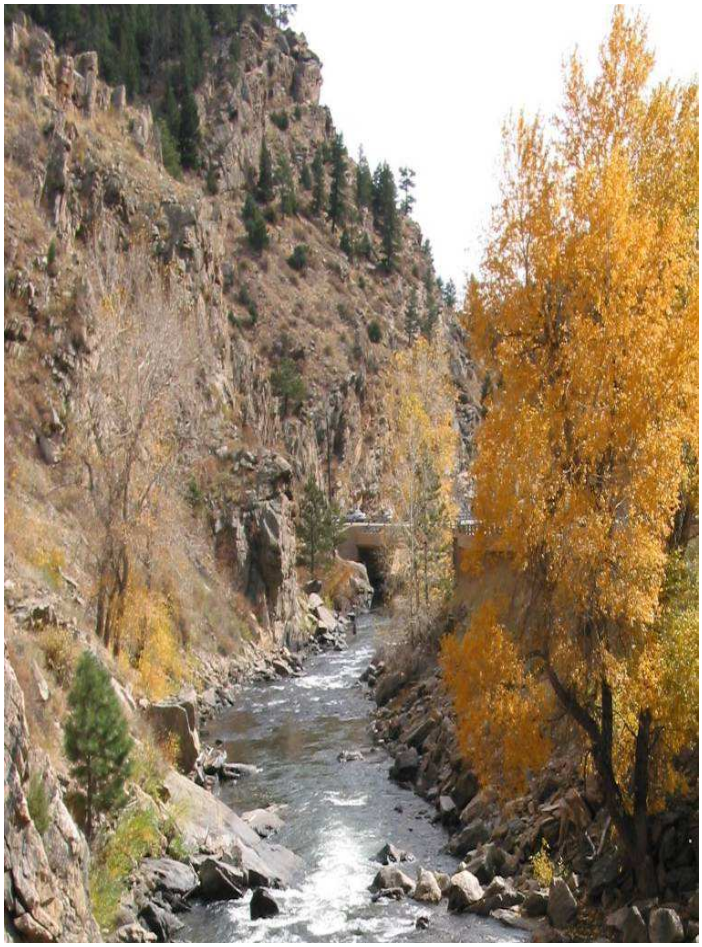
Clear Creek Watershed Management Agreement

2008 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

August 2009

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EXECUTIVE SUMMARY

Introduction

The Clear Creek Watershed is located due west of Denver, Colorado, spanning 575-square-miles from the Creek's headwaters near the Continental Divide (14,000 feet in elevation) to just under one mile high when it joins the South Platte River in the northern metropolitan Denver area. The watershed includes five counties, six towns and a considerable rural/mountain population. The historic Mineral Belt bisects the Clear Creek Watershed and while the mining and milling boom was an economic benefit to our State, it left a legacy of negatively impacted water quality throughout the watershed.

Clear Creek is a hard working Creek. It supplies water to approximately 350,000 people in the watershed, supports numerous industries, including those focused on recreation and farming, and provides habitat for some of the best fisheries close to an urban setting in Colorado. Standley Lake is the largest reservoir that is filled with water from Clear Creek. Standley Lake is an agricultural and municipal water supply storage reservoir for downstream users including the Cities of Northglenn, Westminster, and Thornton and farmers on the plains of Adams and Weld counties. Standley Lake is owned and operated by Farmers Reservoir and Irrigation Company (FRICO).

Regulatory History

In response to a failed request by the Standley Lake Cities (SLC) to establish a phosphorus standard on Standley Lake at the 1989 SPRMH, 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. The Agreement required the development of a management plan for Standley Lake and a monitoring plan to address nutrient loadings. The Agreement is included as Appendix A to this report.

The 1993 narrative standard for Upper South Platte, Big Dry Creek Segment 2, 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.*

Many water quality improvements have been made in the watershed since the 1993 Agreement was signed. Additionally, there now exists a rigorous, 14 year database. The SLC felt that the next logical step in the nutrient criteria development process would be to propose a site specific chlorophyll a standard for Standley Lake at the 2009 SPRHM. The Cities' rationale was based on the expectation that the WQCC would adopt nutrient standards in 2010 and that a site specific standard is preferable.

Monitoring Program Summaries

The monitoring program is divided into three geographically based sub-programs: Upper Clear Creek, Tributary Basin and Standley Lake. Detail regarding the monitoring program is included in the Monitoring Program section of this report. A monitoring location map is included at the end of the Executive Summary as Figure ES-4.

A total of 3,869 samples have been collected since 1994, resulting in more than 30,000 individual, analytical results. The rigorous quality assurance/quality control program ensures reliable and accurate analytical results. Refer to Appendix B for all sample data. The annual monitoring costs for the entire monitoring program are in excess of $190,000.

Stream Gages and Flow Summary

Stream flow information is required to determine nutrient loadings into Standley Lake. Gages are supported financially by the SLC, the Upper Clear Creek Watershed Association, the Clear Creek Watershed Foundation, the United States Geological Survey, the Federal Highway Authority, and the Colorado Department of Transportation. These agencies all recognize the importance of acquiring reliable flow data as a key component in assessing nutrient loading. The USGS gage in Golden (CLEGOLCO) is the gage closest to the diversion canal headgates to Standley Lake. The stream flows recorded at the USGS gage in Golden is used as the point for comparing stream flow patterns and trends (see Figure ES-1). The average annual stream flow at the USGS gage in Golden for the period 1994 through 2007 was 193 cfs. The average annual stream flow in 2008 was below this average at 182 cfs.

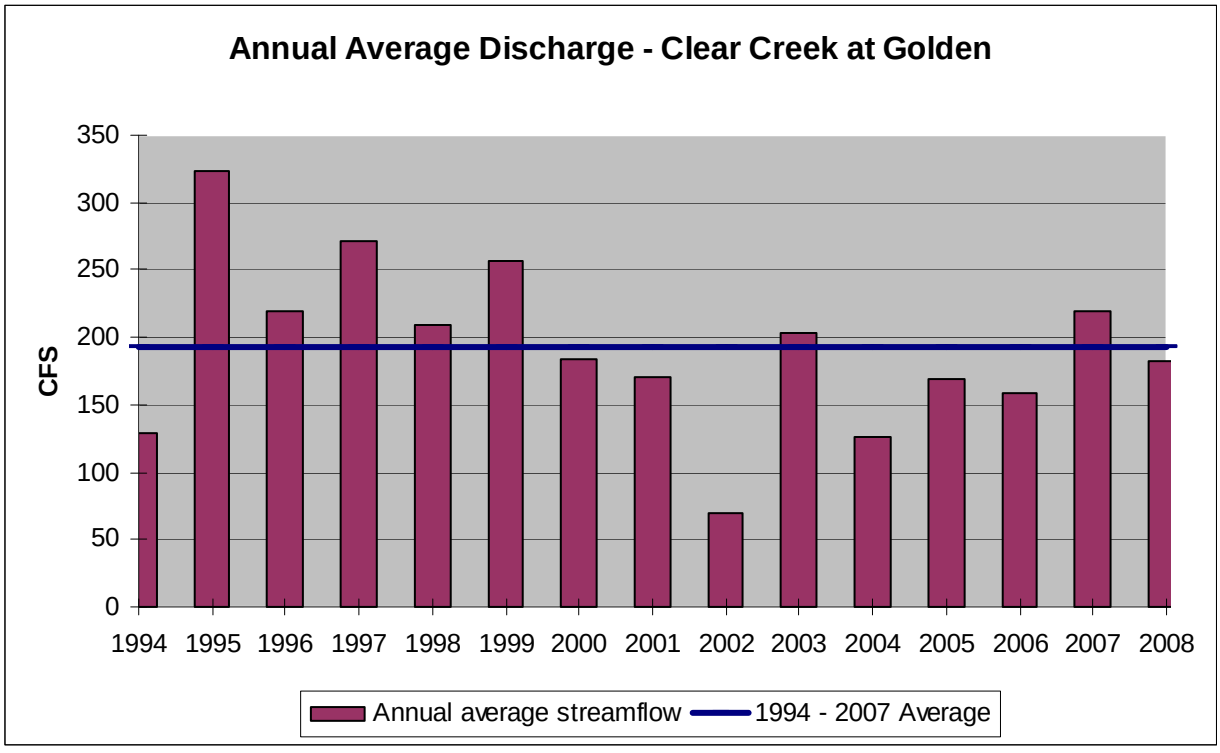

Figure ES-1. Average annual stream flow comparison – Clear Creek at Golden

Clear Creek Summary

In an effort to understand anthropogenic impacts on water quality and in support of the narrative standard on Standley Lake, nutrient data from grab samples at three key locations on the mainstem of Clear Creek were evaluated using trending analysis to compare 2008 results to the average results for the previous five years. The data is summarized in Table ES-1. The nutrient concentrations have decreased for all three locations except for dissolved phosphorus at CC40 – the midstream location.

Table ES-1. Comparison of 2008 Average to 2003-2007 Average

Parameter	Site Location					
	CC26 (upstream)		CC40 (midstream)		CC60 (downstream)	
	2008	2003 – 2007	2008	2003 – 2007	2008	2003 – 2007
Total Phosphorus (mg/L)	0.0096	0.0117	0.0151	0.0176	0.0159	0.0194
Dissolved Phosphorus (mg/L)	0.0018	0.0026	0.0059	0.0051	0.0038	0.0043
Total Nitrogen (mg/L)	0.48	0.49	0.44	0.48	0.42	0.53

In addition to grab samples, water quality in the Creek is also monitored 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 precipitation events as well as impacts from construction or other watershed activities. Four autosamplers have been installed since 2005 at strategic locations on the Mainstem and North Fork of Clear Creek.

During 2008, all of the in-stream monitoring and automated sampling sites were 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 CC26, CC49 and CC50 sites have presented numerous challenges since installation including inaccurate triggering for storm event sampling, fouling of analytical probes by environmental debris, and occasional instrument malfunctions. Gaps in the continuous data record resulted from these interruptions.

A data summary for the three year period of record of 48 hour ambient composite samples at CC59 is presented in the body of the report. Summary data for CC26, CC49 and CC50 are not presented in this report due to the short period of record and operational difficulties encountered.

Tributary Basin Summary

Three principal ditches deliver water to Standley Lake from Clear Creek. They are: Croke Canal (Croke), Farmers' Highline Canal (FHL) and Church Ditch (Church). The Kinnear Ditch Pipeline (KDPL) delivers water to Standley Lake from Coal Creek and/or the Boulder Diversion Ditch. Understanding the diversion seasons assists in the characterization of pollutant sources. For example, the FHL diversion season is April 14th through October 31st which includes a few weeks of winter flows which are predominately wastewater, spring runoff, and summer storm runoff.

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.

Table ES-2 characterizes nutrient loadings by source, the loading inflow for each ditch was divided by the number of 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.

Table ES-2. Pounds of nutrient loading per acre-foot of water diverted

Ditch	**Diversion Season**	**lbs/acre-ft diverted**			**% of Total 2008 Diversions**
		TP	**DRP**	**TN**	
FHL	4/14 to 10/31	0.07	<0.01	0.78	70%
Croke Canal	10/31 to 4/14	0.07	0.01	1.22	28%
Church	4/14 to 10/31	0.06	0.05	1.69	4%
KDPL	Year round	0.21	0.12	1.56	0.2%

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

Standley Lake Summary

Water quality monitoring of Standley Lake includes grab samples for parameters used in the assessment of the trophic status of the lake and a lake profiler that collects data on the lake from its surface to 5 feet off the bottom four times a day when deployed (ice off season). Lakewatch, proprietary software developed by Noel Burns, and Microsoft Excel software programs were used to evaluate Standley Lake data. The last five data years, 2004-2008, were used for all trending analysis. The trending results are summarized in Table ES-3.

The SLC believe it is important to note that dissolved oxygen (DO) is both an aquatic health and a drinking water concern. In evaluating DO for aquatic life, only data taken when the lake is isothermal is evaluated. For drinking water treatment, all data regardless of stratification status is evaluated as low DO results in nutrient and metal resuspension which has increased treatment costs and the potential for taste and odor events. The number of days of anoxia at the bottom of the lake is evaluated for both aquatic life and treatment implications. The average length of anoxia, DO <2 mg/L, for the 5 year period is 11 weeks, an increase from 8.85 weeks for the 1994 to 2000 period.

Table ES-3. Summary Table of Standley Lake Water Quality Data for 2004-2008*

Parameter	Significant Trend (Y/N)	If Yes, Annual Change	Comments
Chlorophyll a	N		Higher concentrations observed Oct – Feb
Secchi Depth	Y	↑ 0.1348 m/yr	Reservoir clarity is improving
TP	N		
TN	Y	↓ 6.334 µg/L/yr	
NO3	Y	↓ 3.504 µg/L/yr	
DRP	N		
DO	N		

* All data collected was utilized for assessing trends.

In support of the narrative standard, the trophic status of Standley Lake is evaluated using the Carlson method and Lakewatch software. 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. 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 the designated use or uses of the water. A summary table of trophic status by year is presented in the main body of text of this report. **Standley Lake remained mesotrophic in 2008.**

The nutrient loadings into Standley Lake are evaluated annually. Nutrient removal via pipeline withdrawals are calculated and subtracted from inflow loading yielding a net reservoir loading. Table ES-4 details the lake nutrient loads for the last five years.

Table ES-4. Standley Lake nutrient loads 2004 - 2008

Year	Total Phosphorus (lbs)			Dissolved Reactive Phosphorus (lbs)			Total Nitrogen (lbs)		
	Inflow Load	Outflow Load	Net Reservoir Loading	Inflow Load	Outflow Load	Net Reservoir Loading	Inflow Load	Outflow Load	Net Reservoir Loading
2004	3,902	1,146	2,756	632	611	21	39,784	26,115	13,669
2005	2,902	751	2,151	682	179	503	41,233	11,524	29,709
2006	4,461	2,121	2,340	1,241	883	358	43,399	30,448	12,951
2007	2,740	1,528	1,212	770	576	194	56,139	28,862	27,277
2008	2,848	1,632	1,216	670	578	92	37,254	27,435	9,819

* For calculation purposes, the method detection limit (MDL) concentration was substituted for non-detected concentrations less than the method detection limit. The loadings have been adjusted from previous published reports to reflect corrected flow calculations.

Lake data are also collected from a profile instrument. The profiler 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 also be downloaded manually. The aging profiler (RUSS) was replaced in 2008 with the YSI profiler. The instrument performs 4 profiles each day or one profile every 6 hours. The following parameters are measured: dissolved oxygen, pH, temperature, conductivity, chlorophyll a, and turbidity.

Data collected from the YSI profiler provided timely notification of two algae blooms in 2008. The smaller bloom in August evolved into the larger bloom in September. The chlorophyll a data collected from the YSI profiler is considered screening level data and the results are generally about 1 µg/L less than the analytical results achieved using standard laboratory procedures for quantifying chlorophyll a. The profiler data assisted water treatment operators in selecting appropriate treatment alternatives to reduce the algae impact on the drinking water. Figures ES-2 and ES-3 are isopleths generated from data collected by the YSI profiler detailing algae blooms and the seasonality of dissolved oxygen at the lake bottom throughout the year.

