

# Bear Creek Watershed Association



## 2010 Annual Report for the Water Quality Control Commission



Bear Creek Watershed Association  
1529 South Telluride St  
Aurora, CO 80017

Manager: Russell N Clayshulte  
303-751-7144

[rclayshulte@earthlink.net](mailto:rclayshulte@earthlink.net)  
[www.bearcreekwatershed.org](http://www.bearcreekwatershed.org)

Approved April 13, 2010

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

## Table of Contents

Bear Creek Watershed Control Regulation.....	1
Bear Creek Watershed Association .....	1
Members and Associates.....	1
2010 Program Participation .....	1
Control Regulation Requirements.....	3
Status of Water Quality in the Reservoir and Watershed .....	3
Monitoring Program Updated .....	3
2010 Hydrology .....	6
2010 Nutrients.....	8
2010 Reservoir Trophic Index Variables.....	11
Bear Creek Reservoir Aeration Practice Manages Summer Dissolved Oxygen .....	14
Bear Creek Sediment Study .....	15
2010 Bear Creek Kerr/Swede Gulch E. coli Study.....	17
Wastewater Treatment Facilities Loading and Compliance .....	19
Wasteload Compliance .....	19
Permit Compliance and Plant Expansions/Actions.....	20
Trading Program .....	21
Regulated Stormwater Management.....	22
Nonpoint Source Loading and Appropriate Best Management Practices .....	22
Septic System Management.....	22
Watershed Nonpoint Source Program Elements.....	23
Association Land-Use Review.....	23
Coyote Gulch Nonpoint Source Restoration.....	23
Regional Parks Recycling Efforts .....	25
Aspen Park/ Conifer Waste Recycling Program.....	26
Invasive Species Protection Program.....	26
Bear Creek Reservoir .....	26
Evergreen Lake .....	26
Meeting Water Quality Goals and Standards for the Watershed.....	26
Dissolved Oxygen Compliance in Bear Creek Reservoir.....	26
Bear Creek Reservoir Temperature Compliance .....	27
Watershed Stream and Lake Compliance .....	28
Other Projects/ Programs Planned or Implemented By BCWA .....	29
Additional Association Annual Reporting.....	31
Appendix A: 2010 Overview of Lakewood Municipal Separate Storm Sewer System Operations .....	32
Illicit Discharges Program .....	32
Follow up on Outfall Test.....	32
Illicit Discharge Inspections .....	32
Notice of Violation .....	32
Manholes.....	32
The Rooney Road Recycling Center.....	33
Construction Sites Program .....	33
Maintenance Program .....	33
Educational Efforts .....	34

## List of Figures

Figure 1	Bear Creek Watershed .....	2
Figure 2	Reservoir Monitoring Stations; Site 2 is the Routine P1 Station.....	4
Figure 3	Monitoring Station in Bear Creek Park .....	4
Figure 4	General Sampling Locations and Wastewater Treatment Plants .....	5
Figure 5	Bear Creek Reservoir Inflow and Outflow .....	6
Figure 6	Annual Flows into Bear Creek Reservoir .....	7
Figure 7	Bear Creek above Bear Creek Reservoir Annual Acre-feet/year Flow .....	7
Figure 8	Bear Creek above Evergreen Annual Acre-feet/year Flow .....	7
Figure 9	2010 Inflow Bear Creek Reservoir .....	8
Figure 10	Estimated Total Phosphorus loading in 2010 .....	8
Figure 11	Estimated Nitrate loading in 2010 .....	9
Figure 12	2010 Total Phosphorus .....	9
Figure 13	Annual Total Phosphorus Inflow .....	9
Figure 14	Bear Creek Reservoir Nitrogen Concentrations .....	10
Figure 15	Nitrogen Bear Creek Reservoir.....	10
Figure 16	Annual Nitrate Inflow .....	10
Figure 17	2010 Phytoplankton Diversity .....	12
Figure 18	2010 Secchi Depth Bear Creek Reservoir .....	12
Figure 19	2010 Chlorophyll .....	13
Figure 20	2010 Growing Season Total Phytoplankton Densities .....	13
Figure 21	Walker Trophic Index Trend Bear Creek Reservoir.....	14
Figure 22	Stocking Bear Creek Reservoir.....	14
Figure 23	Reservoir Aeration Operational Testing .....	15
Figure 24	Bear Creek Reservoir Bottom Sample Sites .....	15
Figure 25	Total Organic Carbon in Bear Creek Reservoir Sediments .....	16
Figure 26	Total Phosphorus Estimates in Bottom Sediments .....	16
Figure 27	Grain-Size Distribution in Bottom Muds.....	17
Figure 28	Kerr/Swede Gulch Sample Sites .....	18
Figure 29	Flow in Coyote Gulch.....	23
Figure 30	Phosphorus Loading in Coyote Gulch .....	24
Figure 31	Nitrate Loading in Coyote Gulch.....	25
Figure 32	Total Phosphorus Reduction .....	25
Figure 33	2010 DO Compliance Bear Creek Reservoir.....	27
Figure 34	2010 Temperature Compliance Bear Creek Reservoir. ....	27
Figure 35	20" Greenback Cutthroat Trout – Summit Lake.....	31

## **List of Tables**

Table 1	Association Membership, Dischargers and 2010 Meeting Attendance .....	1
Table 2	Diversion of Bear Creek Water by the Arnett-Harriman Ditch .....	6
Table 3	Bear Creek Reservoir Selected Trophic Index Variables .....	11
Table 4	Reservoir Summary for Select Trend Parameters.....	12
Table 5	Kerr/Swede Gulch Data Summary.....	18
Table 6	E. Coli 2010 Geometric Mean Summary.....	19
Table 7	Treatment Facility Wasteload Allocations.....	20
Table 8	Wastewater Planning Status.....	20
Table 9	Phosphorus Trading Activity in Bear Creek Watershed.....	21
Table 10	Jefferson County Storm Water 2010 Activities and Actions.....	22
Table 11	Nitrate and Phosphorus Load Estimates at Coyote Gulch .....	24
Table 12	2010 DO Compliance in Bear Creek Reservoir.....	26
Table 13	2010 Temperature Record Bear Creek Reservoir. ....	27
Table 14	Watershed Temperature Compliance Summary Warm/ Cold Seasons .....	28

## Bear Creek Watershed Control Regulation

The Bear Creek Watershed (Figure 1) is a specific geographic area identified in the Bear Creek Watershed State Control Regulation (Regulation #74, 5 CCR 1002-74) (Control Regulation) 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 on the western end to the Town of Morrison on the eastern end. The two major tributaries are Bear Creek and Turkey Creek. The goal of the Control Regulation is to attain site-specific water quality standards and classifications through control of total phosphorus and chlorophyll. The Bear Creek Watershed Association (Association) oversees implementation of the Control Regulation.

## Bear Creek Watershed Association

The Association is the local water quality agency responsible for implementation of monitoring and tracking water quality in the Bear Creek Watershed. 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 tracks nonpoint source practices, programs and loadings within the watershed. The Association management and implementation programs are at a watershed level.

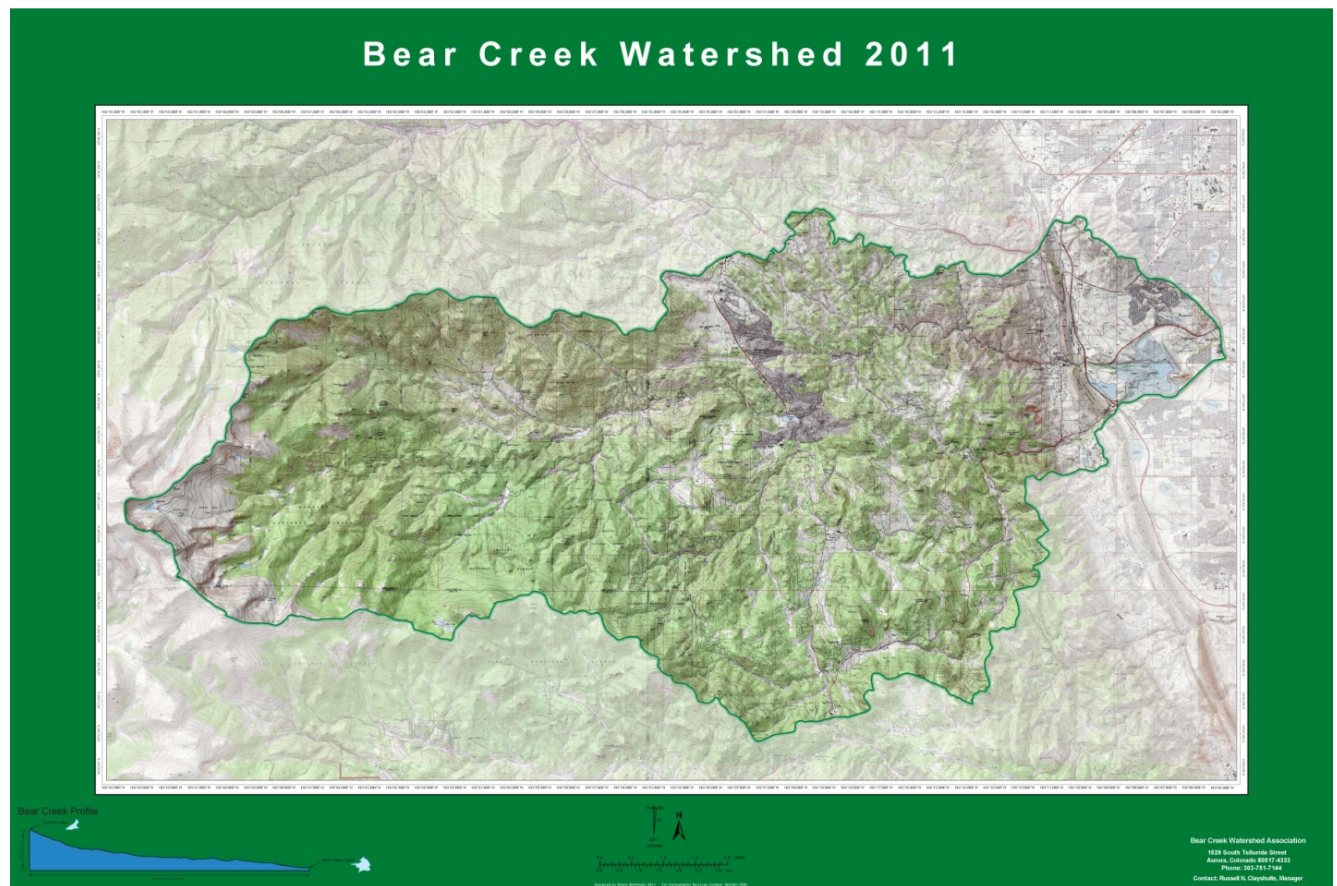
The Association provides watershed reporting as posted on the Association website [www.bearcreekwatershed.org](http://www.bearcreekwatershed.org), which serves to keep federal, state, and local governments and others informed on the state of the watershed. The Control Regulation defines specific reporting 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 Association Membership, Dischargers and 2010 Meeting Attendance**

Members and Associates	Wastewater Discharger	2010 Program Participation
<u><b>Counties</b></u>		
Jefferson County		<b>Active</b>
Clear Creek County		<b>Active</b>
Park County		<b>No Dues, Not Active</b>
<u><b>City and Towns</b></u>		
City of Lakewood		<b>Active</b>
Town of Morrison	<b>Yes</b>	<b>Active</b>
<u><b>Water &amp; Sanitation Districts</b></u>		
Aspen Park Metropolitan District	<b>Yes</b>	<b>Active</b>
Bear Creek Cabins	<b>Yes</b>	<b>Active (In-kind Service)</b>
Brook Forest Inn	<b>Yes</b>	<b>Active (In-kind Service)</b>
Conifer Sanitation Association	<b>Yes</b>	<b>Dues Paid, Not Active</b>
Conifer Metropolitan District	<b>Yes</b>	<b>Dues Paid, Not Active</b>
Evergreen Metropolitan District	<b>Yes</b>	<b>Active</b>
Forest Hills Metropolitan District	<b>Yes</b>	<b>Dues Paid, Not Active</b>



Members and Associates	Wastewater Discharger	2010 Program Participation
Genesee Water & Sanitation District	Yes	Active
Geneva Glen	Yes	Dues Paid, Not Active
Jefferson County School District	Yes	Dues Paid, Not Active
Kittredge Water & Sanitation District	Yes	Active
Singing River Ranch	Yes	Dues Paid, Not Active
The Fort Restaurant	Yes	Dues Paid, Not Active
Tiny Town Foundation, Inc.	Yes	Dues Paid, Not Active
West Jefferson County Metropolitan District	Yes	Active
<b><u>Active Associate Agencies/ Groups</u></b>		
Denver Water Department		Active
Kimberly Gortz-Reeves LLC		Active
Natural Resources Conservation Service		Active
U.S. Army Corps of Engineers		Active



**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 and technical memorandums on additional activities. The remainder of this report addresses these reporting requirements: 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**

### **Monitoring Program Updated**

The monitoring plan details the 2010 reservoir and watershed monitoring programs as approved by the BCWA Board and accepted by the Water Quality Control Division staff (WQCD). This monitoring plan serves as a supplement to the adopted Association Quality Assurance Project Plan (Bear Creek Watershed Association, 2006). The 2010 monitoring program (version 2010.03) was similar to the 2009.02 version with the following adjustments:

- New monitoring sites added in Kerr and Swedes Gulches.
- Inclusion of Evergreen Lake in the State's high water quality study.
- Increase monitoring for Evergreen Lake chemistry and adjust position of temperature data loggers in water column.
- Initiate sediment and nutrient internal loading studies in Bear Creek Reservoir.
- Document dewatering of Bear Creek Segment 1b below both the Arnett-Harriman and Ward ditches.
- Update listing of 2010 monitoring sites with the BCWA site identifiers, data logger location and chemistry-monitoring sites by new stream segment descriptions. Identify reference sites for segments. Maintain larger scale maps maintained by Association on Web site.

The routine monitoring program (P1) focuses on Turkey Creek drainage and Bear Creek drainage inputs, and discharge from Bear Creek Reservoir (Figure 2) into lower Bear Creek with a central pool characterization of the reservoir near the dam (BCWA site 40). As shown in Figure 2, the outlet structure is near BCWA site 41 with Bear Creek inflow near BCWA site 44 and Turkey Creek inflow near BCWA site 43. The reservoir chemistry and biological characterization monitoring occurs at BCWA site 40. Vertical probe samples for specific conductance, temperature, Dissolved Oxygen, and pH measured at 1-meter intervals at all reservoir sites. The current monitoring program optimizes data generation to evaluate reservoir inflow loading, trophic state changes within the reservoir, and reservoir outflow, while minimizing monitoring cost. The aeration sites are visible in Figure 2. Figure 3 shows all monitoring stations within Bear Creek Park. Figure 4 shows a map of recent sampling sites and wastewater treatment plants.

