BLUE RIVER WATER QUALITY MANAGEMENT PLAN 2012

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1.0 WATERSHED OVERVIEW

Geography and Hydrology

The Blue River drains an area of 680 square miles in the central Rocky Mountains, west of the continental divide in Colorado. The watershed drains northward, from elevations reaching 14,270 feet along the southeastern perimeter, to where it flows into the Colorado River south of Kremmling at an elevation of 7,400 feet. A map of the watershed is provided as Figure B-1.

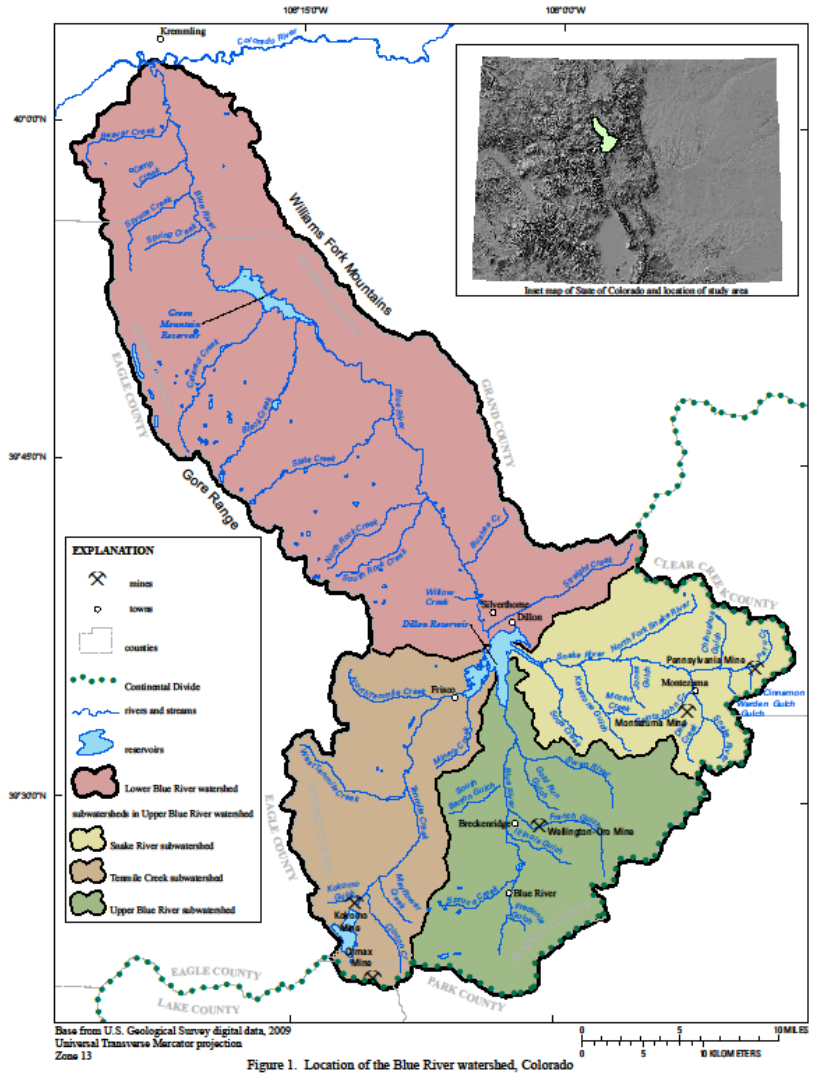


Figure 1. Location of the Blue River watershed, Colorado

Figure B-1 Blue River Watershed Map.

Three major tributaries in the Blue River watershed come together at Dillon Reservoir forming the Upper Blue River watershed: the Snake River, a westerly flowing tributary with its source originating at Webster Pass on the continental divide; the Blue River, a northerly flowing tributary with its headwater at the continental divide at Hoosier Pass; and Tenmile Creek a northeasterly flowing stream with its source at the continental divide at Fremont Pass. Each contributes approximately 1/3 of the flow to Dillon Reservoir. The lower Blue River watershed is approximately the same size as the upper Blue River watershed, and contributes approximately the same virgin yields (averaging approximately 160,000 acre feet per year).

Most of the annual stream flow results from snow melt during the spring and early summer (May through July). Major snowfall typically occurs January through April. Thunderstorm activity produces significant, although short-lived rainfall events in July and August. Stream flows above major water storage facilities have marked seasonal variability, with highest flows occurring during the snow melt, and low flows, sustained by groundwater, occurring October through April. Discharge from groundwater systems contribute about a quarter of the total surface water flow (Summit County Small Reservoir Feasibility Study, 1989).

Two significant water storage facilities are located in the watershed: Dillon Reservoir, with a capacity of 254,036 acre feet and a surface area of 3,233 acres; and Green Mountain Reservoir, with a storage capacity of 154,645 acre-feet and a surface area of 2,100 acres. Dillon Reservoir was constructed and is operated by the Denver Water Department as a municipal water supply. Green Mountain Reservoir was built and is operated by the United States Bureau of Reclamation. Its primary purpose is to provide compensatory water storage for the western slope (2/3's of its storage capacity) and augmentation water for the Colorado-Big Thompson project (1/3). It also provides hydroelectric power.

Average Blue River undepleted flows are approximately 310,000 acre-feet (Summit County Small Reservoir Study, WBLA, Inc. 1989). In 2000, the ten-year annual average of water exports from the watershed was 75,109 acre-feet through the Straight Creek, Roberts, Hoosier Pass and Vidler tunnels and Boreas Pass ditch. The actual quantity of water diverted out of the Upper Blue River watershed from November 2005 to October 2006 was 122,018 acre feet of water (Colorado Division of Water Resources and Colorado Water Conservation Board, 2008). . Water exports result from water diversions by the Cities of Colorado Springs, Denver Water, other Front Range cities and agricultural users.

1.2 Land Uses and Population Characteristics

The Blue River watershed includes all of Summit County which encompasses approximately 619 square miles (383,260 acres). An additional 80 square miles lie within Grand County and the very head of the Tenmile basin lies within Lake County. Federal lands (Forest Service and Bureau of Land Management) account for approximately 79% (436 square miles or 279,145 acres) of the total area in Summit County. Private lands comprise 110,890 acres (approximately 21% of the County) and are concentrated along the major stream corridors in the valleys [Summit County Wetland Grant RFP, November 29, 2001]. Public lands in the Blue River watershed within Grand County account for approximately 18 square miles (11,520 acres of Forest

Service and BLM property). The major population centers within the Blue River watershed are the towns and unincorporated areas of Blue River, Breckenridge, Copper Mountain, Frisco, Keystone, Dillon, and Silverthorne. The permanent resident population of Summit County in 2006 was and estimated 27,964 and the peak seasonal population was 121,496 [Summit County Planning Department, 2006 Table A13]. The resident population growth in Summit County over the last nine years has averaged 7% per year. During the 2007-08 ski season, the number of skier days (skier day is one individual visiting a ski area for a day to ski) at Summit County ski areas was 4,125,391 (Summit County Government, 2009).

Economic and land use activities in Summit County include: recreation; mining; agriculture (including silviculture); and urban development. Recreation serves as the dominant economic base in Summit County, with four major ski areas in the county (Arapaho Basin, Breckenridge, Copper Mountain, and Keystone). The major historical mining areas in the county are at the headwaters of the watershed in the Tenmile, Blue and Snake Rivers. Agricultural products consist mainly of livestock, hay, and timber, with most of the irrigated acreage located in the Blue River valley downstream from Dillon Reservoir. Urban development in the county is primarily residential along the major tributaries in the vicinity of the ski areas, although development pressure and land prices have pushed development increasingly into unincorporated areas.

The lower portion of the Blue River watershed is situated within Summit and Grand Counties. This area is rural in nature and the predominant private land use is pasture and hay production (approximately 9,000 acres of irrigated land according to the State Engineer's Office, Division of Water Resources).

In the Blue River watershed there are community, transient non-community, and private drinking water systems, serving a combined total population of 89,899 persons [Colorado Department of Public Health and Environment, Water Quality Control Division, Data Supervisor, accessed January 13, 2011]. Thirty-five of the systems are reliant upon ground water and ten systems are reliant upon surface water. This information does not include systems serving less than 25 people, see Appendix 4..

1.3 Watershed Water Quality Management

In the Blue River watershed, the Summit Water Quality Committee (SWQC) has been involved in water quality issues since 1984 and is comprised of local governments and major municipal dischargers in Summit County. The organization is formalized through an intergovernmental agreement and has been actively involved in water quality monitoring, assessment and the implementation of improvement projects in the Blue River watershed. The SWQC developed and administers a water quality management program for Dillon Reservoir in which Denver Water assists through funding of routine monitoring costs. The group is primarily focused on nutrient control as outlined in CDPHE's Dillon Reservoir Control Regulation. SWQC has implemented a phosphorus trading program and established trading guidelines in cooperation with the WQCD, these guidelines list most of the phosphorus control projects completed. More recently SWQC has become involved in issues associated with metals from abandoned mines and contaminants of concern from pharmaceuticals and personal care products. The Committee's mission statement is "To protect and enhance water quality in Lake Dillon, Green Mountain Reservoir, and their tributaries."

On a more grassroots level the Blue River Watershed Group (see http://www.blueriverwatershed.org/) provides outreach on water issues to Summit County.

2.0 WATERSHED WATER QUALITY ASSESSMENT

Generally, water quality in the Blue River watershed is of high quality. A portion of the Blue River below Dillon Reservoir has been designated as a gold medal fishery by the Division of Wildlife. One segment in the watershed is on the State's 303(d) list of impaired waters due to impacts associated with historical hard rock mining. TMDLs were completed by CDPHE for the Snake River and Peru Creek which are also impacted by trace metals from historical mining and natural sources. Other general water quality issues include concerns regarding sediment (a TMDL was completed by the State and approved by EPA in 2000 for Straight Creek along I-70), and nutrients, both nitrogen and phosphorus. Municipal wastewater treatment facilities in the Blue River watershed all have tertiary treatment for phosphorus removal. The facilities also remove ammonia to meet the State stream standards and antidegradation provisions. Certain small areas in the watershed had historically demonstrated fairly high nitrate levels (greater than 5 mg per liter) in ground water, most likely as a result of septic system influence. However, a water quality study for groundwater samples collected from 1996 through 2004 for 1,234 domestic groundwater wells indicated that nitrate concentrations in about three percent of groundwater samples collected were greater than 1 milligram per liter (Bausch and Yacob, USGS Retrospective Analysis of Water Quality in the Blue River Watershed, Colorado, 1984 through 2007, 2011 in press).

Most of the stream segments in the Blue River watershed are designated Aquatic life cold water class 1, primary contact recreation, water supply, and agriculture. In general, the water in the Blue River watershed meets the water quality standards associated with these designated uses.

2.1 Straight Creek (part of Blue River Stream Segment 18)

Straight Creek has been heavily impacted by sediment related to the Interstate 70 corridor. In 1992, an EPA grant was awarded to the Summit Water Quality Committee to assess the sediment impacts on the aquatic community and develop metrics for assessing changes in sediment load. Macroinvertebrate densities, number of species, and species diversity have been negatively impacted by sediment accumulation. Fish populations were documented to be affected due to loss of pool habitat (pools were filled by sediment) [Straight Creek Sedimentation Investigation, December 1993. The Colorado Department of Transportation voluntarily began significant efforts in 1992 to address sediment inputs from road sanding operations as well as erosion from cut and fill slopes along the I-70 corridor. Monitoring is also taking place to assess the decrease in sediment loads as a result of these efforts. Water quality data collected in Straight Creek in 1993 by Western Environmental Associates (2 sites, 18 dates) indicates that Straight Creek water is generally higher in nutrients and sediment than other inflows to the Blue River Straight Creek is currently listed on the State 305(b) report as 'not supporting' the designated Aquatic Life Cold 1 standards due to sediment.

An EPA approved TMDL was developed for sediment in Straight Creek. Entities involved in the development of the TMDL included: the Forest Service; the Colorado Department of Transportation; the Division of Wildlife; the Town of Dillon; the Dillon Valley Metropolitan District; Northwest Colorado Council of governments; the Summit Water Quality Committee and the Water Quality Control Division. The Summit Water Quality Committee has coordinated the monitoring activities associated with the TMDL.

The established water quality targets of the TMDL are: 1) a minimum substrate D_{50} of 60 mm; 2) Maximum pool V* of 0.15; 3) Stable stream morphology; and 4) Five age classes of brook trout.

Federal grants and state funds have been used by the Colorado Department of Transportation to construct sediment retention ponds, stormwater rundowns, sediment retention barriers, remove traction sand and stabilize cut and fill slopes in order to reduce sediment loading to Straight Creek. .

SWQC has monitored several of the TMDL metrics since the early1990's. In 2007 the USFS Dillon Ranger District undertook a detailed analysis of this data to evaluate the status of the TMDL and the effectiveness of the BMPs. The conclusion of that assessment is that biological and habitat conditions have not been attained in spite of o the sediment control practices that have been completed, and that the D_{50} sediment metric may not be attainable.(Greg Laurie, White River National Forest, May 2007)

Straight Creek has no Colorado Water Conservation Board minimum instream flow filings below Laskey Gulch and has the potential for being completely diverted, de-watering the stream from Laskey Gulch to the confluence with the Blue River (approximately 2 1/2 miles). The Denver Water Board has conditional water rights (7 cfs) on Straight Creek, and the Town of Dillon and Dillon Valley Water District divert 7 cfs at Laskey Gulch (return flows are at the Silverthorne/Dillon Joint Waste Water Treatment Plant on the Blue River, approximately 3 miles down stream of the confluence).

2.2 Snake River and Peru Creek (Blue River segments 6, 7, 8, & 9)

The town of Montezuma was established as a mining community in the headwaters of the Snake River in the late 1860s. The community (approximate population: 70, 2000 US census data) does not provide water or sewage facilities, although the town owns senior water rights in the basin.

The Montezuma mining area of the Snake River basin is impacted by heavy metals and low pH (most heavily in Peru Creek). This part of the watershed contains large amounts of zinc veins in the Tertiary Montezuma stock. The ore deposits are thin veins along joints, faults, and contact surfaces. Bog-iron ore deposits are also known to exist in the upper Snake River basin and are believed to be a major contributor of acid to the streams [USGS, Reconnaissance Evaluation of Surface Water Quality in Eagle, Grand, Jackson, Pitkin, Routt, and Summit County, 1979].

Most of the ore deposits and abandoned mines are oriented north to south in the upper reaches of Peru Creek and the Snake River. Trace element concentrations in the Snake

River and Peru Creek upstream of the major ore deposits indicate that some of the trace element contamination is from natural origins.

Water quality has been documented as being impacted in the upper sections of the Snake River by bog-iron ore deposits and historical mining activities upstream of the confluence of Deer Creek [USGS, 1979]. In a 1994 survey, DOW staff found no aquatic life in the first half mile of the Snake River above the confluence with Deer Creek. Aluminum, lead, copper, cadmium, and zinc are above the aquatic life standard above the Deer Creek confluence. DOW staff in 1994 found a healthy trout population in Deer Creek above the confluence with the Snake (Blue River Stream Segment 9). The acid production from the area above the confluence with Deer Creek results in low pH's for the upper section of the Snake River [McKnight and Feder, Hydrobiologia 119, 1984]. Another paper by McKnight et al. (Environmental Science and Technology, July1992) states "The Upper Snake River is acidic and has high concentrations of dissolved Al and Fe. Although some veins containing lead, zinc, and silver minerals have been mined sporadically, no effects on water chemistry in Deer Creek are evident." The Snake River downstream from Peru Creek showed a relatively neutral pH, indicating a recovery from possible acidity upstream.

A 1979 study done by Dave Holm, Timothy Sullivan and Bruce Stenulson, “The Restoration of Peru Creek”, indicated that the most significant source of metals in Peru Creek is the Pennsylvania Mine Complex. Only dissolved manganese exceeded water supply standards. Downstream from the majority of the mines on Peru Creek, all trace-element concentrations increase, with dissolved manganese exceeding water supply standards while concentrations of total cadmium, copper, lead and zinc exceeded standards for aquatic life [USGS, 1979]. Seasonal variation in trace element concentrations appears as a dilution effect, with lower concentrations as a result of spring runoff. No aquatic insects have been observed at sites downstream of the abandoned mine activity on Peru Creek. Water quality impacts resulting from metals concentrations are documented in the 1989 Addendum of the 1988 Nonpoint Source Assessment Report [Water Quality Control Division in association with the Colorado Nonpoint Source Taskforce] which reports that Peru Creek is devoid of aquatic life (Blue River Stream Segment 7). A Division of Wildlife (DOW) survey in October of 1994 found no aquatic invertebrates or fish 400 feet upstream of the Pennsylvania mine site. All the other Snake River tributaries, as well as the Snake River, support only minimal aquatic life due to both acute and chronic metals problems.

