Clear Creek / Standley Lake Watershed Agreement

2015 Annual Report

September 9, 2016

Clear Creek Watershed Annual Report – 2015

September 9, 2016

Submitted to the Water Quality Control Commission by:

Black Hawk/Central City Sanitation District
Central Clear Creek Sanitation District
Church Ditch Water Authority
City of Arvada
City of Black Hawk
City of Golden
City of Idaho Springs
City of Northglenn
City of Thornton
City of Westminster
Clear Creek County
Clear Creek Skiing Corporation
Clear Creek Watershed Foundation
Climax Molybdenum Company/Henderson Operations
Colorado Department of Transportation
Farmers' High Line Canal and Reservoir Company
Farmers' Reservoir and Irrigation Company
Molson Coors Brewing Company
Gilpin County
Jefferson County
St. Mary's Glacier Water and Sanitation District
Town of Empire
Town of Georgetown
Town of Silver Plume
Upper Clear Creek Watershed Association

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List of Acronyms and Abbreviations

AF – Acre feet

AS - Autosampler

BHCCSD – Black Hawk / Central City Sanitation District

BMP – Best Management Practice

BNR – Biological Nutrient Removal

CC05 – Clear Creek Sampling Station: Clear Creek at Bakerville

CC26 – Clear Creek Sampling Station: Clear Creek at Lawson Gage

CC40 – Clear Creek Sampling Station: Clear Creek near the junction of US-6 and I-70

CC60 – Clear Creek Sampling Station: Clear Creek at Church Ditch Headgate

CCAS26 – Clear Creek Autosampler Station: Clear Creek at Lawson Gage

CCAS59 – Clear Creek Autosampler Station: Clear Creek 2 Miles West of Highway 58/US6 in Golden

CCWF – Clear Creek Watershed Foundation

CDOT – Colorado Department of Transportation

CDPHE – Colorado Department of Public Health and Environment

CFS –Cubic Feet per Second

Church – Church Ditch

Croke – Croke Canal

CSFS – Colorado State Forest Service

CWPP - Countywide Community Wildfire Protection Plan

CWPIP - Community Wildfire Protection Implementation Plan

CY –Cubic Yard

DE- Diatomaceous Earth

DNR – Colorado Department of Natural Resources

DO – Dissolved Oxygen

ESD – Equivalent Spherical Diameter

EWM – Eurasian watermilfoil

FEMA – Federal Emergency Management Agency

FHL – Farmers' High Line Canal

FRICO – Farmers' Reservoir and Irrigation Company

IGA - Intergovernmental Agreement

I-70 – U.S. Interstate 70

KDPL – Kinnear Ditch Pipeline

MGD – Millions of Gallons per Day

MS4 – Municipal Separate Storm Sewer System

N/A – Not Available

ORP – Oxidation/Reduction Potential

OWTS – Onsite Wastewater Treatment System

Reg. – Regulation

SL10 – Standley Lake Sampling Location Near Water Treatment Plant Intake

TIN – Total Inorganic Nitrogen

TN – Total Nitrogen

TP – Total Phosphorus

TSS – Total Suspended Solids

UCC – Upper Clear Creek

UCCWA – Upper Clear Creek Watershed Association

UDFCD – Urban Drainage and Flood Control District

USGS – United States Geological Survey

UV – Ultraviolet

WFPTF - Wildfire Protection Task Force

WRRG - Wildfire Risk Reduction Grant

WQCC – Water Quality Control Commission

WWTF – Wastewater Treatment Facility

Executive Summary

ES-1. Introduction

Standley Lake is an off-channel, municipal and agricultural reservoir located in Jefferson County. This 43,000 acre-foot reservoir is a direct-use drinking water supply for over 250,000 consumers in the downstream cities of Northglenn, Thornton and Westminster. The reservoir also provides water to farms located in Adams and Weld counties, as well as recreational opportunities. The Standley Lake watershed consists of 400 square miles of the upper Clear Creek watershed (the Upper Basin), small direct drainage areas to delivery canals (the Canal Zone), and the lake's relatively small direct watershed. Figure ES-1 shows Standley Lake, the Upper Basin, and the Canal Zone.

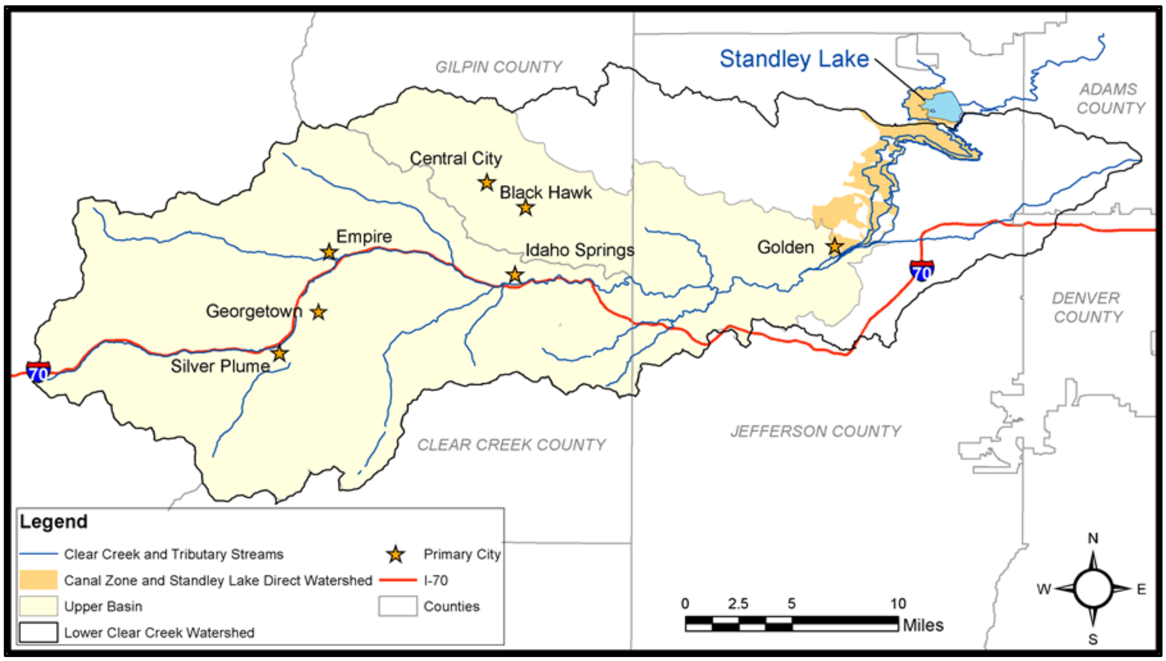


Figure ES-1. Standley Lake and Its Watershed

Water quality in the Upper Basin is affected by a variety of sources. The region contains nine wastewater treatment facilities (WWTFs) which serve the local population and resorts. Additionally, the Upper Basin contains operating and abandoned mines and receives water from trans-basin diversions. Water quality in the Upper Basin may also be impacted by nonpoint sources of pollution, including numerous onsite wastewater treatment systems (septic systems, OWTS), application of roadway deicers and traction sands, and residential and commercial stormwater runoff.

In 1993, the Clear Creek/Standley Lake Watershed Agreement (1993 Agreement) was signed to address certain water-quality issues and concerns within the Clear Creek watershed. The focus of the 1993 Agreement is water quality as it affects Standley Lake. In accordance with the annual reporting obligations set forth in the 1993 Agreement, this report presents an overview of monitoring, management, accomplishments and other activities protective of water quality. This information is supported by a summary of observed 2015 water quality in: WWTF effluent, Clear

Creek, the Canal Zone, and Standley Lake. This water-quality data is evaluated in the context of the previous five years of record.

ES-2. 2015 Monitoring Activities

Flow measurements and water-quality samples are collected in Standley Lake and at numerous stations throughout the watershed to monitor the concentrations and loading of nutrients, select metals, and other key constituents.

Upper Basin and Canal Zone monitoring for water quality includes the collection of grab samples and the use of autosamplers for the collection of composite samples. The monitoring program has a strong emphasis on the collection of composite samples instead of grab samples. In comparison to grab samples, the 24-hour composite ambient samples collected by autosamplers provide a better representation of average water quality on the date of sampling. In addition to collecting 24-hour ambient samples, the autosamplers are also used to collect event-triggered samples. Events samples are typically storm events. However, they also include first-flush samples collected in the Canal Zone during the initiation of water delivery to Standley Lake. Table ES-1 summarizes sample counts in 2015 by sample type and sub-region of the watershed.

Standley Lake is monitored throughout the year when ice is off the lake. Daily lake profiles are taken, and bi-monthly grab samples are also collected at three depths (at the surface, in the photic zone, and in the hypolimnion). Table ES-1 provides a summary of water-quality sampling in Standley Lake in 2015.

Table ES-1. Summary of 2015 Water-Quality Sample Collection

Sub-Region	Type of Sample	Number of Locations	Total Number of Samples Collected
Upper Basin	Grab Samples	17	43
	Ambient Composites	4	21
	Storm-triggered Composites	3	8
Canal Zone	Grab Samples	8	61
	Ambient Composites	2	14
	Storm-triggered Composites	2	8
	First Flush Composites	0	0
Standley Lake	Grab Samples	1 (3 depths)	54
	Vertical Profiles	1	Four Times Daily When Ice-Free, Every Meter

ES-3. 2015 Activities and Accomplishments

Efforts to manage, enhance, and protect water quality throughout the Clear Creek watershed and in Standley Lake continued in 2015. These activities were completed by a variety of groups and entities. The following groups of activities are described:

- Canal Maintenance;
- Wastewater Treatment Facilities;
- Illicit Discharges and Emergency Response;
- Nonpoint Source Control and Stormwater Management;
- Public Education, Outreach, and Partnerships; and
- Other Activities.

This section provides highlights of this work in 2015. This is not a complete list, and additional activities and details are presented in the main report.

Canal Maintenance

- Continued efforts to repair damage from the September 2013 flooding event continued in 2015.
- Routine operations protect the water quality of Standley Lake by diverting the first flush away from Standley Lake. Additionally, diversions are stopped, as appropriate, in response to occurrences reported through the emergency call-down system.
- Routine maintenance of the canals also protects the water quality of Standley. These activities reduce the risk of blockages, increase ditch capacity and decrease sedimentation by erosion.
- The Kinnear Ditch Pipeline was returned to operation for the first time since the flooding of September 2013.

Wastewater Treatment Facilities

- WWTFs continued to sample for, and report, nutrient concentrations in effluent to comply with the requirements of the Colorado Department of Public Health and Environment (CDPHE) Regulation 85 (issued in 2012).
- The City of Idaho Springs continued planning and engineering work to switch to ultraviolet (UV) disinfection. This will provide for greater operational safety relative to the current gaseous chlorine and sulfur dioxide system. Also in 2015, a new process control system was installed.
- Georgetown completed the construction and start-up of a biosolids facility. This facility has sufficient capacity to accept biosolids from other sources.

Illicit Discharges and Emergency Response

- The City of Golden responded to 34 reports of illicit discharges or potential discharges to the storm sewer system in 2015. This resulted in eight written warnings and 21 verbal warnings being issued. In addition, one fine was issued and in another case clean-up costs were charged.
- The City of Arvada issued 17 written Notices of Violation. Further, the City conducted clean-ups on seven spills with no identified responsible party.
- Jefferson County inspected 36 reports of illicit discharges.
- The Clear Creek Office of Emergency Management continued to maintain and update the Code Red Emergency Call-Down System to promptly and effectively notify downstream users of Clear Creek water of any potential contamination from an upstream source.
- The Call-Down system was launched 11 times in 2015.

Nonpoint Source Control and Stormwater Management

- The City of Golden administered 22 stormwater-quality construction permits and conducted 709 erosion and sediment control inspections.
- The Stormwater Maintenance Program of the City of Golden performed 288 inspections resulting in 194 letters sent to land owners requesting maintenance. In addition, the City's Stormwater Division inspects and cleans municipal inlets twice per year. Lastly, the Tucker Gulch sediment trap collected 28 truckloads of sediment in 2015 and has already proven to be more maintainable.
- The MS4 Program of Jefferson County conducted 2,782 inspections. These resulted in enforcement actions in 28 cases.
- The City of Arvada completed 1,556 erosion and sediment control inspections on 140 active construction sites.
- The Stormwater Program of the City of Arvada inspected 31 permanent BMPs in 2015. In addition, 21 new BMPs were added to the 173 previously installed.
- In 2015, Clear Creek County issued six permits for floodplain development and finalized four. In addition, 13 permits were issued for BMPs and five finalized. These actions are part of its efforts to control the release of sediment to Clear Creek.
- In 2015 Clear Creek County continued implementation of new regulations for OWTS adopted in 2014. Under the new regulations, two new types of OWTS permits are now required in Clear Creek County—Use Permits and Operating Permits. In 2015, 103 Use Permits were issued and 27 Operating Permits were issued, primarily for new construction.
- The Colorado Department of Transportation (CDOT) continued work on a number of projects in the watershed. These include: the completion of most phases of the I-70 Twin Tunnels, continued work on the Peak Period Shoulder Lane and completion of the Clear Creek Tributaries Sediment Control and Metal Removal project. All include improvements to sediment control and the minimization of impacts to Clear Creek.