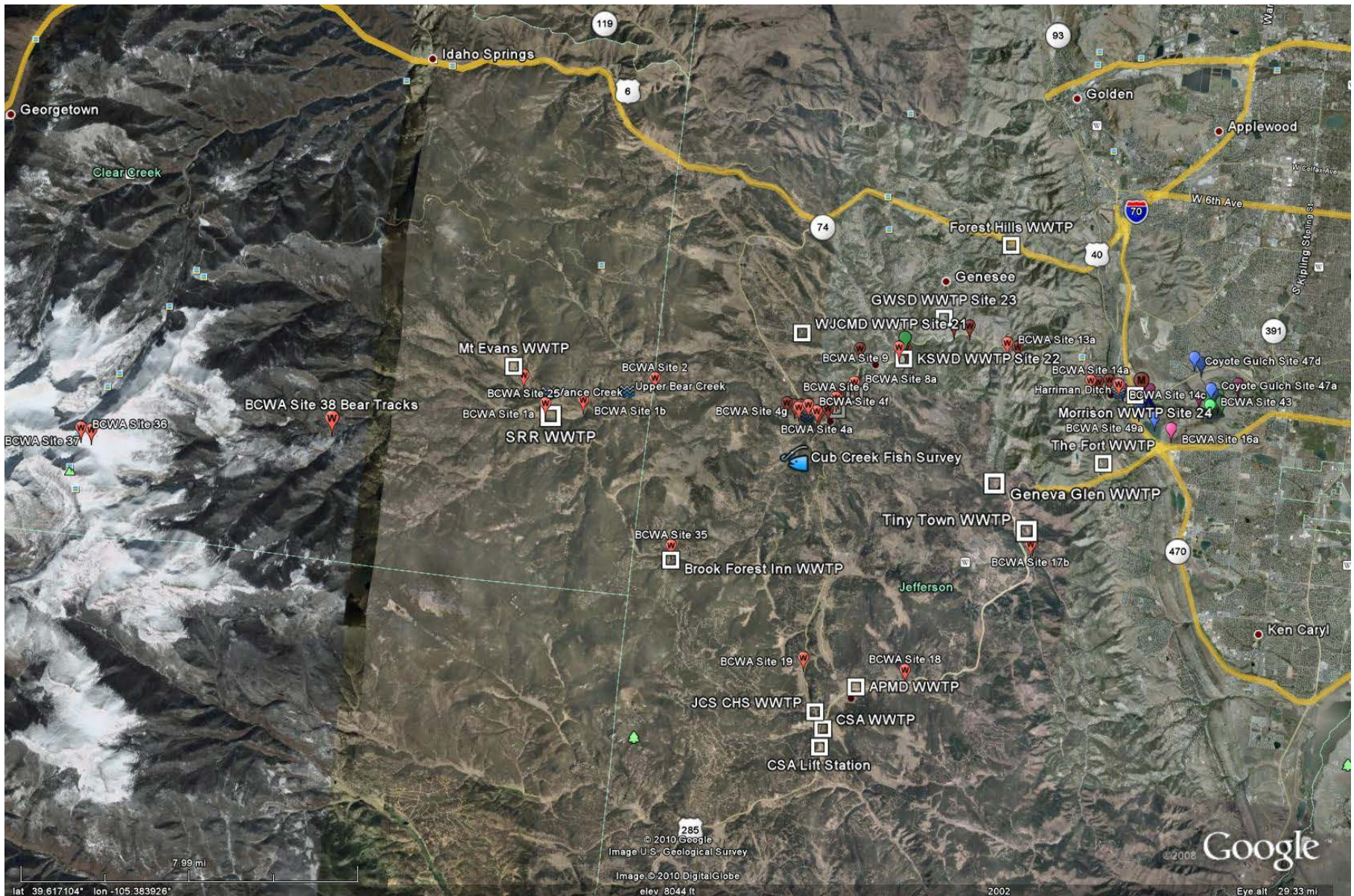


**Figure 2 Reservoir Monitoring Stations; Site 2 is the Routine P1 Station**



**Figure 3 Monitoring Station in Bear Creek Park**





**Figure 4** General Sampling Locations and Wastewater Treatment Plants



## 2010 Hydrology

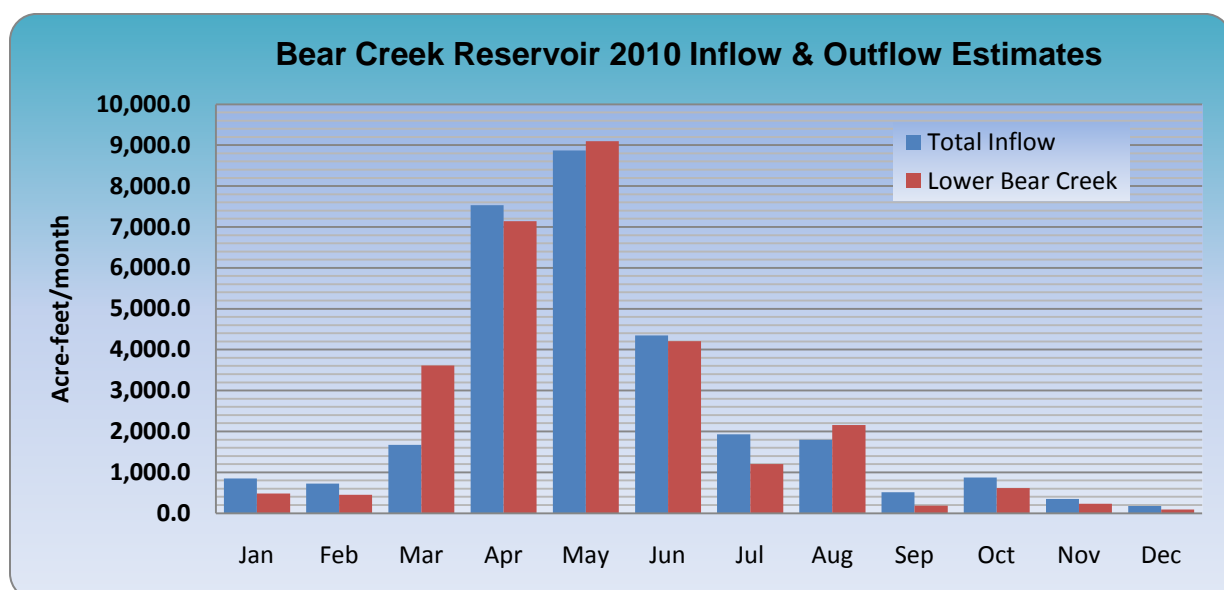
Evaluation of water quality in the reservoir includes examination of the basin hydrology, as well as chemistry. Figure 5 shows the Association estimated 1987-2010 total annual flow discharge into Bear Creek Reservoir. In 2010, the total estimated annual discharge into Bear Creek Reservoir was about 29,627 acre-feet (Figure 5) with about 29,462 acre-feet flow through and 166 acre-feet of evaporation. Figure 6 shows the total reservoir inflow trend from 1987-2010.

Bear Creek flow diverts at the Harriman Ditch in Morrison, and a portion of the Turkey Creek flow diverts for water uses. Bear Creek flow diverts into the Arnett- Harriman during the irrigation season. The Association analyzed diversion data at both the Arnett-Harriman and Ward diversion points from 1999-2007. The Arnett-Harriman ditch reduces flows in lower Bear Creek below 10 cfs in the operational season about 31% of the time (Table 2). The ditch systems can completely dewatered lower Bear Creek for periods of up 11 consecutive days. In 2010, lower Bear Creek dewatered (<5 cfs flow) for 50 days or 14% of the time.

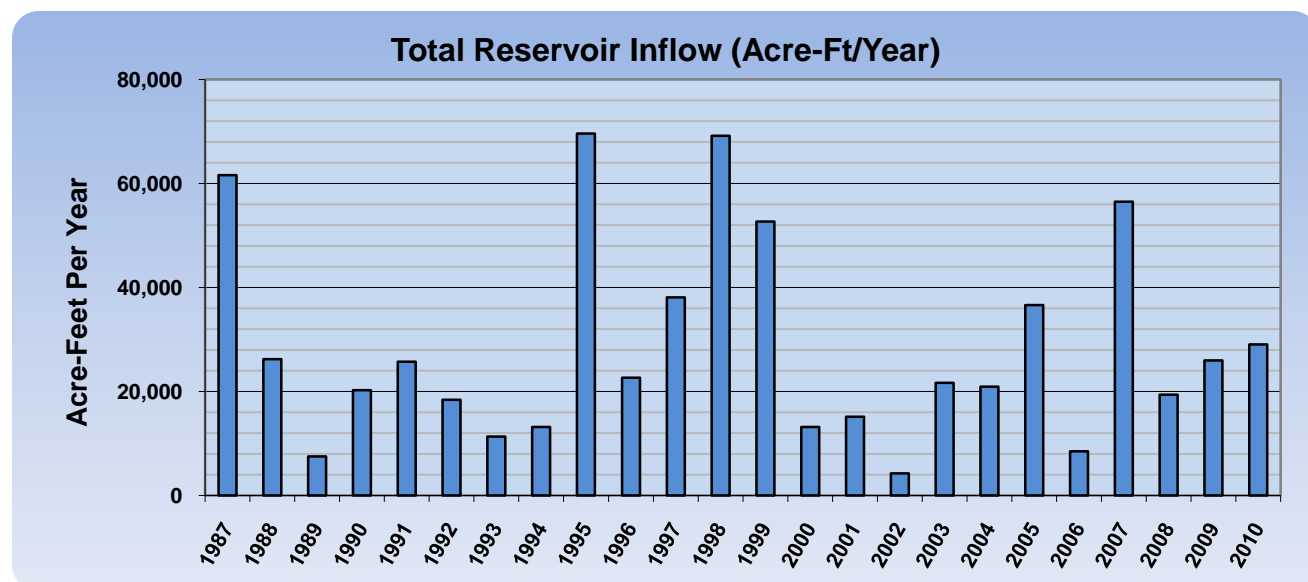
**Table 2 Diversion of Bear Creek Water by the Arnett-Harriman Ditch**

Flow Below Arnett-Harriman Diversion						
	Total Days Diversion	days below <10 cfs	days below <2.5 cfs	days below <1 cfs	days below <0 cfs	Consecutive Days <1 cfs
1999-2007	2591	813	350	172	85	Up to 11 days
		31.4%	13.5%	6.6%	3.3%	

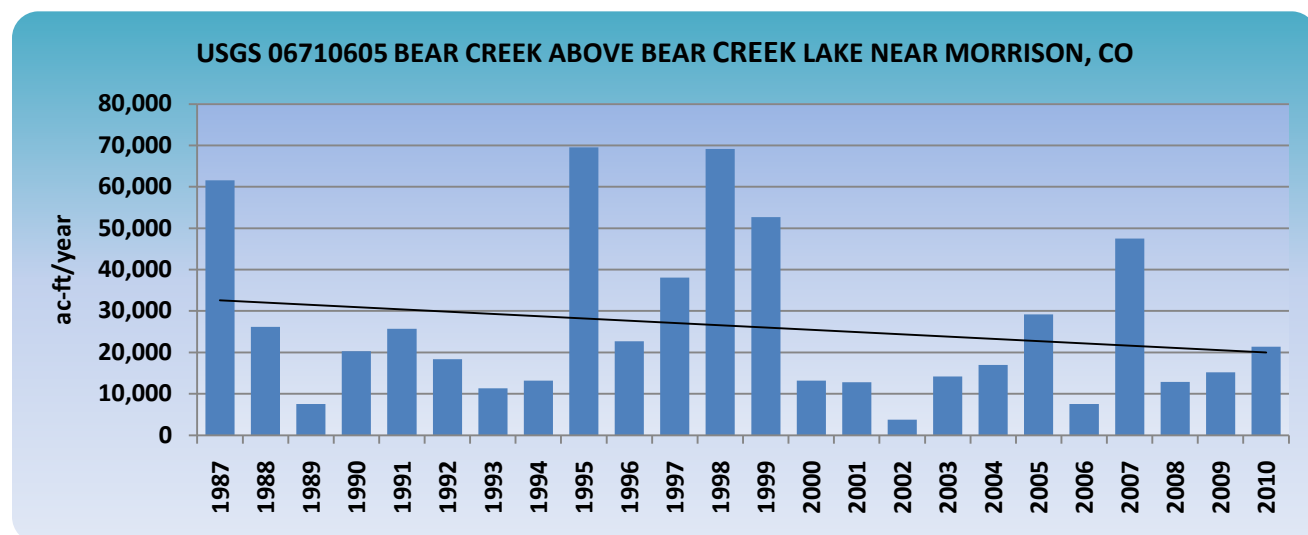
The reservoir inflow represents flows below the water diversions and is not representative of the total watershed water flows. Bear Creek flows above Bear Creek Reservoir (Figure 7) and at the Evergreen gaging station (Figure 8) provide an estimate of the amount of water diverted from the watershed before reaching the reservoir. For example, in 2010 the Bear Creek water use diversion reduced flow to the reservoir by about 2,200 ac-ft (-10 %). Additionally, the longer time trends shown in Figures 6 and 7 depict a basic linear trend of declining flow in Bear Creek. Figure 9 compares the 2010 reservoir monthly inflow estimates from Bear Creek (72%) and Turkey Creek (28%). Peak runoff occurred in April-May 2010. The increased Bear Creek flow in June came from two large rainfall events.



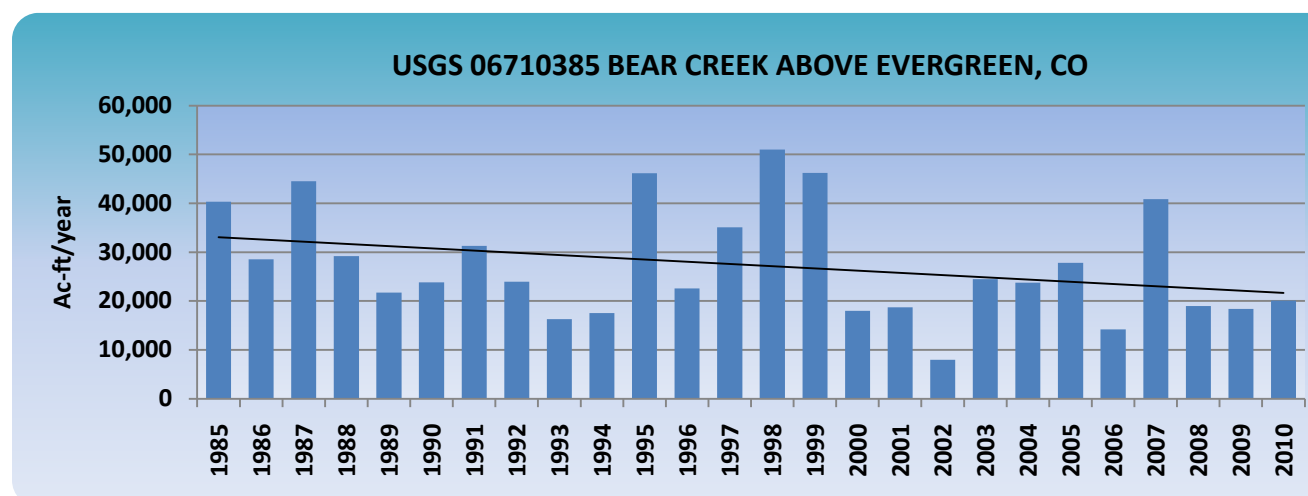
**Figure 5 Bear Creek Reservoir Inflow and Outflow**



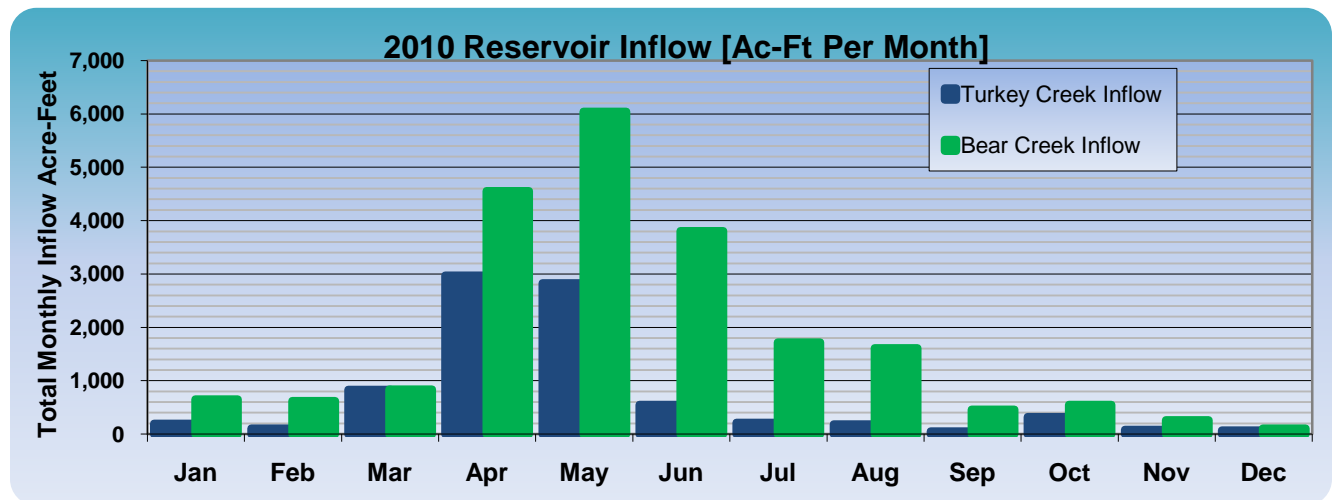
**Figure 6 Annual Flows into Bear Creek Reservoir**



**Figure 7 Bear Creek above Bear Creek Reservoir Annual Acre-feet/year Flow**



**Figure 8 Bear Creek above Evergreen Annual Acre-feet/year Flow**



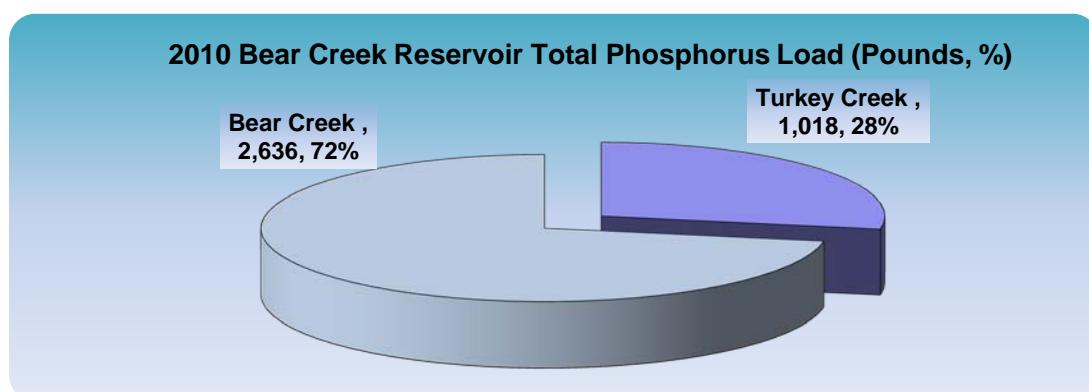
**Figure 9** 2010 Inflow Bear Creek Reservoir

### 2010 Nutrients

The watershed-monitoring program characterizes nutrient loading into Bear Creek Reservoir from two primary drainages: Bear Creek and Turkey Creek. The Association monitors for total phosphorus, dissolved phosphorus, and nitrate-nitrite nitrogen on a monthly basis, and for total nitrogen in the Bear Creek Reservoir from July-September, and below the reservoir.

