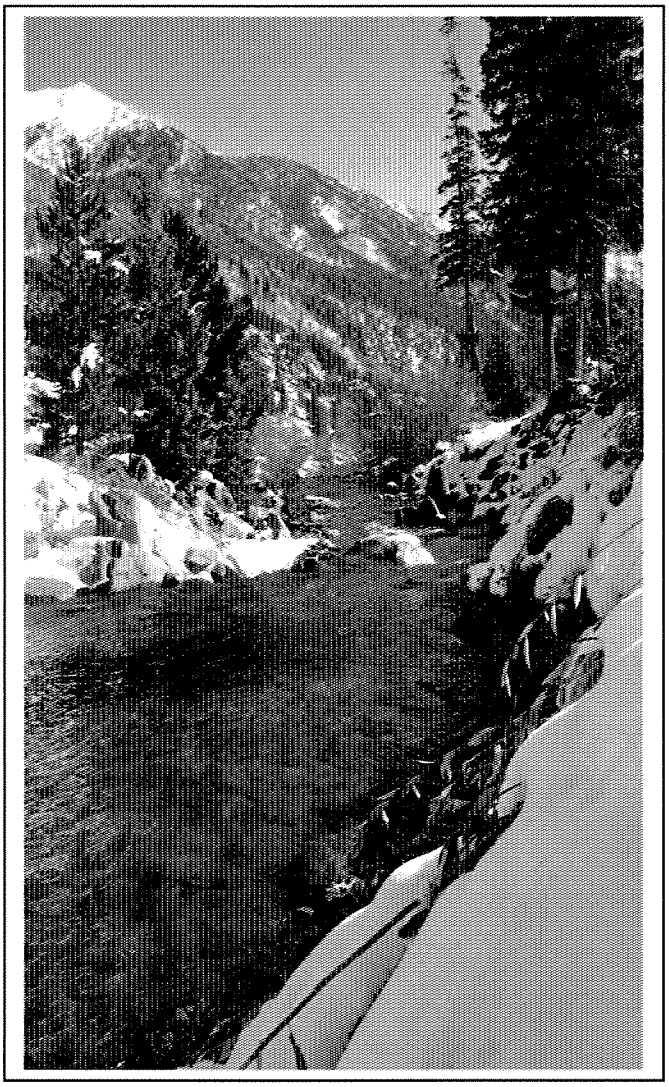
Clear Creek Watershed Management Agreement

2006 Annual Report



Black Hawk/Central City Sanitation District
Central Clear Creek Sanitation District
Church Ditch Company
City of Arvada
City of Black Hawk
City of Central
City of Golden
City of Idaho Springs
City of Northglenn
City of Thornton
City of Westminster
Clear Creek County
Clear Creek Ski Corporation
Climax Molybdenum Company
Colorado Department of Transportation
Farmers Reservoir and Irrigation Company
Farmers' Highline Canal Company
Coors Brewing Company
Gilpin County
Jefferson County
Mt. Vernon Country Club Metropolitan District
Saddleback Metropolitan District
Shwayder Camp
St. Mary's Glacier Water & Sanitation District
Town of Empire
Town of Georgetown
Town of Silver Plume

June 2007

This page intentionally left blank

Table of Contents

EXECUTIVE SUMMARY

Introduction

Located due west of Denver, Colorado, the 575-square-mile Clear Creek Watershed spans from its headwaters near the Continental Divide at 14,000 feet in elevation down to the Denver-Metropolitan area at 5,000 feet in elevation where it joins the South Platte River. In addition to offering numerous recreational opportunities, Clear Creek supplies drinking water to approximately 350,000 people in the suburban Denver area, industrial water to Coors Brewing Company and other businesses, and agricultural water to farmers. Clear Creek Watershed includes five counties, six towns and a considerable rural/mountain population. The historic Mineral Belt of Colorado bisects the Clear Creek Watershed. The historic mining and milling boom was an economic benefit to our State but left a legacy of negatively impacted water quality throughout the watershed.

Standley Lake is an agricultural and municipal water supply reservoir located in Jefferson County Colorado that is supplied with water primarily from Clear Creek. The reservoir supplies water for agricultural use by the Farmers Reservoir and Irrigation Company (FRICO) and for municipal supply for the cities of Northglenn, Thornton, and Westminster (Standley Lake Cities). In response to a request by the Standley Lake Cities (SLC) for a Rulemaking Hearing to establish water quality standards and resulting control regulations for Standley Lake, 23 entities developed and agreed to the Clear Creek Watershed Management Agreement (Agreement). This Agreement, adopted in December 1993, sought to address certain water quality issues and concerns within the Clear Creek Basin, specifically, issues that could affect Standley Lake (i.e. Reservoir) water quality. The parties to this Agreement are governmental agencies and private corporations having land use, water supply, and/or wastewater treatment responsibilities within the Clear Creek Basin.

Narrative Standard

A narrative standard for Standley Lake was adopted in lieu of a numeric standard and control regulations. The parties agreed to additional testing, monitoring, and implementation of best management practices on a voluntary basis. The narrative standard for Segment 2, Big Dry Creek, Standley Lake reads:

> *The trophic status of Standley Lake shall be maintained as mesotrophic as measured by a combination of common indicator parameters such as total phosphorus, chlorophyll a, Secchi depth, and dissolved oxygen. Implementation of this narrative standard shall only be by Best Management Practices and controls implemented on a voluntary basis.*

The Agreement provided that should the narrative standard not be met and substantial progress not made in reducing the nutrient loads to Standley Lake, additional measures may be required including numeric standards or effluent limitations for phosphorus and/or nitrogen in the Upper Basin, and for additional best management controls in Standley Lake. The Clear Creek/Standley Lake Watershed Agreement, Clear Creek Watershed Management Monitoring Program, and the Standley Lake Management Plan are included as appendices to this report.

Monitoring Program Summary

The monitoring program is divided into three geographically based sub-programs, Clear Creek, Tributaries/Canals, and Standley Lake. Extensive detail regarding the entire monitoring program is included in the Monitoring Programs Summary section of this report. A monitoring location map is included at the end of the Executive Summary.

Table 1. Monitoring program summary

Event description	#Sampling Sites	# Sampling Events	Total # of samples
Creek	25*	8 (6 short, 2 long)	98
Tributary	8	12	96
Canal	3	8	24
Lake	3	16	48

* 17 creek sites +.8 WWTF

Clear Creek Program

In addition to grab samples, the creek is also sampled with autosamplers and continuous, in-stream probes. Automated sampling equipment (autosamplers) provides the ability to initiate remote sample collection. Continuous monitoring of the in-stream conditions captures the impacts to water quality and stream flows from natural precipitations events as well as impacts from construction or other watershed activities. Three autosamplers were installed starting in 2005. These sites are, upstream to downstream:

CC49 -- On the mainstem of CC upstream of the confluence with the North Fork of CC
CC50 -- North Fork of CC above confluence with the mainstem of CC
CC59 -- on the mainstem of CC approximately 100 yards upstream of the Church Ditch Headgate.

During 2006, the in-stream monitoring and automated sampling site located at CC59 was fully functional providing continuous water quality data acquisition for turbidity, conductivity, pH, and stage height. In addition, in-stream probes were set to trigger sampling when water quality or flow parameters exceeded pre-determined limits, thus providing sample data associated with non-ambient type conditions in Clear Creek.

The autosamplers at CC49 and CC50 sites have presented some challenges since installation in 2006: inaccurate triggering for storm event sampling, various analytical probe interferences, instrument damage from rock slides, and vandalism. Gaps in the continuous data record resulted from these interruptions.

Due to the short period of record at CC59 and difficulties experienced at both CC49 and CC50, no data summary from any autosampler sites are presented in this report.

Canal and Tributaries program

Grab samples are taken on all the supply canals to Standley Lake on a monthly basis when the individual ditches are running. The Croke and Farmers Highline canals are sampled at three points along the ditch, headgate, midpoint, and inlet. The Church and KDPL are sampled at the headgate and inlets. The Croke and Farmers' High Line Canals are also sampled with autosamplers as a part of the CC monitoring program. The canals are also referred to as the Standley Lake tributaries. The inlet data is used to calculate loadings into Standley Lake.

Standley Lake Program

Standley Lake is monitored consistently on a bi-weekly basis throughout the year provided the lake is not covered with ice. Samples are collected at the surface, in the photic zone, and five feet off the bottom of the lake. Lake samples were collected in an attempt to accurately assess algal growth, the period of hypolymnetic anoxia, nutrient trends, and lake turnover. A total of 537 grab samples have been collected since 1999. Multiple analyses were performed on each of the samples.

In addition to grab samples, water quality on Standley Lake is monitored using a Remote Underwater Sampling Station (RUSS) unit. The RUSS is placed on the lake at ice off and retrieved before ice on. Two sensors measure standard field parameters plus chlorophyll a, in a depth integrated manner twice daily. During 2006, the RUSS executed at least one full-column profile on 215 separate days.

Table 2. Summary table of number of grab samples for the period of record - 1994 through 2006

Site Location	**N=**
Clear Creak - stream	1,303
Clear Creak – waste water plants	678
Canal/Tributaries	808
Standley Lake*	537
Total	3,326

* Record is 1999-2006

The 3,326 samples have resulted in more than 27,000 individual, analytical results. The monitoring committee has also instituted a rigorous quality assurance/quality control program. It is safe to say that monitoring is the foundation of the Clear Creek Agreement. Refer to Appendix C for sample data results. The annual monitoring costs for the entire monitoring program are greater than $201,000. See Figures 3 and 4 for a detailed breakdown of monitoring costs.

Data Results for Grab Samples

Clear Creek

In an effort to understand anthropogenic impacts on water quality and in support of the narrative standard on Standley Lake, upstream to downstream nutrient data comparisons for 2006 were made against the 1994 through 2005 sample data.

Table 3. Comparison of 2006 Average to 1994 through 2005 Average

Parameter	Site Location		
	CC26** (upstream)	CC40 (midstream)	CC60 (downstream)
Total Phosphorus	↑ 4%	↓ 13%	↓ 26%
Dissolved Phosphorus	↑ 17%	↑ 18%	↑ 18%
Total Nitrogen*	↑ 13%	↑ 18%	↓ 2%

*TN data begins in 1996
** CC26 data begins in 1998

The maximum concentration for total phosphorus was recorded on 5/25/06 at CC50 (N. Fork). The reading was 0.0416 mg/L TP. The highest concentrations recorded for both dissolved reactive phosphorus and total nitrogen were recorded at CC60. The readings were 0.0198 mg/L DRP on 6/14/06 and 0.87 mg/L TN on 2/07/06.

Standley Lake - Loadings from Canal/Tributaries, trend analysis and trophic status

Data was analyzed for loadings, trophic status, and seasonal and regression trends. Multiple statistical tools were used including Microsoft Excel and Lakewatch programs. Canal/Tributaries data was used to determine loadings into Standley Lake.

The total reservoir loadings in 2006 were:

- Total phosphorus – 4,303 pounds
- Dissolved reactive phosphorus - 1,173 pounds
- Nitrate + nitrite as N – 19,670 pounds
- Ammonia as N – 1,463 pounds

The 2002 through 2006 period (five years) was used for all trending analysis. Chlorophyll a is trending downward at a rate of 0.3639 ug/L/yr. The trend is significant. Total algae are trending slightly upward. The trend is not significant. Dissolved oxygen (DO) levels are trending downward at a rate of 0.1421

mg/L/yr. The trend is significant. The average length of anoxia, DO <2 mg/L, for the 2002 through 2006 period was 11.60 weeks, up from 8.85 weeks for the 1994 to 2000 period. Secchi depth is trending upward at a rate of 0.1634 meters/yr. The trend is significant. Total phosphorus and dissolved phosphorus are both trending slightly upwards. The trends are not significant. Total nitrogen is trending downward at a rate of 12.85 ug/L/yr. The trend is significant.
Lakewatch uses chlorophyll a, secchi depth, total phosphorus, total nitrogen, and hypolimnetic volumetric oxygen depletion parameters to determine trophic status. Both secchi depth and total nitrogen trophic indices were the best in the ten years of record. Chlorophyll a and total phosphorus trophic indices were both in the middle range of the 1994 through 2006 period of record. Standley Lake remains mesotrophic.

Upper Basin Summary

The new Black Hawk/Central City Sanitation District (District) plant became fully operational in January 2006. The plan is continuing to meet all discharge permit limits. Built to handle 2 million gallons/day, plant capacity could expand to 4 million gallons/day. Current flow is 0.37 million gallons/day with a peak flow over 1 million gallons/day. As the result of an Intergovernmental Agreement, the plant incorporates full scale Biological Nutrient Removal (BNR) and filtration. The IGA, with the SLC, limits seasonal nutrient loadings and sets daily maximums for both total phosphorus and total inorganic nitrogen. The District, Black Hawk, Central City, Gilpin County and the SLC continue to work together on operations to maintain nutrient removal at or below the levels outlined in the stipulation. There currently are no nutrient limits in the District's CDPS permit. The plant experienced three events of sudden, unanticipated elevated phosphorus levels in the summer of 2006. The District responded and brought total phosphorus levels back to well below 0.3 mg/L through the addition of acetic acid, alum, and magnesium hydroxide.

The Clear Creek Wastewater Study Group is organized as a subcommittee of the Upper Clear Creek Watershed Association, with Clear Creek County administering the contract. In November, 2006, Clear Creek County entered into a contract with Richard P. Arber and Associates of Lakewood, Colorado to complete a Countywide Wastewater Utility Plan study during 2007. This contract for $143,000 was supported by contributing entities from the watershed, and by a grant in the amount of $50,000 from the Colorado Department of Local Affairs. As part of this effort in 2006, UCCWA members updated the DRCOG maps of Clean Water Planning areas and Wastewater Utility Service Areas (WUSAs).

Several projects were completed in 2006 that were upgrades or replacements of existing wastewater treatment plants.

