas River Sub-Basin								
Mainstem and tributaries	13	Selenium	12	Unknown	12	12	0	0
		Sulfate	1	Unknown	1	1	0	0
		Uranium	1	Unknown	1	1	0	0
		Iron	3	Unknown	3	1	0	2
		<i>E. coli</i>	1	Unknown	1	0	0	1
		Dissolved oxygen	1	Unknown	1	0	0	1
		Mercury	1	Unknown	1	0	0	1
				Subtotal	20	Total No. TMDLs	20	15
Fountain Creek	6	Selenium	3	Unknown	3	3	0	0
		<i>E. coli</i>	5	Unknown	5	0	0	5
		PCE	1	Groundwater	1	0	1	0
				Subtotal	9	Total No. TMDLs	9	3
Basinwide Totals								
Arkansas River Basin	39	Selenium	20	Unknown	20	19	0	1
		<i>E. coli</i>	7	Unknown	7	0	0	7
		Iron	4	Unknown	4	2	0	2
		Dissolved oxygen	4	Unknown	3	0	0	3
				Not assessed	1	0	0	1
		Mercury	3	Unknown	3	0	0	3
		Zinc	2	Unknown	2	0	1	1
		Uranium	2	Unknown	2	1	0	1
		Cadmium	1	Unknown	1	0	1	0
		Lead	1	Unknown	1	0	1	0
		Copper	1	Not assessed	1	0	0	1
		pH	1	Not assessed	1	0	0	1
Sulfate	1	Unknown	1	1	0	0		

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
		PCE	1	Groundwater	1	0	1	0
		Total	48	Total No. TMDLs	48	23	4	21

¹The 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.

²“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 2010b; WQCD 2010a, appendices A to D.

6.4 TMDLs as Water Protection Strategies

6.4.1 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 biannual 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 2010b).

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.

6.4.2 TMDLs Required to Be Developed

Exhibit 6-54 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 48 impairments occurred in 39 distinct waterbody segments for the basin as a whole. Selenium requires the greatest number of TMDLs to be developed (20 total). The TMDLs are almost evenly distributed across the high and low priority categories, with the WQCD assigning a high priority and low priority to developing 21 and 23 of the 48 TMDLs (44% and 48% respectively). The remaining four TMDLs are assigned a medium priority for development. Ninety five percent of the 20 selenium TMDLs are assigned a low priority for TMDL development.

Exhibit 6-54 also presents TMDL information for each sub-basin. The Middle Arkansas River Sub-basin has the lowest number of individual impaired waterbody segments when compared to the other sub-basins (18% of the 39 impaired segments in the basin as compared to 33% and 49% for the Upper Arkansas and Lower Arkansas, respectively). The Lower Arkansas River Sub-Basin has both the highest number of distinct impaired segments and the greatest number of TMDLs to be developed. However, 18 of the 29 (62%) TMDLs to be developed in the Lower Arkansas River Sub-basin are assigned a low priority for development, compared to the Upper Arkansas River Sub-basin where 6 of the 9 (66%) of the TMDLs to be developed are assigned a high priority. A thorough review of exhibits 6-43 to 6-48 (at end of chapter) and exhibit 6-54 will provide readers with a better appreciation of nuances such as these.

Exhibit 6-54. Arkansas River Basin Summary of Impairments, Affected Waterbody Segments, and TMDL Priority Development Status

	Total Number of Distinct Segments Impaired ¹	Affected Stream Segments		Affected Lake-Only Segments		Impairment	Number of Impaired Segments by Pollutant ¹	Number of Affected Segments and TMDL Priority Status by Pollutant		
		No. (n=95)	Miles (n=21,913)	No. (n=24)	Acres (n=60,171)			Low	Medium	High
Basin-wide	39	31	3,061	8	30,759	Cadmium	1	0	1	0
						Copper	1	0	0	1
						Dissolved oxygen	4	0	0	4
						Lead	1	0	1	0
						pH	1	0	0	1
						Zinc	2	0	1	1
						Mercury	3	0	0	3
						<i>E. coli</i>	7	0	0	7
						Selenium	20	19	0	1
						Iron	4	2	0	2
						Uranium	2	1	0	1
						Sulfate	1	1	0	0
						Perchloroethylene (PCE)	1	0	1	0
						Total No. TMDLs to Be Developed	48	23	4	21
Impaired Segments as Percent of Total Segments and Miles/Acres in Basin	33%	14%	33%	51%	Affected Segments as Percent of TMDL Priority Status	48%	8%	44%		