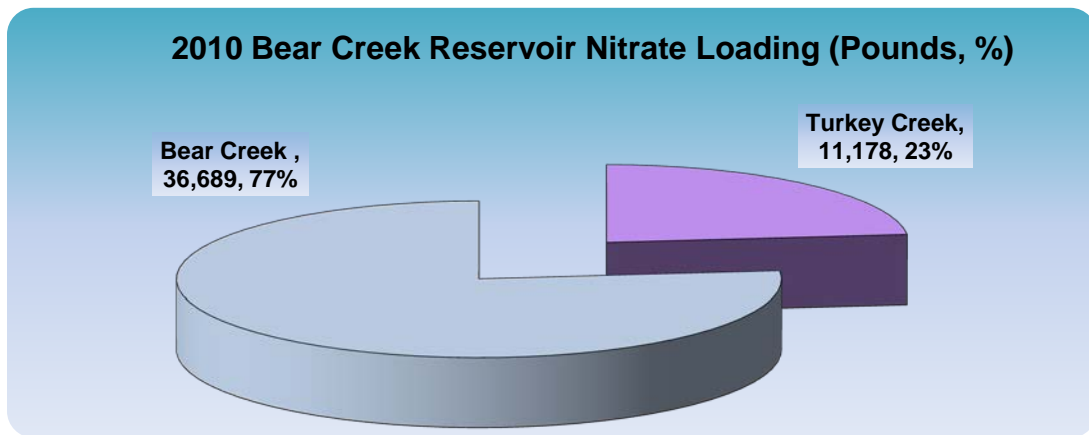
The total phosphorus load from the watershed comes from a combination of wastewater treatment plant point source loads and nonpoint sources, including runoff. There are over 27,000 septic systems in the watershed. The estimated total phosphorus load in 2010 from all sources reaching the reservoir was 3,654 pounds at a flow of about 29,627 acre-feet. Bear Creek drainage contributed 72% of the load (Figure 10). The nitrate loading (47,868 pounds) was typical of past flow conditions (Figure 11) with 77% of the load coming from Bear Creek. Although the point source discharges of total phosphorus were about **1121.41** pounds, the water diversions above the reservoir are removing a portion of this phosphorus load and inflow water before it reaches the reservoir.

Figure 12 shows the 2010 total phosphorus concentrations at the routine watershed monitoring stations. The management program targets reduction of total phosphorus reaching the reservoir on an annual basis. Figure 13 shows the total phosphorus inflow trend. Figure 14 shows the 2010 nitrate concentration at the routine watershed monitoring stations. Figure 15 shows the summer total nitrogen in comparison with the annual reservoir nitrate concentrations. The nitrogen data has shown greater fluctuation over the years with no clear long-term trend (Figure 16).

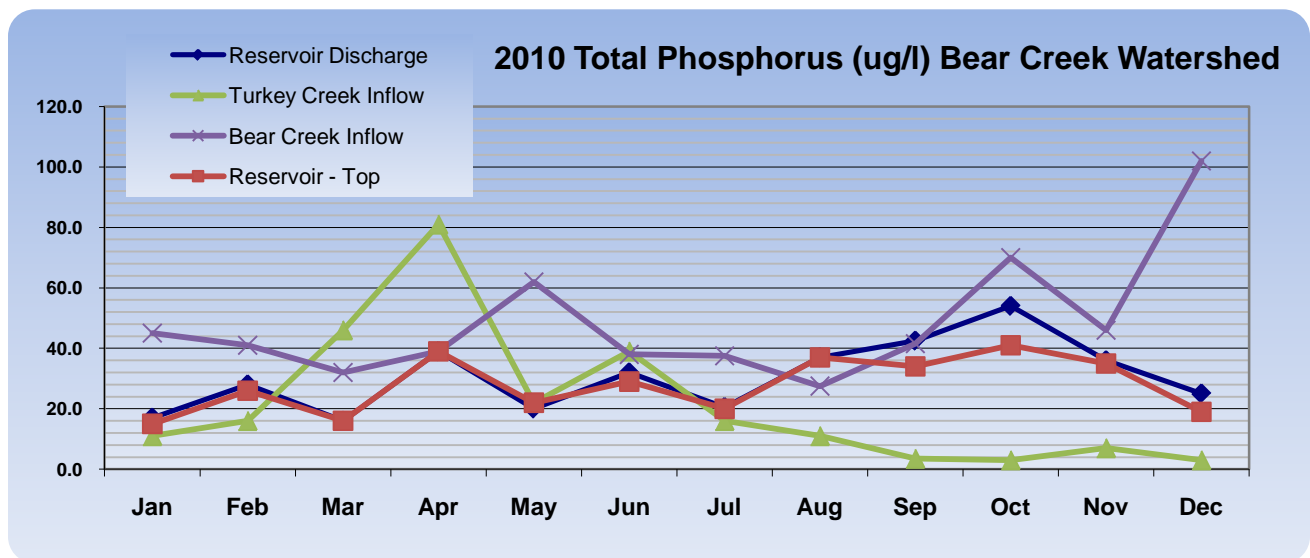


**Figure 10** Estimated Total Phosphorus loading in 2010

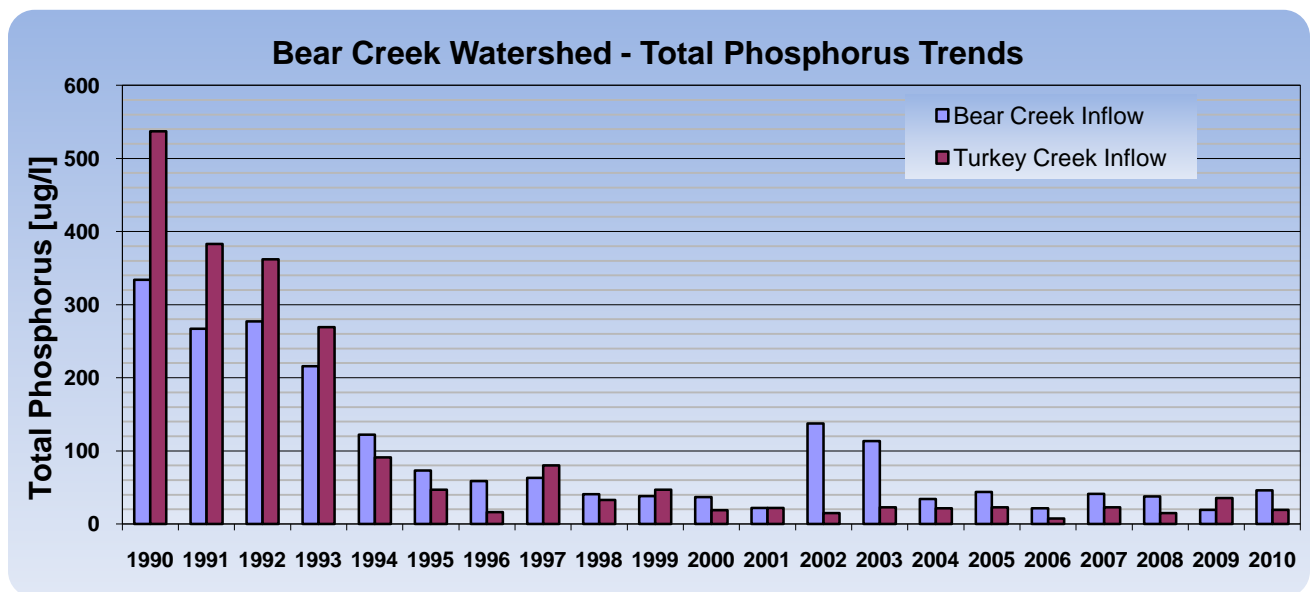




**Figure 11**      **Estimated Nitrate loading in 2010**



**Figure 12**      **2010 Total Phosphorus**



**Figure 13**      **Annual Total Phosphorus Inflow**

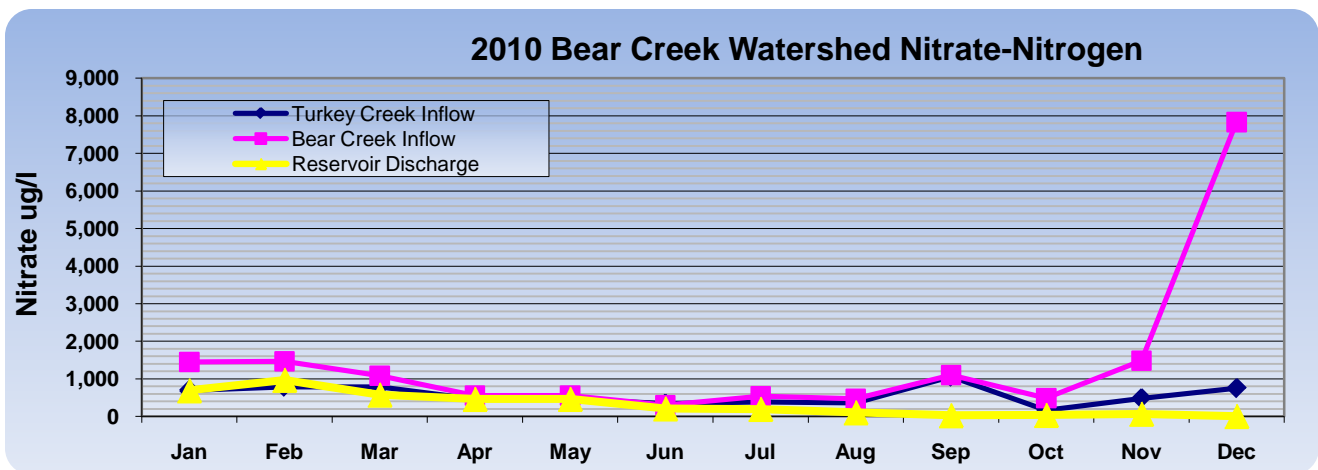


Figure 14 Bear Creek Reservoir Nitrogen Concentrations

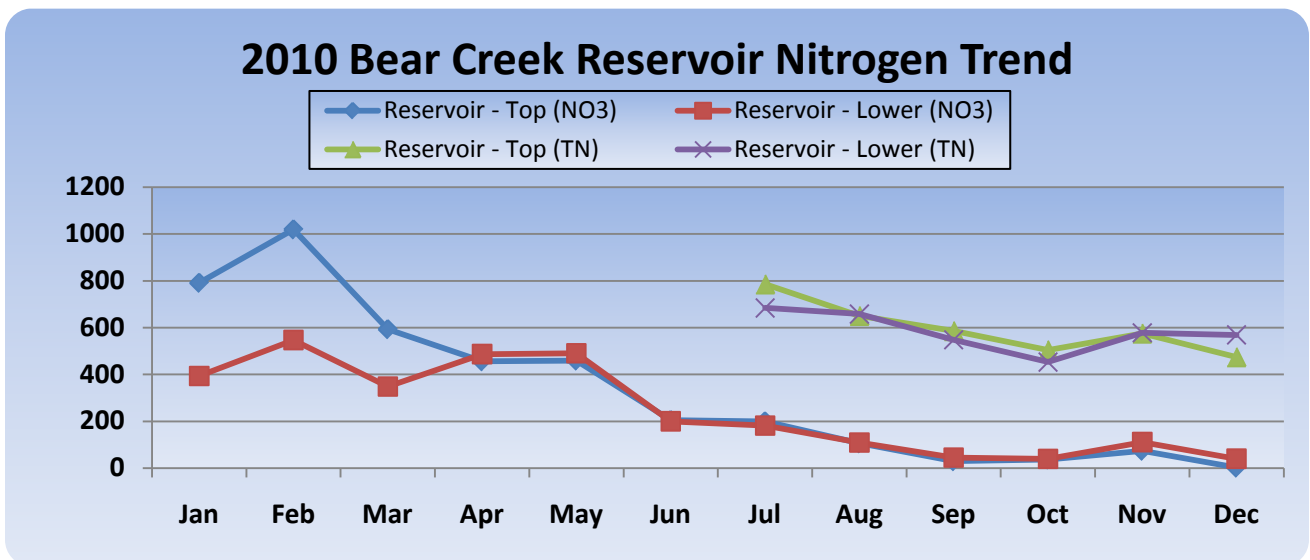


Figure 15 Nitrogen Bear Creek Reservoir

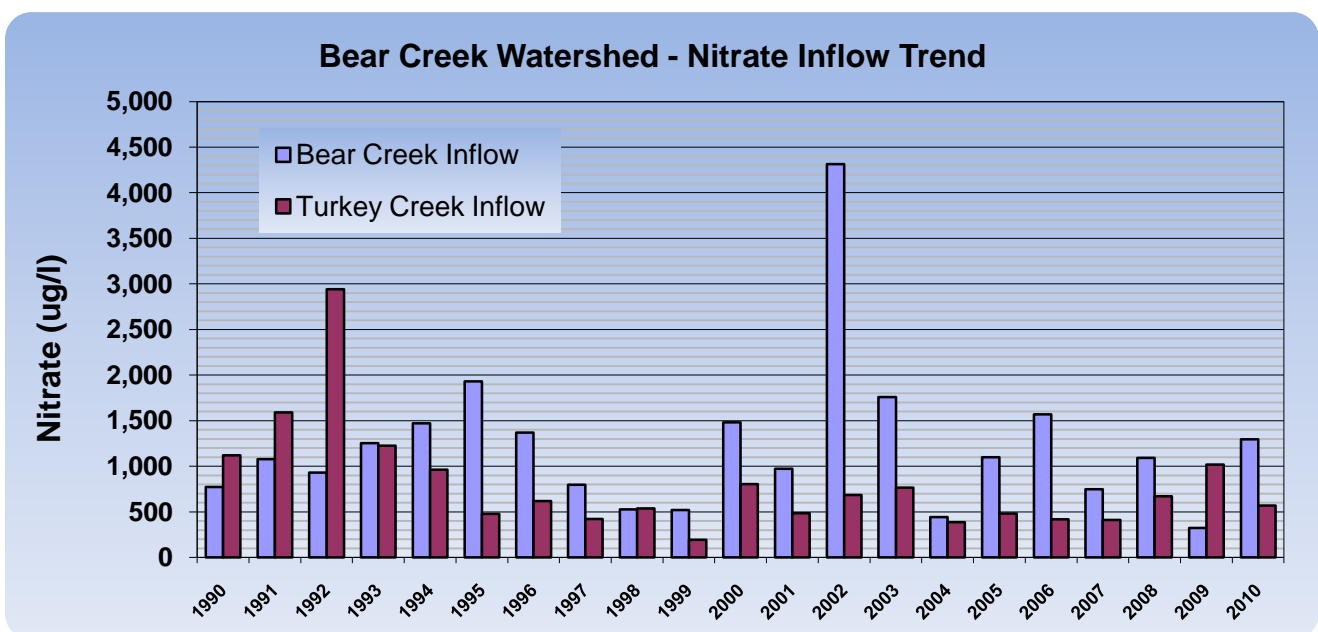


Figure 16 Annual Nitrate Inflow

### **2010 Reservoir Trophic Index Variables**

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 3 presents data summaries for these Association trophic indicators. Table 4 summarizes the 2010 reservoir data compared with the long-term patterns from 1991 through 2010.

Overall, 2010 water quality improved over historic trends. Figure 17 shows the general distribution of phytoplankton species. Figure 18 shows the general clarity trend in the water column using Secchi measurements. April had the poorest clarity caused by runoff and phytoplankton blooms.