In Idaho Springs, several demand and preventative maintenance projects were completed including, drained / cleaned chlorine contact chamber and installed new sedimentation pumps, drained / cleaned one of two reactors, bar screen and grit removal improvements, new SCADA computer and upgraded software / hardware, phase / voltage protection and standby power upgrades, flow measurement upgrades and multiple improvements and repairs in aeration, plumbing and electrical. These changes and upgrades have resulted in improved operations, discharge quality and plant reliability. Plant and employee safety was also addressed and refined in 2006
In Georgetown, projects completed included new headworks and a new chlorine contact basin for a cost of $650,000. Georgetown also took the following steps to address ammonia levels:

1. Mean cell residence time was changed in February 2006
2. Hydrogen peroxide was added as a treatment beginning in April 2006
3. New bar screen installed as part of Phase I Improvements project became operational in October 2006.

St. Mary's Glacier Water and Sanitation District, the Town of Silver Plume, and the City of Golden all completed projects to reduce inflow and infiltration in the wastewater collections systems and reduce flows into wastewater treatment plants.
For several years Shwayder Camp has had issues with its waste water treatment system. In 2006,

Shwayder trucked all wastewater offsite for disposal at a downstream wastewater treatment plant. After a thorough search, Shwayder Camp enlisted the services of AquaWorks DBO to engineer a new wastewater treatment system and has chosen to install a Fluidyne SBR system that will be operated by AAA Operations. Pending final approvals from the State, construction should begin in mid to late May 2007. There were four launches of the spill notification Call-Down System in 2006. The system alerts downstream users to a situation in the upper watershed that may affect water quality. All of the spills were addressed in a timely manner and none of the spills resulted in significant pollution to the creek.

In February, the Clear Creek Watershed Foundation (CCWF) organized and hosted the **WATERSHED SUSTAINABILITY WORKSHOP: Creating an Action Plan for the Clear Creek Watershed**. Later in the year, CCWF applied for and received an EPA Watershed Sustainability Grant and began activities funded by the grant. The Foundation continued its tradition of public education about watersheds and mining through projects focused on elementary school education, public tours, and exhibits/booths at events such as the State Fair.

On the ground, the CCWF:
- Supported two US Forest Service projects: 1) the Minnesota Mine maintenance project on Lions Creek ($102K), and 2) the Good Samaritan project with Phelps Dodge at the Doctor Mine on the West Fork of Clear Creek ($64K).
- Secured a 319 grant to fund the Gilson Gulch project (total budget $425K).
- Conducted a characterization study of mining-related impacts to Trail Creek and prepared and submitted for grant funding.
- Signed an agreement with the State and Iowa Tank Lines to assist in implementation and long-term maintenance of the Maude Monroe site. This Supplemental Environmental Project (SEP), valued at $600,000 is in lieu of Iowa Tank Lines paying a fine.
- Funded 2006 trace metals addendum by Dr. Timothy Steele of TDS Consulting, Inc.

Tributary Basin Summary

On October 26, 2006 the Cities of Arvada, Northglenn, Thornton, and Westminster signed an intergovernmental agreement with the Church Ditch Water Authority authorizing the use of a section of the ditch as an inceptor canal for the purpose of diverting all or portions of storm water flows around Standley Lake. When the project is completed, the Church Ditch will divert stormwater runoff from 3,996 acres of land around Standley Lake.

The City of Arvada is aggressively implementing their Phase II stormwater permit requirements.

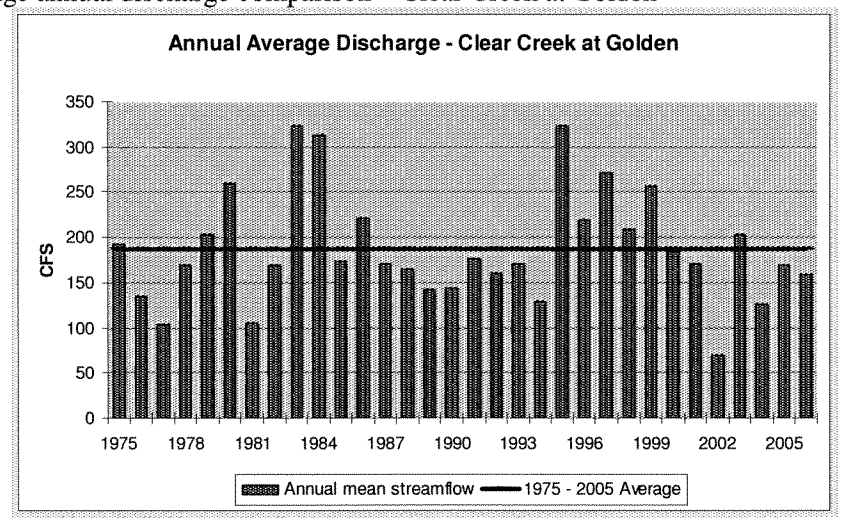
Standley Lake Cities Summary

The Standley Lake Cities agree that the trophic status of the reservoir was mesotrophic in 2006. The Standley Lake Cities remain concerned with taste and odor events caused by winter algae blooms, the increasing number of weeks of anoxia, and repeated enforcement and compliance issues at numerous upstream wastewater treatment plants. The Standley Lake Cities are encouraged by the progress made on the regional wastewater treatment study and progress made in clarifying the Black Hawk Central City Wastewater Treatment Plant water quality stipulation.

Stream Gaging & Flow Summary

To provide the flow data needed for calculating nutrient loadings, the Upper Clear Creek Watershed Association, Standley Lake Cities, Clear Creek Watershed Foundation, United States Geological Survey, Federal Highway Authority, and the Colorado Department of Transportation continue to work on a program to maintain stream and staff gages. See Figure 2 for gage locations. The average annual streamflow at the USGS gage in Golden (CLEGOLCO) for the period 1975 through 2005 was 187 cfs. The average annual streamflow in 2006 was slightly below this average at 157 cfs.

Figure 1. Average annual discharge comparison – Clear Creek at Golden



Nonpoint Source Control Efforts Summary

Nonpoint source control efforts play an important role in improving water quality. The majority of governmental entities in both the upper and tributary basins has adopted and is implementing nonpoint source control regulations. In 2003, the lower basin cities of Arvada, Northglenn, Thornton, Westminster and Golden received Phase II stormwater permits as required by the Clean Water Act. The cities have successfully completed program goals for each year since 2003. Additionally, all of the lower basin cities have adopted regulations providing for erosion control during construction, permanent BMP maintenance and prohibition of illicit discharges. For specific information on completed programs call the Stormwater Coordinator for the city or county of interest. For information on Upper Basin pollution prevention/control efforts, see Section II, Upper Clear Creek Watershed Association (UCCWA).

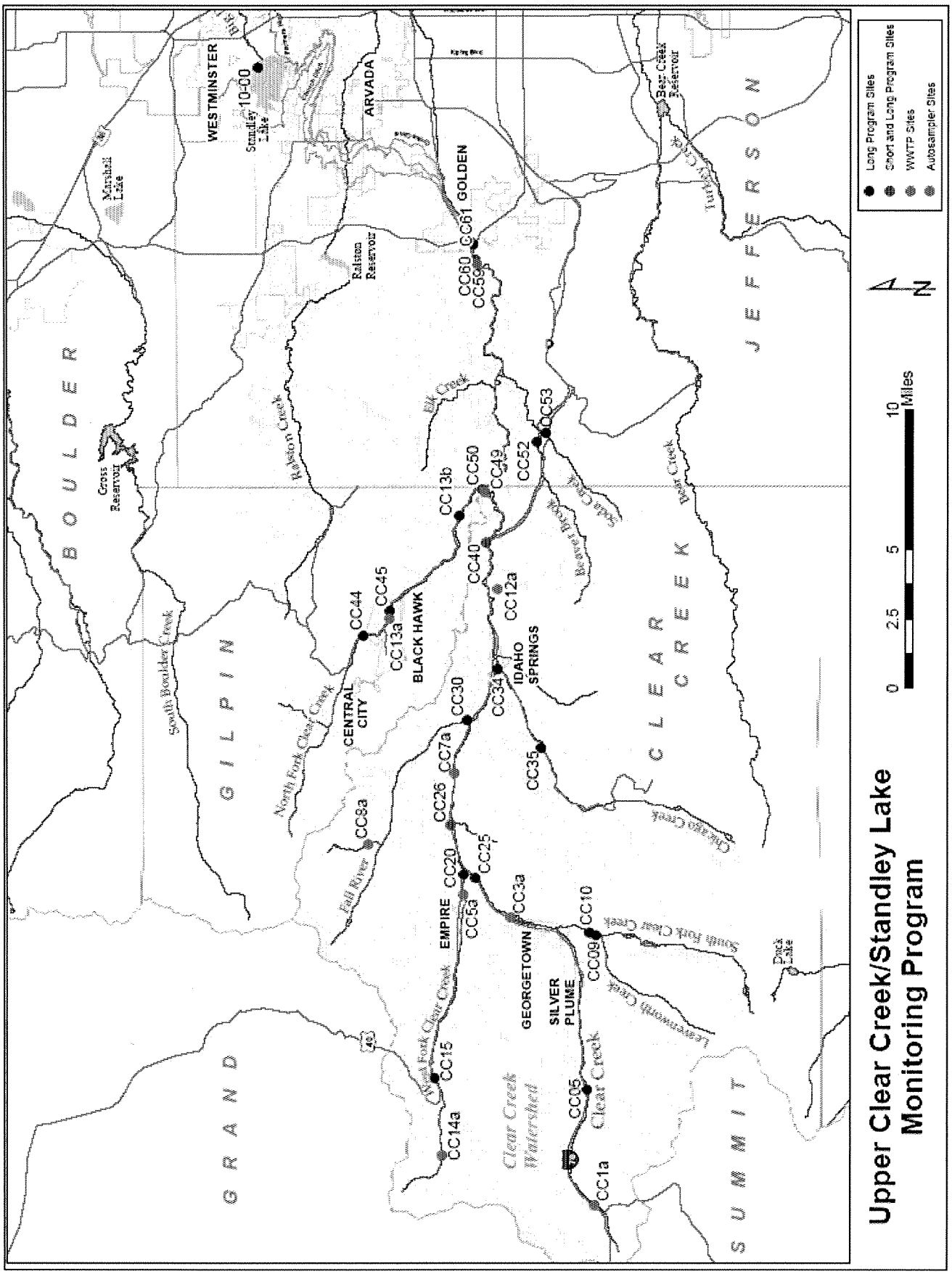


Figure 2. Sampling location map

I. MONITORING PROGRAM

A copy of the Clear Creek Watershed Management Agreement (Agreement) is contained in Appendix A. Section II, paragraph 4, of the Agreement provides for joint design, implementation, and funding of a monitoring program to evaluate nutrient loading from point and non-point sources in the Upper Basin, nutrient loadings from non-point sources in the Tributary Basin, internal Lake loadings and the effect of nutrient reduction measures implemented by the various parties on the trophic status of Standley Lake. The monitoring program is outlined in the Clear Creek Watershed Management Monitoring Program (Appendix B).

Sampling Overview

Clear Creek Grab samples

Seventeen Clear Creek sites and eight wastewater treatment plants were monitored under the program in 2006. Two types of schedules were sampled: a short schedule (February, April, June, July, August, and December) which included four stream sites and four wastewater treatment plants and a long schedule (May and October, i.e. high and low flow) which included all seventeen creek sites and eight wastewater treatment plants. Specific sites sampled during the short and long schedule are represented in Table 5. Data results can be found in Appendix C.

All samples were transported by the sampling teams in coolers with ice to the City of Golden Environmental Services Laboratory for compositing and generation of the quality control splits and spikes. Analyses were performed as follows:

Table 4. Monitoring responsibilities

Entity	Parameter/Analyte	Sample Type
Northglenn	TP & DRP	Grab
Westminster	TN, NO3 & Ammonia	Grab
Thornton	TSS ,VSS & TOC	Grab
EPA	Metals	Grab
Golden	Metals for EMC	Grab
Arvada	Splits/Spikes for TP & TN	Grab

Field parameters, including, pH, temperature, conductivity, and dissolved oxygen were analyzed at each site and for each sampling event.

All creek and tributary sites were analyzed for phosphorus, nitrogen, TSS/VSS, TOC and field parameters. Wastewater Treatment Plant effluents (WWTP) were analyzed for phosphorus, nitrogen, TSS/VSS and field parameters. Metals samples were collected in May and October.

The sites included are as follows: See Figure 2 for site location.

Table 5. Monitoring Schedule – grab samples

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
CC05					x					x		
CC09					x					x		
CC10					x					x		
CC15					x					x		
CC20					x					x		
CC25					x					x		
CC26		x		x	x	x	x	x		x		x
CC30					x					x		
CC34					x					x		
CC35					x					x		
CC40		x		x	x	x	x	x		x		x
CC44					x					x		
CC45					x					x		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
CC50		x		x	x	x	x	x		x		x
CC52					x					x		
CC53					x					x		
CC60		x		x	x	x	x	x		x		x
CC1a*					x					x		
CC3a*		x		x	x	x	x	x		x		x
CC5a*					x					x		
CC7a*		x		x	x	x	x	x		x		x
CC8a*					x					x		
CC12a*		x		x	x	x	x	x		x		x
CC13b*		x		x	x	x	x	x		x		x
CC14a*					x					x		

*Represents a wastewater treatment facility

Table 6. Sample count by monitoring program

Event description	#Sampling Sites	# Sampling Events	Total # of samples
Creek	25*	8 (6 short, 2 long)	98
Tributary	8	12	96
Canal	3	8	24
Lake	3	16	48

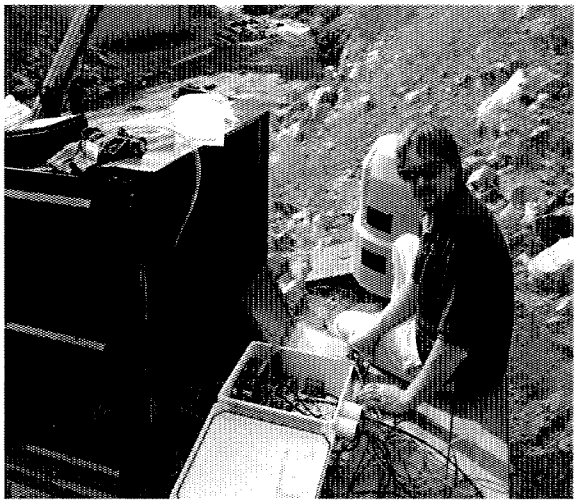
* 17 creek sites + 8 WWTF

Autosamplers and continuous data probes

The monitoring station at CC59 is the first completed step in automated monitoring for the upper Clear Creek watershed. Installed in 2005, this station has been collecting data for a full year. Two other sites were established in 2006 for a total of three autosampler sites. These three sites positioned from upstream to downstream are:

CC49 -- On the mainstem of CC upstream of the confluence with the North Fork of CC
CC50 -- North Fork of CC above confluence with the mainstem of CC
CC59 -- on the mainstem of CC approximately 100 yards upstream of the Church Ditch Headgate

Autosamplers collect event triggered samples as well as monthly, 24 hour composite samples. In-stream water quality monitoring and sampling capability at these sites enable the monitoring program to automatically track water quality changes in the watershed that occur due to anthropogenic and natural factors. The ability to automatically sample when ambient conditions in the Creek change, combined with a continuous picture of water quality in the creek provides critical information on how natural events, such as precipitation, or events associated with construction or other watershed activities can alter water quality. During the 2006 monitoring season, three distinct storm events in Clear Creek were successfully captured and recorded at CC59.



