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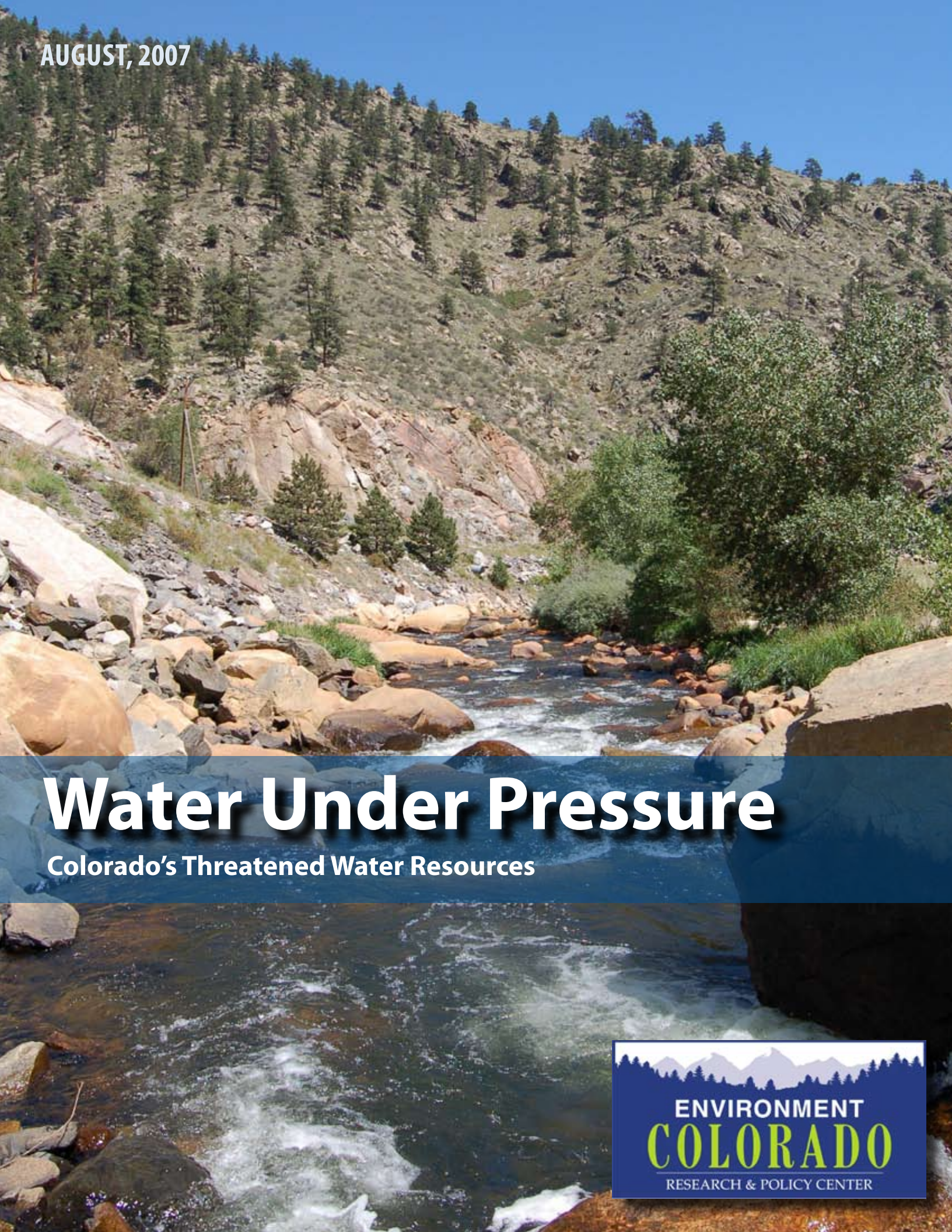
Water Under Pressure

Colorado's Threatened Water Resources



ENVIRONMENT COLORADO
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Acknowledgments

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The Environment Colorado Research and Policy Center is a 501(c)(3) organization that offers an independent, articulate voice on behalf of the public interest in Colorado. Drawing upon 30 years of experience, our professional staff combines independent research and practical ideas to uncover environmental problems, develop pragmatic policy solutions, and engage citizens in our work for meaningful results.

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Executive Summary

People love Colorado for its sunshine, open spaces, and mountains. Images of Colorado are not complete without rushing, clear mountain streams. However, our streams and rivers need stronger protection if they are to remain clear in the face of growing pressures.

The State of Colorado's Waters

Water quality is on the decline in Colorado. The Clean Water Act (CWA) sets the goal that all of the nation's waters be fishable and swimmable. Yet state water quality assessment reports show that over the past 6 years, the percentage of Colorado's rivers and streams found to be fishable decreased by 7%. Even more alarming, the percentage of Colorado's rivers and streams that support all of their classified uses has declined 21% since 1998. Additionally, despite ongoing cleanup efforts, the number of stream segments in Colorado that are listed as impaired rose 53% from 1998 through 2006.

Challenges to Improving Water Quality

The sources of this increased pollution are both natural and manmade, the impact of growth and the price of choices made or not made along the way. While land use choices from over a century ago continue to impact our water quality, the greatest impending threat is how we decide to protect our waters as we use our lands and waters today and tomorrow.

Inspection and Enforcement Problems

The biggest challenge to protecting Colorado's water resources is underfunding and understaffing at the agency charged with this responsibility. The Water Quality Control Division (WQCD) does not have anywhere near enough staffpeople inspecting permit sites and enforcing water pollution laws against violators. In fact, the WQCD is understaffed anywhere from 33 to 80 employees.

Last year, the WQCD was able to inspect only 0.7% of the active permits given to entities that discharge pollutants into our waterways. Likewise, the WQCD only issued 10 final penalty orders on wastewater formal enforcement actions, while 42 new cases were opened. Obviously, at this rate, the WQCD cannot keep up with Colorado's growth.

Urban Development

Residential development in Colorado is skyrocketing: from 1990–2000 our population grew by 31% and there was a 22% increase in housing units. More people means more houses, roads, shopping centers, and parking lots.

The construction of all of these displaces sediment, which, if no preventative measures are taken, will wash off the construction site and into waterways during and after storms. The existence of more impervious surfaces—such as sidewalks, roads, and parking lots—also causes greater runoff during and after storms. Runoff from suburban and urban areas contains sediment, oil and chemicals from cars, fertilizers and pesticides from lawn care, and viruses and bacteria from septic systems.

Energy Development

Colorado is also facing increased pressure from energy development, with drilling expanding rapidly across the state and predicted to increase tenfold in the next decade. In 2006, a record 5,904 permits to drill were approved, which represents a 35% increase over the number granted in 2005 and a 102% increase over the number

granted in 2004. As of the end of 2006, Colorado had about 34,000 active wells, and there are currently no requirements for producers to disclose the chemicals they are using at these well sites.

More wells means a greater potential for pollution. During the construction, production, and maintenance of wells, sediment can flow from construction sites, chemicals kept in pits can leak into waterways, wastes injected into underground wells can leak into groundwater, and hazardous materials can be spilled or run off a site during a storm.

There are regulations in place that require all construction sites across the state, whether for houses, big box stores, or well sites, to implement management practices to prevent sediment and chemicals from being washed into waterways. However, as mentioned above, the agency charged with enforcing these laws is severely underfunded and cannot effectively enforce them.

Agriculture

92% of the water used in Colorado is used for agriculture. Water that runs off of croplands after irrigation can carry large quantities of fertilizers, pesticides, and sediment into rivers and streams. The primary pollutants that show up in Colorado's waters from agricultural lands are selenium, salts and nitrogen.

The law does not require any pollution control measures for the majority of agricultural activities. Because of this very few are implemented, despite the fact that very simple management measures can make a significant difference in the amount of pollution that enters waterways from agricultural activities. However, while simple, these management practices are not cheap: the cost of implementing them across Colorado is about $50 million per year.

Mining

The greatest component of the pollution on impaired streams in Colorado is heavy metals. A significant proportion of these metals drain from some of the more than 23,000 abandoned mines that dot Colorado's landscape. There is no one left to clean up these mines and it is estimated that it will cost at least $314 million to accomplish the task.

Aside from the cost of cleaning up these mines, another impediment is liability concerns. Currently, if a local government or non-profit group wants to clean up a particular mine site to improve water quality in a stream, the law could treat them as responsible for any pollution that discharges from the site from that point on. This acts as a significant deterrent to well-meaning cleanup efforts.

Prior Appropriation

Another impediment to clean water is the system that has evolved for assigning water rights. The emphasis within this system has always been on water quantity—who gets how much water when. Historically, there has been very little consideration of water quality within this system or the benefits of leaving some water in streams to protect aquatic life and the environment.

Recommendations

In order to address the increasing pollution that is degrading our waters, we need to know what is actually going into our waters, and from where. We also need to ensure that discharge limits set in permits are enforced. This is the job of the Water Quality Control Division (WQCD), but

the WQCD does not have the funding or staff it needs to do its job. As the rates of residential and industrial growth increase in Colorado, it is imperative that the WQCD receive the funding and staff needed to keep up.

To address pollution from urban development, Colorado needs both better enforcement of existing laws and new legislation to more effectively deal with runoff from development activities. First, the WQCD needs to be adequately funded and staffed so that there is an effective level of inspectors in the field noticing problems with development activities and permits and a sufficient number of enforcement staffpeople back at the office to process any necessary enforcement actions and ensure that corrective action is taken. Second, legislation that better links water and growth and that requires more effective management of stormwater runoff from development activities would help Colorado address the rising volume of this type of pollution.

To address pollution from energy development, Colorado needs better enforcement of existing laws, as explained above. Colorado also needs the energy industry to be required to report the identities and quantities of the chemicals it uses in its processes, so that these chemicals can be properly monitored and prevented from polluting our waterways.

To address pollution from agricultural activities, we need to find ways to fund and incentivize pollution control practices on agricultural lands. This may include using existing grant and loan programs as well as developing some sort of fee system that allows the costs of pollution control to be paid by the ultimate beneficiary of agricultural activities: the consumer.

To address pollution from mining, two things need to be addressed. First, legislation needs to be passed that eliminates potential liability for certain "Good Samaritans" who want to clean up old mine sites. Second, money must be raised to fund cleanups. This could be done through a fee on existing mining operations that is put towards a cleanup fund.

Lastly, Colorado needs to prioritize integrating protection of water quality into the water rights system and encouraging both agricultural and residential water use efficiency. Only by doing this will Colorado accurately value and effectively protect its water resources.