**Table 3 Bear Creek Reservoir Selected Trophic Index Variables**

<b>Trophic Indicator</b>	<b>Reservoir</b>
<b>Chlorophyll</b>	
Average Growing Season Chlorophyll-a [ug/l (surface waters only)]	10.6
Average Annual Chlorophyll-a [ug/l (surface waters only)]	15.2
Peak Chlorophyll-a [ug/l]	24.1
<b>Phosphorus</b>	
Average Annual Total Phosphorus [ug/l]	33.6
Seasonal Annual Total Phosphorus [ug/l]	38.8
Peak Annual Total Phosphorus [ug/l]	87
Average Annual Ortho Phosphorus ug/l]	11.1
Seasonal Average Ortho Phosphorus [ug/l]	20.7
Peak Annual Ortho Phosphorus [ug/l]	83
<b>Nitrogen</b>	
Average Annual Nitrate-Nitrogen [ug/l]	254
Seasonal Average Nitrate-Nitrogen [ug/l]	112
Seasonal Total Nitrogen [ug/l]	635
Peak Annual Nitrate-Nitrogen [ug/l]	1,019
<b>Clarity</b>	
Average Annual Secchi Depth (meters)	1.7
Seasonal Average Secchi Depth (meters)	1.6
<b>Total Suspended Sediments</b>	
Annual Average Total Suspended Sediments [mg/l]	8.1
Seasonal Average Total Suspended Sediments [mg/l]	9.8
Peak Total Suspended Sediments [mg/l]	25.2
<b>Phytoplankton Species</b>	
<b>Phytoplankton Species Co-dominant Species</b>	Stephanodiscus niagarae
	Anabaena flos-aquae
	Aphanizomenon flos-aquae
	Microcystis aeruginosa
	Cryptomonas erosa
	Melosira ambigua
	Schroderia sp.
	Gloeotrichia echinulata
	Gomphoneis herculeana
<b>Peak Phytoplankton Density</b>	<b>Peak Biovolume (um3/mL)</b>
Stephanodiscus niagarae	1,363,947

Table 4

Reservoir Summary for Select Trend Parameters

Parameter	Site	Reservoir Annual Average Concentration	
		2010	1991-2010
Chlorophyll-a (ug/L)	Top	10.6	14.6
Nitrate-Nitrogen (ug/L)	Top	287	341.0
	Bottom	222	313.7
Total Phosphorus (ug/L)	Top	28.3	63.1
	Bottom	38.9	91.7
Total Suspended Solids (mg/L)	Top	7.3	6.5
	Bottom	8.9	10.6
Secchi Depth (m)	Top	1.7	2.2

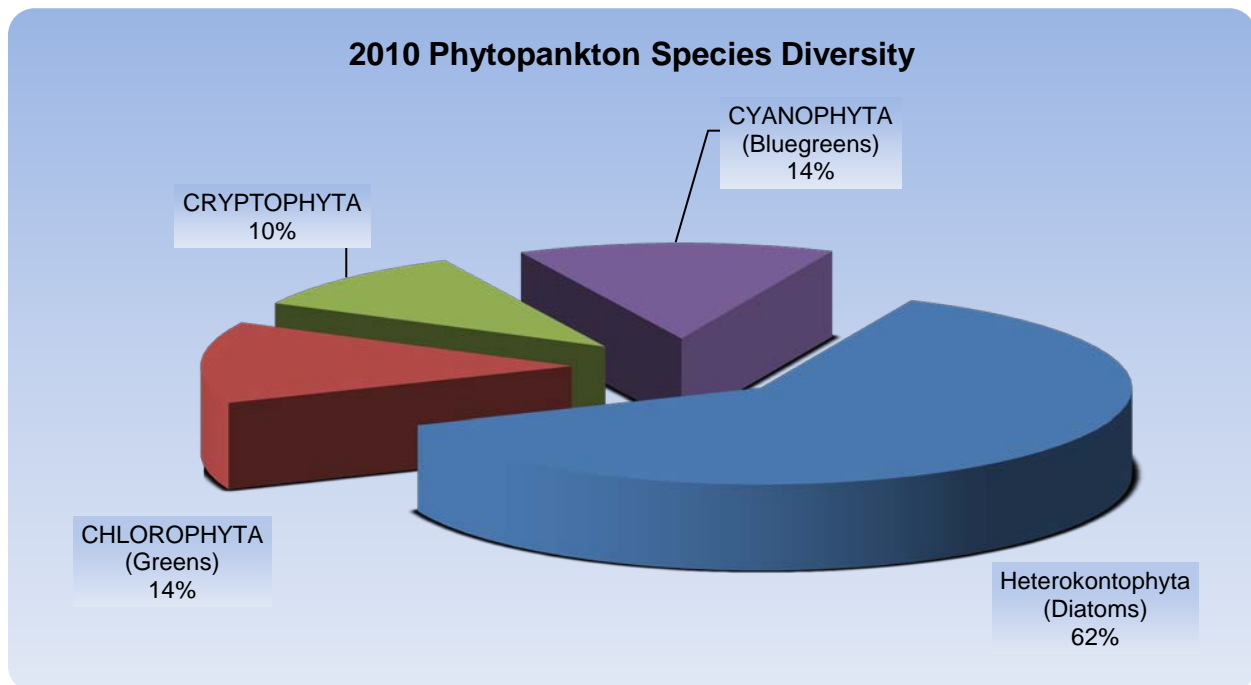


Figure 17 2010 Phytoplankton Diversity

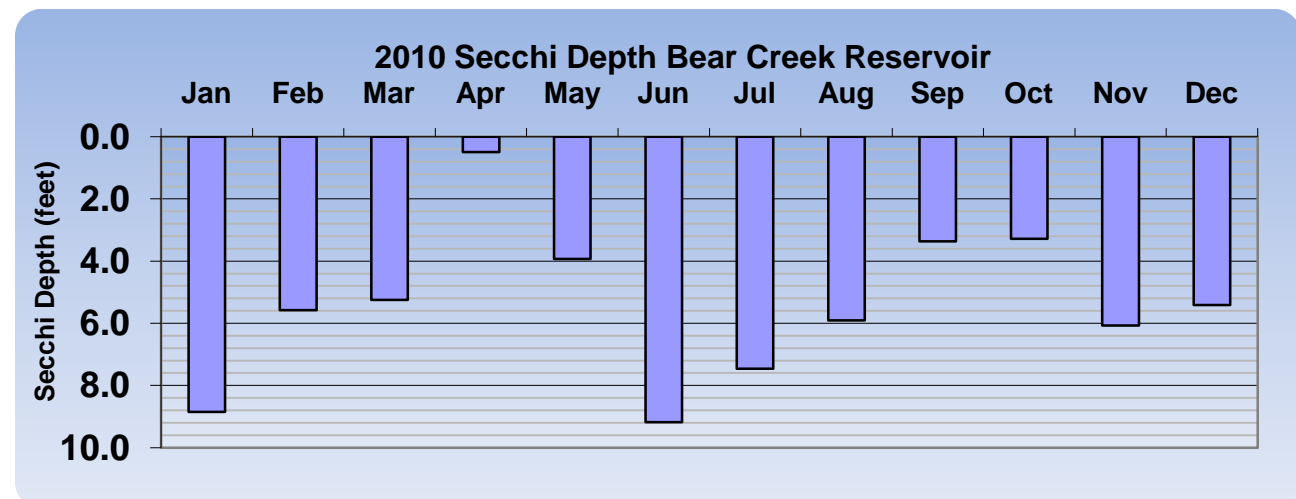
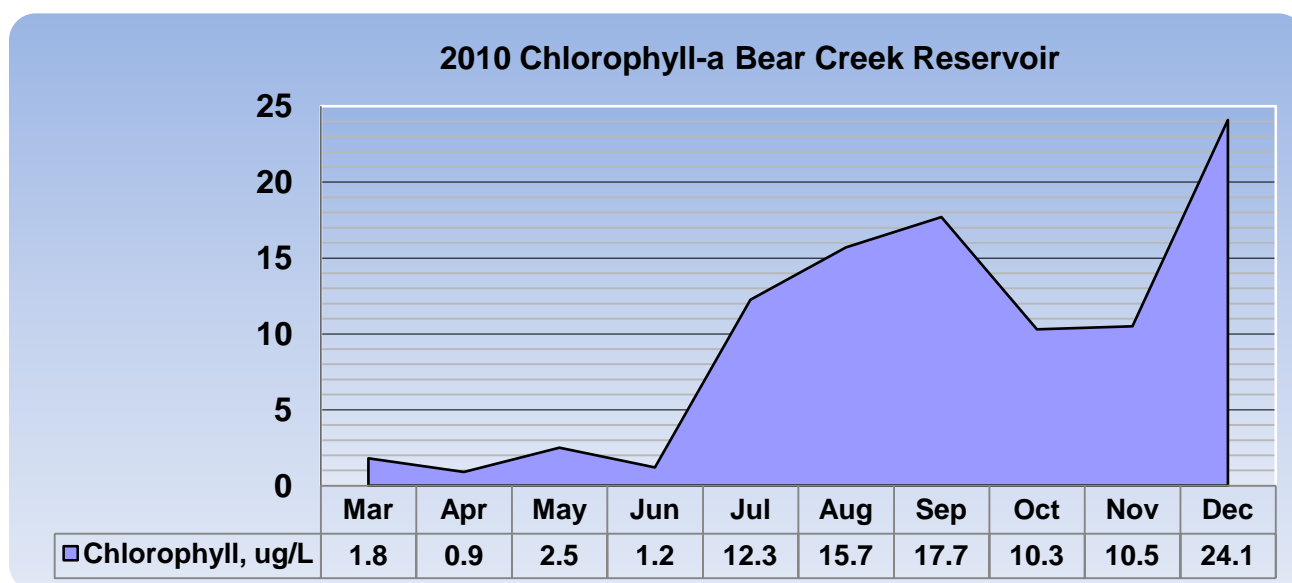


Figure 18 2010 Secchi Depth Bear Creek Reservoir

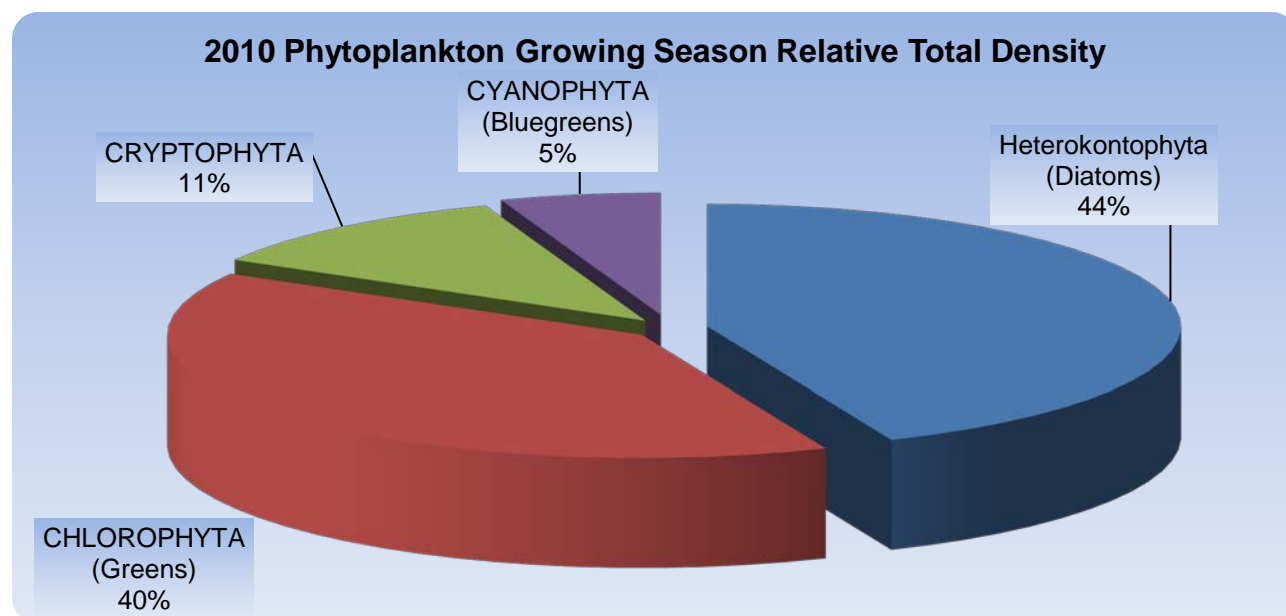


The reservoir had several algal blooms in 2010 as evidenced by the peak September chlorophyll concentration of 17.7 ug/l (December average Chlorophyll was unusually high at 24.1 ug/l). In 2010, bloom frequency increased in September, as evidenced by the surface chlorophyll concentrations (Figure 19). The peak phytoplankton density in 2010 was 1,363,947  $\mu\text{m}^3/\text{mL}$  caused by a diatom phytoplankton species. Historically, blue-green phytoplankton species are associated with major blooms in the reservoir. This was not the case in 2010, where the blooms were dominated by green and diatom phytoplankton species (Figure 20).

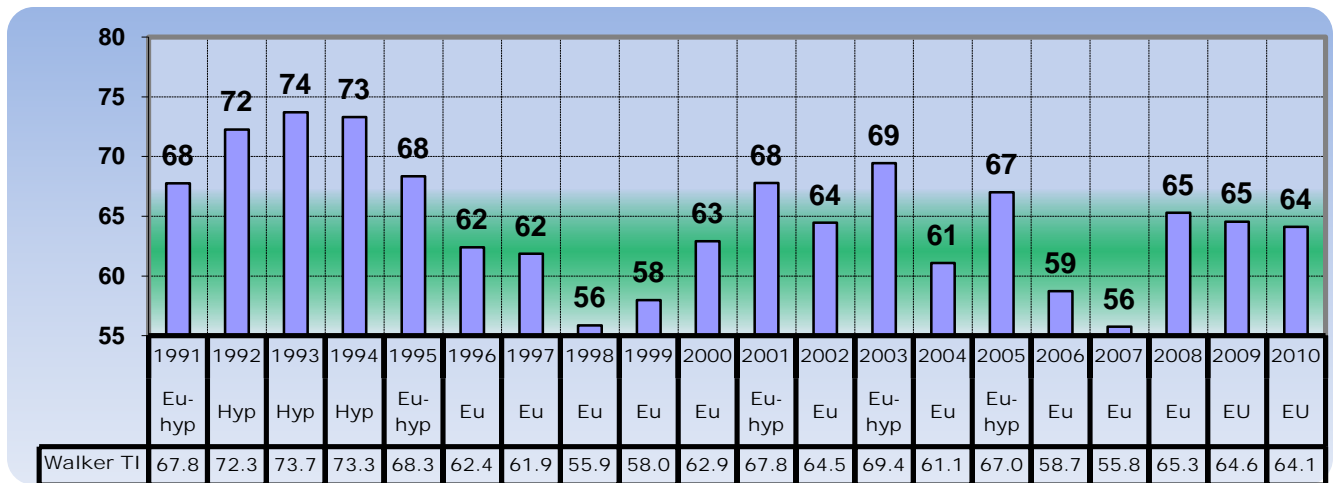
Generally, the reservoir trophic state in 2010 was eutrophic (Walker Index, Figure 21). The Carlson Index shows a similar eutrophic trend. Although external nutrient loads were lower than historic trends, the reservoir continues to have an internal nutrient loading problem, which causes eutrophic water quality conditions.



**Figure 19** 2010 Chlorophyll



**Figure 20** 2010 Growing Season Total Phytoplankton Densities



**Figure 21 Walker Trophic Index Trend Bear Creek Reservoir**

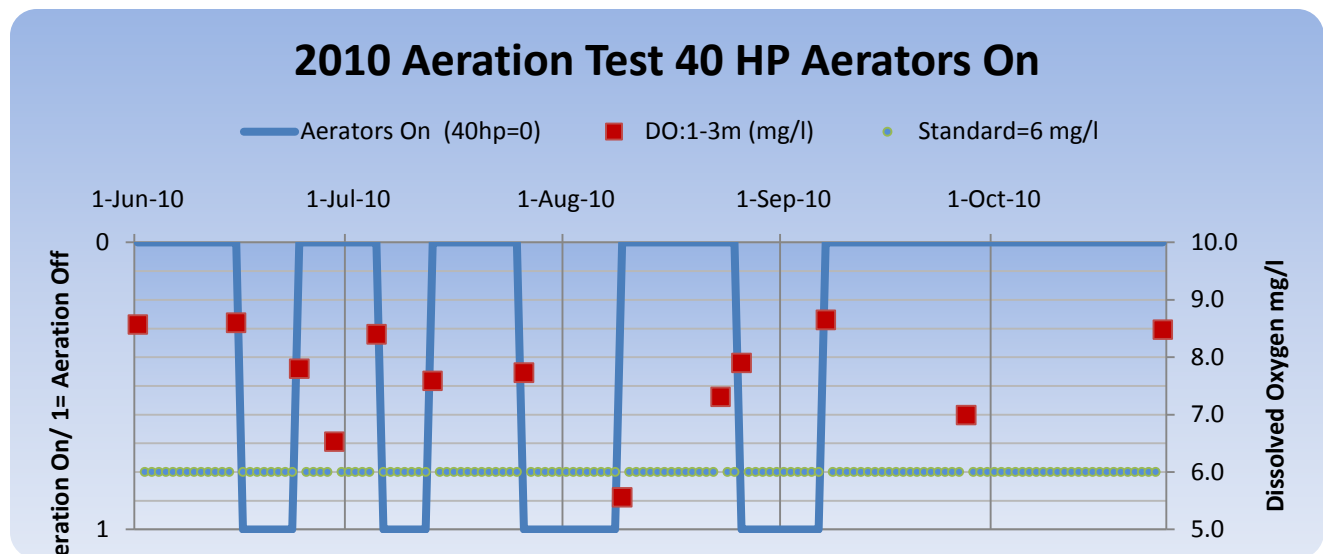
### **Bear Creek Reservoir Aeration Practice Manages Summer Dissolved Oxygen**

The reservoir aeration system reduces chlorophyll productivity, possibly through the partial control of internal nutrient loading that can trigger algal blooms. The Association adopted a policy that makes the reservoir aeration system a permanent reservoir management tool. The Association determined through ongoing monitoring that the de-stratifying aeration system in Bear Creek Reservoir is a necessary and long-term or permanent management practice necessary to protect the quality reservoir fishery (Figure 22) and prevent Dissolved Oxygen standard exceedances during summer months of June 1-September 30. Reservoir aeration is also a necessary management tool in low flow conditions.