As a result of discharge from Peru Creek, dissolved manganese concentrations still exceed water supply standards, at the Water Quality Control Division (WQCD) sampling site below Keystone. Dissolved zinc concentrations exceed applicable water quality standards for aquatic life at this station based on EPA STORET data collected by the WQCD between 1988 and 1994.

The Water Quality Control Division conducted sampling in 1996 and 1997 in the Snake River watershed. This sampling found that the Peru Creek drainage contributes 9 percent of the copper loading in the Snake River watershed, 18 percent of the cadmium, 21 percent of the manganese, 35 percent of the zinc, and 42 percent of the iron [rebuttal statement of the Water Quality Control Division, Upper Colorado River Basin Standards hearing, July 28, 1999].

The Water Quality Control Division has monitored several sites in the upper basin since

fall of 2000. Sites monitored monthly, or as weather has allowed, include Snake River at Montezuma, Peru Creek at the mouth, North Fork of the Snake above Keystone Resort, and the Snake River at the stream gage at Keystone. Zinc, copper, and cadmium generally continue to exceed standards to protect aquatic life. Some exceedances of lead and iron also continue.

1988 Summit Water Quality Committee monitoring results indicated nonpoint source phosphorus levels which deviated significantly from background sources in the Keystone area. A study directed by the Summit Water Quality Committee identifying probable sources was completed in 1990. Potential phosphorus sources were identified: the two unpaved parking lots (East and West lots) located between Keystone Road and the Snake River, on the south side of the river near the Snake River Clinic and Lancaster Lodge; the area above Key Condos; Keystone Lake; and a culvert pond below the development. Other water quality concerns associated with the Keystone area include golf course runoff (currently two), and minimum instream flow depletions in Keystone Gulch due to snow making activities.

The WQCD water quality monitoring data for the Snake River below Keystone during the period 1979-1994 were analyzed by the NWCCOG Water Quality Program. The 1988 208 Plan reported exceedances in numeric standards for copper, lead, zinc, and cadmium were observed. and that when compared with the data for the "most recent three years of this period" (1984-1987), average concentrations of copper and lead were reduced (though still had occasional exceedances of standards), while average concentrations for zinc and cadmium increased.

Data collected by the WQCD at the same site between 1988 and 1994 shows continued exceedances of water quality standards.

The mean of 40 dissolved zinc samples collected by the WQCD during this time period was 0.216 mg/L. The chronic water quality standard for Cadmium and copper also continue to occasionally exceed stream standards. Lead, however, was not detected in 40 samples collected during that same period. Total phosphorus concentrations are high in this reach with respect to measured background concentrations in other parts of the Blue River watershed. Special studies conducted through the Summit Water Quality Committee indicate that the areas around Keystone and Soda Creek (Blue River Stream Segment 5) are the largest contributors of phosphorus to Dillon Reservoir in the Snake River watershed.

Water quality data was collected by the Keystone Science School as part of the Division of Wildlife's River Watch Program at three stations in the Snake River drainage between 1991 and 1997: one on Keystone Gulch; one at the Keystone Science School bridge over the Snake River; and one on the Snake just above the confluence with Dillon Reservoir. Keystone Gulch pH's range from 5.7 to 8.5, and there are very occasional detections of dissolved iron, manganese, and zinc. The Snake River at Keystone Science School bridge has pH's of 5.2 – 8.1, consistent detections of dissolved cadmium, copper, manganese and zinc. The average dissolved concentrations of zinc at this station 32 samples between 1991 and 1997) was 258 ug/L. The Snake River confluence station has pH's similar to Keystone Gulch (5.7 - 8.2), and consistent detections of cadmium, copper, manganese, and zinc. Average dissolved zinc concentrations 32 samples between 1991 and 1996) were 307 ug/L. The chronic table value standard for dissolved zinc for the protection of aquatic life at a hardness of 50 is

65.5 ug/L.

A “Biological Investigation of the Aquatic Communities of the Snake and North Fork of the Snake Rivers” prepared for Keystone Resort by Chadwick Ecological Consultants was completed in September 1996. Macroinvertebrates were found at all five sites on the North Fork and Shannon-Weaver diversity indices ranged from 2.23 to 3.40. “This index generally has values ranging from 0-4, with values from 2.5 to 4.0 indicative of a healthy invertebrate community. Diversity index values less than 1.0 indicate a stream community under severe stress.” The same study sampled five sites on the mainstem of the Snake River from below Peru Creek to above Dillon Reservoir. Sites A and B (both above the North Fork of the Snake River) had 11 and 16 macroinvertebrate taxa and Shannon-Weaver diversity indices of 1.62 and 1.52. Sites C, D, and E on the mainstem of the Snake River below the North Fork confluence had diversity indices of 2.68 to 2.99.

The same Chadwick study found brook trout in the North Fork of the Snake River at 20 to 60 kg per hectare over five sites. No fish were collected from sites A and B (mainstem of the Snake between the north Fork and Peru Creek), while brook, brown, and rainbow trout were collected from sites C (brook and rainbow only), D, and E. Trout biomass at these three sites ranged from 20.4 to 26 kg per hectare. A table in the report summarizes fish biomass in similar streams in the Colorado Rocky Mountains. The mean trout biomass was 37.2 and the median trout biomass was 27.2 kg per hectare. The range of the 20 “reference” sites fish biomass was 10.6–114 kg per hectare.

In June 2001, the Forest Service released a study titled “Keystone Ski Area Water Quality Study” examining the impacts of artificial snowmaking in water quality at the Keystone ski area. Metals concentrations in pit and core snow samples from impacted locations (areas with artificial snow made with Snake River water) were generally substantially higher than those from reference locations (non snowmaking areas). Zinc concentrations were substantially higher in creeks receiving direct runoff from slopes with artificial snow than reference condition streams, but were below aquatic life stream standards. Macroinvertebrate sampling indicated an impact from metals in mayfly numbers and sensitive invertebrate species diversity in streams receiving artificial snow melt runoff.

A group called the Snake River Watershed Task Force formed in the late 1990s to address metals problems in the Snake River watershed. The group’s stated mission is “to improve water quality in the Snake River watershed. The Task Force will focus particularly on identifying, evaluating, and implementing opportunities to reduce heavy metal concentrations of concern.” The objectives of the group are to: obtain better information on the watershed; identify opportunities for improvement; develop criteria to prioritize projects; assist project implementation for projects that meet the Task Force’s criteria; and help establish and obtain reasonable standards. The Task Force has served as the steering committee for extensive characterization studies of the watershed, including a water quality assessment done for NWCCOG (TDS Consulting Inc., 2004) that documents the absence of fish and macroinvertebrates and the metal-enriched water quality conditions (see bibliography of studies at www.snakerivertaskforce.org). EPA has provided resources to assess both the sources and remedial opportunities of heavy metals. In August 2009 a significant surge of metals in Peru Creek, presumably a catastrophic discharge from the Pennsylvania Mine, killed all fish in the lower Snake River near Keystone. This event has renewed efforts to control the discharge of this mine.

In 1999 the Water Quality Control Commission established temporary modifications to segments 6 (mainstem of the Snake) and 7 (Peru Creek). The temporary modifications for cadmium, copper, iron, manganese, and zinc were set at ambient levels. In 2008 these segments were placed on the State of Colorado 303(d) list of impaired waters for non-attainment of aquatic-life use standards because of metal contamination and/or low pH; specifically, copper, zinc, lead, pH, cadmium (mainstem of Snake) and zinc, copper, cadmium, pH, and manganese (Peru Creek). TMDLs have been completed by CDPHE for these segments.

A watershed plan for the Snake River watershed was completed in March, 2009 by the Blue River Watershed Group (http://www.blueriverwatershed.org/overview/the-snake-river-watershed-plan/). The plan was funded by a 319 grant and describes the natural and anthropogenic sources of metals loading and provides recommendations of remedial projects which if implemented could reduce total zinc loading by a projected 18,900 lb/y.

2.3 Upper Blue River and French Gulch (Blue River Stream Segments 1, 2, 10, 11, & 12)

The private lands in the upper Blue River (extending south of the inlet to Dillon Reservoir) have the potential for significant future development. Due to poor soils and shallow ground water, Onsite Wastewater Systems (OWS) could be negatively impact ground and surface water in this area. A limited number of small wastewater treatment plants existed in the area. Breckenridge Sanitation District (now the Upper Blue Sanitation District, “UBSD”) took over the operation of four facilities in the upper basin above Goose Pasture Tarn. These small package plants were abandoned in favor of a single SBR facility in Blue River, the South Blue River Treatment Plant. UBSD has installed several main lines to consolidate the abandoned facilities and is providing incentives for homes utilizing onsite waste systems to hook into their system. Much of this existing development is located downstream of the plant resulting in the need to pump up to the plant which will minimize stream flow depletions associated with retiring the OWS.

Water quality in Goose Pasture Tarn downstream of the South Blue River plant has been characterized as "good", by the Town of Breckenridge, with no algal blooms. Goose Pasture Tarn serves as the water storage facility for the Town of Breckenridge's water supply.

The upper portion of French Gulch (above the Wellington/Oro Mine) supports a healthy fishery of native Colorado River cutthroat trout, according to the DOW.

The 1989 Addendum to the 1988 Nonpoint Source Assessment Report prepared by the WQCD noted that zinc, cadmium, lead, and copper concentrations are above the aquatic life standard on the Blue River from French Gulch to Dillon Reservoir.

French Creek from the Wellington–Oro Mine complex to the Blue River exceeded the water supply standard for dissolved manganese, and the aquatic life standard for cadmium, copper, lead, mercury and zinc. The benthic organism community diversity is extremely low and is almost entirely composed of chironomids (midges, tolerant of

poorer water quality).

An investigation of the chemical-biological integrity of French Creek and the Blue River was conducted in May and September of 1989 by the WQCD. The major source of metals loading is the Wellington-Oro Mine complex. The primary components of metal toxicity are zinc and cadmium, of which zinc exhibited the most serious and persistent downstream effects. Seasonally, the greatest loading, potential toxicity, and furthest downstream effects occur during the spring snowmelt period. Water quality and habitat degradation has eliminated trout from the lower 2-3 miles of French Creek. Metals contamination of the Blue River below its confluence with French Creek appears to have seriously reduced trout populations for an undetermined distance downstream.

Summit County High School monitored water quality on French Gulch as part of the Division of Wildlife's River Watch Program, but no dissolved metals data was collected between 1992 and 1998. The pH for the station ranged-from 6.5-8.0 and dissolved oxygen concentrations range between 8 and 11 mg/L - excellent for aquatic life. Hardness ranges from 13 - 164, with an average of 40 mg/L.

WQCD water quality data collected at their routine monitoring site on the Blue River, approximately 3 miles downstream of French Creek, between 1988 and 1994 indicated one exceedance of the chronic silver standard out of 26 samples collected and occasional exceedances of the chronic cadmium standard. There were no exceedances of copper, manganese, or zinc (44 samples each).

WQCD data collected in November 1993 in the Blue River below the confluence with French Creek indicated that zinc significantly exceeded the temporary modification standard for the segment (the Blue River from the French Creek confluence to the confluence with the Swan River): 2.946 mg/L vs. the temporary standard of 1.7 mg/L. Water quality standards for aquatic-life protection were exceeded most frequently at mining sites and sites downstream of historic mining sites, especially in French Gulch, Illinois Gulch and Blue River sites downstream of the confluence with French Gulch.

As part of the French Gulch Remediation Opportunities Group (FROG) activities, the Summit Water Quality Committee and the Northwest Colorado Council of Governments coordinated a water quality monitoring effort on the Blue River above and below French Gulch from April 1997- September 1998. That monitoring effort documented that metals values in the Blue River above French Gulch meet table value standards, while below French Gulch, zinc and cadmium exceed acute and chronic table value standards.

The USGS monitored fish and invertebrates in the Blue river in the vicinity of French Gulch. The USGS fact sheet “Effects of Water Quality and Habitat on Composition of Fish Communities in the Upper Colorado River Basin” by Jeffery Deacon and Scott Mize (October 1997) documents the fishery findings. Fish were not present in French Gulch downstream from the mined area to the mouth of the stream in 1995 and 1996 (Deacon and Mize, 1997; Deacon and Stephens, 1998). Zinc from mine drainage is the primary cause of trace-element toxicity to fish and other aquatic life in French Gulch (Kimball and others, 1999; U.S. Environmental Protection Agency, 2008b).

A draft “Wellington-Oro Mine Pool Engineering Evaluation/Cost Analysis” prepared by Adrian Brown for B&B Mines December 13, 2000, documents existing water quality in French Gulch and the Blue River. Potential contaminants of concern in French Creek

include cadmium, iron, lead, manganese, and zinc. Potential contaminants of concern in the Blue River include cadmium, lead manganese, and zinc.

Another report by Adrian Brown ("Tiger and Jessie Mines surface Water and Soil Characterization" for B&B Mines, August 4, 2000) documents limited water quality sampling on Gold Run and the Swan River. Discharging adits exist at both mines. The Tiger mine adit discharges cadmium and zinc at levels above Table Value Standards. The Jessie Mine adit discharges manganese and zinc at levels above Table Value Standards. One sample on the Swan River (June 2000) at the confluence with the Blue suggests that at that location table Value Standards are met.

Two "Analytical Results" reports produced by the Colorado Department of Public Health and Environment's Hazardous Materials and Waste Management Division in May of 2001 found portions of the Swan and Gold Run to be above Table Value Standards for cadmium and zinc. The elevated metals were found to be attributable to the Royal Tiger Mine and mill site about ¼ mile east of Muggins Gulch, and the Jessie Mine and mill site along Gold Run Gulch

A report prepared by the Division of Wildlife in June of 2001 titled "Aquatic Habitat Analysis: French Gulch and Blue River, Summit County Colorado" for the Hazardous Materials and Waste Management Division of the Colorado Department of Public Health and Environment documents the impacts to both French Gulch and the Blue River. The report states, "[t]he physical habitat of both the Blue River and French Gulch was highly modified by human actions in the last 100 years through a variety of activities including mining, road building, and urbanization of mountain terrain. As a consequence of these modifications, the amount of habitat available to support adult trout may have become compromised to the point where large numbers of fish will not be present." Blue River site 1 (just upstream to the confluence with French Gulch) and Blue River site 2 (just below the confluence) had 14 and 16 percent stream substrate with useable habitat for resting adult brown trout, respectively, compared to three other "reference" sites which had between 21 and 24 percent useable habitat. The report also states, "[e]ven if metals loading from French Gulch were to be reduced the physical habitat of the stream would need to be altered for trout numbers to increase substantially."

A Use Attainability Analysis was completed in 2003 by Summit Water Quality Committee. The UAA found that lower French Creek was habitat limited due to historic dredge mining and could not support a fishery. "Ambient Quality" was recommended for stream standards for cadmium, lead and zinc in the reach, whereas TVS we recommended upstream to protect the cutthroat. The UAA further recognized that the Blue River downstream of French Gulch was isolated from Dillon Reservoir by dredge piles and that at times the flow of the Blue River was entirely subsurface in the upper portion of this segment. In this upper portion brown trout were stocked and surviving. These circumstances led to recommendations for cadmium and zinc that were protective of adult brown trout in the reach of the Blue River between French Gulch and the instream barriers approximately at the confluence with the Swan River, Based on the UAA recommendations, the WQCC divided Blue River segment 2 in 2a and 2b and adopted site specific standards for these segments as well as French Gulch (segment 11) in July 2003.

The Town of Breckenridge and Summit County purchased the B&B Mine property which included the Wellington Oro Mine. (see

http://www.epa.gov/region8/superfund/co/frenchgulch/). These local governments then entered into a settlement decree with EPA and the State of Colorado for the construction of a new wastewater treatment plant using sulfide precipitation (http://bioteq.ca/water-treatment/operations/wellington-oro-co/) to remove cadmium and zinc from entering French Gulch at the Wellington-Oro mine site. The facility opened in November of 2008. The consent decree also stipulated cleanups at the Jessie and Royal Tiger Mine sites, which have also been completed (http://www.cdphe.state.co.us/hm/covenant/index.htm)

Illinois Gulch is on the State of Colorado 2008 303(d) list of impaired waters due to non-attainment of aquatic life use standards for dissolved zinc (Colorado Department of Public Health and Environment, 2008a). Gold Run Gulch below Jessie Mine and South Branch Swan River below Royal Tiger Mine are on the State of Colorado 2008 Monitoring and Evaluation list for zinc; Gold Run Gulch is also listed for cadmium (Colorado Department of Public Health and Environment, 2008a).

Additionally, stream flow in Blue River stream segment 2a (French Gulch to Swan River) is highly controlled due to the Town of Breckenridge's water supply from Goose Pasture Tarn and the ski area's snow making water rights. This occurs in an area that was historically dredged for gold and destroyed the stream channel and its associated riparian habitat (Blue River Restoration Master Plan, February 14, 2000 by Tetra Tech, Inc. for the Blue River Restoration Steering Committee and Northwest Colorado Council of Governments). Under the existing water rights situation it is possible for the surface flows in this segment to be non-existent during late summer and winter conditions (Scott Hummer, Colorado State Engineer Division 5 Blue River Water Commissioner, personal communication).