I. Cleaning Up Water Pollution

The biggest inroad the CWA has made into addressing water pollution is its regulation of point sources. Point sources are discrete conveyances such as pipes and man-made ditches that discharge pollutants directly into surface waters. Typically, point sources include discharges from wastewater treatment plants (WWTPs), like water and sewer plants, and discharges from industrial facilities. Since the passage of the CWA, and with advancement in our understanding of water pollution, more and more sources, such as runoff from construction sites, have been designated point sources.

The CWA requires point source facilities to obtain permits, which allow them to discharge specified amounts of pollutants into waterways for a specified period of time. These permits are managed by EPA, and those states to which EPA has delegated the authority, through the National Pollutant Discharge Elimination System (NPDES) permit program.

As opposed to point source pollution, nonpoint source (NPS) pollution comes from diffuse sources. NPS pollution comes from water moving across and through the ground, along the way picking up natural and man-made pollutants and depositing them in waterways. NPS pollutants include excess fertilizers, herbicides, and insecticides from residential and agricultural lands; oil, grease, and toxic chemicals from urban runoff and energy production; sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks; salt from irrigation practices; acid drainage from abandoned mines; and bacteria and nutrients from livestock, pet wastes, and faulty septic systems.[1]

Due to its diffuse nature, NPS pollution is much more difficult to address than point source pollution. It cannot be controlled at the end of a pipe since it is not coming from any discrete source. Further, Congress has not mandated control of NPS pollution. There is no requirement that NPS polluters be directly regulated under the CWA; rather, there are voluntary programs.

The main tool provided by the CWA is the Section 319 grant program, which gives states money to address NPS pollution through activities like conducting education programs, providing technical assistance, and conducting demonstration projects. There are also opportunities to implement controls through the Section 208 regional planning process, the Section 303(d) total maximum daily load process, and best management practices that can be used onsite to control runoff.

In addition to attempting to regulate what goes into our waterways, the CWA also sets water quality standards for our waterways. Water quality standards designate the uses that a water body should support and then set scientific criteria to protect those uses.[2] In Colorado, the designated uses that can be set for water bodies are agricultural use, support of aquatic life, recreation, and drinking water.

Waterways are divided into stream segments for regulatory purposes. Designated uses are then set for each stream segment. In this manner, all the surface waters of a state are accounted for and regulated. Colorado has over 600 stream segments and often one stream segment is designated for more than one use.[3]

Where a stream segment is not meeting its water quality standards, it is considered an impaired segment and the CWA requires that the state impose a "pollution budget," called a total maximum daily load (TMDL). A TMDL determines the maximum amount of a pollutant that a water body can receive and still meet water quality standards. The state then allocates to point

sources and to nonpoint sources the amounts that each is allowed to discharge into the waterway. For point sources, the state can implement these limits through discharge permits; for nonpoint sources, the state may only address implementation through voluntary measures.

The TMDL requirement in the CWA was ignored for decades, until public interest groups began to sue EPA to move forward with the program.[4] The Clinton administration finalized a rule in 2000 to speed up and clarify the TMDL regulations.[5] However, in 2003, the Bush administration withdrew this rule, and today there is no requirement that states do implementation plans.[6]

Colorado law has also created another alternative: temporarily placing the segment on a "monitoring and evaluation" (M&E) list. The M&E list contains water body/pollutant combinations that the Water Quality Control Division (WQCD) suspects do not meet water quality standards or support designated uses, but for which the WQCD determines that the information currently available is not sufficient to place the segments directly on the TMDL list.[7] The WQCD must determine the appropriate status for these segments within 10 years of their placement on the M&E List.[8]

II. How Clean Is Colorado's Water?

Colorado boasts 95,533 river miles and 252,261 lake acres.[9] All of these waters are governed by provisions of the CWA.

Section 305(b) of the Clean Water Act (CWA) requires states to report to Congress and the public about general water quality conditions in the United States.[10] States make reports every two years to the EPA on water quality, water quality problems, and the programs implemented to restore and protect our waters.[11] The reports are printed in even years (2006, 2004, 2002, etc.) In Colorado, the WQCD is responsible for making these reports.

Water quality data reported in the 305(b) Reports is gathered by the WQCD through the following methods. The WQCD conducts stream monitoring on a schedule that coordinates with its separate duty under the CWA and the Colorado Water Quality Control Act (CWQCA) to review and update its water quality standards every three years.[12] For purposes of monitoring, the state has been divided into four major river basins: the Colorado River Basine, the Arkansas and Rio Grande Basin, the South Platte Basin, and the San Juan, Animas, Dolores and Gunnison Basin.[13] Each of the four major basins is sampled intensively once every 4 years.[14] In every fifth year, the sampling is more evenly allocated among the four basins.[15] Therefore, the WQCD reviews each basin only once every five years. As discussed later in the report, this may be the best staff at WQCD can do with the resources currently available to them.

The data yielded by this process is neither complete nor up to date. Due to the sampling schedule, the data is relatively recent for only one of the basins. For one basin in each 305(b) Report, the data is four to five years old, for one it is three to four years old, and for one it is two to three years old. Additionally, even during the year in which a basin is intensively sampled, the entire basin is not assessed.[16]

Cache la Poudre River – © Sebastien Windal, under license from Shutterstock.com

In each basin, a significant proportion of the stream miles and lake acres are classified as having insufficient data available to determine whether they are meeting water quality standards. According to the WQCD, impairment is suspected on these stream segments, yet they have not been assessed for any uses.[17] Because of a lack of resources, the WQCD must put off evaluation of these segments until a TMDL is performed for them, typically years down the line. A shocking proportion of Colorado's waters are currently classified in this "insufficient data" category.

Despite these limitations, the 305(b) reports provide the most complete picture of Colorado's water quality available, and may even provide more in-depth data than other states provide in their reports. By comparing the reports from the last 3 reporting periods, we can get a pretty good picture of the recent downward trend in Colorado's water quality.

The CWA sets as a goal that all of the nation's waters be fishable. In Colorado over the past 6 years, fewer river miles were assessed in each period and waterways have become less fishable and able to support aquatic life. In 2002, of the 75,020 miles of streams assessed, 92% were fishable.[18] In 2004, of the 58,836 miles of streams assessed, 88% met this goal.[19] In 2006, of the 68,242 miles of streams assessed, 85% were fishable.[20] Therefore, over the past six years, the number of stream miles assessed has decreased by almost 10%, and the percentage meeting the fishable goal has decreased by 7%.

The percentage of Colorado's waters meeting water quality standards and supporting their designated uses has also steadily declined. In the 1998 305(b) Report, 96% of river miles and 88% of lake acres met standards and supported all of their designated uses.[21] In the 2002 Report, this number went to 93% of river miles and 86% of lake acres.[22] In the 2004 Report, the data showed that only 88% of river miles and 83% of lake acres met water quality standards and supported all of their designated uses.[23] In the most recent report, 2006, this number again dropped, to 75% of river miles and 57% of lake acres.[24] This is a 21% decrease in river miles, and a 29% decrease in lake acres meeting water quality standards over an 8 year period.

The 305(b) Reports also provide data on what is causing our waterways not to meet water quality standards. This data, however, is not conclusive because so much is unknown. Due to lack of resources, the WQCD generally does not examine what is causing a stream segment to be impaired until it does a TMDL for that segment.[25]

Over time, the miles of streams on which the source of impairment is unknown has been increasing. Data from the 2002 Report shows that on 5,227 miles of impaired streams, the source of impairment was unknown.[26] The 2004 Report shows that on 6,812 miles of impaired streams, the source of impairment was unknown.[27] Data from the 2006 Report shows that on 6,854 miles of impaired streams, the source of impairment was unknown.[28] All three Reports show that, for the stream segments where a source of impairment could be determined, the leading source was metals.[29]

Additionally, the number of stream segments that are impaired and require TMDLs is increasing. From June 1998 through June 2004, the WQCD completed 56[30] TMDLs.[31] This works out to an average of 9.33 TMDLs per year. At the same time, the number of TMDLs still to be done continued to grow. As of 2006, there were 121 segments still on the list of segments needing TMDLs, as compared to 117 in 2004, 95 in 2002, and 79 in 1998.[32] If the WQCD's past performance is any indication, it will take 13 years to complete the TMDLs that are on the list as of 2006. This does not account for any additional TMDLs that will be added to the list.

The 305(b) Reports divide Colorado's waters into

seven basins. By reviewing information from each basin, we should be able to get a picture of the health of the waters in each basin and the major challenges facing each basin. However, the clearest picture that emerges is how much we *don't* know.

A. Arkansas Basin

The Arkansas Basin covers 27% of the surface area of Colorado and contains 25,592 stream miles.[33] It drains most of southeastern Colorado and a portion of the central mountains.[34] The largest cities in the basin are Colorado Springs and Pueblo.[35] 25% of the basin is in agricultural use and the portion between Buena Vista and Pueblo reservoir is the area most extensively used for recreation in the state.[36]

In fact, the Arkansas River is a valuable recreation spot. Every year multitudes of individuals and families enjoy the pleasures of kayaking and rafting down its rapids. The Arkansas River is also a premier trout river and its shores offer abundant opportunities for camping, picnicking, hiking, wildlife watching, and mountain biking. All of this supports an important recreation economy in the basin. In 2006, outfitters along the Upper Arkansas River collected $11.8 million in gross revenue, as 237,160 people booked white water rafting and float fishing trips.[37]

The Arkansas Basin's water quality was comprehensively assessed in early 2007, but the data available in the latest 305(b) reports reflects the 2000 and 2001 assessments, plus more recent assessments from the TMDL process.[38] The Arkansas Basin contains some waters, like those within the Mount Massive and the Collegiate Peaks wilderness areas, which are pristine and considered outstanding waters.[39] However, at last assessment, only 33% of river miles and 34% of lake acres fully supported all designated uses.[40] 52% of river miles and 27% of lake acres were placed in the insufficient data category.[41]

The water quality issues facing the Arkansas Basin include the effects of urban and rural development, active and historic mining pollution, agricultural irrigation, and a Superfund site near Leadville.[42] Different sources affect different parts of the basin. In the upper basin, the biggest problem is acid mine drainage; in the middle basin, municipal and industrial discharges cause the most problems; and in the lower basin, extensive agricultural irrigation depletes streams and pollutes streams with sediment, nutrients and agricultural chemicals.[43]

An example of the problems caused by acid mine drainage can be found in the Leadville area, which was one of the nation's key mining centers for over 100 years. By 1900, there were 400 individual mines in Leadville and more than 100 miles of underground workings, producing enormous piles

Picture courtesy of Weylin Ryan

of mine and mill wastes leaching an endless stream of mine-drainage water into the Arkansas.[44] In 1906, miners completed the Yak Tunnel, a four-mile long combination ore-haulage and drainage tunnel, to drain 60 miles of underground workings and dispose of acidic heavy-metal-laden water into the Arkansas River, through California Gulch.[45] Complicating this, during World War II, the government built the Leadville Mine Drainage Tunnel in order to dewater more mines and speed up production, and during the Korean War, the government built the two-mile long Leadville Drain for the same purpose, to discharge waste into the Arkansas River through the California Gulch.[46]

Most mines in Leadville closed by the 1960s, but the tunnel drainage continued at a rate of 4 million gallons a day.[47] The effect on the river was devastating. For several miles downstream of Leadville there were absolutely no fish, and for up to 40 miles downstream fish showed elevated metal levels.[48]

With the passage of the CWA and the creation of the EPA in the 1970s, attention focused on this pollution.[49] In 1983, the California Gulch mine area was declared a Superfund site and EPA began studying ways to clean up the mess.[50] Water-treatment plants were built at the Leadville Drain and the Yak Tunnel-California Gulch area to treat the tunnel flow and remove heavy metals before they reached the Arkansas River.[51] These plants cost $5 million and $8.5 million (respectively) to build, and $600,000 and $1 million annually (respectively) to operate.[52]

The Arkansas cleanup is paying off in terms of healthier fisheries, improved riparian habitat, and more appealing water recreation and river aesthetics.[53] More than 90% of the acid mine drainage has been eliminated.[54] While the pollution still affects the Arkansas River, ecologists monitoring toxicity levels say fish populations are starting to recover.[55] More information on pollution from mining is included in Section III(E) below.