Monthly, from April through October, two consecutive 24-hour composites were sampled and analyzed for nutrients, TSS/VSS, and metals. Field probes for pH, conductivity, temperature, and turbidity were installed and monitored daily using telemetry. During the winter months, only temperature and conductivity data were collected. This data was routinely downloaded. The autosampler stations will continue to be sampled monthly as two consecutive 24-hour composites in 2007.

The sites at CC49 and CC50 have presented some event triggered sampling challenges due to a variety of circumstances from light-interference with the turbidity probes and upstream placer-mining by hobbyists causing

a non-event sample to be taken. The solar panel was stolen from CC50. A series of rock-slides destroyed the solar panel and did major damage to the steel enclosure at CC49. All of the equipment has been repaired or replaced.

Calibration of the instruments at CC49 was an issue in 2006, because the instruments could not be safely removed and replaced during high flows. A possible method for safely removing and replacing the instruments has been developed and will be implemented in 2007.

The City of Golden provides funding for the CC59 monitoring station. Costs include professional consultation regarding the operation and maintenance of the monitoring station and year end data analysis. City staff is responsible for downloading data from the site throughout the year and also maintains the database for the autosampler monitoring program. The other two autosampler sites are funded and maintained by the SLC.

Supply Canals – Croke, Kinnear Ditch Pipeline (KDPL), Church, and Farmers High Line

Grab samples are taken on all the supply canals to Standley Lake on a monthly basis when the individual ditches are running. The Croke and Farmers Highline canals are sampled at three points along the ditch, headgate, midpoint, and inlet. The Church and KDPL are sampled at the headgate and inlets.

The Croke and Farmers' High Line Canals are also sampled with autosamplers as a part of the CC monitoring program. One of the two canals was sampled routinely within seven (7) days following each Upper Clear Creek Basin sampling event. There were three (3) sampling sites on each canal: the headgate, midpoint and inlet to Standley Lake.

Canal autosamplers were set up to collect one sample every hour for a 24-hour composite. The midpoint autosampler was set to start 4-6 hours after the headgate sampler and the lake inlet autosampler was set to start 4-6 hours after the midpoint autosampler. The delay in start times was varied based on flow velocity.

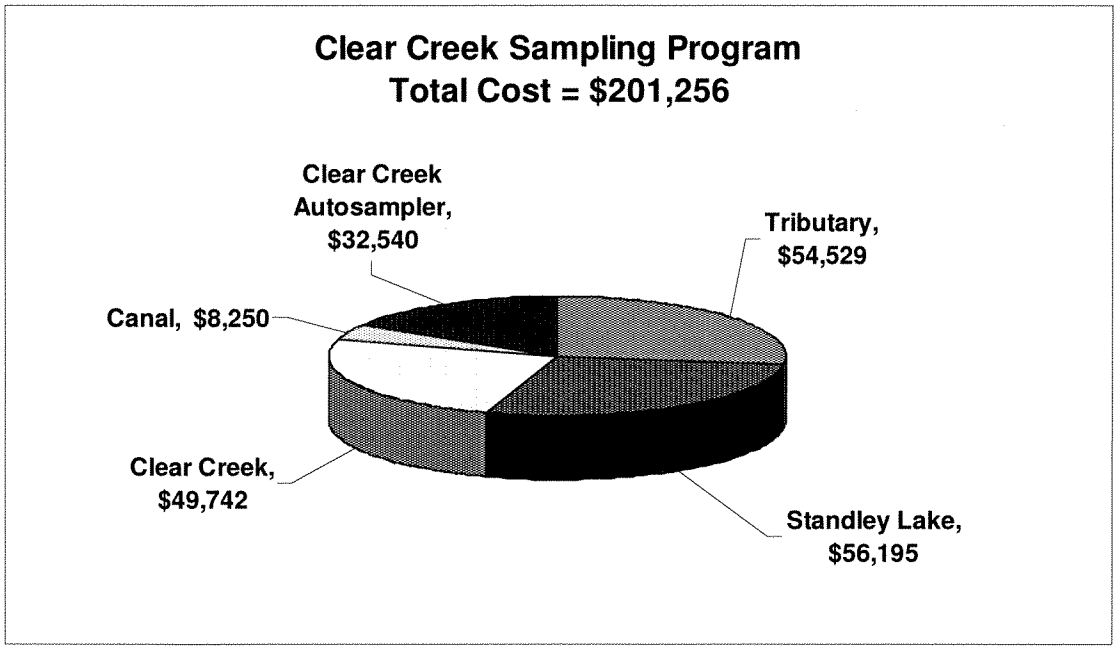
Standley Lake Monitoring

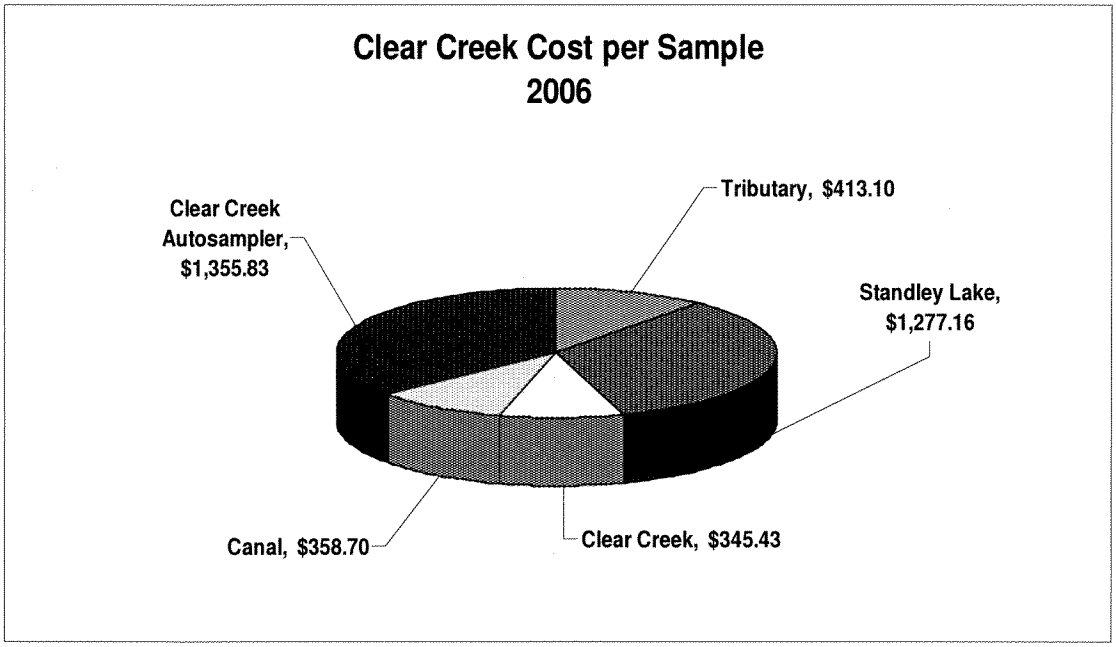
In 2006, Westminster Laboratory staff sampled Standley Lake from a boat on 22 dates from January 10th through December 18th at site SL10, on the east side of the lake near the dam. At this location, samples were collected at up to three levels: the surface, the photic zone (twice the secchi disk depth) and five feet from the bottom. Lake samples were collected twice a month (weather permitting) in an attempt to accurately assess algal growth, the period of hypolimnetic anoxia, and lake turnover. Secchi depth is measured to determine clarity and define the photic zone. A multi-parameter sonde with sensors to measure temperature, specific conductance, pH, ORP, turbidity, chlorophyll a and dissolved oxygen was lowered through the water column to take readings at 1-meter intervals. Westminster staff also performed laboratory analyses for total nitrogen, nitrate and ammonia. Northglenn staff performed total phosphorus and dissolved reactive phosphorus analyses. Thornton staff performed coliform, solids, total hardness, algae count, algae identification, and chlorophyll a analyses. Parameters that were collected on an intermittent basis included metals (quarterly), gross alpha and beta (5 samples) and TOC (11 samples). Additionally, six samples were collected at the boat ramp for BTEX analysis during the summer months to assess water quality impacts from boating.

The Remote Underwater Sampling Station (RUSS) unit was deployed on Standley Lake on April 12, 2006. Daily profiles were taken until November 21, 2006 when the unit was removed due to ice. Two

identical YSI 6600 sondes were alternately placed on board the profiler. During the deployment period, the RUSS executed at least one full-column profile on 215 separate days.
During the summer of 2006, a Biosonics© DT-X single-beam digital tranducer and echosounder system were used to survey Standley Lake. The data were analyzed to create an ArcGIS bathymetric map. A partial survey of submerged aquatic vegetation (SAV) was also conducted using the Biosonics© system. In 2007, the system will be used to conduct a detailed SAV survey.

Monitoring Costs
Figures 3 and 4. Monitoring costs by program and cost per sample





Costs include administrative time for data entry, quality control, and report writing at $35/hour. No costs for instrumentation are included. Commercial laboratory rate/sample was used when available.

Monitoring Contributions

Arvada

- X Operated one auto-sampler for canal sampling
- X Coordinated and funded independent quality control laboratory services – long program only
- X Provided sampling personnel for Clear Creek and canal sampling
- X Provided funding and personnel for autosampling program CC49, CC50

Golden

- X Prepared quality control samples
- X Administered the Clear Creek / Standley Lake database
- X Provided laboratory for turbidity analysis for the long program
- X Printed Chain of Custody forms
- X Provided funding and personnel for autosampling program CC59

Northglenn

- X Performed phosphorus analysis (total and dissolved reactive)
- X Provided one auto-sampler and staff for canal sampling
- X Coordinated canal sampling program
- X Conducted and coordinated the tributary sampling program
- X Provided funding and personnel for autosampling program CC49, CC50
- X Lakewatch Committee
- X Database Peer Review
- X Provided financial support for the spill call down system

Thornton

- X Provided field testing instrumentation and analyses
- X Coordinated overall Clear Creek monitoring program
- X Coordinated delivery of Clear Creek samples to laboratory
- X Routinely provided personnel for Clear Creek sampling
- X Routinely provided personnel for Tributary sampling
- X Delivered sample bottles to sampling teams
- X Provided personnel and autosampler for canal sampling
- X Performed algae counts and identification, chlorophyll a, TSS/VSS, TOC & *E. coli* analyses
- X Lakewatch Committee
- X Database Peer Review
- X Provided financial support for the spill call down system

Upper Clear Creek Watershed Association

- X Provided funding for metals sampling
- X Sample collection for wastewater treatment facilities
- X Maintenance of the spill call down list

Westminster

- X Conducted Standley Lake sampling program
- X Provided boat and field testing equipment
- X Routinely provided sampling personnel for Clear Creek sampling
- X Performed total nitrogen, nitrite/nitrate, and ammonia analyses
- X Maintains RUSS equipment and RUSS database
- X Database peer review and data distribution

X Provided funding and personnel for autosampling program CC49, CC50
X Lakewatch Committee
X Database Peer Review
X Provided financial support for the spill call down system

Quality Assurance / Quality Control

Quality control samples were collected, prepared, and analyzed in 2006. See Appendix B for details on this program.

Central City Parkway

In 2006, storm water staff from the Cities of Golden, Northglenn, Thornton, and Westminster inspected the Central City Parkway on three occasions for erosion control best management practices. Four key locations were evaluated: 1) Hidden Valley exit, 2) area right after the first turn (1st pullout – right side), 3) Russell Gulch and 4) Nevada Gulch/Quartz Mine. The group looked for erosion problems, sediment buildup, effectiveness of BMPs, curb inlets, related outfalls and revegetation. In general, many of the straw bale barriers were failing and needed to be cleaned or replaced. Curb inlet and outfall structures needed to be cleaned. Revegetation has started to take place in several locations. Erosion continued to deteriorate all four key locations. Central City staff participated in the June 2006 field inspection. Monitoring and inspection of the road project will continue.

Monitoring Results

Clear Creek Grab Sample Summary Tables

In an effort to understand anthropogenic impacts on water quality and in support of the narrative standard on Standley Lake, upstream to downstream nutrient data comparisons for 2006 were made against the 1994 through 2005 sample data. All of the data used in the following summary were generated from grab samples taken over the hydrograph (8 times/year).

CC26 (Upstream): I-70 at the Lawson gage below the confluences of West Fork CC, Leavenworth Creek and South Fork CC. Anthropogenic influences include wastewater treatment facilities, commercial and domestic septic systems, treated mine waste and stormwater runoff from roadways.

CC40 (Midstream): USGS gage at Kermit's Restaurant, below the confluences of West Fork CC, Leavenworth Creek, Chicago Creek, Fall River, and South Fork CC, upstream of the confluence with North Fork. Anthropogenic influences include multiple wastewater treatment plants, septic systems, abandoned mines, and stormwater runoff from towns and roadways.

