Bear Creek Watershed Association

2007 Annual Report for the Water Quality Control Commission

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April 28, 2008

The Bear Creek Watershed Association protects & restores water & environmental quality within the Bear Creek Watershed from the effects of land use

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Bear Creek Watershed Control Regulation

The Bear Creek Watershed (Figure 1) is recognized by the Denver Regional Council of Governments in *the Metro Vision 2020 Clean Water Plan* (DRCOG 1998) as a specific geographic area requiring special water quality management. The watershed includes all tributary water flows that discharge into Bear Creek Reservoir. The watershed extends from the Mount Evans Wilderness toward the west to the Town of Morrison on the eastern end. The two major tributaries are Bear Creek and Turkey Creek. Water quality in Bear Creek Reservoir and its watershed is managed through implementation of requirements defined in the Bear Creek Watershed Control Regulation (Regulation #74, 5 CCR 1002-74) (Control Regulation). The Control Regulation uses the same geographic area of the Bear Creek Watershed as designated by DRCOG. The goal of the Control Regulation is to attain site-specific water quality standards through control of total phosphorus. The total phosphorus standard and Control Regulation for Bear Creek Reservoir differ from other control regulations because the total phosphorus standard derives from a narrative standard (Regulation #38, 5 CCR 1002-38). The Bear Creek Watershed Association (Association) oversees implementation of the Control Regulation.

Bear Creek Watershed Association

The Association is the local water quality management agency responsible for implementation of monitoring and tracking water quality in the Bear Creek Watershed (Figure1). The Association membership includes counties, local general-purpose governments, special districts (wastewater dischargers), associate agencies, and local citizen groups (Table1). The Association membership monitors point sources and characterizes nonpoint source practices, programs and loadings within the watershed. The Association management and implementation programs are at a watershed level.

The Association provides watershed reporting as posted on the Association website www.bearcreekwatershed.org, which serves to keep local governments and others informed on the state of the watershed. The Control Regulation defines specific reporting requirements, which helps the Association keep the Water Quality Control Commission and Water Quality Control Division staff updated on progress of the Association in implementing the Control Regulation.

Table 1 Bear Creek Watershed Association Membership and Dischargers

Members and Associates	Wastewater Discharger	2007 Association Participation
Counties		
Jefferson County		**Active**
Clear Creek County		**Active**
Park County		**Not Active**
City and Towns		
City of Lakewood		**Active**
Town of Morrison	**Yes**	**Active**
Water & Sanitation Districts		
Aspen Park Metropolitan District	**Yes**	**Active**
Bear Creek Cabins	**Yes**	**Not Active**
Brook Forest Inn	**Yes**	**Not Active**
Conifer Sanitation Association	**Yes**	**Active**

Members and Associates	Wastewater Discharger	2007 Association Participation
Conifer Metropolitan District	**Yes**	**Active**
Evergreen Metropolitan District	**Yes**	**Active**
Forrest Hills Metropolitan District	**Yes**	**Not Active**
Genesee Water & Sanitation District	**Yes**	**Active**
Geneva Glenn	**Yes**	**Not Active**
Jefferson County School District (Conifer High School & Evans Outdoor School)	**Yes**	**Intermittent**
Kittredge Water & Sanitation District	**Yes**	**Active**
Lost and Found Inc.	**Yes**	**Active**
The Fort Restaurant	**Yes**	**Intermittent**
Tiny Town Foundation, Inc.	**Yes**	**Not Active**
West Jefferson County Metropolitan District	**Yes**	**Active**
Associate Agencies		
Aspen Park Homeowners Association		**Active**
Colorado Department of Transportation		**Intermittent**
Denver Regional Council of Governments		**Active**
Department of Public Health & Environment		**Active**
Jefferson County Health Department		**Active**
Natural Resources Conservation Service		**Active**
U.S. Army Corps of Engineers		**Intermittent**

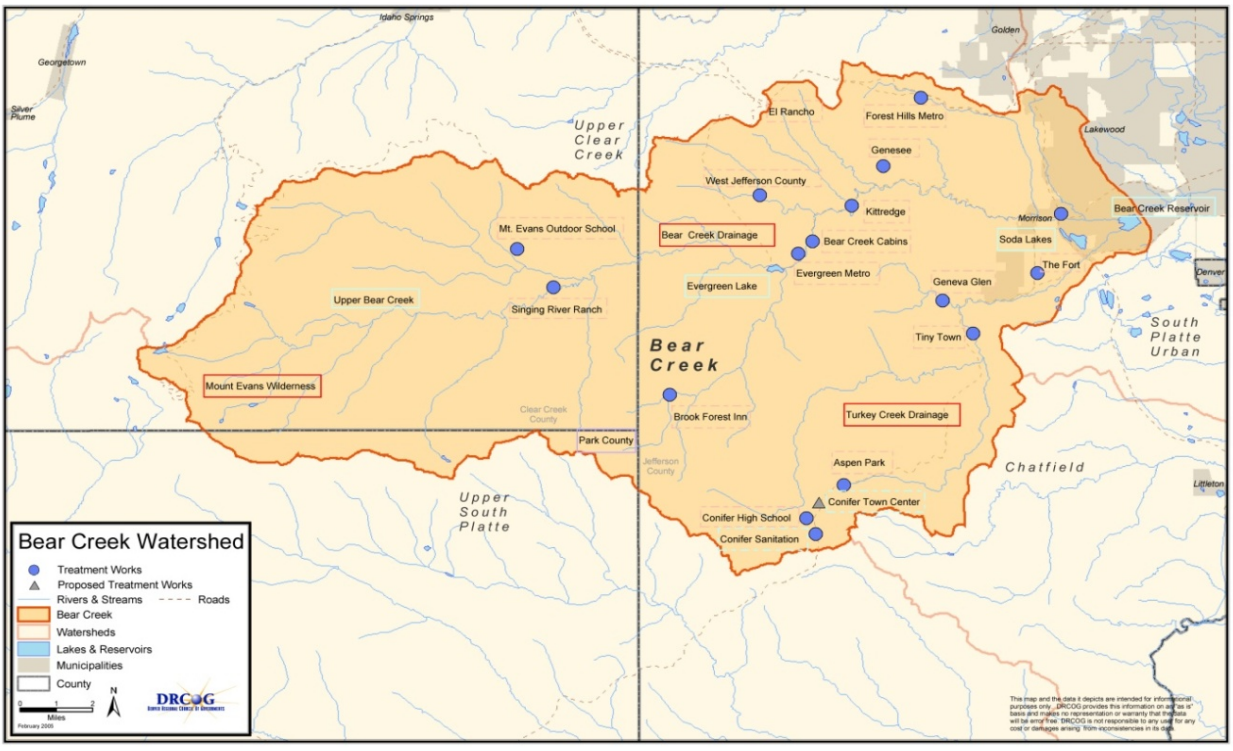


Figure 1 Bear Creek Watershed

Control Regulation Requirements

The Control Regulation (Regulation #74; 5 CCR 1002-74) identifies the Association's annual reporting requirements for presentation to the Water Quality Control Commission. The Association also produces reports on additional activities. The remainder of this report addresses these reporting requirements:

The reporting requirements as listed in the Control Regulation are:

1. Summarize status of water quality in the watershed for the previous calendar year.

2. Information on the wastewater treatment facilities loading and compliance with permit limitations

3. The nonpoint source loading and appropriate best management practices,

4. In-stream and reservoir data analyses that indicate whether water quality goals and standards for the watershed are being met.

5. Information about water quality projects planned or implemented in the watershed

6. Information on phosphorus trading programs.

Status of Water Quality in the Reservoir and Watershed

2007 Hydrology

Evaluation of water quality in the reservoir includes examination of the basin hydrology, as well as chemistry. Figure 2 shows the 1986-2007 annual flow discharge in Bear Creek Reservoir. Bear Creek Watershed demonstrated some drought flow recovery from 2003 through 2005; the hydrology shows a return to drought runoff conditions in 2006. In 2007, the total annual discharge into Bear Creek Reservoir increased to about 55,500 acre-feet per year. Figure 3 shows the 2007 reservoir monthly inflow. Peak runoff periods occurred in March and May 2007. The historic peak runoff period was June. The watershed hydrology remains low in recent years.