B. Rio Grande Basin

The Rio Grande Basin covers 7,543 square miles in the south central portion of Colorado.[56] Its largest cities are Alamosa and Monte Vista, and it contains the San Luis Valley.[57] There are 6,875 stream miles within the basin.[58]

The Rio Grande Basin's water quality was last comprehensively assessed in 2001 and 2002, though some segments may have been more recently assessed as part of the TMDL process.[59] At last assessment, 72% of its river miles and 17% of its lake acres fully supported all of their designated uses.[60] 24% of river miles and 58% of lake acres were placed in the insufficient data category.[61]

The major water quality concern in the basin is the effect of historic mining activities throughout the headwaters region and the San Juan and Sangre de Cristo mountains.[62] In fact, there are two historic mining sites so polluted that they have been designated as Superfund sites: the Summitville Mine and the Bonanza Mining District.[63] The other water quality concern in the basin is agricultural runoff in the San Luis Valley.[64]

Conejos River – Picture courtesy of gartholson.net

The Summitville Mine is in the San Juan Mountains in Rio Grande County and has been a sporadic gold mine ever since 1870.[65] In 1984, Summitville Consolidated Mining Company, Inc. ("SCMCI") began gold mining at Summitville using the cyanide heap leach method to remove gold from low-grade ore, and between 1984 and 1992 the company produced gold worth about $81 million.[66] This resulted in toxic mine waste–including copper, iron, manganese, zinc, aluminum and cadmium–leaking from the leach pad into the headwaters of the Alamosa River (a tributary of the Rio Grande), causing a massive fish kill and ongoing acid mine drainage.[67] This pollution has contaminated the river, killed fish and wildlife, and damaged crops and irrigation equipment in the San Luis Valley, where Alamosa River water is used for irrigation.[68]

In 1992, after informing the State that cleanup of the site would cost $20 million, SCMCI declared bankruptcy and abandoned the mine in the middle of the night, despite the fact that the chairman of the parent company is reputed to be worth some $400 million.[69] Shortly thereafter, the State of Colorado asked the EPA for emergency help to prevent a cyanide-contaminated pond from overflowing into the river.[70] EPA placed the site on the Superfund list and began cleanup, which has cost about $210 million so far and is predicted to continue to cost $1.5 million per year for years, possibly decades, to come.[71]

C. San Juan Basin

The San Juan Basin covers approximately 6,667 square miles in southwest Colorado.[72]

There are approximately 7,103 stream miles within the basin, and its largest cities are Durango and Cortez.[73]

The San Juan Basin's water quality was last comprehensively assessed in 2004 and 2005, though some segments may have been more recently assessed as part of the TMDL process.[74] At last assessment, 51% of river miles and 0% of lake acres fully supported all of their designated uses.[75] 39% of river miles and 38% of lake acres were placed in the insufficient data category.[76]

Water quality issues in the basin include population growth, historic mining, and salinity.[77] In the headwaters of the Animas River, near Silverton, historic mining negatively impacts water quality.[78] Salinity is a major concern in the lower basin and all of southwestern Colorado. It affects agriculture by reducing crop yield and increasing water demands, municipal uses by increasing water treatment costs and decreasing the life of plumbing and water utility equipment, and industrial water uses by decreasing the life of equipment.[79] Some of this salt comes from natural sources, and some comes from human activities like irrigation.

The Dolores River picks up approximately 205,000 tons of salt annually, primarily from natural sources, as it crosses the Paradox Valley.[80] The

Animas River near Durango – © Amygdala Imagery, under license from Shutterstock.com

Paradox Valley was formed from the collapse of a salt formation millions of years ago, which resulted in a bed of salt that now underlies the valley from near the surface to a depth of approximately 14,000 feet.[81] The Dolores River bisects the valley and is relatively fresh as it enters the valley and very saline as it leaves. To deal with this salt, facilities costing $67.4 million have been built to remove the salt from the river and inject it deep into the ground.[82] These facilities are able to remove 128,000 tons of salt per year, at an operating cost of $2.8 million per year.[83]

D. Colorado Basin

The Colorado Basin covers 18,140 square miles in western Colorado.[84] Within it are 24,708 stream miles, with major tributaries including the Blue River, the Eagle River, the Roaring Fork River, and the Gunnison River, and major cities including Grand Junction and Glenwood Springs.[85]

Colorado River – Picture courtesy of Ron and Alice Puening

The Colorado River Basin's water quality is comprehensively assessed in pieces, as part of three other basins; therefore the Upper Basin was last assessed in 2003, the Gunnison and Lower Dolores Rivers were last assessed in 2001, and the Lower Colorado River was last assessed in 2001 and in 2003.[86] Based on these assessments, 68% of river miles and 67% of lake acres in the Basin fully support all of their designated uses.[87] 5% of river miles and 11% of lake acres were placed in the insufficient data category.[88]

Water quality issues differ in different portions of the basin. In the upper basin, water quality is impacted by sediment and nutrient loading from residential construction, metals from historic mining, and depletion of streams due to transbasin diversions to the Front Range (water is taken out of the Colorado Basin and transferred to another basin permanently for use in that basin).[89] In the lower basin, high salinity is the biggest problem.[90]

Much of the economy in the upper part of the basin is based on outdoor recreation and water-based activities such as skiing, fishing, boating, camping, and hiking.[91] Yet the Front Range is taking more and more of the region's water through transbasin diversions, decreasing the dilution capacity of streams by removing water from the system.[92] Currently, Front Range communities divert 60% of the natural flows of streams in Grand County and 25% of the natural flows of streams in Summit County.[93] Denver Water alone already diverts 50% of the Fraser River headwater flows and plans to divert another 10%.[94]

As population on the Front Range continues to

grow, Front Range citizens need to think about where their water comes from and how they can use it more efficiently to minimize the demand for West Slope water as much as possible. More investment in things like conservation and reuse, more efficient water sharing, and transfers from agriculture are essential to ensuring that rivers in the Colorado River Basin remain viable into the future.[95]

E. Green River Basin

The Green River Basin is comprised of the Yampa, White, and Green River Basins and covers 21,000 square miles in the northwest corner of Colorado.[96] Its largest cities are Craig and Steamboat Springs and it includes 14,600 stream miles.[97]

Green River – Picture courtesy of Chris Carroll

The Green River Basin's water quality was last comprehensively assessed in 2002 and 2003.[98] Based on this assessment, 52% of river miles and 59% of lake acres fully support all of their designated uses.[99] 44% of river miles and 14% of lake acres were placed in the insufficient data category.[100]

The high mountain headwaters of the basin have extremely good water quality and some are designated as Outstanding Waters.[101] However, the lower basin has water quality concerns stemming from naturally occurring salts and increased sedimentation.[102] Approximately half of the basin is federally-owned and used for livestock grazing and recreation.[103] Significant coal and oil shale reserves are located in the basin. Poor water quality results from groundwater coming into contact with mineral and oil shale deposits, then being fed into streams in the Piceance Creek Basin.[104] Other lower elevation streams suffer poor water quality due to poor land management practices on highly erosive soils.[105]

Intense interest is focused on the Piceance Basin because it is thought to contain 1 trillion barrels of oil locked away in sedimentary rock, as much oil as the world's proven oil reserves.[106] The problem is getting it out economically. It cannot simply be pumped out like liquid oil, it must be removed through either underground or surface mines.[107] Once it is removed, the rock must be heated to a high temperature and then the liquid collected, separated, and processed.[108] All of these processes have significant potential adverse water impacts.

Depending on the technology employed, oil shale

production in the Piceance Basin has the potential to pollute the waters in the region through mine drainage, surface discharges from surface operations, and leaching from the byproduct of the process–spent oil shale.[109] The biggest problem would likely be the spent oil shale, which tends to be very salty and contain arsenic and selenium.[110]

Currently, the economics of oil shale production and existing technologies do not support the development of the resources in the Piceance Basin.[111] However, oil companies are very seriously researching how to overcome these difficulties and, if they do, there could be dire consequences for water quality in the Green River Basin.

Another big threat to the Green River Basin is posed by potentially huge transbasin diversions to the Front Range. Currently, two large projects are being proposed that would take enormous quantities of water out of the basin permanently. The loss of that water could reduce streamflows, harm endangered species, and preclude use of that water for other uses. The first project, championed by entrepreneur Aaron Million, proposes to divert 250,000-450,000 acre feet of water from the Green River and pipe it 400 miles across Colorado and Wyoming to the Front Range to supply cities and farmers with water.[112] The other project, championed by Northern Colorado Water Conservancy District, proposes to divert 300,000 acre feet of water from the Yampa River and pipe it 250 miles across Colorado to supply the same users with water.[113]

Both of these projects face significant hurdles, including obtaining necessary permits and approvals and demonstrating that the basin truly has that quantity of water available for diversion. However, if either of them goes through, the Green River Basin will face the same sorts of impacts with which the Colorado River Basin currently deals.