Public Education, Outreach, and Partnerships

- The Clear Creek Watershed Foundation organized and hosted the seventh annual Clear Creek Watershed Festival in September 2015. Approximately 600 people attended the event held in central Idaho Springs. The event and creek-side venue provide the opportunity for watershed stakeholders to share their message and educate participants.
- On May 12, 2015, fourth and fifth graders converged to learn about a variety of Colorado water topics at the 2015 Youth Water Festival. Over 1,025 students, teachers and parents attended the event, which offered a day of fun and educational workshops featuring active learning and hands-on activities.
- In addition, Golden held another successful Public Works Academy in 2015. This 20-hour program educates citizens about the range of facilities and activities of the Public Works department. Golden also participated in the Osher Lifetime Learning Institute through the University of Denver.
- The City of Arvada hosted water-quality education booths at five festivals in and spoke one-on-one to attendees about issues concerning water quality.
- Clear Creek County operated three waste disposal programs in 2015. This included the year-round Transfer Station, a free-yard waste disposal event, and the Household Hazardous Waste Program.
- In addition, Clear Creek County participated in the Paint Care Program. This program has collected and disposed of eight Gaylord boxes (4’ by 4’ by 4’) of household paints and has saved the County and residents more than $7,200.
- The City of Arvada and Arvada Police collected 2,276 pounds of medications during a drug take-back event on April 11th.

Other Activities

- The Clear Creek County Wildfire Risk Mitigation and Preparedness Grant Program is a community-based cost share program that provides matching grants to eligible neighborhood, subdivision and community homeowner groups. These grants provided $30,000 towards the reduction of fire danger in in Clear Creek County.
- The Town of Georgetown completed a Source Water Protection Plan. The purpose of the plan is to prevent contamination of their drinking water supply.
- The Cities of Golden, Blackhawk and Georgetown performed maintenance and upgrades to the infrastructure for the supply and treatment of water.
- The monitoring and management of aquatic invasive species in Standley Lake continued. The densities of Eurasian Watermilfoil remained low in 2015. Sampling demonstrated that Standley Lake continues to be free of zebra and quagga mussels.

ES-4. 2015 Observed Flow and Water Quality

To assess 2015 conditions in Clear Creek and Standley Lake, flow and water-quality records were reviewed and compared to the previous five years of record (2010-2014). For Clear Creek and the canals, the water-quality analyses focused on total suspended solids (TSS), total nitrogen (TN), and total phosphorus (TP). For Standley Lake the assessment also included chlorophyll *a*, Secchi depth, and dissolved oxygen. In the Upper Clear Creek Basin, data analyses focused on results from two locations: the upstream location at Lawson (stations CCAS26/CC26); and near the downstream end of the Upper Basin at stations CCAS59/CC60, located near the canal diversion points to Standley Lake. Water-quality analyses of Standley Lake focused on results from sampling location SL10, near the deepest part of the lake. Highlights of findings from these analyses are presented below.

2015 Discharge

Annual hydrographs for Upper Basin location (CC26) exhibited a fairly typical pattern in 2015 (Figure ES-2). This pattern can be described as rising in early April and steeply increasing mid-May, coinciding with snowmelt runoff. The annual hydrograph at the lower location (CC60) followed the same basic pattern. In 2015 a period of rainfall from May through mid-June affected the Plains and lower foothills. At the lower location (CC60), this rainfall resulted in additional flows during the peak runoff period. Peak annual flow rates occurred in mid-June. The falling limb of the snowmelt hydrograph extended through the summer punctuated by occasional increases in streamflow associated with precipitation events. Total annual flows at the upper station (CC26) were slightly (8%) above the 2010-2014 average. For the lower location, the effects of the May-June rainfall in the lower basin are evident in the total annual flow volumes. Annual flows at the lower station were 44% higher than the 2010-2014. Compared to the longer-term record (1975-2014), flows in Clear Creek at CC60 were 52% above average.

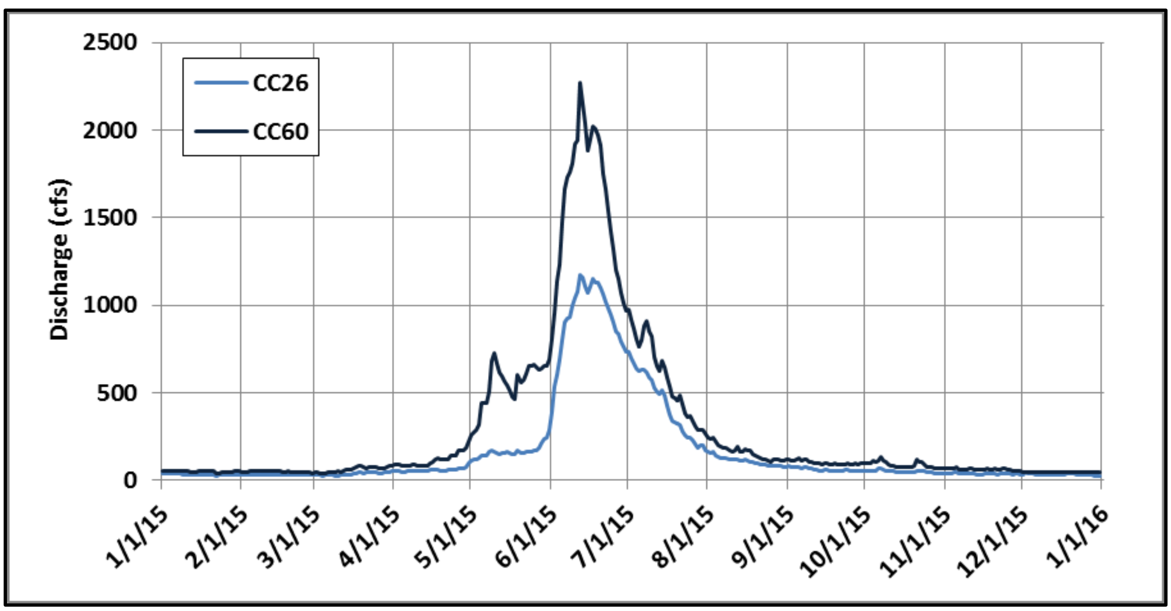


Figure ES-2. 2015 Clear Creek Hydrographs (CC26, CC60)

WWTF Effluent Concentrations

The WWTFs in the Clear Creek watershed continued efforts in 2015 to reduce nutrient discharges. In 2012, the Water Quality Control Commission (WQCC) adopted Regulation 85, the Nutrients Management Control Regulation, which established numeric standards for nutrient concentrations in WWTF effluent. WWTFs with a design capacity of less than or equal to 1.0 MGD, or WWTFs owned by a disadvantaged community are not required to meet the discharge limits set in the regulation. Of the nine WWTFs in the watershed, only Black Hawk/Central City (with a design hydraulic capacity of 2.0 MGD) is subject to Regulation 85.

A summary of 2015 TP and TN effluent data from the 7 WWTFs sampled in the watershed is presented in Table ES-2. This summary only includes facilities subject the sampling requirements of Regulation 85 (this excludes the Eisenhower Tunnel and Henderson Mine WWTFs).

Table ES-2. Summary of Total Phosphorus and Total Nitrogen Concentrations in Wastewater Treatment Facility Effluent in 2015 (Grab Samples)

Location	WWTF	Flow (MGD)	Total Phosphorus (mg/L)			Total Nitrogen (mg/L)		
			Min	Max	Average	Min	Max	Average
Upstream	**Loveland Ski Area**	0.009	0.27	5.6	1.5	1.0	103	38
↓	**Georgetown**	0.40	0.02	0.71	0.20	3.6	7.6	5.7
	Empire	0.03	0.02	2.32	0.93	19	36	26
	Central Clear Creek	0.041	0.87	4.7	2.4	21	49	33
	St. Mary's	0.009	0.29	3.4	1.3	2.8	19	12
	Idaho Springs	0.299	0.17	0.67	0.42	1.2	6.1	3.9
Downstream	**Black Hawk / Central City**	0.357	0.05	0.35	0.14	4.2	14	8.0

Total Suspended Solids and Nutrients in Clear Creek

Concentrations and loads of TSS, TP, and TN in 2015 in the Upper Basin of Clear Creek were generally comparable to ranges observed for 2010-2014 for non-event samples. The exception to this observation was an ambient water quality sample collected on 6/15/2015. This sample was collected at the tail end of the May-June rainfall event and exhibited elevated TSS and TP concentrations.

Concentrations of TSS were higher in the lower part of the basin as opposed to the upper portion (Figure ES-3). This is consistent with observations from previous years and reflects expected land use loading patterns. Downstream (CC60) peak TSS concentrations are well above the values observed over the previous five years. Considering the antecedent period of rainfall, it is likely that this high TSS sample is associated with high flows due to the rain. This observation is supported the low TSS (14 mg/L) at the upper basin location on the same date. Peak TSS concentrations at CC26 were consistent with peak concentrations observed in previous years. At CC26, TSS loads in 2015 were above average, but generally comparable to loads in past years. At CC59/60, loads in 2015 were higher than all but the flood year of 2013.

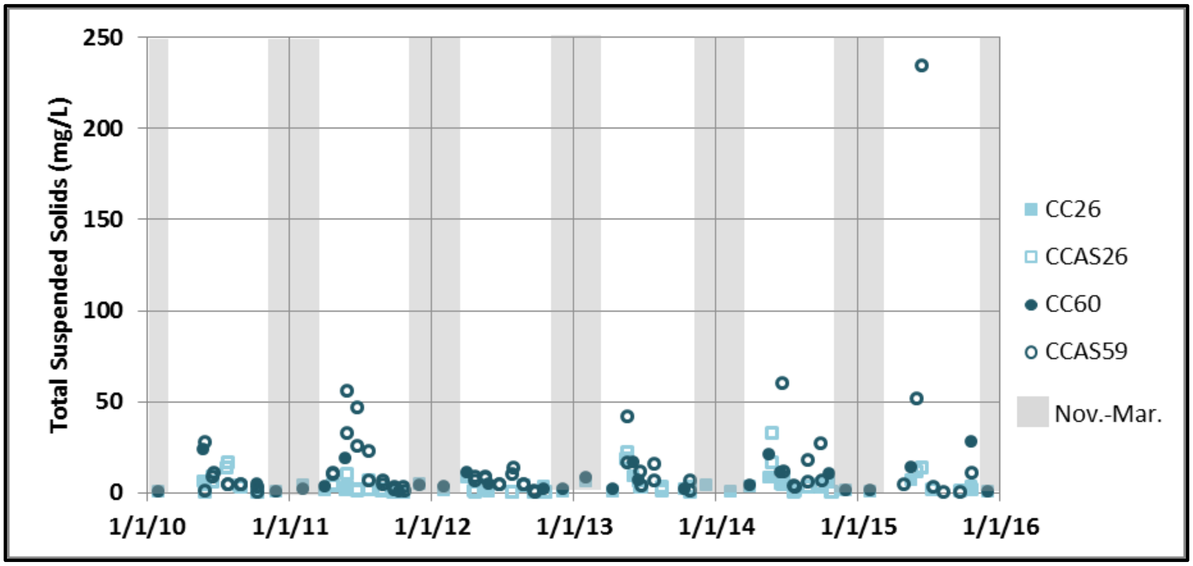


Figure ES-3. Total Suspended Solids Concentrations (Non-Event) in the Upper Basin, 2010-2015

Temporal patterns in TP concentrations track those for TSS, showing three distinct periods: peak concentrations during snowmelt, decreasing concentrations during the summer, and low concentrations during fall and winter (Figure ES-4). This pattern is consistent with the tendency for phosphorus to adsorb to suspended sediments. TP results from 2015 showed patterns similar to those observed for TSS. Concentrations at CC26 typically fell within observed ranges from the previous five years, while concentrations at CC60 showed elevated TP concentrations for the 6/15/2015 sample. TP loading at CC59/60 in 2015 was above the 2010-2014 average and comparable to loads in the previous two years. Loads at CC26 were below the 2010-2014 average.