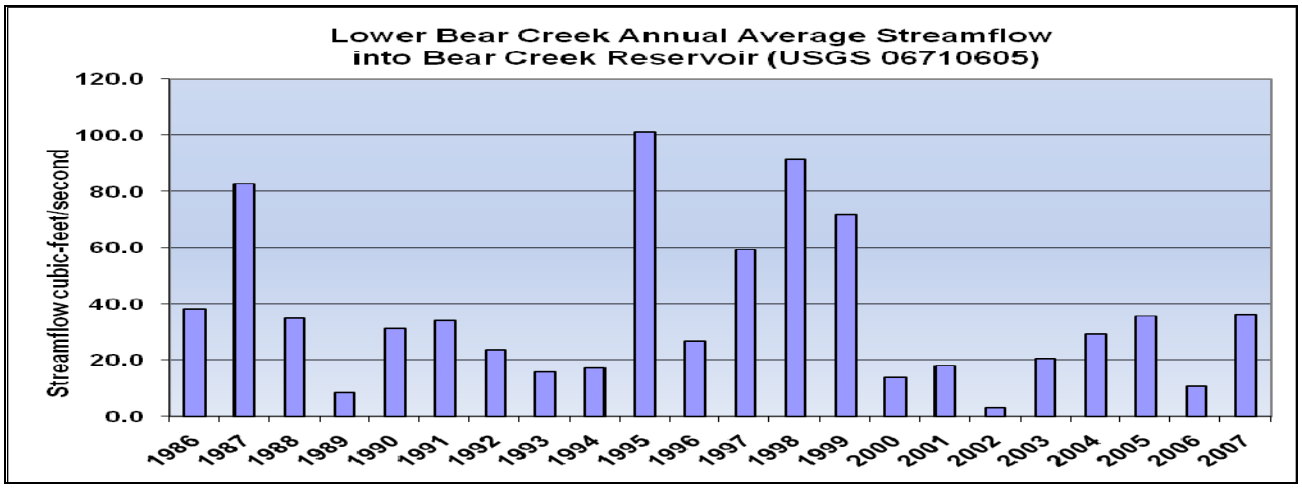


Figure 2 Annual Flow into Bear Creek Reservoir

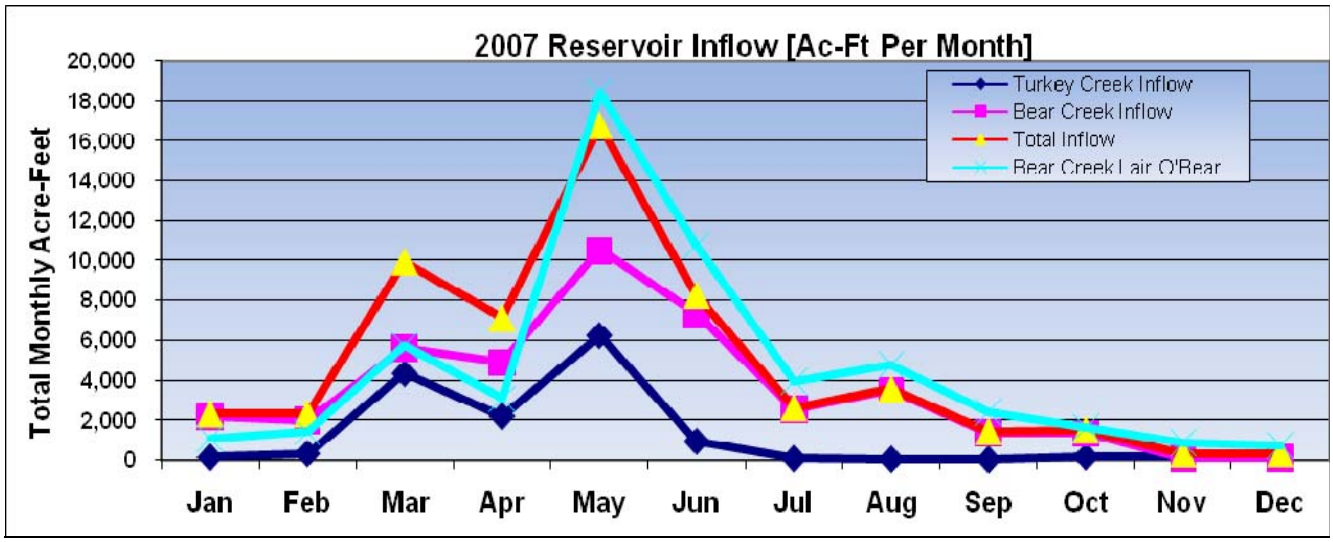


Figure 3 2007 Inflow at Bear Creek Reservoir

2007 Nutrients

The monitoring program characterizes nutrient loading into Bear Creek Reservoir from two primary drainages: Bear Creek and Turkey Creek drainages. The total phosphorus load from the watershed comes from a combination of wastewater treatment plant point source loads and nonpoint sources, including runoff. The estimated total phosphorus load in 2007 from all sources reaching the reservoir was 6,357 pounds at a flow of about 55,500 acre-feet. Bear Creek drainage contributed 71% of the load (Figure 4). The nitrate (60,225 pounds) loading was typical of past moderate flow conditions (Figure 5). Although the point source discharges of total phosphorus were about 1,874 pounds, the water diversions above the reservoir are removing a portion of this phosphorus load and inflow water before it reaches the reservoir.

Figure 6 shows the 2007 total phosphorus concentration as predicted from the routine watershed monitoring stations. Figure 7 shows the 2007 nitrate concentration from the routine watershed monitoring stations.

The management program targets reduction of total phosphorus reaching the reservoir on an annual basis. Figure 8 shows the total phosphorus inflow. The nitrogen data has shown greater fluctuation over the years with no clear pattern (Figure 9).