A population of Colorado River cutthroat trout exists in the North Fork of the Swan River. A culvert and a series of beaver ponds, barriers to fish passage have been responsible for maintaining this fairly "pure" population, but brown trout have been reportedly seen in these beaver ponds. This is a concern to the Division of Wildlife which is attempting to maintain "pure" cutthroat trout populations. The migration of brown trout upstream of the beaver dams could impact the genetic purity of the cutthroat population.

2.4 Tenmile Creek (Blue River Stream Segments 13, 14, & 15)

Tenmile Creek discharges to Dillon Reservoir in the Town of Frisco, approximately 18 miles northeast of the Climax Mine, which forms the headwaters of Tenmile Creek. The Climax mine and mill operations lie within a contiguous 14,300 acre land block on the upper reaches of the Arkansas, Eagle and Tenmile drainages atop the Continental Divide.

The Climax Mine site contains the richest molybdenum deposit discovered in the world to date (1980), Activity of State Interest, Summit County Permit Application, Climax Molybdenum Company, August 1992
The Tenmile Creek watershed is highly mineralized and was a primary target of prospectors and mine development dating to the late 1860s. The upper stream segment (Segment 13) has continuing water quality problems due to extensive and intensive metal mining activities that occurred throughout the upper Tenmile Creek drainage. The historic lode operations mined and milled pyritic poly-metal ores. Many of these sites continue to discharge acidic waters. In the 1970's Climax constructed the West and

East Interceptor ditch systems above its operations to divert stormwater and snowmelt around its facilities. As part of the interceptor system project, Climax consolidated into its water treatment system mine drainage and stormwater and snowmelt contact water from several of the worst pollutant sources in Searle and Kokomo Gulches. Numerous other historical mine sites located on federal lands contribute mine drainage and contaminated runoff to the interceptor system which discharges directly to Tenmile Creek.

The lower segment (from West Tenmile Creek to Dillon Reservoir) receives dilution flows from West Tenmile Creek, which is of high quality. A report titled "Water Quality Monitoring for Copper Mountain Resort Results for 1999 and 2000" prepared by William Lewis and James Saunders [December 15, 2000, available from the Summit Water Quality Committee] provides information on phosphorus concentrations and yields in West Ten Mile Creek. This study occurred during a time of significant base area development at Copper Mountain Resort. Between 44 and 91 kilograms of phosphorus were attributed to Interstate 70 (above the Lake Dillon model background estimate for the watershed), and between 9 and 91 kilograms of phosphorus were attributed to runoff from the ski area and base development.

The fishery on Tenmile Creek was completely eradicated by the impacts of acidic mine water drainage, smelter effluent and waste from the mining settlements in the late 1880s

Since that time, there have been substantial improvements to the physical characteristics of the stream associated with DOW guidance efforts related to the construction of Interstate 70 through West Tenmile Canyon. Tenmile Creek was restored as a fishery, although not to a pre-disturbance condition, by 1971. Tenmile Creek and Clinton Reservoir are viable fisheries that support game fish species including brook, brown, cutthroat, and rainbow trout (Clinton supports only cutthroat trout). Production data for all these surface water bodies have not been compiled (DOW, 1993), although fisheries production data has been compiled for CMC annually since 1970 [Climax Mines, Bryce Romig, personal communication, 1995].

During a wetland delineation along Tenmile Creek done as part of a Analytical Results Report Screening Site Inspection done for the EPA by URS Consultants September 29, 1994 [URS, 1995], a powder white coating was visible on rocks in the stream channel on the upper reaches of Tenmile Creek. Numerous persons have noted this condition. Climax Mine has identified this as un-reacted lime, an artifact of the water treatment process [Bryce Romig, personal communication, 1995].

The 1979 USGS study (previously cited) documented levels of heavy metals, which exceeded standards for water supply and aquatic life. The Dillon Clean Lakes Study documented high concentrations of phosphorus in Tenmile Creek [Lewis, Saunders, and Brendecke, Clean Lakes Study of Dillon Reservoir in Summit County, 1983]. It should be noted that significant reclamation activity and improvement in the water treatment system at the Climax Mine has occurred since the 1980s.

Historically, Tenmile Creek from its beginning at Climax outfall 001 West Tenmile Creek contained zinc, copper, cadmium, and lead above the basic standards for aquatic life; water supply standards were also exceeded for cadmium, lead, and manganese [1988 208 Plan]. Below the West Tenmile Creek confluence (Blue River Stream Segment 14), concentrations of these metals were reduced due to dilution; however, cadmium, copper,

and zinc still exceeded table value standards for aquatic life [1988 208 Plan].

Currently there is no sulfate standard for Segment 13, however 1993 and 1994 CMC water quality data collected on Tenmile Creek below Humbug Creek shows that sulfate concentrations usually exceed the 250 mg/L Table Value Standard for domestic water supplies (the 1993 average was 632 mg/l and the 1994 January through October average was 691 mg/L). The same data showed no exceedances of the copper, one exceedance of zinc at 0.26 mg/L (June, 1993), and one exceedance of manganese at 1.43 mg/L in July of 1993. This water includes non-Climax Mine historic mining pollutant sources. The point of including historical data is to show that significant progress has been made in improving water quality in Tenmile Creek; water quality from the Climax property boundary outfall (beginning of Segment 13), currently meets all applicable standards (2012).

In early 2012, Climax had resumed mining and milling operations after years of a “care and maintenance” status. Based on sampling conducted by Climax sincethe 1980s, there have been no obvious trends in phosphorus concentration at the Tenmile Creek outfall during either the time of historic operation or when the mine was not operating. There also is no obvious trend in nitrate concentrations. Climax Mine is exempt from a phosphorus wasteload allocation under their existing and draft permits. However, Climax will continue to monitor for phosphorus and nitrate as part of its environmental monitoring program.

Historically, cyanide, copper, and zinc have been the primary contaminants discharged from the Climax Mine site that have exceeded WQCD discharge permit limits. There have been no exceedances of cyanide, copper, or zinc stream standards since 1986 (Climax no longer uses cyanide as a processing reagent) . Elevated concentrations of arsenic, cadmium, copper, silver and zinc were present in sediment samples from Tenmile Creek, and elevated concentrations of aluminum, cadmium, and zinc were present in surface water samples below the Climax Mine. Cyanide was not found in sediment or surface water samples. Observed elevated levels of copper, silver and zinc were detected in sediment samples 3.1 miles downstream from Climax Mine, and elevated levels of aluminum and zinc were detected in surface water samples at the same site [URS, 1995]. These metals were not elevated at the Climax Mine property boundary, suggesting sources other than Climax Mine. It should be noted that water discharged by Climax Mine under its discharge permit (CDPS Permit No. CO-0000248) is in compliance with all conditions of this permit. This permit is currently under renewal.

Climax Mine also contracts for annual biological studies. In 1993, brown, brook, and rainbow trout were collected at study sites on Tenmile Creek. At the TM3 site (upper Tenmile) only two brown and one brook trout were collected (all <15 cm). The number of fish at this site was low in 1993, compared to 1989 and 1990, when 25 and 20 fish were collected, respectively. Young of the year have not been collected at this site since 1989. However, more recent studies of fish population at TM3 show a continual improvement in stream health. The most recent fish survey in 2011 estimate the fish population of 216 fish per hectare, with the number of fish captured increasing 30% from 2010.

At downstream sites density and biomass are relatively similar to previous years, and

natural reproduction occurs annually at the collection site near Wheeler Flats. The macroinvertebrate community is showing some improvement over time at the upper site. Although total density remains low, number of taxa and species diversity has increased. Chironomids, highly tolerate organisms which previously accounted for 80 to 90% of all the organisms collected accounted for 37% of the organisms collected in 1993.

The macroinvertebrate community at the Climax Mine sampling site upstream of Frisco did not appear to be stressed in the 1993 study, and all major taxonomic groups were found.

Improvements in infrastructure at Climax ensures that all mine drainage is captured and sees full treatment prior to discharge. Additionally, there have been numerous wastewater treatment improvements – a new and efficient lime delivery system, 2-stage pH adjustment system which is more effective in removing metals. In the last 30 years, diversion of clean water around mining impacted areas, water treatment with lime neutralization and reclamation at the Climax Mine area in the headwaters of Tenmile Creek have resulted in substantial improvements to water quality in Tenmile Creek (GlobalInfoMine, 2008, Climax Molybdenum Mine: GlobalInfoMine, accessed December 2009, at http://technology.Infomine.com/articles/1/3616/molybdenum.tailings.water/climax.molybdenum.mine.a.spx ; White River National Forest, 2008, Copper Mountain Resort, Environmental assessment, Tenmile Creek facilities improvements and reclamation project: U.S. National Forest Service, White River National Forest, Dillon, Ranger District, 161 p., accessed Dec 2009, at http://www.fs.fed.us/r2/whiteriver/projects/copper/CopperMtnResortTenmileEA.pdf)

There has been more involved management of Clinton Reservoir by the owner (Clinton Reservoir and Ditch Company) since 1999. Much of this is related to the installation of the water diversion for Copper Mountain just above Wheeler Flats on the mainstem of Tenmile Creek. It is likely that the diversion may be doing two things- 1) providing increased instream flow of Clinton Reservoir water during low flow periods, and 2) pulling flows from the main stem from winter low flow – thus allowing West Fork of Tenmile chemistry to dominate during some period of the year. Good data on the volumes or timing of these diversions, may not be available but empirically, this management may be of some overall benefit to Tenmile Creek.

Climax has monitored macroinvertebrates and fish from 1990–present. Sites include: (TM3), Wheeler flats (TM5) and Frisco Bridge (TM6). The results of 2010 monitoring indicate that Tenmile Creek is in good overall health. Fish sampled in all three sites indicate a healthy fishery, although fish diversity fluctuates and may be a result of CDOW fish stocking. Data has been parsed into 1990-1994 and 1995-1998. The data is summarized below in Table B-1. TM3 has been identified as a problematic site, due to habitat issues, and work is done to identify a more representative site for biological sampling.

Table B-1. Biotic indices in Ten Mile Creek

Parameter	TM3			TM5			TM6		
	1990-1994	1995-1998	2010	1990-1994	1995-1998	2010	1990-1994	1995-1998	2010
Mayfly			2	2.0	7.5	4	3.5	3.5	6

species									
Stonefly species			5	3.5	10.5	6	5.0	5.0	10
Caddisfly species			2	1.5	3.5	2	2.8	2.8	1
Fish per acre			35/ha		780 ('98)	533/ha		3.5	198/ha

Climax Mine's involvement in the July 2000 basic standards hearing resulted in a application of EC10 for most state waters for manganese with some allowance for higher hardness waters such as those found in segment 13. The current manganese standard, which is hardness based, is limited to maximum hardness of 400. Climax is interested in obtaining a manganese standard, which accounts for hardness values above 400 mg/L, as found in the upper Ten Mine Creek. The manganese effluent concentration currently in place, based on 400 hardness is 3100 ug/l.

Several municipal wastewater dischargers in the Blue River basin (Copper Mountain, Frisco, Silverthorne/Dillon,) also have a cooperative agreement with Climax Mine for the disposal and composting of their biosolids which are used as a soil amendment for site reclamation. Most of these facilities have a contingency arrangement with the Summit County landfill composting facility.

The Division of Wildlife reports that a cyclical fish population that reflects changing metal concentrations is found in the lower stretch of Tenmile Creek [1988 208 Plan].

The Colorado Water Quality Control Division's water quality monitoring data for Tenmile Creek at Frisco during the period 1979 –1987 were analyzed by NWCCOG for the 1988 208 Plan. Occasional high levels of total inorganics, suspended solids and total phosphorus were reported to exist. Approximately 29 percent of the surface water total phosphorous load entering Dillon Reservoir during 2006 came from Tenmile Creek (Lewis, W.M., Jr., 2005, Lake Dillon monitoring project, 2004 annual report: Silverthorne, Colo., Summit Water Quality Committee). Exceedances of numeric standards for sulfate, copper, lead, zinc, and cadmium occur infrequently. A comparison of the analysis from the most recent three years of that period (1984-1987) indicated an improvement for all parameters except suspended solids and sulfate. Occasional exceedances of the standard for lead still occurred during this period. Between 1988 and 1994, 55 dissolved lead samples were collected with no detections present, indicating that lead is no longer a concern. Sulfate is still a problem, with an average value of 215 mg/L for samples collected between 1979 and 1994, while averages for the other three WQCD stations in the Blue River watershed range from 27 – 34 mg/L. The average suspended solids concentration at this station for the same time period (1979-1994), >12.1 mg/L, is in line with the other WQCD average values for the watershed (averages range from 10.6 to 19.3 mg/L).

Summit County High School no longer monitors water quality at the Tenmile Creek confluence with Dillon Reservoir. The data available (three samples between 1993 and 1994) show a pH of 7.6 and saturating dissolved oxygen conditions – which indicates those parameters are good for aquatic life. Hardness (ranging from 360 to 518) is significantly different than most of the streams in the watershed which are significantly lower in hardness than Tenmile Creek. This indicates that there is a greater dissolved

ion concentration in this stream than most in the watershed (such as calcium carbonate or sodium sulfate). Hardness does buffer (offset) the impact that dissolved metals have on aquatic life. No metals data is available for this station.

2.5 Dillon Reservoir (Blue River Stream Segment 3)

Dillon Reservoir was the subject of a Clean Lakes Study, which was conducted in 1982 [Lewis, Saunders, and Brendecke, Clean Lakes Study of Dillon Reservoir in Summit County, 1983], with water quality data collection continuing through the present. Nutrient enrichment due to phosphorus loading from nonpoint sources is the principle concern in Dillon Reservoir. The study concluded that Dillon Reservoir is mesotrophic (moderate amount of nutrients), whereas a previous EPA study had found the reservoir to be oligotrophic (few nutrients). Nutrient enrichment studies in 1982, 1984, and 1987-1988 concluded and continue to indicate that the growth of phytoplankton and bacterioplankton is phosphorus-limited during the majority of the year (Clean Lakes Studies, and master's thesis and doctoral dissertation by Donald Morris, University of Colorado, Boulder).

Approximately 45% of the phosphorus loading is attributable to background runoff, 13% to precipitation, 16% to major point sources, 8% to septic systems, and 18% to all other sources. These percentages have been refined and revised through annual monitoring. For 1991 (adjusted to 1982 hydrologic conditions), approximately 50% of the phosphorus loading is attributable to background runoff, 18% to precipitation, 3% to major point sources, 15% to septic systems, and 14% to all other sources [SWQC Phosphorus Accounting System, 1995].

Conclusions from continued monitoring indicate sustained reduction in total phosphorus loading as compared with the levels observed in 1981 and 1982. Improved land use practices and performance of wastewater treatment plants are the apparent reasons for the reduced loads.

In 1984 the Water Quality Control Commission passed a control regulation, setting a phosphorus standard of 7.4 ug/L during the growing season (July-October), and establishing point source phosphorus load allocation for Dillon Reservoir. As previously noted, phosphorus was identified as the nutrient limiting algae growth in the reservoir.

This standard was set to protect the lake from algal blooms by establishing a "cap" at 1982 seasonal average chlorophyll levels. Wasteload allocations for the major dischargers were based on projected "build out" flows and a discharge treatment level of 0.2 mg/L total phosphorus. Wasteload allocations for the minor dischargers were based on the percentage of phosphorus available to the minor domestics without exceeding the total allowable load and allocated to the individual sources based on professional judgment. Since 1982, the regulatory limit of the growing season average of 7.4 ug/L has been exceeded twice, during 2002 and 2004. Elevated total phosphorous concentrations in these years are the result of drought (low reservoir inflow) rather than an increase in total phosphorous from natural and anthropogenic sources (Lewis, W.M., Jr., 2005, Lake Dillon monitoring project, 2004 annual report: Silverthorne, Colo., Summit Water Quality Committee).

The Climax Molybdenum Mine was identified in the Clean Lakes Study as a significant uncontrolled source of phosphorus (approximately 5% of the total phosphorus load in 1982) which behaved like a point source (coming from one identified source). This phosphorus impact was assumed to be associated with the workforce not the mining, per se. During the Clean Lakes Study the workforce numbered over 3,000. Since the time of the initial study the mine has reduced operations and a corresponding drop in the loading from the mine has resulted. The total Climax workforce is expected to grow to approximately 350 employees when at full-scale operations. . Current plans (2012) include the construction of stage 2 metals removal facility to replace Mayflower TSF when it becomes operational – phosphorus is not part of the treatment design. Approximately 29 percent of the surface water total phosphorous load entering Dillon Reservoir during 2006 came from Tenmile Creek (Lewis, W.M., Jr., 2005, Lake Dillon monitoring project, 2004 annual report: , Summit Water Quality Committee). In 2006, approximately 44 percent of the surface water nitrate load entering Dillon Reservoir came from the upper Blue River, 35 percent was from Tenmile Creek and 31 percent was from the Snake River.