The current aeration system has been operational since the summer of 2002 and uses a fine-bubble diffusion system with aerators distributed across the hypolimnion. In 2010, the Association and Lakewood ran operational studies to determine the effectiveness of the aeration system in oxygen transfer during phased on-off cycling (Figure 23). The aeration system can increase the Dissolved Oxygen concentrations throughout the water column by about 2 mg/l within a two-week period. The Association will continue operational testing in 2011.



**Figure 22 Stocking Bear Creek Reservoir**



**Figure 23      Reservoir Aeration Operational Testing**

### Bear Creek Sediment Study

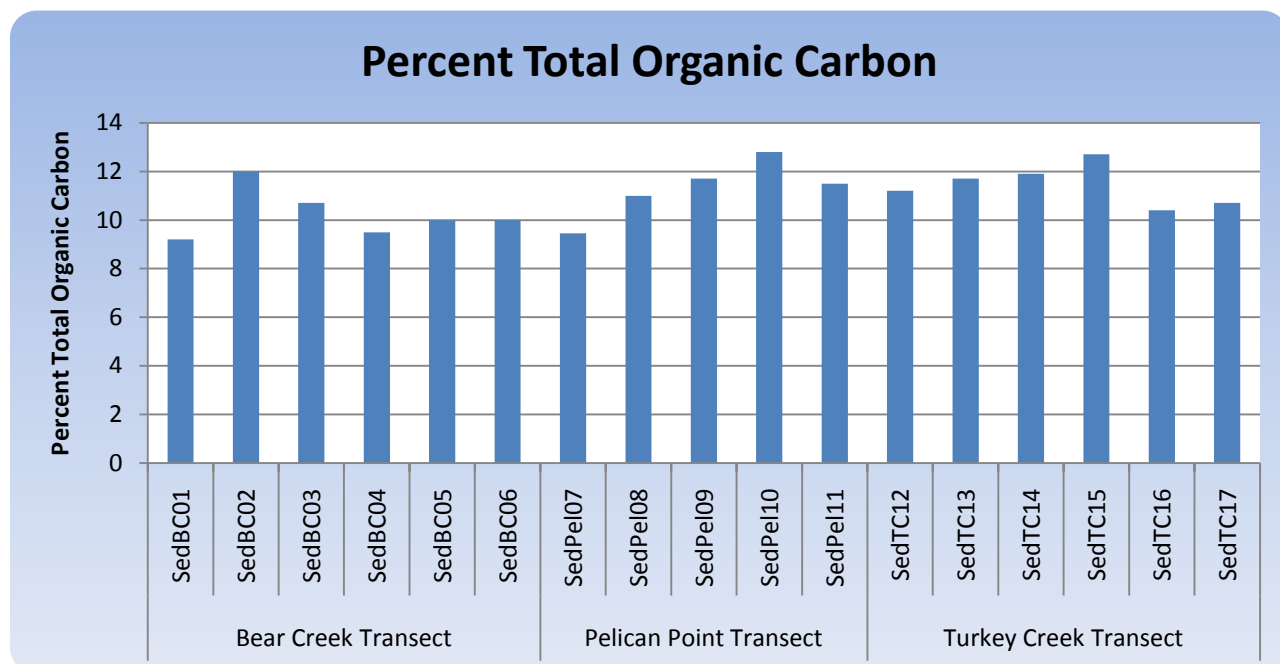
The total suspended sediment load in the reservoir has been generally constant over the historic monitoring period with periodic storm events dumping large volumes of sediment into the reservoir. The Association in 2010 noted no significant change in reservoir depth. Bottom sediments remain a mixture of fine sand, silt and mud.

Bear Creek Reservoir was field sampled on August 26, 2010. Bottom samples obtained with a petite Ponar sampler. Two dredge drops made at each site resulting in 1.5 to 3 liters of bottom mud. GPS coordinates taken at each site. The locations in Figure 24 estimate sample sites. Two samples bagged from the composite mud sample at the site

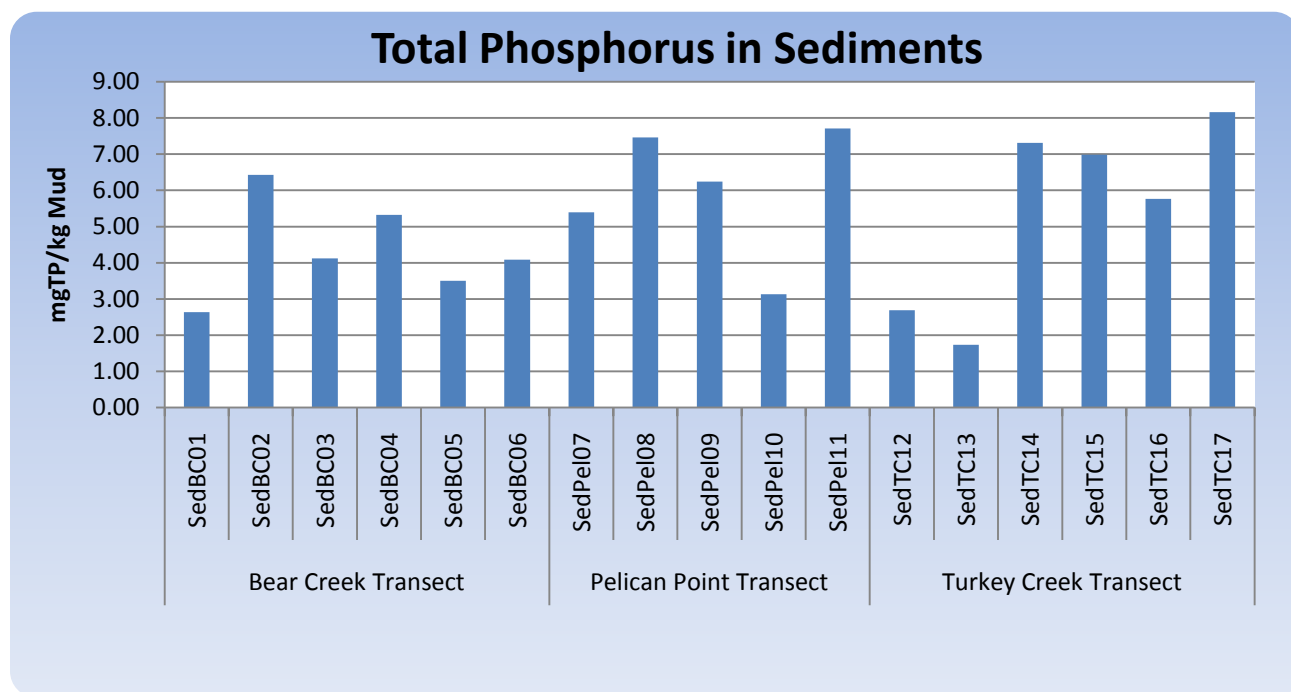


**Figure 24      Bear Creek Reservoir Bottom Sample Sites**

Figure 25 summarizes the total organic carbon (TOC) in bottom sediments. The TOC ranges from 9-13 % within the top 1/4m of the bottom sediments. The Association determined the total phosphorus content of the sediment (mg TP/kg Mud) as shown in Figure 26. The Total phosphorus content ranged from 1.5 to 8 mg TP/kg Mud. There is a considerable amount of phosphorus within the bottom muds. Figure 27 characterizes the sediment grain-size distribution. The bottom sediment contains about 20% clays and silts. The Association will continue the sediment program in 2011.

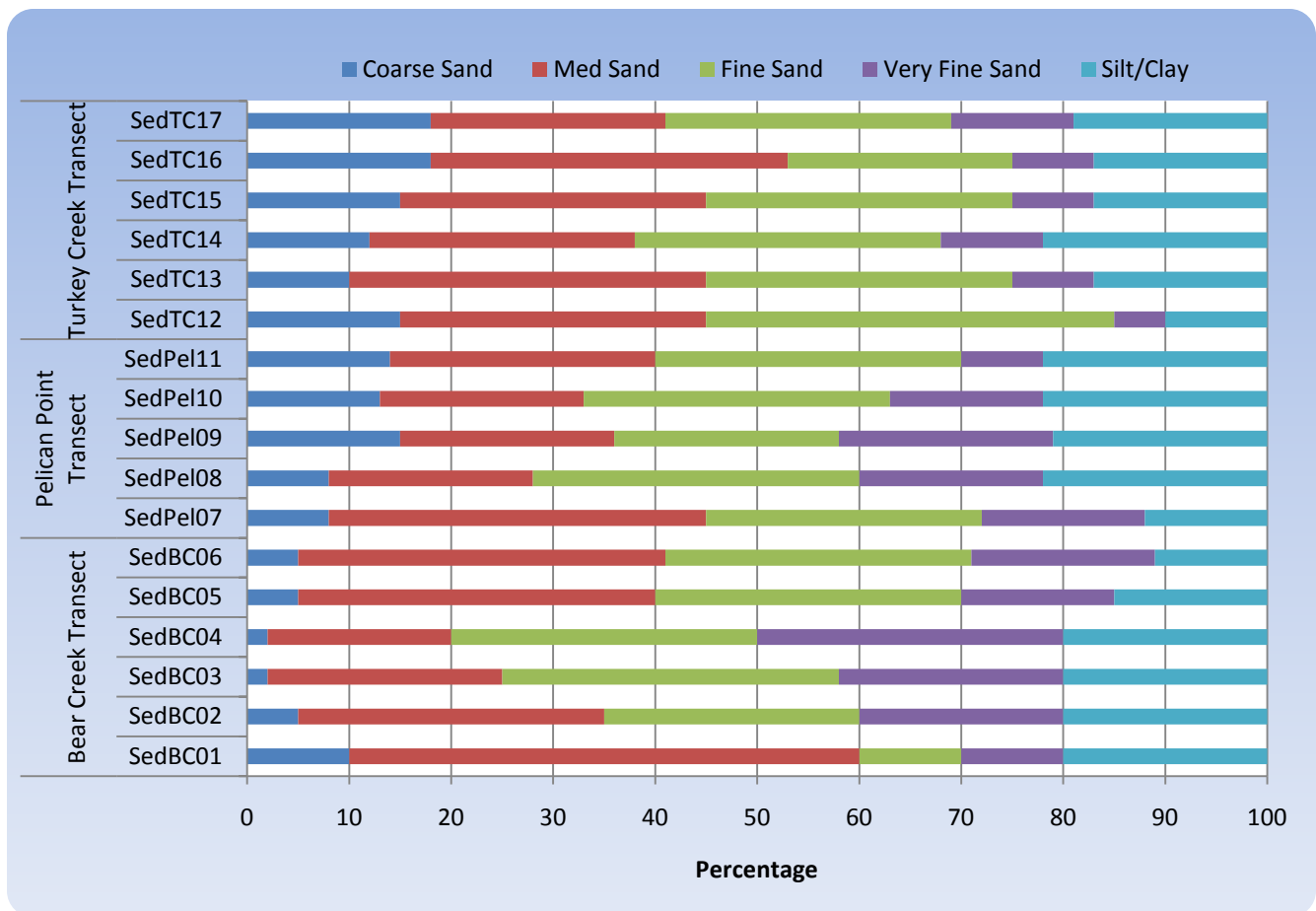


**Figure 25** Total Organic Carbon in Bear Creek Reservoir Sediments



**Figure 26** Total Phosphorus Estimates in Bottom Sediments





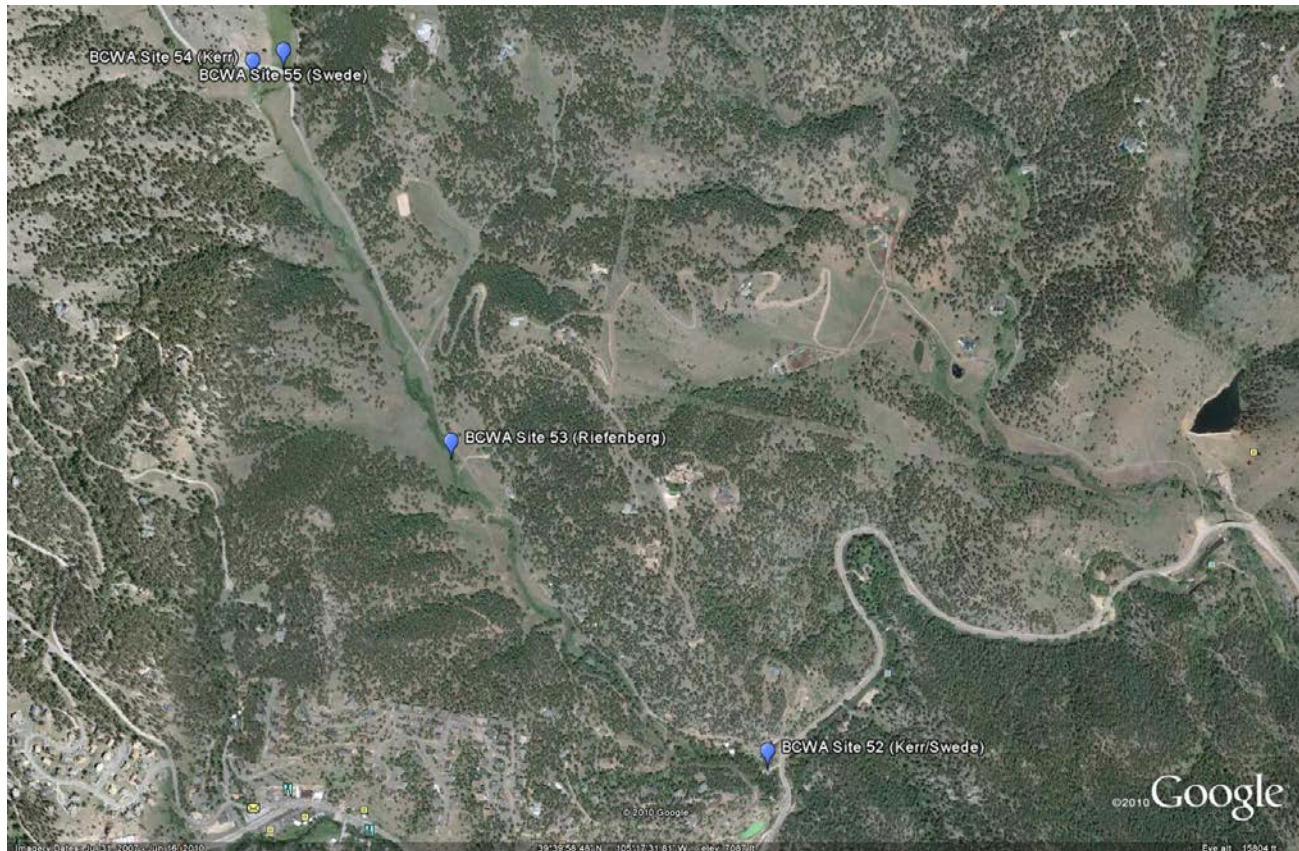
**Figure 27 Grain-Size Distribution in Bottom Muds**

### 2010 Bear Creek Kerr/Swede Gulch E. coli Study

The Colorado 303(d) list lists Swede Gulch as a low priority for E. coli. The mainstem is Kerr/Swede Gulch with the western gulch upstream of the upper confluence as Kerr Gulch and the eastern tributary as Swede Gulch (Figure 28). The Division and Association agree this area maybe a good candidate to understand the impact of septic systems to the water quality in tributaries. The Division and Association agree there is a water quality problem that requires further investigation.

The Association commits to a 5-years monitoring program to evaluate E. coli on Kerr/Swede Gulch (confluence with Bear Creek, below confluence of Swede Gulch and just upstream of confluence on Kerr Gulch) and lower Swede Gulch. The Association will monitor E. coli at 4-sites (Figure 28) from January (provided winter flows) through December over a 5-year period. The Association will also collect data for temperature, pH, specific conductance and Dissolved Oxygen using the field probe. The Association established GPS coordinates at selected sites and begin special monitoring program in May 2010. The Association is using the wastewater treatment plant laboratories for the E. coli analyses.

Table 5 shows the 2010 data summary for Kerr/Swede Gulch sample sites. Table 6 shows the Geometric mean for E. coli. The E. coli standard is 126/100ml (Measured as a geometric mean of data). There were no exceedances of the E. coli standard. The Association is also monitoring nitrogen and phosphorus, flow and standard field parameters. Technical Memorandum 2010.02 (BCWA, December 2010) summarizes all data for this study.