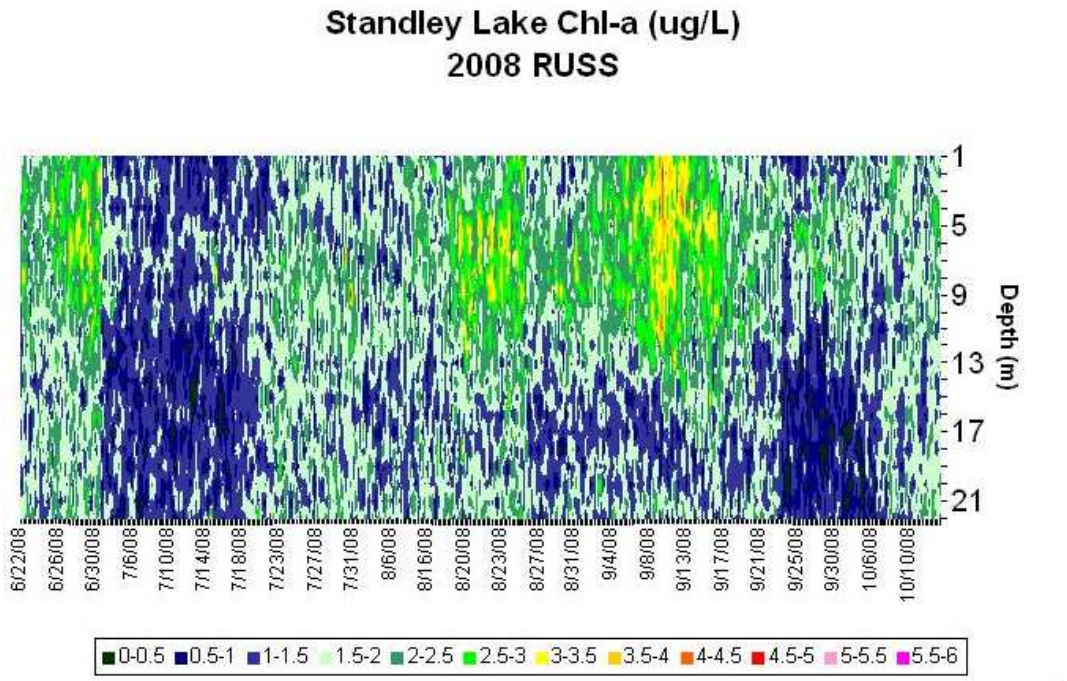

Figure ES-2. Depth integrated profile of Standley Lake for chlorophyll a.

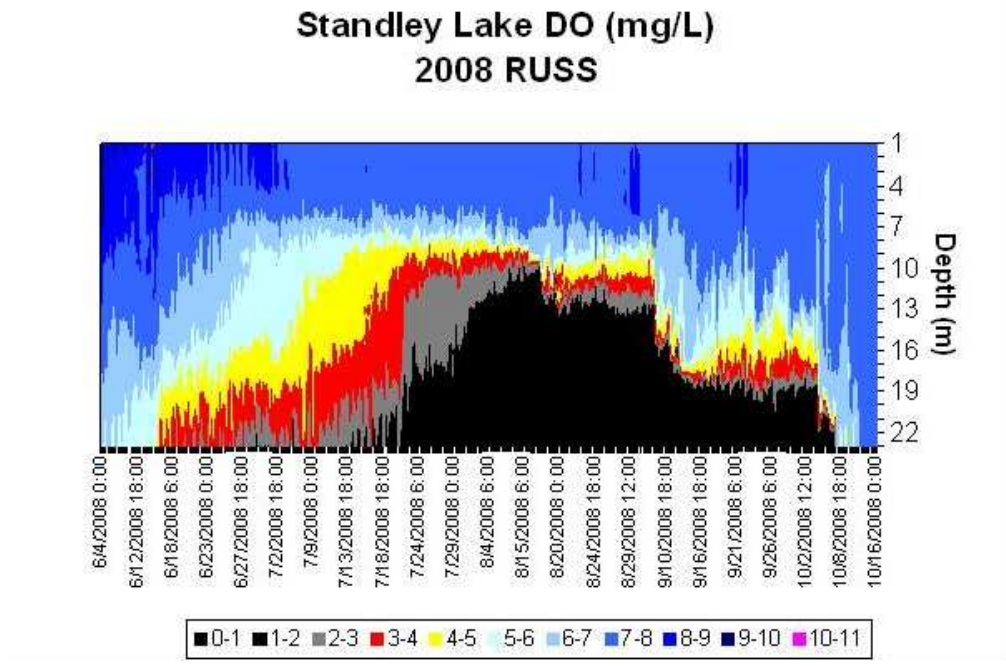

Figure ES-3. Seasonal Dissolved Oxygen in Standley Lake

UCCWA Summary

The Upper Clear Creek Watershed Association focused on two main areas in 2008 in addition to its ongoing activities as a 208 Management Agency which involves the reviewing and monitoring of plans and projects.

Work begun in 2007 toward a Countywide Wastewater Utility Plan and individual Wastewater Utility Plans for each of the ten dischargers in Clear Creek County neared completion. As of December 31, 2008, all the Wastewater Utility Plans had been accepted by the individual dischargers. Five were reviewed by UCCWA and forwarded to DRCOG for final approval; the remaining five were scheduled for UCCWA review in early 2009. The Wastewater Utility Plans are important for improving wastewater plant performance, effluent quality, and therefore Clear Creek water quality, especially regarding nutrient levels, over time.

UCCWA continued work with consultants in preparation for a Water Quality Control Division hearing to establish new underlying zinc standards and updated temporary modifications for several segments in Clear Creek and presented a proposal at the Water Quality Control Commission's December hearing. The revised zinc standard was tabled for reconsideration until spring 2009, but updated temporary modifications were adopted through 2014.

In its role as the 208 Management Agency for the Watershed, UCCWA reviewed six projects referred for comment. UCCWA membership voted to comment on three other matters that, while not officially referred for comment, were deemed of significance in the Watershed.

At the invitation of the Standley Lake Cities, UCCWA began participation in the Cities' Source Water Protection Project. An official UCCWA representative was designated, and other member entities also participate. The project final report is expected in 2009 with implementation of the best management practice to follow in 2010.

Tributary Basin and 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. The cities of Arvada, Northglenn, Thornton, Westminster and Golden have Phase II stormwater permits have adopted regulations providing for erosion control during construction, permanent BMP maintenance and prohibition of illicit discharges.

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. The Church Ditch project was completed in 2008 so that stormwater runoff from 3,996 acres of land in the tributary basin is diverted around Standley Lake. Construction of the new inflow structure was completed prior to the 2008 runoff season.

Standley Lake Cities Summary

The SLC accomplishments in 2008 were numerous and directed at protecting the water quality in Standley Lake from multiple perspectives:

- The continuous in-stream monitoring and autosampler composite sampling programs were expanded by the inclusion of instrumentation at the Tributary canal inlets to Standley Lake.
- The aging remote underwater sampling station (RUSS) on Standley Lake was replaced with a YSI profiler with the capability of adding two more daily depth integrated profiles, for a total of four daily profiles, at six hour intervals.

- The stakeholder process for development of a Source Water Protection Plan was initiated using grant funding from CDPHE. Significant progress was evident in 2008 in securing stakeholder participation and input.
- The SLC took a proactive approach to protection of Standley Lake from zebra mussel infestation as evidenced by the timely and rapid implementation of a boat inspection, quarantine, and washing program prior to the start of boating season in 2008. Multiple techniques were immediately employed to monitor for zebra mussel veligers.
- Watershed modeling activities were completed in 2008. The WARMF model is used to forecast inputs to the lake, and to identify the most relevant sources of nutrient loading in the watershed.

The SLC agree that the trophic status of the reservoir was mesotrophic in 2008; however, concern remains with the taste and odor events caused by winter algae blooms and the increasing number of weeks of lake anoxia. The Standley Lake Cities are encouraged by the advanced treatment compliance at the Black Hawk/Central City WWTF as well as reductions in nutrient loadings from the Idaho Springs WWTF and that the Town of Georgetown continues to address their WWTF issues.

Source Water Protection

In 2008, the SLC received a Source Water Protection Planning Grant from the Colorado Department of Public Health and Environment, Water Quality Control Division. The Plan's primary focus is the identification of nutrient sources in the watershed and development of best management practices to limit loadings to Clear Creek from both dispersed and discrete sources. The goals are to create a plan that connects and references existing water quality documents (i.e. Inter Governmental Agreements (IGA's), Agreements, lake and watershed modeling), identifies source water protection informational gaps, and addresses nutrient related water quality issues within the watershed through public and stakeholder involvement.

Afterward

Prior to completion of this report, a few significant events transpired in early 2009 that merit mentioning in this report. A site specific chlorophyll a standard for Standley Lake was adopted by the WQCC at the 2009 South Platte Basin Rulemaking Hearing while a slightly modified version of the narrative standard was retained. Also, the Town of Georgetown received more than $9 million dollars of ARRA and DOLA monies in 2009. The money will address both water and wastewater issues locally that will prove an overall benefit to the entire watershed.

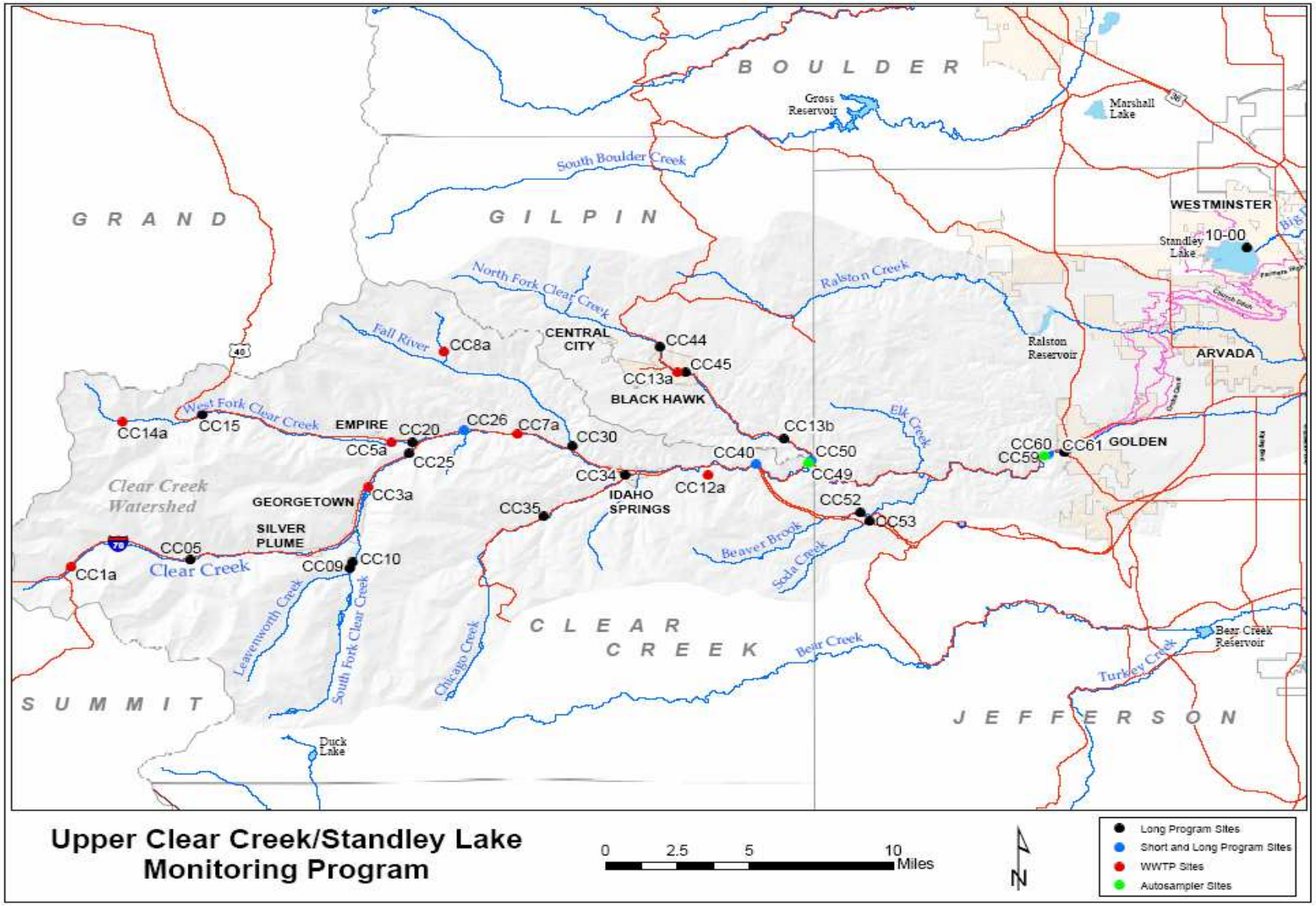

Figure ES-4. Watershed Map including monitoring locations

I. MONITORING PROGRAM

The Clear Creek Watershed Agreement (see Appendix A) directs creation of a jointly designed, implemented and funded monitoring program to evaluate nutrient loading from point and non-point sources in the watershed. The program is also designed to assess internal lake loadings and the effect of nutrient reduction measures implemented by various parties on the trophic status of Standley Lake.

The monitoring program is divided into three geographically based sub-programs, Clear Creek, Tributary Basin and Standley Lake. A monitoring location map is included as the last page in the Executive Summary. Table 1 summarizes the number of samples collected for each sub-program.

Table 1. Monitoring Events Summary – 1994 through 2008

Monitoring Program description	Number of sampling locations	Number of samples collected in 2008	Total number of samples collected 1994 – 2008
Creek (grab)	17	56	1368
Creek (wastewater plants)	9	46	776
Creek (autosamplers) *	4	60	133
Tributaries/ Canals	9	88	953
Lake *	4	64	639
Total	43	314	3869

* Creek autosampler data period of record 2005 -2008. Lake data period of record is 1999 – 2008.

The 3,869 samples have resulted in more than 30,000 individual analytical results. The monitoring program costs for 2008 were greater than $190,000. The Monitoring Committee has instituted a rigorous quality assurance/quality control program for analytical data generation and evaluation. It is safe to say that monitoring is the foundation of the Clear Creek Agreement. Refer to Appendix B for all sample data results.

Clear Creek Ambient Grab Program

Grab samples are single point-in-time samples collected in-stream and at wastewater treatment plant (WWTP) effluents throughout the watershed. Grab sample locations were selected to correspond with established USGS gage stations and additional sites have been included over the years as the monitoring program has evolved.

Grab samples are collected eight times during the year to correspond with seasonally varying flow conditions. The *Short Schedule* is collected six times per year and includes four stream locations and five wastewater treatment plant (WWTP) effluents. The *Long Schedule* is collected twice per year (May and October) and includes 26 locations - all 17 stream locations and all 9 WWTP effluents in the program. The *Long Schedule* captures the lower flows and increasing runoff flows each year.

Clear Creek Autosampler Program

In addition to grab samples, the creek is also sampled with autosamplers and monitored with 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. Four autosamplers have been installed since inception of the autosampler program in 2005. Table 2 summarizes the data collection history for the Clear Creek autosamplers. Geographically situated on the Mainstem and North Fork of Clear Creek, in an upstream to downstream configuration, these sites are identified as:

CC AS 26—On the mainstem of CC downstream of the confluence with the West Fork of CC (Lawson gage)
CC AS 49 – On the mainstem of CC upstream of the confluence with the North Fork of CC
CC AS 50 – North Fork of CC above confluence with the mainstem of CC
CC AS 59 – on the mainstem of CC approximately 100 yards upstream of the Church Ditch Headgate

Table 2. Clear Creek Autosampler History

Location	Data Period of Record	Number of Autosampler Monitoring Events			
		2005-2007		2008	
		Ambient	Event	Ambient	Event
CC AS 26	2008	0	*	6	*
CC AS 49	2006 – 2008	7	6	7	2
CC AS 50	2006 – 2008	8	*	7	*
CC AS 59	2005 – 2008	9	9	7	5

* Not applicable – this autosampler is not programmed to collect event samples.

The continuous in-stream monitoring probes provided continuous water quality data acquisition for turbidity, conductivity, pH, and stage height. Autosamplers were set to trigger a sampling event when water quality or flow parameters exceeded pre-determined limits, thus providing sample data associated with non-ambient conditions in Clear Creek.

The autosamplers at CC26, CC49 and CC50 sites have presented some challenges since installation including inaccurate triggering for storm event sampling, fouling of analytical probes by environmental debris and occasional instrument malfunctions. Gaps in the continuous data record resulted from these interruptions. Ambient autosampler data for CC59 are presented in the Monitoring Results section, but data for CC26, CC49 and CC50 are not presented due to the short period of record and the previously described difficulties.