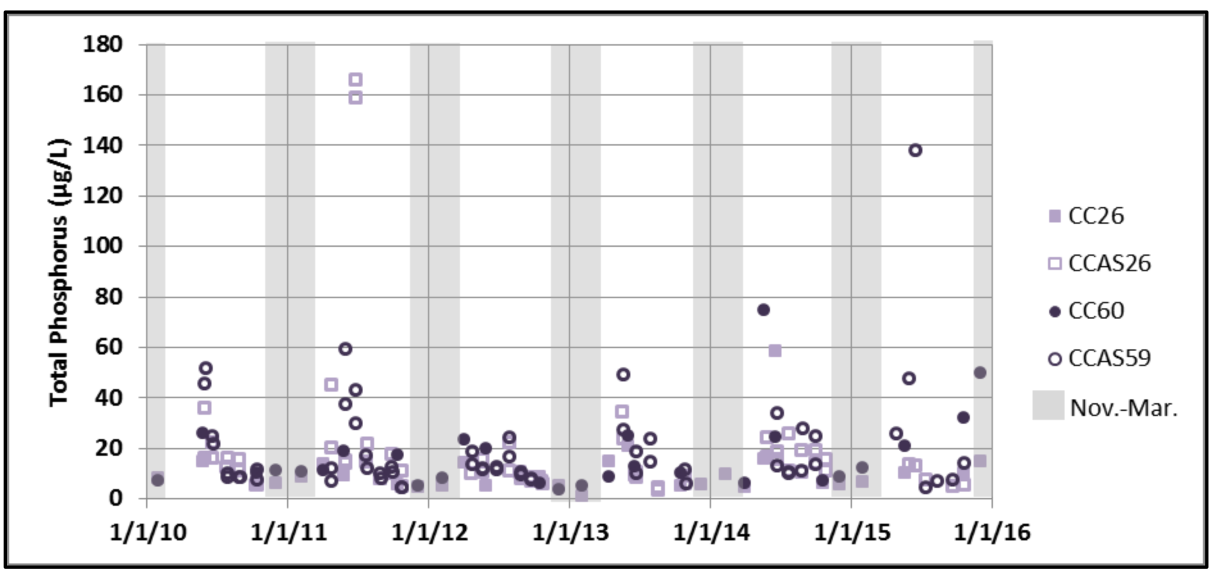


Figure ES-4. Total Phosphorus Concentrations (Non-Event) in the Upper Basin, 2010-2015

TN concentrations follow a seasonal pattern inverse to TSS and TP, with lower concentrations during the summer months, and higher concentrations during the winter and early spring (Figure ES-5). This indicates that the mechanisms of nitrogen loading are different. These non-storm-event results for TN from 2015 all fall within observed ranges from the previous five years. Loadings at CC26 are slightly lower than the average for the previous five years. In contrast, the loadings at CC59/60 are greater than the average of the previous five years.

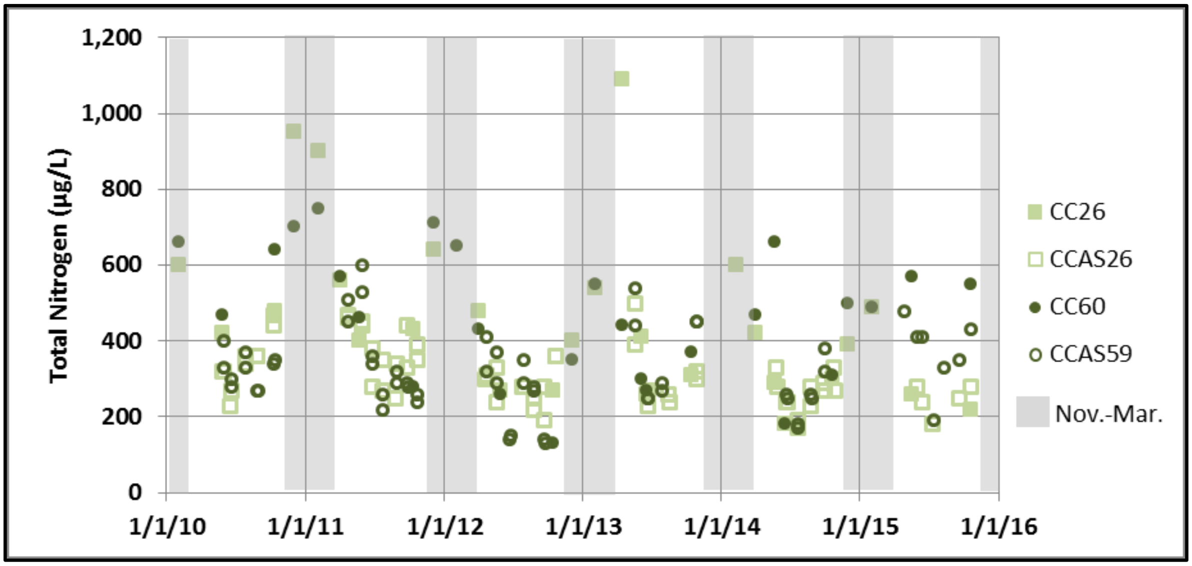


Figure ES-5. Total Nitrogen Concentrations (Non-Event) in the Upper Basin, 2010-2015

Inflow and Loading into Standley Lake

The total volumes of outflow from Standley Lake in 2015 were very close to the 2010-2014 average. In contrast, inflow to Standley Lake was below average in 2015. Figure ES-6 presents total annual inflow and outflow volumes for the period of 2010-2015, as well as the average for 2010-2014.

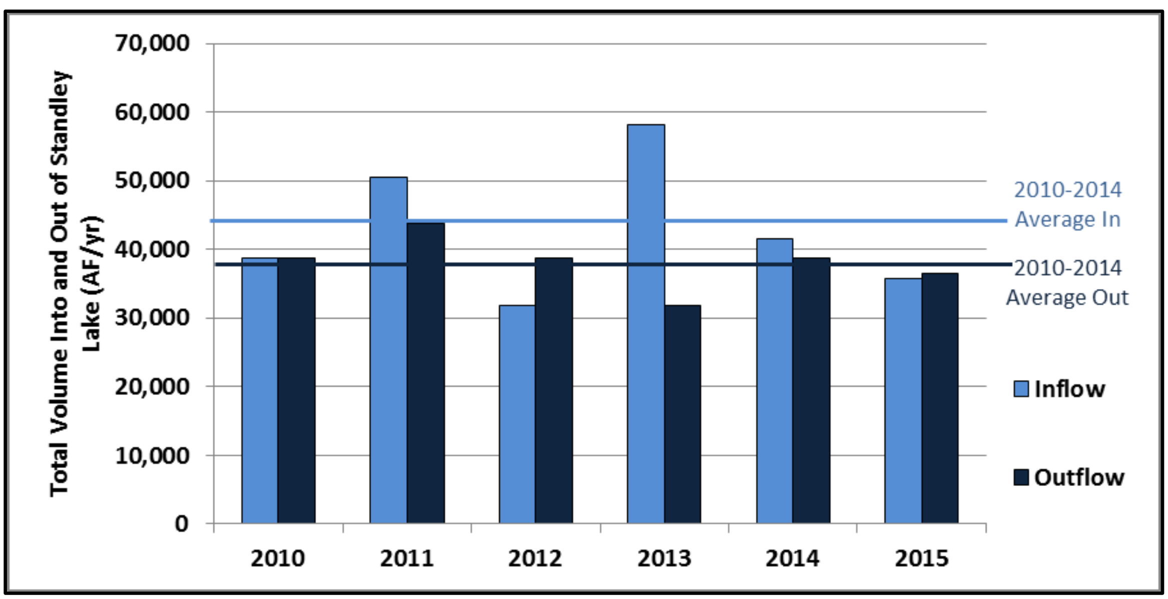


Figure ES-6. Total Annual Inflow and Outflow for Standley Lake, 2010-2015

Standley Lake daily contents for the period of 2010-2015 are presented along in Figure ES-7. The contents of Standley Lake started 2015 higher than in past years. The lake maintained consistently high levels through August, when the lake level dropped substantially before some filling in November and December.

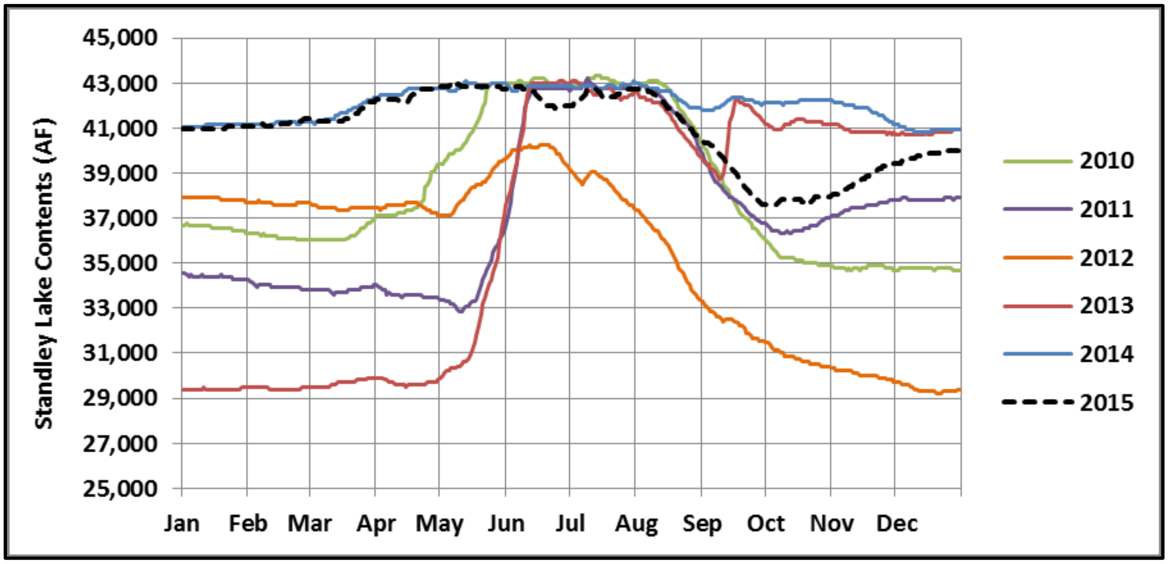


Figure ES-7. Standley Lake Contents, 2010-2015

Total phosphorus loading estimates into and out of Standley Lake based on all ambient (non-storm-event) samples are displayed in Figure ES-8. Total phosphorus loading into Standley Lake was 7% above the 2010-2014 average. The volume-weighted TP concentration of the 2015 inflow was 32% above the 2010-2014 average.

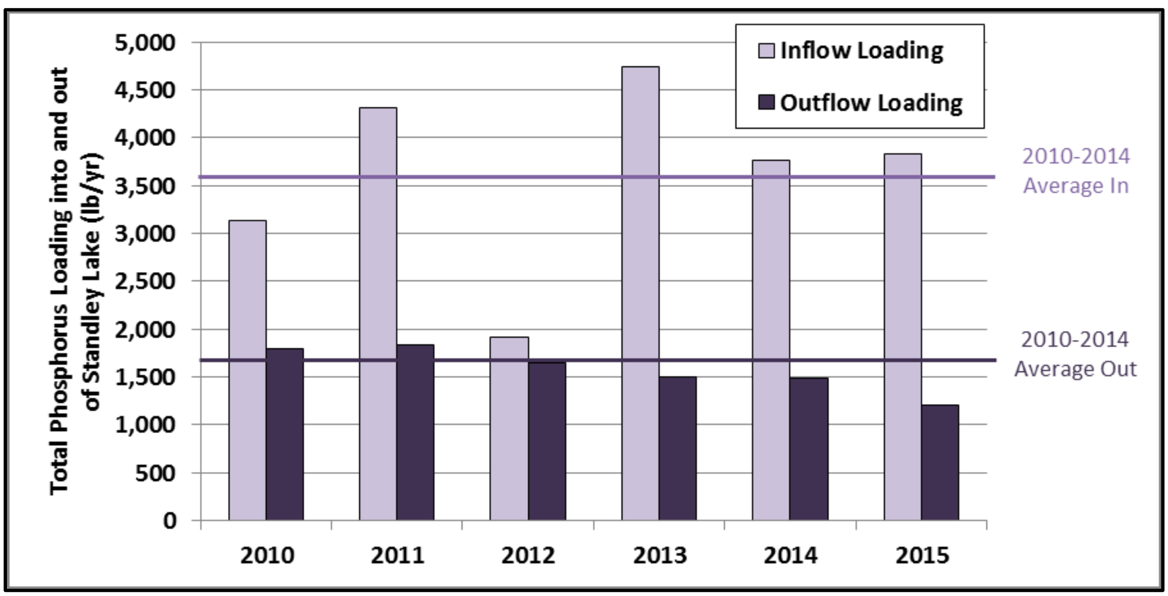


Figure ES-8. Total Phosphorus Loading into and out of Standley Lake, 2010-2015

Total nitrogen loading (based on all non-storm-event samples) into and out of Standley Lake for 2010-2015 is presented in Figure ES-9. Total nitrogen loading was 17% lower than the 2010-2014 average. The 2015 volume-weighted TN concentration into Standley Lake was 3% higher than the 2009-2014 average.