F. Platte River Basin

The Platte River Basin covers approximately 21,000 square miles in the north-central section of Colorado.[114] Though the North Platte sub-basin is sparsely settled, the South Platte sub-basin is by far the most populous basin in the State, its largest cities being Denver, Aurora, and Lakewood.[115]

The Platte River Basin's water quality was last comprehensively assessed in 2003 and 2004.[116] Based on this assessment, 54% of river miles and 36% of lake acres fully support all of their designated uses.[117] 20% of river miles and 44% of lake acres were placed in the insufficient data category.[118]

Approximately one-third of the basin is publicly-owned, largely in the mountains, and waters within these areas are classified as Outstanding Waters (including waters within Comanche Peak, Indian Peaks, Lost Creek, Mount Evans and Rocky Mountain National Park).[119] The Denver metropolitan area sits in the center of the South Platte sub-basin.[120] The Eastern Plains is an area of intensive agricultural use and has extensive canal and reservoir systems in place.[121]

South Platte River – © James W. Alltop, under license from Shutterstock.com

The North Platte sub-basin remains largely untouched by heavy development and is mostly agricultural today, although historically it underwent significant logging activity.[122] Water quality concerns in the North Platte sub-basin include stream erosion and sedimentation.[123] In contrast, the South Platte sub-basin receives extensive transbasin diversions from the Colorado Basin and has more permitted point source dischargers (over 500) than any other basin.[124] It also is impacted by extensive diversions for agriculture.[125] Not surprisingly, the South Platte sub-basin has more water quality issues facing it than any other basin in Colorado.[126]

The upper reaches of the South Platte sub-basin are impacted by historic mining and development.[127] The middle reach flows through the Front Range and consequently is heavily burdened by municipal and industrial wastewater, nonpoint source pollution, and extensive diversions of water.[128] Additionally, the South Platte River through and downstream of Denver consistently exceeds the E. Coli/coliform standard set to protect public health.[129] The lower reach of the South Platte River flows through areas of heavy agricultural diversions and its flow is almost completely controlled by agricultural water use.[130] Nonpoint source pollution, especially pesticides and fertilizers, is the biggest problem in this part of the Basin.[131]

The threats to water quality in the South Platte Basin are a direct result of population pressure: more people equals more demands placed on rivers and streams to serve as a drinking water source, an irrigation water source, a repository for industrial and municipal wastes, and a source of recreation. 88% of Colorado's present population lives along the Front Range.[132] Colorado's population is projected to increase by 65% in the next 25 years, and the vast majority of those new residents will live along the Front Range.[133]

The natural conditions of the South Platte Basin have already been greatly altered and burdened by man: there are 12 major transbasin diversions bringing water into the Basin, there is an extensive reservoir storage system, at certain times the majority of the river's flow is comprised of effluent from wastewater treatment plants through the Denver metro area, and at times irrigation structures in the lower South Platte River divert the entire flow of the river to irrigate agriculture.[134] Increased population will only increase the burden and provide greater challenges to water managers as they attempt to meet demand.

It will also increase the nonpoint source pollution flowing from impervious surfaces along the Front Range. More information on this pollution is included in Section III(B), below.

G. Republican Basin

The Republican Basin covers approximately 8,785 square miles in the northeastern section of Colorado.[135] It is sparsely settled, with less than 1% of the state's population, and contains 5,618 stream miles.[136]

The Republican Basin's water quality was last comprehensively assessed in 2003 and 2004.[137] Based on this assessment, 2% of stream miles and 0% of lake acres fully support their designated uses.[138] 98% of stream miles and 100% of lake acres were placed in the insufficient data category.[139]

There are virtually no publicly-owned lands in the Republican Basin.[140] Most of the basin is used for rangeland, with some agricultural areas.[141] The area primarily depends on groundwater for irrigating croplands and providing drinking water.[142] Threats to water quality include discharges from confined animal feeding operations (CAFOs), and fertilizers and pesticides.[143] There were over 70 hog farms in

the basin as of the 2002 305(b) Report.[144]

Hog farms generate enormous amounts of pollution. The hogs are generally kept in pens with slatted floors, through which waste falls and is washed out, and then either sprayed with large sprinklers over land surrounding the farm or stored in vast waste lagoons.[145] This waste runs off from these fields into nearby streams when the factories spray more waste on the land than it can hold.[146] Waste also can and does leak from lagoons into shallow groundwater, and from there into surface water bodies and drinking water wells, causing elevated levels of nitrogen pollution.[147]

Republican River, courtesy of Stan Murphy, Republican River Water Conservation District

One example of the potential pollution from hog farms is found east of Greeley,[148] where a huge hog farm which closed its doors in 2000 has left behind an abandoned mess that will cost over $1 million to clean up.[149] The farm sprawled over 23,000 acres and produced as many as 150,000 hogs.[150] It also created a "river of swine waste gunned from industrial sprinklers."[151] After state health officials banned land application of waste in the winter to prevent pollution, the company was cited for violating this rule 250 times in 1999 and 2000.[152] Though the farm has been closed for six years, pollution still remains from the farm's activities: groundwater in monitoring wells shows levels of nitrates 10-12 times higher than the health standard.[153]

III. Challenges to Colorado's Water Quality

A. Inspection and Enforcement Problems

The major challenge in addressing Colorado's growing water pollution is a lack of enforcement of existing regulations. Regulations implementing the CWA currently require that states have "inspection and surveillance procedures to determine, independent of information supplied by regulated persons, compliance or noncompliance" with the CWA.[154] They also require that Colorado have a program for "periodic inspections" of permitted facilities adequate to "[d]etermine compliance or noncompliance with issued permit conditions" and verify information submitted by permittees.[155] Colorado is not meeting these requirements.

The WQCD does not have anything close to enough inspectors to perform the inspections necessary to meet CWA requirements and ensure the safety of Colorado's waters. This is especially true in the stormwater program, where applications for permits are growing exponentially in response to increased urban and industrial runoff, but staffing levels remain stagnant.

As of June 2005, the WQCD listed 5,989 active permits, which included 1,200 wastewater permits and 4,379 stormwater permits.[156] Due to increased activities that require stormwater permits, such as residential construction and energy development, 1,774 new stormwater permits were issued in fiscal year 2005, which represented a 14% increase over the number of permits issued the previous year.[157] For fiscal year 2006, 1,974 new stormwater permits were issued, which represented a 15.6% increase over the previous year.[158]

Until late 2006, the WQCD had one inspector, hired in 2003, who spent about one-quarter of his time doing inspections.[159] With this one inspector, the WQCD was able to perform 59 stormwater inspections in fiscal year 2004, or 0.1% of the active permits.[160] In an attempt to improve this situation, for fiscal year 2004 the WQCD entered into contracts with ten local health departments and one private contractor to assist in stormwater inspections.[161] Stormwater inspection training was also given to the Solid Waste Unit within the WQCD, so that when inspectors from that unit visit industrial sites, they can perform stormwater inspections as well.[162]

While these measures increased the number of stormwater inspections performed in fiscal year 2005 to 336, or 0.7% of the active permits, this increased number is but a drop in the bucket compared to the number of inspections needing to be done.[163] In fact, a 2004 EPA Audit of Colorado's NPDES program found that with the current level of available resources, it would take the WQCD 70 years to inspect each stormwater permit just once.[164]

As of October 2006 there were 5,268 active stormwater permits in Colorado.[165] This represents a 20% increase since 2005. The Stormwater Unit added a new employee in the Fall of 2006, who also spends one-quarter of her time inspecting permit sites.[166] That brings the total full-time employees at the WQCD inspecting stormwater permit sites to 0.5. While this is twice the inspection power the Stormwater Unit had prior to 2006, it is still clearly inadequate.

The Stormwater Unit exemplifies the WQCD as a whole. The Unit works hard with what it has, but is so understaffed it cannot hope to meet its CWA duty to protect our waters from illegal stormwater runoff.

This understaffing also causes problems with enforcement of water pollution laws. EPA records indicate issues with permittees complying with their permits. Between July 1, 2003 and December 31, 2004, 48.6% (52) of the major facilities[167] in

Colorado reported exceeding their permit limits at least once.[168] There were 165 total exceedances reported and the average exceedance was 213% over the permit limit that was set by the WQCD.[169]

Based on the enforcement policy at the WQCD, each of these 165 exceedances triggered a notification to the facility of its legal responsibility to comply with permit limits, but not all triggered a more formal enforcement action, like a formal notice of violation and order to cease the violation, or even a penalty assessment.[170] Enforcement actions are only triggered when the exceedance is of a certain magnitude and duration.[171] For major permittees who exceed their permit limits, Division policy is to send a letter notifying the permittee of the violation for infrequent or isolated violations.[172] The response escalates to a more formal enforcement action only if "significant noncompliance" is found, if the significant noncompliance lasts for more than 3 months or if documented environmental damage occurs.[173] Only at this point would the polluter face a formal enforcement action.

This policy may reflect what the 2004 Audit stated, that the WQCD is more effective at issuing permits than in ensuring that they are enforced.[174] Historically, the WQCD has not given the same level of effort to enforcement as to permitting.[175] In 2002, 183 violation letters were issued for violations of permit limits, yet only 16 formal enforcement actions were taken against these facilities.[176] Most of the violations were determined to not be of enough consequence to spark a formal enforcement action.

Since the 2004 EPA Audit, this problem has been exacerbated. In response to criticism in the Audit, the WQCD put resources into increasing inspections, as noted above; however, corresponding resources were not put into increasing enforcement staff (the people who investigate alleged infractions and impose penalties).[177] The unit at the WQCD that handles enforcement has 5 employees–one handles enforcement of drinking water standards, one handles enforcement of stormwater permits, one handles enforcement of industrial discharge permits, one handles enforcement of domestic wastewater permits, and one is their supervisor.[178] One new enforcement person will be hired next year under a provision in the state budget for fiscal year 2007-2008.

Currently, the three enforcement people who work on wastewater cases (stormwater, industrial and domestic permits) are managing about 180 cases between them.[179] In 2006, only 10 final penalty orders were issued on wastewater cases, while 42 new cases were opened, 24 of them stormwater cases.[180] While the new employee may also work on these cases, at this rate it does not appear that the current caseload will diminish significantly any time soon.

Also disconcerting, the 2004 Audit of Colorado's NPDES program noted instances where pollutant discharge limits were removed from permits without any justification or documentation.[181] In at least one case, the permit holder had reported discharging pollution in excess of permit limits and, rather than making the permit holder comply with the permit, the WQCD just removed the limit from the permit.[182]

Another issue is the use of "temporary modifications." While water quality standards are set to protect designated uses, Colorado law allows permittees to request that standards be relaxed at their sites when they are not meeting the standards.[183] State law allows this where the Water Quality Control Commission (WQCC) determines one of the following: 1) that standards are not being met due to a human-induced condition that can be corrected within 20 years, and application

of the necessary corrective measures immediately would cause a "substantial and widespread economic or social impact," or 2) there is significant uncertainty about the appropriate long-term underlying standard.[184]

EPA has criticized Colorado's use of temporary modifications, saying the state uses them too frequently and puts them into place without defensible science.[185] EPA considers the state's willingness to grant loose standards a continuing "high priority source of concern."[186] Even sharper criticism comes from scientists at the Colorado Department of Wildlife (DOW).[187] In 2004, biologists from DOW reviewed the scientific reports backing up 16 proposed temporary modifications for Colorado river basins and found flawed calculations, incomplete data and a lack of scientific rigor.[188]

New Funding Sources Are Needed

The major reason for WQCD's inability to perform complete water quality monitoring, adequately inspect the facilities of permittees, and enforce the law against polluters, is a serious lack of funding. This lack of funding is a direct result of the Taxpayers' Bill of Rights (TABOR) and a lack of political will.