**Figure 28 Kerr/Swede Gulch Sample Sites**

**Table 5 Kerr/Swede Gulch Data Summary**

BCWA Site	Time	Temp ( C )	pH	SC (ms/cm)	DO (mg/l)	Rel NO3 (mg/l)	E. Coli (Cells/100ml)
<b>5/25/2010</b>							
Site 52 - Confluence	12:46	12.5	8.35	0.82	8.57	1.31	10
Site 53 - Riefenberg	13:01	14.6	8.31	0.82	8.12	1.01	6
Site 54 - Kerr	13:15	14.9	8.24	0.8	7.74	0.96	5
Site 55 - Swede	13:10	15.2	8.09	0.88	7.64	0.94	12
<b>6/22/2010</b>							
Site 52 - Confluence	13:20	17.9	8.38	0.83	7.48	2.13	40
Site 53 - Riefenberg	13:35	19	8.3	0.83	7.23	2.15	40
Site 54 - Kerr	13:50	19.1	8.24	0.81	6.63	2.07	76/90
Site 55 - Swede	13:45	21.2	8.22	0.86	6.79	2.13	38
<b>7/20/2010</b>							
Site 52 - Confluence	13:33	15.5	7.51	0.848	8.09		80/128
Site 53 - Riefenberg	13:22	16.2	7.64	0.848	7.73		48/160
Site 54 - Kerr	13:10	16.8	7.9	0.829	7.32		128/280
Site 55 - Swede	13:16	19.2	7.56	0.905	7.08		40/64
<b>8/24/2010</b>							
Site 52 - Confluence	11:14	12.7	8.57	0.84	10.29		52
Site 53 - Riefenberg	10:57	12.7	8.41	0.84	10.02		236
Site 54 - Kerr	10:43	12.5	8.34	0.81	9.52		32

BCWA Site	Time	Temp ( C )	pH	SC (ms/cm)	DO (mg/l)	Rel NO3 (mg/l)	E. Coli (Cells/100ml)
Site 55 - Swede	10:37	13.5	8.26	0.86	9.69		36
<b>9/28/2010</b>							
Site 52 - Confluence	13:27	12	7.77	0.84	8.34		16
Site 53 - Riefenberg	13:44	14.3	7.94	0.8	7.48		16
Site 54 - Kerr	14:01	14.5	8.1	0.83	7.46		20
Site 55 - Swede	13:55	17.1	8.09	0.92	6.79		12
<b>10/26/2010</b>							
Site 52 - Confluence	9:15	2.4	7.98	0.85	10.27		2
Site 53 - Riefenberg	9:26	2.1	8.05	0.84	9.85		4
Site 54 - Kerr	9:36	1.8	8.24	0.84	9.81		2
Site 55 - Swede	9:40	1.7	8	0.85	9.8		4
<b>11/16/2010</b>							
Site 52 - Confluence	9:27	1.5	7.66	0.835	9.86		1
Site 53 - Riefenberg	9:40	2.2	7.9	0.819	9.64		1
Site 54 - Kerr	10:52	2.9	7.84	0.839	8.79		3
Site 55 - Swede	10:58	2.3	8.05	0.786	9.36		1
<b>12/8/2010</b>							
Site 52 - Confluence	1:49	0.9	8.3	0.848	11.31		2
Site 53 - Riefenberg	2:05	0.7	7.91	0.779	10.55		2
Site 54 - Kerr	2:20	0	7.91	0.781	10.84		11
Site 55 - Swede	2:16	0.3	7.92	0.822	10.28		6

**Table 6 E. Coli 2010 Geometric Mean Summary**

BCWA Site	2010
	Geometric Mean
Site 52 - Confluence	13
Site 53 - Riefenberg	16
Site 54 - Kerr	24
Site 55 - Swede	13
<b>Total</b>	16

## **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 7 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 allocations (Table 7).

**Table 7 Treatment Facility Wasteload Allocations**

<b>Bear Creek Watershed Wastewater Treatment Plant</b>	<b>Phosphorus Pounds/ year</b>	<b>2010 Phosphorus Pounds/ year</b>
Evergreen Metropolitan District	<b>1,500</b>	<b>274.23</b>
West Jefferson County Metro District	<b>1,500</b>	<b>278.69</b>
Genesee Water and Sanitation District	<b>1,015</b>	<b>298.81</b>
Town of Morrison	<b>600</b>	<b>143.41</b>
Kittredge Sanitation and Water District	<b>240</b>	<b>56.04</b>
Forest Hills Metropolitan District <sup>1</sup>	<b>80</b>	<b>52.88</b>
Conifer Metropolitan District	<b>80</b>	<b>1.92</b>
Aspen Park Metropolitan District	<b>40</b>	<b>9.65</b>
Jefferson County Schools – Mt. Evans Outdoor School	<b>20</b>	<b>1.79</b>
Jefferson County Schools - Conifer High School	<b>110</b>	<b>1.12</b>
Bear Creek Development Corp. - Tiny Town	<b>5</b>	<b>0.81</b>
Bear Creek Cabins (Bruce & Jayne Hungate)	<b>5</b>	<b>0.48</b>
Brook Forest Inn <sup>3</sup>	<b>5</b>	<b>1.58</b>
Geneva Glen <sup>4</sup>	<b>5</b>	<b>0</b>
<b>Total Operational Facilities</b>		<b>1121.41</b>
The Fort <sup>2</sup>	<b>18</b>	<b>No Monitoring</b>
Singing River Ranch	<b>30</b>	<b>Not Operational</b>
Reserve Pool	<b>2</b>	<b>Not used 2010</b>
<b>Total Phosphorus Wasteload</b>	<b>5,255 lbs/year</b>	

1 Forest Hills Metro District has trade agreement with West Jefferson County Metro District and complies with permit. 88.5 pounds was added into the West Jefferson County allocation, which was 190.21 pounds for a total West Jefferson County Metro District discharge of 278.69 pounds.

2 Permit; No established monitoring

3 Brook Forest Inn reporting is only for August-December 2010, under new owner/operator

4 The Geneva Glen treatment system land applies, dry lysimeters

### **Permit Compliance and Plant Expansions/Actions**

Table 8 shows permitted wastewater treatment facilities in the watershed, status of wastewater planning, and reported permit compliance problems. All wastewater treatment plants in the watershed are minor facilities using the WQCD permit classification system. The Association worked on planning and review efforts for Forest Hills Metro District and Town of Morrison.

**Table 8 Wastewater Planning Status**

<b>Facility</b>	<b>Wastewater Utility Plan</b>	<b>Any Updates, Lift Station, or Amendments</b>	<b>Facility Upgrades [2011-2014]</b>	<b>Compliance Problems</b>
<b>Evergreen Metropolitan District</b>	Yes	Structural upgrades complete, Odor controls	Yes	No
<b>West Jefferson County</b>	Yes	Odor controls Complete	No	Yes, 1 ammonia
<b>Genesee</b>	Yes	Yes, Lift Station	Yes	No
<b>Kittredge</b>	Yes	No	No	No
<b>Morrison</b>	Yes	Updated Utility Plan, planned upgrades 2011	Yes	No
<b>Jefferson County Schools Conifer High School</b>	Yes	Lift Station	Yes	No



Facility	Wastewater Utility Plan	Any Updates, Lift Station, or Amendments	Facility Upgrades [2011-2014]	Compliance Problems
Jefferson County Schools Mt Evan Outdoor	Yes	New facility Design	Yes	Yes
Forest Hills Metropolitan District	No	No	Yes	Yes, will be corrected with plant upgrade
Conifer Sanitation Association	Yes	No	Yes	No
Aspen Park Metro District	Yes	New infiltration gallery	Yes	Yes, Gallery Operation
Conifer Metro District (CMD)	Yes	No	No	Chloride -3-yr window to correct problem
The Fort	Yes	New Treatment Works, Monitoring	Yes	No
Bear Creek Development	No	No	No	No
Bear Creek Cabins	No	No	Yes	No
Singing River Ranch	No	Plugged Influent	No	No
Brook Forest Inn	No	Yes, new plan	Yes	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: Point source to point source trades (regulation and permit); and Nonpoint source to point source total phosphorus trading specific to the Bear Creek Watershed (*Trading Guidelines*).

The *Bear Creek Trading Guidelines* allow 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 9 lists all Association trades. The reserve pool remained at 2 pounds and no changes made in 2010. The trades in the watershed remain consistent with the total wasteload allocations listed in Table 7.

**Table 9 Phosphorus Trading Activity in Bear Creek Watershed**

Involved Agencies	Type of Trade	Active Trading in 2010
Forest Hills Metro District (FHMD) has trade agreement with West Jefferson County Metro District(WJCMD) <sup>1</sup>	Point Source to Point Source	Yes (reflected in WLA; see Table 5)
City of Lakewood Coyote Gulch Project	Nonpoint source trade credits	Under data collection/ review by Association; no trade credit assigned in 2009
The Fort Restaurant	Reserve Pool to Point Source	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 facilities
Conifer Metropolitan District	Reserve Pool to Point Source	Trade reflected in reserve pool limit previously granted by the WQCC

<sup>1</sup>The trade agreement is between WJCMD and FHMD for phosphorus removal. FHMD is allowed to discharge PO<sub>4</sub> at a concentration of 1.0 mg/L. WJCMD agrees to remove the remainder. The calculations are as follows:

- Total lbs of PO<sub>4</sub> 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 PO<sub>4</sub> WJCMD agrees to remove
- Total lbs of PO<sub>4</sub> WJCMD removes is calculated by FHMD flow X calculated concentration X 8.34
- The total lbs of PO<sub>4</sub> discharged by WJCMD is calculated by the total of WJCMD + Excess FHMD PO<sub>4</sub> pounds

### **Regulated Stormwater Management**

The City of Lakewood has a municipal separate storm sewer permit. Lakewood supports many stormwater management programs in the watershed, 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 2010. This process keeps materials out of septic systems and helps reduce illegal dumping in the watershed. Lakewood regularly reports to the Association on stormwater management practices and programs. More information about Lakewood's municipal separate storm sewer system permittee activities contained CDPS Stormwater Permit Annual Report for 2010 (City of Lakewood, April 1, 2011) and summarized in Appendix A.

Jefferson County also has a municipal separate storm sewer permit. Jefferson County's program includes: Public Education and Outreach; Public Participation and Involvement; Illicit Discharge Detection and Elimination; Construction Site Runoff Control; Post Construction Site Runoff Control; and Pollution Prevention/Good Housekeeping. The county provides opportunities for residents and visitors in the watershed to learn and be involved in environmental stewardship and programs that promote water quality. The county has a comprehensive storm sewer outfall map to trace sources of potential illicit discharges and illegal dumping in the watershed.

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).

**Table 10      Jefferson County Storm Water 2010 Activities and Actions**

<b>Activity</b>	<b>Inspections/ Action</b>
Illicit Discharge Verbal Notification of Violation	5
Illicit Discharge Monetary Penalty/Fine	0
Construction Sites Covered by Program	267
Construction Inspections	2014
Enforcement Verbal Notification of Violation	550
Post-Construction Inspections	8
Storm drain marking program	Ongoing

## **Nonpoint Source Loading and Appropriate Best Management Practices**

### **Septic System Management**

In 2010, the Association continued limited discussions with Jefferson County Health Department based on previous presentations made to the Jefferson County Board of Health and the Jefferson County Commissioners. Jefferson and Clear Creek counties reviewed their septic system regulations. The Association predicts onsite wastewater systems in a number of specific areas in the Bear Creek Watershed contribute to water quality degradation. There are estimated 27,000-onsite systems in the watershed.

Jefferson County updated to its comprehensive plan. This update addressed onsite issues with the intent to ensure quantity and quality of water resources are maintained in areas using septic systems. Policies in the Comprehensive Plan note, "When well and septic are proposed, inside the Mountain Ground Water Overlay District (MGWOD), the overall gross density should not exceed 1 du/7.5 acres

and the minimum lot size should be 5 acres. When well and septic are proposed, outside the MGWOD, the overall gross density should not exceed 1 du/5 acres and the minimum lot size should be 3.5 acres."

### **Watershed Nonpoint Source Program Elements**

The management of nonpoint sources in the Bear Creek Watershed is a component of the Association planning and management programs. Phosphorus reduction from nonpoint sources is still required in the watershed. A lack of implementation authority limits the nonpoint source program. The Association does maintain a comprehensive watershed-monitoring program to determine sources of nutrient loading into waterways.

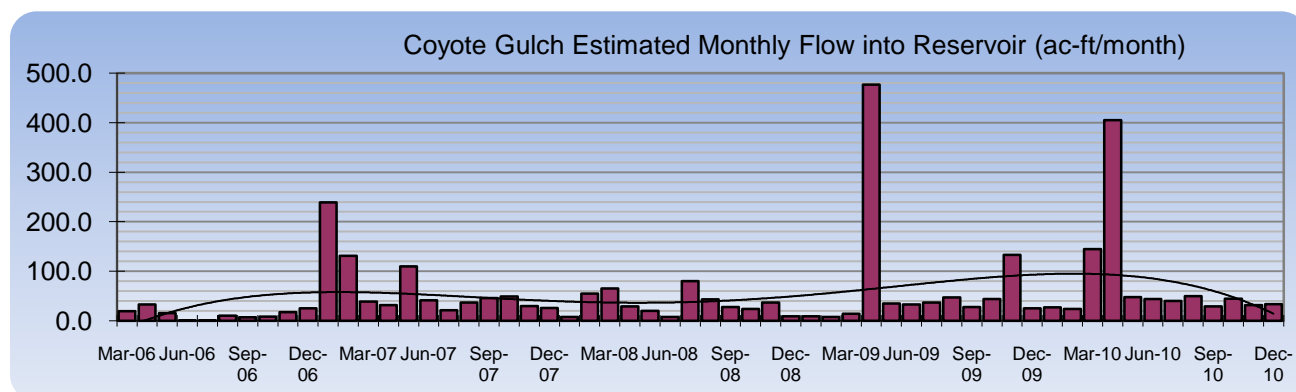
The Association will increase monitoring of stormwater loadings in select locations in the middle section of the watershed. The Association has identified a number of potential project locations requiring corrective land use controls. The Association has worked with several local businesses that caused minor nonpoint source runoff from their business sites with the implementation of runoff controls. These runoff control programs were very successful.

### **Association Land-Use Review**

The Association has 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 addresses nonpoint sediment loading before it becomes a watershed problem. Referred land use applications that cause a land disturbance and/or a potential to degrade water quality are subject to review and comment by Association. The Association completed six referrals in 2010 that addressed issues related to erosion, septic management, land disturbance, re-zoning, water quality degradation and appropriate use of best management practices.

### **Coyote Gulch Nonpoint Source Restoration**

The Association is involved in a nonpoint source project sponsored by the City of Lakewood that restored a severely eroded section of Coyote Gulch. Coyote Gulch revegetation began in June 2007 and became well established in 2008. The Association has a paired water-sampling program, which allows 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 29; flow record).

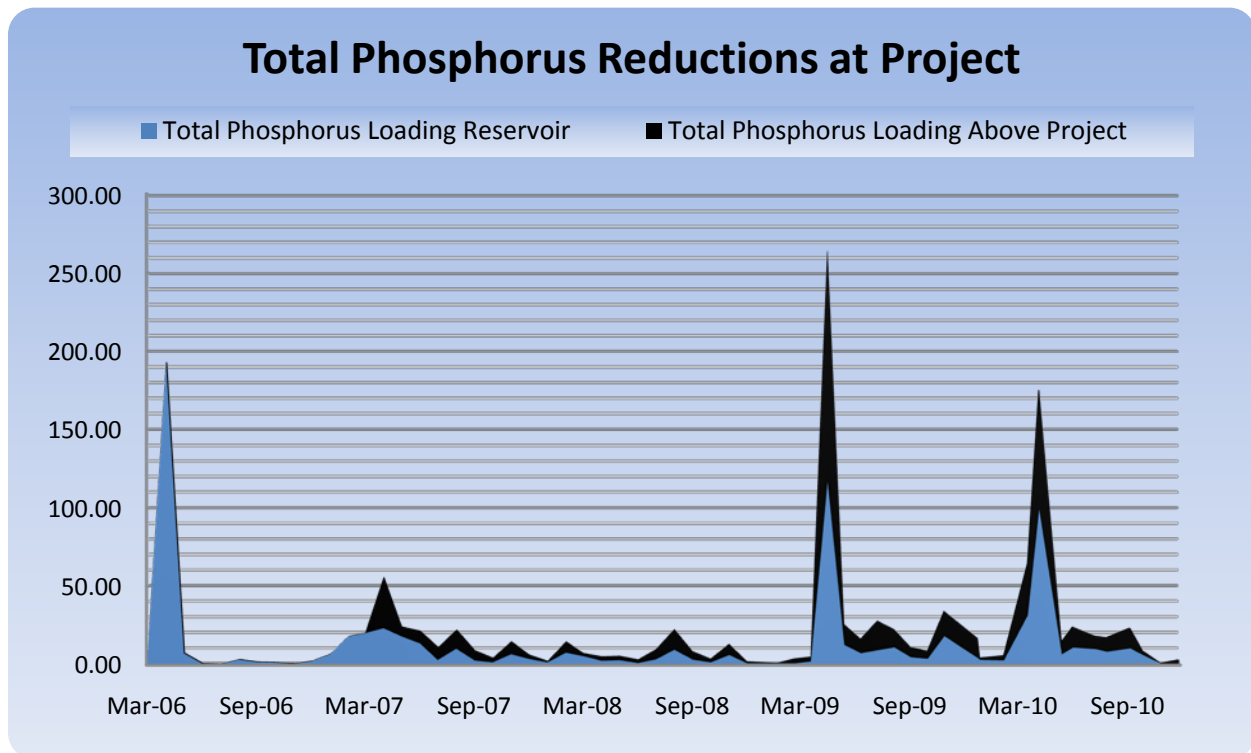


**Figure 29** Flow in Coyote Gulch

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 10). After completion of the project, the monthly average base load of total phosphorus reduced from 60-88% (Table 11). Figures 30 and 31 show the 2006-2010 pre-construction and post-construction nutrient summaries. Figure 32 shows the project reduced the annual base load of total phosphorus reaching the reservoir. Based on the 2010 results, there are about 71.4 pounds of total trade phosphorus available from the project on an annual basis (based on a 2:1 trade ratio). The total project cost was about \$440,000. Consequently, the trade phosphorus has an estimated value of \$6,200 per pound. The Association and the City of Lakewood will develop a trade agreement for these total phosphorus pounds after establishing a 5-year base-line data set.