CC60 (Downstream): At the Church Ditch Headgate, below the confluences of North Fork CC, Beaver Brook, Soda Creek and Elk Creek. Anthropogenic influences include multiple wastewater treatment plants, septic systems, abandoned mines, rock/gravel mines, and stormwater runoff from towns and roadways.

Table 7. Comparison of 2006 average to 1994 through 2005 average

Parameter	Site Location		
	CC26** (upstream)	CC40 (midstream)	CC60 (downstream)
Total Phosphorus	↑ 4%	↓ 13%	↓ 26%
Dissolved Phosphorus	↑ 17%	↑ 18%	↑ 18%
Total Nitrogen*	↑ 13%	↑ 18%	↓ 2%

*TN data begins in 1996
** CC26 data begins in 1998

Eight grab samples were used to generate the following table. For the entire data set, see Appendix C.

Table 8. Comparison of minimum and maximum concentrations

	Minimum Concentrations			Maximum Concentrations		
Analyte	Site	Date	Concentration	Site	Date	Concentration
TSS	CC40 & 60	Multiple dates*	< 1 mg/L	CC26	06/14/06	57 mg/L
Turbidity	CC26	02/07/06	0.70 NTU	CC50**& 60	06/14/06	30.2 NTU
Total Phosphorus	CC26	12/07/06	0.0048 mg/L	CC50**	05/25/06	0.0416 mg/L
Dissolved Phosphorus	Multiple locations*	Multiple dates*	0.0013 mg/L	CC60	06/14/06	0.0198 mg/L
Total Nitrogen	CC40	08/15/06	0.36 mg/L	CC60	02/07/06	0.87 mg/L

* Dissolved phosphorus was not detected at multiple locations on multiple dates during 2006. Refer to the data in Appendix C for specific information.
** Site CC50 at the confluence of North Fork of Clear Creek and the mainstem recorded the highest turbidity measurements in 2003, 2004 and 2005 and the highest total phosphorus measurements in 2004 and 2006.

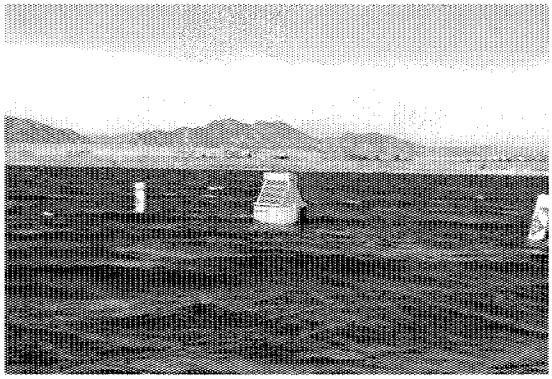
Graphs of nutrient data, 1994-2006, for sites CC26, CC40 and CC60 are located at the end of section III.

Standley Lake

In support of the Standley Lake Management Plan, (Appendix D), the SLC evaluate trends and trophic status using the Lakewatch computer software. Lakewatch was developed by Dr. Noel Burns, renowned limnologist. Dr. Burns suggests that selecting an appropriate time period is crucial for trend detection. He also suggests using a minimum of three years data. "It is important not to extend trend lines from years where a particular trend is evident to other years where the trend no longer exists." A table with the Carlson trophic status values follows in the Trophic Status section. For purposes of trend analysis, the 2002 thru 2006 time period was selected. The following sets of graphs were generated using the Lakewatch software. All indicators were measured at Standley Lake site SL10, near the dam face. Westminster staff sampled Standley Lake from a boat on 22 dates in 2007.

Two types of Lakewatch graphs are presented. One type is a regression graph with the top regression line being observed data; the bottom regression line, plotted as residuals, is deseasonalized data, i.e. data from which seasonal variation has been removed. Regression lines using least square regressions are calculated for both sets of data. A low p-value correlates to a low probability that the fit of the line is attributable to chance, i.e. there is a high probability of a trend. All data for the 2002 through 2006 period was used to develop these graphs, regardless of thermal stratification status. The second type of Lakewatch graph groups the entire data set by month resulting in a seasonal variation graph.

Lake data is collected annually using a remote underwater sampling station (RUSS). The RUSS unit consists of a floating platform containing solar panels, marine batteries and an on-board computer and



communications package. A data cable connects the computer to a combination leveling profiling device and sensor package that floats below the platform. The sensor system moves up and down through the water column. The sensors transmit data via the communication cable to the on-board computer. Data can be downloaded manually or via a SCADA system.

Chlorophyll a

The following graphs were generated using the Lakewatch software program. Figure 5 indicates that the change in uncorrected chlorophyll a (chla) is trending downward at a rate of 0.3639 ug/L/yr and the trend is significant.

Figure 5. Chlorophyll a trend

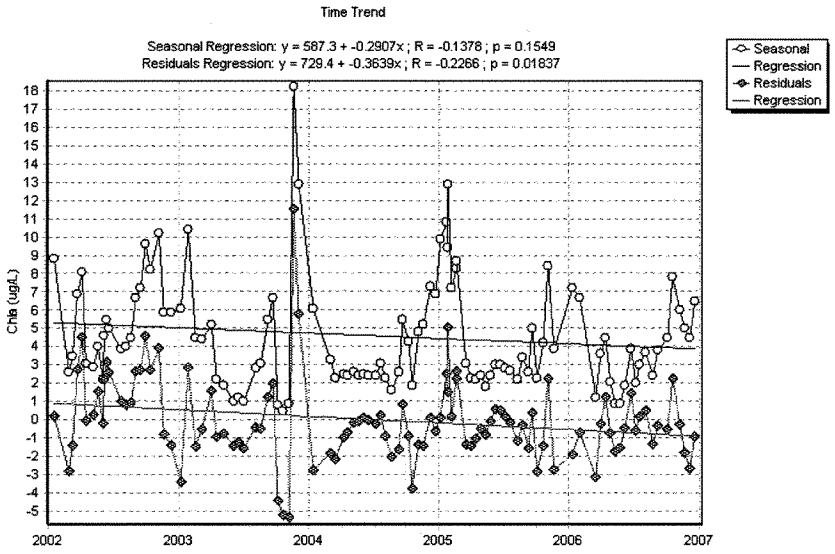
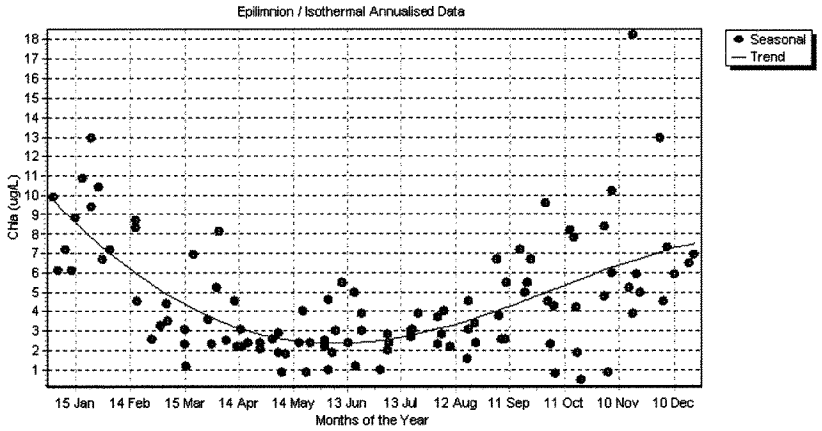


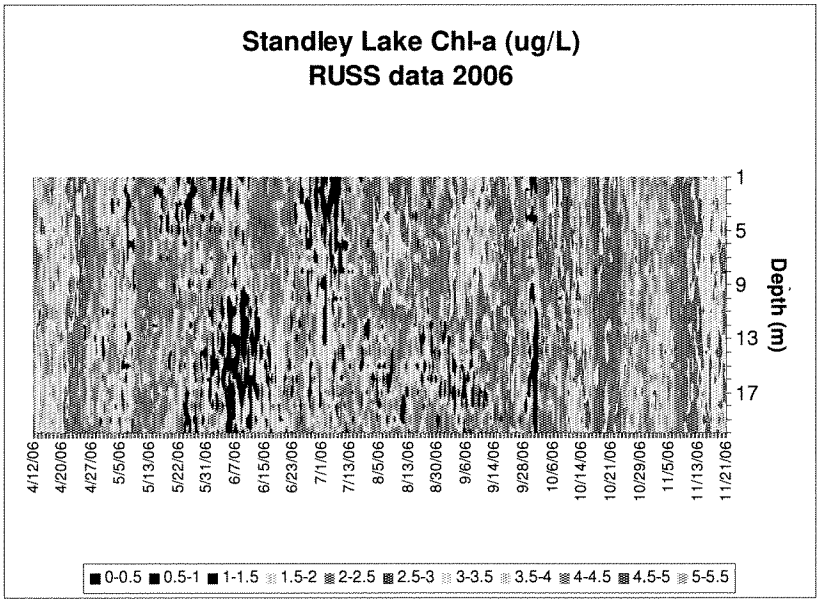
Figure 6 plots the 2002 through 2006 data by month, allowing the data to be viewed seasonally. Higher chla concentrations are measured in the fall and winter months with lower concentrations observed in the spring and summer months.

Figure 6. Seasonal chlorophyll



In 2006, the fall through winter chla concentrations ranged from 2.5 to 5.0 ug/L. The Cities of Westminster and Northglenn experienced a taste and odor event at the higher concentrations. The City of Thornton was not distributing Standley Lake water at the time. High chla concentrations were measured on April 12, 2006 at RUSS deployment. Concentrations dropped during the summer and increased again after turnover in September. Following turnover, algae concentrations increased with concentrations remaining high through November when the RUSS was taken off the lake due to impending ice cover. This supports the SLC assertion that Fall/Winter is the growing season.

Figure 7. Chlorophyll concentration in Standley Lake



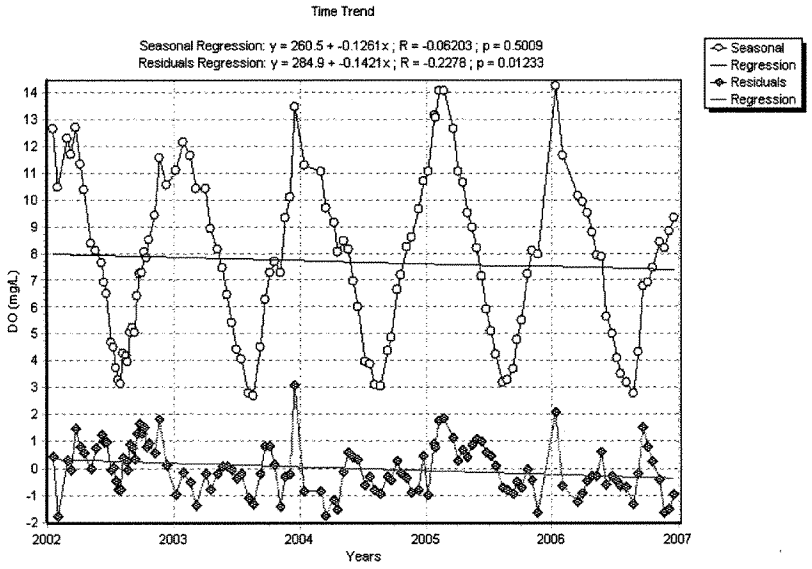
Total algae

The total algae count demonstrates a slight trend upward. The trend is not significant. The winter algae bloom on Standley Lake caused taste and odor problems for the Cities of Westminster and Northglenn and the event increased treatment costs. Asterionella was the principal genus that bloomed during this event.

Dissolved Oxygen

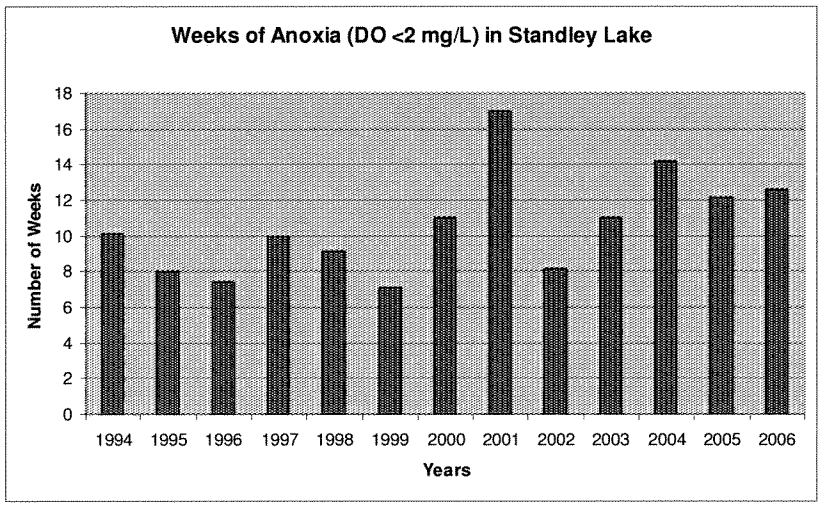
Dissolved oxygen (DO) levels are trending downward. The trend is significant. The rate of change is 0.1421 mg/L/yr.

Figure 8. Dissolved oxygen trend



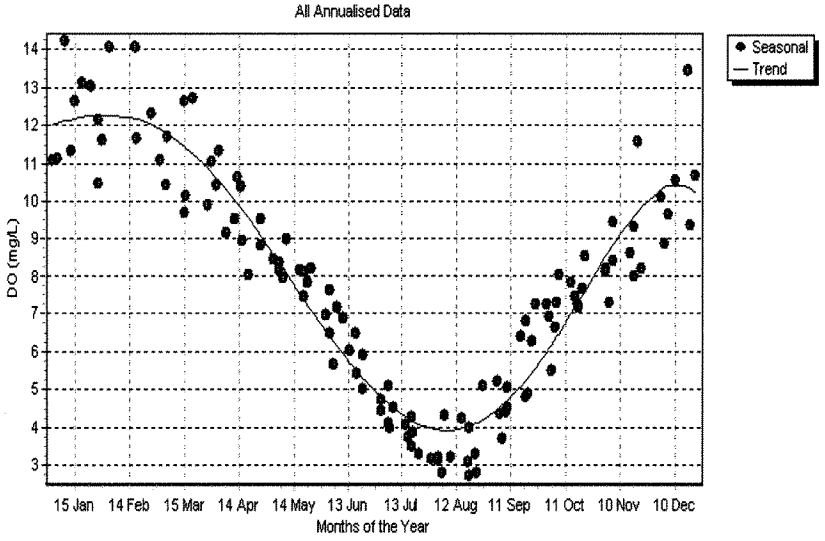
During the period 1994 to 2000 the lake was anoxic (<2mg/L) an average of 8.98 weeks. For the period 2002 through 2006, the average length of anoxia increased to 12.5 weeks.