Figure 1. Monitoring Station Installation

Tributary Basin program
Grab samples are collected on all the supply canals to Standley Lake on a monthly basis when the individual ditches are running. In addition, the Croke and Farmers' High Line canals are equipped with continuous in-stream monitoring probes and autosamplers. Lake loadings are calculated using the lake inlet data.

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 (two times the Secchi depth) 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 639 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 profiler. The profiler is placed on the lake when the ice has melted in the spring and is retrieved from the lake before the surface freezes. Analytical probes measure standard field parameters plus chlorophyll a, in a depth integrated manner four times daily. The profiler executed at least one full-column profile on 240 separate days in 2008.

Monitoring Results

Clear Creek Grab Sample Results

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 2008 were made against the previous five years of sample data at strategic locations on the Clear Creek mainstem. All of the data summarized in Table 3 were generated from grab samples taken over the hydrograph (8 times/year). Figures 2 through 7 provide nutrient data over the past five years.

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 3. Comparison of 2008 averages to 2003 through 2007 averages

Parameter	Site Location					
	CC26 (upstream)		CC40 (midstream)		CC60 (downstream)	
	2008	2003 – 2007	2008	2003 – 2007	2008	2003 – 2007
Total Phosphorus (mg/L)	0.0096	0.0117	0.0151	0.0176	0.0159	0.0194
Dissolved Phosphorus (mg/L)	0.0018	0.0026	0.0059	0.0051	0.0038	0.0043
Total Nitrogen (mg/L)	0.48	0.49	0.44	0.48	0.42	0.53

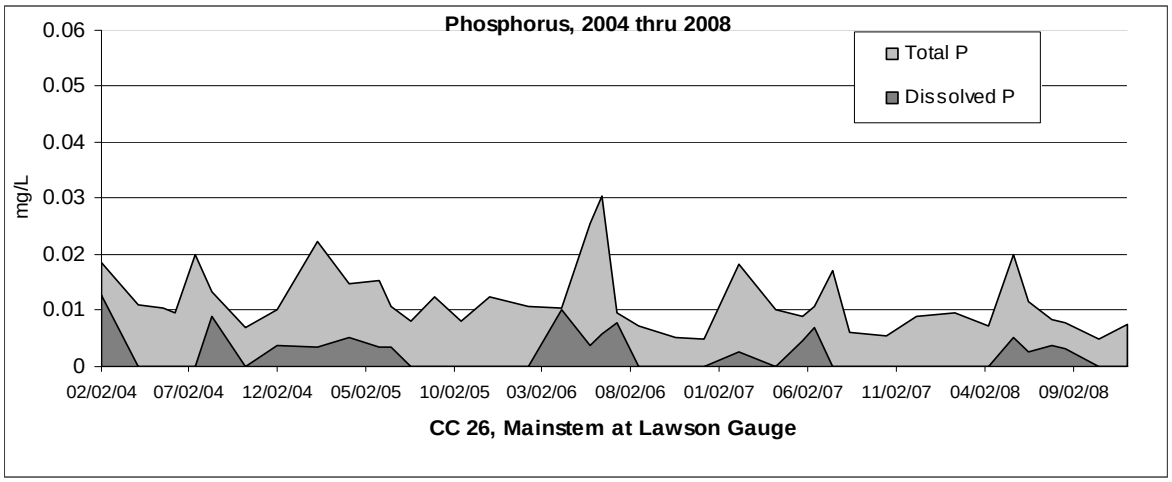

Figure 2. Phosphorus results for CC26 (upstream)

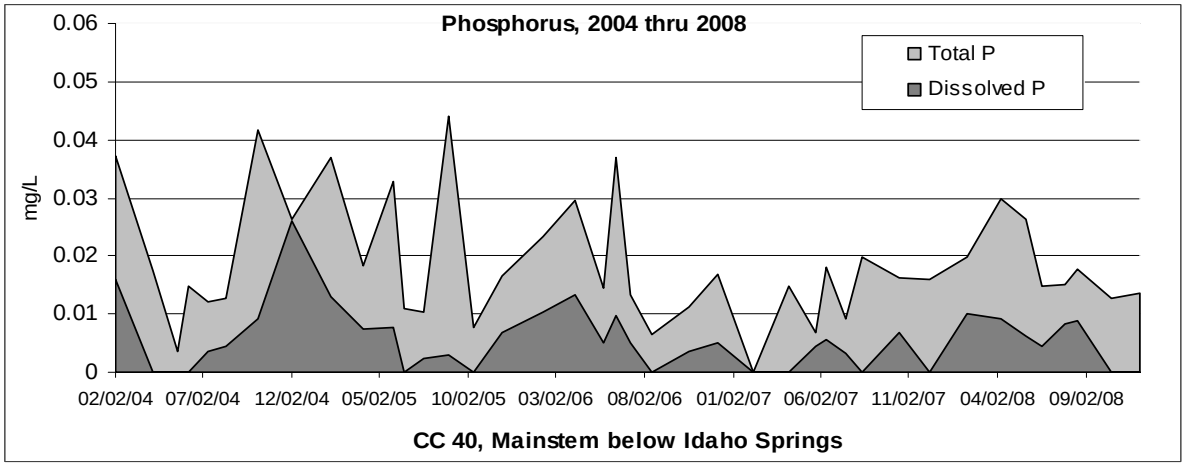

Figure 3. Phosphorus results for CC40 (midstream)

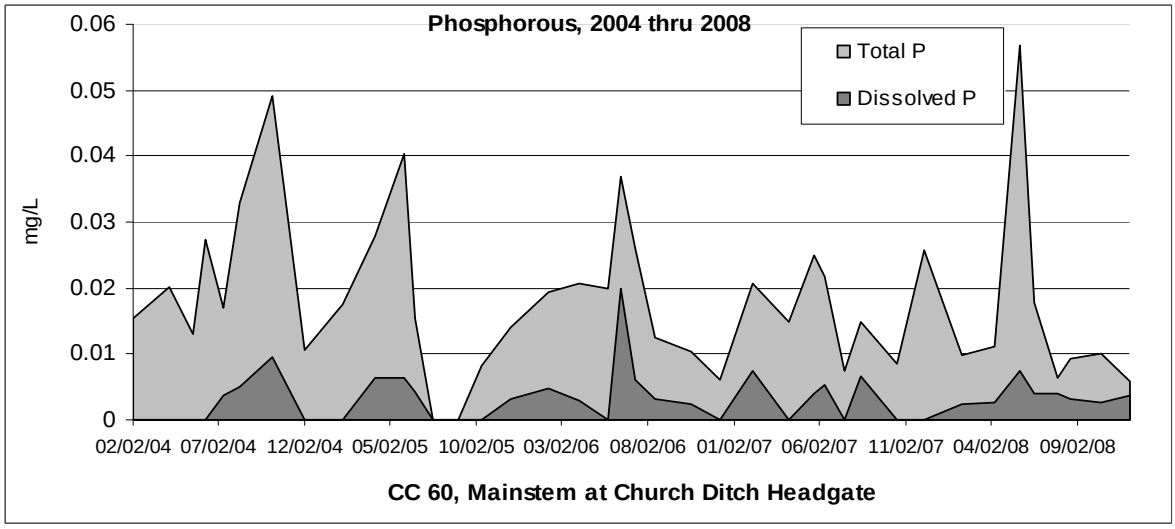

Figure 4. Phosphorus results for CC60 (downstream)

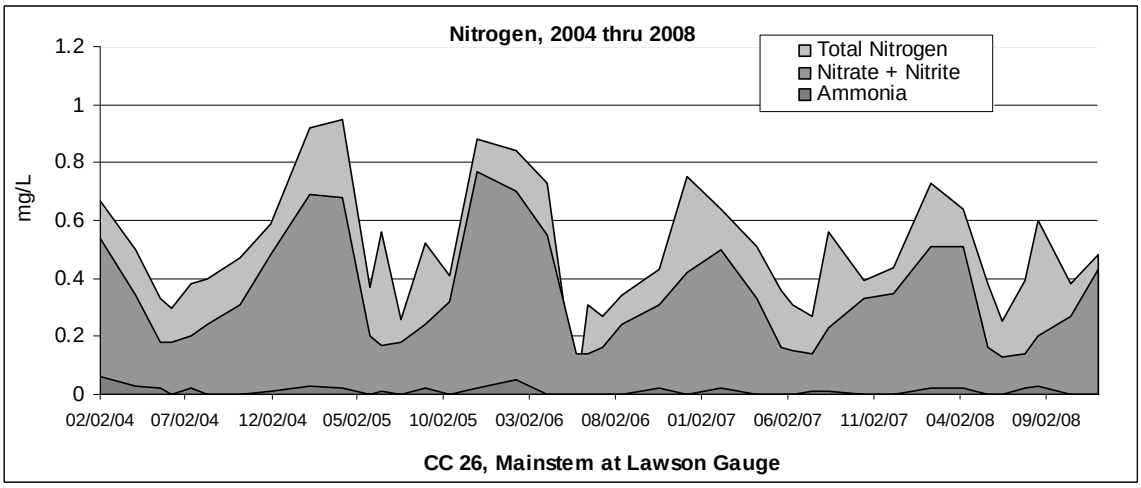

Figure 5. Nitrogen results for CC26 (upstream)

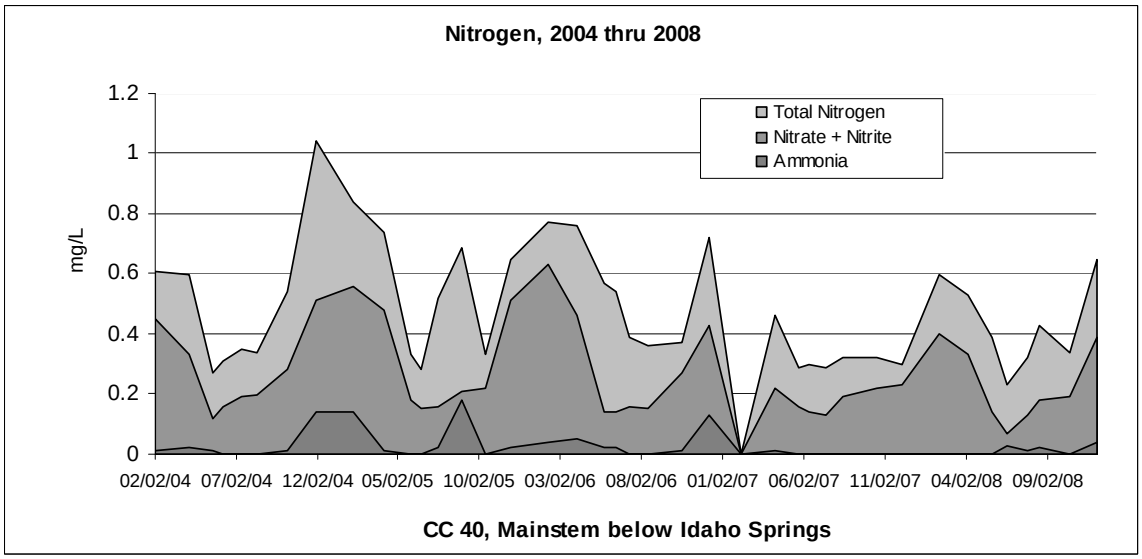

Figure 6. Nitrogen results for CC40 (midstream)

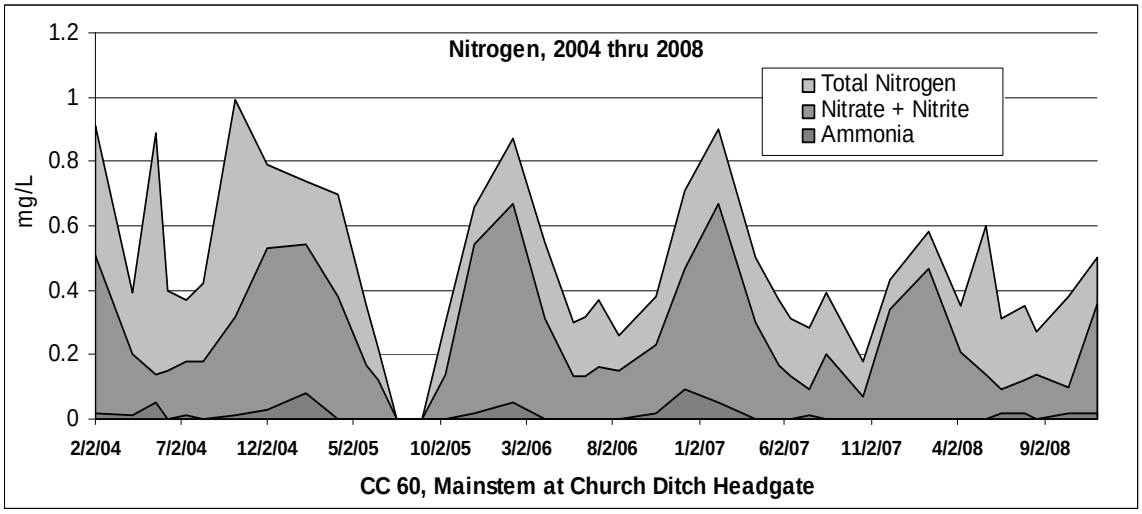

Figure 7. Nitrogen results for CC60 (downstream)

Clear Creek Autosampler Results

Autosamplers collect event triggered samples in addition to monthly composite samples. In-stream water quality monitoring and sampling capability at these sites allows for tracking of 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 2008 monitoring season, five distinct storm events in Clear Creek were successfully captured and recorded at CC59.

From April through October, two consecutive 24-hour composites were sampled and analyzed for nutrients, TSS/VSS, and metals. Continuous read 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 as these probes can withstand the cold temperatures and require less frequent calibration than the additional probes.

The autosampler network is maintained by the cities of Golden, Arvada and the SLC. CC AS 59, located immediately upstream of the Church Ditch Headgate in Golden, has been in use since 2005. CC AS 49 and CC AS 50, mainstem at Kermits, and N. Fork respectively, have been in use since 2006. The newest autosampler, CC AS 26, mainstem at Lawson, was installed in 2008. The following graphs (Figures 8 through 11) were generated using 2006 - 2008 ambient (nonevent) data at CC AS 59, the autosampler with the longest period of record. Scatter plots for total nitrogen and total phosphorus are presented with correlations to average daily discharge and total suspended solids. Daily average flow was taken from the USGS gage at Golden (CLEGOLCO). Trending of the data was not performed due to the limited period of record.