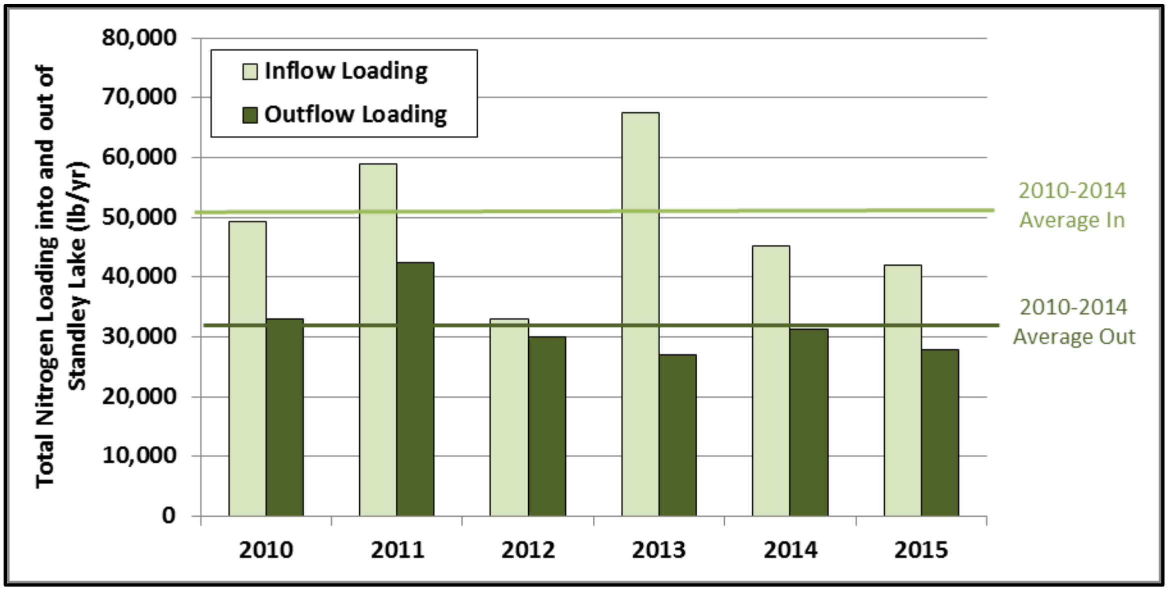


Figure ES-9. Total Nitrogen Loading into and out of Standley Lake, 2010-2015

In 2015, four storm events were sampled on Farmers' High Line Canal (FHL); however only two of these samples were analyzed for TN and TP. Incorporation of the two observed storm events yields a 2% increase in the estimated 2015 TN and TP loading to Standley Lake from FHL.

Water Quality in Standley Lake

Overall, the monitored water-quality parameters indicated that high water quality was maintained in 2015. This observation of good water quality is consistent with recent years, and a testament to the diverse efforts of stakeholders to maintain high water quality throughout the basin.

In 2015, Standley Lake had a period of hypoxia (< 2 mg/L dissolved oxygen in the hypolimnion) of 120 days. This period was longer than the 2010-2014 average of 98 days (Figure ES-10).

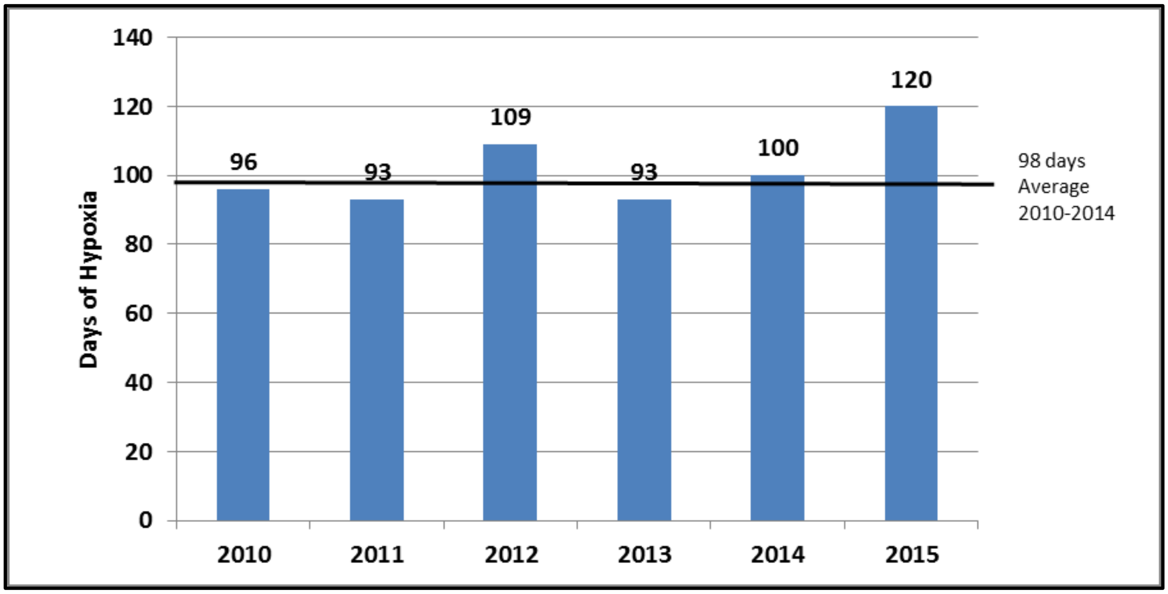


Figure ES-10. Days of Hypoxia (DO < 2.0 mg/L), 2010-2015

Nutrient concentrations at the top and bottom of Standley Lake followed typical seasonal patterns and concentrations ranges. As shown in Figure ES-11 and ES-12, TN and TP concentrations at the bottom of the reservoir increased, as usual, during the period of stratification and hypoxia in the hypolimnion, due to internal loading from sediments. Overall, the average TP concentration in 2015 was 16% lower in the hypolimnion than the respective 2010-2014 average and 26% lower in the photic zone. Average TN concentrations in 2015 were 19% higher in the hypolimnion and 2% lower in the photic zone, as compared to the averages from 2010-2014.

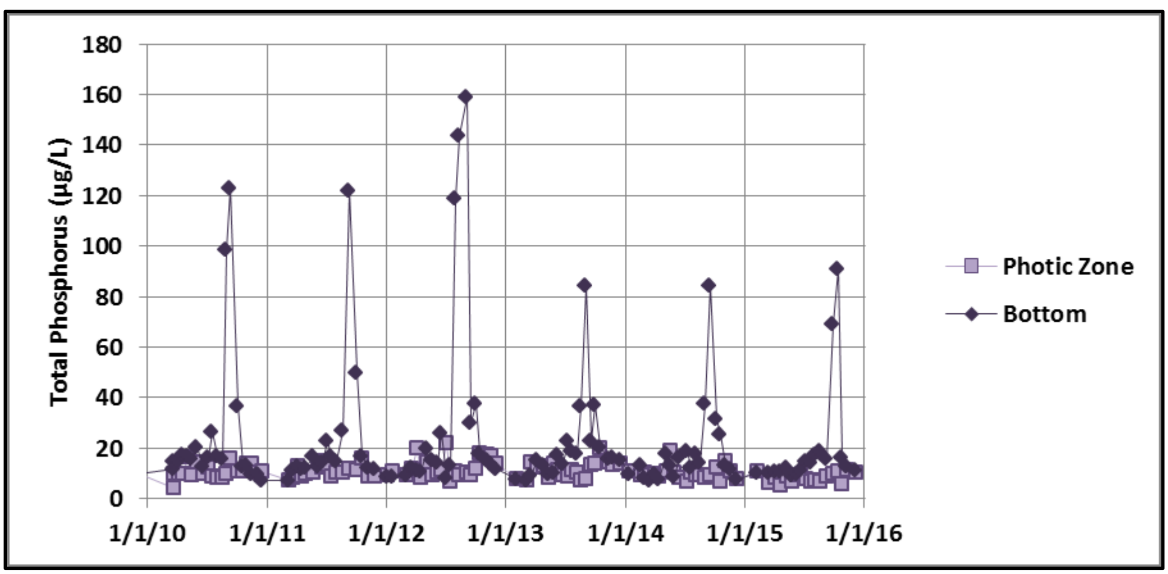


Figure ES-11. Total Phosphorus Concentrations in the Photic Zone and Bottom of Standley Lake, 2010-2015 (Site SL10)

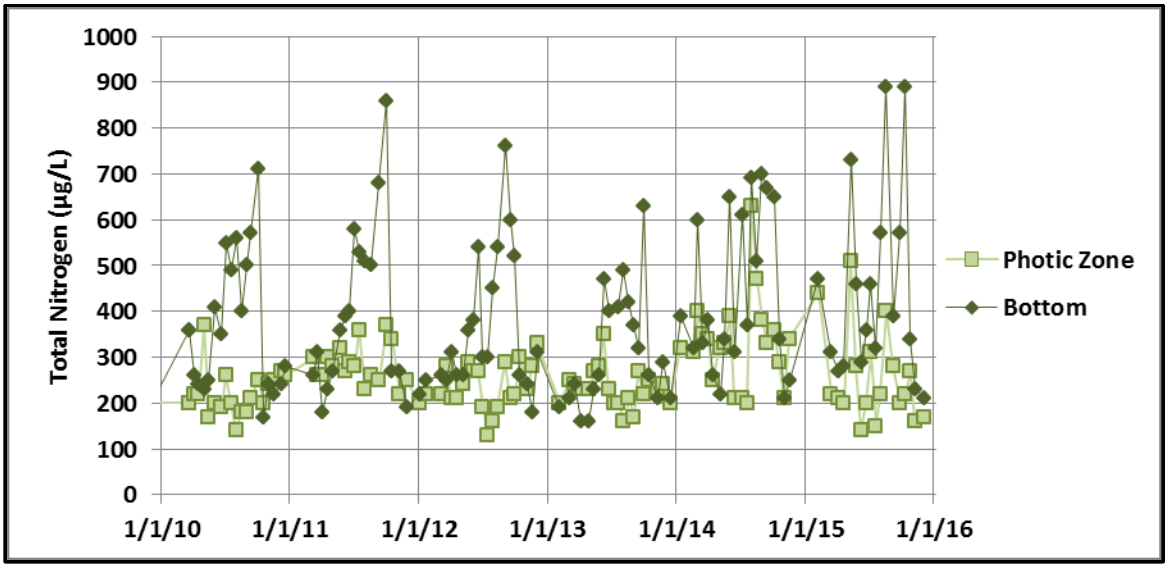


Figure ES-12. Total Nitrogen Concentrations in the Photic Zone and Bottom of Standley Lake, 2010-2015 (Site SL10)

As seen in previous years, chlorophyll *a* concentrations in Standley Lake in 2015 were low during summer months, with the peak concentration of 670 µg/L observed in November, and a spring peak of 6.0 µg/L observed in late May. The site-specific March through November chlorophyll *a* standard of 4 µg/L was once again met in 2014 with an average value of 3.5 µg/L. The standard is met when four out of the five recent years have a March-though-November average below 4.0 µg/L. For the five-year period 2011-2015, each year had a March-November average concentration below 4.0 µg/L. Of the last ten years, only one year (2007, at 4.8 µg/L) had a March-November average concentration above 4.0 µg/L.

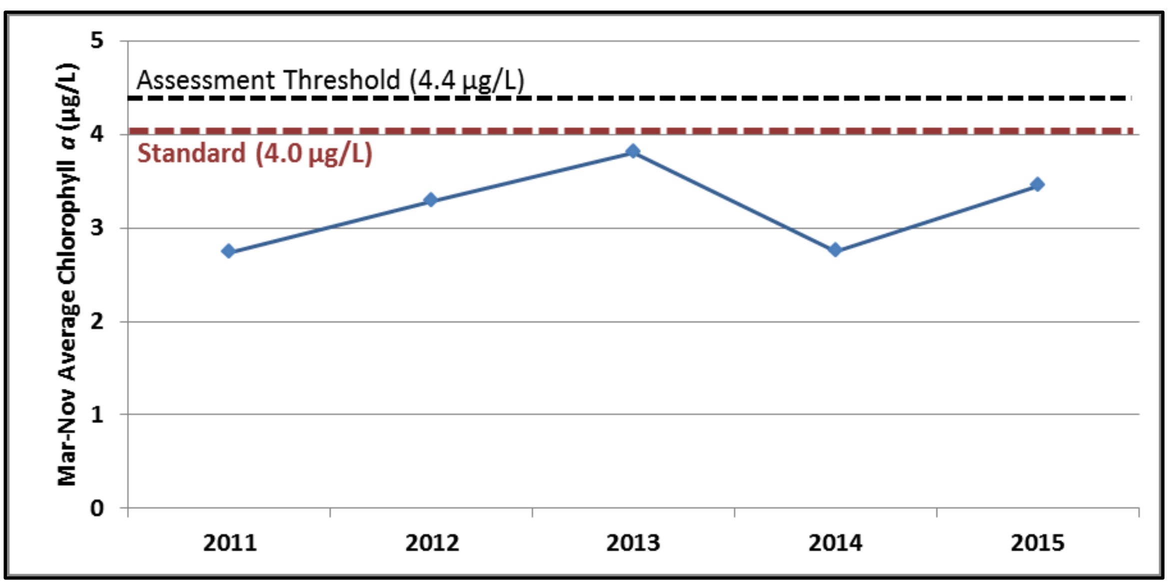


Figure ES-13. Observed Average Chlorophyll *a* Concentrations (Mar-Nov) Compared with the Standard and the Assessment Threshold, 2011-2015 (Site SL10)

The average clarity in 2015, measured as the Secchi depth, was 4.1 meters. The individual Secchi depth measurements observed in 2015 were in the range of those from previous years. The 2015 average was the deepest annual average over the ten year period from 2005 to 2015.