Construction activities and septic systems were also identified as a significant source of nutrients in the Clean Lakes Study .Between 2002 and 2009 SWQC contracted a construction site inspector to improve the use and maintenance of BMPs on development sites as well as providing education and outreach on stormwater management. The project was terminated in 2009 due to significantly reduced rate of growth.

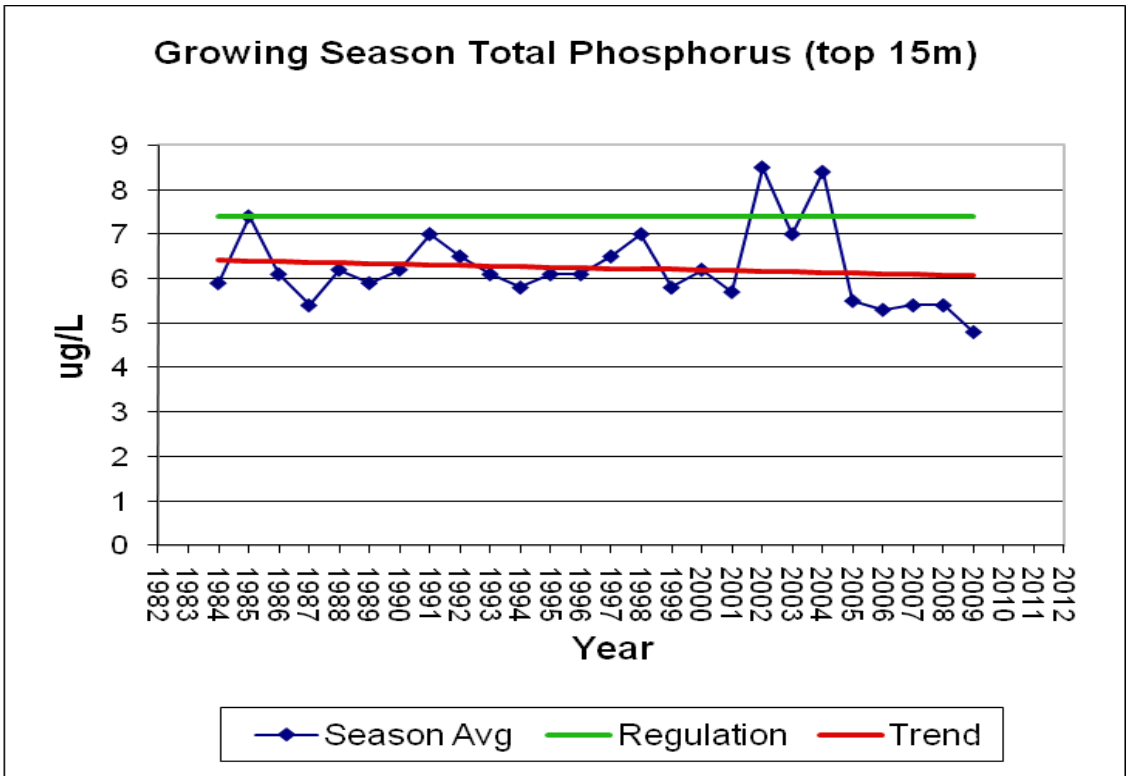
In 1982, the contribution of phosphorus from septic systems to the reservoir was 8% of the total phosphorus load. In 1991, the Dillon Reservoir model predicted that 15% of the phosphorus load is attributable to septic systems. Considering the projected growth anticipated to occur in areas not currently served by advanced waste water treatment plants, nutrient contributions due to areas served by septic systems are anticipated to be a significant nonpoint source problem in the future, based on Dillon Reservoir model projections, see Nonpoint Source section. In 2000 the Frisco Sanitation District converted 106 older onsite systems to central sewer as part on a point/NPS trade that included the Copper Mountain Metro District and the Copper Ski Area. By 2006 the Snake River WWTP had converted about 30 onsite older onsite systems to central sewer in a subdivision north of Keystone. In 2010 Upper Blue Sanitation District installed sewer lines into much of the area near the town of Blue River that would potentially be developed using onsite wastewater systems.

In 1997,a special study entitled “Effects of Reservoir Management on Phosphorus and Chlorophyll Concentrations on Lake Dillon” was sponsored by the Summit Water Quality Committee. Reservoir management operation information was provided by Denver Water Department. Modeling was based on three sets of conditions intended to span full range of alternatives that might be realized for future years. 1) status quo- or existing conditions, 2) greater water demand (approximately the year 2015), and 3) maximum demand (year 2045). Three factors potentially affect phosphorus concentrations in the reservoir: land use, hydrology, and reservoir operations. Of these three, land use has by far the strongest effect, in other words, changes that are anticipated in land use between the present conditions and full build out (in the watershed above the reservoir) will have a much stronger effect on the total phosphorus concentrations than any variation in hydrology from year to year. Hydrology has the second strongest effect, and reservoir management has a small adverse effect on phosphorus concentrations in dry years at

full build out.

In 1999 Western Environmental Analysts produced a report titled “A Quantitative Evaluation of Factors Controlling Transparency in Lake Dillon Colorado” [William Lewis and James Saunders, July 13, 1999]. This study, paid for by the Summit Water Quality Committee, evaluated the contribution of dissolved organic carbon, algae, and “other factors”, including bacteria and very fine particulate matter. The main source of suspended non-algal material affecting transparency was found to be external from the tributaries rather than from internal (i.e. lake processes) sources. This study determined that over 90% of the extension of light in Dillon Reservoir was attributable to substances dissolved and suspended in the water and not absorption of light though the water. Algae were responsible for one quarter of the total extension of light, dissolved organic carbon accounted for about one quarter of the total light absorption, and that “non-algal particulate” material is responsible for 30-50 percent of the light absorption. The report concluded “The results suggest that emphasis on algae, with respect to the appearance of Lake Dillon, is warranted but perhaps is overly one-sided, and that a better balance of results might be achieved through practices that control not only phosphorus but also transport of particulate material associated with development.” This study precipitated SWQC’s construction site inspection program mentioned above.

The 2008 SWQC Annual Report on Dillon Reservoir, documented that the total phosphorus concentration during the growing season in 2008 averaged 5.4 ug/L, one of the lowest values observed for the years 1981 through 2008. The mean growing season chlorophyll a concentration was 3.8 ug/L, and the 2008 the average Secchi disk depth was 3.32 meters. The total phosphorus load to Dillon was above average for the period of record (3374 kg/y), as would be expected for a high runoff year, but the discharge weighted average was near the median value. One table in the report shows the three year rolling average of phosphorus loading since 1982; there is virtually no change in this in spite of significant growth during that period. The 2008 Annual Report provides a quantitative assessment of phytoplankton taxa. The presence of small quantities of nuisance blue green algae in 2009 should be noted. In 2009, a year of reduced SWQC monitoring frequency, the average total phosphorus concentration during the growing season was an all time low of 4.8 ug/L.



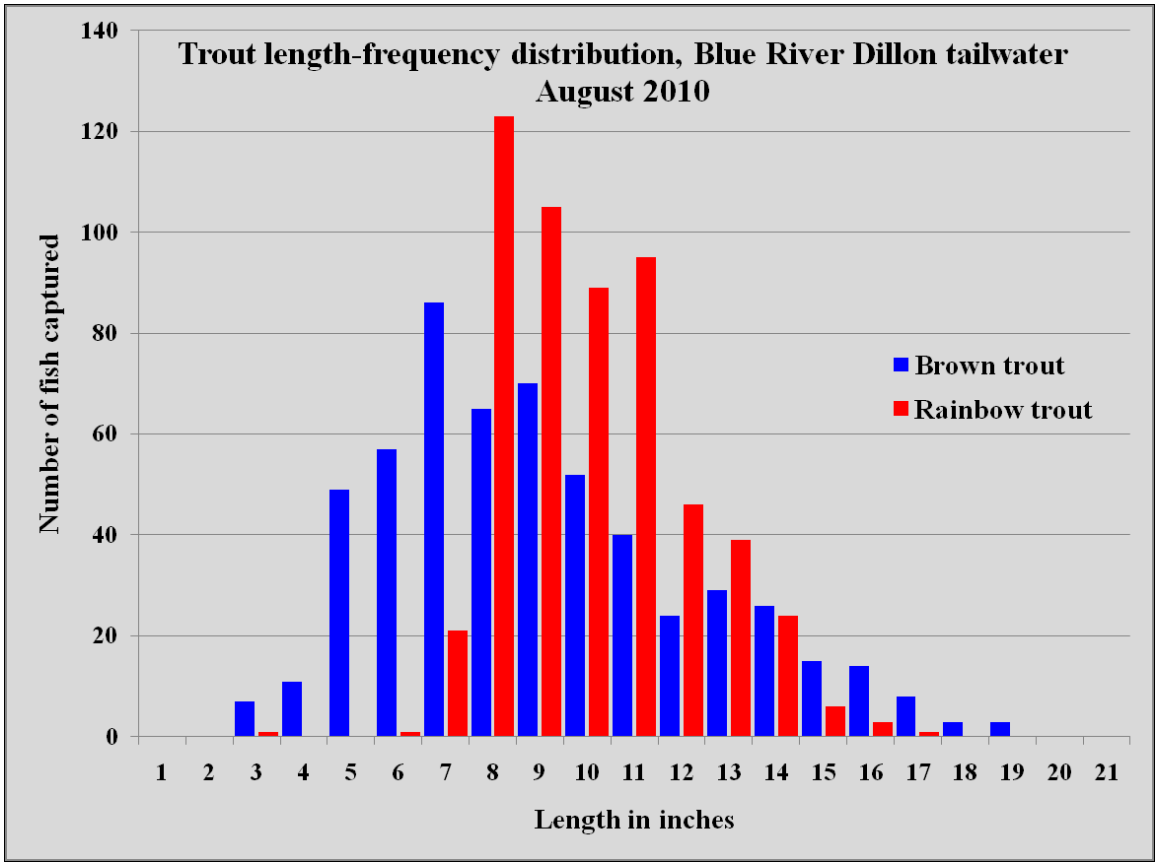
2.6 Lower Blue River (Blue River Stream Segments 16, 17, 18, 19 & 20)

The lower Blue River flows through alluvium underlain in descending order by: Pierre shale; the Cretaceous Niobrara formation; and Dakota sandstone. Sulfate concentrations measured at sites in this reach of the stream (Silverthorne to Green Mountain Reservoir) indicate some contact with these formations, either through direct contact with surface water or through ground water return flows which have been in contact with these formations. The dissolved solids concentrations did not increase in this reach of the river [USGS, 1979]. Downstream from the Dillon-Silverthorne wastewater treatment plant discharge, concentrations of total cadmium, lead, and zinc exceeded standards for aquatic life, and dissolved manganese exceeded water supply stream standards (Segment 17) [USGS, 1979]. This site is probably affected by a sand and gravel mining operation immediately upstream. However, a complete recovery was seen in trace element concentrations at the nearest downstream site (above Pass Creek). The dissolved oxygen concentrations were greater than or equal to 6.0 mg/L, the CDPHE standard for aquatic life, on 308 of 318 sample sites (Bauch and Yacob, Retrospective Analysis of Water Quality in the Blue River Watershed, Colorado, 1984 through 2007, USGS, in press).

Approximately 725 platted lots in nine un-sewered subdivisions exist adjacent to the Town of Silverthorne. Although there is no current indication of surface or ground water contamination, the potential exists, due to clayey soils, gravely soils, small lots and/or shallow ground water in these areas.

In 1977, the highest benthic organism diversity in Summit County was measured in the

lower Blue River downstream of the area where water quality recovers from the effects of mining, construction, and urban activities upstream (USGS, 1979). The Blue River from Dillon Dam to the confluence with the Colorado River below Kremmling is designated a Gold Medal fishery. The Division of Wildlife performed an assessment of the fishery in August 2010 using a raft electrofishing technique. Results of the 0.7 mile sampling effort that started just downstream of the dam indicated 83 lbs/acre of trout biomass and 13 fish over 14" per acre. This barely meets a gold medal fishery criteria. CDOW think that the very low temperature from reservoir releases results in slow growth and maturity of fish. Brown trout are self sustaining and not stocked, however rainbows are not reproducing and are stocked in large numbers.



The WQCD water quality monitoring data for the Blue River below Dillon Reservoir during the period 1979-1987 were analyzed by NWCCOG for the 1988 208 Plan. Occasional exceedances in the numeric standard for cadmium were observed. This finding was verified in the Two Forks EIS. The WQCD water quality monitoring data for the Blue River below Dillon Reservoir during the period 1988-1994 were analyzed for cadmium. Of 43 samples, there were 8 detections of cadmium with no exceedances of numeric standards. Since April of 1992 cadmium has not been reported above the detection limit.

Summit County High School no longer monitors water quality of the lower Blue River at the Silverthorne Factory Stores as part of the Division of Wildlife's River Watch Program. November 1992-January 1994 data does not include metals analyses. Dissolved oxygen concentrations range from 5 to 10 mg/L (the standard for coldwater aquatic life is

6 mg/L, and 7 mg/L when fish are spawning). Only once was dissolved oxygen observed at less than 6 mg/L.

Summit County Middle School monitors the Blue River above Bushee Creek below Silverthorne as part of the Division of Wildlife's River Watch Program. Data available is from November 1992 through February 1994. Dissolved oxygen (7 - 13 mg/L) and pH values (7.7 - 8.4) are excellent for aquatic life protection. Hardness values ranged from 76 - 162, with an average of 100. Monitoring occurred between 1992 and 1998. Total cadmium was detected in 10 of 40 samples, but levels never exceeded 0.39 ug/L total cadmium. The standard for cadmium at 100 hardness is 2.24 ug/L dissolved cadmium.

In 1999 the Summit Water Quality Committee received the results of the special study titled "Effects of Urbanization on Water Quality in the vicinity of Silverthorne, Summit County, Colorado". The study was designed to provide representative information on potential water quality impairment caused by development in and near the Town. The results indicated that development caused mobilization of suspended solids, soluble phosphorus, and particulate phosphorus. There is also some mobilization of ammonia, but this is not very significant. Mobilization of heavy metals in soluble form is minor or undetectable

In 2003 the Town of Silverthorne and others implemented a stream restoration project in the heavily fished area downstream of Dillon Dam with the purpose of addressing flow alterations and improving habitat, see: http://wildfish.montana.edu/Cases/browse_details.asp?ProjectID=42.

Monitoring (1985 -1989) conducted by the Summit Water Quality Committee (SWQC) indicates annual total phosphorus concentrations ranging from 0.011 to 0.016 mg/L on the Blue River just above Green Mountain Reservoir. In 1993, phosphorus loading to Green Mountain Reservoir was the highest since 1985, although point source loading was the lowest on record. The Two Forks EIS reported no exceedances for the metals cadmium, copper, lead or zinc on the Blue River above Green Mountain Reservoir.

West Grand High School monitors water quality at two stations on the Blue River below Green Mountain Reservoir: Knorr Ranch road bridge; and Trough Road. Total metals data is collected at these stations. Dissolved oxygen and pH at these stations appears good for aquatic life. Total cadmium was occasionally detected, with the highest value of 0.33 ug/L being observed. Total zinc was also regularly detected, with values ranging from 0 to 78 ug/L between 1992 and 2000. Assuming an average hardness of 100, the chronic dissolved zinc standard would be 117 ug/L.

Spruce Creek in the lower Blue River are on the State of Colorado 2012 Monitoring and Evaluation list for total recoverable iron*).*

2.7 Green Mountain Reservoir (Blue River Stream Segment 17)

Average growing season total phosphorus concentrations in Green Mountain Reservoir were 9.0 ug/L in 1993, just below the median values for the last ten years [SWQC Lake Dillon/Green Mountain Reservoir Monitoring Report, 1993]. Average growing season chlorophyll concentrations in 1993 were 3.6 ug/L, higher than the median value over the last ten years of 3.0 ug/L. The hydraulic residence time in 1993 (0.37 years) was also

above the ten-year median value of 0.35 years. Based on the seasonal chlorophyll and Secchi disk depth (3.4 meters in 1993, ten year median 3.2 meters), Green Mountain Reservoir can be classified as a mesotrophic reservoir.