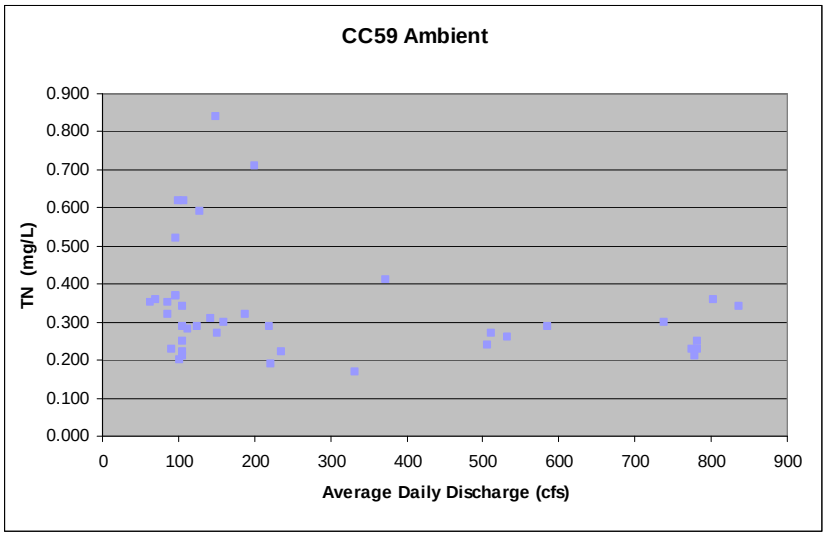

Figure 8. CC59 ambient data graph (2005-2008) - total nitrogen and average daily discharge

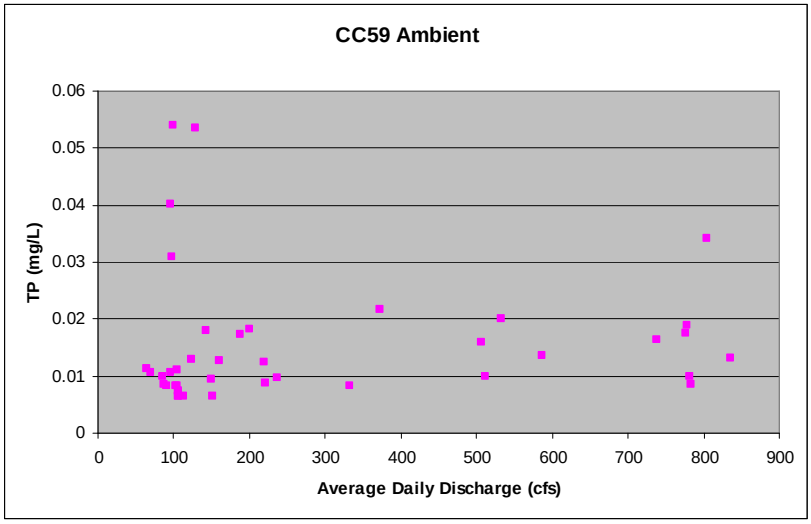

Figure 9. CC59 ambient data graph (2005-2008) - total phosphorus and average daily discharge

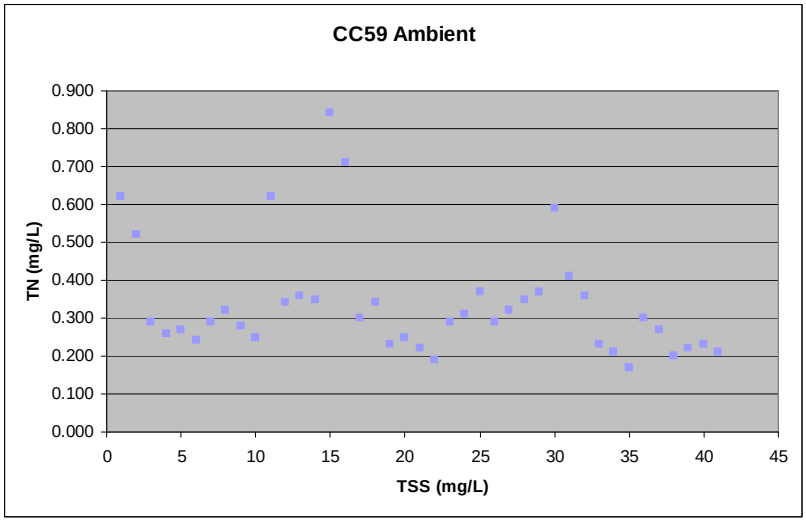

Figure 10. CC59 ambient data graph (2005-2008) - total nitrogen and total suspended solids

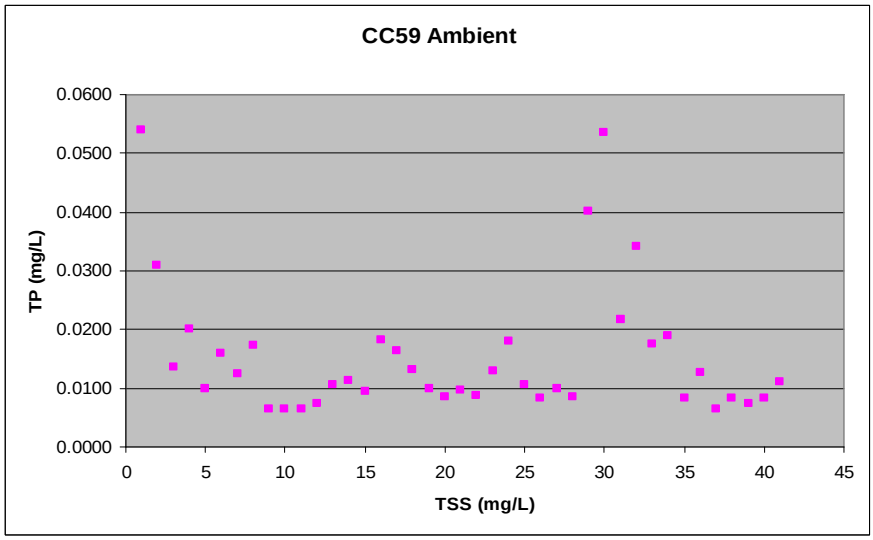

Figure 11. CC59 ambient data graph (2005-2008) - total phosphorus and total suspended solids

Tributary Basin Results

Three principal ditches deliver water to Standley Lake from Clear Creek. They are: Croke Canal (Croke), Farmers' Highline Canal (FHL) and Church Ditch (Church). Additionally, the Kinnear Ditch Pipeline (KDPL) delivers water to Standley Lake from Coal Creek and/or the Boulder Diversion Ditch. Understanding the diversion seasons assists in the characterization of pollutant sources. The diversion seasons are detailed in Table 4. 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 when the ditch is in priority.

To characterize nutrient loadings by source, the loading inflow for each ditch was divided by the number of 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. Table 5 summarizes nutrient inflows by ditch for 2008.

Table 4. Pounds of nutrient loading per acre-foot of water diverted

Ditch	**Diversion Season**	**Factors affecting water quality**	**lbs/acre-ft diverted**			**% of Total 2008 Diversions**
			TP	**DRP**	**TN**	
FHL	4/14 to 10/31	Low flows comprised of wastewater. Higher flows are precipitation or spring runoff driven.	0.07	<0.01	0.78	70%
Croke Canal	10/31 to 4/14	Wastewater dominated.	0.07	0.01	1.22	28%
Church	4/14 to 10/31	Low flows comprised of wastewater. Higher flows include precipitation events and spring runoff.	0.06	0.05	1.69	4%
KDPL	Year round	On-site waste system (septic) and precipitation driven.	0.21	0.12	1.56	0.2%

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

Table 5. Total nutrient loadings by ditch/canal

Ditch	**Nutrient Loadings for 2008 (lbs)**		
	TP	**DRP**	**TN**
FHL	1,822	433	21,182
Croke Canal	768	146	13,396
Church	243	82	2,562
KDPL	15	9	114

Standley Lake Results

In support of the Standley Lake Management Plan, the SLC evaluate trends and trophic status using the Lakewatch computer software. Lakewatch was developed by Dr. Noel Burns, renowned limnologist. A table with the Carlson trophic status values follows in the Trophic Status section (see Table 7). For purposes of trend analysis, the last five years of data were used. All indicators were measured at Standley Lake site SL10, near the dam face. Westminster staff sampled Standley Lake from a boat on 19 dates in 2008.

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 (see Figures 13, 16 and 17). 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 2004 through 2008 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 (see Figures 12 and 14). All Lakewatch graphs were generated using grab sample data.

Chlorophyll a and Secchi Depth

Chlorophyll a is generally lower in the summer months, rising in the fall after turnover with continued increases through the winter.

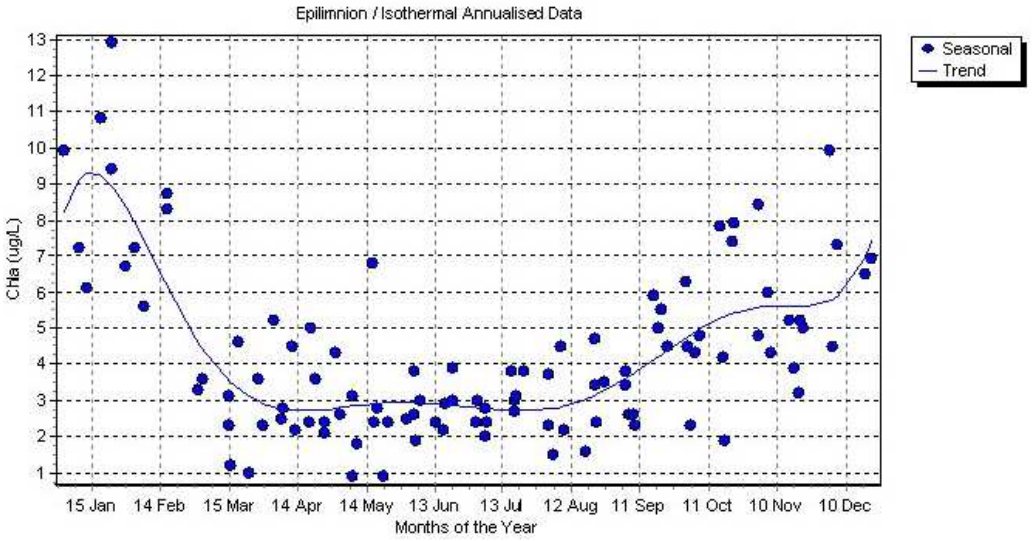

Figure 12. Seasonal chlorophyll a as measured in the lake photic zone (2x secchi depth).

The following two graphs were generated using the Lakewatch program. The first graph (Figure 14) is a regression. It shows that secchi depth is trending slightly upward (i.e. reservoir clarity is increasing). The trend is significant and the rate of change is 0.1348 meters/yr. Secchi depth is measured in the photic zone which is the depth to which light can penetrate. The second graph (Figure 15) shows seasonality; secchi depth gradually increases over the spring to summer months peaking in June and July followed by a gradual decrease. Figure 15 is a comparison of secchi depth and chlorophyll a over the most recent five years. In general, secchi depth decreases with increased chlorophyll a concentrations and visa versa.

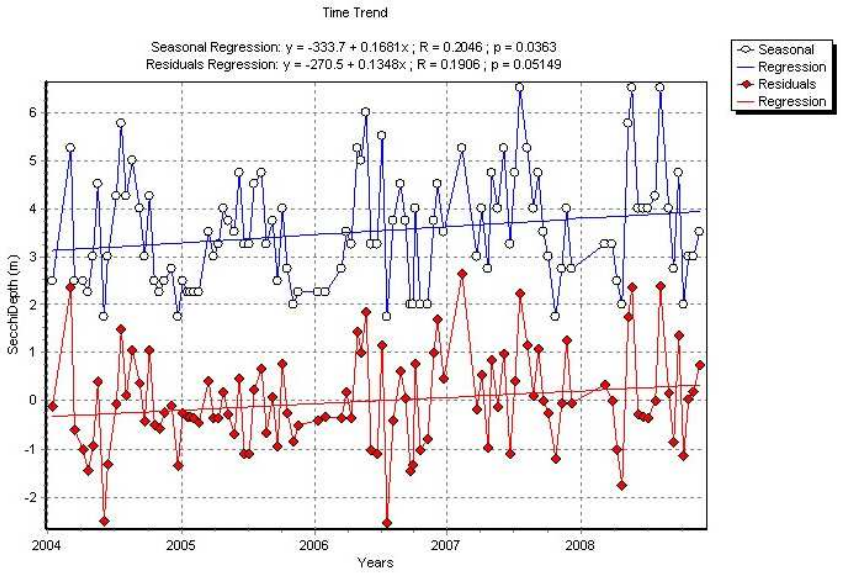

Figure 13. Secchi depth trend

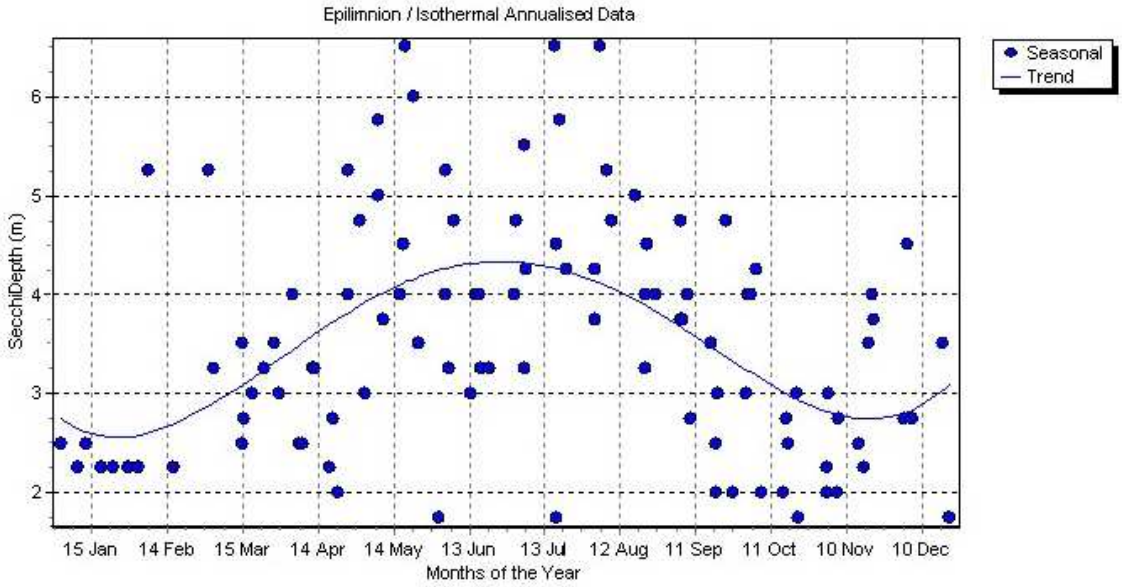

Figure 14. Seasonal Secchi depth

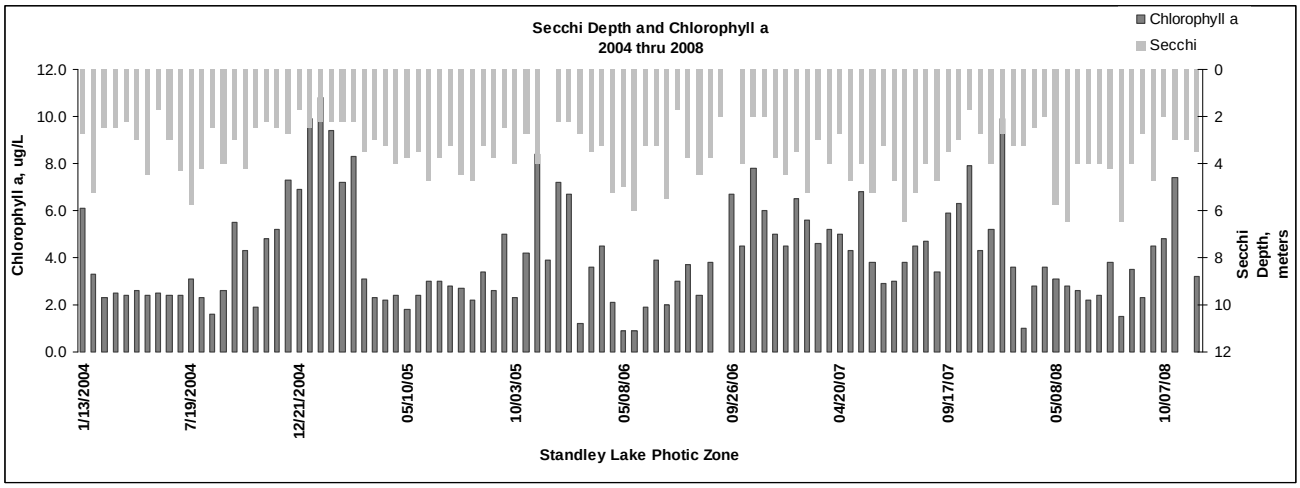

Figure 15. Comparison of Chlorophyll a and Secchi Depth.

Nutrients

Total phosphorus in Standley Lake is trending upward; however the trend is not significant. Refer to Figure 16. Total nitrogen (TN) is trending downward and the trend is significant with a rate of change is 6.334 ug/L/yr. Refer to Figure 17.