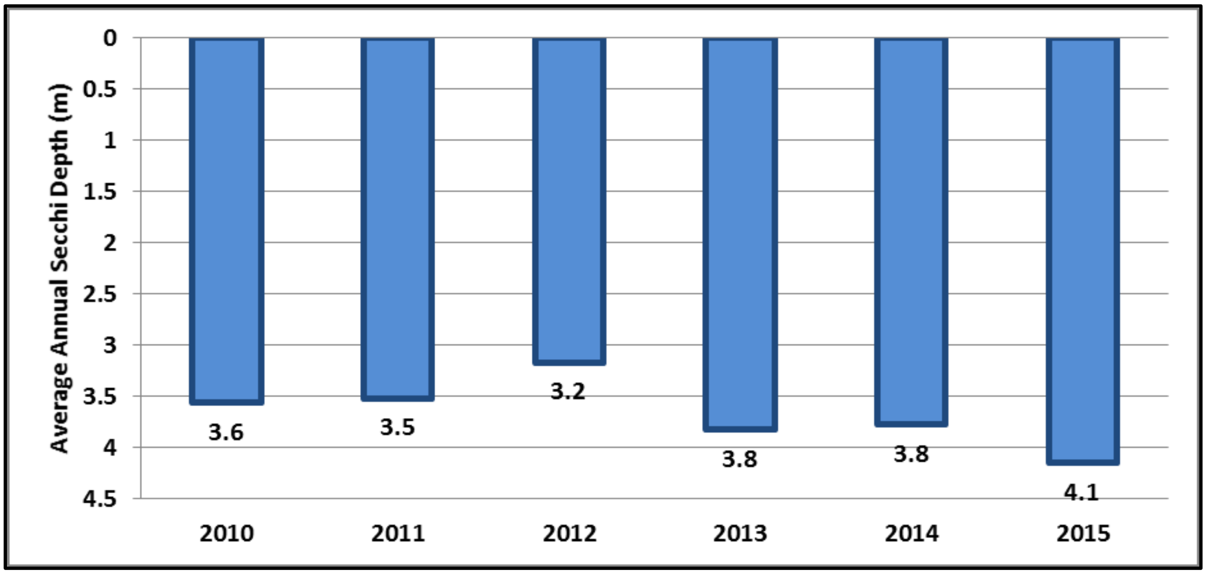


Figure ES-14. Average Annual Secchi Depth in Standley Lake, 2010-2015

I. Introduction

A. Purpose and Scope of Report

In 1993, the Clear Creek/Standley Lake Watershed Agreement (1993 Agreement, Appendix A) was signed by a contingent of governmental agencies and private corporations to address water-quality issues and concerns within the Clear Creek watershed – specifically as they affect the water quality of Standley Lake. This annual report provides a review of 2015 water-quality efforts in the Clear Creek watershed, according to the annual reporting obligations set forth in the 1993 Agreement. Water-quality data for 2015 are also presented and compared to the previous five years of data (2010-2014).

B. Organization of the Report

Following this introductory section, this report is organized as follows:

- **Section II. Description of Standley Lake, Its Watershed, and Routine Monitoring** – An overview of the reservoir and its watershed, including maps and monitoring practices.
- **Section III. Activities and Accomplishments** – A summary of 2015 activities related to water-quality management and improvement in the Clear Creek Basin, canals, and Standley Lake.
- **Section IV. Upper Basin Water Flows and Water Quality** – A presentation of data collected from two key locations in the Upper Basin, with a focus on nutrient concentrations and annual loading of total nitrogen, total phosphorus, and total suspended solids.
- **Section V. Canal Zone Flows and Water Quality**—A presentation of flows in the canals that flow into Standley Lake. This section also includes an analysis of changes in total nitrogen, total phosphorus, and total suspended solids concentrations observed across the length of the Farmers' Highline and Croke canals.
- **Section VI. Standley Lake Flows, Contents, and Loading –** A summary of 2015 inflow to Standley Lake, outflow from the lake, and lake storage. This section also includes an analysis of nutrient loading into and out of the lake, with consideration of total nitrogen and total phosphorus loads from each canal.
- **Section VII. Standley Lake Water Quality -** An analysis of lake water quality with a focus on total nitrogen, total phosphorus, chlorophyll *a,* dissolved oxygen, and clarity.
- **Section VIII. Conclusions** – A summary of findings from the report.

In addition, four appendices are included to provide additional background and detailed information:

- Appendix A. Clear Creek / Standley Lake Watershed Agreement;
- Appendix B. Upper Clear Creek / Standley Lake Watershed Water Quality Monitoring Plan;
- Appendix C. Clear Creek, Canal, and Standley Lake Water-Quality Monitoring Data for 2015; and
- Appendix D. Regulation 85 Water-Quality Monitoring Data--2015

II. Description of Standley Lake, Its Watershed, and Routine Monitoring

A broad description of Standley Lake and its watershed is provided in this section. The watershed is comprised of the Upper Basin and the Canal Zone. The Upper Basin is a portion of the larger Clear Creek watershed. The Canal Zone refers to the lands draining either directly to the lake or to the canals which flow into the reservoir. Routine monitoring activities for each area are also summarized.

A. Standley Lake

Standley Lake is an off-channel, municipal and agricultural reservoir located in Jefferson County, Colorado (Figure 1). This reservoir covers approximately 1,200 acres and has a storage capacity of 43,000 acre-feet (AF). It serves as a direct-use drinking water supply for over 250,000 consumers in the downstream cities of Northglenn, Westminster, and Thornton. In addition, the reservoir supports recreational activities and provides water to farms located in Adams and Weld counties. It is owned and operated by the Farmers' Reservoir and Irrigation Company (FRICO).

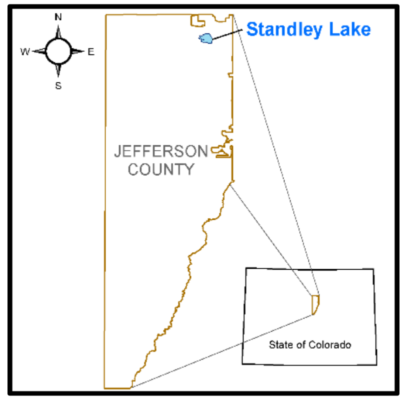


Figure 1. Location of Standley Lake

Through the Standley Lake Monitoring Program, the lake is monitored regularly during the ice-free period. Although the lake is sampled at multiple locations, the focus for this report is on results from the deepest sampling location, SL10 (Figure 2). This location is approximately one-quarter mile south of the municipal supply intakes. Routine monitoring practices for Standley Lake are described in detail in the Upper Clear Creek/Standley Lake Watershed Water Quality Monitoring Program (Appendix B). Lake monitoring efforts at SL10 are summarized below:

- **Daily Profiles –**Standley Lake water quality is measured four times per day using an automated profiler (Figure 3). Measurements are taken every meter, from the surface to within 2 meters of the bottom. The profiler is equipped with a multi-probe sonde which provides readings of field parameters. These include water temperature, dissolved oxygen, pH, conductivity, turbidity, oxidation/reduction potential (ORP), and chlorophyll *a* concentrations.
- **Water-Quality Sampling** – Grab samples are collected in the lake at three depths: the surface, in the photic zone (at two times the measured Secchi depth), and one meter from the bottom. Sampling occurs twice each month if the lake is not frozen. A wide range of constituents are measured, including nutrients, metals, algae, suspended solids, and field parameters.
- **Zooplankton Tows** – Zooplankton tows are conducted during each lake sampling event.
- **Invasive Species Monitoring** – Monitoring for zebra and quagga mussels is conducted during each lake sampling event. Monitoring for Eurasian watermilfoil is performed once per year.

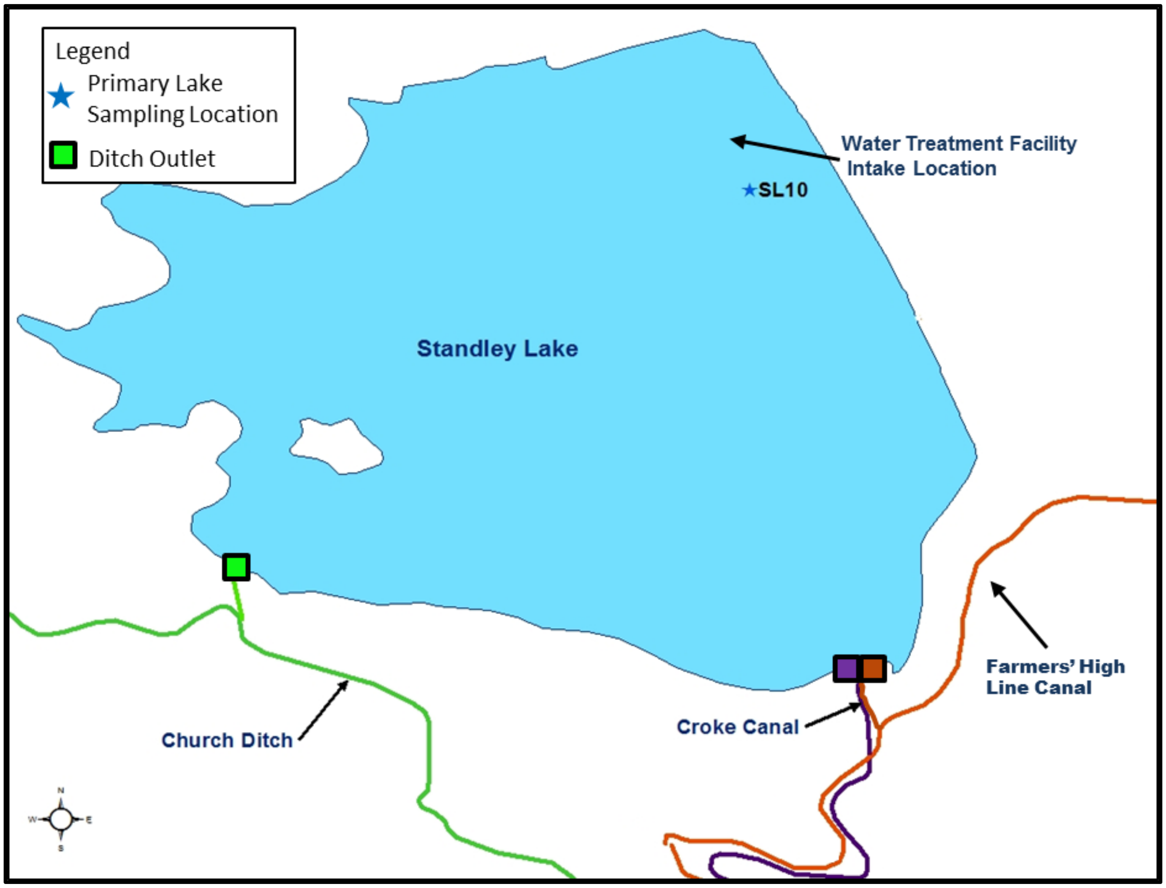


Figure 2. Standley Lake, Sampling Location SL10, and the Locations of Canal Inflows

Figure 3. Water-Quality Profiler at SL10

B. Description of the Watershed

The Clear Creek watershed is located west of Denver, Colorado, with its headwaters in the mountains at the Continental Divide (Figure 4). The watershed covers an area of 575 square miles; spanning elevations from nearly 14,000 feet to approximately 5,000 feet at the confluence with the South Platte River in north Denver. In addition to supplying drinking water to 350,000 residents in the watershed, Clear Creek provides water for recreational, agricultural, and industrial purposes.