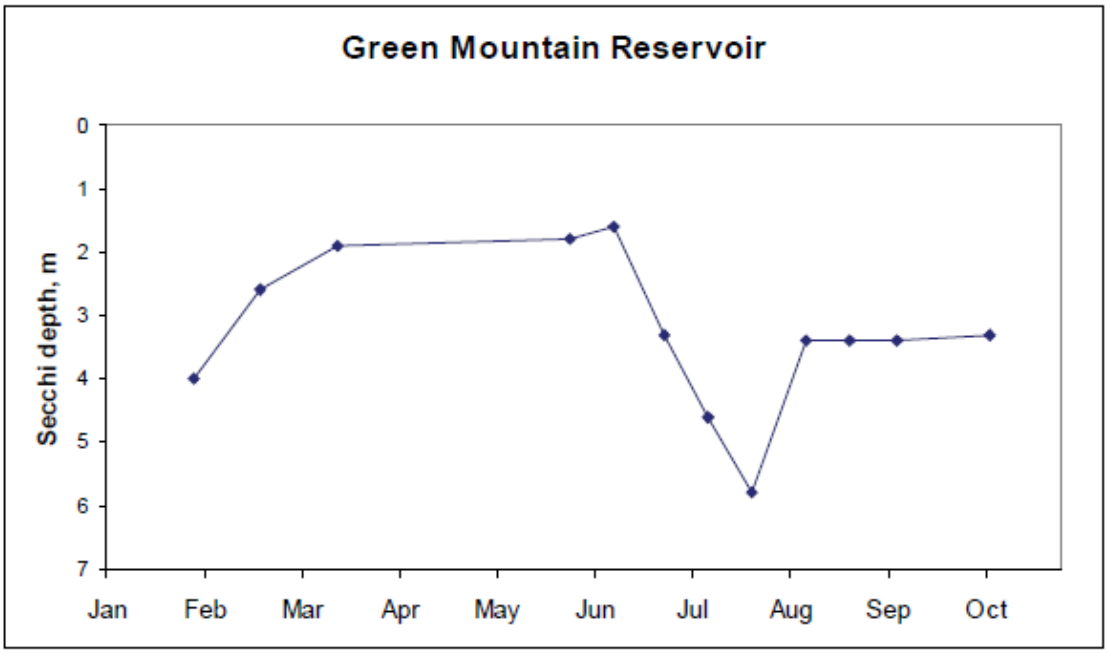
In 1999 the hydraulic residence time in Green Mountain Reservoir was 0.29 years. The growing season average phosphorus concentration in the reservoir was 7.6 ug/L and the growing season annual average chlorophyll concentration was 2.2 ug/L. The Secchi disk depth average for 1999 was 4.4 meters, which was the highest annual average (a good thing) ever observed by the Summit Water Quality Committee's Green Mountain Reservoir sampling effort. More recent trophic status conclusions are discussed below.

Green Mountain Reservoir underwent an analysis of the lake's trophic status and sources of nutrient enrichment study that began in 1987. This study, sponsored by the SWQC, the Colorado River Water Conservation District and the Denver Water Department was completed in 1990 and documented the trophic state indicators and nutrient sources in relation to land use. Results indicated that phosphorus concentrations in the Green Mountain Reservoir watershed are higher than the Dillon Reservoir watershed. Otter Creek, a tributary to the Reservoir has been identified as carrying sediment and elevated phosphorus loads that come from natural geological sources. The study found that 1/4 of the phosphorus reaching Green Mountain Reservoir comes from Dillon Reservoir, 1/4 from background runoff, 1/4 from agricultural land use, and the final 1/4 from all other sources combined. Point sources account for approximately 2%, and septic systems account for approximately 1/8 of the total load (based on work done on septic systems upstream of Dillon Reservoir).
Hydraulic retention time was found to be the most significant controlling factor in the growth of algae in the Reservoir. Full expression of algal growth in the reservoir does not occur until the hydraulic residence time increases to 0.8 years, and the average hydraulic residence time under present operating conditions is about 1/3 of this (0.27 years). The factor most responsible for algal concentrations, management of reservoir operations, is not subject to water quality control regulations. According to statute (CRS 25-8-104-1), "no provision of this article shall be interpreted so as to supersede, abrogate, or impair rights to divert water and apply water to beneficial uses . . .." Thus numeric standards for nutrients cannot, by law, impair the beneficial uses of the reservoir. Nutrient standards are meaningless without recognition of the operational characteristics of the reservoir. The residence time and draw down of Green Mountain Reservoir, as compared to Dillon Reservoir, limit the phytoplankton response to a greater extent than nutrient loading. It is not recommended that nutrient standards be applied to Green Mountain Reservoir unless it can be worked out to optimize water quality issues through operational management without impairing water rights.

During 2007, approximately 69 percent of the nitrate flowing into Green Mountain Reservoir came from Dillon Reservoir outflow; 29 percent from the Blue River, non-Straight Creek tributaries, and effluent between the two reservoirs, and two percent from Straight Creek. Total phosphorous concentrations ranged between 0.002 and 0.042 mg/L for 1984-2007 (Bauch and Yacob, Retrospective Analysis of Water Quality in the Blue River Watershed, Colorado, 1984 through 2007, USGS, in press).

The 2009 SWQC Annual Report on Green Mountain, indicated that the hydraulic residence time was 0.24 years, as compared to Dillon Reservoir in 2009 which was 0.99 years (which was less than the 1.11 year median). 140,364 a.f. flowed out of the Green Mountain Reservoir spillway, the second highest flow between 1981 and 2009. The

average total phosphorus concentration during the growing season in 2009 was 8.3 ug/L, as compared to Dillon Reservoir which was 4.9 ug/L. Concentrations of nitrate were never depleted in Green Mountain Reservoir. The mean growing season chlorophyll a concentration was 1.5 ug/L, and the 2009 the average Secchi disk depth during this period was 3.98 meters, see graph below. In 2009 the total phosphorus load to Green Mountain Reservoir was 8616 kg/y which is within the normal range for the reservoir. Sources of this phosphorus were Straight Creek (3.3%), JSA effluent (0.97%), Dillon Reservoir (20.9%), the watershed between Dillon and Green Mountain Reservoirs (74.8%). Concentrations of phosphorus flowing into Green Mountain were approximately 11 ug/L which is about 50% higher than that going into Dillon. The 2009 Annual Report provides a quantitative assessment of phytoplankton taxa.



2.8 Watershed Instream Flows

The Colorado Water Conservation Board (CWCB) has instream flow filings in the Blue River watershed. Colorado statute (CRS 37-92-102(3) recognizes that preserving the natural environment to a reasonable degree, through the protection of instream flows and maintenance of natural lake levels in natural lakes is a beneficial use of water. Under the same statute, the Colorado Water Conservation Board is declared the exclusive agent authorized to appropriate water rights for the purpose of preserving the natural environment, although water rights can be donated to the CWCB for instream flow protection. It is also stated that the acquisition of the water rights to protect minimum instream flows has to be made within the context of existing water rights appropriation regulations. Minimum instream flows are therefore subject to appropriation dates, and the CWCB can only call out water rights junior to their own for maintenance of those flows. Most of the appropriation dates in the Blue River watershed are between 1977 and 1989.

Information to access minimum instream flow information, including the stream name,

length of segment, amount of flow and appropriation date for all CWCB instream flow appropriations in the watershed can be found at http://cwcb.state.co.us/technical-resources/instream-flow-water-rights-database/Pages/main.aspx.

The CWCB appropriation flows, determined in consultation with the Division of Wildlife and the Division of Parks and Outdoor Recreation, are the flows necessary "to preserve the natural environment to a reasonable degree" (CRS 37-92-102(3)). The fact that the CWCB has filings for these instream flows does not ensure that stream flows will always exceed the minimum necessary to protect the natural environment, as the water rights associated with these flows have relatively junior appropriation dates. Exercise of water rights that are senior in date to the CWCB instream flow appropriation dates can result in stream flows lower than the CWCB appropriation amount.

3.0 WATER QUALITY ISSUES

3.1 Point Source Issues

Point source (discrete, identifiable water pollutant discharges) problems in the Blue River watershed were extensively evaluated by the Colorado Department of Health in 1974 as part of the Blue River Basin 303(e) Plan. Point source treatment needs, consolidation of wastewater treatment facilities, waste load allocations, treatment alternatives and other related matters were addressed in the basin plan. The principal problems included the needs for phosphorus removal capability at wastewater treatment facilities to protect Dillon and Green Mountain Reservoirs from accelerated eutrophication and the feasible extent of providing service to relatively rural parts of the basin. Since the adoption of the basin plan in 1974 and the 1978 version of the 208 Plan, the development of wastewater treatment facilities has generally proceeded in accordance with its recommendations. Facility plans under Section 201 of the Clean Water Act have defined the precise treatment mechanisms and locations for wastewater treatment and have implemented the recommendations of both the 208 and basin plans.

3.1.1 Municipal Discharges

The larger (over 10,000 gallon per day) point source discharges in the Blue River watershed are municipal or domestic wastewater treatment plants, listed in Table B-2 along with their Colorado Discharge Permit System number and their hydraulic capacity.

Table B-2. Blue River Watershed Domestic Wastewater Treatment Facilities

CDPS #	Facility Name	Responsible Party	Hydraulic capacity MGD
COX-621035	South Blue River	Upper Blue SD	0.194
CO-0045420	Iowa Hill	Upper Blue SD	1.500
CO-0021539	Farmers Korner	Upper Blue SD	3.0
COX-042731	Vail Pass	CDOT	0.012
CO-0021598	Copper Mountain	Copper Mt. Consol. Metro D	1.1

CO-0020451	Frisco	Frisco SD	2.0
CO-0023876	Arapaho Basin	Dundee Reality	0.035
COX-622013	Keystone Summit House	Keystone Resorts	0.021
CO-0029955	Snake River	Summit County	2.6
CO-0020826	Blue River	Silverthorne/Dillon Joint Sewer Authority	4.0

A more detailed list of the wastewater treatment facilities in NWCCOG's Region XII is included in Appendix 3. The sanitation districts in Summit County have agreements with Climax Molybdenum Company for a joint biosolids disposal program at Climax Mine.

Snake River Wastewater Treatment Plant

The Snake River Wastewater Treatment Plant discharges to Soda Creek, directly upstream of Dillon Reservoir. The plant is an activated sludge facility with tertiary treatment for phosphorus removal. A $17 Million expansion was completed in 2001-2002 to increase capacity to 2.6 MGD and serve the needs of the service area's projected build-out equivalent population of 10,400 taps. During the expansion new antidegradation rules were passed, as a result the hydraulic capacity of the facility used in the current permit was 1.5 MGD and the organic capacity of the facility was 3,130 pounds of BOD per day, and amended in March, 2006 to 2.6 MGD and 6506 lbs. BOD per day. A facility plan has been developed for the Snake River plant which includes the possibility of discharging to the Roberts Tunnel a portion of plant effluent containing no more than Summit County's annual phosphorus allocation to Chatfield Reservoir. The current permit expired January 31, 2008, and has been extended until permit renewal is issued by CDPHE.

Upper Blue Sanitation District

Farmer's Korner Wastewater Reclamation Facility
The main Upper Blue Sanitation District wastewater treatment facility located at Farmer's Korner, adjacent to Dillon Reservoir discharges to a diversion channel from the Blue River which discharges to Dillon Reservoir. The wastewater treatment plant is a 3.0 MGD activated sludge facility with tertiary treatment for the removal of phosphorus. The organic capacity of the Farmer's Korner facility is rated at 8,760 pounds of BOD per day. The discharge permit for this facility expires July 31, 2015. The treatment facility is recently expanded and is a 5.0 MGD treatment facility with a new permit issued in 2012.

Iowa Hill Wastewater Reclamation Facility

Another Upper Blue Sanitation District plant named the Iowa Hill facility with an 1.5 MGD flow capacity was permitted in 1999. The organic capacity of the facility is rated at 3,753 pounds of BOD per day. The facility includes: an influent pump station, rotary bar screen and grit removal, activated sludge, biological aerated filters, floculation/ sedimentation, final filtration, chlorine disinfection and dechlorination. The facility provides ammonia and phosphorus removal. The facility was designed with an ultimate

hydraulic capacity of 3.0 MGD, however it will likely be eliminated and influent directed to the Farmers Korner plant. The discharge permit expires July 31, 2013.

South Blue River Wastewater Reclamation Facility
A new South Blue River Plant (rotating biological contactor) was constructed in 1995 and is now owned and operated by the Upper Blue Sanitation District. The facility's hydraulic capacity is rated at 0.194 MGD and organic capacity is rated at 325 pounds of BOD per day. The plant currently treats an average of 35,000 gallons of sewage per day. The new plant is now treating the wastewater flow from Quandry Condominiums, Skier's Edge, Valley of the Blue, ad McDill Placer. The discharge permit for this facility expires April 30, 2012,

In the January 8, 2001 Dillon Reservoir Control Regulation Rulemaking Hearing, Upper Blue Sanitation District's phosphorus wasteload allocations for each facility were consolidated into one wasteload allocation. Instead of seven individual allocations, one allocation of 708.8 pounds of phosphorus per year for the District is shown in the regulation (5-CCR 1002-71). This change was made at the request of the District and the Summit Water Quality Committee to provide streamlined facility consolidation, flexibility in operation, and improved reporting to the Division.

Vail Pass Rest Area

The Vail Pass Rest Area is served by a 12,000 GPD sequencing batch reactor facility with chemical/physical phosphorus removal and discharging to two leach fields. The facility recently installed an Advance Water Treatment filter with chemical treatment prior to the discharge point. The organic capacity of the facility is rated at 52 pound of BOD per day. The facility is owned and operated by the Colorado Department of Transportation. The permit for this facility expires December 2003. While CDOT experienced staff operation and maintenance problems with this facility in the past, the last 15 years the it has been fully staffed with two full time operators and one contract operator to cover absences of the full time staff. The discharge permit was reissued on September 25, 2008 and expires on April 30, 2012.

Copper Mountain Consolidated Metropolitan District

Copper Mountain Consolidated Metropolitan District wastewater treatment plant discharges to Tenmile Creek, just above the confluence with West Tenmile Creek. The plant is a 1.1 MGD activated sludge facility with tertiary treatment for phosphorus and ammonia removal. The discharge permit expires July 31, 2011.

Frisco Sanitation District

The Frisco Sanitation District wastewater treatment plant discharges to Dillon Reservoir at Miner's Creek. The plant is an activated sludge facility with tertiary treatment for the removal of phosphorus. Frisco expanded their plant capacity in 1994 at a cost of 5.4 million dollars. Current hydrologic capacity is rated at 1.7 MGD, which will serve 4,000 taps, however anticipating a new discharge permit in 2011, the addition of flow equalization for the tertiary units will increase plant capacity to 2.0 MGD to serve 6,060 taps. The organic capacity of the facility is currently rated at 2,500 pounds of BOD per day. Centrifuges were added to the treatment plant in 2001 for sludge disposal.

Additions to the treatment plant over the last ten years included centrifuges for sludge dewatering, additional blower and diffuser capacity in the aeration basins and digester, covered flow equalization basins for the tertiary treatment units and Ultra Violet disinfection.

Silverthorne/Dillon Joint Sewer Authority

The Silverthorne/Dillon Joint Sewer Authority (JSA) wastewater treatment plant is a 4.0MGD facility with a conventional activated sludge process, tertiary treatment for phosphorus, ammonia and aerobic digestion of biosolids. The organic capacity of the facility at 4.0MGD is rated at 10,000 pounds of BOD per day. The JSA provides wastewater treatment and transmission services for the Towns of Silverthorne and Dillon, the Dillon Valley District, Buffalo Mountain Metropolitan District and the Mesa Cortina Water and Sanitation District. The Silverthorne/Dillon wastewater treatment plant discharges to the lower Blue River at the north end of the Town of Silverthorne. The discharge permit expires July 31, 2011.

The ski areas in the Blue River watershed either have their own wastewater treatment plants (Arapaho Basin, Keystone Summit House and Copper Mountain), or are connected to a municipal wastewater treatment facility (Breckenridge and Keystone).

3.1.2 Population Statistics and Projections

Population projections for the county and the municipalities in the Blue River watershed are listed in Table B-3. Summit County's permanent population in 1980 was 8,848, in 1990 it was 12,881, and in 2000 it was 23,548. In 2009, the permanent population of Summit County was 29,225 according to the State Demography Office. The percent change between 1980 and 1990 was 45.5% and between 1990 and 2000 it was 82.8%.

Table B-3. Summit County Population Estimates and Projections

Permanent Population

Entity	1980	1990	2000	2000 projected[2]	2009	2020
Summit County	8,848	12,881	23,548	15,799	29,225[3]	38,593[5]
Blue River	230	440	685	551	733	n/a
Breckenridge	818	1,285	2,408	1,626	3,934	n/a
Dillon	337	553	802	690	853	n/a
Frisco	1,221	1,601	2,443	2,028	3,005	n/a
Montezuma	17	60	42	71	53	n/a
Silverthorne	989	1,768	3,196	2,298	4,263[4]	n/a

[2]: 1996 NWCCOG 208 Plan based on State Demographer's 1994 projections
[3]: Population projections: State Department of Local Affairs, State Demographers Office, October 2009 projections
[4]: Unicorporated areas of Summit County add another estimated 16,384 permanent residents to the 2009 estimates.
[5]: The State Demographer and Summit County do not currently project any municipal population forecasts for 2020.