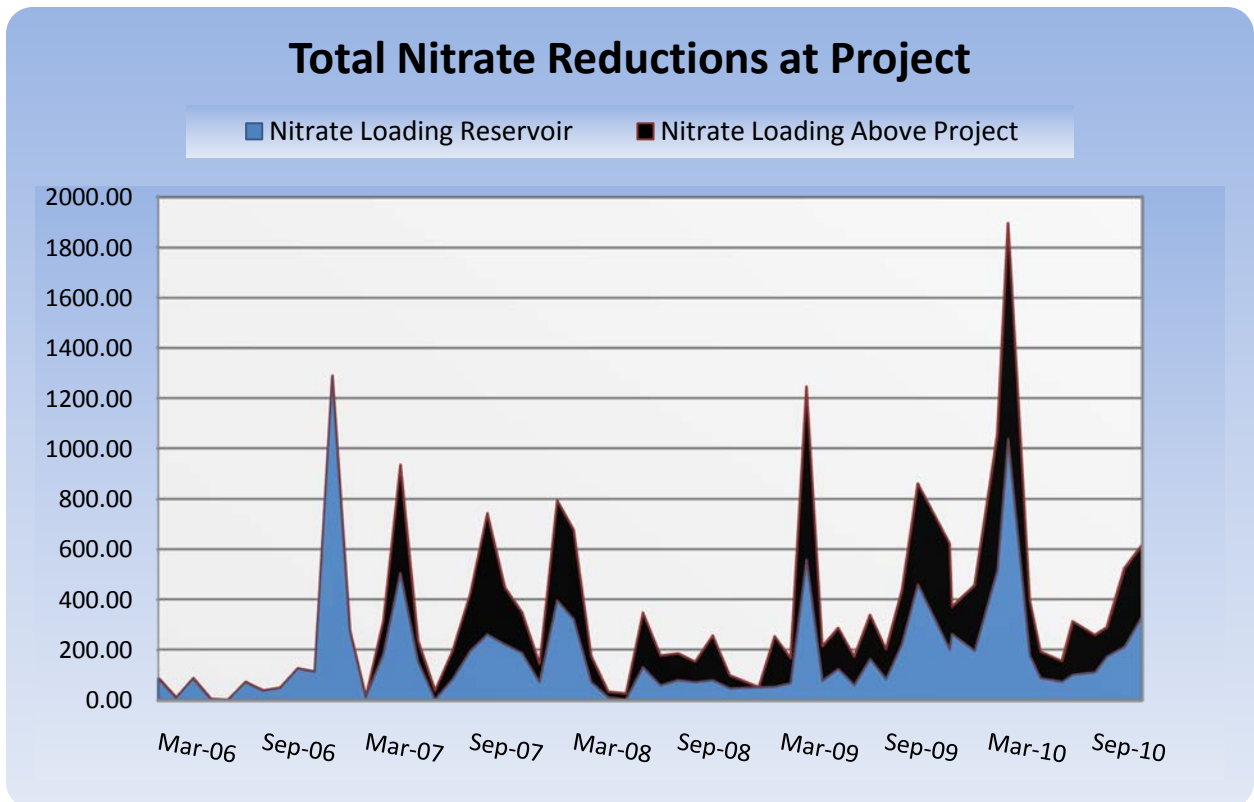
**Table 11 Nitrate and Phosphorus Load Estimates at Coyote Gulch**

Average Loading Pounds Per Year					
		Reservoir		Above Project	
		Nitrate	T Phos	Nitrate	T Phos
Pre-construction	2006-2007	200.7	20.0		
Post-Construction	2007-2008	128.7	4.4	160.9	5.2
	2009*	142.0	6.7	185.9	8.9
	2010*	203.7	8.1	216.7	8.5
Loading Pounds After Stable					
		Reservoir		Above Project	
		Nitrate	T. Phos	Nitrate	T Phos
Total Pounds		5,948	409	6,875	456
Average		180	12	208	14
Median		102	5	148	6
2009*/2010* average loadings per year excludes April storm loadings					

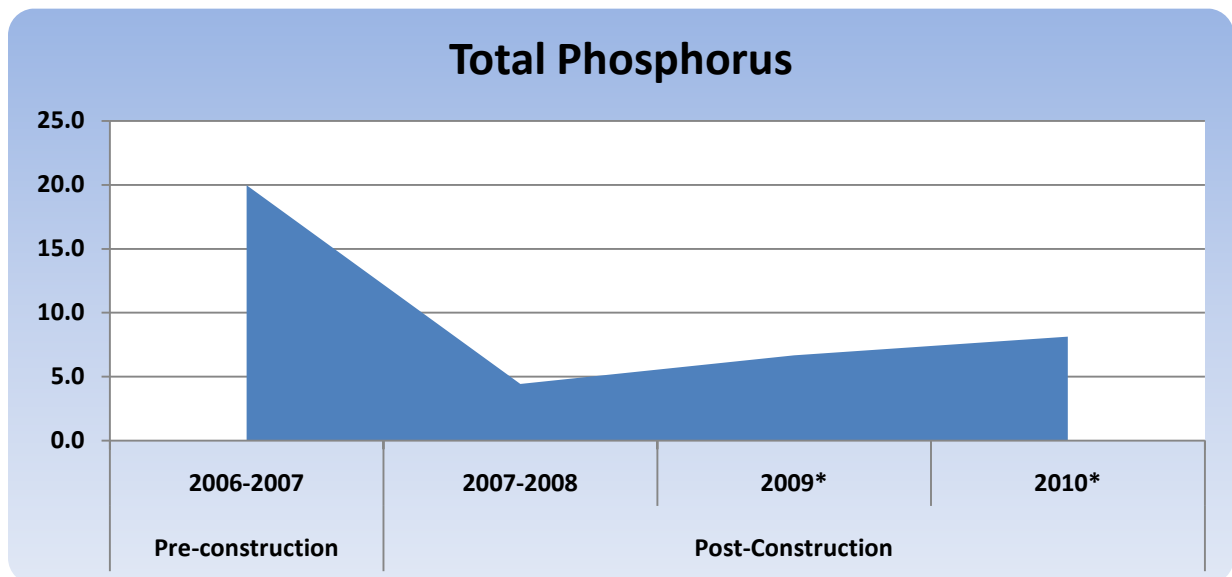


**Figure 30 Phosphorus Loading in Coyote Gulch**





**Figure 31** Nitrate Loading in Coyote Gulch



**Figure 32** Total Phosphorus Reduction

#### Regional Parks Recycling Efforts

The City of Lakewood is in their 7<sup>th</sup> year of recycle and litter management at their regional parks, including Bear Creek Park. In 2010, the program recycled motor oil (10 gallons), aluminum (1095 pounds), steel and tin (2,500 pounds), glass (8 cubic yards), plastic and paper products (98 cubic yards), light bulbs, tires, all batteries, paints, and other chemical, which disposed at the Rooney Road Recycling Center. The city continues trash clean up along Bear Creek and Turkey Creek drainages and around the reservoirs. In 2010, over 70 volunteers did erosion control, willow planting, park clean-up, trail work and vegetation management.

### **Aspen Park/ Conifer Waste Recycling Program**

The Conifer Area Council has established a “Recycling / Sustainability Committee”, which supported community-recycling efforts in 2010. Information from this committee distributed to the Association membership.

### **Invasive Species Protection Program**

#### **Bear Creek Reservoir**

Bear Creek Lake Park is involved in Colorado efforts to stop the spread of Aquatic Nuisance Species in Colorado waters. A Watercraft Inspection and Decontamination station is located in the Whitetail parking lot. All trailer and motorized boats require inspection by state certified inspectors at the station for any aquatic invaders. Station staffed from 6am to 8pm on Fridays and the weekends, then every morning and evening during the week. During the middle of weekday, the entrance gate would call out when a boat came in and the nearest staff member would do the inspection. Annually, the lake closes from November 15 to March 15. Overall, the park did 1800 standard inspections with one high-risk inspection and no positive samples.

#### **Evergreen Lake**

The Evergreen Park & Recreation District requires a permit for all personal watercraft to be on Evergreen Lake. This is an opportunity to do the mussel inspection at the Lake House prior to launch. The Recreation District staff was trained on proper inspection of boats and trailers

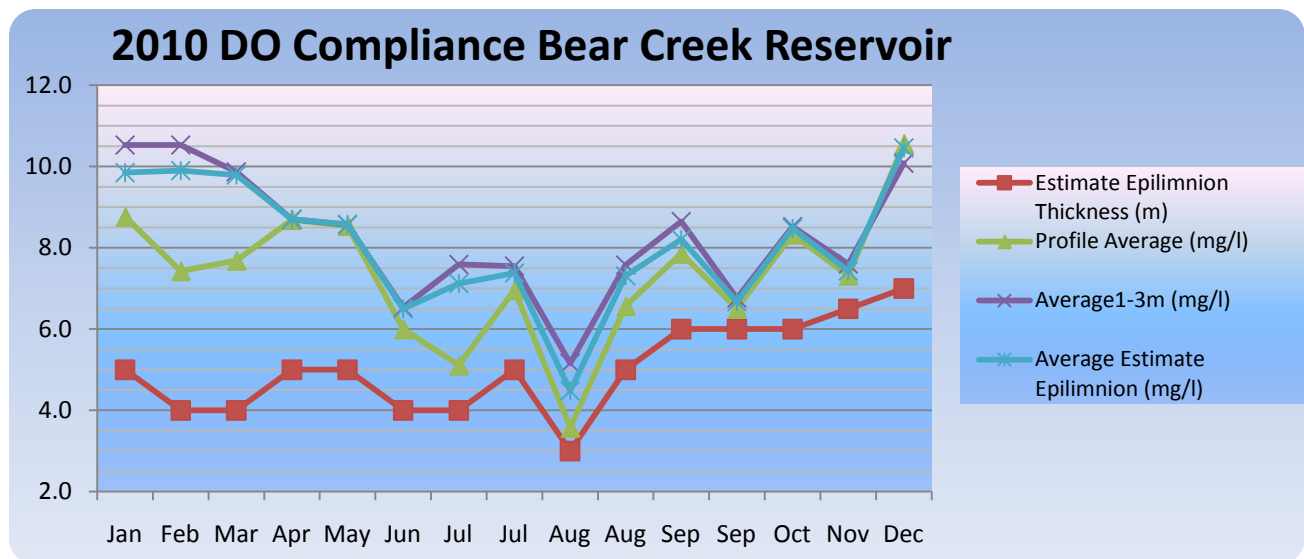
## **Meeting Water Quality Goals and Standards for the Watershed**

### **Dissolved Oxygen Compliance in Bear Creek Reservoir**

Bear Creek Reservoir is on the Colorado monitoring list for Dissolved Oxygen. As such, the Association takes multiple profile readings at five profile stations in the reservoir to determine Dissolved Oxygen compliance. The Association Dissolved Oxygen data set from 2003-2010 for Bear Creek Reservoir shows over 98% compliance with the standard for the upper water column (surface through the mixed layer). The Dissolved Oxygen values in the mixed layer in 2010 were greater than 6 mg/l except for a 1-week period in August (Table 12, Figure 33). The aeration system was not operating when the Dissolved Oxygen dropped below 6.0 mg/l. The aeration system raised the Dissolved Oxygen above 6.0 mg/l within 6-days. Data collected in the 2010 growing season shows the aeration system adds a maximum of 2.5 mg/l dissolved oxygen to the water column when under normal operation. Generally, the aeration system increases water column dissolved oxygen by about 1 mg/l, which results in dissolved oxygen compliance within the mixed layer.

**Table 12      2010 DO Compliance in Bear Creek Reservoir**

Reservoir Site 40	2010 DO Compliance Bear Creek Reservoir														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Jul	Aug	Aug	Sep	Sep	Oct	Nov	Dec
Planar Thermocline (m)	4.0	5.0	5.0	6.0	6	5.5	5	6.0	4.0	5.0	5.0	5.0	4.0	4.0	5.0
Total Depth Profile (m)	8.8	10.8	10.9	10.9	7	11.0	11	11.0	10.6	10.9	10.6	10.5	10.4	10.5	10.2
Estimate Epilimnion Thickness (m)	5.0	4.0	4.0	5.0	5	4.0	4	5.0	3.0	5.0	6.0	6.0	6.0	6.5	7.0
Profile Average (mg/l)	8.8	7.4	7.7	8.7	8.5	6.00	5.1	7.0	3.6	6.6	7.9	6.5	8.3	7.3	10.6
Average 1-3m (mg/l)	10.5	10.5	9.9	8.7	8.6	6.53	7.6	7.6	5.2	7.6	8.7	6.8	8.5	7.6	10.1
Average Estimate Epilimnion (mg/l)	9.9	9.9	9.8	8.7	8.6	6.50	7.1	7.4	4.5	7.3	8.2	6.7	8.5	7.4	10.5



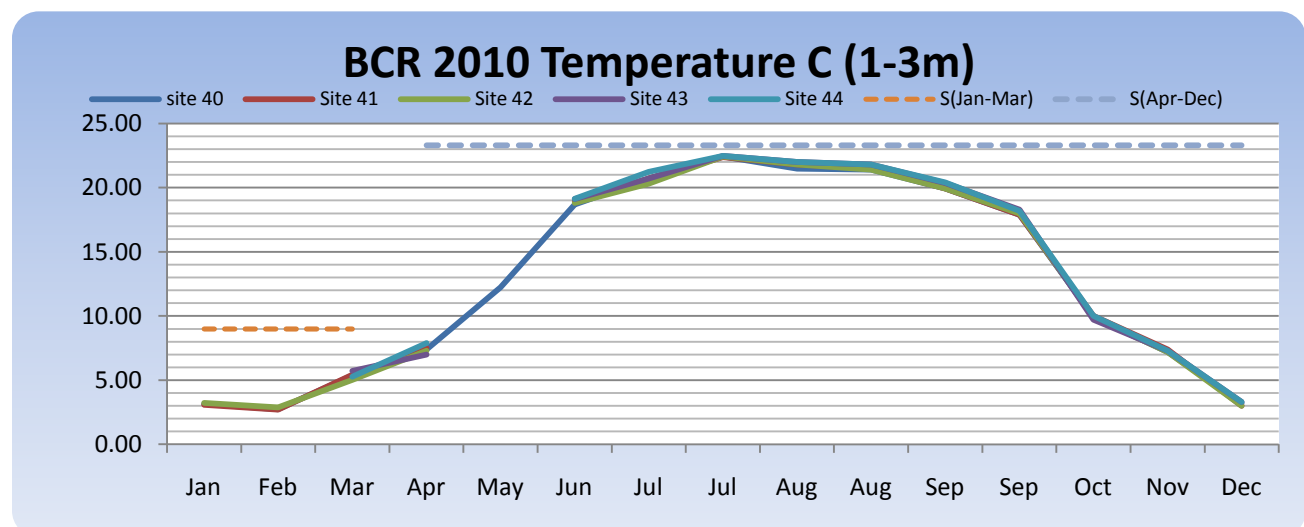
**Figure 33 2010 DO Compliance Bear Creek Reservoir**

#### Bear Creek Reservoir Temperature Compliance

The Association takes multiple profile readings at five profile stations in the reservoir to determine temperature compliance. Table 13 and Figure 34 show temperature standards and the compliance record for Bear Creek Reservoir.