Figure 9. Weeks of anoxia



Dissolved oxygen concentrations show strong seasonality with lower concentrations during the summer months when the lake is stratified.

Figure 10. Season dissolved oxygen



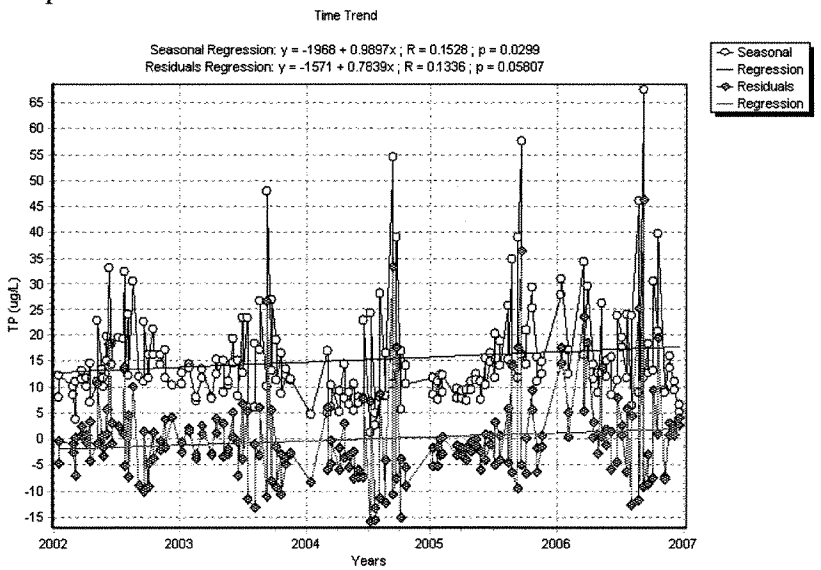
Secchi Depth

Secchi depth is trending slightly upward. The trend is significant and the rate of change is 0.1634 meters/yr. The photic zone is the depth to which light can penetrate and is calculated by doubling the secchi depth.

Total Phosphorus

Total phosphorus (TP) is trending slightly upward. The trend is not significant.

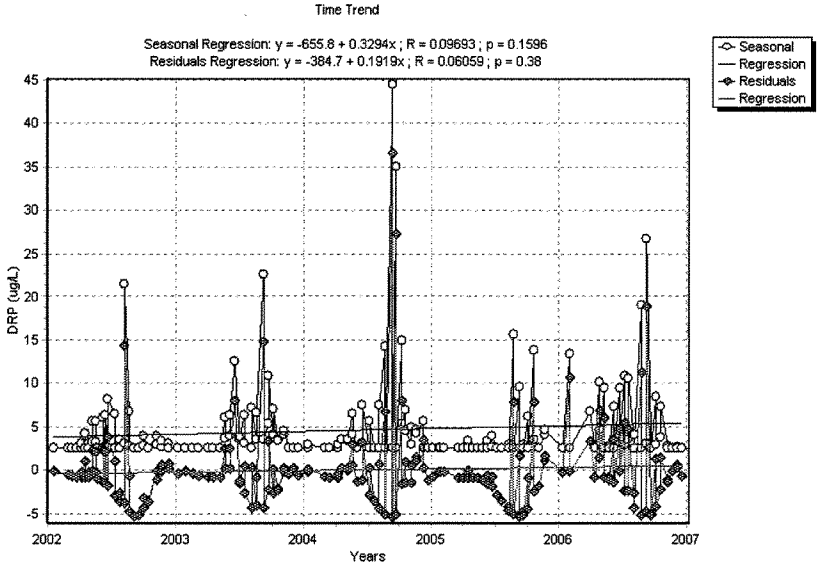
Figure 11. Total phosphorus trend



Dissolved reactive phosphorus

Dissolved reactive phosphorus (DRP) is trending slightly upward. The trend is not significant.

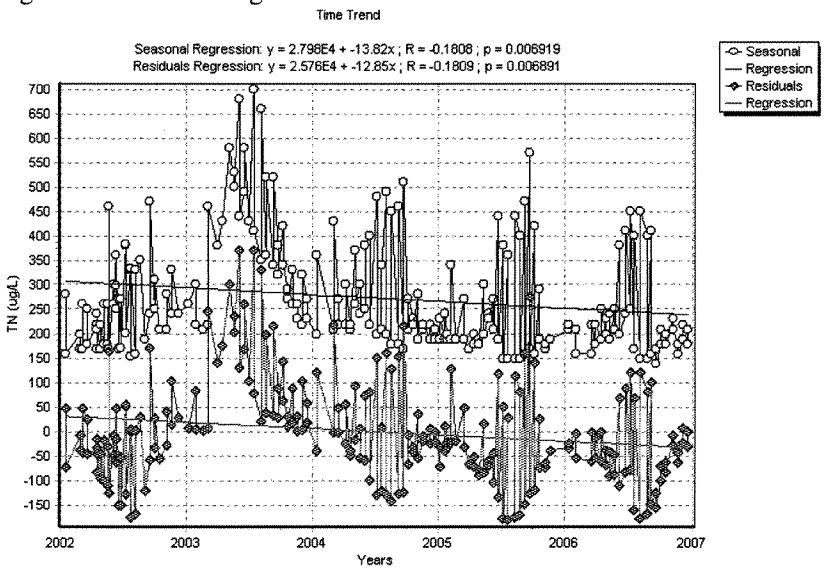
Figure 12. Dissolved reactive phosphorus trend



Total nitrogen

Total nitrogen (TN) is trending downward. The trend is significant. The rate of change is 12.85 ug/L/yr.

Figure 13. Total nitrogen trend



To further characterize water quality in Standley Lake, a mass balance loading calculation was performed and trophic index assessed using the Carlson method.

Loadings and Trophic Index

Dr. Noel Burns, noted limnologist and developer of the Lakewatch program, defines trophic state as "the life supporting capacity per unit volume of a lake. Six commonly measured variables are widely accepted as good indicators of the trophic level of a lake: Chlorophyll a (chla), Secchi depth (SD), total phosphorus (TP), total nitrogen (TN), hypolimnetic volumetric oxygen depletion rate (HVOD) and phytoplankton species and biomass." Four of the six indicators are mentioned in Standley Lake's narrative standard. Dr. Burns further explains that "trophic levels of lakes are critical indicators of water quality. They provide a measure of the nutrient status of a body of water." Trophic state is related to water quality but the two terms are not synonymous. Trophic state is a scale based on multiple, commonly measured parameters. Water quality is a relative term based on use or uses of the water.

Commonly used indices to determine trophic state or status include: Vant (1987), Carlson (1977), Chapra et al. (1981) and Burns et al. (2000). The Lakewatch program uses both the Carlson and Burns classification schemes. The concept of trophic status is based on the fact that changes in nutrient levels influence algal biomass as measured by chlorophyll *a* which in turn causes changes in lake clarity as measured by Secchi depth. A trophic state index is a convenient way to quantify this relationship. The SLC agree that the lake is currently mesotrophic but remain interested in developing a water quality index that would serve as an indication of achievable condition. Coupling this information with trending analysis can serve as an early warning allowing implementation of management options to prevent the lake from becoming eutrophic.

Table 9 is a summary of the trophic status by year. The middle columns in the table transform the raw data to a trophic index value. In turn, the individual trophic index values are combined, resulting in an annual TSI average. Highlighted years indicate the lowest value, i.e. better water quality. The year 2004 showed the lowest annual average TSI, 38.46.

Table 9. Carlson trophic state

Carlson Trophic State Index Values and Trends

Period	chla (ug/L)	SD (m)	TP (ug/L)	TN (ug/L)		TSc	TSs	TSp	TSn		TSI avg	Std Error TS avg
May 1994-Dec 1994*	3.03	2.62	20.75	312.81								
Jan 1995-Dec 1995	2.94	2.51	21.63	320.27		41.49	46.12	47.88	37.68		43.29	2.31
Jan 1996-Dec 1996	3.10	2.29	14.36	281.11		41.71	48.03	42.57	36.14		42.11	2.43
Jan 1997-Dec 1997	2.84	2.43	16.44	313.90		40.83	47.21	44.53	37.73		42.57	2.08
Jan 1998-Dec 1998	2.75	2.88	17.51	346.32		40.52	44.76	45.43	39.15		42.46	1.55
Jan 1999-Dec 1999	1.82	3.09	10.69	281.45		36.47	43.73	38.31	36.16		38.67	1.75
Jan 2000-Dec 2000	2.68	2.72	14.79	226.49		40.26	45.57	43.00	33.02		40.46	2.71
Jan 2001-Dec 2001	4.09	3.08	17.47	268.28		44.42	43.80	45.39	35.46		42.27	2.29
Jan 2002-Dec 2002	5.60	2.76	18.08	241.71		47.51	45.38	45.89	33.96		43.19	3.11
Jan 2003-Dec 2003	4.70	3.00	11.77	335.48		45.78	44.17	39.70	38.69		42.09	1.71
Jan 2004-Dec 2004	3.54	3.31	8.26	234.06		43.01	42.75	34.70	33.50		38.46	2.56
Jan 2005-Dec 2005	5.00	3.20	12.44	198.33		46.38	43.26	40.50	31.11		40.31	3.30
Jan 2006-Dec 2006	3.91	3.47	15.82	195.14		43.98	42.08	43.97	30.87		40.22	3.15
Average	**3.54**	**2.87**	**15.39**	**273.49**		**42.74**	**44.74**	**42.66**	**35.29**		**41.34**	**2.41**

*Partial year, trophic status not determined

Utilizing the trophic indices, loadings, and other evaluated data, assists the SLC in developing management options to maintain Standley Lake in a mesotrophic state.

Table 10. Standley Lake Mass Loading Summary, 1994 through 2006 (BDL=MDL)

Year	Total Phosphorus (lbs)			Dissolved Reactive Phosphorus (lbs)			Nitrate + Nitrate as N (lbs)			Ammonia as N (lbs)		
	Inflow Load	Outflow Load	Net Reservoir Loading	Inflow Load	Outflow Load	Net Reservoir Loading	Inflow Load	Outflow Load	Net Reservoir Loading	Inflow Load	Outflow Load	Net Reservoir Loading
1994	1,974	2,949	(975)	772	783	(10)	17,507	14,269	3,238	2,507	4,831	(2,324)
1995	8,166	2,611	5,555	1,201	773	427	35,473	27,865	7,608	5,168	2,413	2,755
1996	4,283	1,834	2,448	793	666	127	26,550	18,416	8,135	3,322	4,339	(1,017)
1997	6,177	1,934	4,243	1,202	381	820	33,188	16,493	16,695	4,077	4,058	20
1998	10,304	1,761	8,543	978	2,191	(1,213)	39,148	20,598	18,551	3,377	3,188	189
1999	8,179	2,601	5,579	944	179	764	47,687	25,090	22,597	4,778	2,441	2,337
2000	3,604	1,749	1,855	650	674	(24)	13,865	6,625	7,240	1,405	1,188	217
2001	11,535	2,270	9,265	898	444	454	27,240	12,457	14,783	1,905	5,417	(3,512)
2002	1,827	1,629	198	395	485	(90)	14,605	4,562	10,043	1,160	2,156	(996)
2003	5,116	1,526	3,590	1,197	623	574	45,161	26,223	18,938	2,014	1,844	170
2004	3,902	1,146	2,756	626	625	1	21,283	10,799	10,484	1,144	2,039	(895)
2005	2,902	751	2,151	682	179	503	24,014	9,941	14,073	1435	1,903	473
2006	4,303	2,120	2, 201	1,173	883	290	19, 670	11, 035	8, 635	1,463	2,483	(1,020)

Notes: Parentheses indicate a negative value.
For calculation purposes, the method detection limit (MDL) concentration was substituted for non-detected concentrations less than the method detection limit.

Total nitrogen and total phosphorus net reservoir loadings in the 1999 to 2001 time period and again in the 2003-2004 years support the observed changes in Trophic State Index Values. Figures 14 and 15 show total annual nutrient inflow and outflow loadings on the Y axes with acre feet of water inflows on the second Y axes.