Table B-3 (continued). Summit County Population Statistics by Area*

Area	1990			2000			2010		
	Resident	2nd home	Peak pop.	Resident	2nd home	Peak pop	Resident	2nd home	Peak pop
County	13,123	58,622	88,750	20,946	80,450	121,496	29,626	116,789	167,332
Snake	1,875	9,487	18,053	2,939	14,862	24,801	5,209	20,788	32,101
U Blue	4,140	22,218	30,977	6,437	29,869	42,306	5,029	44,497	59,819
Copper	151	3,810	8,549	229	4,590	9,819	346	6,540	12,549
Frisco	2,023	5,686	7,962	3,535	9.078	13,113	4,907	12,847	18,304
S/D	4,638	16,473	21,956	7,360	20,829	29,689	10,190	30,248	41,988
L Blue	296	938	1,253	446	1,222	1,768	577	1,869	2,571

*: Information on 2nd home and peak populations from Summit County Planning Department, Table A-13, Jerry Vest, 2000, this data is no longer generated by Summit County.

As growth continues in the watershed, water diversions will increase, leading to lower stream flows and increased water consumption. When combined with other in-basin uses and transmountain diversions stream flows approaching the CWCB minimum instream flows will occur on a more frequent basis. Augmentation plans for maintaining minimum stream flows will need to be critically examined by the State Engineer's Office and the CWCB.

As future wastewater treatment plant expansions are considered, it is critical that the water and sanitation districts consider the effects of increased diversion on instream flows and the effects of movement of return flows. Reuse of wastewater should be examined as one method of reducing stream diversions.

3.1.3 Industrial Discharges

Industrial discharges in the Blue River watershed include: construction dewatering activities throughout the watershed, stormwater permits for construction activities throughout the watershed, Climax Mine discharge to Tenmile Creek and gravel mining activities along the upper and lower Blue River. Other than Climax Mine, these activities have, for the most part, small quantities of discharge, but cumulatively are significant. Occasionally these discharges affect water quality, but usually these effects are temporary in nature. The greatest concern with these discharges is the cumulative impact (especially with respect to sediment) these discharges have on the Blue River.

3.1.4 Point Source Issues - Summary

In summary, the current point source water quality issues in the Blue River watershed are:

Nutrient enrichment due to both point and (primarily) non point source contributions of phosphorus to Dillon and Green Mountain Reservoirs with potential to cause excessive algal growth. Although the point source contribution of phosphorus is regulated to the maximum extent feasible with advanced waste water treatment, increases in phosphorus loading is expected as a result of future growth. Maintaining phosphorus loading to Dillon Reservoir at the levels specified in the Dillon Control Regulation (5 CCR 1002-71)

requires a coordinated effort of point and nonpoint source control.

Continuing to avoid ammonia toxicity problems in the Blue River. Current levels of wastewater treatment are adequate to meet existing water quality standards, but decreased levels of stream flows due to upstream water development projects may require higher levels of treatment to maintain existing water quality in the Blue River. Significant reductions in annual average stream flow will result in corresponding increases in pollutant concentrations downstream of point source discharges. A pumpback project between Dillon Reservoir and the Town of Breckenridge is being evaluated as one means of protecting these flows and associated dilutions.

Instream depletions are becoming greater. Both diverters and dischargers can help to alleviate the problem through water conservation and wastewater reuse programs. Pump back systems and satellite wastewater treatment plants operated by the major sanitation districts are other methods which should be explored to alleviate instream flow depletions.

Elevated metal and sulfate levels in Tenmile Creek, which result, in part, from the Climax mine.

Gravel mining operations adjacent to the Blue River have, upon occasion, had releases of significant suspended and dissolved solids. Operations at these facilities are beginning to wrap up and these operations are being converted to other land uses including stream restoration. .

Nutrient criteria currently (2011) being proposed by CDPHE will potentially have a significant financial impact on dischargers in the watershed. Identified instream algae problems are mostly located downstream of Green Mountain Reservoir and are related to the noxious didymo species (http://en.wikipedia.org/wiki/Didymosphenia_geminata) which thrives in nutrient poor waters, rather than problems with nutrient enrichment,

3.2 Point Source Recommendations

Policy 1 - Water Quality; Policy 2 - Water Use and Development; Policy 4 - Domestic, Industrial and Municipal Wastes; and Policy 6 - Management System Recommendations; should be implemented by the appropriate local agencies in the Blue River watershed, in order to address the point source issues listed in Section 3.1.3.

As future wastewater treatment plant expansions are considered, it is critical that the water and sanitation districts consider the effects of increased diversion on instream flows.

The antidegradation rule should be used appropriately by the Water Quality Control Division prior to triennial review of basin water quality standards to evaluate the extent of potential changes in water quality.

Reuse of wastewater should be examined as one method of reducing instream flow diversions.

The County should examine methods for alleviating the ground water situation (lowering

of the ground water table) in the Upper Blue watershed, such as rezoning, and requiring water conservation and the use of native plant landscaping.

The County should examine opportunities to connect homes in the un-sewered subdivisions adjacent to the town boundary to the Silverthorne/Dillon Joint Sewer Authority wastewater facility. The cost of connection has been estimated at $15,000 per lot for water and $20,000 for sewer service [Letter to South Forty Property owners from Rick Pocius, County Engineer, June 4,1999].

3.3 Nonpoint Source Issues

The major nonpoint source water quality issues in streams and lakes in the Blue River watershed include: the effects of both existing and inactive mining activities; urban and construction activities (including septic systems); agricultural activities (specifically silvicultural), and hydrologic modifications.

3.3.1 Mining Impacts

Excessive trace element concentrations are found in the Upper Blue, the Snake River and Tenmile Creek as a result of drainage from historical mining areas. Activities are currently underway in the Snake River basin, as previously discussed in section 2.2 and in French Gulch in section 2.3 to decrease water quality impacts from mines in these areas. Climax Mine is actively reclaiming the mine site and water quality downstream of the mine is improving, however there are numerous "orphan sites" located on federal lands, which continue to impact water quality in Tenmile Creek. Additionally, the expected reopening of the Climax mine and mill operations may have an effect on water quality.

Additionally, hydrologic modification impacts can result from mining activities. An example of this is the Blue River between the confluence of Swan River and Breckenridge. Historical use of mechanical dredge boats for mining placer gold has resulted in the loss of surface water flows during low stream flow periods, loss of channel stability, and loss of aquatic and riparian habitat. Although not a direct impact to water quality, this activity has resulted in significant negative impact to the classified aquatic life beneficial use.

3.3.2 Urban and Construction Activities

Relatively high (compared with background) nutrient loads are found in the tributaries to Dillon and Green Mountain Reservoirs. Maintaining phosphorus loading to Dillon Reservoir at 1982 levels will require a coordinated effort of point and non point source control. Actions taken to date to control these sources include locally adopted regulations for construction activities and stream setbacks. In 1993 the Summit Board of County Commissioners passed a resolution approving a Water Quality Mitigation Plan. In 1994 the SWQC began work on improvements to the phosphorus trading procedures that were originally approved by the Water Quality Control Commission in 1987. These were modified into “Trading Guidelines” in 2010. In addition, a number of water quality projects for the control of runoff from urban areas have been implemented in Summit

County in an effort to reduce nutrient loads. Projects in Breckenridge, Dillon, and Frisco include underground vaults and groundwater infiltration to trap sediment and reduce phosphorus loads to Dillon Reservoir. SWQC focused on control of sediment from construction sites through an inspection/education program through most of the construction boom cycle starting in 1998.The project has received substantial local public support and is being used in 2002 as a model for other watersheds., but was discontinued in 2009 as construction slowed down significantly.

The expanded use of septic systems can increase nutrient loading. Documented water quality problems from septic systems include high levels of bacteria in private and public water supplies and elevated levels of nutrients [Septic Tank System Effects on Ground Water Quality, Canter and Knox, 1985; SWQC An Evaluation of Methods to Control Phosphorus Contributions to Lake Dillon From Onsite Sewage Disposal Systems, 1988]. Regulation of septic systems is performed by Summit County utilizing state and local criteria. The requirements for installation of septic systems are currently being rewritten to comply with new state guidelines and County interests. In Summit County, the Dillon Reservoir Clean Lakes Study and subsequent special studies have documented the contribution of nutrients from areas served by septic systems And other sources. Several notable projects have been undertaken in the Ten Mile and Snake drainages to convert old septic systems to central sewer with advanced phosphorus removal This follows a thorough review of existing literature where it was determined that the most cost effective approach to controlling phosphorus from septic systems is by targeting systems which perform poorly and correcting those systems, rather than requiring more sophisticated designs on new systems being installed. Summit County Environmental Health is now requiring inspection of onsite systems when a home is sold in an effort to identify poorly performing systems. Upper Blue Sanitation District has consolidated several older small wastewater facilities into the South Blue WWTP and installed main lines in anticipation of conversion of older septic systems to central sewer near the Town of Blue River.

A study was sponsored over two years by the Summit Water Quality Committee entitled "The Use of Nitrogen Stable Isotope Signature for Nitrate as an Indication of contamination in Well Water Subject to Septic System Influences in Summit County, Colorado". This report (2000) summarizes the findings of the nitrogen isotope concentrations and nitrate concentrations in wells from three areas of Summit County that are served by residential septic systems. Overall, the results indicate that all of the wells show some proportion of nitrogen derived from septic system effluent, with proportions varying from 30% to 100%.
Summit County's Environmental Health Department has tested private drinking wells since 1994 in response to the Board of County Commissioners adoption of the Summit County Water Quality Mitigation Plan, which placed significant responsibility for man-made nonpoint source phosphorus loading to Dillon Reservoir on septic systems. The Department focused on total coliform and nitrate as parameters for sampling, as there are no drinking water standards for phosphorus and nitrate and bacteria are known to move more readily than phosphorus through soils under certain conditions. Sampling has been conducted on both a "shotgun" approach and in more focused efforts (subdivision level). Several areas have been identified with what the County would consider possible emergent drinking water quality issues related to ISDS, but much more intensive study is necessary to confirm this relationship. Almost 1,200 unique wells have been sampled between December 1994 and March 2001, with 8.2% of the

wells having positive bacterial samples (this includes repeat samples). Of 2,370 well nitrate samples, 83.9% were considered to be at background levels (below 2 mg/l nitrate), 16.2% of the total nitrate samples from drinking water wells were considered above background concentrations. 0.5% of the samples were above the 10 mg/L drinking water standard. Subdivisions of the county that had relatively high incidences of bacteria detections and above background nitrate concentrations included Ten Mile Vista, Frisco Terrace, Lakeview Meadows, and 39 Degrees North.

3.3.3 Hydrologic Modifications

Water diversions reduce instream flows. Both trans-basin and in-basin diversions impact water quality in those segments in which the water is lacking. Trans-basin diversions, which often occur high in the watershed, reduce flows below their point of diversion, without a point of return in the basin, thus being 100% consumptive in the basin of origin. In-basin diversions are generally on the order of 10-50% consumptive with the majority of the wastewater returned to the stream at some point downstream.

3.3.3.1 Hydrologic Modifications Associated with Trans-basin Diversions

Increased trans-basin diversions occurring above Dillon Dam would increase the average concentration of pollutants in the lower Blue River through the reduction of dilution flows. The average virgin flows for the Blue River, 1958-1982, were calculated to total 349,059 acre feet per year for the entire watershed (Summit County Small Reservoir Feasibility Study, September 1989). Denver Water's Draft Moffat EIS for the Moffat Collection system uses their PACSM model to simulate stream flows and reservoir releases. It documents current average annual Roberts Tunnel diversions as 69,676 af , whereas at full use of the existing system it would be 99,939 a.f., an increase in diversion of 39% on average. Releases from Dillon Reservoir would decrease from 124,392 a.f. to 99,668 or a 22% reduction on average. Green Mountain Reservoir releases would decrease by about 10% from 284,276 a.f. to 256,192 a.f on average.

Trans-basin diversions could divert 2/3's of the virgin yield of the Blue River above Dillon Reservoir through the existing Blue River system. Table B-4 lists the current trans-basin diversions which take water out of the Blue River, the amount diverted in the 2009 water year and the ten-year average.

Table B-4. Blue River Watershed Trans-basin Diversions

Diversion	Principal owner	Quantity (acre-feet)	
		2009	10-year avg
Roberts Tunnel	Denver Water Board	54,538	84,066.2
Hoosier Tunnel	Colorado Springs/Aurora	15,205	9,922.5
Vidler Tunnel	Vidler Water Company	1,289	614.7
Straight Creek Tunnel	Golden, CDOT	192.5	263
Boreas Pass Ditch	Englewood	212	138.4

In 2009, 71,436.5 acre-feet of water were diverted to the eastern slope from the Blue River watershed [2009 Annual Report, Division 5 Water Resources]. To put this in perspective, in the 2000 water year 150,576 acre-feet of water flowed past the USGS

gage 0.3 miles below Green Mountain dam [USGS, 2000 Water Resources Data, Colorado Volume 2]. The trans-basin water diversions, therefore account for approximately 40% of the total stream flow in the Blue River watershed.

Existing water development projects have had an effect on the water quality and Colorado River salinity. Diversion of snow melt high in the basins with very low salinity results in less dilution of downstream salinity inputs.

Wastewater treatment needs in the area have been affected by the creation of reservoirs, requiring the provision of advanced wastewater treatment for phosphorus removal to prevent eutrophication.

Existing wastewater treatment levels have been based on meeting water quality standards under existing hydrologic conditions. Changes in the operations of the reservoirs to increase system yields, including reduction in residence times, second fill rights, and routing of new sources of nutrients to Dillon and Green Mountain Reservoirs, have the potential to modify future wastewater treatment requirements to maintain the same level of water quality. The concern is that discharge permit limits can be made more stringent to meet instream water quality standards, when actual discharge quantities have not changed. For example, plants discharging to Dillon Reservoir could have significantly more stringent permit limits, and thus increased treatment costs, as a result of changes in Dillon Reservoir operations. This was made very obvious when the Breckenridge Sanitation District conducted a mixing zone study in the spring of 1995 under low reservoir elevations and in the fall of 1995 when the reservoir was full [Breckenridge Sanitation District, personal communication, 1995].

Wastewater treatment levels for the Silverthorne/Dillon treatment plant downstream of Dillon Reservoir may also be affected by changes in the operational hydrology which are currently being planned. Existing treatment levels are determined, in part, by the one day in three year low flow event (1E3, used for establishing acute level discharge limits) and 30 day in three year low flow events (30E3, for establishing chronic level discharge limits). With consistently lower stream flows, average concentrations of pollutants will increase and the flow available for dilution will also decrease. Because ambient conditions are considered in effluent permit discharge limitations, more stringent permit limits could result from increased average concentrations of pollutants even though flow levels are not below the permit's low flow criteria.

The State’s antidegradation policy for streams which are not "Use Protected" requires the assimilative capacity of waters to be protected and in some cases the existing quality must be maintained unless lowering water quality is necessary to accommodate important economic or social development in the area. Plant discharge concentrations would have to decrease if stream flows decreased, in order to maintain the existing water quality, although the antidegradation policy is not applicable unless a plant expands or the permit expires.

The ability of the Blue River downstream of Dillon Reservoir to carry peak flows without channel cutting and the loss of aquatic habitat has been diminished as a result of lower flows. Channel stability impacts have occurred in the Blue River downstream of Dillon Reservoir due to channel encroachment by vegetation. This situation was improved in 2003 with the lower Blue River stream improvements described above.

Green Mountain Reservoir has the potential for increased or decreased eutrophication as a result of modified operational criteria affected by water resource development activities. Significant changes to the very short hydraulic residence time, which limits the algal concentrations, will impact the trophic status of the reservoir.

3.3.3.2 Hydrologic Modifications Associated with In-basin Diversions

In-basin diversions, although not on the scale of trans-mountain diversion, also impact water quality in the Blue River. This is especially true in the Blue River Segments 1 and 2, where water is diverted at Goose Pasture Tarn to serve the Breckenridge community and ski area, and the municipal return flows are to Dillon Reservoir. In that intervening distance are numerous pollutant sources, such as French Gulch, urban, industrial, and construction activities that impact the river. The lower stream flows diminish the stream's ability to dilute these pollutant sources. The Iowa Hill WWTF which went on line in 2000 has addressed this situation to some extent by discharging just downstream of the Town of Breckenridge. In addition a pump back project to bring water from near Dillon Reservoir to the Town of Breckenridge is currently being considered.

Hydrologic modification impacts due to snowmaking are also a significant concern. These diversions occur during the time of lowest stream flows, when the streams are least able to meet fishery flow requirements, and returns occur when least needed - during the spring runoff. Snow making is estimated to be approximately 20% consumptive by the State Engineer's Office Division Five Engineer, as part of the work done on the Clinton Reservoir agreement [Scott Fifer, Resource Engineering, personal communication, 2001]. These impacts are also discussed under recreational activities (3.3.5).