	Total Number of Distinct Segments Impaired ¹	Affected Stream Segments		Affected Lake-Only Segments		Impairment	Number of Impaired Segments by Pollutant ¹	Number of Affected Segments and TMDL Priority Status by Pollutant		
		No. (n=38)	Miles (n=5,144)	No. (n=5)	Acres (n=6,024)			Low	Medium	High
Upper Arkansas River Sub-Basin	13	11	290	2	428	Cadmium	1	0	1	0
						Copper	1	0	0	1
						Dissolved oxygen	3	0	0	3
						Lead	1	0	1	0
						pH	1	0	0	1
						Zinc	1	0	1	0
						Mercury	1	0	0	1
						Total No. TMDLs to Be Developed	9	0	3	6
						Impaired Segments as Percent of Total Segments	29%	6%	40%	7%

Upper Arkansas River Sub-Basin	Total Number of Distinct Segments Impaired ¹	Affected Stream Segments		Affected Lake-Only Segments		Impairment	Number of Impaired Segments by Pollutant ¹	Number of Affected Segments and TMDL Priority Status by Pollutant		
		No. (n=38)	Miles (n=5,144)	No. (n=5)	Acres (n=6,024)			Low	Medium	High
and Miles/Acres in Sub-Basin										

Middle Arkansas River Sub-Basin	Total Number of Distinct Segments Impaired ¹	Affected Stream Segments		Affected Lake-Only Segments		Impairment	Number of Impaired Segments by Pollutant ¹	Number of Affected Segments and TMDL Priority Status by Pollutant		
		No. (n=19)	Miles (n=2,368)	No. (n=4)	Acres (n=1,729)			Low	Medium	High
	7	6	226	1	157	<i>E. coli</i>	1	0	0	1
						Selenium	5	4	0	1
						Iron	1	1	0	0
						Zinc	1	0	0	1
						Uranium	1	0	0	1
						Mercury	1	0	0	1
						Total No. TMDLs to Be Developed	10	5	0	5
Impaired Segments as Percent of Total Segments and Miles/Acres in Sub-Basin		32%	10%	25%	9%	Affected Segments as Percent of TMDL Priority Status	50%	0%	50%	

Lower Arkansas River Sub-Basin	Total Number of Distinct Segments Impaired ¹	Affected Stream Segments		Affected Lake-Only Segments		Impairment	Number of Impaired Segments by Pollutant ¹	Number of Affected Segments And TMDL Priority Status by Pollutant		
		No. (n=26)	Miles (n=14,402)	No. (n=15)	Acres (n=52,418)			Low	Medium	High
	19	14	2,546	5	30,174	Selenium	15	15	0	0
						<i>E. coli</i>	6	0	0	6
						Iron	3	1	0	2
						Mercury	1	0	0	1
						Dissolved oxygen	1	0	0	1
						Sulfate	1	1	0	0
						Uranium	1	1	0	0
						Perchloroethylene (PCE)	1	0	1	0
						Total No. TMDLs to Be Developed	29	18	1	10
Impaired Segments as Percent of Total Segments and Miles/Acres in Sub-Basin		54%	18%	33%	58%	Affected Segments as Percent of TMDL Priority Status	62%	3%	34%	

¹When 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, in the latest monitoring cycle the segments showed that they are not meeting the standard(s) for one or more assigned use classifications.

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

6.4.3 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. The previous exhibit identifies segments in these circumstances and the applicable pollutant(s), while also showing newly identified impaired segments.

To date, the WQCD has completed and had approved TMDLs covering 10 waterbody segments in the Arkansas River Basin, all of which are in the Upper Arkansas River Sub-basin. Metals are the pollutants most frequently addressed through TMDLs in the Arkansas River Basin (exhibit 6-55).