Figure 14. Total nitrogen load and inflow comparison

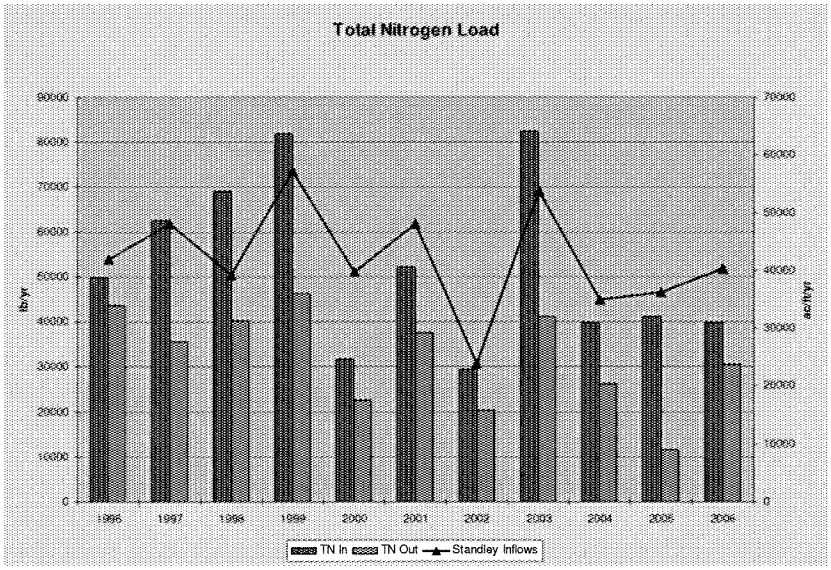
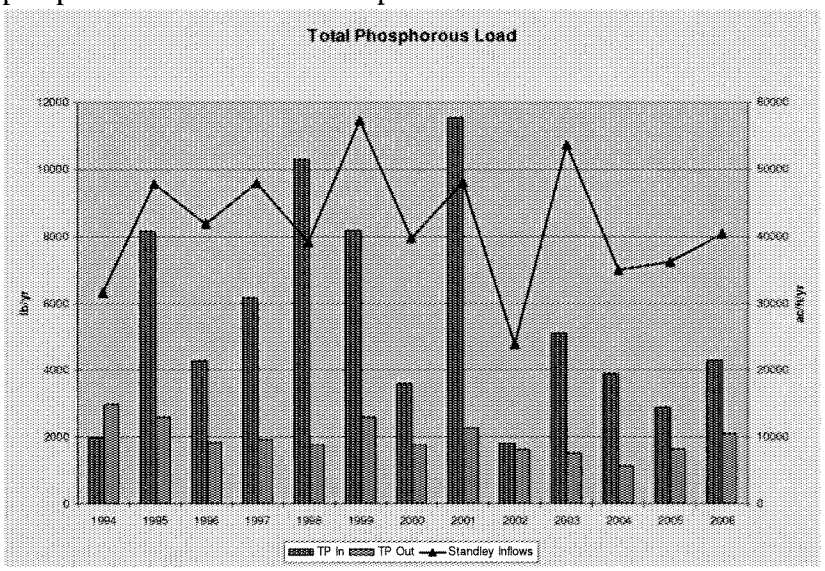


Figure 15. Total phosphorus load and inflow comparison



Three principal ditches deliver water to Standley Lake from Clear Creek. They are: Croke Canal (Croke), Farmers' Highline Canal (FHLC) and Church Ditch (WC Church). The Kinnear Ditch Pipeline (KDPL) delivers water to Standley Lake from Coal Creek or the Boulder Diversion Ditch. Understanding the diversion seasons assists in the characterization of pollutant sources. For example, the FHLC diversion season is April 14th through October 31st. The Croke diversion season is generally October 31st through April 14th. These waters are predominately low flows and are influenced by wastewater facilities and stormwater runoff. The diversion season for the Church Ditch is April 14th through October 31st. Actual diversion dates may vary slightly due to the seniority of water rights on the South Platte and Clear Creek. Multiple water sources are delivered through the KDPL which allows diversions to occur essentially year round in this ditch.

To characterize nutrient loadings by source, the loading inflow for each ditch was divided by the acre feet of water diverted, yielding pounds of nutrient per acre foot of water diverted. This exercise evaluates the presence or absence of seasonal variation and assists with identifying potential nutrient sources. The information can then be used to identify potential actions to reduce nutrient loadings into Standley Lake. Tables 11 and 12 below summarize nutrient inflows by ditch for 2006.

Table 11. Pounds of nutrient loading per acre foot of water diverted

Ditch	Diversion Season	lbs/acre ft diverted			% of Total 2006 Diversions
		TP	DRP	TN	
FHL	4/14 to 10/31	0.09	0.02	0.70	60%
Croke Canal	10/31 to 4/14	0.13	0.04	1.46	30%
WC Church	4/14 to 10/31	0.11	0.05	1.21	5%
KDPL	Year round	0.14	0.08	1.21	6%

The total percentage does not add up to 100% due to mathematical rounding.

Table 12. Total nutrient loadings by diversion structure

Ditch	Nutrient Loadings in Pounds for 2006		
	TP	DRP	TN
FHL	2,156	447	16,937
Croke Canal	1,619	461	17,728

Ditch	Nutrient Loadings in Pounds for 2006		
	TP	DRP	TN
WC Church	212	88	2,282
KDPL	316	177	2,813

II. THE UPPER CLEAR CREEK WATERSHED ASSOCIATION

Introduction

2006 was a year of collaboration for the Upper Clear Creek Watershed Association with two very important collaborative efforts in the Upper Clear Creek Basin taking hold. First, ten wastewater dischargers, with funding from other partners and the Colorado Department of Local Affairs, undertook a utility plan project and a county-wide effort for evaluation of consolidation and regionalization possibilities. This $143,000 study by Arber & Associates will establish the framework for the basin's dischargers' development and improvements for the next twenty plus years.

Second, the basin's major dischargers formed a working group to develop a Use Attainability Analysis in response to a proposed metals TMDL from the Colorado Water Quality Control Division. This effort builds on previous work funded by our 319 grant in 2005. This working group and UCCWA will retain consultants during 2007 to formulate proposed revisions to Clear Creek underlying metals standards for presentation to the WQCD in summer 2007.

In addition to these efforts, three permanent monitoring and sampling stations, established by UCCWA and IGA member cities, were fully operational in 2006.

Black Hawk

In 2006, the City of Black Hawk finished the following water quality improvement projects:

- completed the replacement of the 100-year-old mountain supply pipeline in 4-Mile Gulch with 4,400 feet of 8-inch ductile iron pipe to eliminate water leakage and to enable selective diversion of well and spring waters during turbid surface water conditions;
- constructed a Meter Vault and Pond Intake T-screen system at Hidden Valley Water Plant to allow more accurate monitoring of water diversion, along with unimpeded operational capability during winter conditions;
- constructed an automated Water Truck Filling Station at the North Clear Creek Infiltration Gallery and Pump Station site alongside Highway 119;
- completed a pilot study for waters in North Clear Creek, Chase Gulch, and 4-Mile Gulch in preparation for design of a new water treatment plant to replace the Dory Hill Plant, and
- completed "water hammer" mitigation work for all seven Pressure Reducing Valve Stations, including installation of upgraded PRV units, surge arrestors, flow meters, and instrumentation to automatically measure and monitor pressures and flows. The system has been free of water hammer events through May 2007.

Black Hawk continues to require the use of Urban Drainage and Flood Control District Volume III Best Management Practices (BMPs) on projects in its jurisdiction. Construction projects are also required to obtain storm-water permits from the State. The City also continues to implement its sand and sediment detention pond clean-out program. Black Hawk continued its involvement in the MMRR Quarry proceedings and is specifically concerned about water quality impacts and erosion control.

Black Hawk/Central City Sanitation District

The new Black Hawk/Central City Sanitation District plant became fully operational in January 2006, and

is continuing to meet all discharge permit limits. Currently built to handle 2 million gallons/day, plant capacity could expand to 4 million gallons/day. Current flow is .37 million gallons/day, peak flow over 1 million gallons/day. As the result of an Intergovernmental Agreement, the plant incorporates full scale Biological Nutrient Removal (BNR) and filtration. It removes nutrients to very low levels, even though there are no nutrient limits in its CDPS permit. The plant experienced three events of sudden, unanticipated elevated phosphorus levels in the summer of 2006. The District responded and brought phosphorus levels back to well below 0.3 mg/l through the addition of additional acetic acid, alum, and magnesium hydroxide. In 2006, one-third of the collection system was cleaned and television-monitored with no problems found. The biosolids from this facility are being shipped to Leadville for a mined land reclamation project. The odor control system consists of chemical sprays of sodium hypochloride and sodium hydroxide to remove the sulfur odor.

Central City

Erosion control measures were implemented by the City in 2006 on the Central City Parkway, including replacing hay bales with rip rap, seeding, and rock mitigation. Initial planning was completed for detention pond improvements at Russell Park. Central City completed storm drainage mitigation planning for Quartz Hill with CDPHE.

Central Clear Creek Sanitation District

AAA Operations tests monthly for BOD, TSS, FC, ammonia, flow and % capacity and reports that no effluent violations occurred during 2006. CCSD continues alum addition and controls sludge age to improve nutrient removal. CCCSD is also performing a study on utilization of its biosolids for composting. See Appendix E for detailed table.

Clear Creek County

In 2006 the Clear Creek County Environmental Health Department issued 43 Individual Sewage Disposal System (ISDS) permits (35 new, 8 repairs); conducted 231 inspections; and revised the ISDS permit fee schedule to more fully recover costs incurred by local ISDS program activities.

Clear Creek/Regional Wastewater Study Group

The Clear Creek Wastewater Study Group continued it efforts to evaluate regional wastewater treatment options in the Upper Clear Creek Basin area of Clear Creek County. In November 2006, Clear Creek County entered into a contract with Richard P. Arber and Associates of Lakewood, Colorado to complete a Countywide Wastewater Utility Plan study during 2007. As part of this effort in 2006, UCCWA members updated the DRCOG maps of Clean Water Planning areas and Wastewater Utility Service Areas (WUSAs).

Clear Creek Emergency Call-Down System

In order to notify down-stream users of water from Clear Creek of any potential contamination from an upstream source, Clear Creek uses an emergency call-down system using the Emergency Preparedness Network. The Clear Creek County Office of Emergency Management Director continues to update and maintain the database for the call lists. This system applies to incidents/spills into Clear Creek and tributaries leading into Clear Creek. In 2006 the Standley Lake Cities contributed $750 to this program. In 2006, there were four launches from the Clear Creek County Call-Down System:

- 8/18—Car fire at I-70 east-bound MM243. When putting out the car fire, possible chemical and/or fuel contamination of Clear Creek. 109 numbers called.
- 9/29—Asphalt spill of organic material in the creek at MM216 off I-70. Does not cause problems to humans. There is an emulsified blanket around the spill. 109 numbers called.
- 10/27—No text record of the message. It is unclear if the incident was at the Idaho Springs Water Treatment Plant or not. 106 numbers called.

- 11/25—No text record of the message. It is unclear if the incident was at the Idaho Springs Water Treatment Plant or not. 114 numbers called.

Clear Creek High School

The high school's xenon membrane filtration plant came on line in 2004 with management continuing to be provided by AAA Operations. Alum continues to be added for nutrient removal. Alum addition and control of the sludge age continue to improve nutrient removal. AAA Operations tests monthly for BOD, TSS, FC, ammonia, flow and % capacity and reports that no effluent violations occurred during 2006. See Appendix E for detailed table.

Clear Creek Ski Corporation

Clear Creek Ski Corporation's most recent permit reduced the effluent limit of fecal coli form so it included a compliance schedule in case new construction or modifications were required to achieve the limit. CCSC was able to meet the new limit with operational changes, so no new construction has been planned. See Appendix E for detailed table.

Clear Creek Watershed Foundation

The CCWF's "orphan" mine remediation efforts in 2006 included: 1) supporting two US Forest Service projects—the Minnesota Mine maintenance project on Lions Creek ($102K) and the Good Samaritan project with Phelps Dodge at the Doctor Mine on the West Fork of Clear Creek ($64K); 2) securing a 319 grant to fund the Gilson Gulch project was (total budget $425K); 3) conducting a characterization study of mining-related impacts to Trail Creek and applying for grant funding; 4) signing an agreement with the State and Iowa Tank Lines to assist in implementation and long-term maintenance of the Maude Monroe site, this Supplemental Environmental Project (SEP) valued at $600,000, is in lieu of Iowa Tank Lines paying a fine; and 5) funding a 2006 trace metals addendum.

The CCWF's outreach/education efforts continued throughout 2006 as well. In February the CCWF organized and hosted the **WATERSHED SUSTAINABILITY WORKSHOP: Creating an Action Plan for the Clear Creek Watershed**. Later in the year, CCWF applied for and received an EPA WATERSHED SUSTAINABILITY GRANT and began activities funded by the grant. The Foundation continued its tradition of public education about watersheds and mining through projects focused on elementary school education, public tours, and exhibits/booths at events such as the State Fair.

Climax Molybdenum Company

Henderson

In 2006, Climax began replacing the Henderson Mine potable water system; an existing system was purchased and installation is planned for summer 2007. Climax enhanced the performance of two flumes to measure flows in the watershed (West Fork Clear Creek and Woods Creek). Solar panels were replaced and data continued to be collected. The flumes are equipped with satellite communications and the data are available on-line. Also in 2006, the Henderson Mine site (the Arapaho Project) was selected as one of three finalists for the National Science Foundation's Deep Underground Science and Engineering Laboratory.

Urad Mine site

In 2005, Climax completed design studies to upgrade the stormwater diversion around the upper tailings impoundment in the Urad Valley. Phase II work completed in 2006 minimized any potential contamination of stormwater with mine waste and decreases suspended solids discharging into Woods Creek.

Colorado Department of Transportation

In 2006, CDOT continued its Highway Stormwater Monitoring project along I-70. This includes data on snowmelt and runoff events. CDOT is in the midst of completing the I-70 Corridor Final PEIS. Water quality impacts are among those being evaluated; mitigation will be identified in the PEIS for all significant impacts. CDOT continues to clean traction sand from I-70 and US 40 within the Clear Creek Watershed. The final phase of construction on Berthoud Pass East (Hoop Creek) was completed in 2006 and water quality monitoring will continue for three years. Three large sediment control basins were added during the final phase. Resurfacing of I-70 was completed in 2006, including cleaning sediment from several culverts and installing permanent sediment basins along I-70 between Easter Seals Camp and Georgetown. Along the westbound side is a large, concrete basin. Along the eastbound side are several small basins. I-70 Ramp Metering Phase I constructed in 2006 included addition of water quality control basins at two sites—a sediment control basin between US 40 on-ramp and the Lawson off-ramp and minor grading and adding a slow-drain inlet at the Idaho Springs East on-ramp. Smaller rundown protections are included in the US 40 on-ramp to minimize erosion of the banks of Clear Creek.