3.3.4 Agricultural Activities

Timbering activities which disturb large areas of land can produce a significant water quality impact. A study funded by the Summit Water Quality Committee examined three types of forest management practices in Summit County: control (no action); overstory removal (partial removal of timber); and clear cut (complete removal of timber). Eight sites were studied over a two-year period. The combined data show beyond reasonable doubt (better than 90% confidence) that increased phosphorus loads may result from areas subject to overstory removal and that clear cutting can increase the phosphorus load by as much as 30 times higher than background phosphorus yields. Thus clearcutting, in particular, could be a significant source of phosphorus for Dillon Reservoir. For example, a 1,000 hectare clearcut would be estimated to yield 1,200 pounds of phosphorus (the regulatory load limit to Dillon Reservoir is approximately 8,500 pounds per year based on an inflow of 212,000 acre feet).

Much of the forest in the Blue River watershed is infested by bark beetles. The full water quality ramifications of this epidemic is not well understood. Coordination on addressing the environmental and socio economic aspects in the north central mountain area is being done through the Bark Beetle Cooperative: http://www.nwc.cog.co.us/index.php/affiliated-programs/colorado-bark-beetle-cooperative/

Agricultural activities in the lower Blue River area (including cattle grazing and hay production) contribute phosphorus and nitrogen to the aquatic environment, although the significance of this contribution is undocumented in the Blue River watershed.

3.3.5 Recreational Activities

Numerous recreational activities impact water quality. These include golf courses; snow making for skiing; and activities associated with water features such as fishing, rafting, etc.

Development of new homes and associated infrastructure, secondary impacts from recreational development, can be a significant impact on water quality.

Some of the activities associated with skiing which impact water quality include: snowmaking (reduced stream-flows at low flow times), large scale soil disturbance activities during construction of ski runs, runoff from denuded slopes that are not well vegetated, increased urbanization and impervious surfaces, and habitat loss (wetland and riparian areas).

Golf courses impact water quality through fertilizer and pesticide runoff, large scale soil disturbance during construction, increased runoff, and watering practices.

Activities associated with water features can impact the riparian and aquatic community as well as water quality. Erosion from foot and vehicle traffic; increased stream bottom disturbance; introduction of nuisance species like dydimo algae, inadequate toilet facilities; and littering can all lead to water quality impacts.

3.4 Nonpoint Source Recommendations

Policy 1 - Water Quality; Policy 2 - Water Use and Development; Policy 3 - Land Use and Development; Policy 4 - Domestic, Municipal, and Industrial Wastes; and Policy 5 - Chemical Management; in Volume I should be implemented by the appropriate management agencies in the Blue River watershed to address nonpoint source issues discussed in Section 3.3.

Water conservation practices, including in-home, landscaping, and wastewater reuse need to be vigorously pursued.

Municipal and county nonpoint source water quality improvement projects should continue to be supported by local, state and federal funding.

It is recommended that the County explore more aggressive approaches to identifying problem OWS in areas adjacent to Silverthorne currently served by septic systems (excluding Ruby Ranch, because of the size of the parcels). This could include potentially requiring permits for all systems including older ones that were in place prior to current OWS requirements in order to identify noncompliant and problem systems.

The Summit Water Quality Committee should continue to monitor and evaluate water quality throughout the watershed. Green Mountain Reservoir should continue to be

monitored on a regular basis to assess water quality. This monitoring would be useful in assessing any management changes that might be contemplated.

The Snake River watershed and French Gulch mine sites should continue to be high priority remediation sites.

Collaborative efforts such as the Snake River Task Force should continue as a means to integrate water quality and water quantity planning and include consideration of negative water quality impacts of trans-basin diversions, so that constructive arrangements, such as the Clinton Reservoir agreement, can be created.

In-basin storage, or other projects designed to augment or improve instream flows, should be pursued.

Reduction of agricultural impacts in the riparian and wetland areas through the voluntary implementation of best management practices, such as riparian area fencing, intensive grazing management, and bank stabilization, could potentially improve water quality.

4.0 WATERSHED IMPROVEMENT PROJECTS

4.1 Existing Projects

4.1.1 Town of Frisco Stormwater Project

The purpose of this project was to reduce phosphorus concentrations in stormwater runoff from the Town of Frisco into Dillon Reservoir. The project consists of drop inlets, underground sedimentation vaults, and perforated pipe. Four years of monitoring have indicated phosphorus removal levels of 67 to 163 pounds of total phosphorus per year.

The Frisco phosphorus control project was constructed in a joint effort by the Town of Frisco, the Frisco Sanitation District, and the Colorado Department of Health using EPA 319 funding. EPA provided grant funds for half of the project, with the Town and the Sanitation District splitting the other half. Total cost of the project was approximately $180,000. The original project built in 1985 drains 120 acres, with a second project in 1993 draining an additional 20 acres. Additional information can be obtained by contacting the Town of Frisco.

4.1.2 Town of Dillon Stormwater Project

A drainage and water quality enhancement system was incorporated in the "Dillon Town Center Project" and constructed in 1993 and 1994. The drainage improvements included 26 inlets, 7 roof drain connections, 8 manholes, 3 sediment vaults, and various sections of perforated pipe. Total cost of the project was approximately $258,000. Phosphorus removal was an important part of the design because the project discharges to Dillon Reservoir. The project design assumes removal of 24.6 pounds of phosphorus per year, based on modeling. Monitoring for total dissolved phosphorus and particulate phosphorus will commence in 1995 and continue for three years. Additional information can be obtained by contacting the Town of Dillon.

4.1.3 Town of Breckenridge Blue River Restoration

The Town of Breckenridge has completed a three year, $3.5 million restoration project on the Blue River through the core of town. The project re-channelized and lined 2000 lineal feet of the Blue River which was dredged for gold during the early 1900s. Mining operations left the river barren of vegetation and without surface flows for seven months of the year. A liner was installed to achieve year-round surface flows in a new channel designed for 100 year flood stability, fish habitat, and public accessibility. Additional information can be obtained by contacting the Town of Breckenridge.

4.1.4 Town of Breckenridge Stormwater Quality Enhancement Project

The Town of Breckenridge spent $150,000 on storm sewer improvements within the river corridor. Thirty year old storm sewers which previously discharged directly to the river were retrofitted with sedimentation vaults and infiltration galleries to improve water quality. The vaults have a baffling system to trap larger sediments, while the infiltration galleries absorb low flows, reducing discharge to the river. Monitoring has been set up to evaluate the effectiveness of the new system. Additional information can be obtained by contacting the Town of Breckenridge.

4.1.5 Peru Creek Project

Work was begun in the Peru Creek drainage in the late 1970s. A 1979 report by the Division of Mined Land Reclamation (The Restoration of Peru Creek) found that 60% of the metals in the Peru Creek drainage could be attributed to the Pennsylvania Mine, four miles above the Snake River confluence. Work began at the Pennsylvania Mine in Peru Creek in 1985 to reduce metal loading to Peru Creek.

Since 1990 pilot-scale passive mine treatment demonstrations have been conducted in an attempt to address the extreme metals loading discharging from the portal of the abandoned mine. A demonstration Passive Mine Drainage Treatment System involving an innovative hydro-powered acid neutralization system, sludge settling pond, and sulfate reducing bacteria (SRB) treatment cells (constructed by the Volunteers for Outdoor Colorado in 1994, and consisting of three large beds filled with peat, gravel, and sand, through which the mine drainage is directed, have been constructed at the site. The system has not yet been operated due to remaining long-term liability issues, and sludge disposal concerns have yet to be resolved. It is anticipated that resolution of these issues will eventually allow the demonstration project to proceed. Additional information on this project can be obtained by contacting the Division of Minerals and Geology.

A group called the Snake River Watershed Task Force was established in 1999 and has been facilitated by the Keystone Center. The group's mission is "to improve water quality in the Snake River watershed". The objectives of the Task Force are to "obtain better information on the watershed, identify opportunities for improvement, develop criteria to prioritize projects, assist in implementation for projects that meet the Task Force's criteria, and obtain reasonable standards." This group has reviewed and provided input on numerous activities sponsored by individual groups or entities that are members of the Task Force. Studies and activities have included the USGS, EPA,

Summit County, the Institute for Arctic and Alpine Research (University of Colorado Boulder), and the Water Quality Control Division. There has also been synoptic sampling by the USGS throughout the watershed, and University of Colorado professor Dianne McKnight's students' have done similar work.

EPA and several State agencies are cooperating with Summit County to open up the Pennsylvania Mine in 2011 to evaluate sources of water into the mine and opportunities to close the mine as a source of pollutants to Peru Creek and the Snake River. In addition, NWCCOG received a 319 grant to help fund several small water quality improvement projects to be implemented by Division of Reclamation and Mine Safety in the Cinnamon Gulch drainage adjacent to the Pennsylvania Mine.

4.1.6 Division of Minerals and Geology French Gulch Project

The French Gulch project is located on French Gulch two miles above its confluence with the Blue River near Breckenridge. Since 1989, the Wellington-Oro Mine and mill complex has been studied to characterize the heavy metals loading to French Gulch and the Blue River associated with historic lead-zinc mining activity. Several sources of metals have been identified at the site, including mine and mill wastes sitting in the water table, storm runoff, as well as the mine pool discharge through faults and fractures above shallow areas of the underground workings. Due to the complexity of the site and projected high costs of remediation, the site has been withdrawn as a nonpoint source remediation proposal. Additional information can be obtained by contacting the Summit Water Quality Committee, the Northwest Colorado Council of Governments, or the Division of Minerals and Geology.

Currently Summit County and the Town of Breckenridge are exploring the possibility of purchasing all of the B&B Mine's lands for open space preservation purposes, which includes the Wellington-Oro complex. An Engineering Evaluation/Cost Analysis for the clean-up of the Wellington-Oro Mine Pool is expected to be completed by March of 2002. This document will identify the appropriate response actions and remedial objectives for the site. Discussions through the French Gulch Remediation Opportunities Group (FROG), have focused on a goal of a reproducing brown trout fishery in the Blue River below the confluence of French Gulch. The Division of Wildlife (John Woodling, personal communication, January 2000) has suggesting for a goal of this nature, that a site-specific stream standard of 225 ug/L of zinc would be an appropriate target.

4.1.7 Summit Water Quality Committee Straight Creek Sediment Investigation Project

In 1992 the Summit Water Quality Committee was awarded a $20,000 EPA grant for the identification of sources of sediment to Straight Creek and quantity loads from these sources which would result in acceptable stream conditions. The work was carried out in 1993, and resulted in identification of four sources of sediment and a recommendation for appropriate physical and biological indices to evaluate stream recovery. Additional information can be obtained by contacting the Summit Water Quality Committee.

The Summit Water Quality Committee continues to coordinate the monitoring of physical and biological monitoring efforts associated with the development of a TMDL for Straight

Creek, which was approved by EPA in July of 2000. (See next project for description of TMDL goals)

4.1.8 CDOT Straight Creek Sediment Retention Project

Stormwater runoff containing sand and sediment from winter highway maintenance and cut and fill slope erosion along I-70 has impacted Straight Creek. The Colorado Department of Transportation (CDOT) has undertaken many activities to reduce the loadings to Straight Creek. Some of these activities include: construction of small silt fences in the cut-slope ditch (a 319 funded EPA project); collection of sand material through sweeping and cleaning around guard rails; completion of an erosion control project and planned 1995 construction of a maintenance access road to facilitate sediment basin cleanout. The construction costs of the erosion control project, which included 13 permanent sediment basins, 55 acres of fill and cut slope seeding, pipe rundowns and drainage control, was $2,000,000. Many truck loads of sanding material have been collected through sweeping, and approximately 800 tons of highway sand and sediment have been collected by the sediment basins. Additional information can be obtained by contacting the Colorado Department of Transportation, Staff Design Branch.

A TMDL was completed by the Water Quality Control Division in 2000, and approved by EPA in July of 2000. The goal of the TMDL is the attainment of the narrative sediment standard. The water quality targets are: a minimum substrate D50 size of 60 mm or more; a maximum stream pool V* of 0.015; stable stream morphology; and five age classes of brook trout. The TMDL was developed using the participation of the Straight Creek Clean Up Committee, which included CDOT, US FS, US EPA, NWCCOG, DOW, Summit Water Quality Committee, Summit County, Town of Dillon, and Dillon Valley Water District.

The Town of Silverthorne sponsored a 319 grant to fund CDOT work to direct clean water away from erosive areas. That project was completed in 2009.

4.1.9 South Blue River Regional Wastewater Reclamation Facility

Upper Blue Sanitation District constructed the South Blue River regional wastewater treatment plant in 1995. The cost of the plant is $800,000 and has a permitted capacity of 40,000 gallons per day, with the capability of expansion to 0.3 MGD. This plant will also provide for the conversion of septic systems in the area to central sewer and replaces the Skier's Edge, McDill Placer, and Valley of the Blue wastewater treatment plants.. Additional information can be obtained by contacting the Upper Blue Sanitation District.

4.1.10 NWCCOG Biological Restoration Goals for French Gulch and Peru Creek

EPA awarded Northwest Colorado Council of Governments a grant in 1994 for the development of methodology for establishing aquatic biological goals for areas impacted by acid mine drainage. Out of this grant has developed a group called the FROG, or French Gulch Remediation Opportunities Group, which is developing a community-based approach to mine site reclamation. Additional information can be obtained by

contacting NWCCOG.

Goals for Peru Creek and the Snake River have yet to be defined. The Snake River Watershed Task Force is the appropriate organization to develop recommendations to the State Water Quality Control Division, and likely to be involved in the development of a TMDL for this watershed. The focus on goals for the French Gulch clean up by the FROG has been on the establishment of a reproducing brown trout fishery in the Blue River below the confluence of French Gulch, which would require a dissolved zinc standard of approximately 225 ug/L..

4.1.11 NWCCOG Blue River Restoration Master Plan

EPA awarded NWCCOG a grant in 1999 for the development of a Blue River Restoration Master Plan for a 2-mile segment of the Blue River between Breckenridge and Dillon Reservoir. In this segment, dredge and placer mining destroyed the river and its adjacent floodplain. The goal of the master plan is "Enhance the Blue River for both private and public property landowners while considering the following: protect private property and owners rights, protect water rights, protect natural resources, and provide a tool for landowners to coordinate efforts and to guide river design and land use planning." The Master Plan was completed in February 2001, and endorsed by the entire Steering Committee.

Summit County Open Space and Trails implemented a habitat restoration project on the lower 1500' portion of this segment in fall 2006. The primary goal was to enhance aquatic habitat while addressing such issues as channel and streambank stability, sediment dynamics, channel capacity and form, and riparian and wetland habitat. The primary activity was to construct a sustainable stream channel through this County-owned portion of the Blue River, create wetland habitats of various types, and restore a portion of the site to an upland meadow. Trout biomass in this segment soured from 141 lbs/acre in 2007 to 241 lbs/acre in 2009 and is a good measure of the success of the project.

4.1.12 Climax Mine Revegetation Biosolids Partnership

A consortium of entities in Summit County have produced a solution to the challenges of mine land reclamation, wastewater treatment biosolids recycling, and wood waste recycling. The consortium currently includes the Climax Mine Copper Mountain, Frisco, and Silverthorne/ Dillon wastewater districts. Biosolids are delivered regularly to the mine, which is mixed with wood chips from various sources. Capital cost savings to the wastewater treatment plants have been significant, with the Silverthorne/Dillon Joint Sewer Authority avoiding the cost of a $1,000,000 digester.

4.1.13 Sediment and Erosion Control Specialist Position

The Summit Water Quality Committee established a pilot project in 1998 to provide a sediment and erosion control specialist for all local governments in Summit County. The position involves both education and enforcement of local erosion control regulations. The project has received a National Association of Counties award, and has been very

well received by the local community. Over 120 individuals have received the CDOT certification training for erosion and sediment control that has been sponsored by the SWQC under this project. The project received EPA Regional Geographic Initiative funding in 2001 to implement a similar program in Eagle and Grand Counties. The project was stopped in 2009 due to a slowdown in construction.

4.1.14 Emerging contaminates

The Summit Water Quality Committee with assistance from EPA initiated an outreach effort to draw attention to water quality issues associated with flushing unused pharmaceuticals and use of personal care products. The project was started in 2010 and involves dropoff and collection of unused medicines at local pharmacies, water quality monitoring for 43 potential contaminants, and public outreach through the High Country Conservation Center.

4.1.15 Jessie and Royal Tiger Mine improvements.

Summit County managed the reclamation of two mine sites in the Swan River drainage as part of the final settlement of the B&B properties in 2006, see: http://www.cdphe.state.co.us/hm/covenant/pdf/HMCOV00042.pdf and http://www.cdphe.state.co.us/hm/covenant/pdf/HMCOV00043.pdf

4.1.16 Shoe Basin

Summit County provided for the reclamation of the Shoe Basin mine in Peru Creek in 2008, see: http://www.cdphe.state.co.us/hm/covenant/pdf/HMCOV00063.pdf

4.2 Blue River Watershed Group

The Blue River Watershed Group (BRWG) began as a gathering of local citizens in October 2004, with the emphasis of the group focused on public education and involvement with basic water law and water issues affecting the area. The group received not for profit 501(c)3 status in 2005, has held many public information sessions in years since on topics such as flood potential, snow-making impacts on water quality, and legislative and governmental issues related to water and potentially affecting the Blue River watershed. In 2007, the BWRG held a public water forum with different experts to discuss how the pine beetle problems in Summit County could affect the watershed and water supply.