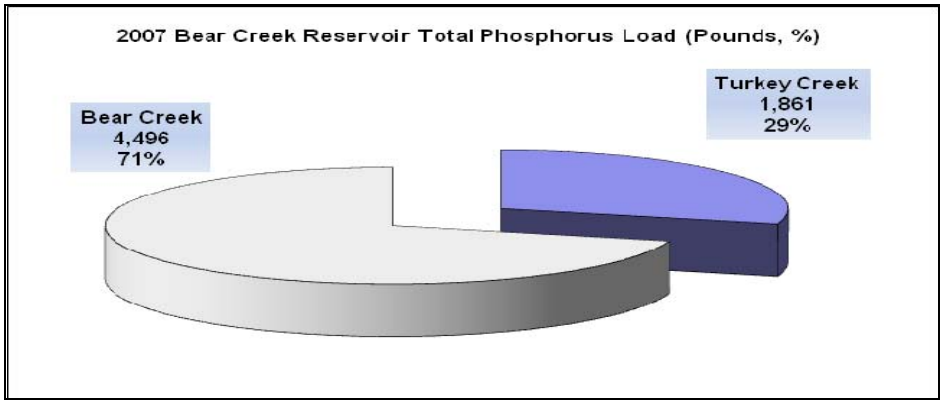


Figure 4 Estimate Total Phosphorus loading in 2007

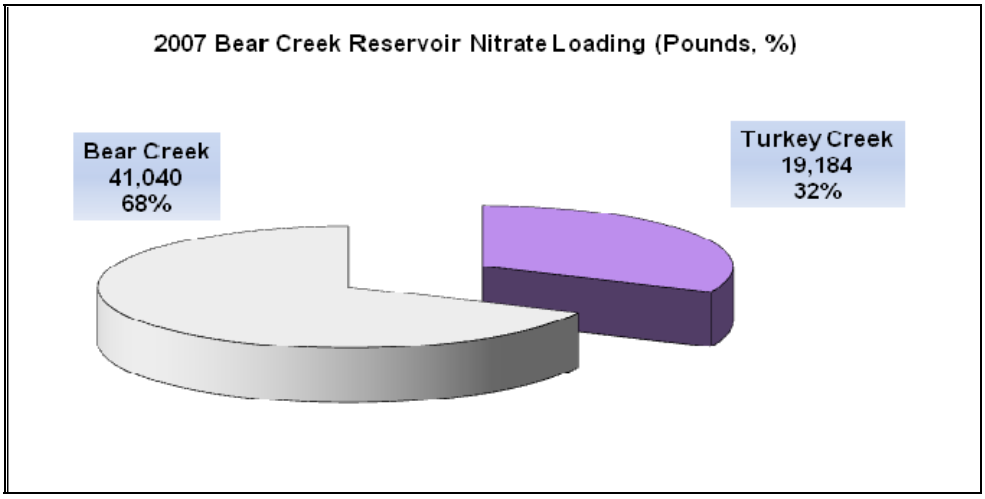


Figure 5 Estimate Nitrate loading in 2007

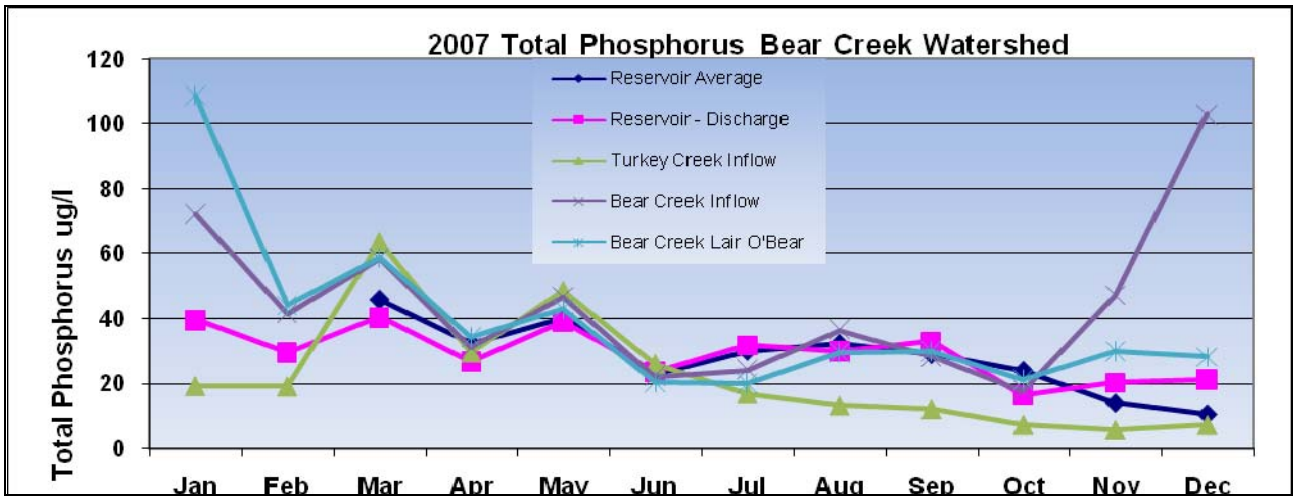


Figure 6 2007 Total Phosphorus

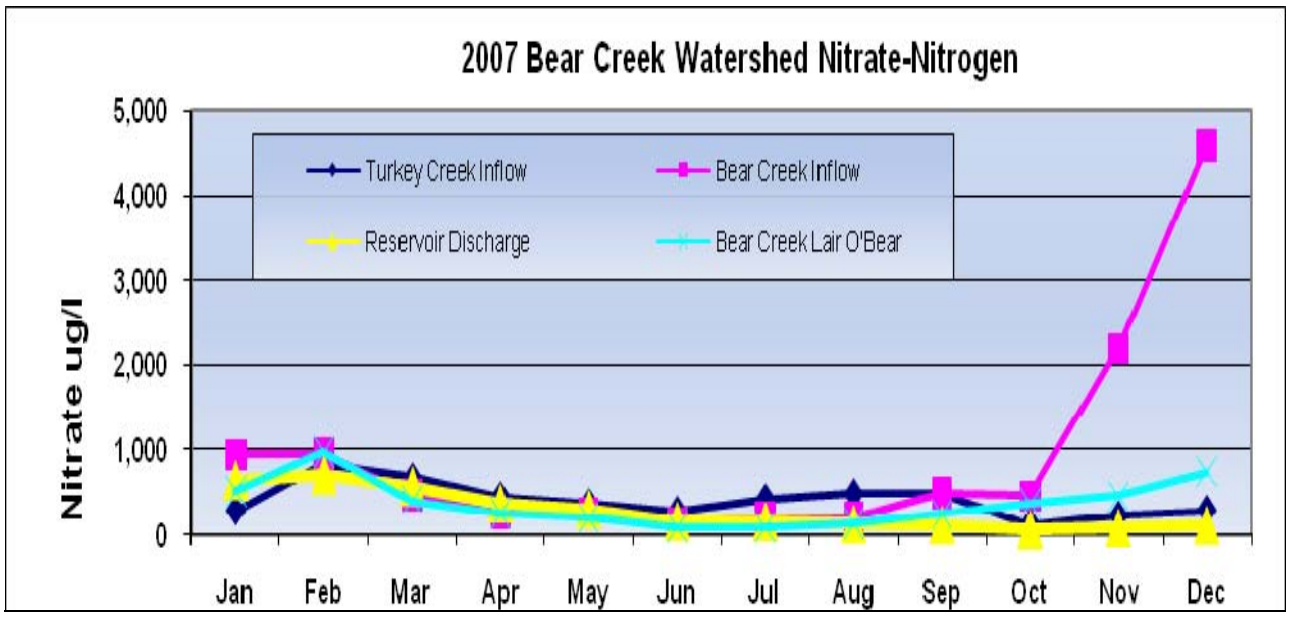


Figure 7 2007 Nitrate

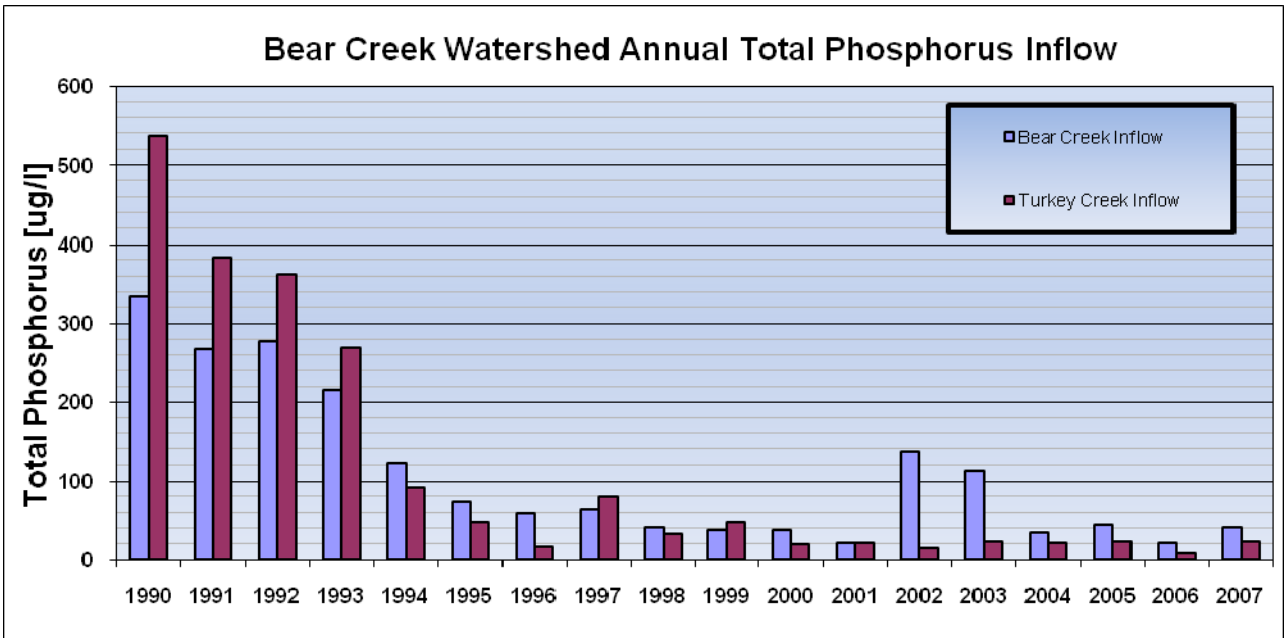


Figure 8 Annual Total Phosphorus Inflow

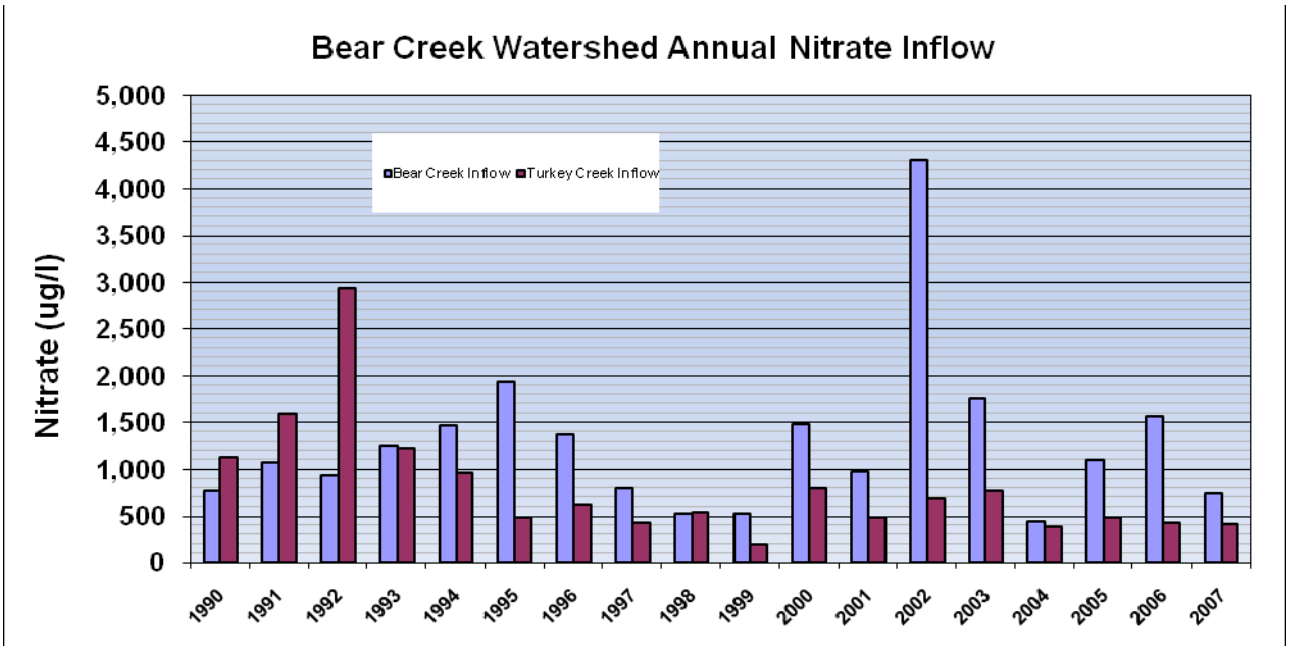


Figure 9 Annual Nitrate Inflow

2007 Trophic State of Reservoir

Colorado State Regulation #38 also lists a narrative phosphorus standard for Bear Creek Reservoir. The reservoir narrative standard requires shifting the reservoir trophic index from a eutrophic-hypereutrophic condition toward the mesotrophic-eutrophic boundary condition:

> Narrative Phosphorus Standard for Segment 1c of Bear Creek. *"Concentrations of total phosphorus in Bear Creek Reservoir shall be limited to the extent necessary to prevent stimulation of algal growth to protect beneficial uses. Sufficient dissolved oxygen shall be present in the upper half of the reservoir hypolimnion layer to provide for the survival and growth of cold-water aquatic life species. Attainment of this standard shall, at a minimum, require shifting the reservoir trophic state from a eutrophic and hypertrophic condition to a eutrophic and mesotrophic condition."*

The Association's reservoir monitoring program collects samples to analyze nutrient (nitrogen and phosphorus) concentrations, chlorophyll-a, total suspended sediments and Secchi depth as trophic index variables. Table 2 presents data summaries for these trophic indicators. The Association analyses these trophic parameters to predict attainment with the narrative standard. Table 3 summarizes the 2007 reservoir data compared with the long-term patterns from 1991 through 2006.

The monitoring data indicates management efforts have helped shift the trophic index away from the poor hypereutrophic conditions originally monitored in the reservoir (Association 2006). Generally, the reservoir trophic state in 2007 was eutrophic (Walker and Carlson Indices). The reservoir had several algal blooms in 2007 as evident by the peak chlorophyll concentration of 50.2 ug/l. However, the 2007 bloom frequency is reduced over the historic monitoring period with fewer big blooms that lasted for a shorter duration. Figure 10 shows the 2007 surface chlorophyll concentration. The peak phytoplankton density in 2007 was 18,750 cells/ml caused by a green phytoplankton species. Historically, blue-green phytoplankton species caused major blooms. The 2007 zooplankton diversity in the reservoir is comparable to historic observations.