Coors Brewing Company

In 2006, Coors' staff initiated the Colorado Water and Wastewater Treatment Network and updated UCCWA members about website development for the Network. The Colorado Water and Wastewater Treatment Network website is now available thanks to the sponsorship of Coors in cooperation with the Clear Creek Watershed Foundation. The purpose of this website is to provide Colorado Water and Wastewater Professionals an avenue to exchange information and technical knowledge about their operations, to enable operators to help each other troubleshoot and problem solve with other professionals, and to provide increased training opportunities for all.

Easter Seals Camp

Easter Seals Camp was notified by CDPHE that its multiple ISDSs are under the State's jurisdiction under Policy Water Quality Standard #6. Easter Seals Camp applied for PELs and will be issued a CDPS discharge permit. Easter Seals Camp is actively exploring either consolidation with Central Clear Creek Sanitation District or upgraded on-site facilities.

Georgetown

The treatment processes upgraded in 2005 remain in place. 2006 work included new headworks and a new chlorine contact basin for a cost of $650,000. Georgetown did a "cured in place" sliplining of 405 feet of sewer lines in 2006 to seal out more I&I. The Georgetown WWTP had two ammonia limit violations in 2006. In February, the limit of 7.5 mg/L was exceeded at 9.0, and in April the limit of 7.0 mg/L was exceeded at 7.1. Georgetown took the following steps to address ammonia levels:

1. Mean cell residence time was changed in February 2006
2. Hydrogen peroxide was added as a treatment beginning in April 2006
3. New bar screen installed as part of Phase I Improvements became operational in October 2006

Gilpin County

The Gilpin County Public and Environmental Health Services Department issued 33 ISDS permits (21 enhanced systems; 2 vaults; 10 standard; and 1 cluster system) in 2006 and conducted 161 inspections of ISDS systems. ISDS locations were widely spread throughout the County. In 2006, 211 water samples were tested for *E.coli* and coliform in the Gilpin County's state certified water lab. Of those, 29 tested positive for coliform and 1 tested positive for *E.coli*. Note that these statistics are for the entire county, which includes areas outside the Clear Creek Watershed boundaries. During 2005 and 2006, Gilpin County participated in water quality testing programs in collaboration with CSU and the Department of Agriculture. Very few of the 77 wells tested by CSU were above any detection limit. The CSU

cooperative extension also tested 27 additional wells for the presence of pesticides. All came back negative. Gilpin County Public and Environmental Health Services are also working on mapping the locations of ISDS and well heads in the County.

Golden

Water Quality

The Inflow and Infiltration Mitigation program repaired or replaced 3000 feet of sewer line in Arapahoe Gulch, 750 feet in Miner's Alley and an additional 1000 feet of line in other parts of the City.

Stormwater Program

In 2006, the City continued activities in accordance with its Municipal Stormwater Permit under the Colorado Discharge Permit System. The Environmental Services Division responded to 42 illicit discharges or spills to the storm sewer system. One fine was issued; 1 case was forwarded to CDPHE for further investigation; two requests for reimbursement to the City were obtained for costs incurred for clean-up; 15 written warnings were sent to responsible parties; and, approximately 40 brochures were distributed to a neighborhood where the source could not be determined. All other incidents were determined to be one of the following: 1) an allowable non-stormwater discharge; 2) the location of pollution could not be located from reported information; 3) the source of pollution could not be determined and the City assumed responsibility for clean-up; or 4) the offending party satisfactorily addressed the situation and had not been documented as a previous offender.

The construction site runoff control program managed 45 stormwater quality permits for construction site activities, conducted 1,116 erosion and sediment control inspections, and issued 29 compliance orders and 8 stop work orders. The long-term stormwater management program conducted 4,406 maintenance inspections of storm sewer systems including inlets, manholes and structural BMPs. Maintenance requests following the inspections resulted in the completion of approximately $100,000 worth of work by property owners.

Watershed/Other Activities

The City continued participation and financial support of the Rooney Road Recycling Center; and the permanent monitoring and sampling site established by the City at CC59 was fully operational and successfully sampled three non-ambient triggered flow events in addition to the regularly scheduled sampling program.

Idaho Springs

Idaho Springs remains active in the **Upper Clear Creek Watershed Association**, **Regional Wastewater Treatment Study Group** and the **TMDL Subcommittee**, contributing over $16,000 for dues and projects. The City has also stepped up sampling efforts for point source discharge and in Clear Creek. Several demand and preventative maintenance projects were completed in 2006 including, drained / cleaned chlorine contact chamber and installed new sedimentation pumps, drained / cleaned one of two reactors, bar screen and grit removal improvements, new SCADA computer and upgraded software / hardware, phase / voltage protection and standby power upgrades, flow measurement upgrades and multiple improvements and repairs in aeration, plumbing and electrical. These changes and upgrades have resulted in improved operations, discharge quality and plant reliability. There were no violations, injuries or incidents at the Idaho Springs wastewater treatment plant.

Jefferson County

In 2006 Jefferson County continued its existing stormwater programs and other programs that were implemented as measurable goals, such as the Small Construction Site Inspection program. This program element requires erosion and sediment control on construction sites that are smaller than one acre if they were part of a larger plan of development. Additionally, Jefferson County passed Zoning Resolution

Section16 to allow the County to ensure long-term function and maintenance of permanent stormwater quality structures. The Jefferson County Stormwater Quality Coordinator developed a presentation and photo display about Mountain Stormwater management. This presentation is part of a Low Impact development effort to show people how to manage stormwater to allow infiltration, protect baseflow and riparian areas. A mountain stormwater management flyer was created and several other resources are available on the Jefferson County Stormwater web page so that this information can be a State-wide resource.

Jefferson County also developed a 2' x 3' educational sign that will be installed at a waterway restoration project which shows pictures of down cut and destabilized waterways to show the effects of urbanization and photos to illustrate how the construction techniques used to stabilize waterways.

Saddleback Metropolitan District

Three homes have been constructed in the Saddleback residential development, with nine more under construction. Well and ISDS monitoring are underway. Sampling continues at the three groundwater monitoring wells required down-gradient of the subdivision, and no impacts have been seen to date.

St. Mary's Glacier Water & Sanitation District

St. Mary's continues to make steady and consistent progress in its I/I program. Each year, sewer lines are cleaned and videotaped. Deficiencies in the system are corrected to the extent possible. Each year since the program was implemented, runoff flows through the plant have been lower. St. Mary's considers the program to be a success in improving I/I in its system. AAA Operations tests monthly for BOD, TSS, FC, ammonia, flow and % capacity and reports that no effluent violations occurred during 2006. AAA continues to control sludge age for nutrient removal. See Appendix E for detailed table.

Shwayder Camp

For several years Shwayder Camp has had issues with its waste water treatment system. In 2006, Shwayder trucked all wastewater offsite for disposal at a downstream wastewater treatment plant. Shwayder Camp enlisted the services of AquaWorks DBO to engineer a new wastewater treatment system and has chosen to install a Fluidyne SBR system that will be operated by AAA Operations. Pending final approvals from the State, construction should begin in mid to late May 2007.

Silver Plume

The storm water drain line for Cherokee Gulch has been replaced as part of Silver Plume's water system replacement project. The storm water will no longer travel cross country, thereby reducing sediment loading. In 2006 Silver Plume also replaced its water plant distribution system, which eliminated 100,000 gallons per day in leaks.

Superfund (CDPHE/EPA) Remediation Projects

The Argo Water Treatment plant continues to operate, now using lime as the primary reagent. In 2006, additional mine impacted waters including 20 to 30 gpm from the Big Five Mine adit and 10 to 50 gpm of baseflow from Virginia Canyon were included in the waters treated by the Argo Plant. CDPHE and EPA funded design of sediment control measures including mine waste pile erosion protection sediment detention structures on Nevada and Russell Gulches and completed the first phase design that includes addressing five mine waste piles and two sediment collection structures intended to reduce sediment transport to North Clear Creek. Sediment ponds on Virginia Canyon are effective and have needed to be cleaned out. EPA and the Colorado School of mines are performing treatability testing on sulfate reducing bioreactors for the National Tunnel water. CDPHE and EPA have teamed with the Black Hawk Central City Sanitation District on the design of a mitigation wetland that is twice the size that the

Sanitation District would have otherwise implemented. It is anticipated that during low flow up to one quarter of North Clear Creek flow will be able to be routed through the wetland.
Numerous ongoing Superfund projects are taking place in the upper portion of the Clear Creek Watershed to control sediment and metals loading into Clear Creek and associated tributaries; this remediation has the additional benefit of incremental decreases in phosphorous loading, as well.

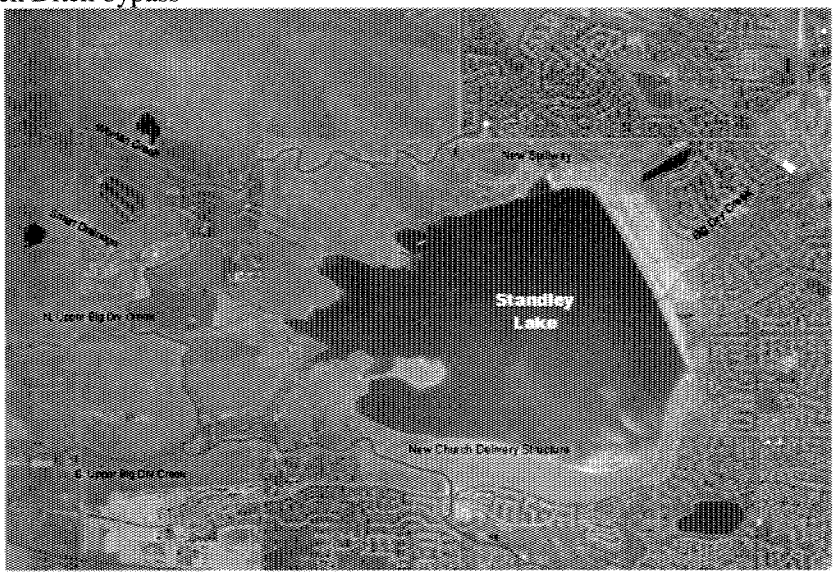
III. TRIBUTARY BASIN, CANAL COMPANIES AND STANDLEY LAKE

Tributary Basin Area

The Standley Lake watershed consists of approximately 282,000 acres, including the Clear Creek Basin above Golden and the Tributary Basin. The Tributary Basin consists of approximately 20,750 acres. Tributary entities continue to work with ditch companies to prevent stormwater inflows into the Standley Lake supply ditches. At the end of 2006, approximately 13,300 acres or 64% of the total Tributary Basin were separated and therefore no longer drain into canals and subsequently into Standley Lake.

The biggest diversion effort occurred on October 26, 2006 when the Cities of Arvada, Northglenn, Thornton, and Westminster signed an intergovernmental agreement with the Church Ditch Water Authority authorizing the use of approximately a 5 mile section of the ditch as an inceptor for the purpose of diverting all or portions of the storm water flows around Standley Lake. When completed, this effort will prevent 1,392 acres from draining into the Church Ditch, as well as diverting runoff from 2,604 acres that currently drain directly into Standley Lake. Construction of a new Church Ditch inlet structure will begin in 2007. The ditch will be enlarged to a capacity of 125cfs.

Figure 16. Church Ditch bypass



In addition to these drainage improvements, permanent Best Management Practices structures such as extended detention basins and stormwater separators are installed in all subdivisions in Arvada.

City of Arvada

Source Control

Enforcement Actions

Arvada aggressively enforces the 1993 ordinance prohibiting unlawful discharges to its stormwater facilities. Arvada issued eight warning letters, two of these incidents resulting in enforcement actions; however, there were no impacts on stormwater quality.

Public Education

Arvada personnel placed 123 markers on curbs next to storm drain inlets that say "No Dumping, Drains To Creek". Over 200 pamphlets informing citizens of the impact of individual activities on storm water and streams were distributed; non-point education message was included in water bills to over 30,000 accounts; letters were set to 26 landscaping companies along with a brochure "The landscapers Guide to Protecting our Water Resources" and 222 letters were sent to restaurants with a brochure "Prevent Water Pollution: Food Service Operations".

Spill Prevention for Municipal Operations

Spill Prevention Control and Countermeasure Plans are in place for all city facilities with 91 staff trained on spill response and illicit discharge prevention.

Erosion Control During Construction

Arvada continued to enforce its existing ordinance concerning erosion and sediment control during construction. The ordinance was adopted in 1993 and incorporates, by reference, the criteria for erosion and sediment control during construction specified in the Urban Drainage and Flood Control District Criteria Manual, Volume 3 - Best Management Practices. Arvada's erosion control ordinance is consistent with the requirements of the Tributary Basin Management Plan.

Permanent Stormwater Quality Control for New Development or Significant Redevelopment

Arvada continues to enforce the requirements that the owner or developer of a new development or a significant redevelopment must provide and maintain reasonable structural best management practices for permanent stormwater quality control within the development, incorporating the criteria for permanent stormwater quality control specified in the Urban Drainage and Flood Control District Criteria Manual, Volume 3 - Best Management Practices.

Hazardous Substance Spills

In 2006, Arvada responded to 43 calls reporting illicit discharges with five of these incidents within areas that drain to the Standley Lake tributaries. Fortunately, these spill incidents were responded to quickly and there were no impacts on nearby waterways.

Other Activities

Clear Creek Water Quality Monitoring Activities

Arvada, Golden, Northglenn, Thornton and Westminster continued water quality monitoring activities on Clear Creek. Personnel from these cities sampled the Creek, contributed to the purchase and set up of autosamplers and continue to work towards mutual water quality goals.

Public Education Activities

Arvada continues to educate the public on illicit discharge prevention through presentations given to schools and other groups.

Settling Basin Studies

During the summer of 2006, samples were collected from Clear Creek water after it had gone through a settling basin and before the water entered Arvada Reservoir. The results below are from 9 sampling events.

Table 13. Average percent of constituents removed by settling

Parameter	TP	TN	TSS	Pb	Zn	Cu	Fe	Al
% Reduction	26	15	41	23	43	9	35	39

Household Hazardous Waste Disposal and Recycling

Arvada is an active member of the Rooney Road Recycling Center, which provides a very effective program for recycling trees and shrubs and for the safe disposal of household hazardous wastes, including pesticides, herbicides, automotive products and electronic waste.