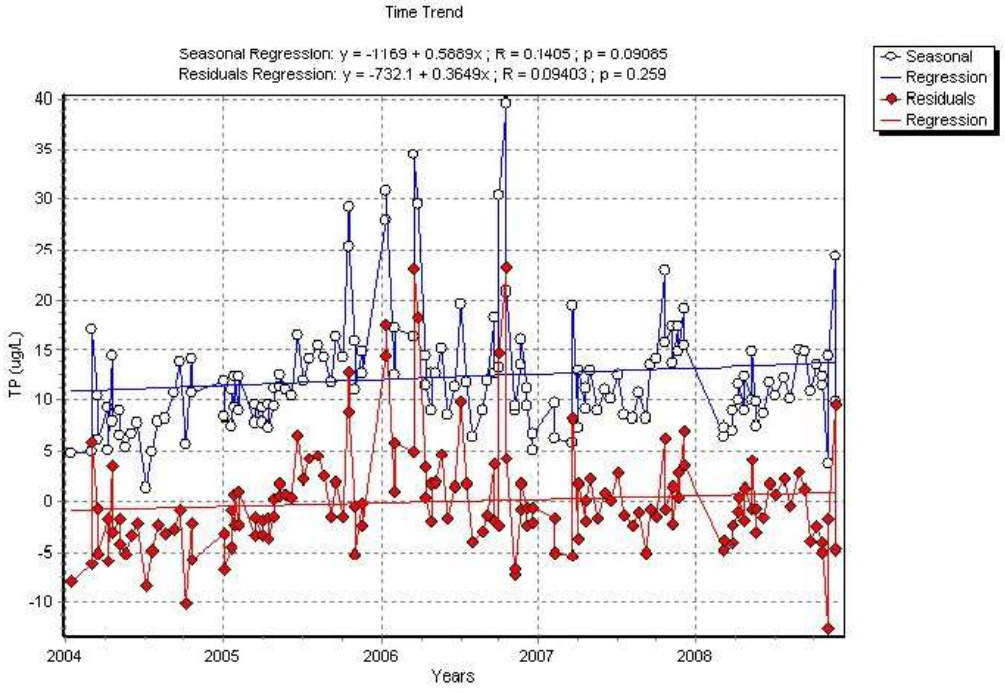

Figure 16. Total Phosphorus

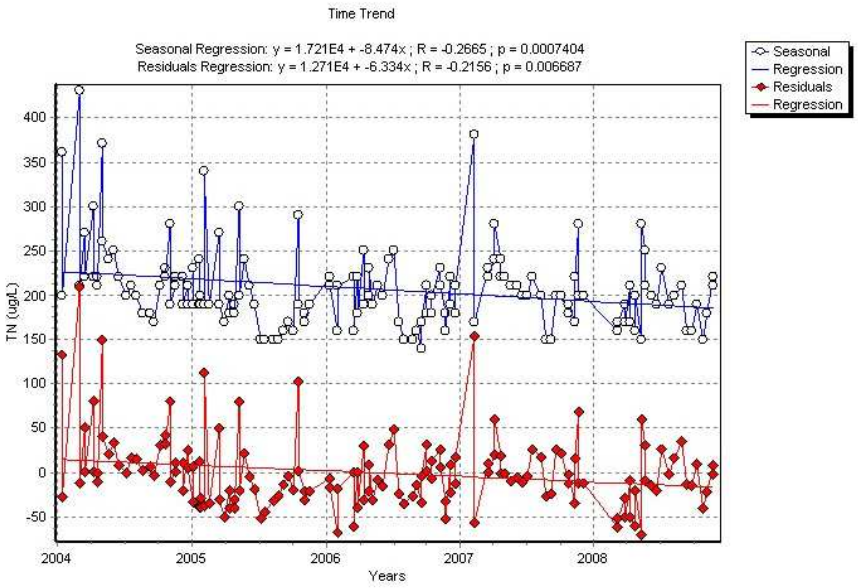

Figure 17. Total Nitrogen

Water quality trends for trophic status parameters on Standley Lake for the last five years are summarized in Table 6.

Table 6. Summary Table of Standley Lake Water Quality Data for the 2004-2008 period

Parameter	Significant Trend (Y/N)	If Yes, Annual Change	Comments
Chlorophyll a	N		Higher concentrations observed Oct – Feb
Secchi Depth	Y	↑ 0.1348 m/yr	The reservoir clarity is improving
TP	N		
TN	Y	↓ 6.334 µg/L/yr	
NO3	Y	↓ 3.504 µg/L/yr	
DRP	N		
DO	N		

Lake data is also collected from a profile instrument or remote underwater sampling station (RUSS). The profiler 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. The aging profiler (RUSS) was replaced in 2008 with the YSI profiler. The instrument performs 4 profiles each day or one profile every 6 hours. The following parameters are measured: dissolved oxygen, pH, temperature, conductivity, chlorophyll a, and turbidity. The YSI profiler was launched on May 30, 2008.

Figure 18. YSI profiler replaces RUSS on Standley Lake.

Data collected from the YSI profiler detail two algae blooms in 2008 – approximately August 22nd and September 8th (see Figure 19). The smaller bloom in August evolved into the larger bloom in September. The chlorophyll a data collected from the YSI profiler is considered screening level data and the results are generally about 1 µg/L less than the analytical results achieved using standard laboratory procedures for quantifying chlorophyll a

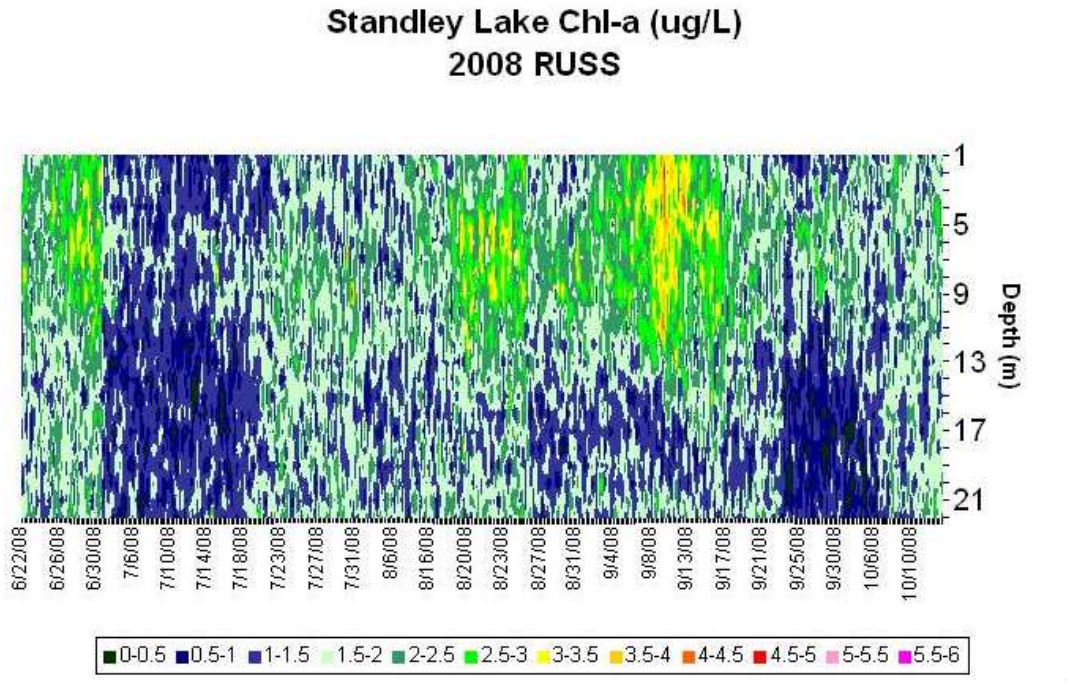

Figure 19. Depth integrated profile of Standley Lake for chlorophyll a.

Figure 20 reveals the strong seasonality demonstrated by dissolved oxygen with lower concentrations at the lake bottom during the summer months when the lake is stratified.

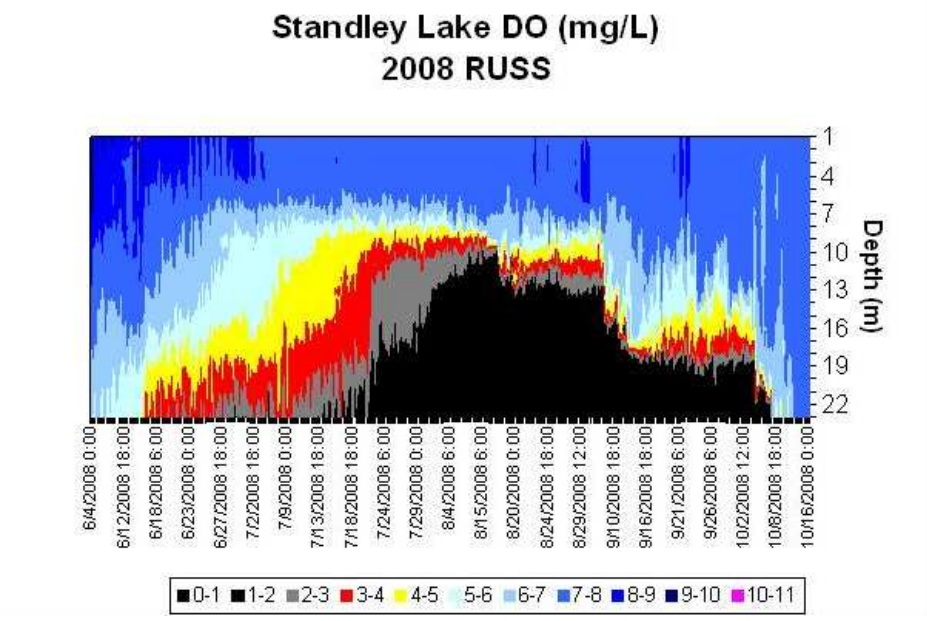

Figure 20. Seasonal Dissolved Oxygen

The duration of lake anoxia has increased over the last 14 years. The average period of anoxia during 1995 - 2000 was 63 days. The average period of anoxia during 2002 -2008 was 81 days. The 2001 drought year was not averaged into either time period. Figure 21 details the days of lake anoxia for 2005 – 2008.

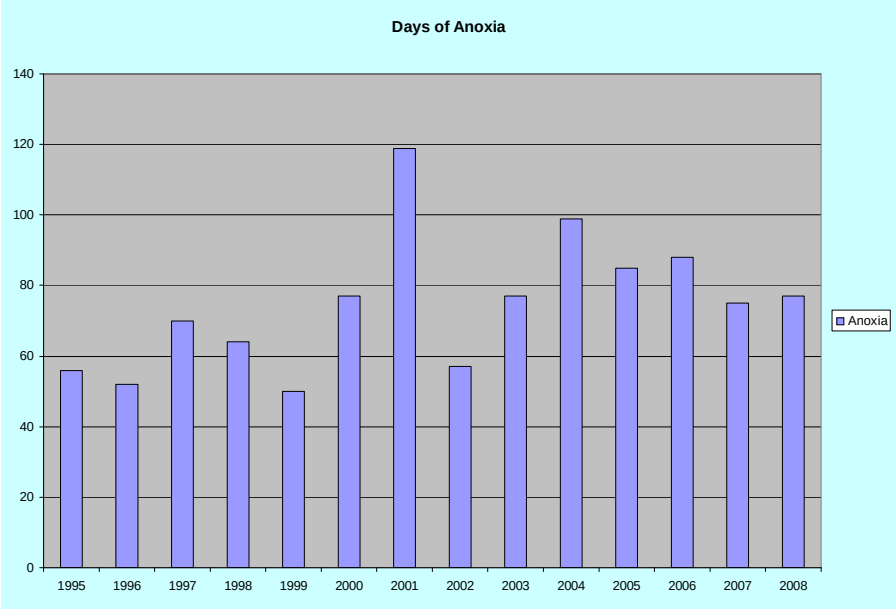

Figure 21. Days of lake anoxia

Loadings and Trophic Index

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

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 designated 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 7 is a summary of the trophic status by year. The middle columns in the table convert 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. 2008 showed the lowest annual average TSI, 38.01, for the entire period of record, surpassing 2004.

Table 7. Carlson Trophic State Index Values and Trends

Period	Nutrient Averages					Trophic Index Value					Annual Trophic Status Index	
	chla (ug/L)	SD (m)	TP (ug/L)	TN (ug/L)		TSc	TSs	TSp	TSn		TSI avg	Std Error TS avg
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
Jan 2007-Dec 2007	5.11	3.96	17.53	267.89		46.60	40.17	45.45	35.44		41.92	2.57
Jan 2008-Dec 2008	3.24	3.84	11.04	190.37		42.14	40.60	38.79	30.51		38.01	2.59
Average	**4.16**	**3.56**	**12.01**	**206.40**		**44.42**	**41.77**	**39.69**	**31.64**		**39.38**	**1.18**

Utilizing the trophic indices, loadings, and other evaluated data, assists the SLC in developing management options to maintain Standley Lake in a mesotrophic state. The 2008 mass loadings for nutrients are summarized in Table 8. Figures 22 and 23 are graphs of the nutrient loads for the past five years.

Table 8. Standley Lake Mass Loading Summary, 1995 – 2008*

Year	Total Phosphorus (lbs)			Dissolved Reactive Phosphorus (lbs)			Nitrate + Nitrite as N (lbs)			Ammonia as N (lbs)			Total Nitrogen (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	Inflow Load	Outflow Load	Net Reservoir Loading
1995	8,166	2,611	5,555	1,201	773	427	35,473	27,865	7,608	5,168	2,413	2,755	NA	NA	NA
1996	4,283	1,834	2,448	793	666	127	26,550	18,416	8,135	3,322	4,339	(1,017)	49,674	43,672	6,002
1997	6,177	1,934	4,243	1,202	381	820	33,188	16,493	16,695	4,077	4,058	20	62,478	35,472	27,006
1998	10,304	1,761	8,543	978	2,191	(1,213)	39,148	20,598	18,551	3,377	3,188	189	69,037	40,175	28,862
1999	8,179	2,601	5,579	944	179	764	47,687	25,090	22,597	4,778	2,441	2,337	81,963	46,272	35,691
2000	3,604	1,749	1,855	650	674	(24)	13,865	6,625	7,240	1,405	1,188	217	31,598	22,604	8,994
2001	11,535	2,270	9,265	898	444	454	27,240	12,457	14,783	1,905	5,417	(3,512)	52,184	37,565	14,619
2002	1,827	1,629	198	395	485	(90)	14,605	4,562	10,043	1,160	2,156	(996)	29,381	20,223	9,158
2003	5,116	1,526	3,590	1,197	623	574	45,161	26,223	18,938	2,014	1,844	170	82,462	41,147	41,315
2004	3,902	1,146	2,756	632	611	21	21,283	10,799	10,484	1,144	2,039	(895)	39,784	26,115	13,669
2005	2,902	751	2,151	682	179	503	24,014	9,941	14,073	1,435	1,903	473	41,233	11,524	29,709
2006	4,461	2,121	2,340	1,241	883	358	21,597	11,037	10,560	1,571	2,484	(913)	43,399	30,448	12,951
2007	2,740	1,528	1,212	770	576	194	28,341	11,298	17,043	2,541	2,475	66	56,139	28,862	27,277
2008	2,848	1,632	1,216	670	578	92	18,459	9,409	9,050	1,142	2,729	(1,587)	37,254	27,435	9,819

Notes: Parentheses indicate a negative value. NA- Not Available. The loadings have been adjusted from previous published reports to reflect corrected flow calculations.
* For calculation purposes, the method detection limit (MDL) concentration was substituted for non-detected concentrations less than the method detection limit.