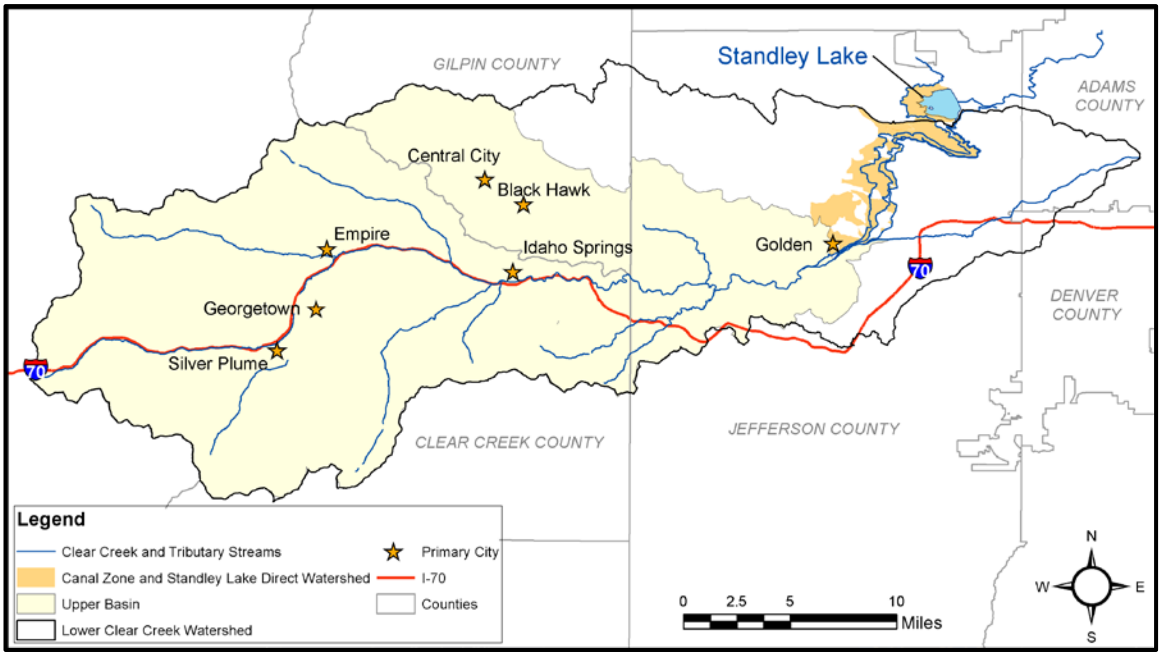


Figure 4. The Standley Lake Watershed, Upper Basin, Canal Zone, and Direct Watershed

The Standley Lake watershed includes the Upper Basin of the Clear Creek watershed, the canals used to transport water from Clear Creek to the lake and their drainage areas (the Canal Zone), and a direct lake watershed. The following subsections describe the Upper Basin and the Canal Zone.

1. Upper Basin

The Upper Basin region of the Clear Creek watershed (Figure 4) comprises nearly 400 square miles upstream of the Croke Canal headgate. This region includes the upper portion of Clear Creek and its tributaries -- the most prominent of these being the West Fork of Clear Creek, Leavenworth Creek, the South Fork of Clear Creek, Fall River, Chicago Creek, the North Fork of Clear Creek, Beaver Brook, Soda Creek, Tucker Gulch, and Elk Creek. Numerous cities and towns are scattered throughout this mountainous area including Idaho Springs, Black Hawk, Central City, Empire, Georgetown, and Silver Plume. Additionally, U.S. Interstate 70 (I-70) runs through the watershed. This highly-utilized transportation corridor averages approximately 40,000 vehicles per day near Idaho Springs (CDOT 2015).

Water quality in the Upper Basin is affected by a variety of sources. The region contains nine wastewater treatment facilities (WWTFs) which serve the local population and resorts (Figure 5).

Additionally, the Upper Basin contains operating and abandoned mines and receives water from trans-basin diversions. Water quality in the Upper Basin may also be impacted by nonpoint sources of pollution, including numerous onsite wastewater treatment systems (OWTS), application of roadway deicers and traction sands, and residential and commercial stormwater runoff.

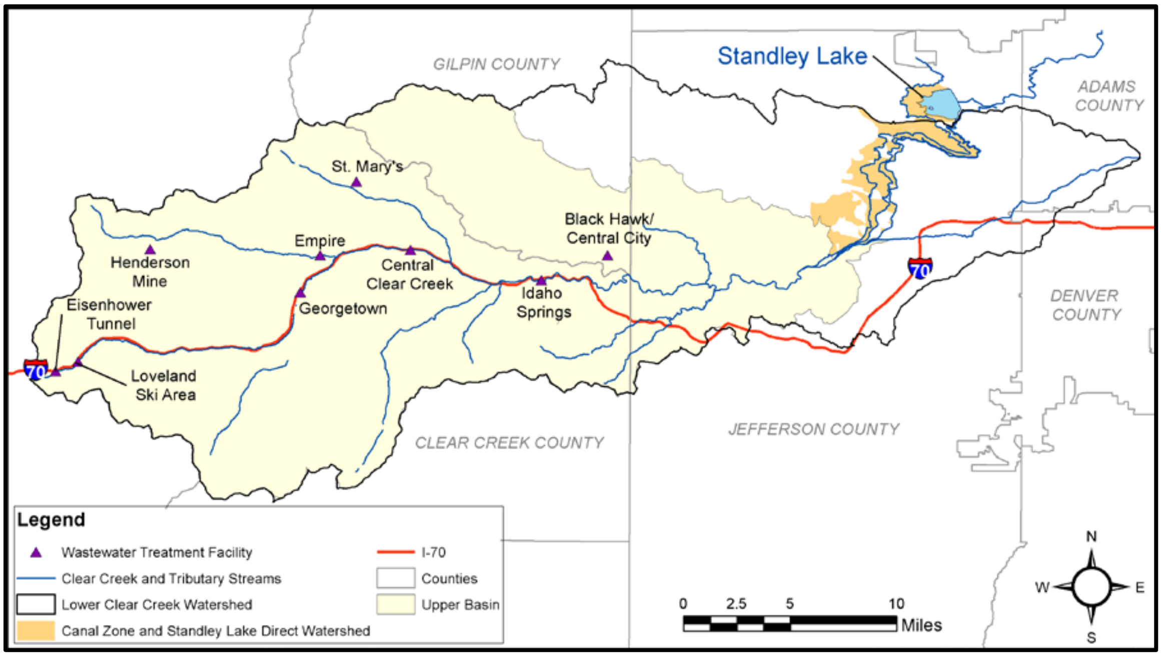


Figure 5. Wastewater Treatment Facilities in the Upper Basin

Flow measurements and water-quality samples are collected at numerous stations throughout the watershed to monitor the concentrations of nutrients, select metals, and other key constituents (Figure 6).

Upper Basin monitoring activities have been designed in order to evaluate the relative contributions of various nutrient sources, effectiveness of best management practices (BMPs), WWTF operational changes, and nutrient reductions from WWTF upgrades. The monitoring program has a strong emphasis on composite samples collected by autosamplers versus grab sampling. Relative to grab samples, composite samples provide a more complete picture of water quality over the course of the sampling period. These composite samples are of two types: ambient and event. Ambient samples are collected on a periodic basis and are collected over a 24-hour period. Event samples are storm-triggered. Routine monitoring for the Upper Basin is described in detail in Appendix B.

The analyses described in the Upper Basin portion of this report are based on data from two key sampling areas (circled on Figure 6, described in Table 1), selected based on their location and higher frequency of sampling (Key locations for this report are circled). For this report, three important constituents are analyzed: total phosphorus (TP), total nitrogen (TN), and total suspended solids (TSS).

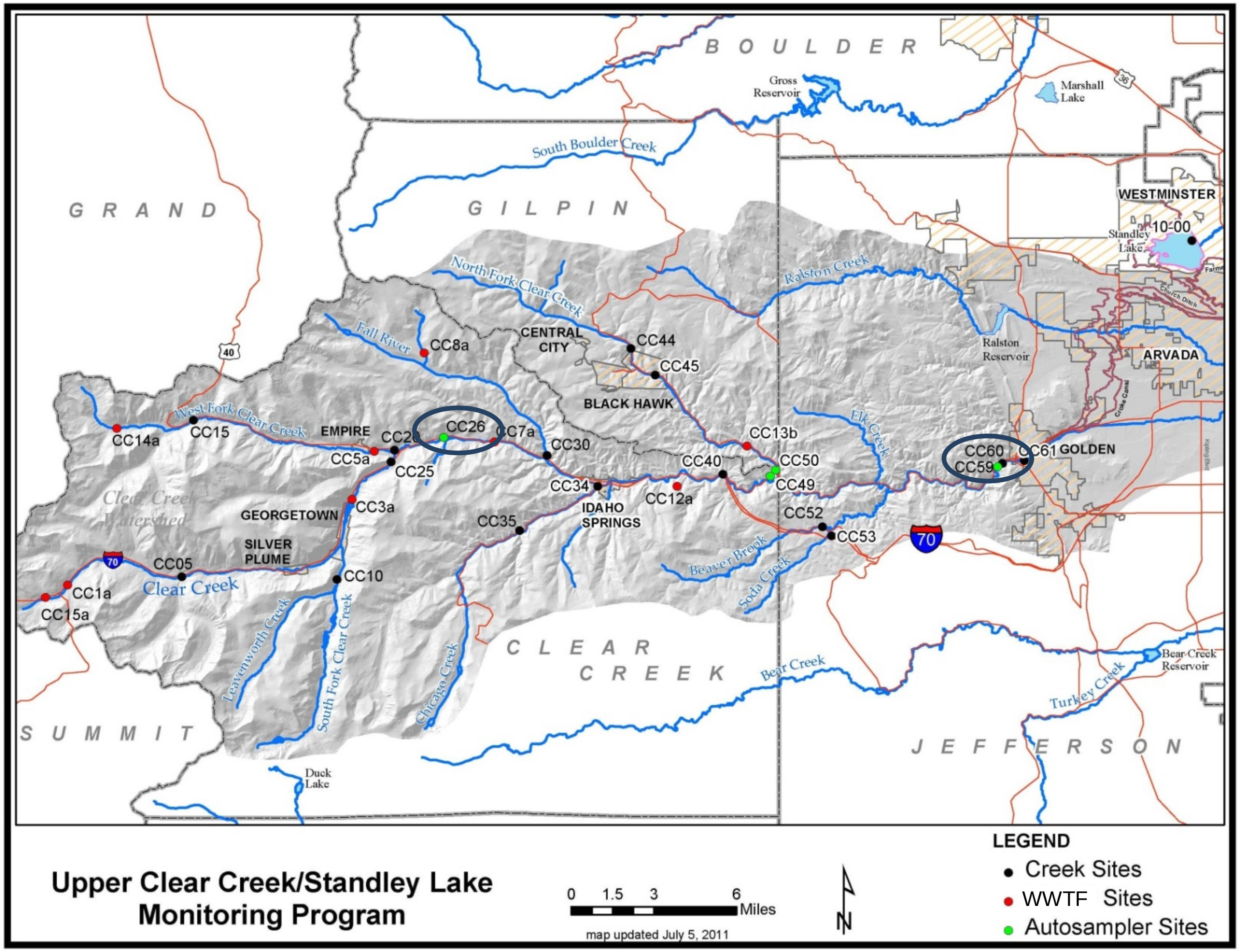


Figure 6. Upper Clear Creek Sampling Stations (Key locations for this report are circled)

Table 1. Key Watershed Locations in the Upper Basin

General Area	Purpose	Station Name and Location	Station Type
Clear Creek main stem, downstream of the confluence with the West Fork, at the location of USGS* Lawson flow gage	Characterize water quality in the upper portion of the Upper Basin	CC26 – Clear Creek at Lawson Gage	Grab Sample Station
		CCAS26 -- Clear Creek at Lawson Gage	24-Hr Composite Autosampler
Clear Creek main stem, near the canal headgates, near Golden	Characterize water quality near the Clear Creek canal diversions to Standley Lake	CC60 – Clear Creek at Church Ditch Headgate	Grab Sample Station
		CCAS59 – Clear Creek 2 miles west of Highway 58/US6	24-Hr Composite Autosampler

*United States Geological Survey

2. Canal Zone

The Canal Zone contains the canals (and surrounding drainage areas) that divert water from Clear Creek into Standley Lake: Church Ditch (Church), Farmers' High Line Canal (FHL), and the Croke Canal (Croke) (Figure 7). In addition to these three canals from Clear Creek, the Kinnear Ditch Pipeline (KDPL) also contributes water to Standley Lake sourced from the Coal Creek, South Boulder Creek, and Fraser River basins. The canals are open and largely unlined ditches that are slow-flowing (low gradient). The canals are subject to nonpoint-source loading from adjacent horse and cattle operations, agricultural operations, and residential properties (some with OWTSs). Since the 1990s, a substantial percentage (~80%) of the direct runoff into the Clear Creek canals has been hydrologically disconnected from the canals to protect Standley Lake water quality.

To provide information for evaluation of the nutrient loadings from nonpoint sources in the Canal Zone, the three Clear Creek canals are sampled at the headgates, where water is diverted, and at the inlets into the lake. The KDPL is sampled near the inlet into the lake. Figure 7 shows the inlet monitoring location for each canal (CCT4, CCT11, CCT27, and CCT22d). Routine monitoring for the Canal Zone is described in detail in Appendix B.