TABOR was passed in 1992 as a set of constitutional amendments that prohibit any tax increase in Colorado without a vote of the people.[189] It also places strict limits on how much revenue the state can keep and spend, and specifies that any revenue collected above these limits must be refunded to taxpayers.[190] TABOR imposes on Colorado the strictest revenue and spending limits in the nation.[191] In 2003, facing budget difficulties due to TABOR, the Colorado legislature eliminated all general fund monies previously provided to the WQCD to fund its water protection activities.[192] The legislature gave the WQCD approximately 10 days in which to craft a legislative proposal to replace the lost general fund monies with fees.[193] The result was Senate Bill 276, which temporarily replaced these monies with increased wastewater fees and new drinking water fees.[194] These temporary fees were to (and did) sunset two years later, on June 30, 2005.[195]

During these two years, the WQCD was to investigate and report on its business practices and future funding needs and options.[196] As part of its investigation, the WQCD evaluated its staffing needs.[197]

In evaluating how many additional full-time employees it needs to protect Colorado's waters, the WQCD used models that were developed by EPA and state water professionals through the Association of State Drinking Water Administrators (ASDWA) and the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) as part of a nationwide effort to document shortfalls in resources for state water programs.[198]

Using the ASDWA model, which EPA has called "the most thorough and accurate model available for government drinking water operations,"[199] the WQCD calculated it would need approximately 30 additional full-time employees to ensure that Colorado complies with the Safe Drinking Water Act.[200] Using the ASIWPCA model, the WQCD calculated that it would need approximately 50 additional full-time employees to ensure that Colorado complies with the CWA.[201]

However, this is not what the WQCD asked for in its report to the Legislature. Instead, the WQCD only asked for what it termed (without explanation of what this means) its "Priority 1 Needs," or 32.7 new full-time employees, over a 4 year period (approximately 22 in the clean water program and approximately 10 in the drinking water program).[202]

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New Funding Sources Are Needed

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According to the SB 276 Report, this request was based on a process whereby unit managers identified the number of full-time employees needed to meet current and future requirements, then senior management reviewed these lists, pared them down, and sent them back to the unit managers with instructions to prioritize their needs on a scale of 1 to 4.[203] After this was done, senior management took only those staffing needs identified as Priority 1 needs and determined how to phase them in over a four year period, from 2006-2010.[204] No attempt was made to explain why the WQCD does not need the 80 employees the national models said it needed. Rather, the WQCD stated that the purpose of using the ASDWA and ASIWPCA models was "not to identify a specific number of needed full-time employees (FTEs)," but rather was "valuable in determining that Colorado's program is quite efficient," as compared to other states.[205] Tellingly, the WQCD did admit that the models showed that "it may not be reasonable to expect that, in the long term, Colorado can achieve all of its water quality goals with existing resource levels."[206]

Again, the SB276 temporary fee increase sunset on June 30, 2005. For the 2006-2007 fiscal year, the WQCD was planning to ask for the authority to raise fees via legislation. However, the Owens administration nixed this effort, and therefore emergency general funding was restored at roughly the pre-2003 levels.[207] This allowed the WQCD to hire 10 new employees.
For the 2007-2008 fiscal year, the WQCD sought and received an increase in its spending authority to fund 7 new full-time employees. Through House Bill 07-1329, the WQCD will also be able to add 5 new full-time employees, funded by increased fees on wastewater dischargers.[208] These measures are a positive step in the right direction, but they do not get the WQCD fully staffed. Additionally, all of these increases have been based on the assumption from the SB 276 Report that the WQCD only needs 33 new FTEs. This assumption may well be faulty.

States across the country are facing similar shortfalls in the level of funding needed to adequately meet all federal and state statutory mandates. Those that are most successfully meeting this challenge and maintaining adequate staffing levels are generally those more heavily supported by permit fees.[209] For example, Florida and Nevada, which have programs fully supported by permit fees, did not experience any budget cuts or layoffs in the face of state budget problems.[210] Seeing this, other states, such as Oregon and California, are moving in the direction of increasing their fees to offset severe state general fund shortfalls.[211] Colorado needs to do the same.

B. Urban Development

Urban and suburban development fueled by population growth add increasing quantities of pollution to our rivers and streams. Colorado's population is skyrocketing: from 1990-2000, it grew by 31%.[212] There was an accompanying 22% increase in housing units built in Colorado during this time period.[213] If growth continues at this rate, Colorado's population will reach 6.4 million people by 2025.[214] More people means more houses, roads, shopping centers and parking lots to service them.

Initially, urbanization affects water quality through erosion, with mass quantities of sediment and other chemicals running off construction sites into waterways.[215] When land is disturbed by construction activities, erosion can increase up to 200 times on sites that were formerly under pasture and up to 2,000 times on sites that were formerly forested.[216] Sediment runoff is the second leading cause of impairment in rivers and streams and the leading cause of pollution of wetlands.[217] It causes increased turbidity of water, decreased oxygen levels, and reduced growth of aquatic grasses needed by fish and other aquatic species.[218] Sediment itself can kill fish, make filtering drinking water more difficult, and result in the loss of drinking water reservoir storage capacity.[219]

Anyone conducting a construction activity that results in a land disturbance of one or more acres is required by the CWA to obtain a stormwater

permit from the WQCD and control runoff through a pollution prevention plan.[220] This requires the use of erosion and sediment control "best management practices" (BMPs), such as silt fences, temporary detention ponds and hay bales, and a set of procedures for things like regular site inspections and recordkeeping.[221]

If implemented diligently, these BMPs are very successful in preventing runoff from reaching waterways. Unfortunately, in Colorado there are low rates of compliance with stormwater permit requirements.

Further in the development process, other pollution occurs that is typically more diffuse and harder to control and regulate. There is an increase in water pollution from transportation (oil and grease), green space chemicals (pesticides and fertilizers), and human waste from sewage treatment plants.[222] The basic explanation for this increase in pollution is that the more surfaces there are that are impervious (do not absorb liquid), the more runoff there is. With urbanization, there are more and more areas that go from forests and fields to construction sites, then to sidewalks, streets, driveways, and parking lots. A typical city block characterized by pavement and rooftops generates over nine times more runoff than a forested area of equal size.[223]

Urban runoff results in heavy loads of sediment, nutrients, heavy metals (especially copper, lead and zinc) and bacteria going into our waterways.[224] As noted above, of the 211 stream segments currently either listed as impaired or placed on the monitoring and evaluation list, 44 are over the limits for sediment, 24 are over the limits for copper, 44 are over the limits for zinc, 15 are over the limits for lead, and 44 are over the limits for sediment.[225] Some of this pollution undoubtedly comes from urban development.

Nutrients (nitrogen and phosphorus), often coming from the application of lawn and green space fertilizers, have also impaired water quality in lakes and reservoirs throughout Colorado, which are often near new developments.[226] Coliform bacteria (E. coli), found in the waste products of humans and animals, is also present at high levels in urban runoff and usually exceeds standards during and immediately after storm events.[227] Of the 211 stream segments currently either listed as impaired or placed on the monitoring and evaluation list, 24 are over the limits for E. coli; 15 of these are in the South Platte Basin.[228]

Another challenge that accompanies increased development is increased use of septic systems,

Residential construction - © Chad McDermott, under license from Shutterstock.com

which are a nonpoint source of pollution. In Colorado, 33% of all homes are currently served by septic systems; by 2020 this will increase to about 837,000 people served by septic systems.[229] Millions of gallons of septic tank effluent percolate into the soils of Colorado annually; some of that reaches waterways.[230] By 2020, wastewater flowing from septic tanks is projected to exceed 100 million gallons per day statewide (roughly equal to the average flow in the South Platte River).[231] This volume of flow could produce 38,000 pounds of nitrogen and 13,000 pounds of phosphorous per day.[232] Even if a large amount of this were absorbed into the soil, there would still be enough entering waterways to degrade water quality.[233]

C. Energy Development

An industry that has been expanding by leaps and bounds in Colorado over the past few years is the energy industry. In 2006, 5,904 permits to drill were granted by the Colorado Oil and Gas Conservation Commission, which was a 35% increase over the 4,363 permits granted in 2005, a 102% increase over the 2,917 permits granted in 2004, a 194% increase over the 2,007 permits granted in 2003, and a 286% increase over the 1,528 permits granted in 2000.[234] As of the beginning of 2007, there were more than 30,000 wells in production in Colorado.[235]

Drilling rig – © Jim Parkin, under license from Shutterstock.com

Certain areas of Colorado are being harder hit by this energy development boom than others. Of the 5,904 permits to drill granted last year, 31% were in Garfield County and 24% were in Weld County.[236] These areas face greater threats to their water quality than areas with less drilling.

Water quality impacts from energy development can occur at any point in the development process. Each new well site requires construction activities, which have the same pollution potential of construction activities anywhere. The well pad has to be constructed, as well as roads around the site. With over 30,000 active wells currently in Colorado, and more being constructed all the time, this represents a huge potential for water pollution via sediment runoff. Stormwater permits and erosion control measures are required for construction activities on oil and gas sites in Colorado, as on all other sites. However, problems with compliance and a lack of inspection and enforcement personnel are also the same, as described elsewhere in this report.

Additionally, throughout the active life of the well, and even after, chemicals kept in pits can leak into waterways, wastes injected into underground wells can leak into groundwater, and hazardous materials can be spilled or run off a site during or after a storm. Detection of such pollution is often difficult before a problem occurs. To make this even more difficult, currently, the energy industry

in Colorado is not even required to disclose the nature and content of the chemicals it uses in its development processes, unless a producer reports a spill.