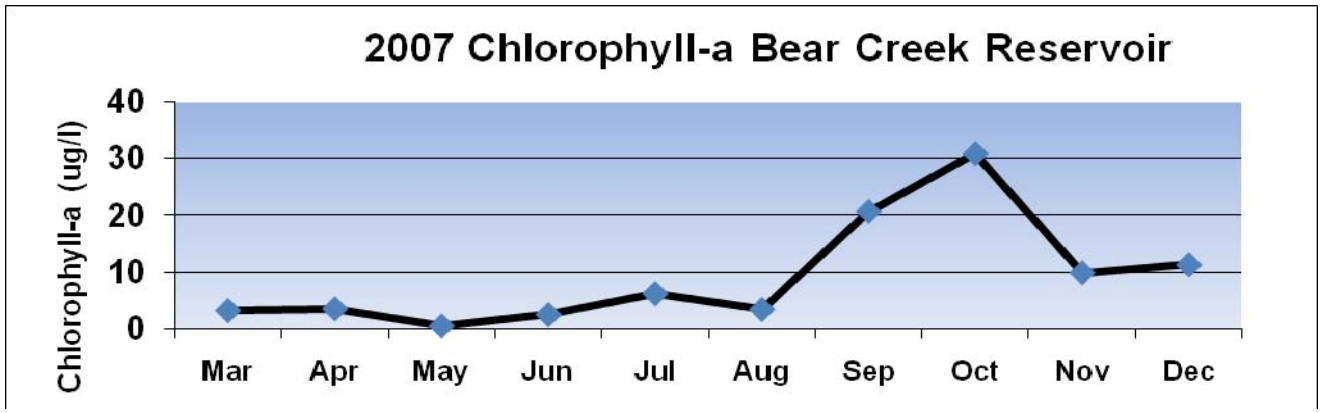


Figure 10 2007 Chlorophyll

The reservoir aeration system appears to help reduce chlorophyll productivity, possibly through the partial control of internal nutrient loading that can trigger algal blooms. The City of Lakewood operated aeration system helps prevent a dissolved oxygen problem in the reservoir bottom waters. The current aeration system has been operational since the summer of 2002 and uses a fine-bubble diffusion system with aerators distributed across the reservoir bottom.

The total suspended sediment load in the reservoir has been generally constant over the historic monitoring period with periodic storm events dumping large volumes of sediment into the reservoir. The Association has measured a reservoir maximum depth decline of about 3 meters (10-11 feet) since 1991 (Association 2006). The Association in 2007 measured no significant change in reservoir depth. Bottom sediments remain a mixture of fine sand, silt and mud. At the Authority's primary reservoir monitoring station, bottom sediments in 2007 were predominately-fine mud.

Table 2 Bear Creek Reservoir 2007 - Selected Trophic Indicators

Growing Season June to September

Trophic Indicator	Reservoir
Chlorophyll	
Average Growing Season Chlorophyll-a [ug/l (surface waters only)]	6.5
Average Annual Chlorophyll-a [ug/l (surface waters only)]	9.3
Peak Chlorophyll-a [ug/l]	50.2
Phosphorus	
Average Annual Total Phosphorus [ug/l]	30.7
Seasonal Annual Total Phosphorus [ug/l]	28.6
Peak Annual Total Phosphorus [ug/l]	50.3
Average Annual Ortho Phosphorus ug/l]	9.8
Seasonal Average Ortho Phosphorus [ug/l]	10.2
Peak Annual Ortho Phosphorus [ug/l]	24.4
Nitrogen	
Average Annual Nitrate-Nitrogen [ug/l]	229
Seasonal Average Nitrate-Nitrogen [ug/l]	145
Peak Annual Nitrate-Nitrogen [ug/l]	575
Clarity	
Average Annual Sechhi Depth (meters)	1.7
Seasonal Average Secchi Depth (meters)	2.5
Total Suspended Sediments	
Annual Average Total Suspended Sediments [mg/l]	9.8
Seasonal Average Total Suspended Sediments [mg/l]	7.3
Peak Total Suspended Sediments [mg/l]	18.3
Phytoplankton Species	
Phytoplankton Species Co-dominant Species: *Asterionella formosa, Ankyra judayi, Chlorella minutissima, Choricystis minor, Chromulina sp., Cryptomonas curvata, Plagioselmis nannoplanctica, Anabaena lemmermannii, Aphanothece smithii, Microcystis aeruginosa, Chrysochromulina parva, Monomastrix sp.*	
Peak Phytoplankton Density	
Chlorella minutissima	18,750 cells/ml
Zooplankton Diversity	
species Copepoda	8 species
species Cladocera	6 species
species Rotifera	20 species

Table 3 Reservoir Summary for Select Trophic Parameters

Parameter	Site	Reservoir Annual Average Concentrations	
		2007	91-07 Mean
Chlorophyll-a (ug/L)	Top	**9.3**	**14.8**
	Mid		**9.4**
	Water Column	**9.3**	**12.3**
Nitrate-Nitrogen (ug/L)	Top	**222**	**347.3**
	Mid	**234**	**338.5**
	Bottom	**233**	**318.6**
	Water Column	**229**	**333.7**
Total Phosphorus (ug/L)	Top	**29.7**	**64.4**
	Mid	**31.5**	**63.7**

Parameter	Site	Reservoir Annual Average Concentrations	
		2007	91-07 Mean
	Bottom	**30.8**	**93.4**
	Water Column	**31**	**74.0**
Total Suspended Solids (mg/L)	Top	**5.7**	**6.3**
	Mid	**5.7**	**6.9**
	Bottom	**6.0**	**10.0**
	Water Column	**6**	**7.8**
Secchi Depth (m)	Top	**1.7**	**2.2**

Wastewater Treatment Facilities Loading and Compliance

Wasteload Compliance

The total wasteload allocation of phosphorus from all wastewater treatment facilities in the Bear Creek Watershed is 5,255 pounds per year. Table 4 lists the permitted wastewater treatment facilities. Each individual discharger in the Bear Creek Watershed is limited to an annual wasteload of total phosphorus, except as provided through trading provisions. Wastewater discharges cannot exceed a total phosphorus effluent concentration of 1.0 mg/l as a 30-day average. All reporting facilities were in attainment with the assigned wasteload allocation (Table 4). There were several violations of permit effluent limits reported to the Association in 2007.

Table 4 Treatment Facility Wasteload Allocations

Treatment Plant	Phosphorus Pounds/ year	2007 Phosphorus Pounds/ year
Evergreen Metropolitan District	**1,500**	**380.31**
West Jefferson County Metro District	**1,500**	**799.41**
Genesee Water and Sanitation District	**1,015**	**471.4**
Town of Morrison	**600**	**75.0**
Kittredge Sanitation and Water District	**240**	**79.47**
Jefferson County Schools - Conifer High School	**110**	**2.0**
Forest Hills Metropolitan District	**80**	**54.15**
Conifer Sanitation Association	**40**	**0.51**
Aspen Park Metropolitan District	**40**	**3.64**
Conifer Metropolitan District	**40**	**3.65**
Lost and Found Inc. - Singing River Ranch	**30**	**1.3**
Jefferson County Schools – Mt. Evans Outdoor School	**20**	**1.6**
The Fort	**18**	**No Monitoring**[2]
Geneva Glen	**5**	**No Discharge**[3]
Bear Creek Development Corp. - Tiny Town	**5**	**0.22**
Bear Creek Cabins (Bruce & Jayne Hungate)	**5**	**0.52**
Brook Forest Inn	**5**	**4.1**
Reserve Pool	**2**	**Not used**
Total Phosphorus Wasteload	**5,255 lbs/year**	**1,877.28**

1 Forest Hills Metro District has trade agreement with West Jefferson County Metro District and complies with permit. 114.24 pounds was added into the West Jefferson County allocation, which was 482 pounds for a total West Jefferson County Metro District discharge of 800 pounds.
2 Site application complete; Permit Development; No established monitoring;
3 The Geneva Glen treatment plant is not discharging as reported to the Association by the WQCD.

Permit Compliance and Plant Expansions/Actions

Table 5 shows permitted wastewater treatment facilities in the Bear Creek Watershed, summarizes status of wastewater planning, and reported permit compliance problems. All wastewater treatment plants in the Bear Creek Watershed are classified as minor facilities using the WQCD permit classification system. This clarification is important because of permitting implications.

The Evergreen Metro District put on line in 2007 its new 2.0 million dollar aerobic digester facility. This facility allowed the District to convert digester capacity from the old plant into aeration tank capacity; thereby increasing the plant's capacity to maintain nitrifying bacteria in the winter. The Districts plans to address, in the near future, additional secondary clarification, and tertiary filtration needs. Along with this design change, there will be a replacement cover over the secondary treatment building.

The wastewater treatment system at the Singing River Ranch in the upper part of the watershed was taken over by Lost and Found, Inc. The Association in 2007 worked with Lost and Found, Inc. on facility review and operation as part of a rezoning request with Clear Creek County. An updated wastewater utility plan is anticipated for the treatment works in the near future. The Association has identified concerns with the existing discharge permit.

The Association also worked on planning and review efforts for Morrison, The Fort Restaurant, Forest Hills Metropolitan District, Aspen Park Metropolitan District, Conifer Metropolitan District, Conifer Sanitation Association, and the Jefferson County Schools Mt. Evans Outdoor School. The Association provided data to the WQCD for development of a new stream model for use in discharge permits for facilities in the Bear Creek drainage.