**Table 13 2010 Temperature Record Bear Creek Reservoir.**

Reservoir Sites	2010 Temperature C WAT (1-3 m)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Jul	Aug	Aug	Sep	Sep	Oct	Nov	Dec
Standard	9.0 (13.0)			23.3 (23.8)											
site 40	3.15	2.73	5.37	7.4	12.23	18.7	20.71	22.42	21.47	21.40	19.93	17.9	9.9	7.2	3.2
Site 41	3.09	2.70	5.43	7.5		18.93	20.70	22.39	21.80	21.50	19.93	17.9	10	7.4	3
Site 42	3.23	2.87	5.03	7.3		18.8	20.30	22.44	21.80	21.40	19.93	18	9.9	7.2	3
Site 43			5.73	7		19.1	20.70	22.49	22.00	21.80	20.37	18.3	9.7	7.3	3.3
Site 44			5.27	7.9		19.13	21.22	22.47	22.00	21.80	20.40	18.2	10	7.3	3.3
S(Jan-Mar)	9	9.00	9.00												
S(Apr-Dec)				23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3



**Figure 34 2010 Temperature Compliance Bear Creek Reservoir.**

## Watershed Stream and Lake Compliance

The Association conducts special stream monitoring programs within the Bear Creek Watershed including Bear Creek, and a portion of the Turkey Creek Drainage (North and South Turkey Creek). The monitoring year divides into a warm-season period with more intense sampling and a cold-season period, designed to provide minimal winter and spring data. The Association 2010 Data Report summarizes temperature and water quality monitoring data, sampling results obtained from in-stream locations, and data from five-wastewater treatment plant effluents. The complete water quality data set is an electronic data report.

Stream and lake sampling and monitoring data, including pH, Temperature, Dissolved Oxygen, Specific Conductance, Ammonia, Nitrate+Nitrite, Total Inorganic Nitrogen (calculated) and Total Phosphorous was collected from July through September, at 22 sites. Stream and lake temperature dataloggers located at 32 Sites, including the Evergreen Lake profile station, excluding the five-wastewater treatment plants. Eight sites have dataloggers temperatures from January 1 through December 30. The 24 remaining sites have temperature data from May through September. Manual flows measured at 16 sites during the July to September timeframe.

The warm-season temperature measurements show 10 exceedances of chronic standard (excluding Genesee Reservoir) and 10 exceedances of daily maximum in Segments 1a (Bear Creek above Evergreen Lake), 1b (Bear Creek below the Harriman Ditch), 1e (Bear Creek below Evergreen Lake) and 6b (North Turkey Creek, at Flying J Ranch Bridge) with established standards (Table 14). In the cold season (Table 14), there was only one exceedance of the weekly average temperature (segment 1a) and 15 exceedances daily maximum in segments 1a, 3 (Vance Creek), and 6b.

**Table 14 Watershed Temperature Compliance Summary Warm/ Cold Seasons**

<b>BASIN SEGMENT</b>	<b>COLD SEASON</b>		<b>WARM SEASON</b>	
<b>Segment 1a(CS-I)</b>	<b>9.0°C WAT</b>	<b>13.0°C DM</b>	<b>17.0 WAT</b>	<b>21.2 DM</b>
# of Exceedances	1	5	1	3
# of Measurements	24	181	52	374
% Compliance	95.83	97.24	98.08	99.20
<b>Segment 1b(CS-II)</b>	<b>9.0°C WAT</b>	<b>13.0°C DM</b>	<b>19.3°C WAT</b>	<b>23.8°C DM</b>
# of Exceedances	0	0	1	0
# of Measurements	52	291	138	400
% Compliance	100.00	100.00	99.28	100.00
<b>Segment 1d(CLL)</b>	<b>9.0°C WAT</b>	<b>13.0°C DM</b>	<b>18.2°C WAT</b>	<b>23.8°C DM</b>
# of Exceedances			5	0
# of Measurements			110	628
% Compliance			95.45%	100%
<b>Segment 1e(CS-II)</b>	<b>9.0°C WAT</b>	<b>13.0°C DM</b>	<b>19.3°C WAT</b>	<b>23.8°C DM</b>
# of Exceedances	0	0	3	1
# of Measurements	138	1020	272	1940
% Compliance	100.00	100.00	98.90	99.95
<b>Segment 2(WS-II)</b>	<b>13.7°C WAT</b>	<b>14.3°C DM</b>	<b>27.5°C WAT</b>	<b>28.6°C DM</b>
# of Exceedances	0	0	0	0
# of Measurements	4	28	3	32
% Compliance	100.00	100.00	100.00	100.00
<b>Segment 3(CS-I)</b>	<b>9.0°C WAT</b>	<b>13.0°C DM</b>	<b>17.0 WAT</b>	<b>21.2 DM</b>
# of Exceedances	0	7	0	0
# of Measurements	4	31	18	125
% Compliance	100.00	77.42	100.00	100.00



BASIN SEGMENT	COLD SEASON		WARM SEASON	
<b>Segment 5(CS-II)</b>	<b>9.0°C WAT</b>	<b>13.0°C DM</b>	<b>17.0 WAT</b>	<b>21.2 DM</b>
# of Exceedances			0	0
# of Measurements			62	453
% Compliance			100%	100%
<b>Segment 6a(CS-II)</b>	<b>9.0°C WAT</b>	<b>13.0°C DM</b>	<b>18.2°C WAT</b>	<b>23.8°C DM</b>
# of Exceedances	0	0	0	0
# of Measurements	23	175	25	187
% Compliance	100.00	100.00	100.00	100.00
<b>Segment 6b(CS-I)</b>	<b>9.0°C WAT</b>	<b>13.0°C DM</b>	<b>17.0 WAT</b>	<b>21.2 DM</b>
# of Exceedances	0	3	0	6
# of Measurements	4	31	18	127
% Compliance	100.00	90.32	100.00	95.28
<b>Segment 10(CL)</b>	<b>9.0°C WAT</b>	<b>13.0°C DM</b>	<b>17.0 WAT</b>	<b>21.2 DM</b>
# of Exceedances			36	25
# of Measurements			88	427
% Compliance			59.10%	89.46%
<b>TOTAL # of Exceed.</b>	<b>1</b>	<b>15</b>	<b>46</b>	<b>35</b>

BCWA Site 38 (Bear Creek on the Bear Tracks trail in Mount Evans Wilderness) experienced a low pH measurement on July 12, 2010. The pH sensor calibrated correctly. There were no other water quality exceedances of standards measured in the 2010 watershed-monitoring program.

### Other Projects/ Programs Planned or Implemented By BCWA

The Association is assembling a comprehensive water quality, biological and physical characterization data set to define reference sites and conditions. The Association continues data collection efforts to quantify technical components necessary for watershed management. The Association involved, planned or implemented projects not otherwise described in this annual report include:

1. Increased Stormwater Monitoring. District watershed monitoring staff gathering data prior to, during and after storm events occurring in the watershed. Continuous monitoring of each storm event could allow up to 36 hours of data. The parameters are Temperature, Dissolved Oxygen, pH, and Conductivity. The intent is to measure changes in these parameters due to run off from adjacent properties including roadways, parking lots and open spaces.
2. Evergreen Park & Recreation District provides maintenance around Evergreen Lake. These efforts all aid in maintaining good water quality. Some of the projects the District does are: maintenance of the wetlands located on the west end of the lake, work on repairs and improvements to the retaining walls and rocks structure that support the road and walking paths. This work helps to minimize erosion of the area, which contributes to silt and sand accumulations in the lake. The District also contracts with a company that periodically removes rooted vegetation located on the shoreline.
3. Evergreen Metropolitan District's Collections and Distribution Department monitors and maintains a storm sewer catch basin at Evergreen Lake. The catch basin is located near the inlet to Evergreen Lake and installed by CDOT to reduce the amount of road grit entering into Bear Creek. The Association will also monitor the performance of this catch basin and determine if the installation of additional catch basins along Bear Creek Canyon would of benefit to the watershed.

4. Sanitary Sewer Incentive Programs in the Evergreen Area. The Evergreen Metropolitan District is offering a 50% discount to the current sewer tap fee to property owners within the District Boundaries connected to Individual Septic Disposal Systems (ISDS) willing to connect. Tanks must be completely drained and removed, filled or collapsed after the property connects to the public collections system. The West Jefferson County Metropolitan District is also offering a discount of \$10,000 to the current sewer tap fee to property owners within the District Boundaries connected to ISDS. Tanks must be completely drained and removed, filled or collapsed after the property connects to the public collections system.
5. Ongoing Education. Annually, the fourth grade classes at Wilmot Elementary School in Evergreen participate in a one-day class centered on the ecology of Evergreen Lake. This is a day of walking tours around the lake. Several sites around the lake are set up for each group to spend time at, including a stop at the Evergreen Metro District Water Treatment Facility. Association members are involved in numerous educational and training efforts for schools, clubs, and local agencies and often assist with seminars and conferences.
6. Educational Grant Opportunities. The Association developed and sought several educational grants in 2010.
7. Evergreen High School Junior Watershed Managers Program. The Association has established a pilot program with the high school that provides educational opportunities related to watershed and water quality management. The Association has a “Watershed 101” training course. The Association is working with students to develop several monitoring and restoration projects on the school property and along Wilmont Creek.
8. The Association participates with Evergreen Earthday Activities and Programs - The Association provides information to the community on water quality management and environmental issues and supports educational programs. The Association supported the Evergreen Chamber with the Duck Races.
9. New Signage Kiosk at Summit Lake. The Association will develop and install new educational signage in the Mount Evans Wilderness on water quality protection.
10. Partnership Programs - The Association will work with Evergreen Trout Unlimited in identifying and implementing new stream restoration projects/programs.
11. Installation of Stream Staff gages and Involvement of Members to Gather Stream Data.
12. 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 collected temperature monitoring on Turkey Creek drainages in preparation for potential site-specific standards.
13. Continue Fishery and Stream Characterizations – Support Division of Wildlife fishery surveys. Characterize how trout populations respond to both natural and human induced alterations. Collect macroinvertebrate data. Conduct additional stream flow studies. Maintain Fishery Analysis and Protocols Guidance.



**Figure 35      20" Greenback Cutthroat Trout – Summit Lake**

14. Continued Evaluation Of Management Strategies for Watershed Implementation.
15. Community Plan Development and Development Reviews – The Association supports Jefferson County and Clear Creek County in the update and development of community plans for select portions of the watershed. The Association is an active referral agency to these counties.
16. New Membership. The Denver Water Department initiated a watershed study in cooperation with the Association and is an active new member.

### **Additional Association Annual Reporting**

The Association produces an annual data summary as a *2010 Master Data Spreadsheet (February 2010)* that includes data analyses, and raw data (Association website [www.bearcreekwatershed.org](http://www.bearcreekwatershed.org)). The Association transmits this data report to the Water Quality Control Division Staff. The watershed-monitoring program summarized in an Association data report (Bear Creek Watershed Association Data Report, April 2010). All of the Association annual reporting documents are available electronically and posted on the website. The Association provides multiple reporting documents designed to meet the multiple functions of various 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.

## **Appendix A: 2010 Overview of Lakewood Municipal Separate Storm Sewer System Operations**

For decades, the City of Lakewood was unable to adequately maintain its drainage facilities. The investment in pipes, inlets, ditches and gulches was substantial and the potential for property damage and personal injury was increasing because of inadequate maintenance. The Stormwater Management Utility is providing the resources to care for the existing drainage system with a systematic maintenance program. The Stormwater Management Utility is providing revenue to match available funds from the Urban Drainage and Flood Control District. Improvements were made and federally mandated water quality program requirements are being met.

### **Illicit Discharges Program**

The City of Lakewood continues to implement its illicit discharges program as described in the permit application. Dry weather field screening was conducted during the previous permit period. The City presently utilizes existing ordinances and state and federal regulations to stop illicit discharges when discovered. The Environmental Manager and the Police Department can cite violators. The agents work with the dischargers when possible to permanently correct the problem. When necessary, enforcement action is taken, including court actions to obtain settlements and mitigate environmental damages.

### **Follow up on Outfall Test**

The City implements approved procedures outlined in the permit application. When the field crews or citizens notify the City of a possible pollutant, crews begin an immediate search for the source and, when necessary, notify the Police Department's Hazardous Materials Response Unit. If required, field crews expand the search to underground piped systems. A grid sampling approach narrows the scope of the search. Immediate actions taken to eliminate the discharge and mitigate any impacts for identified sources.

### **Illicit Discharge Inspections**

The City responds as appropriate to all reports of illicit discharges and improper disposal. During 2010, there were 50 reports by citizens and staff of illicit discharges with appropriate actions taken. The time elapsed between reports of an illicit discharge to identification of the source, was one day or less in all cases.

### **Notice of Violation**

The City tries to work with the source of an illicit discharge to encourage compliance with the program by stopping the discharge or ensuring the discharger obtains a CDPS permit. Where necessary, the City takes legal action to ensure compliance. During 2010, the City imposed rapid compliance schedules for elimination of the illicit discharges and mitigation of impacts to the storm sewer. All incidents were resolved satisfactorily and in an expeditious manner. Responding to spills with the proper equipment requires three different agencies play a role. The West Metro Fire Protection District is usually the first to respond to spills. Coordination is also required between the Public Works Department and the Lakewood Police Department Hazardous Materials Unit for the cleanup of any spill.

### **Manholes**

The City implemented a program to promote proper management and disposal of toxic materials. Impressions in newly constructed storm sewer inlets with a metal stamp are being phased out and replaced with the same message cast into the metal portions of the inlet or inlet grate. The City feels



that the uniformity and permanent message cast into the public improvements will last longer and provide a lasting benefit by educating the public. At all new development and repaired manholes within the City manhole covers imprinted with the message, “Dump No Waste, Drains to Stream”, are installed. The City has adopted these criteria for the standard manhole cover detail. New construction utilizes the new standard details for inlets, manholes, etc.

### **The Rooney Road Recycling Center**

The Rooney Road Recycling Center provides proper disposal programs for residents of Unincorporated Jefferson County and the cities and towns of, Arvada, Golden, Lakewood, Mountain View, Lakeside, Edgewater, Morrison, Westminster and Wheat Ridge, to recycle their household hazardous waste (HHW). HHW includes electronic waste, household chemicals, paints, propane cylinders and automotive products. HHW materials collected at the facility since 1994 total more than 4.5 million lbs of potential surface water and ground water pollutants. In 2010, the HHW program serviced 3,561 participants, with 2.2% of those utilizing the Door-to Door program. 868 participants were from the City of Lakewood accounting for over 24 % of the total participation. 461 participants were from the Bear Creek Watershed accounting for 38.5% of the total participants.

Fire mitigation efforts and pine beetle infestation bolstered the Rooney Road Organic Recycling Program. In 2010, the organic recycling program improved their site expanding capacity for yard waste, tree branches, leaves, grass clippings, sod and construction waste from residents. Program fees ranged from \$5 to \$40 per vehicle depending on size. There were more than 18,000 participants with 3780 were from Lakewood comprising nearly 21% of the total. This included individuals with pick-up trucks, trailers and dump trucks. An estimated 61 million pounds or 78,000 cubic yards of material were 100% recycled.

### **Construction Sites Program**

The City of Lakewood’s Construction Sites Program is divided into several elements, including Procedures for Site Planning, Structural and Non-Structural Best Management Practices (BMPs), Procedures for Site Inspection and Enforcement, and Training and Education for Construction Site Operators. In 2010, the City continued to improve existing procedures for construction site inspection and enforcement. We continue to reserve the right to perform erosion control work on construction sites and bill the property owner/contractor for any expenses incurred by the City. We believe the existing program is very successful in requiring BMP installation and maintenance on construction sites. Courtesy inspections also seem to encourage some contractors and developers to address potential violations and provide sustained maintenance of BMP’s. During the permit period in 2010, there were 3,160 inspections of construction sites and 882 enforcement actions. Courtesy inspections also seem to encourage some contractors and developers to address potential violations and provide sustained maintenance of BMP’s.

### **Maintenance Program**

The maintenance program is a cyclical program that ensures all facilities inspected every two years. All obstructions removed the same year as they are identified during inspection. Last year, the following inspections occurred:

- 1749 inlets and associated discharge pipes
- 55 culverts
- Six miles of gulches
- 487 cubic yards of debris removed because of the inspection and maintenance program.

### **Educational Efforts**

The educational effort is widely focused to educate as many groups as possible that can affect water quality. Educational programs during the year included:

- Distributed three brochures titled “Caring for Your Lawn and Garden,” “Managing Your Construction Site,” and “Managing Your Household Wastes.”
- Distributed a booklet focused on pollution prevention designed for industrial and commercial businesses. The West Metro Fire Protection District distributed over 250 booklets during their annual fire protection inspections.
- Distributed 600 mailers encouraging contractors registered with Lakewood to participate in the Red Rocks Community College course on erosion and sediment control.
- Distributed the award-winning video “Nailed - Enforcing your National Pollution Discharge Elimination System Permit Requirements.”
- Continued periodic airing of “Solutions to Water Pollution” and public service announcements on KLTV-8 and other public access stations.
- Participated in pre-construction meetings, reviewed more than 50 erosion control or stormwater management plans, and provided many courtesy inspections as part of the City’s land development process.