Exhibit 6-55. Arkansas River Basin Completed and Approved TMDLs

Segment Data		Use attained in the latest WQCD Assessment?	Parameter
Segment	Description of Affected Segment Portion		
Upper Arkansas River Sub-Basin			
COARUA01b	East Fork Arkansas River above Birdseye Gulch	No	Lead
		No	Zinc
COARUA02a	Arkansas River, Birdseye Gulch to California Gulch	No	Zinc
COARUA02b	Arkansas River above Lake Fork	No	Cadmium
		No	Zinc
COARUA02c	Arkansas River, Lake Creek to Pueblo River	No	Cadmium
		No	Zinc
COARUA03	Arkansas River, Lake Creek to Pueblo Reservoir	No	Cadmium
		No	Zinc
COARUA05	Halfmoon Creek	No	Cadmium
		No	Lead
COARUA07	Evans Gulch	No	Zinc
COARUA10	Lake Creek – Public Notice Draft	No	DO
		No	pH
		No	Copper
COARUA11	Sayres Gulch and South Fork Lake Creek, Sayres Gulch to Lake Creek	No	Aluminum
		No	Cadmium
		No	Copper
		No	Zinc
COARUA12a	Chalk Creek	No	pH
		No	Lead
Middle Arkansas River Sub-Basin			
<i>Currently, no TMDLs have been completed and approved for segments in the Middle Arkansas River Sub-Basin.</i>			
Lower Arkansas River Sub-Basin			
<i>Currently, no TMDLs have been completed and approved for segments in the Lower Arkansas River Sub-Basin.</i>			

Sources: WQCC 2010b; WQCD 2002, 2006b, 2008, 2010a.

6.4.4 TMDL Implementation Strategies

Exhibit 6-56 at end of chapter summarizes information in the TMDL reports completed to date.¹⁰ Specifically, it summarizes current and potential future strategies identified in the TMDL reports. The discussion should not be considered to be complete or exhaustive in terms of strategies that could or should be undertaken in the basin. Moreover, the WQCD recognizes that many other entities have undertaken or are planning activities that will contribute to improvements in water quality in the basin. Finally, 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.

6.4 Planned Point Source Treatment Upgrades

As shown in exhibit 6-57, there are a total of 159 public and private point source dischargers in the Arkansas River Basin¹¹. Of this number, 37 (23%) are in the Upper Sub-basin, 14 (9%) are in the Middle Sub-basin, and 108 (68%) are in the Lower Sub-basin. The point source dischargers are located in 18 counties. The counties with the greatest number of point source dischargers are El Paso with 45 (28%), Las Animas with 22 (14%), Fremont with 13 (8%), and Pueblo with 12 (8%). Cheyenne, Kiowa, and Larimer counties have the least number of dischargers with one each.

Exhibit 6-57. Arkansas River Basin Summary of Point Sources by County

Sub-Basin	Applicable Counties	Number of Point Sources by County
Upper	Chaffee	7
	Custer	3
	Fremont	13
	Lake	7
	Larimer	1
	Teller	6
Total Upper Sub-Basin <i>(as % of Total in Basin)</i>		37 <i>(23%)</i>
Middle	El Paso	4
	Huerfano	5
	Pueblo	5
Total Middle Sub-Basin <i>(as % of Total in Basin)</i>		14 <i>(9%)</i>
Lower	Baca	4
	Bent	4
	Cheyenne	1
	Crowley	5
	El Paso	41
	Huerfano	1
	Kiowa	1

¹⁰ Time and resource constraints prohibited a review of TMDLs beyond those available on WQCD’s website at <http://www.cdphe.state.co.us/wq/assessment/TMDL/TMDLs.html>.

¹¹ 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 2010c), and the Water Pollution Control Revolving Fund annual Intended Use Plan (WQCD 2010b).

Sub-Basin	Applicable Counties	Number of Point Sources by County
	Las Animas	22
	Lincoln	3
	Otero	9
	Prowers	8
	Pueblo	7
	Teller	2
Total Lower Sub-Basin (as % of Total in Basin)		108 (68%)
Basin-wide	Baca	4
	Bent	4
	Chaffee	7
	Cheyenne	1
	Crowley	5
	Custer	3
	El Paso	45
	Fremont	13
	Huerfano	6
	Kiowa	1
	Lake	7
	Larimer	1
	Las Animas	22
	Lincoln	3
	Otero	9
	Prowers	8
Pueblo	12	
Teller	8	
Total All Basins	18	159

Sources: USEPA 2010a, 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 113 planned treatment projects were identified for point source facilities in the Arkansas River Basin.¹² Exhibit 6-58 provides a summary of the project types by sub-basin and includes the number of projects for each, the estimated costs of the project, and the population expected to benefit. Wastewater treatment facility projects lead the list in terms of the greatest number of scheduled projects (83 of 113, or 74%). Source water protection projects follow with a total of 17 (or 21%).