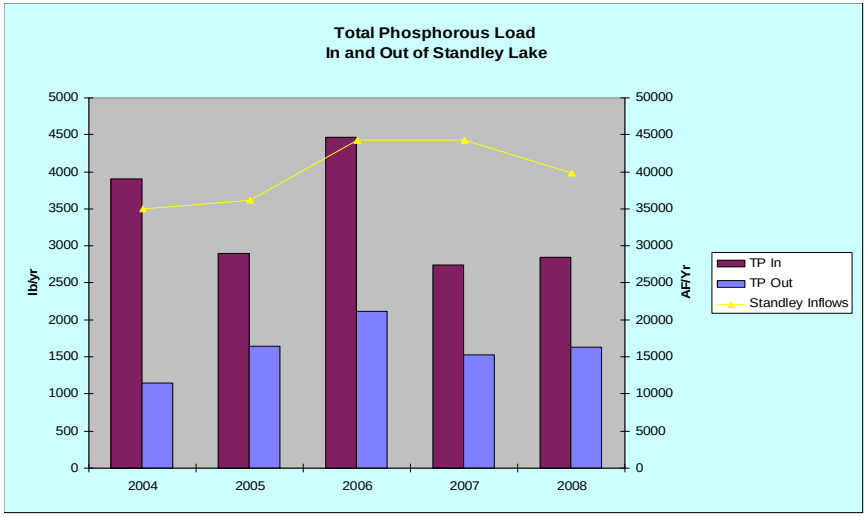

Figure 22. Total phosphorus load and inflow

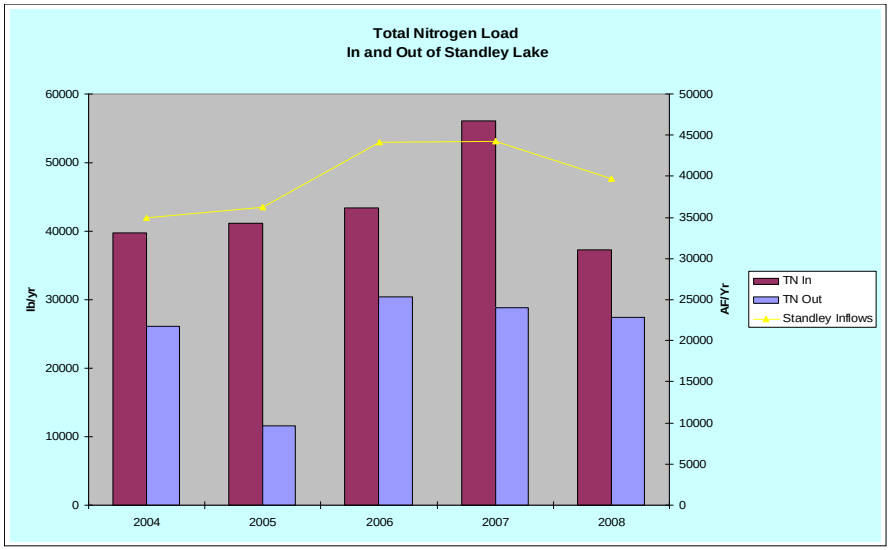

Figure 23. Total nitrogen load and inflow

Aquatic Nuisance Species

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 and it was positively identified in 2000.

Eurasian Watermilfoil Weevils were stocked in Standley Lake in 2002, 2004, 2005, and 2006. Weevils are used to control the growth of EWM. Weevils were stocked in 8 locations through out the west side of the reservoir. Adult weevils hibernate along the shoreline in the winter and migrate out to the milfoil plants in the spring. They lay their eggs on the top part of the stem and the larvae burrow into the plant, which causes it to fall out of the water column. The figures below show how the grazing weevils reduce the milfoil biomass through out the summer growing period. As the weevils graze and damage the milfoil, the height and densities decrease. Weevils will never get rid of milfoil completely, but they can control the density of the plants.

Figure 24. EWM beds in Standley Lake

Figure 25 depicts the 2008 average milfoil density for 2008 relative to the previous five years. Figure 26 documents three months of submerged aquatic vegetation bathymetric surveys completed on the west side of Standley Lake in 2008. Non-surveyed areas of the lake are depicted by dark grey shading. The milfoil has been the predominant vegetative species in the lake, but appeared to decline in July of 2008. Numerous native plants reappeared in Standley Lake.

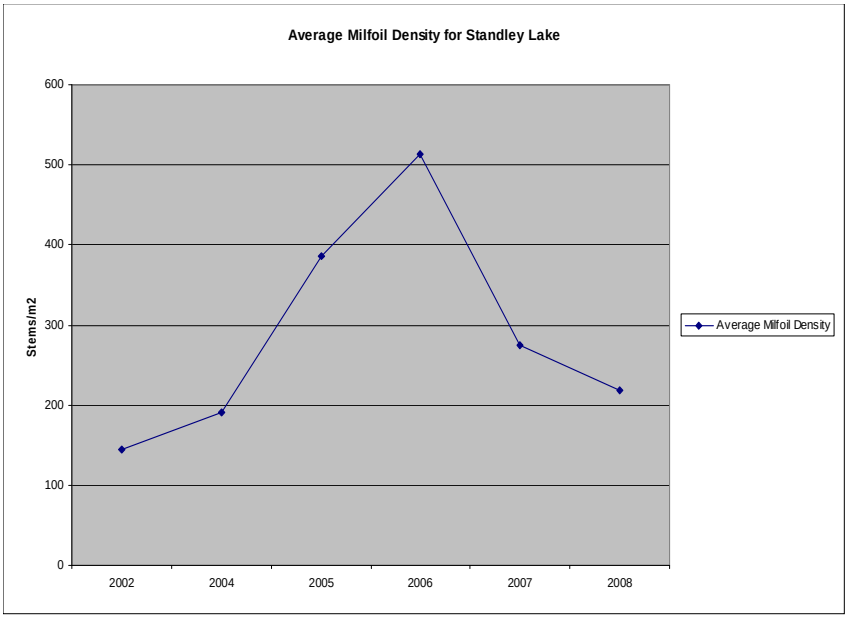

Figure 25. Standley Lake average EWM density for 2002 – 2008.

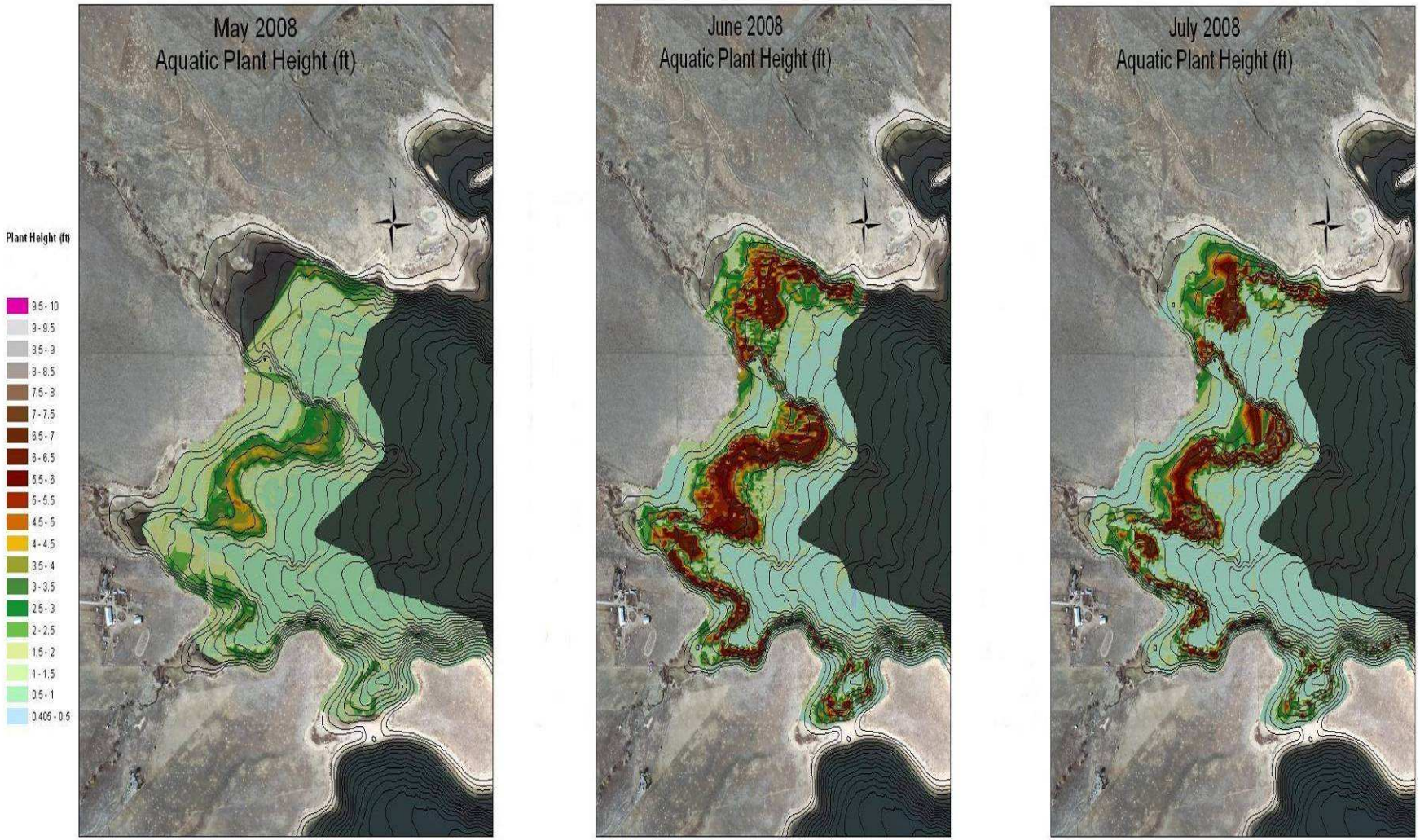

Figure 26. Submerged aquatic vegetation mapping of Standley Lake – May, June and July 2008

Zebra and Quagga Mussels

When zebra mussels were discovered in Lake Pueblo in 2008, quick action was needed by City of Westminster staff to develop a protection program for Standley Lake. By May 1st, the beginning of boating season, a zebra/quagga mussel prevention program was implemented that included a combination of inspecting, tagging and quarantining boats, spray washing stations, restrictions on aquatic bait, and an education program for the public and Standley Lake guests.

To date, no zebra or quagga mussels have been detected in Standley Lake. Monitoring methods initiated, or continued in 2008 include microscopic analysis, genetic analysis, shoreline surveys, and substrate samplers. Early detection efforts are important to best prepare operations staff of threats to the drinking water treatment infrastructure.

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 1995 – 2008 and that the trophic status of the reservoir did not change in 2008 based on commonly acceptable trophic parameters such as secchi depth, total phosphorus, and chlorophyll a.

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 take corrective action should it appear that water quality is deteriorating.

Watershed Activities

Modeling

A Clear Creek/Standley Lake Watershed Management Model (WMM) was originally prepared by Camp Dresser and McKee, Inc. in 1994. Several updates have been conducted since that time. The original model and subsequent updates predicted nutrient loadings to Standley Lake from upstream land use use coverage and pollution sources such as wastewater treatment plants. The original watershed model was limited in its ability to link with the Standley Lake Eutrophication Model. The Lake Model assesses the impact of nutrients and organic carbon on water quality in Standley Lake.

In 2008, the SLC started using the Watershed Analysis Risk Management Framework (WARMF) watershed model to predict inputs to the lake, and to identify the most relevant sources of nutrient loading in the watershed. The lake model predicts how the lake responds to those pollution inputs. The WARMF model provides all stakeholders with a better perspective on the relative impacts of various activities on Standley Lake water quality and helps with decision making on the most beneficial and cost effective watershed management activities. The new WARMF model incorporates relevant updated information from the old model.

WARMF includes a GIS-based watershed model that calculates daily runoff, shallow ground water flow, hydrology and water quality of a river basin. A river basin is divided into a network of land catchments (including canopy and soil layers), stream segments, and lake layers for hydrologic and water quality

simulations. Land surface is characterized by land use / land cover and precipitation is deposited on the land catchments to calculate snow and soil hydrology, and resulting surface runoff and groundwater accretion to river segments. Water is then routed from one river segment to the next, until watershed terminus is reached. Instead of using export coefficients, a complete mass balance is performed starting with atmospheric deposition and land application as boundary conditions. Pollutants are routed with water in throughfall, infiltration, soil adsorption, exfiltration, and overland flow. The sources of point and nonpoint loads are routed through the system with the mass so the source of nonpoint loading can be tracked back to land use and location. The algorithms of WARMF were derived from many well established codes such as ILWAS, SWMM, ANSWERS, and WASP.

Source Water Protection

In 2008, the SLC received a Source Water Protection Planning Grant from the Colorado Department of Public Health and Environment, Water Quality Control Division. The goals are to create a plan that connects and references existing water quality documents (i.e. Inter Governmental Agreements, Agreements, lake and watershed modeling), identify source water protection informational gaps, and addresses nutrient related water quality issues within the watershed through public and stakeholder involvement. The Plan's primary focus is the identification of nutrient sources in the watershed and development of best management practices to limit loadings to Clear Creek from both dispersed and discrete sources.

II. The Upper Clear Creek Watershed Association

The Upper Clear Creek Watershed Association focused on two main areas in 2008 in addition to its ongoing activities as a 208 Management Agency which involves the reviewing and monitoring of plans and projects.

Work begun in 2007 toward a Countywide Wastewater Utility Plan and individual Wastewater Utility Plans for each of the ten dischargers in Clear Creek County neared completion. As of December 31, 2008, all the Wastewater Utility Plans had been accepted by the individual dischargers. Five were reviewed by UCCWA and forwarded to DRCOG for final approval; the remaining five were scheduled for UCCWA review in early 2009. The Wastewater Utility Plans are important for improving wastewater plant performance, effluent quality, and therefore Clear Creek water quality, especially regarding nutrient levels, over time.

UCCWA continued work with consultants in preparation for a Water Quality Control Division hearing to establish new underlying zinc standards and updated temporary modifications for several segments in Clear Creek and presented a proposal at the Water Quality Control Commission's December hearing. The revised zinc standard was tabled for reconsideration until spring 2009, but updated temporary modifications were adopted through 2014.

In its role as the 208 Management Agency for the Watershed, UCCWA reviewed six projects referred for comment. UCCWA membership voted to comment on three other matters that, while not officially referred for comment, were deemed of significance in the Watershed.

At the invitation of the Standley Lake Cities, UCCWA began participation in the Cities' Source Water Protection Project. An official UCCWA representative was designated, and other member entities also participated. The project is expected to reach conclusion and final report in 2009.

City of Black Hawk

In 2008, the City of Black Hawk undertook the following water quality improvement projects:

- Completed construction of the Dory Hill Vortex Pretreatment Building and reactivation of the Historic Rock Tank for raw water storage. The City of Black Hawk currently operates a diatomaceous earth filtration water treatment plant and a raw water storage reservoir at its Dory Hill site. Raw water is supplied to the reservoir from wells and springs along 4-Mile Gulch through the Historic Mountain Supply Pipeline, and from North Clear Creek by pumping from the North Clear Creek infiltration gallery and pump station. Spring runoff flows and summer thunderstorm events create turbid water conditions that exceed the Dory Hill treatment plant capability. Raw water diversion was suspended whenever turbidity levels exceed treatment plant capability. Construction of the Pretreatment Building and reactivation of the Historic Tank has enabled raw water cleanup to levels suitable for treatment plant use during periods of turbid water conditions.
- Completed design and began construction of the one-million-gallon Silver Gulch Potable Water Storage Tank and connector mains with Project completion scheduled for October 2009: Commercial interests in Black Hawk are constructing facility expansions that will add more than 530 hotel rooms to the existing inventory when completed in October 2009. Weekend and holiday water demand typically exceeds diversion and treatment capacity for the potable water systems. Construction of the new water storage tank and connector mains will enable meeting expected weekend demand peaks while maintaining a consistent water diversion and treatment rate.
- Designed and constructed the 12-inch Miners Mesa Bypass Pipeline and Pressure Reducing Station Project: The bypass pipeline serves to replace a section of the water supply main that tended to entrap air and initiate a water hammer condition during high flow rates. The added

pressure reducing station splits a 130 psi pressure step between the new station and an existing pressure reducing station.