Table 5 Wastewater Planning Status

Facility	Wastewater Utility Plan	Any Updates, Lift Station, or Amendments	Facility Upgrades [2008-2012]	Compliance Problems
Evergreen Metropolitan District	Yes	Yes	Yes	80% hydraulic capacity - May
West Jefferson County	Yes	Yes	Yes	80% hydraulic capacity - April, May; PO4 - 1.0 mg/L - Sept.
Genesee	Yes	no	no	Phosphorus Dec
Kittredge	Yes	Yes	no	No
Morrison	Yes	no	yes	No
Jefferson County Schools Conifer High School	Yes	no	yes	No
Jefferson County Schools Mt Evan Outdoor	No	no	no	No
Forest Hills Metropolitan District	No	Yes	yes	No
Conifer Sanitation Association	Yes	Connect with CMD; New Lift Station	no	No
Aspen Park Metro District	Yes	Amend utility plan	yes	No
Conifer Metro District (CMD)	Yes	no	no	No
The Fort	Yes	Utility plan/ site application	yes	No
Bear Creek Development	No	no	no	No
Davidson Lodge	No	no	no	Yes
Lost and Found	No	re-issued permit	yes	No
Brook Forest Inn	No	no	no	No
Geneva Glen	Yes	no	no	No

Trading Program

The Association maintains a pollutant-trading program as defined in *Trading Guidelines* (Association 2006) and in *Bear Creek Reservoir Control Regulation #74* for total phosphorus trades specific to the Bear Creek Watershed:

1. Point source to point source trades (regulation and permit); and

2. Nonpoint source to point source total phosphorus trading specific to the Bear Creek Watershed (*Trading Guidelines*).

The *Bear Creek Trading Guidelines* allows permitted point source dischargers (Colorado Wastewater Discharge Permits) to either receive phosphorus pounds for new or increased phosphorus wasteload allocations in exchange for phosphorus loading reductions from nonpoint source pollutant reduction or through approved point source trades. Table 6 lists all Association trades. The reserve pool remained at 2 pounds and no changes were made in 2007. The trades in the watershed remain consistent with the total wasteload allocations listed in Table 4.

Table 6 Phosphorus Trading Activity in Bear Creek Watershed

Involved Agencies	Type of Trade	Active Trading in 2007
Forest Hills Metro District (FHMD) has trade agreement with West Jefferson County Metro District(WJCMD)[1]	Point Source to Point Source	Yes (reflected in WLA; see Table 4)
City of Lakewood Coyote Gulch Project	Nonpoint source trade credits	Under review by Association; no trade credit assigned in 2007
The Fort Restaurant	Reserve Pool to Point Source	Site Approval and Utility Plan Complete; Permit in Progress; Trade reflected in reserve pool limit previously granted by the WQCC
Jefferson County Schools (Conifer High School and Mt. Evans Outdoor School	Point Source to Point Source	In Discharge Permits; no change in pounds; reallocation between faculties
Conifer Metropolitan District	Reserve Pool to Point Source	Facility operational in 2007; trade reflected in reserve pool limit previously granted by the WQCC

[1]The trade agreement is between WJCMD and FHMD for phosphorus removal. FHMD is allowed to discharge PO4 at a concentration of 1.0 mg/L. WJCMD agrees to remove the remainder. The calculations are as follows:

- Total lbs of PO4 FHMD is allowed to discharge is calculated by Flow X 1.0 mg/L X 8.34
- mg/L is subtracted from the FHMD reported average monthly concentration
- This is the concentration of PO4 WJCMD agrees to remove
- Total lbs of PO4 WJCMD removes is calculated by FHMD flow X concentration X 8.34
- The total lbs of PO4 discharged by WJCMD is calculated by the total of WJCMD + Excess FHMD PO4 pounds

Regulated Stormwater Management

City of Lakewood has a municipal separate storm sewer permit. Lakewood supports many stormwater management programs, including the *Rooney Road Recycling Center*, which also serves as watershed prevention BMP. Lakewood collected waste products for proper disposal (includes oil, paint, antifreeze, misc. chemicals, and solid wastes) from an Evergreen area collection in 2007. This process keeps materials out of septic systems and illegal

dumping in watershed. Lakewood regularly reports to the Association on stormwater management programs.

Jefferson County also has a municipal separate storm sewer permit. Jefferson County implements six minimum control measures:

- Public Education and Outreach
- Public Participation and Involvement
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control
- Post Construction Site Runoff Control
- Pollution Prevention/Good Housekeeping

The county provides opportunities for residents and visitors in the Bear Creek Watershed to learn and be involved in environmental stewardship and programs that promote water quality. The county completed a storm sewer outfall map to trace sources of potential illicit discharges and illegal dumping in the watershed. More information about municipal separate storm sewer system permittee activities is provided in Appendix A.

Nonpoint Source Loading and Appropriate Best Management Practices

Septic System Management

Water quality impacts are predicted from onsite wastewater systems in a number of specific areas in the Bear Creek Watershed. However, the magnitude and nature of these problems requires further verification in the watershed. In fact, few well-documented studies in Colorado directly link water quality or health risks with onsite wastewater systems (*Recommendations of the Individual Sewage Disposal System Steering Committee*, February 14, 2002, WQCC). Although few site-specific studies are available, it appears substantial cumulative loadings of nutrients to Bear Creek Watershed waters are likely occurring in some areas where there are a significant total number and density of onsite wastewater systems (Association 2006). There are areas of known nitrate contamination and increased nitrate levels in ground water, including alluvial groundwater, in areas of high density (lots less than one acre) and a significant number of homes (Bossong, 2002; Bossong et.al., 2003).

In some surface water basins, phosphorus loadings from onsite wastewater systems are a potentially significant water quality factor. Water quality monitoring in the Bear Creek Watershed over an 18-year period has shown that there is a potential phosphorus-loading problem in the Bear Creek watershed. Screening surveys completed by the Association show elevated levels of phosphorus in areas with a higher density of on-site wastewater systems, such as the community of Idledale (Bear Creek Watershed Association, 1998; 1997 Bear Creek Watershed Association Annual Report; Bear Creek Watershed Association, 1997a, *Management Program Review and 1990-1995 Water Quality Summary*).

In 2007, the Association renewed discussions with Jefferson County with presentations made to the Jefferson County Board of Health and the Jefferson County Commissioners. Jefferson and Clear Creek counties are reviewing their septic system regulations.

Watershed Program Elements

The management of nonpoint sources in the Bear Creek Watershed is a component of the Association membership planning and management programs. Based on water quality data,

point source controls have reduced phosphorus loading to Bear Creek Reservoir. However, phosphorus reduction from nonpoint sources is still required to achieve the reservoir goal of a mesotrophic & eutrophic boundary system as measured by modeled trophic indexes. A lack of available Association resources and implementation authority limit the nonpoint source program. Table 7 shows other management strategies and associated implementation tools used by the Association.

Table 7 Association Nonpoint Source Management Strategies

Association Management Strategies	Specific Implementation Tools
1. Local support	1. Local involvement in associated programs & activities; presentations; information source 2. Review agency for community plans 3. Provide data and information support to other agencies and special projects 4. Provide educational support and information 5. Partnerships with other groups and agencies 6. Technology transfer
2. Stable funding source	7. Member funding support 8. Seek nonmember funding and grants
3. Provide recommendations to Counties on projects (Referral Agency)	9. Referral agency for land use projects in Jefferson County and Clear Creek County 10. Low impact Development Policy 11. Manure management Policy 12. Septic Management Policy 13. Maintain a list of appropriate best management practices for review
4. Characterize water quality	14. Maintain water quality monitoring network to measure inputs & output from the reservoir
5. Track nonpoint source nutrient loading in Bear Creek & Turkey drainage systems	15. Characterize nutrient loading from the two major drainage systems: Turkey Creek & Bear Creek
6. Maintain watershed & reservoir models	16. Maintain & use reservoir models (Trophic index, Secchi depth and nutrient loading) developed during the Clean Lake Study
7. Annually review best management practices	17. Update BMPs as appropriate
8. Actively promote the implementation of water quality projects & activities	18. Maintain a repository of documents, data & other information; support local water quality plans and efforts as feasible
9. Support other watershed efforts and groups	19. Continued involvement in groundwater studies, ISDS regulation review & sediment & erosion control
10. Waste Stream Collection & Disposal	20. Lakewood and Jefferson County collect waste products for proper disposal (includes oil, paint, antifreeze, misc. chemicals, and solid wastes). This process keeps materials out of septic systems and illegal dumping in watershed 21. Association promotes programs and provides education and information

Association Review Policies

The Association has adopted a limited number of "policies" to help with management of the watershed program. The Association is a referral agency to land use agencies within the Bear Creek Watershed, including cities and counties. The Association reviews referral applications for consistency with local, regional and state water and environmental regulations, associated policies and the watershed management plan. To assist the Association in the referral process a "Referral Review Guidance" (Association 2007) outlines general components of the Association land disturbance mitigation preferences, Association review and comment guidance. This guidance is a tool to address nonpoint sediment loading before it becomes a watershed problem. Referred land use applications that cause a land disturbance and/or a potential to negatively affect water quality are subject to review and comment by Association. The Association completed 15 referrals in 2007 that addressed issues related to erosion, manure management, land disturbance, re-zoning, water quality degradation and appropriate use of best management practices.