Exhibit 6-58. Arkansas River Basin Summary of Scheduled Point Source Improvements

Project Type	Sub-Basin	Number of Projects	Estimated Cost of Projects ¹	Population Expected to Benefit from Projects	Number of Projects Reporting Population Data
Wastewater Treatment Facility	UPPER	22	\$61,335,909	28,195	86% (19 of 22)
	MIDDLE	5	\$35,560,000	52,082	100%
	LOWER	56	\$295,319,468	2,539,621	100%
Total Wastewater Treatment Facility Projects		83	\$392,215,377	2,619,898	
Nonpoint Source	UPPER	0	\$0	0	0%
	MIDDLE	1	\$467,717	102,000	100%
	LOWER	4	\$7,944,266	531,160	100%
Total Nonpoint Source Projects		4	\$8,411,983	633,160	
Stormwater	UPPER	4	\$29,900,000	43,522	100%
	MIDDLE	1	\$3,218,278	102,000	100%
	LOWER	3	\$18,573,820	386,501	100%
Total Stormwater Projects		8	\$51,692,098	532,023	
Source Water Protection	UPPER	3	\$75,000	1,776	100%
	MIDDLE	1	\$10,000	2,800	100%
	LOWER	13	\$160,000	7,601	100%
Total Source Water Protection Projects		17	\$245,000	12,177	
All Projects	UPPER	29	\$91,310,909	73,493	
	MIDDLE	8	\$39,255,995	258,882	
	LOWER	76	\$321,997,554	3,464,883	
TOTAL ALL PROJECTS		113	\$452,564,458	3,797,258	

¹ 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 and 2010c; WQCD 2010b.

The total estimated cost of the 113 projects in the Arkansas River Basin is \$452,564,458. Wastewater treatment facility improvement projects constitute 87% of the total, or \$392,215,377. They are followed by stormwater projects at \$51,692,098 and nonpoint source projects at

¹² 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.

\$8,411,983 (11% and 2%, respectively, of total estimated project costs). Although source water protection projects are second in terms of the number of planned activities, they have the lowest value associated with them (\$245,000 for 17 projects, or 0.05% of estimated costs for all projects). Exhibits 6-59 to 6-61 (at end of chapter) provide additional detail at the sub-basin scale. 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.¹³ Total funding has also not increased significantly under section 319 in spite of nonpoint sources being the leading source of water pollution nationwide.

6.6 Nonpoint Source Management

Exhibit 6-62 (at end of chapter) summarizes CWA section 319 nonpoint source management projects in Colorado for the past 5 years. A total of four CWA section 319 nonpoint source projects were identified for the Arkansas River Basin—three in the Upper Arkansas River Sub-basin and one in the Lower Arkansas River Sub-basin. The principal objective of these projects was to address abandoned mine drainage and the associated problems posed by legacy mining pollutants. The four projects had a total cumulative budget of \$3,749,961. Approximately 27% of this amount (\$1,028,979) was provided through section 319 grant funds; the remaining funds were from other sources and represent the grant recipients' cost-share agreement with the WQCD.

¹³ 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).

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Map References

Exhibit 6-1. Arkansas River Basin Physical Location

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Exhibit 6-4. Arkansas River Basin Level III Ecoregions

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Exhibit 6-6. Arkansas River Basin Nonconsumptive Needs Assessment

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Exhibit 6-8. Arkansas River Basin Land Ownership

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Exhibit 6-15. Arkansas River Basin Key Diversions and Streamflow Gauges

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Exhibit 6-16. Arkansas River Basin Wells and Aquifers

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Exhibit 6-17. Upper Arkansas River Sub-Basin Classified Waterbody Segments

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Exhibit 6-18. Middle Arkansas River Sub-Basin Classified Waterbody Segments

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Exhibit 6-19. Lower Arkansas River Sub-Basin Classified Waterbody Segments

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Exhibit 6-42. Arkansas River Basin Impaired Waterbody Segments

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