Ditch Inflows to Standley Lake

Croke Canal, Church Ditch, Farmers Highline Canal, and Kinnear Ditch Pipeline all divert water to Standley Lake. Transbasin water from the Fraser River Basin is diverted via the Berthoud Pass Ditch to Clear Creek where it is picked up by the Church Ditch for delivery to Standley Lake. All of these canals/ditches received routine maintenance in 2006. Routine maintenance related to water quality includes the following activities:

- Diverting the first flush of the canals and preventing it from entering Standley Lake to avoid contamination from trash and debris, sediment, and other contaminants that accumulate in the canals over the winter
- Cleaning canals to restore capacity
- Placing the removed spoils below the canal's banks and grading slopes to drain away from the canals
- Requiring all development projects adjacent to the ditches to install water quality BMP's designed to mitigate impacts caused by stormwater drainage entering the ditch
- When possible, re-routing stormwater drainage from developments around Standley Lake

Woman Creek Reservoir Authority (WCRA) operates Woman Creek Reservoir and associated delivery structures. Built in 1996 to protect Standley Lake from runoff from the former Rocky Flats Site, water from Woman Creek is intercepted and diverted around Standley Lake to Walnut Creek. Routine maintenance was performed to ensure that all the facilities are in good working order.

Standley Lake Status

The Statement of Basis and Purpose for the narrative standard for Standley Lake adopted by the Water Quality Control Commission in 1994 stated: "Data collected over the last eleven years for chlorophyll *a* for Standley Lake indicates that the lake has been mesotrophic over that period. The trophic status of Standley Lake is based on the average magnitude of trophic state indicators measured during the period from March 1 through November 30."

The SLC and the Tributary Basin Entities continue to believe that Standley Lake was mesotrophic during 1994 – 2006 and that the trophic status of the reservoir did not change in 2006 based on commonly acceptable trophic parameters such as secchi depth, total phosphorus, and chlorophyll *a*. Based on this data and the data available for previous years, Standley Lake has been mesotrophic for the past 22 years.

The cities are concerned with the large chlorophyll a spikes and algae blooms that occur during the winter and with increases in the duration of hypolimnetic anoxia. The SLC believe it will be important to observe water quality trends closely and take further corrective action should it appear that water quality is deteriorating.

Eurasian Water Milfoil

Eurasian Watermilfoil (EWM), *Myriophyllum spicatum L*, is a non-native, aquatic, noxious weed that grows rapidly and to a depth of 35 feet. EWM grows in dense mats that severely interfere with recreation and has been known to provide a substrate for blue-green algae growth. Blue-green algae blooms can ultimately cause taste and odor events in drinking water supplies. EWM was first observed in Standley Lake in 1998. It was positively identified in 2000.

During the summer of 2006, a Biosonics© DT-X single-beam digital tranducer and echosounder system was used to survey Standley Lake and the data analyzed to create an ArcGIS bathymetric map. A partial survey of submerged aquatic vegetation (SAV) was also conducted using the Biosonics© system.

Upper Basin Regional Wastewater Study and Other Water Quality Activities

In 2006, the Upper Clear Creek Watershed Association (UCCWA) received a Colorado Department of Local Affairs grant to study regional wastewater options. UCCWA formed a subcommittee to follow this process. The Cities of Arvada, Westminster and Northglenn contributed $2,500 each towards the study. City of Westminster staff also regularly attends update meetings. The DRCOG Clean Water Planning areas and Wastewater Utility Service Areas (WUSAs) were updated as part of this effort.

The spill call down system is activated whenever there is a spill in or adjacent to Clear Creek. Notification allows the SLC's to decide whether to shut headgates, preventing the spill from entering Standley Lake. The system is maintained by Clear Creek County and contains more than 100 phone numbers. The SLC's helped fund maintenance and operation of the system with a donation of $750.

III. OUTSTANDING NOTICE(S) OF EXCEEDANCE FOR UPPER BASIN WWTF'S

SLC completed a review of State discharge monitoring reports and EPA enforcement and compliance history online, (ECHO), for the upper basin wastewater treatment facilities. The following wastewater treatment facilities in the Upper Clear Creek Basin received or have outstanding notices of exceedence in 2006:

Table 14. ECHO Notices of Exceedances

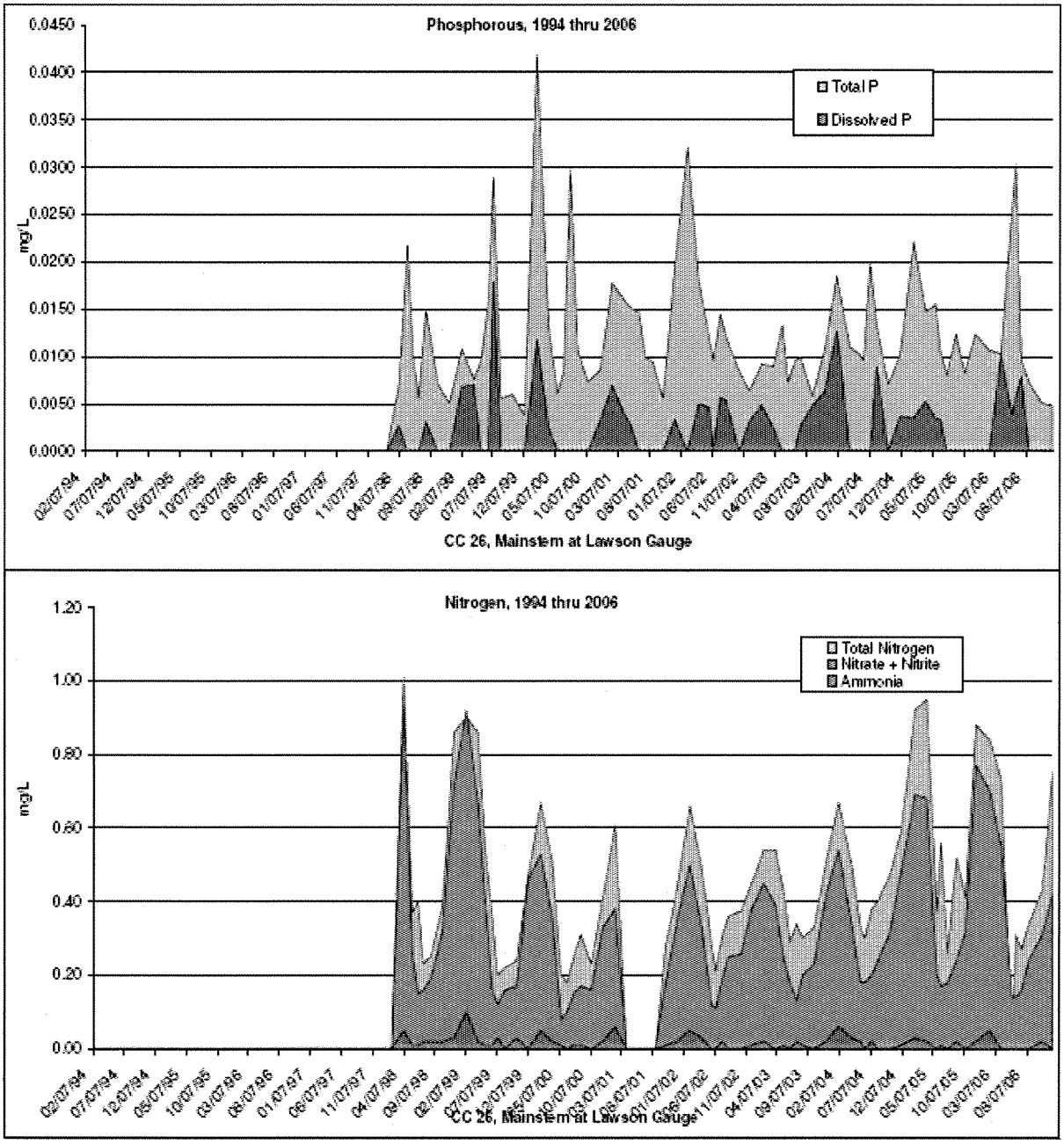
Facility Identifier	Exceedence Date	Parameter
Clear Creek School District	2nd quarter	Nitrogen, Ammonia as N
	3rd quarter	Solids, Suspended % Removal
Clear Creek Ski Corp	9/2004 to date	Not received, 1st report of progress
	6/2004 to date	Not received, implement plan
	3/2004 to date	Not received, Compliance schedule design report
	9/2005 to date	**Significant non-compliance, not received operational level attained**
Eisenhower Tunnel WWTF	1st and 2nd quarter	Coliform, Fecal General
	1st and 2nd quarter	BOD, 5-day % removal
	1st quarter	Solids, Suspended % Removal

Facility Identifier	Exceedence Date	Parameter
Eisenhower Tunnel WWTF	2nd quarter	BOD, 5-day
	2nd quarter	Chlorine, Total Residual
Georgetown, Town of	1st and 2nd quarter	Nitrogen, Ammonia as N
	1st and 3rd quarter	BOD, 5-day % removal
	6/2006 to date	Not received, Special study
Henderson Mine (Climax)	7/2006, Reportable non-compliance	Not received, 4th report of progress
Idaho Springs, City of	1st quarter	Copper, potentially dissolved
	3/2005 to date	Not received, Corrective action completed
	1/2004 to date	Not received, Monitoring program design
Shwayder Camp WWTF	2nd quarter	BOD, 5-Day Mthly
	2nd quarter	Solids, Suspended % Removal
St. Mary's Glacier W&SD	9/2005 to 5/2006	Achieved Late, submit I/I report #4

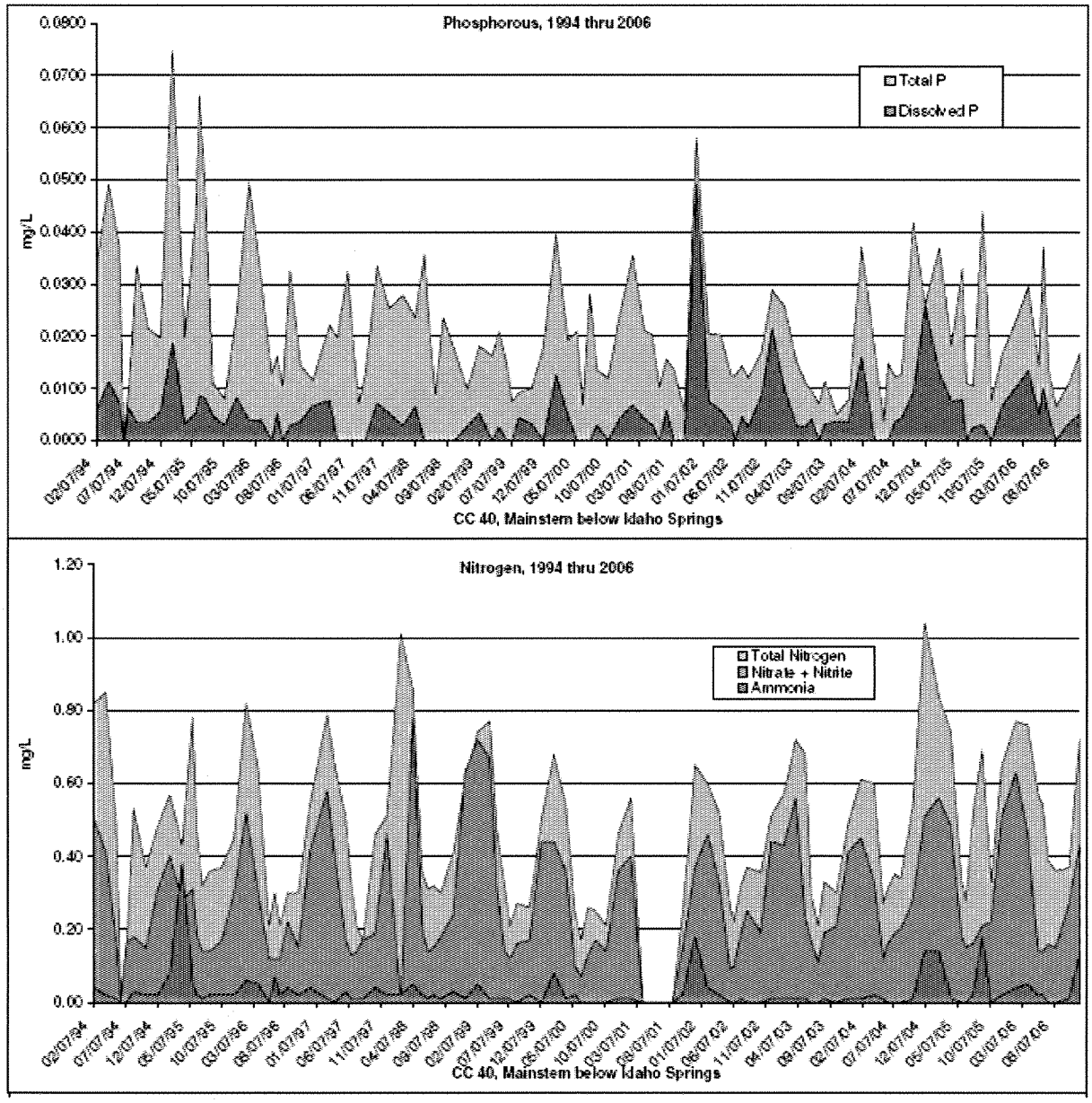
The table is a sobering reminder that more than 80% of permitted wastewater treatment plants in the upper basin are in violation of their permits. While incomplete or partial paperwork violations would appear minor, actual water quality impacts to Clear Creek could be occurring and are being ignored or hidden by failure to report. The SLC are deeply concerned with the multi-year violations of several of the WWTFs.

IV. NUTRIENT GRAPHS FOR SELECTED CLEAR CREEK SITES – upstream to downstream

Figures 17 and 18. Mainstem of Clear Creek at Lawson Gage – CC26



Figures 19 and 20. Mainstem of Clear Creek at Idaho Springs – CC40



Figures 21 and 22. Mainstem of Clear Creek at Golden – CC60