The Associations' *Manure Management and Stabled or Confined Animal Nutrient Generation* review policy applies to new facilities where animals are or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period ("Animal Facility") within the Bear Creek Watershed. It also applies to existing *Animal Facilities* that are enlarged, expanded, extended, increased, altered, or moved for any reason within the Bear Creek Watershed. If an existing *Animal Facility* discontinues use for any reason for a period of more than 12 consecutive months, the facility should comply with this policy.

Coyote Gulch Nonpoint Source Restoration

The Association is involved in a nonpoint source project sponsored by the City of Lakewood that restored severe erosion on Coyote Gulch (Figure 11). The construction and restoration effort was complete in May 2007 with revegetation beginning in June 2007. The Association has a paired water quality sampling program, which should allow a future determination on the effectiveness of the restoration effort. The Association has monitored flow and limited chemistry since March 2006 in Coyote Gulch (Figure 12; flow record). Additional photographs are shown in Appendix B.

Figure 11 Before and After Pictures of Coyote Gulch

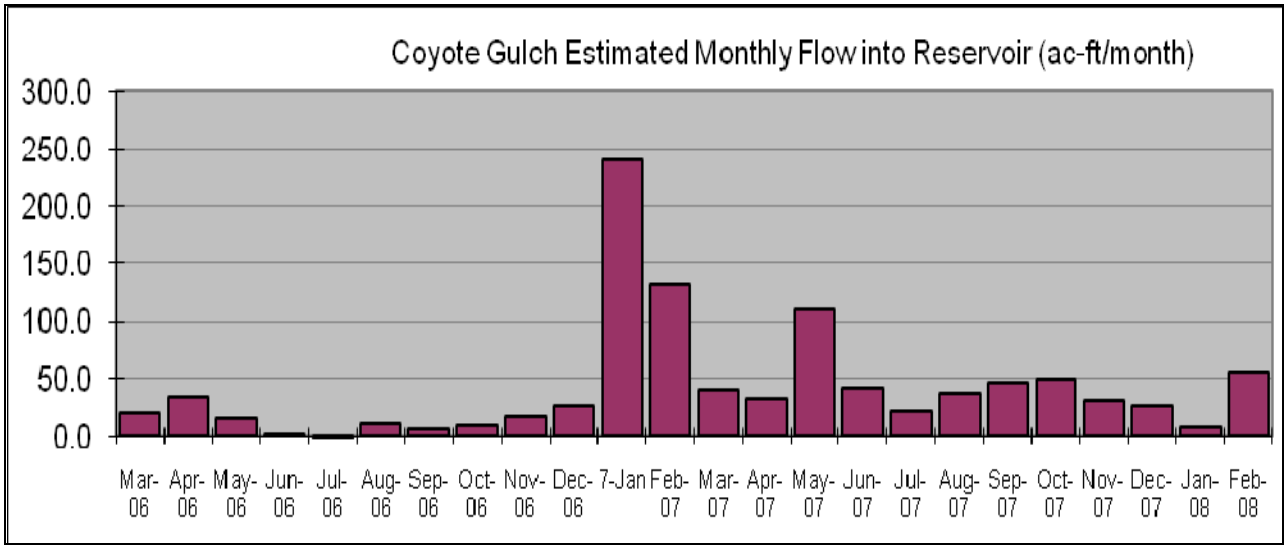


Figure 12 inflow in Coyote Gulch

Prior to construction, the average monthly base load of total phosphorus was about 20 pounds per month with specific storm loading events that could exceed several 100 pounds (Table 8). Shortly after completion of the project, the monthly average base load was reduced by about 70% (Table 8). However, the Association following construction has not measured high storm event loads. The 2007 pre-construction and post-construction summaries are shown in Figures 13 and 14.

Table 8 Nitrate and Phosphorus Load Estimates at Coyote Gulch

		Reservoir		Storm Loads (1 inch/24-hrs)	
		Nitrate (lb/mo)	T Phosphorus (lb/mo)	Nitrate (lbs/event)	T Phosphorus (lbs/event)
Pre-construction	**2006-2007**	189.86	20.05	1290	193
Post-Construction	**2007**	157.79	5.76		

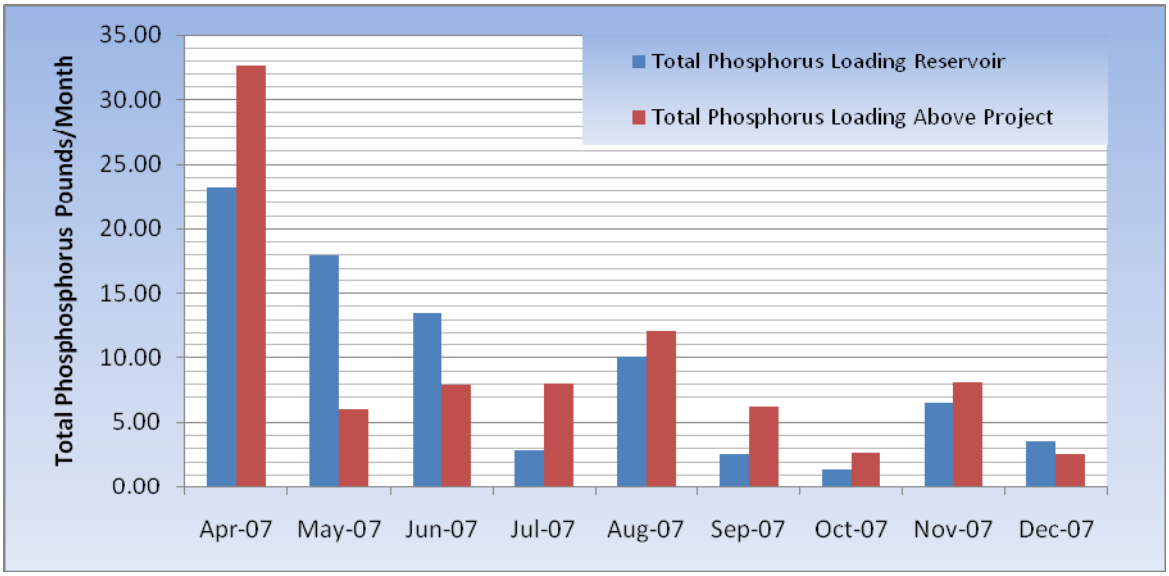


Figure 13 Phosphorus Loading in Coyote Gulch

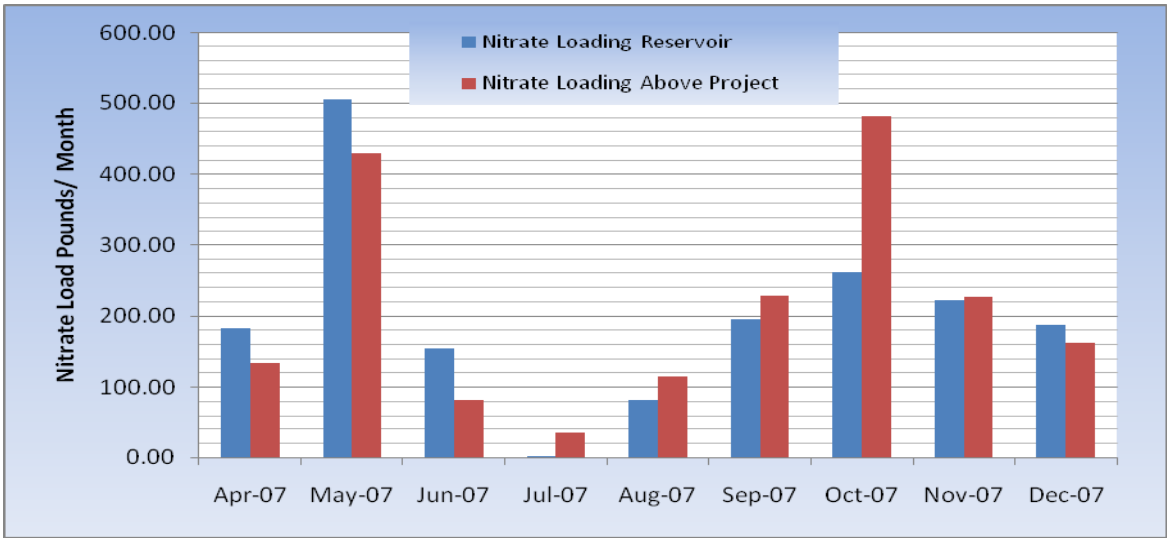


Figure 14 Nitrate Loading in Coyote Gulch

Meeting Water Quality Goals and Standards for the Watershed

The Association believes water quality goals and standards are being met in the watershed. Based on perceived water quality issues and the 303 (d) listing process and monitoring and evaluation lists, the following topics are included for more discussion.

Reservoir Temperature Exceedance - Bear Creek Reservoir is listed as class 1 cold water, the normal pattern of summer temperatures shows the reservoir to be transitional cool water that cannot meet the existing cold-water temperature criteria. The Association temperature data set clearly shows Bear Creek Reservoir will not meet a chronic temperature standard of 20 °C (Maximum Weekly Average Temperature: MWAT) (Table 9). The monthly average temperature in July and August from 1997-2007 exceed 20 °C. The temperature profile data in the reservoir often shows a uniformly higher temperature pattern throughout the water column as characteristic of a small reservoir system. As such, an adequate temperature/ dissolved oxygen refugium is not present for aquatic life below the mixed layer (either epilimnion or mesolimnion), which can be near the bottom of the reservoir within the hypolimnion. The Association is not aware of any recent aquatic life impairment concerns for the reservoir and there is no indication of an existing problem.