The BRWG is a member of Colorado River Watch and collects and analyzes water quality samples from the Snake and Blue Rivers, and has recently completed a watershed plan to examine the effects and potential restoration strategies related to trace metal impacts from mining and geology in the Snake River watershed. More information on the group can be found at http://www.blueriverwatershed.org.

4.3 Snake River Watershed Plan

In 2008, the Blue River Watershed Group was awarded a State Section 319 nonpoint source pollution grant to study and prepare a watershed plan for the Snake River

subwatershed. The Plan was completed in 2009. The Snake River subwatershed drains a heavily mineralized part of the Blue river watershed. The Snake and several of its tributaries are on the Colorado 303(d) listing as streams that do not meet water-quality stream standards due to low pH and high concentrations of four trace metals: dissolved cadmium, copper, lead and zinc. Many studies have been completed to understand and address the water quality problems, beginning at least in the early 1970's. Most of the study has focused in the tributary Peru Creek, which is home ot the largest and longest serving mine in the area, the Pennsylvania Mine. This mine has been targeted as the largest source of pollution in the watershed since the early studies. The Snake River Watershed Plan was developed to put the overall problem in context, summarize work that has been done to date to solve the problem, and identify and prioritize the many sources of water-quality degradation that exist, both natural (acid-rock drainage) and man-made (anthropogenic, or, mine related).

Parts of the Snake Rive subwatershed area heavily impacted by natural water quality degradation associated with geology, however, available data are not sufficient to definitely determine the contribution of natural and anthropogenic sources watershed wide. The issue is complicated by recent water-quality data that show higher levels of trace metals at most of the sites in the watershed (post-2006 data). Understanding the increase in metals concentrations is important to prioritize and implement appropriate mitigation strategies, since naturally deteriorating water-quality conditions for yet unknown reasons may negate the prioritization and implementation of remediation of man-made mining issues.

The Snake River Watershed Plan identifies ten priority remediation project sites that are significantly degrading the water-quality in the watershed, provides estimates of annual zinc load from each site, and proposes the necessary Best Management Practices (BMP's) at each of the sites and the level of removal of zinc that might be practical. The Plan estimates reduction in additional dissolved zinc loads of about 18,900 lbs/y through implementation of these priority projects. However, the Plan also provides an assessment that even if the ten priority sites were remediated, water quality standards in the Snake River at Keystone would not be attained, but overall water improvement in the lower portions of the watershed would still be significant and may lead to improvement in the fishery int eh lower basin above the confluence witht the North Fork Snake River (NFSR). The Snake River above the NFSR and below Peru Creek does not sustain fish currently. The entire plan is viewable at http://www.blueriverwatershed.org/overview/the-snake-river-watershed-plan/.

4.4 Future Project Needs

Future project needs in the Blue River basin include the continued work on Straight Creek (sediment impacts); Peru and French Creeks (heavy metals and acid mine drainage impacts); Tenmile Creek (heavy metals and acid mine drainage impacts, I-70 impacts), lower Blue River (reservoir operation modifications to minimize water quality concerns, reducing nonpoint source nutrient loads); and upper Blue River (hydraulic dredging impacts); and removal of "high risk" septic systems (nutrient and potential human health impacts).

Additional project priorities in this watershed include the following:

- Blue River Restoration of historic hydrologic modifications
- TMDL implementation for Peru Creek/Snake River

- Sediment/Erosion Control practices for construction/land disturbance areas (including Straight Creek and other areas)
- Ground water sensitivity/enhanced septic system management

5.0 LAND USE REGULATIONS APPLICABLE TO WATER QUALITY PROTECTION AND IMPROVEMENT

This section summarizes the Town and County regulations applicable to water quality protection and improvement and includes such things as stream setbacks, watershed protection ordinances, "1034" regulations, Individual Sewage Disposal System regulations and maintenance and inspection program, etc. Examples of local ordinances for water quality protection are found in Appendix 6.

The County and the Towns of Breckenridge and Silverthorne have 1041 permitting authority (CRS 24-65.1-101 *et. seq.)* over a number of activities which impact water quality.

Under State enabling legislation (commonly known as 1034 authority, CRS 29-20-101 et seq.) most of the towns and the county have a 25 foot stream setback requirement. All the towns and the county have construction erosion control requirements. The County's enforcement of the erosion control requirements is carried out through the Building Department, both at the planning stage, and out in the field. The County and towns also have regulations concerning stormwater runoff (off-site historical levels must be maintained), snow storage, and road construction practices.

Summit County has developed a water quality regulation that is intended to complement the U.S. Army Corps of Engineers wetland permitting with greater restrictions of disturbances to wetlands while also providing for a 25 foot setback from wetlands. A subdivision improvements agreement may also be required to provide a financial guarantee of any wetland mitigation work that is required.

The Town of Frisco has included wetlands as requiring a 25 foot setback. Within the setback, soil disturbance is not allowed.

The Town of Silverthorne has a Drainage Master Plan, which requires that all stormwater runoff be detained for all sites and subdivisions, except single-family and duplex units in existing subdivisions. All stormwater detention sites are required to have a 100-year design frequency and outlet works designed to release runoff at the historic rate.

In 1999 the Town of Silverthorne adopted “Waterbody, Wetland, and Riparian Protection Regulations”. This regulation requires a setback of 25–125 feet from wetlands and other waterbodies, depending on the presence of site specific features and the use of best management practices.

In 2000 the Town to Breckenridge passed an ordinance regarding a “Protective Management Area” for the Cucumber Gulch area. There are two protective boundaries within this area. One is a 100-foot setback from the wetlands, the other a 300-foot setback from primary bodies of water. The two areas were created after three

consultants advised the Town to avoid the wetlands to protect existing boreal toad habitat.

Summit County adopted an OWS Use Permit regulation that requires inspection of OWS prior to property transfer or major remodel. This is an effort to identify poorly operating OWS, all OWS fields must be >75 feet from surface water and >4 vertical feet from groundwater.

6.0 WASTELOAD ALLOCATIONS

According to EPA guidance and regulations, wasteload allocations are the portion of the receiving water's loading capacity attributed to point sources; load allocations are the portion attributed to nonpoint sources.

6.1 Phosphorus Wasteload Allocations

Phosphorus wasteload allocations have been in place for the upper Blue River watershed since 1984. A control regulation enacted in 1984 established a phosphorus standard of 7.4 ug/L during the growing season in the upper 15 meters of Dillon Reservoir, in order to keep algal growth to a low to moderate level. The control regulation established a phosphorus load allocation for the dischargers upstream of Dillon Reservoir. These allocations were based on "maximum buildout" discharges and an effluent discharge phosphorus concentration of 0.2 mg/L.

The Dillon Reservoir Control Regulation (5CCR 1002-71), amended May 30, 2007 forms the basis for the phosphorus allocations which are as follows:

Major Municipal		
	Breckenridge SD	708.8 pounds total phosphorus per year
	Copper Mountain MD	218
	Frisco SD	341
	Snake River Facility	340
Minor domestic		
	Bekkedal Subdivision	2.5 pounds total phosphorus per year
	High Country Lodge	1.7
	Arapahoe Basin	11.4
	Keystone Summit House	4.4
	Summit Motor Lodge	2.7
	Vail Pass Rest Area	3.9
Reserve Pool		66.9
Grand Total		1,701.3 lbs/yr total allowed phosphorous

6.2 Ammonia Allocations

The Water Quality Control Division has indicated that discharges to Dillon Reservoir will be evaluated for effluent limits for ammonia when permits are renewed. The concern with respect to ammonia is its un-ionized form, due to its toxicity to fish. In 2010 the

Water Quality Control Commission adopted new ammonia standards. Initial concentrations, temperature, pH, and mixing are the key elements in determining the amount of unionized ammonia which could be toxic to fish. Thus, site specific measurements need to be collected in order to establish appropriate effluent limits and discharge concentrations. In the case of ammonia, load allocations are not appropriate for Dillon Reservoir, as it is the aquatic life in the vicinity of each discharge that is being protected, not the entire reservoir. The total load of ammonia to the reservoir is not the concern, therefore mixing zone studies are the appropriate mechanism for this issue. The districts and the Water Quality Control Division have negotiated the requirements for adequate mixing zones for discharges to Dillon Reservoir through the use of site-specific studies.

Upper Blue Sanitation District's Iowa Hills facility has monthly ammonia limits that vary from 3.5 to 7.6 mg/L total ammonia..

The Copper Mountain Consolidated Metropolitan District wastewater facility has monthly ammonia limits which range from 17.2 to 27.2 mg/L total ammonia.

The Silverthorne Dillon Joint Sewer Authority wastewater facility has monthly ammonia limits which vary with discharge flows. For discharges greater than 2.7 but less than 4.0 MGD the ammonia limits range from 9.2 to 14.9 mg/L total ammonia..

7.0 WATER QUALITY MONITORING

7.1 Existing Water Quality Monitoring Efforts

The Water Quality Control Division as maintained five long-term water quality monitoring stations in the Blue River watershed. As a result of funding issues, the Division has proposed cutting back the number of stations in the watershed to one. The most substantial loss with respect to this cut back will be the loss of metals concentrations data in the Blue River watershed.

The Division of Wildlife has a program called River Watch which currently monitors seven stations in the Blue River watershed. These stations have been discussed in the Evaluation of Water Quality (Section 2.0).

The Summit Water Quality Committee monitors nutrient and some inorganic parameters in the watershed, but does not collect water samples for metals analysis. The loss of WQCD monitoring data will make it difficult to assess whether progress is being made with respect to historic mine site impacts on water quality.

In 1999, the USGS was contracted by the Summit Water Quality Committee to develop a water quality database containing information collected by various entities: http://rmgsc.cr.usgs.gov/cwqdr/Blue/index.shtml . Cost increases by USGS to maintain the database have SWQC putting the project on hold while other options are evaluated. That database was utilized in developing the "Retrospective Analysis of Water Quality in the Blue River Watershed, 1984 through 2007". The document is complete, however still in press in early 2011. Analysis of stream and groundwater data was focused primarily on October 1995 through December 2006 for stream and May 1996 through September 2004 for groundwater. Stream data for the Snake River, upper Blue River,

and Tenmile Creek subwatersheds upstream from Dillon Reservoir and the Lower Blue River watershed downstream from Dillon Reservoir were analyzed separately. Analysis is also provided for Green Mountain Reservoir and Lake Dillon. This analysis provides stream, reservoir and groundwater data (including trend data) in comparison to State of Colorado water quality standards, and where sufficient data were available, trend analysis was conducted to identify changes in water quality over time.

US EPA has undertaken a significant amount of monitoring associated with characterization of mines and metal loading in the Snake River watershed, with a particular focus on Peru Creek. Because this water quality data is generated through CERCLA it is housed in their SCRIBE database rather than STORET.

7.2 Water Quality Monitoring Needs

Other issues requiring monitoring to either address questions or determine the success of various water quality protection or enhancement efforts include the following:

Evaluating water quality improvements over time associated with the conversion of septic systems in the upper Blue River area to central sewer provided at the South Blue WWTF. .

Monitoring the success of remediation efforts on French Creek, Peru Creek, and Straight Creek.

Additional monitoring to assess and improve the aquatic and recreational resources in Tenmile Creek.

Monitoring the impact of bark beetle management by the Forest Service and others to evaluate nutrient contributions to the reservoir, with the intent of determining management approaches to minimize increased phosphorus loads from timber harvesting.

The potential impact of resuming operations at the Climax Mine on water quality and the aquatic community.

The impact of future Dillon Reservoir operations on reservoir trophic status and downstream water quality and the aquatic environment, especially the loss of sustained high spring runoff and resultant sediment accumulation.

Monitoring the impact of increasing ground water depletions in the upper Blue River areas on flows in the Blue River and associated water quality.

8.0 WATER QUALITY STANDARDS AND RECOMMENDATIONS

8.1 Existing Classifications and Standards

The current water quality classifications, designated uses, and standards for the various water body segments in the Blue River watershed are found at:

http://www.colorado.gov/cs/Satellite?blobcol=urldata&blobheadername1=Content-Disposition&blobheadername2=Content-Type&blobheadervalue1=inline%3B+filename%3D%22Numeric+Standards+Tables.pdf%22&blobheadervalue2=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1251810001872&ssbinary=true . The Blue River watershed has 22 segments identified by the Water Quality Control Commission. Four of the twenty-two segments have been designated "Use-Protected", while the remaining 18 are reviewable under the State's "Antidegradation" regulations.

Waterbodies in the Gore/Eagle's Nest and Ptarmigan Peak Wilderness areas were designated "outstanding waters" in the 1999 Upper Colorado River Basin Classification and Standards hearing.

Waterbodies designated "Outstanding Waters" "shall be maintained and protected at their existing quality" (5 CRR 1002-8, 3.1.8.1.a). These waters are considered to be of the highest quality, and are afforded the most protection.

Regulated activities taking place in reviewable waters are subject to antidegradation review.

Antidegradation review requires that regulated activities (discharges to those waters) be reviewed to: determine if the activity will result in significant degradation of that water; and if so, if "the degradation is necessary to accommodate important economic or social development is the area in which the waters are located." (5 CRR 1002-8, 3.1.8.3.d.).

Use Protected" designation indicates that those waters so designated do not require the special protection of antidegradation review (generally speaking, waters not meeting several water quality criteria or standards, or subject to significant point source discharges), but no activity can result in the exceedance of water quality standards.

Most of the segments in the watershed are classified for these uses: Aquatic Life Cold 1; Primary Contact Recreation; Water Supply; and Agriculture.

8.1.1 Designated Use Impairment Stream Segments

The state has listed eight stream segments in the Blue River watershed as "Use Impaired". Those segments, as well as the identified constituent are listed in Table B-5. Water quality limited indicates the potential impairment of the designated uses of the stream segment in the near future. This list indicates stream segments in which water quality is, or may be a concern. Not supporting indicates that the designated uses are not fully impaired or supported.

Six of the stream segments listed are impacted by metals, one is impacted by sediment and one is impacted by E. Coli from unknown sources and listed as not assessed.

8.1.2 303(d) List

The Clean Water Act requires the state to list those stream segments or waterbodies

which require Total Maximum Daily Load (TMDL) allocations in order for the segment to attain or maintain water quality standards. The State's 2000 305(b) report lists the current 303(d) list.. In the Blue River watershed, five stream segments are identified.

Table B-5. 303(d) Listed Segments in the Blue River

Segment	Description	Impairment	Priority
COUCBL02	Blue River, French Gulch to Swan River	Cd, Zn	M
COUCBL06	Snake River, Peru Creek to Dillon Res.	Cd,Cu,Pb,Mn,Zn	M (TMDL completed)
COUCBL07	Peru Creek, source to Snake River	Cd,Cu,Mn	M (TMDL completed)
COUCBL11	French Gulch, Wellingon-Oro to mouth	PH, Cd, Zn	H
COUCBL18	Straight Creek, source to mouth	Sediment	M (TMDL completed)

A TMDL is the estimated assimilative capacity of a waterbody, which estimates how much of a pollutant may enter a water body without affecting its designated uses. The TMDL represents the sum of the point sources, the nonpoint sources, and a margin of safety (which can include anticipated future pollutant loadings).

Four segments are listed due to metal concentrations, and one is due to sediments. All are listed as low priority, except for Straight Creek (sediment impacts), which is listed as medium priority.

8.2 Recommendations

8.2.1 Support of Existing Standards

Water quality standards (including use designations and criteria) for the Blue River watershed are generally adequate to protect the existing uses under current conditions.

NWCCOG is supportive of the State’s antidegradation provision and protection of high quality waters.

Existing standards in the Blue River watershed should be continued

8.2.2. Outstanding Waters Designations

The Northwest Colorado Council of Governments does not currently recommend any additional waterbodies to the list of “Outstanding Waters” designation. If new wilderness areas within the watershed are approved by Congress, NWCCOG recommends investigations of waterbodies within those areas for appropriateness of “outstanding waters” designation.

8.2.3 Green Mountain Reservoir Nutrient Standards

Although NWCCOG's previous 208 Plan (1988) stated the intent to revise water quality standards for phosphorus and other nutrients in Green Mountain Reservoir, based on the detailed study of the Reservoir completed in 1990, nutrient standards for Green

Mountain Reservoir are not appropriate unless some operational impacts on water quality are addressed. The Summit County Land Use and Development Code, along with the development of a septic system inspection and maintenance program is the most appropriate nutrient limitation method for protection of Green Mountain Reservoir water quality. Through the use of enforceable streamside development setbacks, wetlands setbacks, maintenance of historical runoff levels, erosion control ordinances, and other Best Management Practices that the County now requires of land development, nonpoint source nutrient loads to Green Mountain Reservoir should be minimized.