D. Agriculture

92% of the water diverted from streams and aquifers in Colorado is used for agriculture, mainly for irrigating crops.[237] A large percentage of the water that is put on crops for irrigation ends up back in water bodies as nonpoint source runoff and return flow, after having picked up nutrients, agricultural chemicals, and sediment along the way. Though agricultural NPS pollution is the leading source of water quality impacts on rivers and lakes across the country, agricultural return flows were exempted from regulation under the CWA by Congress in the original 1972 CWA, and this has not changed.[238]

This loophole has a tremendous impact on water quality. In arid areas, like Colorado, excessive irrigation causes increased erosion; the runoff of nutrients, pesticides, and heavy metals; and a buildup of the toxic metal selenium.[239]

The primary pollutants that run off into Colorado's waterways from irrigated lands are selenium, salts, and nitrogen.[240] The selenium and salts exist naturally in the soil and are dislodged and deposited into waterways along with sediment as large quantities of water move over and through the soil on the way back from irrigated lands.[241] Of the 211 stream segments currently either listed as impaired or placed on the monitoring and evaluation list, 53 are over the limits for selenium and 44 are over the limits for sediment.[242] Though it is known that salts negatively impact water quality in many areas, notably in the Lower Arkansas Valley, Colorado does not currently have a numeric criteria for salinity, therefore stream segments impacted by salts are not counted.

Another major pollutant of waterways from agricultural activities is nitrogen, which results from fertilizer application and animal waste. As an example, the U.S. Geological Survey estimates that about 300,000 tons of nitrogen enters the South Platte Basin each year.[243] Agriculture accounts for about 75% of this, while effluent from municipal wastewater accounts for only 2%.[244] In fact, agricultural discharges of nitrogen into the South Platte Basin are roughly equivalent to the wastewater of 47 million people.[245]

Because agricultural runoff and return flows are exempt from CWA permit requirements, they are managed through relatively simple "best management practices" (BMPs). The cost to implement BMPs for irrigation, however, is estimated at $25 million per year, plus an additional $15 million per year for nutrient management BMPs and $5 million per year for pest

Irrigation of agricultural fields - © Muriel Lasure, under license from Shutterstock.com

management BMPs.[246] Some government programs exist to help farmers design and pay for BMPs to reduce NPS pollution, including grants, technical assistance, and economic assistance.[247] However, since the use of BMPs is voluntary and more expensive than assistance may cover, many farmers do not implement them.

E. Mining

Beginning in the 1850's, when gold was discovered in Cherry Creek, and continuing through the present, with the subsequent discovery of silver, molybdenum, diamonds, limestone and clay, Colorado has been a mining hot spot.[248] Unfortunately, the legacy of this mining heritage is abandoned mines leaking toxic chemicals into our waterways, and those that profited from them long gone, leaving taxpayers holding the bag.

Upper Animas River, acid mine drainage – Photo courtesy of U.S. Geological Survey

Colorado currently has over 23,000 abandoned mines, generally within the mineral belt, which extends from Boulder south and southwest to Silverton.[249] A 1998 study showed that more than 1,300 miles of streams in Colorado are affected by heavy metal contamination.[250] Of the 211 stream segments currently either listed as impaired or placed on the monitoring and evaluation list, 24 are over the limits for copper, 44 are over the limits for zinc, 18 are over the limits for iron, 15 are over the limits for lead, and 18 are over the limits for cadmium.[251]

The major problems with cleaning up these mines are the lack of funding and regulatory hurdles. A special study by the WQCD estimated the cleanup costs for these mines at over $314 million dollars.[252] Since most of the mining companies are gone or have declared bankruptcy, there is no one to hold responsible for cleaning up the mess and the mines continue leaking poisons into our rivers and streams.

Additionally, there is the fact that under the CWA and the Superfund law, any party conducting reclamation or remediation at an abandoned mine site may become liable for discharges of pollution from the site in perpetuity.[253] This prevents well-intentioned non-profit groups, governments, and mining companies from undertaking remediation projects.

Because of this, western states and the mining industry have called on Congress to pass a so-called "Good Samaritan" law that would exempt those working on remediating abandoned mine sites from liability under some or all environmental laws for pollution resulting from that remediation work.[254] Good Samaritan legislation has been

floating around Congress for the last decade, with multiple bills introduced.[255] The challenge is to allow "Good Samaritans" to voluntary clean up abandoned mine pollution they did not create by providing them with protection from liability under environmental laws and, in some cases, less stringent environmental cleanup standards, without providing loopholes in the law that bad actors can use to undertake additional mining activities at the site without having to comply with environmental laws.[256]

During the 2006 congressional session, four Good Samaritan bills were introduced into the U.S. Congress: H.R. 1266, introduced by Colorado Representative Mark Udall; S. 1848, introduced by Colorado Senator Ken Salazar; and two identical bills introduced at the request of the Bush administration-S. 2780, introduced by Senator James Inhofe, and H.R.5404, introduced by Representative James Duncan.[257] None passed due to the need to draw the right balance between liability waivers and environmental protection. No Good Samaritan bills have yet been introduced into the 2007 congressional session.

F. The Bias of the Prior Appropriation System

In Colorado, water quality concerns have historically been treated as secondary to water quantity concerns (taking water out of streams and putting it to beneficial use) because public uses of water are subject to the right of private parties to appropriate water for private use. This principle is sacrosanct in Colorado history and law. In fact, §104 of the CWQCA mandates that no water quality regulation shall "supercede, abrogate, or impair rights to divert and apply water to beneficial uses."[266]

Impediments to the Development of Nonpoint Source Management Measures

The management of NPS pollution such as agricultural return flow and acid mine drainage is constrained by lack of a regulatory framework and lack of funding. The 1987 amendments to the CWA addressed nonpoint sources by requiring states to conduct an assessment of waters impacted by nonpoint sources and identify best management practices that can be used to reduce NPS pollution. However, under the CWA, NPS management remains voluntary and non-regulatory, and the use of these BMPs is not mandatory.

The CWQCA likewise lacks requirements for NPS control. Additionally, the CWQCA contains specific constraints on regulating agriculture: it specifically requires that non-regulatory methods be used before any regulatory approaches may be used for agricultural NPS pollution.[258] The WQCC has the authority to pass regulations addressing nonpoint source pollution, which theoretically could be an enforceable program for NPS pollution, but it has not done so.[259] Due to all of these factors, improvements to streams impaired by NPS pollution are typically dependent on local stakeholder groups recognizing a problem and voluntarily acting upon it.[260]

Improvements to impaired streams are also currently dependent on federal funding. Colorado uses federal grants to implement voluntary NPS pollution reduction projects; no state monies go towards this activity.[261] The need far outweighs the funds available.

Colorado's allocation of the federal nonpoint source funds available is about $1.9 million per year.[262] This is a drop in the bucket compared to the clean up needs. For example, the cost to clean up waters impacted by legacy mines is $314 million dollars.[263] The cost to upgrade agricultural irrigation management throughout the state is $45 million dollars per year.[264] $2 million dollars per year is not going to touch these costs.[265] Obviously, other methods of financing NPS pollution control will need to be investigated and implemented.

The legal system that evolved to appropriate water rights in Colorado was designed to deal with issues of water scarcity in our arid state. This system, known as the "prior appropriation" sytem, and commonly described as "first in time, first in right," allows for a priority system to determine the proper allocation of water amongst water users on a stream when supply cannot satisfy all demands.[267]

Priority within the prior appropriation system is based on seniority; senior rights holders are those who first diverted the water and put it to a beneficial use.[268] Later diverters have more junior rights. In times of shortage, diverters do not share the shortage; rather, senior diverters will get all of their water before junior users get any.[269]

Traditionally, the prior appropriation system has given very little, if any, consideration to the amount of water that needs to stay in a stream to support aquatic life and a healthy environment. Over time, as more demand has been placed on our rivers and streams and less water has been left in them, water quality has worsened and this concern has come to the forefront. However, the prior appropriation system is deeply embedded in Colorado law and has been exceedingly slow to address water quality issues.

Water diversion structure – © Elisa Locci, under license from Shutterstock.com

The Colorado legislature has recently made an inroad into this quagmire. In 2007, the Colorado legislature took a step towards integrating water quality concerns into the prior appropriation system when it passed House Bill 1132. This bill, which was signed into law by Governor Ritter, will allow water court judges to consider environmental impacts and water quality in decisions involving large, permanent transfers of water.[270] While this may sound logical, previously judges were not allowed to consider water quality at all in these types of decisions.

However historic the passage of HB 1132, it does not sufficiently integrate water quantity and water quality concerns to protect water quality and Colorado's natural environment. More needs to be done. The prior appropriation system must be made to evolve with the times, as it has shown little inclination to do so on its own.

Times have changed. In the past, water was used mainly for extractive purposes, such as farming, mining, and industry. Very little value was placed on protecting water quality. Today, however, our use of water as a society, and the value we place on it, has shifted. Recreation and tourism, which depend on healthy, flowing streams, inject about $8.5 billion per year into Colorado's economy and employ about 8% of Colorado's workforce.[271] People also place a much greater value on environmental and aesthetic values than they did 100 years ago. The prior appropriation system needs to adapt to reflect the contemporary needs of all Coloradans, not just the powerful few who now hold senior water rights. While protecting private property rights is embedded in the spirit of the American West, it must be balanced against the value of our recreation economy and the health of our aquatic ecosystems.

IV. Recommendations

According to a recent survey, 95% of Coloradans think clean drinking water, ground water and rivers are extremely important issues.[272] More than 75% of Colorado residents recognize that better agricultural practices, preservation of agricultural land and open space, and watershed management are important to protecting water resources in Colorado.[273] In order to protect our water resources, we need to address the water quality issues discussed above.

A. Inspection and Enforcement Problems

Colorado's leaders need to ensure that its water protection agency can respond effectively to all the work that has been generated by Colorado's growth over the past few decades. More employees are needed to adequately handle the increasing volume of permits being granted by the WQCD. This does not mean simply writing the permits, but also inspecting them and enforcing them, as required by the CWA.

As noted by the EPA, the WQCD "needs to substantially increase both the number of inspections and the enforcement escalation of storm water permit violations."[274] Though the exact number of new employees needed is unclear, it may be closer to the 80 predicted by the respected national models than the 33 requested by a WQCD under political pressure to cut costs and programs.

Considering the realities of TABOR, it is unlikely that there will be an increase in general funding to provide for these new employees. Rather, those water users whose activities add to the ever-increasing workload should pay the associated costs. This could be accomplished through some combination of permit fee increases and fees to fund WQCD activities not traditionally supported by permit fees, such as water quality standards hearings.

Some of the money generated would be well spent on the program at WQCD that utilizes trained local health department personnel to conduct permit site inspections for state permits. It uses local people to check out sites in their backyards, rather than sending WQCD inspectors from Denver or Grand Junction. This saves time and money, as well as utilizes local knowledge. However, currently the only part of the process for which local inspectors are funded by the state is for the initial training course. Many, if not most, local health departments cannot afford to take on another responsibility without reimbursement. Infusing more money into the program could allow local inspectors to be reimbursed by the WQCD for performing inspections, thereby increasing the pool of local inspectors willing to help.