- Acquired a joint interest in Green Lake in liaison with Clear Creek County, along with a water delivery right by way of Vidler Tunnel to Leavenworth Creek: Green Lake will then receive water diverted from Leavenworth Creek and will provide up to 270 acre-feet of good quality high altitude raw water storage for use during low stream flow conditions in Clear Creek.
- Completed the final design for improvements at Green Lake and contracted with Jennison Construction Company for their construction, all in liaison with Clear Creek County: The improvements include repair of the inflow pipeline from Leavenworth Creek to Green Lake, construction of an outfall pipeline from Green Lake to South Clear Creek, minor repairs to the existing dam and construction of a pump station and control vault at Green Lake.
- Acquired the decommissioned Jerry B. Buckley Power Plant and three-acre site alongside Clear Creek at Georgetown Lake: Black Hawk intends to dismantle and salvage the power plant improvements and to eliminate the associated 40 cfs penstock flow potential. The 3-acre site will be sold after removal of the salvage items.

Black Hawk/Central City Sanitation District

The Black Hawk/Central City Sanitation District plant continues to meet all discharge permit limits. Average daily flows remained below 0.55 million gallons/day. As the result of an Intergovernmental Agreement, the plant incorporates full scale Biological Nutrient Removal (BNR) and filtration. It consistently removes nutrients to very low levels, even though there are no nutrient limits in its CDPS permit. During 2008 the plant experienced total phosphorus levels well below 0.3 mg/l.

City of Central

Central City continued the standard erosion control measures in 2008 on the Central City Parkway and throughout the City; including rock mitigation work, cleaning out storm drains; and, removing sand from gutters and on the shoulders from winter maintenance. Central City continues working with Black Hawk on projects of mutual benefit. The City cooperated with CDPHE on several projects in and adjacent to the City.

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 2008. CCCSD continues alum addition and controls sludge age to achieve biological nutrient removal. The CCCSD Board of Directors, managers and operations team are always working to improve plant efficiencies. Records are available for review at AAA.

Clear Creek County

In 2008 the Clear Creek County Environmental Health Department issued 33 Individual Sewage Disposal System (ISDS) permits (25 new, 8 repair) and conducted 190 inspections.

Wastewater Utility Plans (WUPs) developed in conjunction with the Clear Creek County Wastewater Alternatives Evaluation Report from 2007 continued to move through the UCCWA and DRCOG review and approval process. Ten plans were drafted for wastewater dischargers located in the Upper Clear Creek Basin area. The DOLA grant that funded the project, administered by the County, is expected to be closed out in 2009.

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 County uses an emergency call-down system. 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 2008, there were four launches from the Clear Creek Emergency Call-Down System:

- March 20 – Broken sewer line in Idaho Springs, approximately 20 gpm sewage spill into Clear Creek.
- May 13 – Possible contamination from vehicle in Clear Creek.
- July 14 – Vehicle in Urad Lake spilling approximately 20 gallons of gasoline and windshield washer fluid into lake.
- August 21 – Minimum of 50 gallons #2 diesel fuel spilled into Clear Creek.

Clear Creek High School

The Clear Creek High School is a Zenon (MBR) membrane filtration plant. It came on line in 2004 with management continuing to be provided by AAA Operations, Inc. Alum continues to be added for nutrient removal when needed. 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 2008. Records are available for review at AAA Operations, Inc.

Clear Creek Ski Corporation

Clear Creek Ski Corporation's most recent permit reduced the effluent limit of fecal coli form so a compliance schedule was included in the event new construction or modifications were required to achieve the limit. CCSC continues to meet the new limit with operational changes only. Records are available for review at AAA.

Clear Creek Watershed Foundation (CCWF)

In 2008, the CCWF's efforts continued to focus on projects identified in their "2007 Clear Creek Watershed Report: Exploring Watershed Sustainability". This report, funded by an EPA grant, identified threats to cleaner water and opportunities for sustainable management of natural resources. Discourse-based evaluations by watershed stakeholders quantified and prioritized overall threats and project/BMP opportunities/initiatives in the watershed to mitigate the threats and promote sustainable watershed management. CCWF continued to define and advance projects, partnerships, funding, and implementation strategies in the areas of:

Alternative Energy & Transportation

- Spearheaded the Distributed Renewable Energy Initiative (DREI) and Task Force, prepared the DREI Strategic Plan, supported Clear Creek County's Renewable Energy Initiative, testified at PUC hearing, organized and hosted the April Renewable Energy in Clear Creek County Planning Workshop.
- Ongoing involvement with the I-70 SWEEP process.

Water & Wastewater Manangement/Waste Stream Reduction

- Organized and co-hosted with CSM the Clear Creek Resource Recovery Forum in November to further explore the opportunities for Vertad/Vertreat wastewater treatment.
- Ongoing promotion of a county biosolids facility.

Orphan (Abandoned) Mine Remediation/Mineral Resources (Subsurface Rights & Uses)

- Collaborated with the USFS, Coors, and the National Forest Foundation for greenback cutthroat trout habitat creation at Jones Pass (this was add-on work to the 2006 Dr. Mine orphan mine remediation work).
- Ongoing long-term maintenance of the retaining wall at the Maude Monroe site (this $600K SEP project was in lieu of Iowa Tank Lines paying a fine).
- CCWF remediated the West Gold Orphan Mine Site under a $120,000 contract with USFS, with cost match from DRMS; work included drainage controls and removal of the unstable ore bin for display at the Idaho Springs Heritage Museum.
- Upper Trail Creek Orphan Mine Remediation 319 grant ($484K) — ongoing contract

negotiations, PIP/QAPP/SAP preparation, preliminary site characterization.
- Gilson Gulch Orphan Mine Remediation 319 grant ($425K) — ongoing contract negotiations, PIP/QAPP/SAP preparation, preliminary site characterization. Ongoing coordination with DRMS regarding Franklin Mine Bond Revocation/Remediation Project.
- EPA Targeted Watershed Grant ($744K) for remediation projects in Lower Trail Creek, North Empire/Lion's Creek and the Maude Monroe (contract finalized in October) — conducted site characterization, surveys, access/easement research, QAPP/SAP preparation, and water quality monitoring.
- Funded the 2008 Trace Metals Addendum.

Preservation and Promotion of Historic Mine Sites
- Ongoing promotion of Maude Monroe/Donna Juanita site as Living History Museum.
- Worked with HSIS on new mining history exhibit.

Natural Resource Management
- Conducted community outreach for Clear Creek County Community Wildfire Protection Plan, including comment form and April Public Meetings.
- Coordinated with USFS and Mill Creek property owners for wildfire mitigation planning.
- Ongoing discussions with Trout Unlimited and USFS concerning headwaters restoration projects.

Outreach/Education
- Throughout the year, CCWF continued its tradition of public education about watersheds and mining through attendance and presentations made at numerous professional conferences and meetings (including TWG Conference, Colorado Mining Association Conference, Colorado Watershed Assembly Conference); projects focused on elementary school education; public tours of the Clear Creek Watershed Exhibit; updating its website (www.clearcreekwater.org); and exhibits/booths at events such as the State Fair.
- Ongoing communication and meetings with Board of Directors and numerous other watershed stakeholders; and annual Public Hearing with Clear Creek County Board of County Commissioners.
- In the fall, CCWF was honored to be the recipient of the 2008 United States Forest Service Regional Forester Water Partner of the Year Award. CCWF President Ed Rapp attended the Rocky Mountain USFS Regional Forester Honor Awards Ceremony & Dinner to accept this prestigious award.
- CCWF also participated on the 150th Anniversary of the Colorado Gold Rush Planning Committee, including updating and re-printing the *Summer of Gold* student workbook.

Climax Molybdenum Company

Henderson Mine

In 2008, Henderson improved the Storm Water Management Plan by adding 2 new outfalls and several new BMPs. BMPs included a sediment basin by the mine entrance and a culvert to redirect storm water to a retention basin. The existing BMP were cleaned and repaired.

Urad Mine site

A meteorological station and new stream gauging station data loggers were installed at URAD.

Colorado Department of Transportation

In 2008, CDOT continued its Highway Stormwater Monitoring project along I-70. This includes data on snowmelt and runoff events. CDOT is working with stakeholders on the I-70 Corridor PEIS, using the Collaborative Effort (CE) approach. 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.

Since the final phase of construction on Berthoud Pass East (Hoop Creek) was completed in 2006, water quality monitoring continued in this basin. Three large sediment control basins were added during the final phase. Sediment removed from the east side of Berthoud Pass was placed on the mill tailings cap in Empire, which is now full. The cap was regraded in late fall of 2008, and will be reseeded. A new sand disposal site has been identified within CDOT right-of-way along the westbound on-ramp from Fall River to I-70. This area will allow for continued removal of traction sand from CDOT's roads and sediment basins. More chain up sites for trucks are being added to both east and west-bound sides of I-70. This supports the increased enforcement of Colorado chain laws, and should help to reduce truck accidents in winter months. Fewer truck accidents means fewer spills into Clear Creek.

Two sediment dams have been constructed on the north side of I-70 in an effort to capture off-site sediment before it enters highway drainage culverts. The dams are located at Huckle Gulch just west of Idaho Springs, and the other is located east of the west-bound exit ramp to Dumont.

The study of water exiting the Eisenhower-Johnson Memorial Tunnel was shut down in August 2008, both for seasonal and funding reasons. This effort tracks water quality and quantity at the inflow and outflow areas. Although the WWTP at the tunnel treats a much smaller amount of waste since the Homeland Security closed the restrooms to the public, flow levels indicate a large influx of groundwater to the wastewater treatment area. In lieu of keeping the tunnel restrooms open to the public, CDOT supports such facilities at the Georgetown and Silverthorne Visitor Centers.

Coors Brewing Company

Coors Brewing Company continues to fund stormwater efforts, water quality monitoring and habitat restoration funding throughout the Clear Creek watershed. In particular, Coors funded $30,000 to the Clear Creek Foundation and provided funding for the "Golden Mile" in Golden, a Trout Unlimited stream restoration project. In addition, Coors is involved with multiple committees to focus on sustainable and long-term programs to enhance the quality and sustainability of the Clear Creek watershed and ecosystem.

Town of Georgetown

2008 saw $250,000 I/I work completed on the collection system; resulting in a 21% flow reduction the first three months of 2009. Georgetown also participated with UCCWA to work on proposed TMDL's for metals on the affected segments of Clear Creek.
Georgetown did have the following violations in 2008: A 30 day average on ammonias for June, 2008; Hydraulic flow 30 day average over .58 MGD for June.

Frachetti Engineering was hired and completed a preliminary engineering study and up to 30% design for the new wastewater plant. The Town was involved in pilot testing a Koch membrane wastewater plant.

Gilpin County

Gilpin County continues programs that contribute to meeting the goals of the agreement, including requiring best management practices for erosion control, and enhanced individual sewage disposal systems in sensitive areas and areas with higher densities.

City of Golden

Water Quality/Pretreatment Program

- Section 13.13 of the Golden Municipal Code - Wastewater Pretreatment Requirements, was amended to include a general discharge prohibition for prescription drugs. Planning began in December to include a drug take back program to be included as part of the City's annual community recycle and clean up days scheduled in May of each year.
- The Pretreatment Program has completed the requirements for the sanitary sewer Inflow and Infiltration (I&I) study and mitigation program and has exceeded the requirements to reduce I&I contribution to the sanitary sewer as required by the City's CDPS permit. The 5 year evaluation

has demonstrated continuing progress in identifying and improving the wastewater collection system through utility replacement and other associated capital projects.
- In addition to Inflow and Infiltration mitigation activities, the Utilities Division has installed 5 sanitary sewer monitoring stations to evaluate real-time flows to the collection system.
- The Pretreatment Program issued 3 Mobile Power Washing permits in 2008.

Stormwater Program
- The Stormwater Program continues its public education campaign by distributing educational materials and attending public events.
- The City responded to 27 reports of discharges, or potential discharges, to the storm sewer system, issuing 10 written warnings, one summons and requiring one reimbursement for clean-up.
- The City administered 30 stormwater quality construction permits; conducted 895 erosion and sediment control inspections; issued 88 written notifications of violation, 270 verbal notifications of violation, withheld 3 permits, and used performance security for corrections at five sites.
- The Stormwater Maintenance Program conducted 186 inspections of permanent water quality BMPs and sent 139 letters requesting maintenance to land owners, with subsequent 100% compliance.
- The City conducted an erosion and sediment control training required for all contractors performing work under the Capital Projects program.

Watershed/Other Activities
- In 2008, the City contributed $7,903.00 to the Rooney Road Recycling Center.
- The City paid $3,591.00 in annual dues to the Upper Clear Creek Watershed Association and is an active participant in Association activities.
- The City's permanent monitoring and sampling station at CC59, successfully collected samples for 5 stormwater events during the 2008 season and a summary report is available from the City upon request. The CC59 sample site is part of the cooperative monitoring program between the upper and lower basin water users.

City of Idaho Springs

The City of Idaho Springs remains an active member of the Upper Clear Creek Watershed Association, DRCOG WQAC, and local issues including, TMDL, Watershed Protection, and Regional Bio-Solids committees. 2008 marked the third year of a revived commitment to water quality protection. Since 2006 Ramey Environmental Compliance has been the city's ORC, and operations, funding and staffing issues have been greatly improved. The entire water/wastewater staff is new to the city and has doubled since 2005. Six employees have passed thirty-four State Operator License Exams since 2006, and new operators received the CRWA "Rookie Operator of the Year" in 2007 and 2008. The City of Idaho Springs also took on the highly unpopular task of implementing a FOG compliance program in 2008, achieving 100% compliance by the end of the year. Phase two of a three-phase sewer upgrade project was completed in 2008, and phase three is in engineering stage for 2009 completion. When completed, this project will eliminate the majority of I&I, remove manholes from the banks of Clear Creek, and minimize the risks of SSO's in the problematic area. Due to delays in grant funding, upgrades planned for the WWTF in 2008 and 2009 are now in early design stage with aggressive time schedules. The planned improvements will concentrate on reliability and nutrient removal, and a possible switch from batch discharges and gaseous chlorine, to equalization and UV.

Jefferson County

Jefferson County 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. Jefferson County supports many stormwater management programs in

the watershed, including the Rooney Road Recycling Center, which also serves as watershed prevention BMP. 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.

Jefferson County Storm Water 2008 Activities and Actions
Illicit Discharge Verbal Notification of Violation – 4
Illicit Discharge Monetary Penalty/Fine – 1
Construction Sites Covered by Program – 742
Construction Inspections – 4,405
Enforcement Verbal Notification of Violation – 600
Post-Construction Inspections – 37
Storm drain marking program - Ongoing

Saddleback Metropolitan District

The 20 lots in Phase 1 of the 86 lot Saddleback residential development have been sold. Thirteen (13) homes have received a Certificate of Occupancy with five (5) more under construction. Well and ISDS monitoring are underway. Sampling continues at the three groundwater monitoring wells down-gradient of the subdivision, and no impacts have been seen to date. Road construction is nearing completion on Phase 2A (12 lots).

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 partially 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 reducing 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 2008. AAA continues to control sludge age for biological nutrient removal. The District has immediate plans to convert the Silver Lake 'spillway' into an underground culvert with functioning head gate, and review plans for a bar screen and grit removal system at our wastewater treatment plant. Records are available for review at AAA.

Town of Silver Plume

The Town of Silver Plume is keenly aware of Clear Creek flowing through its boundaries and takes action to ensure clean water. Among actions taken over the past year are such things as:

- Use of gravel for road maintenance to minimize the development of fine dust which eventually results in sediment.
- All road grading is performed to ensure no direct storm water runoff goes into the creek.
- The town's administrative board's action focused on ensuring no degradation of water quality.

Superfund (CDPHE/EPA) Remediation Projects

The Argo Tunnel Water Treatment plant continues to operate, treating an average of 250 gallons per minute from the Argo Tunnel, Big Five Mine adit and Virginia Canyon. The plant's operation prevents an average of 890 pounds per day of metals from entering Clear Creek.