Table 9 Bear Creek Reservoir Temperature Summary

	Reservoir Average 0-4 meters						Maximum
	May	June	July	Aug	Sept	Oct	Annual
1997	11.2	14.5	18.8	18.0	17.7	15.0	**20.7**
1998	10.8	13.4	20.2	17.8	18.3	12.6	**22.4**
1999	8.9	13.9	20.2	17.2	15.6		**22.8**
2000	15.0	18.8	21.8	22.8	19.6	13.2	**24**
2001	12.8	18.5	21.6	20.7	17.4	11.9	**23.1**
2002	14.2	19.3	23.0	21.8	18.7	12.7	**24.3**
2003	11.9	17.3	22.1	22.4	18.4	14.2	**23.3**
2004	12.7	16.1	22.4	18.3	16.5	10.8	**20.2**
2005	9.4	15.9	18.3	20.9	18.6	12.0	**23.1**
2006	14.4	20.6	20.9	22.5	17.7	10.1	**23.8**
2007	10.6	14.3	20.4	21.9	20.5	12.8	**23.1**

	Reservoir Average 0-4 meters						Maximum
	May	June	July	Aug	Sept	Oct	Annual
Monthly Average	12.0	16.6	20.9	20.4	18.1	12.5	
Standard Deviation	2.0	2.5	1.5	2.1	1.4	1.5	
25th percentile	10.7	14.4	20.2	18.2	17.6	11.9	
75th percentile	13.5	18.7	22.0	22.2	18.7	13.1	

Bear Creek Segment 1a Temperature Issue – Bear Creek Segment 1a is classified class 1 cold water. The Association has a detailed 6-year data set on a portion of Bear Creek segment 1a from above Evergreen Lake to Morrison. This portion of Bear Creek is a 4th order stream segment below an elevation of 7,300 feet and exhibits thermal behavior indicative of transitional cool water. This "not sensitive" (criteria are applied where cutthroat trout and brook trout are not expected to occur) segment would not consistently meet the underlying chronic temperature standard of 18.2 °C (MWAT). Under very low flow conditions, small portions of this segment also would have a problem meeting an interim chronic temperature standard of 20 °C (MWAT). The Association is investigating a site-specific temperature standard, which includes potential resegmentation of the segment.

Reservoir Narrative Standard – The reservoir narrative standard requires shifting the reservoir trophic index from a eutrophic-hypereutrophic condition toward the mesotrophic-eutrophic boundary condition. The Association uses both the Walker Trophic Index (seasonal and annual) and the Carlson Trophic Index (seasonal; and annual) to evaluate reservoir compliance with the narrative phosphorus standard. A trophic index provides a composite characterization of the reservoir overall quality compared to general water quality categories. Growing Season values over "65" on either the Carlson trophic Index (Figure 14) or Walker Trophic Index (Figure 15) defines a waterbody as being hypereutrophic, which is considered poor quality with likely beneficial use impairment.

The narrative standard targets an average growing season trophic condition throughout the reservoir water column that ranges from "45-60"; with a preferred trophic index range from "45-55". The average trophic state for the reservoir over the period of record is "63" Carlson and "65" Walker, which is a eutrophic waterbody. In the last ten years, the reservoir has met the narrative mesotrophic-eutrophic target 30% of the time. However, the management program has altered the historic trophic state away from a poor quality hypereutrophic system. In order for the reservoir to consistently attain the narrative standard, additional reductions in nonpoint source phosphorus loading are required in the watershed.

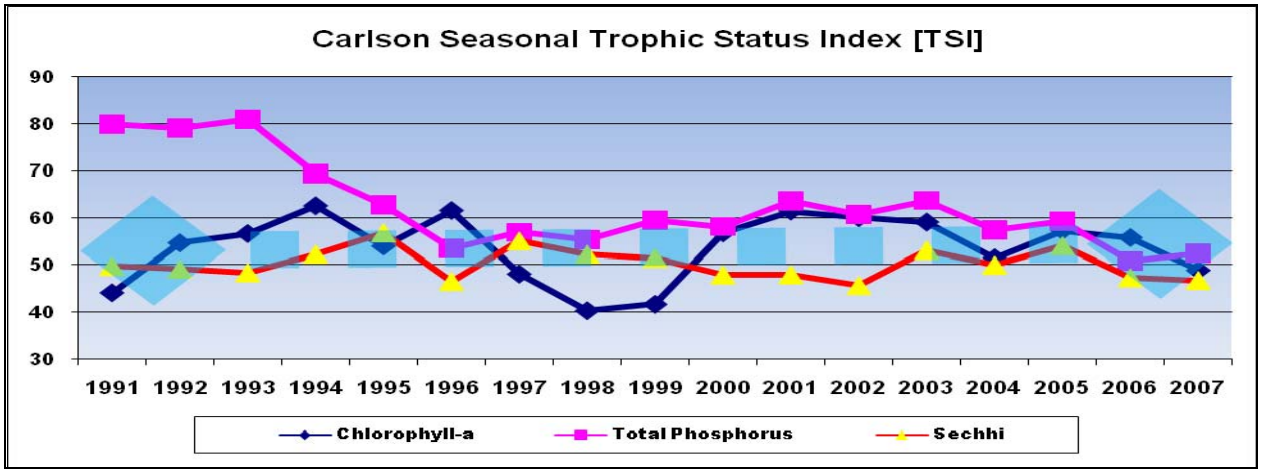


Figure 15 Carlson Seasonal Trophic Index in Bear Creek Reservoir

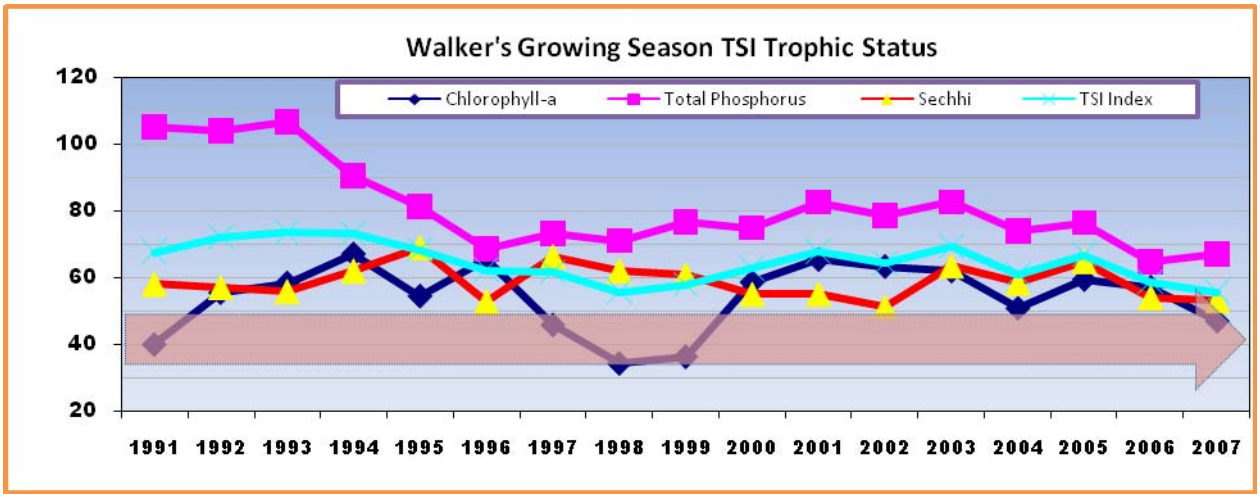


Figure 16 Walker Seasonal Trophic Index in Bear Creek Reservoir

Water Quality Projects Planned or Implemented In the Watershed

The Association is assembling a comprehensive water quality, biological and physical characterization data set to define reference sites and conditions. The Association will continue data collection efforts and work cooperatively with the WQCD to quantify technical components necessary for watershed management. The Association planned or implemented projects include:

1. Continued Monitoring of Bear Creek Segment 1a - The Association obtains water quality data at over 20 sites to determine if temperature and ammonia are water quality problems. The Association will continue the special monitoring efforts on Bear Creek from the Lost and Found site in upper Bear Creek to the Harriman Ditch in Morrison.

2. Expand Monitoring in Watershed - The Association began in 2007 to expand the temporal and spatial monitoring efforts on Bear Creek and within the Turkey Creek drainages. The Association special monitoring has not demonstrated a temperature or ammonia toxicity problem; consequently, the supplemental monitoring effort will assess gaps in the monitoring program. The supplemental data set allows the Association to determine if chemistry is part of the problem. Based on more detailed stream data analyses, the Association can determine the best location and sampling protocol to characterize the entire Bear Creek segment 1a and Turkey Creek drainages.

3. Continues Routine Water Quality Monitoring Program – The Association routine monitoring program was unchanged for 2007. However, the 2008 monitoring program has been modified to provide a focus on the reservoir, inputs and outputs, with the Lair O' Bear site dropped and a reduced sampling program as supported by the Water Quality Control Division.

4. Nutrient Characterization In Watershed - The Association has begun collection of more nutrient data (total phosphorus and nitrate) throughout the watershed. This nutrient database will require several years to assemble.

5. Collect Data Compatible For Modeling - The Association obtains water quality data for future stream modeling and predictions. Additional evaluation and modeling of the temperature information is necessary to determine a management strategy for the watershed. The Association has begun special temperature monitoring on Turkey Creek drainages in preparation for potential site-specific standards.

6. Continue Fishery and Stream Characterizations – Support Division of Wildlife fishery surveys. Characterize how trout populations respond to both natural and human induced alternations. Collect macroinvertebrate data. Conduct additional stream flow studies. Add a new fish-monitoring site in the upper portion of Bear Creek near Lost and Found Day Camp site. Determine fishery composition in Turkey Creek drainages.