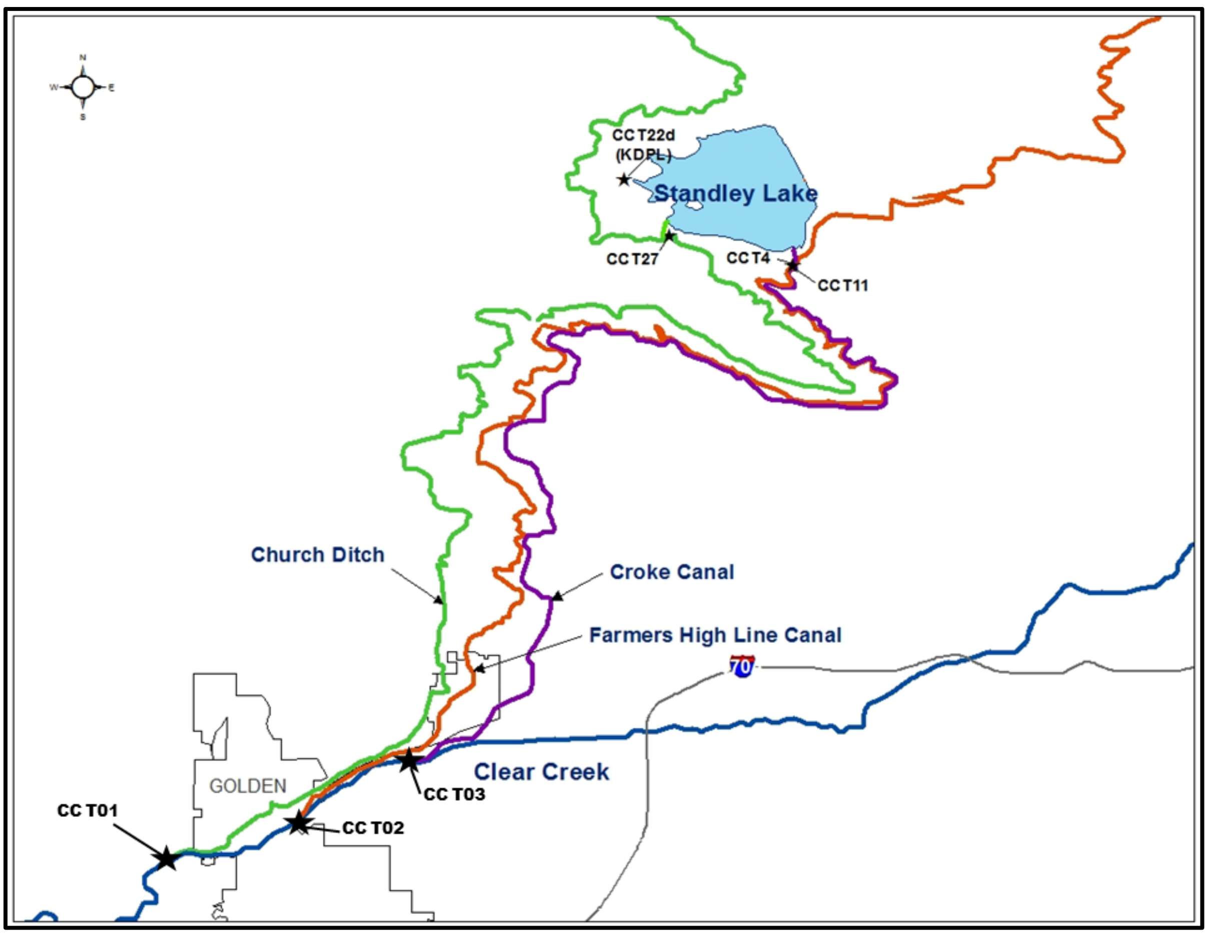


Figure 7. The Three Canals that Divert Water from Clear Creek to Standley Lake and Sampling Stations at the Lake Inflow Locations (Including KDPL)

III. Activities and Accomplishments

Efforts to manage, enhance, and protect water quality throughout the Clear Creek watershed and in Standley Lake continued in 2015. These activities were completed by a variety of groups and entities. This section provides highlights of these activities in 2015. The following groups of activities are described:

- Monitoring;
- Canal Maintenance;
- Wastewater Treatment Facilities;
- Illicit Discharges and Emergency Response;
- Nonpoint Source Control and Stormwater Management;
- General Public Education, Outreach, and Partnerships; and
- Other Activities.

A. Monitoring Activities

The Upper Clear Creek / Standley Lake Watershed Water Quality Monitoring Program provides the framework for routine collection of flow measurements and water-quality samples throughout the Upper Basin, the Canal Zone, and in Standley Lake. Sample collection for 2015 is summarized in Table 2. Samples were analyzed for a number of constituents, as described in the monitoring plan (Appendix B). Some of the funding resources used for flow and water-quality monitoring are listed in Table 3.

New measurements devices were installed at the Croke headgate (CCT03, Figure 7) east of Golden in 2015. This station includes a sonde, datalogger, and autosampler. Installation of this monitoring equipment will increase data collection at this key location and will provide data for the entire season the Croke is operating.

Table 2. Summary of 2015 Water-Quality Sample Collection

Sub-Region	Type of Sample	Number of Locations	Total Number of Samples Collected
Upper Basin	Grab Samples	17	43
	Ambient Composites	4	21
	Storm-triggered Composites	3	8
Canal Zone	Grab Samples	8	61
	Ambient Composites	2	14
	Storm-triggered Composites	2	8
	First Flush Composites	0	0
Standley Lake	Grab Samples	1 (3 depths)	54
	Vertical Profiles	1	Four Times Daily When Ice-Free, Every Meter

Table 3. Summary of 2015 Monitoring Costs

Entity	Activity Funded	2015 Amount
City of Golden	Water Quality Sampling and Analysis	N/A
	USGS gage on the West Fork of Clear Creek	$10,790
Upper Clear Creek Watershed Association (UCCWA)	Gage at CC40	$4,790
Clear Creek County	Support gages: 1) on Leavenworth Creek, 2) at Berthoud Falls on the West Fork of Clear Creek, 3) on Fall River	N/A
Standley Lake Cities	Water-Quality Sampling and Analysis and Flow Gage Support at Bakerville (CC05) and Lawson (CC26)	$200,000+

B. Canal Maintenance

In 2015, the canals which supply water to Standley Lake received both ongoing maintenance and continued repairs of damage caused by the flooding of September 2013. These activities enable the continued efficient delivery of high-quality water to Standley Lake and other water users.

1. Church Ditch

Church Ditch Company continues to repair damage from the 2013 flood. The estimated amount spent in 2015 on flood damage repair is $197,000. Flood damage repair projects completed in 2015 include:

- In 2014, a block wall was installed near 74th and Quaker to repair flood damage. The wall began to fail shortly after installation, posing a risk of complete blockage of the ditch. In 2015, approximately 100 linear feet of block wall were repaired.
- During the September 2013 flood, the Leyden Creek Culvert, below the Church Ditch, became overwhelmed with water and debris. The excess water breached the ditch banks and washed the ditch out. To repair the damage, the Church Ditch was enclosed in a box culvert over Leyden Creek and armored with riprap on both sides of the box culvert.

Repair of Block Wall Near 74th and Quaker. Before (Left), and After (Right).

Ongoing maintenance programs on Church Ditch include vegetation removal, ditch shaping, and bank repair. The removal of vegetation reduces the risk of blockages, increases ditch capacity, and decreases sedimentation from erosion. At various locations vegetation was removed from both sides of approximately 8,500 feet of the ditch. Ditch shaping and bank repair are performed to increase ditch capacity and improve flow. Approximately 2,000 feet of the ditch was reshaped and cleaned in 2015 at a number of locations.

2. Farmers' Highline Canal

Multiple projects were completed in 2015 on the FHL. These included bridge construction, maintenance to the canal and access road, and first flush operations. Further details on each of these are provided below.

As part of the Federal Refuge-to-Refuge trail system, FHL staff worked with Federal, Westminster, and Arvada Open Space staff on the installation of a bridge over the canal. Two pedestrian bridges were installed over the canal as it flows through Arvada. At each of these bridge locations, silt fencing and wattles were installed to mitigate erosion into the canal. At open-cut crossings, canal banks were restored and improved through bank re-seeding. In one case, installation of grouted riprap was utilized to bolster the integrity these structures.

Installation of Bridge Over FHL

One section of the canal had been inaccessible for more than forty years due to overgrown vegetation and the lack of an established access road. With thoughts toward improved maintenance both now and into the future, significant effort went into reclaiming access to this section of canal. This included removing trees, excavation and grading of a new road, slough repair, mowing, and re-seeding. This work will provide passage for maintenance operations to this previously inaccessible section of canal.

Building New Access Road Along the FHL, Before (Left) and After (Right) Construction.

Several locations along the canal experienced sloughing, scouring, and vegetation overgrowth. Overgrown vegetation can interfere with flow in the canal and can inhibit the removal of debris. Problem vegetation was removed to mitigate these concerns. Along other sections of the canal, the banks were reshaped and reseeded. At appropriate locations, riprap was installed to stabilize the canal banks. All these practices reduce sediment and improve maintenance access. In addition, mowing occurred along banks and the access road.

The first flush of water in the spring is turned out at identified structures upstream of Standley Lake. This allows diversion of the vast majority of the debris that has collected during the off-season. This material is then collected at locations where the debris is removed mechanically. Once first flush is complete and the water is running cleaner, water is delivered to shareholders.

3. Croke Canal

In 2015, FRICO completed multiple projects on the Croke canal to repair damage from the 2013 flood. In addition to these special projects, general maintenance activities continued. A description and summary of these projects and activities follows.

Eight sections (approximately 8,700 linear feet) of sloughing and eroding banks were repaired. Some of the sloughing was a result of the 2013 flood event, some was not. Two major areas of repair are described below:

- The section where Ralston Creek crosses the Croke Canal was heavily damaged by the 2013 flood and again in 2015. During these events, debris collected under the pedestrian bridge forcing Ralston Creek to overtop its banks and flood into the Croke Canal. This caused the upstream bank to erode almost down to the bottom of the canal. To repair this damage, excess material that had been washed into the canal was removed; restoring the canal to its original capacity. The removed material was then repurposed to repair the bank of the canal at this and other slough locations.
- One of the largest sloughs along the ditch was located just upstream of Simms Street. This location was originally damaged in the 2013 flood. In 2015 the material that had sloughed into the canal was pushed up onto the upstream bank. In 2016, riprap will be installed to stabilize this location. During the repair, an abandoned beaver dam was removed from the bottom of the canal to restore capacity.

General maintenance projects include activities such as canal cleaning, debris removal, bank armoring, and tree removal. Tree removal focused on trees that had fallen (or were in danger of falling) into the canal. The majority of these were cut up, chipped, and removed from the area of the canal. From Kipling Street downstream to Standley Lake the canal was cleaned, debris was removed, and sloughs were repaired. This included a total of 1,500 feet of canal cleaned near the FHL crossing of the Croke. Also, the canal alignment was straightened above the Standley flume to improve the accuracy of flow measurements.

In addition to operational maintenance, FRICO continues activities to maintain a high-quality water supply for Standley Lake and downstream users. FRICO continues to inspect the canal on a regular basis to look for water-quality impacts to the Croke Canal and to Standley Lake. First flush procedures continue to be used to remove debris built up in the canal during the offseason. During first flush, a flow of 20 cubic feet per second (cfs) is initially released into the canal, later this is gradually increased to approximately 75 cfs. The first flush water is diverted down Little Dry Creek. Following the flushing, the water is routed to Standley Lake.

4. Kinnear Ditch Pipeline

The Kinnear Ditch Pipeline passed a milestone in 2015, returning to operation for the first time since the September 2013 flooding. The flooding in September 2013 resulted in substantial damage to the KDPL headgate. FRICO will continue to repair flood damage in 2016. During periods of low flow in

Coal Creek, water is not taken through the KDPL due to nutrient concerns. The source of the nutrients is believed to be upstream OWTS.

Examples of Flood Damage to KDPL. Headgate Blocked by Rocks and Debris (Left). The Flume is Silted in and the Recorder is Stranded (Right)

5. City of Arvada

In 2015, Arvada continued restoring and improving waterways that were impacted by flooding in 2013. A significant amount of funding and man-hours were dedicated to assisting Jefferson County, Colorado Department of Transportation (CDOT), the Urban Drainage and Flood Control District (UDFCD), and ditch companies with repairing and replacing diversion control structures and erosion control systems. Locations of this work included Leyden Creek, Ralston Creek, Church Ditch, FHL and the Croke Canal.

C. Wastewater Treatment Facilities

As described in Section II, nine wastewater treatment facilities are located in the Upper Basin (Figure 5). The following sub-sections provide a brief discussion of key activities at the three largest WWTFs in the basin. At the end of this section, effluent nutrient concentrations from 2010 to 2015 are presented for each of the WWTFs.