Colorado also needs to shift its enforcement philosophy to more of a focus on deterrence and pollution prevention. By building an effective inspection and enforcement program, the WQCD will provide a strong deterrent to permit violations, which will prevent pollution of our waterways. The current lack of a strong and effective inspection and enforcement program creates a regulatory environment where it often pays to pollute illegally, which creates incentives to break the law and places those who comply with the law at a competitive disadvantage.

In states where penalties for violations are increased, there is typically a resulting decrease in violations. For instance, both New Jersey and California have instituted mandatory minimum penalties for violators of CWA permits.[275] What this means is the state classifies different CWA violations and then requires assessment of at least a minimum penalty for each type of violation.[276] In both states, dramatic improvements in compliance followed institution of the new penalties.[277] A penalty policy along these lines could result in a decrease in violations in Colorado as well.

B. Urban Development

As Colorado continues to experience population growth and rampant, often sprawling, urban and suburban development, this nonpoint source of pollution will only increase. We need to implement controls now to prevent these ever-increasing sources of runoff from reaching our waterways. These controls may include legislation to require better planning for growth, use of existing funding sources to make improvements in specific areas, and increased oversight of traditionally polluting activities associated with growth.

For instance, New Jersey has extensive regional stormwater management laws, requiring detailed GIS mapping of land uses, water bodies, and source water areas, as well as identification and ranking of stormwater-related water quality impacts of existing and projected land uses.[278] New Jersey regulations then further require municipal stormwater management plans that incorporate and implement the elements of the regional stormwater management plans.[279]

Silt fencing, a common BMP for construction sites – © Amy Walters, under license from Shutterstock.com

Additionally, Maryland just passed stormwater management legislation that requires smarter, cleaner development practices in order to protect its waters. The Maryland Stormwater Management Act focuses on pollution prevention, since it is cheaper and simpler to prevent stormwater pollution from entering waterways than to clean it up later.[280] The Act requires developers to use environmental site design to ensure that there is no net increase in runoff from development sites and directs cities and counties to update local zoning codes to allow for low impact design techniques.[281] It also requires the Maryland Department of the Environment to propose a fee schedule to fund increased enforcement of stormwater laws and to create a process for permitting development in a way that better protects waters.[282]

Another way to address some of the effects of growth on water quality is to ensure that growth does not outstrip water supply. If growth is allowed only in areas that have proven supplies of water, this will limit sprawl. Limiting sprawl will likewise concentrate development into planned communities. Planned higher-density communities can reduce water quality impacts from impervious surfaces by accommodating more people and more housing on less land.[283]

Some states have been moving in this direction by passing legislation disallowing new developments unless they can show an adequate future water supply. Arizona has recently built upon its 1980 Groundwater Management Act, which sought to achieve a long-term balance between the amount of groundwater withdrawn from the state's aquifers and the amount of water recharged to those aquifers.[284] The Act did this by creating Active Management Areas (AMA's) around the state's

most populous areas–Phoenix, Pinal, Prescott, Tucson, and Santa Cruz–and implementing within them mandatory water conservation requirements and incentives to augment existing supply.[285] The Act prevents new subdivisions from being approved in AMAs unless developers can prove that renewable water supplies are available for 100 years.[286] On June 4, 2007, Arizona's governor signed into law a bill that furthers Arizona's efforts by authorizing counties and municipalities outside of the AMAs to restrict construction of subdivisions that do not have assured long-term water supplies.[287]

Similarly, in 2001 California passed a law requiring developers of proposed subdivisions of 500 units or more to prove they have sufficient water supply before they can receive final approval.[288] Sufficient water supply is defined as enough water to meet projected demand from the development for 20 years.[289]

Another tool available under Colorado law to manage growth has to do with approvals of new wastewater treatment plants (WWTPs). New WWTPs are necessary for new housing and growth to go forward. Colorado law requires that the WQCD approve new WWTPs and that, in doing so, it consider water quality and local long-range comprehensive plans.[290] The regulation implementing this law says the WQCD, in considering new applications, should ensure that "the objectives of other water quality regulations will not be adversely affected."[291] The WQCD has not been using this authority aggressively, but were it to do so, this law could be a very powerful tool in minimizing the impacts of growth on water quality.

Given the explosive growth rate in Colorado, the effects of pollution generated by that growth on our rivers and streams, and the finite nature of our dwindling water supplies, Colorado's leaders need to wake up and implement some growth management controls to mitigate the detrimental effects of future growth on our waters. Stormwater management strategies and planning tools linking the availability of water with growth, like those outlined above, would be great places to start.

Yet another avenue other states have taken to address water pollution from growth is EPA grants. While grants from the EPA are limited, Colorado water officials should take advantage of any that are available. For example, Nevada reversed the degradation of Lake Mead from sediment runoff caused by increased development through implementation of BMPs, such as constructing erosion control structures, restoring wetland areas, and removing invasive plant species.[292]

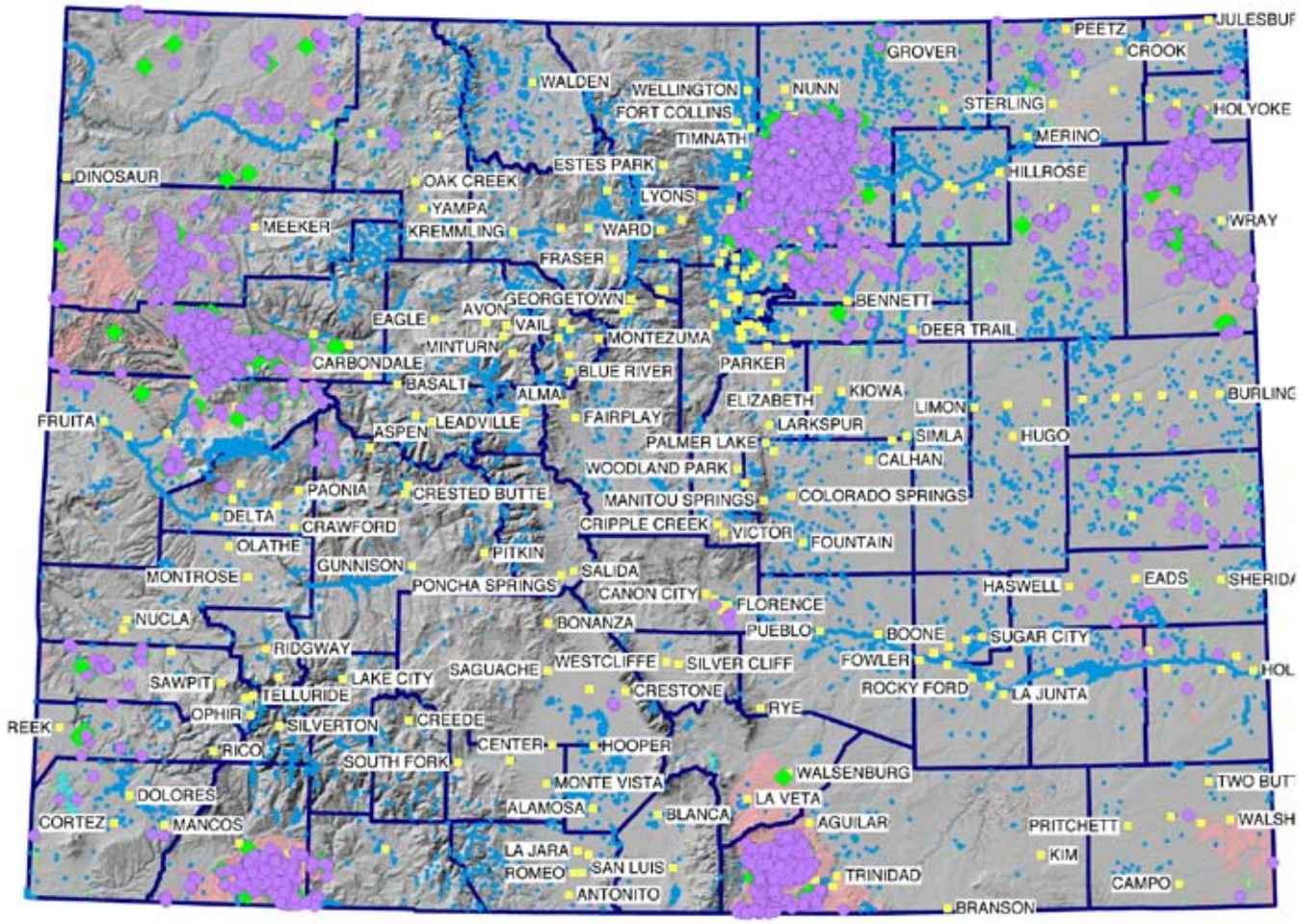
C. Energy Development

The Bush administration exempted construction activities on oil and gas sites from the CWA requirement that all construction activities on one acre or more of land be covered by a stormwater permit in 2005. However, Colorado still requires such permits. Due to the hard work of local governments, citizens, conservation groups, and staff at the WQCD, in 2006 the WQCC decided that continuing to require stormwater permits on oil and gas sites was necessary to protect Colorado's waters. Due again to the hard work of the same entities, the WQCC upheld that requirement in May 2007, after various exemptions and waivers were suggested by the energy industry.

Therefore, Colorado has in place the laws it needs to protect its waters from stormwater runoff from the quickly multiplying oil and gas sites around the state. The weakness, as noted above, is in its inspection and enforcement resources for stormwater permits. The recommendations to increase that power discussed above in Section A apply here as well.

As for other energy development-related water pollution, in order to monitor for pollution, it would help to know what chemicals the industry is using. Yet the Colorado Department of Public Health and Environment (of which the WQCD is a part) says it doesn't have "the resources, capabilities or authority" to demand this information.[293] The Colorado Oil and Gas Conservation Commission, which says it does have the authority, sees no need for such requirements.[294]

This information is necessary to fully protect our waters from pollution from Colorado's energy development boom. If our state agencies won't take action on their own, legislation or a citizen initiative to require energy companies to disclose the chemicals they are putting into our lands and waters may be warranted. Information gathered on chemicals used in oil and gas operations in western Colorado in 2006 by a local non-profit group revealed that toxic chemicals and carcinogens are used throughout the oil and gas development process.[295] Right now, we can only guess at the effect those chemicals are having on our aquatic life and water quality.



Oil and Gas Drilling Permits in Colorado. Purple dots are approved permits, green diamonds are pending permits. Map courtesy of the Colorado Oil and Gas Conservation Commission.

D. Agricultural Runoff

Though control of agricultural runoff is not required under the CWA, its control can be very beneficial to water quality. Agricultural producers will often implement controls if incentives and assistance are offered to help them with the design and implementation process. A number of sources can be tapped for this purpose.