7. Maintain Fishery Analysis and Protocols Guidance.

8. Continued Evaluation of management strategies for watershed implementation.

9. Review scientific bases for control regulation at a watershed level.

10. Support Coyote Gulch Restoration Project – The City of Lakewood restored a portion of Coyote Gulch in Bear Creek Park. The Association supports the water quality-monitoring program for this development project. The Association is developing a post-construction nutrient load estimate through 2008.

11. Community Plan Development and Development Reviews – The Association supports Jefferson County in the update and development of community plans for select portions of the watershed. The Association is an active referral agency.

12. The Association helps with Evergreen Earthday Activities and Other Education Programs - The Association provides information to the community on water quality management and environmental issues and supports educational programs.

Additional Association Annual Reporting

The Association developed a detailed 2007 watershed annual report (Bear Creek Watershed Association June 2008, predicted), will include watershed characterization and water quality summary sheets. The annual report provides information on the watershed configuration, regulatory framework, Bear Creek partnerships, scope of Bear Creek Watershed efforts, management program and water quality summaries. The Association also produces an annual data summary as a *2007 Master Data Spreadsheet* that includes data analyses, and raw data (posted on Association website www.bearcreekwatershed.org). The Association transmits this data report to the Water Quality Control Division Staff. The watershed monitoring program is summarized in an appendix to the Association annual report (*Appendix A 2007 Segment 1a Report*; Bear Creek Watershed Association April 2007, predicted). All of the Association annual reporting documents are available electronically and posted on the website.

The Association provides multiple reporting documents designed to meet multiple functions and groups. The reporting helps member entities with reporting to their respective boards, commissions and groups. There is also a citizen interest in the watershed and reporting

helps keep the public informed. Many educational groups visit the watershed and it has become a widely used outdoor classroom. The Association supplies water quality and environmental materials for these various educational uses. No single document meets all of these needs and requirements. As such, the Association will maintain its current annual report format with fact sheets and provide a separate report to fulfill requirements of the Water Quality Control Division and Commission.

Literature Cited

Bear Creek Watershed Association. 2006. Bear Creek Watershed Report 2006: Annual Report & Water Quality Summary Sheets. Prepared by RNC Consulting.

Bear Creek Watershed Association. 2007. Referral Review Guidance

Bossong, C.R., J.S. Caine, D.I. Stannard, J.L. Flynn, M.R. Stevens, and J.S. Heiny-Dash, 2003, Hydrologic Conditions and Assessment of Water Resources in the Turkey Creek Watershed, Jefferson County, Colorado, 1998–2001: U.S. Geological Survey, Water Resources Investigations Report 03-4034, Prepared in Cooperation with the Jefferson County Planning and Zoning Department, 140 p.

Bossong, K, 2002, Characterizing Watershed Processes in the Turkey Creek Basin with a Precipitation-Runoff Model: *Fractured-Rock Aquifers 2002*, Sponsored by the National Ground Water Association (NGWA), U.S. Environmental Protection Agency (USEPA), and U.S. Geological Survey (USGS), March 14.

Appendix A: Overview of Program-Wide Municipal Separate Storm Sewer System Permittee Operations for 2007

Lakewood

Illicit Discharges

Responded to more than 25 illicit discharges of; paint, motor oil, antifreeze, concrete washout, restaurant grease, raw sewage and sediment. All discharges were removed and the responsible party is involved in the remediation process, as appropriate.

Monitoring and Sampling

Wet Weather monitoring at six locations in the South Platte River is conducted with the USGS to generate the State required annual report entitled, "Stormwater –Quality Monitoring of the South Platte River and Selected Tributaries, Denver Metropolitan Area, Colorado". The USGS performs the data collection and the analyses necessary for the Joint Task Force (consisting of the UDFCD, Lakewood, Aurora and Denver) to meet permit conditions. We sample for stream flow, Ph, specific conductance, hardness, calcium, magnesium, potassium sodium, alkalinity, chloride, fluoride, sulfate, ammonia, orthophosphate, phosphorus, organic carbon, copper, lead, manganese and zinc. Sampling is also conducted within City limits as needed to track, identify and eliminate pollutants per the approved NPDES Illicit Discharge Program.

Public Outreach

Distribution of three separate water quality brochures. The brochure entitled "Caring for Your Lawn and Garden" was the focused distribution to the public this year. Approximately 72,000 color brochures were sent to all citizens and mailing addresses within the City via the Looking at Lakewood newsletter. All three brochures are also available at the Permit Counter and the Rooney Road Recycling Center. Distribution of a new industry and commercial business focused pollution prevention booklet. Coordinated with the Joint Task Force (JTF) to finalize and print the document. As part of their annual fire protection inspections, West Metro Fire distributed approximately 50 booklets to the target audience in 2007. Distribution of NPDES Stormwater Program Coloring Books and Plastic Rulers for Elementary School Children grades one through six. Attended pre-construction meetings with staff, contractors and developers to reinforce National Pollutant Discharge Elimination System (NPDES) permit requirements. Visited numerous construction sites and performed "Courtesy Inspections" to assist contractors and our own inspectors with implementing the proper Best Management Practices (BMP's) at the appropriate phase of the project.

Training and Plan Review

Reviewed more than 50 sets of erosion control plans and/or stormwater management plans during the 2007 development and review process. Provided a resource for City Planners and developers encouraging future intelligent development (with NPDES permit required water quality issues addressed early in the design process). More challenges are anticipated to accompany increasingly stringent state and federal water quality requirements.

Consulted with Engineering Staff to solve water quality design issues and clarify permit requirements. Produced and distributed 600 mailers to encourage all contractors licensed in the City to attend the Red Rocks Community college course on erosion and sediment control. All new contractor licenses are mailed out with information about course dates and costs. Continue cost sharing with Urban Drainage, City of Denver and the City of Aurora to provide technical data to the Colorado Water Quality Commission regarding rulemaking on Basic Standards for Total Maximum Daily Loading (TMDL) for Metro and Lakewood drainage ways. Attended all Joint Task Force meetings with City of Denver, City of Aurora and the Urban Drainage and Flood Control District. JTF meetings provide substantial cost sharing opportunities such as the new Industrial Booklet.

Coordinated with Kit Lammers, the League of Women Voters and Channel 8 staff to run "Solutions to Water Pollution" and other stormwater quality television public service announcements (PSA's) and other water quality videos regularly throughout 2007 (continuing). The intent of the videos is stormwater pollution awareness and pollution reduction in Lakewood. The video is now airing on Lakewood's and many metro area channel 8's. This continues to demonstrate just one of the award winning aspects of the storm water management utility.

Performed Municipal Facilities Environmental Inspections per the permit requirements, at all major and minor facilities. Identified deficiencies and discussed improvements with the facility managers. All needed equipment to bring the sites into compliance was purchased, delivered and installed. For example, absorbent over pack containers were provided to Bear Creek Lake Park Shops and the Quail Street Shops for temporary storage of new absorbent material and for proper disposal of all used absorbent materials. Visited elementary schools and high schools to present the concept of stormwater pollution. There were approximately 100 participants, ages 7 thru 17, who listened to the presentation on stormwater quality. Facilitated a group discussion on non-point source pollution and preventative measures. Students also distributed approximately 200 bilingual door hangers with a consistent environmental message. We received many positive comments on the program from students, citizens and faculty.

Collected annual data on operational programs from Parks, Street Maintenance, Sewer Maintenance, the Environmental Manager, Construction Inspectors, Design Engineering and Development & Review Engineers. All data were organized and accompanied by an assessment of current program effectiveness prior to being submitted to the State of Colorado's Water Quality Control Division in the annual report form.

Promoting Local/Regional Environmental Awareness (and Water Quality)

Attended all board meetings for the Rooney Road Recycling Center as the chairman and Lakewood representative. Worked with a legal firm to obtain the charitable 501c3 status for the RRRC Foundation in July. The Foundation's mission is to increase private funding and expand future operations at the RRRC. More than 5 million pounds of material have been collected and/or recycled at the facility to date.

Jefferson County

Jefferson County also maintains an erosion and sediment control program as part of their MS4 permit. The county maintains a small-site erosion control manual that explains the basic principles of erosion control and illustrates techniques to control sediment from small development sites. Jefferson County has an inspection program for Illicit discharges, construction activities, and includes post-construction Inspections.

Table 10 Jefferson County Storm Sewer Activities and Actions

Activity	Inspections/ Action
Illicit discharges	43 inspections
Illicit Discharge Actions	0
Construction	1275 (since 2005)
Construction Actions	79 NOVs; 29 referred to court for action
Post- Construction	31 inspections
Post-Construction Actions	0
Waterway signs	Completed
Storm drain modeling	Completed

Appendix B: Coyote Gulch and Stormwater Photographs

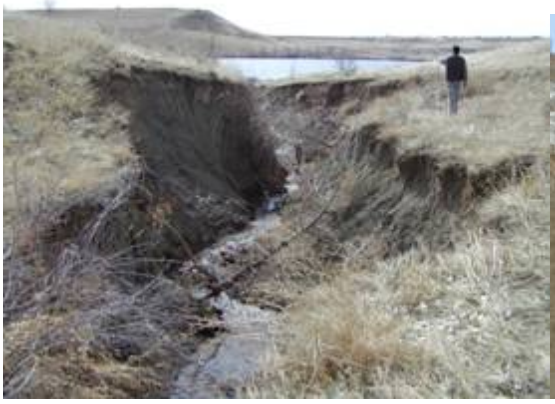
’07 Finished Drop

’04 Failing Embankment

’07 Realignment (looking North)

07 Realignment (looking South)

’04 The 30’ Cut (looking South)



’07 Finished Project

Stenciling w/LHS Students

Paint Discharge

Grease Discharge ***Pollutant Discharge Entering Storm Sewer***