CDPHE constructed most of the Phase II sediment control measures for the Nevada and Russell Gulches areas in 2008. Revegetation is being completed this spring. Phase I, constructed in 2007, included construction of two sediment dams in Nevada and Russell Gulches and erosion protection measures at various waste piles. Phase II included the State's acquisition of a portion of the Church Placer claim in Russell Gulch for future use as a mine waste repository, significant regrading and preparation of the Church Placer property, and capping and erosion control at the Pittsburgh and nearby waste piles. CDPHE transported CDOT rock and soil generated from a CDOT curve straightening project on State Highway (SH) 119 to the Pittsburg mine waste pile for capping mine wastes and to the repository site for use as cover material. Phase III, scheduled for construction in summer 2009, will provide erosion control for mine waste piles in Russell, Willis and Nevada Gulches not already remediated under Phase I or II. It also includes removal of certain waste piles into the on-site repository and covering the repository consolidation area. Four associated mine adits will be closed.

The Golden Gilpin Mill Site remedial action was completed in summer 2008.

On behalf of CDPHE and EPA, Colorado School of Mines (CSM) continued treatability testing of sulfate reducing bioreactors for the National Tunnel mine drainage and made recommendations for the preliminary design/layout of a full-scale system. CDPHE and EPA have been coordinating with CDOT in an effort to leverage the agencies' various interests along North Clear Creek on the SH 119 corridor. These interests will be formalized in an interagency agreement between CDPHE and CDOT, currently under development. CDPHE has identified the SH 119 right-of-way to be an ideal location to site a pipeline for conveying National Tunnel mine drainage to a downstream location for treatment, and CDOT has indicated a willingness to allow CDPHE to locate the National Tunnel pipeline and passive treatment system within the right-of-way during highway widening construction.

CDPHE and EPA continued to evaluate the Bates Hunter water treatment facility for treatment of the Gregory Incline and Gulch waters. Additional information on the relationship between the mine pool, groundwater and surface water was collected. CDPHE and EPA communicated with a Black Hawk landowner regarding a CDPHE/EPA request to drill into the Gregory Incline mine pool.
Construction of the Black Hawk Central City Sanitation District mitigation wetland was completed in 2007 as a teamed project with the Sanitation District and CDPHE/EPA splitting the cost of this project. The project provides flow-controlled wetland cells that polish North Clear Creek water. In 2008, minor readjustments of rocks in North Clear Creek channel were made. Following the 2008 growing season, the vegetation at the wetlands appears pretty well established. A CSM graduate student monitored the wetland cells over the summer and will continue this effort through 2009.

III. TRIBUTARY BASIN and CANAL COMPANIES

Tributary Basin Area

The Standley Lake watershed encompasses 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.

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 (see Figure 27). This effort prevents 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 was completed in 2008 (see Figure 28). The ditch will be enlarged to a capacity of 125cfs in phases as development occurs.

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.

Figure 27. Church Ditch bypass overview

Figure 28. Church Ditch inlet to Standley Lake

Ditch Inflows to Standley Lake

The Croke Canal, Church Ditch and Farmers' High Line Canal divert water from Clear Creek to Standley Lake. West Slope water via the Moffat Tunnel and water from Coal Creek are also diverted to Standley Lake through the Kinnear Ditch Pipe Line. Additional 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. These water delivery structures received routine maintenance in 2008. 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
- Stopping diversions into the canals in response to events that potentially impact water quality such as mine blow-outs, vehicle crashes, and other occurrences reported through the emergency call-down system
- Maintaining and cleaning canals to restore capacity,
- Placing the removed spoils below the canals' banks and grading slopes to drain away from the canals
- Requiring all development projects adjacent to the canals to install water quality BMP's designed to mitigate impacts caused by stormwater drainage entering the canals, and
- 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.

City of Arvada

Standley Lake receives the majority of its water from Clear Creek through three canals which pass through Arvada. Therefore, what Arvada does for surface water protection is important to the health of Standley Lake. The most dramatic surface water protection effort began in 1991 when a plan was developed to return runoff to the natural drainage ways. In 1990, there were almost 21,000 acres that drained into Standley Lake from the lands between Clear Creek and the lake. By the end of 2008 the final pieces were in the design phase that when completed will result in an 81% reduction in the number of acres draining into Standley Lake. Both Arvada and the Standley Lake Cities have cooperatively spent millions of dollars to achieve this reduction.

Arvada's Stormwater program has also enhanced surface water protection efforts. Improperly operated construction site can be the most significant source of sediment to the water ways. To ensure compliance with erosion and sediment control practices Arvada conducts construction site inspections approximately every two weeks. Enforcement action was taken for those sites not following standards resulting in good compliance for all sites.

The illicit discharge detection and elimination (IDDE) program is another source water protection program. The City of Arvada's IDDE Program efforts included inspection of stream outfalls, determination of sources of pollutant discharges to gutters or drains and their toxicity, funding cleanups of spills where the responsible party could not be determined, disposal of abandoned materials, and mapping the City's stormwater infrastructure. In 2008, 65 outfalls that drain into the canals were inspected to ensure there were no illicit connections. To help residents understand that putting waste down the storm drains or gutters pollutes our streams, the City sponsors storm drain marking events, and articles in a city wide newspaper, despite this effort seven spills were responded to in 2008 that could drain to the canals; no spilled substance made it into the canals.

Often canals and ditches are used as dumping rounds for yard waste which can degrade water quality. Over 80 houses that back up to the canals had information provided by means of door hanger about the proper disposal of yard waste and the negative impact to waterways for improper disposal.

All permanent water quality enhancement structures and devices, such as stormwater detention ponds, and proprietary devices to improve water quality in Arvada were inspected and all were functioning properly. Besides the inspections all owners were mailed information on proper maintenance. To ensure proper functioning of the storm sewer system and to reduce sediment from entering the water ways the City has an active storm drain inlet cleaning program.

Another source protection public education program is the City's pet waste control program. Signs are posted at parks that list the rules of the park, including the rule to clean up after your pet and pet waste bag dispensers are in most parks.

Being a water provider Arvada is keenly aware that treatment should not be a substitute for good source water quality, and Arvada's efforts have helped protect a good quality water source.

Appendix A

Clear Creek / Standley Lake

Watershed Agreement

AGREEMENT

The undersigned parties hereto agree as follows:

I. Preamble.

This Agreement seeks to address certain water quality issues and concerns within the Clear Creek Basin of Colorado, and specifically, such issues as they affect the water quality of Standley Reservoir, an agricultural and municipal water supply reservoir located in Jefferson County Colorado, which is supplied with water primarily from Clear Creek. For purposes of this Agreement, the Clear Creek Basin is divided into three (3) areas of segments: the Upper Clear Creek Basin ("Upper Basin"), consisting of Clear Creek and its tributaries from its source to and including the headgate of the Croke Canal in Golden, Colorado; the Standley Lake Tributary Basin ("Tributary Basin"), consisting of the lands directly tributary to Standley Lake, the Church Ditch, the Farmers High Line Canal, the Croke Canal, and lands directly tributary to these Canals; and Standley Lake ("Standley Lake"), consisting of the Lake itself.

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. The parties are: (1) UCCBA; (2) City of Golden; (3) City of Arvada; (4) Jefferson County; (5) Jefferson Center Metropolitan District; (6) City of Westminster; (7) City of Northglenn; (8) City of Thornton; (9) City of Idaho Springs; (10) Clear Creek County; (11) Gilpin County; (12) Black Hawk/Central City Sanitation District; (13) Town of Empire; (14) City of Black Hawk; (15) City of Central; (16) Town of Georgetown; (17) Town of Silverplume; (18) Central Clear Creek Sanitation District; (19) Alice/St. Mary's Metropolitan District; (20) Clear Creek Skiing Corporation; (21) Henderson Mine; (22) Coors Brewing Company; (23) Church Ditch Company; (24) Farmers High Line Canal and Reservoir Company; and (25) Farmers Reservoir and Irrigation Company. For purposes of this Agreement, the parties can be divided into four (4) functional groups, as follows: The Upper Basin Entities ("Upper Basin Users" or "UCCBA"), consisting of the members of the Upper Clear Creek Basin Association (generally representing entities with jurisdiction over land use and wastewater treatment activities in the Upper Basin that can affect water quality in the Upper Basin); the Tributary Basin Entities ("Tributary Basin Entities"), consisting of the Cities of Golden, Arvada, and Westminster, and the County of Jefferson and the Jefferson Center Metropolitan District (generally representing entities with jurisdiction over land use activities that can affect water quality in the Tributary Basin); the Standley Lake Cities ("Standley Lake Cities"), consisting of the Cities of Westminster, Northglenn, and Thornton, (representing the municipal water users from Standley Lake); and the three canal companies (the "Canal Companies"), consisting of the Church Ditch Company, the Farmers High Line Canal and Reservoir Company, and the Farmers Reservoir and Irrigation Company (representing the entities that own and operate canals through which water is conveyed to Standley Lake for municipal and agricultural use).

In accordance with the geographical and functional divisions, this Agreement generally

sets out rights and obligations with respect to certain water quality matters within the Clear Creek Basin (as above defined) by area or segment and by functional group.

II. Agreement.

1. The parties will submit a joint alternative proposal to the Water Quality Control Commission ("WQCC") in the matter captioned "For Consideration of Revisions to the Water Quality Classifications and Standards, Including Adoption of a Narrative Standard, for Segment 2, Standley Lake, of Big Dry Creek, in the South Platte Basin, and Adoption of a Standley Lake Control Regulation" on or before December 23, 1993. Said alternative proposal shall contain the following points:

a. Request the WQCC to adopt a narrative standard only for Standley Lake at this time, with further consideration of any control regulation or numeric criteria for implementation of the standard at or after the triennial review of the South Platte River to be held in 1997. The narrative standard shall require maintenance of Standley Lake in a mesotrophic state, as measured by a combination of relevant indicators, as recommended by the parties' consultants prior to December 23, 1993.

b. Request language in the Rule and in the Statement of Basis and Purpose for the regulation explaining that during the next triennium ending in 1997 ("triennium") the parties hereto will be conducting additional testing and monitoring, as well as implementing certain best management practices and controls on a voluntary basis, the results of which will be reported to the WQCC on an annual basis, and that point-source discharge permits written during the triennium shall not include any new or more stringent nutrient effluent limitations or wasteload allocations to meet the narrative standard. The proposed language will also refer to the intention of the parties and the Commission that should the narrative standard not be met at the end of the triennium, and substantial progress has not been made in reducing the nutrient loads to Standley Lake, additional measures may be required, including numeric standards or effluent limitations for phosphorous and/or nitrogen in the Upper Basin, and for additional best management controls in Standley Lake to be considered.

2. Should the WQCC fail to approve and adopt the substance of the proposed alternative described in paragraphs 1.a. and 1.b. above, this agreement shall automatically terminate and the parties shall be released from all other obligations and rights hereunder.

3. At or after the triennial review in 1997, the UCCBA and Standley Lake Cities agree that if substantial progress has not been made by the UCCBA in reducing its portion of nutrient loading and in developing controls to maintain appropriate reductions in nutrient loads to Standley Lake sufficient to maintain the narrative standard, they

will jointly petition the Commission to adopt a control regulation for Standley Lake containing the following points:

a. Total Phosphorous effluent limitation of 1.0 mg/l as P as a thirty (30) day average at the Upper Clear Creek Wastewater Treatment Plants, or such other numeric standard(s) or effluent limitations (s) for phosphorous or nitrogen, or in combination, with opportunity for point to point source and nonpoint source to point source trading among the entities that operate the UCCBA treatment plants, as has been determined will be effective in achieving and maintaining the narrative standard for Standley lake. Such numeric standard(s) or effluent limitation(s) shall be implemented over a three year period to allow time for the affected entities to fund, design and construct improvements necessary to meet the standards.

b. In-lake treatment to reduce internal phosphorous loading by 50% from the 1989-90 measured loadings in the 1993 USGS report by Mueller and Ruddy, or such other standards for reduction of internal phosphorous and nitrogen loading as has been determined will be effective in achieving and maintaining the narrative standard for Standley Lake, within three (3) years.

4. The UCCBA, in consultation with the Standley Lake Cities and Tributary Basin Entities will prepare a Best Management Practices Manual by December 31, 1994 for nonpoint sources that will cover disturbed areas of 1 acre or more and use its best efforts to have it approved and adopted for implementation by all jurisdictions within the Upper Basin by July 1, 1995. This Manual will be prepared to deal with the geologic, topographic and weather conditions existing within the Upper Basin to facilitate the reduction of nutrient loading from the various activities of the Upper Basin. This Manual will be coordinated with the Standley Lake Cities and Tributary Basin entities. The plan will include a program for monitoring representative results, to be included in the overall basin monitoring plan. For purposes of development of BMPs, Jeffco will not be considered to be part of the UCCBA.

5. The UCCBA, in consultation with the Standley Lake Cities and the Tributary Basin Entities, will examine the costs and effects of nutrient removal at UCCBA wastewater treatment plants, including operational controls or modifications which would decrease nutrient loads. Recommendations of such review shall be furnished to all the parties hereto by June 30, 1994. The UCCBA will use its best efforts to have its members implement operational modifications which can be implemented without significant capital improvements as quickly as reasonably practical.

6. The Standley Lake Cities, in consultation with the other parties, will develop a Standley Lake Management Plan by December 31, 1994 which will address in-lake nutrient loading and potential nutrient loading from lake activities, water supply operations, recreational activities, and activities in the watershed. The Standley Lake Cities will use their best efforts to implement the Lake Management Plan by

June, 1995. It is understood that the water rights implications of the plan must be considered.

7. The parties will jointly design, implement, and fund in such allocations as they shall agree a monitoring program to evaluate (1) nutrient loadings from point sources; (2) nutrient loadings from non-point sources in the Upper Basin; (3) nutrient loadings from non-point sources in the Tributary Basin; (4) internal Lake loading; and (5) the effect of nutrient reduction measures implemented by the various parties on the trophic status of Standley Lake. The results of the monitoring program will be provided to the Water Quality Control Commission for informational purposes annually. A description of the monitoring program will be included with the Annual Reports.

8. The Tributary Basin Entities and the Standley Lake Cities, in consultation with the other parties, will develop Best Management Practices (BMPs) for each of their jurisdictions by December 31, 1994, and shall use their best efforts to have them adopted as regulations by July, 1995. The BMPs will be designed to remove pollutants to the maximum extent practical considering the costs and benefits of possible measures; provided, however that no retro-fitting of existing construction or development will be required.

9. The Tributary Basin Entities, the Standley Lake Cities and the Canal Companies will develop a Management Plan for the Tributary Basin, addressing stormwater quality and quantity, hazardous substance spills, canal flushing, crossing permits, the Canal Companies' stormwater concerns, and the water rights implications of the above by December, 1994, and use their best efforts to achieve adoption of the portions of the Plan under the control of each entity by July, 1995. If not all affected parties adopt the agreed measures, then the parties that have adopted such measures will determine whether or not to implement the Plan despite such non-adoption by one or more parties.

10. Each functional group (The UCCBA, The Tributary Entities, The Standley Lake Cities, and the Canal Companies) shall provide each other group with semi-annual reports detailing the progress made on the implementation of its responsibilities herein, including development of any BMPs, nutrient reduction programs or controls, or other items required by this agreement, beginning in June, 1994. The parties shall also meet periodically after each report is completed to discuss progress by the parties. It is anticipated that the various functional groups may assign or appoint task groups or committees to address specific tasks or areas of concern (e.g. BMPs; ISDS; Wastewater Plant operational changes; monitoring, etc). If so, then the task groups shall provide the appropriate reports and participate in follow-up meetings.

11. This agreement may be enforced as a contract according to the laws of the State of Colorado; however, this agreement shall not create any right to claim or recover monetary damages for a breach thereof.

12. It is anticipated that other regional agencies with land use and/or water quality responsibilities or impacts within the Clear Creek Basin (as above defined) may join in the parties' monitoring and other efforts pursuant to this Agreement.

13. This Agreement may be executed in counterparts.