Section 319 nonpoint source control grants are one such source. In fact, over 40% of these grants nationwide have been used to control NPS pollution from farms and ranches.[296]

For example, using Section 319 funds, North Carolina has successfully reduced the nitrogen and phosphorous coming from agricultural operations through a program that utilized BMPs, such as riparian buffer protection, reduced fertilizer use and implementation of conservation tillage practices.[297] Using these practices, agriculture met its goal of 30% nitrogen reduction in the Tar-Pamlico Basin ahead of schedule and more than 396,000 tons of sediment were prevented from being washed away by erosion.[298]

In Colorado, 63 projects aimed at reducing NPS pollution from agriculture were funded by Section 319 grants from 1990-2005.[299] Of the nearly $2 million of Section 319 funding given to the State of Colorado in 2005, $1.2 million were spent on nonpoint source activities in segments on the impaired waters/TMDL list.[300]

Another source states can use is the Clean Water State Revolving Fund (CWSRF), which provides reduced-rate loan funding for water quality projects of all kinds, including agricultural BMPs.[301] Many states have used their CWSRF programs to fund agricultural BMPs.[302]

In Delaware, staff from the Department of Agriculture and local conservation districts help agricultural producers complete needs assessments and plan and design projects, then the producers receive low-interest loans from the CWSRF to implement BMPs.[303] Through this program, Delaware has funded more than 341 agricultural projects at a cost of about $2.89 million.[304]

In Minnesota, there are many partners in the CWSRF/agricultural loan program.[305] Counties receive the loans from the CWSRF and manage agricultural loan programs at a local level.[306] Soil and water conservation districts assist farmers with needs assessments and project planning and design.[307] Local banks review loan applications and guarantee repayment of the loans in return for a percentage of the loan interest payments.[308] In this way, Minnesota has funded more than 1,961 agricultural projects at a cost of about $32.2 million.[309]

Buffer zones of vegetation between agricultural fields and rivers can be effective BMPS - © Micael Antonio Maria Nussbaumer, under license from Shutterstock.com

Lastly, West Virginia uses its CWSRF program to provide low-interest loans that farms use as the cost-share match for U.S. Department of Agriculture (USDA) grant programs.[310] Soil and water conservation districts help farmers with needs assessments and project planning and design and local banks review loan applications and guarantee loans for a percentage of the loan interest payments.[311] Through this program, West Virginia has funded more than 174 agricultural best management projects at a cost of about $3.9 million.

In addition to these funding sources, there are other cost-share programs with USDA and the CWCB that can be used to implement agricultural BMPs.[312] One such program, reauthorized through the 2002 Farm Bill, is the Environmental Quality Incentives Program (EQIP).[313] The EQIP program is a voluntary conservation program for farmers and ranchers that aims to marry agricultural production and environmental quality by offering financial and technical assistance to participants to install or implement structural and management practices on agricultural land.[314] EQIP may cost-share up to 75% of the costs of certain conservation practices with producers, and in some cases, with limited resource and beginning farmers and ranchers, may cost-share up to 90% of costs.[315] Reduction of NPS pollution is one of the national priorities for the EQIP program.[316]

While all of these funds should be tapped, they are very limited and cannot meet the $45 million per year cost to upgrade all of the irrigation systems in Colorado. Obviously, other measures will need to be used to decrease pollution from agricultural areas. Colorado may need to consider some legislation incentivizing or mandating pollution control by agricultural producers. The costs of these pollution control measures could be paid by some kind of tax or fee on consumers who buy and eat the products grown on the lands on which the pollution controls need to be installed.

E. Mining

Successful measures to address pollution from abandoned mine sites will need to combine some level of waiver for activities taken to further the cleanup with some measure of increased funding for cleanups or incentives to encourage private parties to undertake cleanups.

A Good Samaritan law that is narrowly drafted so that it protects true Good Samaritans from ongoing liability under the CWA for discharges directly related to remediation activities is needed. Such a law would enable groups like the Animas River Stakeholders Group (ARSG) to clean up highly contaminated watersheds like the Upper Animas River, which is impaired by tailings from abandoned gold, silver, lead and zinc mines from the historic Eureka mining district.[317]

River polluted by mining runoff – © Andrey Shchekalev, under license from Shutterstock.com

The ARSG is a collaborative effort involving more than 30 public and private interests focused on improving water quality and aquatic habitats in the Animas River watershed.[318] It was founded in1994 and has put more than $28 million into investigation and remediation of abandoned mines.[319] Liability concerns hamper the ARSG in its cleanup efforts; a Good Samaritan bill that shields it from ongoing CWA responsibilities would help the group accomplish more.[320]

However, a Good Samaritan bill that is too broad can do more harm than good. A successful bill should be narrowly drafted so that it allows governmental, non-profit, and private entities to act as Good Samaritans, as long as they have no responsibility for the site and no unresolved cleanup liability anywhere in the United States for an abandoned hardrock mine.

A Good Samaritan should be allowed to profit from recycling and reprocessing waste at the site, as long as its profits go to defray the costs of the remediation at that site or other appropriate abandoned mine sites. The waste from those activities should not cause a worsening of water quality below the conditions present at the beginning of the remediation process. The clean up standard for the site should be that the project must improve water quality to a significant degree from conditions present at the beginning of the remediation process and meet water quality standards to the maximum degree reasonably practicable. The bill should waive the ongoing requirements of the CWA only, not requirements from other environmental laws.

The other major impediment to cleaning up abandoned mine sites is a lack of funding. A hard rock mining trust fund, similar to the one established by the 1977 Surface Mining Control and Reclamation Act (SMCRA) to clean up abandoned coal mines, could assist with this issue.[321]

Under the SMCRA, all coal mining operators pay into the fund 35 cents per ton of coal produced by surface mining and 15 cents per ton of coal produced by underground mining.[322] The monies in the fund are used to reclaim coal mining operations that were abandoned before the passage of the SMCRA in 1977 and to reduce their negative impact on land and water resources.[323] Roughly $330 million per year is collected under this program and distributed across federal, state and tribal programs for abandoned mine cleanup.[324] A similar program for hardrock mining could help clean up the legacy of pollution the industry has left behind over the years.

Legislation has been unsuccessfully introduced in the U.S. Congress to establish a reclamation fee on hardrock mining and create a reclamation trust fund similar to the coal trust fund.[325] The mining industry has argued against such legislation, claiming that such a fee would adversely affect international pricing of their products.[326] Given the high prices of commodities such as gold, this argument is less than compelling.[327] In 2006, the gold produced in Colorado rose in value by 41%, and molybdenum produced in Colorado rose in value by 194%.[328]

Legislation at the state level to implement a hard rock mining trust fund in Colorado might be more successful. According to the Colorado Division of Reclamation Mining and Safety, there are 1,700 active non-coal mines in Colorado.[329] According to the Colorado Mining Association, hardrock mining generates close to $1.3 billion per year in sales revenue.[330] Some sort of tax or fee on production or processing of these minerals would go a long way to cleaning up Colorado's abandoned mines.

F. The Bias of the Prior Appropriation System

Colorado's prior appropriation system needs to

integrate protection of water quality into its bias towards protecting water rights at all costs. HB 1132 was a great step in this direction, but it is a small step. Provisions allowing consideration of water quality in other water court proceedings would be further steps in the right direction.

While separate pieces of legislation that integrate water quality considerations into the water rights system piecemeal would be steps in the right direction, really what is needed is a major overhaul. This could be done through the repeal of Section 104 of the CWQCA.

This section states that nothing in the CWQCA can cause a "material injury to water rights."[331] Its effect is to allow water rights holders to claim no responsibility to assist in water quality protection if there would be an adverse effect on the exercise of their water rights. This section, in fact, embodies the bias of the prior appropriation system towards the removal of water from streams for use. It acts as a trump card of water rights over water quality.

Changing it would be a gargantuan task politically, as water rights holders have very powerful voices in Colorado and would fight it tooth and nail. While it may not be politically feasible right now, however, no discussion of integrating water quality into the prior appropriation system would be complete without it.

The other major issue with the prior appropriation system that needs to evolve is its effect of encouraging inefficient uses of water. In an arid environment such as Colorado's, water conservation needs to be encouraged, for the health of our ecosystem as well as for the efficiency of our water use system. Currently, Colorado operates under a "use it or lose it" system, where water users only have a right to the amount of water they put to beneficial use. Therefore a farmer who applies 60 cubic feet per second (cfs) to her field via flood irrigation retains the right to that 60 cfs of water. However, if she were to install drip irrigation, thereby reducing her requirements for that field to 30 cfs, she would lose the right to, and value of, that other 30 cfs because she would no longer be putting it to beneficial use. In an arid environment, or any environment for that matter, this system is backwards.

With the competition for our finite supply of water growing, we must move to a system that encourages and rewards efficient use of water. One such measure would be an agricultural salvage bill.

A "salvage" bill would change water law to allow an irrigator who increases his efficiency to benefit from that action by retaining the ability to sell or lease that water to another water user. This would give irrigators a big incentive to implement efficiency measures because they could make money from the water they save. It would also free up potentially huge amounts of water that could be used elsewhere in the system, whether by cities or to protect our ecosystems and water quality. The

Xeriscaped yard – Photo courtesy of www.xeriscape.org

salvage issue has some technical complexities in determining the amount of water that is available for salvage, but if these can be figured out, and some mechanism can be put in place to leave some of the salvaged water in streams, this is a potentially beneficial direction to turn as we look to find ways to protect our water quality.

In addition to agricultural conservation, Coloradans need to increase the efficiency of our residential and urban landscape irrigation. Colorado is an arid climate, not meant to support the types of landscapes that flourish on the East Coast of the U.S., such as Kentucky bluegrass and water-hogging shrubbery. Coloradans need to accept this and embrace the limitations of the climate in which we live by modifying our landscapes to fit our environment.

We can do this by xeriscaping our yards and therefore using less water. Currently, over 50% of residential water use in Colorado is applied to lawns and landscaping.[332] Xeriscaping can reduce landscape water use by 60%.[333] This is water savings that we cannot afford not to make as our population grows and the competition for our limited water supply increases.

Major water providers on the Front Range have voluntary programs that encourage water conservation. However, as anyone driving around Colorado's cities knows, this is NOT working. Most lawns are still all bluegrass and people still water their lawns, flowers, etc. at all times of the day and night, through rainstorms, and with undue frequency. To successfully implement residential/urban efficiency, more than encouragement of voluntary measures is needed. Legislation requiring xeriscaping or water rate/price structures that provide a price incentive for consumers to use water more efficiently would be worthwhile options.[334]

All of these measures to increase the efficiency of our water use can benefit our water quality. Less overwatering of croplands and residential landscapes alike will result in less runoff into our rivers and streams of nutrients, sediment and chemicals. Also, less water needed for these uses will free up more water in our overappropriated system. This water can be used to protect our water quality and the natural environment Coloradans love and rely upon.

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