1. Idaho Springs WWTF

The City of Idaho Springs WWTF continued work on planning and engineering for an upgrade to ultraviolet (UV) disinfection of plant effluent. This replacement of the existing gaseous chlorine and sulfur dioxide system is scheduled for 2016. In 2015, a new process control system was installed. This control system allows for remote monitoring of the facility from any location, provides redundant computer back-up, and can send alarms and call-outs to staff via text message. Annual averages for nutrient monitoring in 2015 were: 1.10 mg/L of ammonia, 0.95 mg/L of nitrate, and 0.48 mg/L of phosphorus.

2. Georgetown WWTF

In 2015 the Georgetown WWTF continued to operate well, as expected following the expansion and upgrade in 2011. During 2015, the Town of Georgetown constructed and brought on-line a biosolids facility. The capacity of the biosolids facility is greater than the existing needs, which allows it to accept biosolids from other sources.

3. Black Hawk / Central City Sanitation District WWTF

The Black Hawk / Central City Sanitation District (BHCCSD) continues to achieve excellent nutrient removal at their WWTF. The WWTF employs enhanced biological nutrient removal (BNR) treatment plus tertiary filtration with mechanical disk filters. Following filtration, an additional chemical coagulation / flocculation process is used to further reduce soluble reactive phosphorus. Nitrogen concentrations are controlled by nitrification / denitrification reactions in the BNR process. The final treatment step prior to discharge is UV-disinfection.

The treatment methods continue to result in very low levels of nutrients in the effluent. Effluent concentrations of TP and total inorganic nitrogen (TIN, Table 4) are substantially lower than the Regulation 85 values[1].

Table 4. BHCCSD WWTF 2015 Effluent Concentrations Compared to Regulation 85 Limitations

	Total Phosphorus (mg/L)		Total Inorganic Nitrogen (mg/L)	
Percentile	BHCCSD WWTF	Reg 85 Value	BHCCSD WWTF	Reg 85 Value
50th	0.12	1.0	6.9	15
95th	0.27	2.5	12.1	20

The average daily flow volume in 2015 was 0.408 million gallons per day (MGD). This is consistent with the range of volumes observed since 2012 (0.392 to 0.416 MGD).

BHCCSD monitors and calculates seasonal TP and TIN loadings to North Clear Creek pursuant to a 2000 intergovernmental agreement (IGA) among Central City, Black Hawk, Gilpin County and the District. In Figure 8 and Figure 9, total phosphorus and total inorganic nitrogen loadings for 2015 are compared to the loading goals specified in a 2000 Water Court Stipulation. BHCCSD was not party to the Stipulation, but agreed under the IGA to use its best efforts to operate and maintain the WWTF, which was designed to meet these loading goals. The loading goals are based on an average effluent TP concentration of 0.3 mg/L and an average effluent TIN concentration of 10 mg/L. BHCCSD continues to successfully meet the loading goals (Figure 8 and Figure 9).

[1]While actual flows are less than 1.0 MGD, the design capacity of the plant is 2.0 MGD. Regulation 85 is further described in the following section.

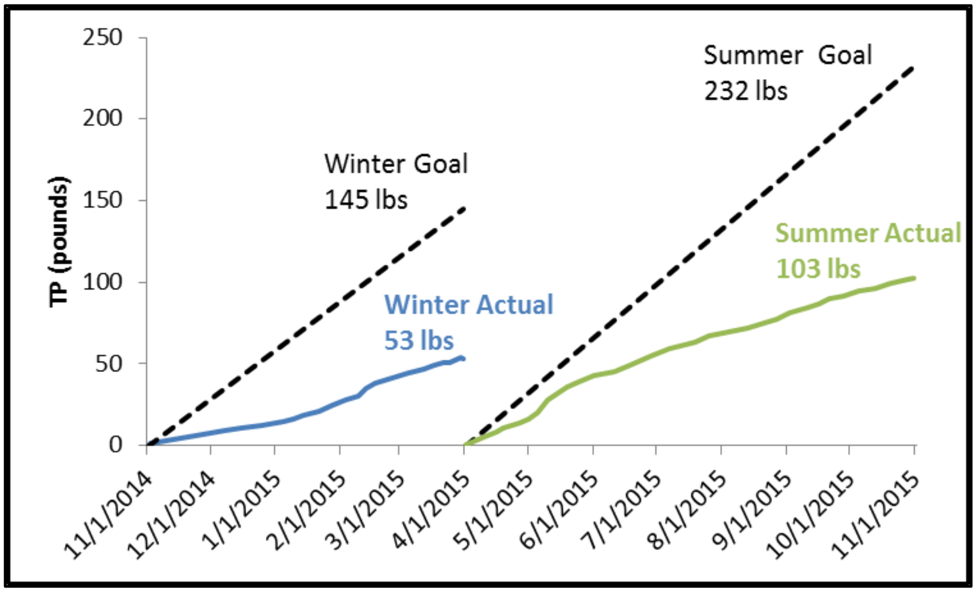


Figure 8. Seasonal TP Loadings to the North Fork of Clear Creek from BHCCSD WWTF

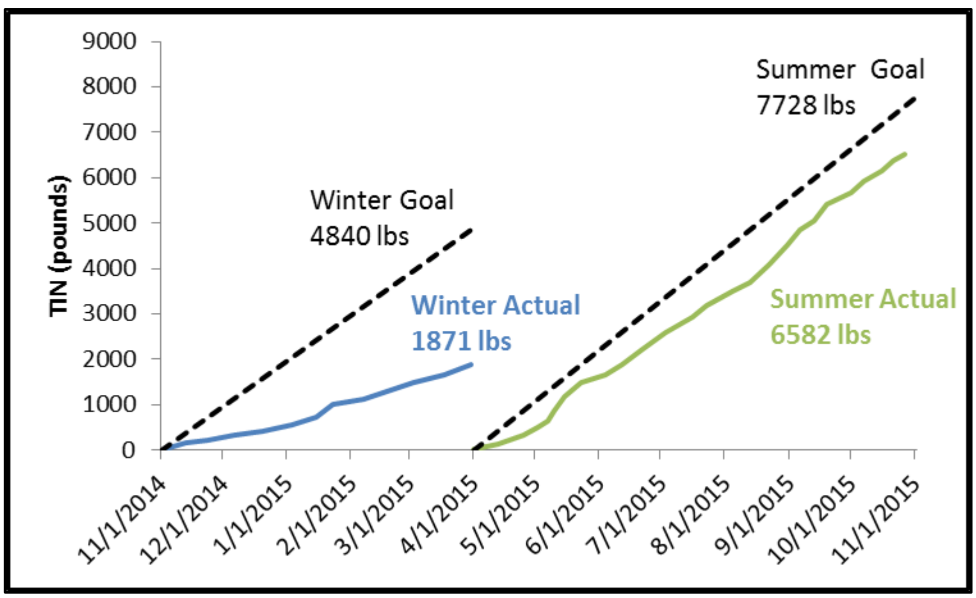


Figure 9. Seasonal TIN Loadings to the North Fork of Clear Creek from BHCCSD WWTF

4. Observed WWTF Effluent Concentrations

In 2012, the Water Quality Control Commission (WQCC) adopted Regulation 85 (CDPHE 2012), the Nutrients Management Control Regulation, which establishes numeric standards for nutrient concentrations in WWTF effluent (Table 5). WWTFs with a design capacity of less than or equal to 1.0 MGD or WWTFs owned by a disadvantaged community are not required to meet the discharge limits set in the regulation. Of the nine WWTFs in the watershed, only Black Hawk / Central City (with a design hydraulic capacity of 2.0 MGD) is subject to Regulation 85.

Table 5. Regulation 85 Limitations, Existing Facilities, for TP and TIN

Constituent	Units	Median (50th Percentile)	95th Percentile
Total Phosphorus	mg/L as P	1.0	2.5
Total Inorganic Nitrogen	mg/L as N	15	20

The WQCC through Regulation 85 also requires all WWTFs to sample and report effluent nutrient concentrations. For minor dischargers (less than 1 MGD), sampling is required at minimum once every two months. For major WWTF dischargers (greater than 1 MGD), monthly sampling is the required minimum frequency. With the exception of BHCCSD, all of the WWTFs in the watershed are classified as minor dischargers. Sampling under Regulation 85 began in April of 2013. Prior to this, periodic effluent sampling for nutrients was conducted as part of the Upper Clear Creek (UCC) Monitoring Program. Nutrient analysis of samples from the WWTFs was discontinued with the implementation of Regulation 85. Data from the UCC Monitoring Program and data collected to meet Regulation 85 requirements represent end-of-pipe concentrations and are generated by different laboratories, in some cases, using different methods.

TP and TN concentrations measured for each WWTF in 2010-2015 are presented in Figure 10 through Figure 15. These figures show observations from both the UCC Monitoring Program (through early 2013) and Regulation 85 sampling (2013 to present). Note that the sampling frequency varied by WWTF and over the course of the year. Data collected as part of the UCC Monitoring Program are depicted with filled data points, and data collected as part of Regulation 85 are depicted with hollow data points. For context, the average daily flow for each plant in 2015 is provided on each figure.

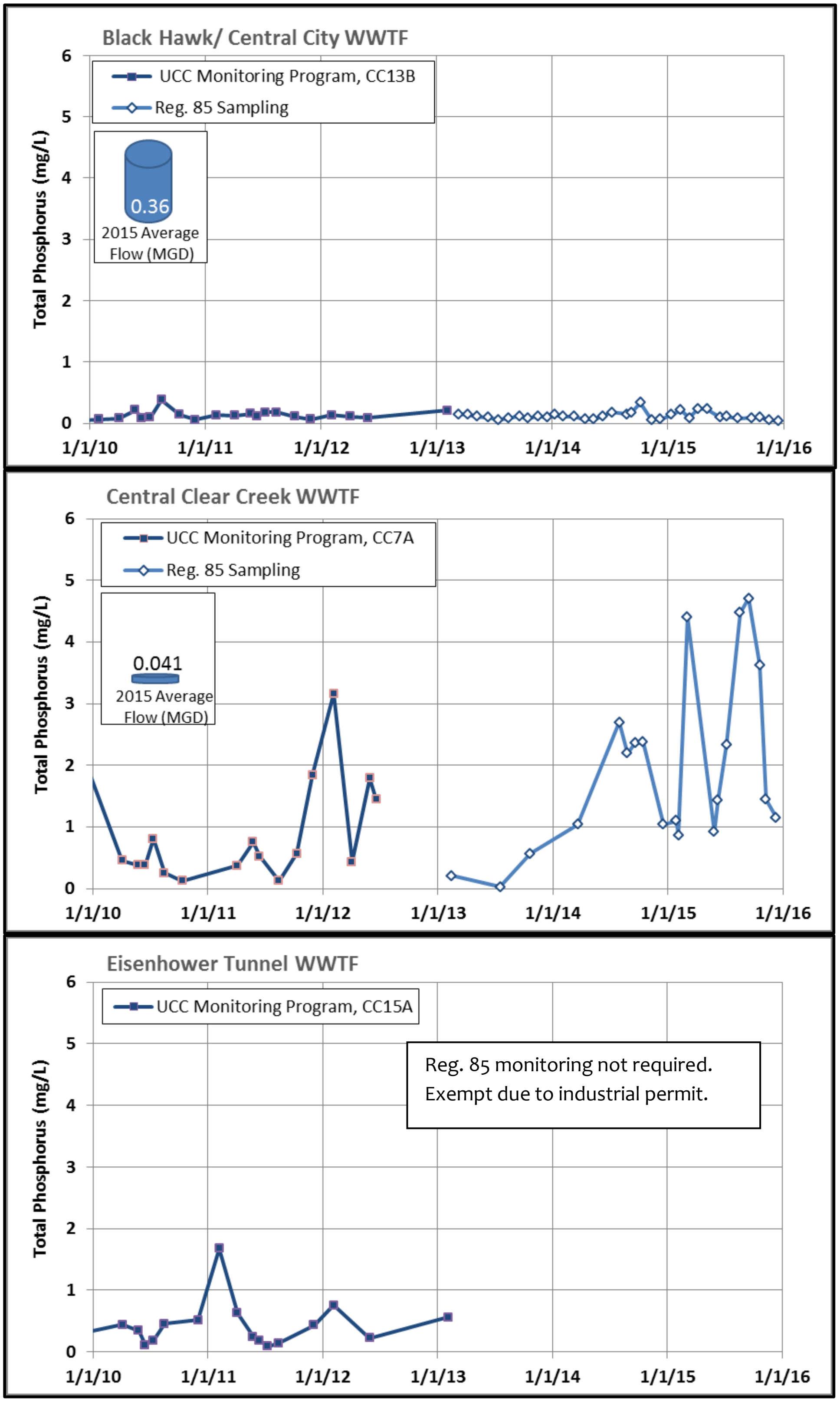


Figure 10. Effluent TP Concentrations (2010-2015) for Black Hawk/Central City, Central Clear Creek, and Eisenhower Tunnel WWTFs

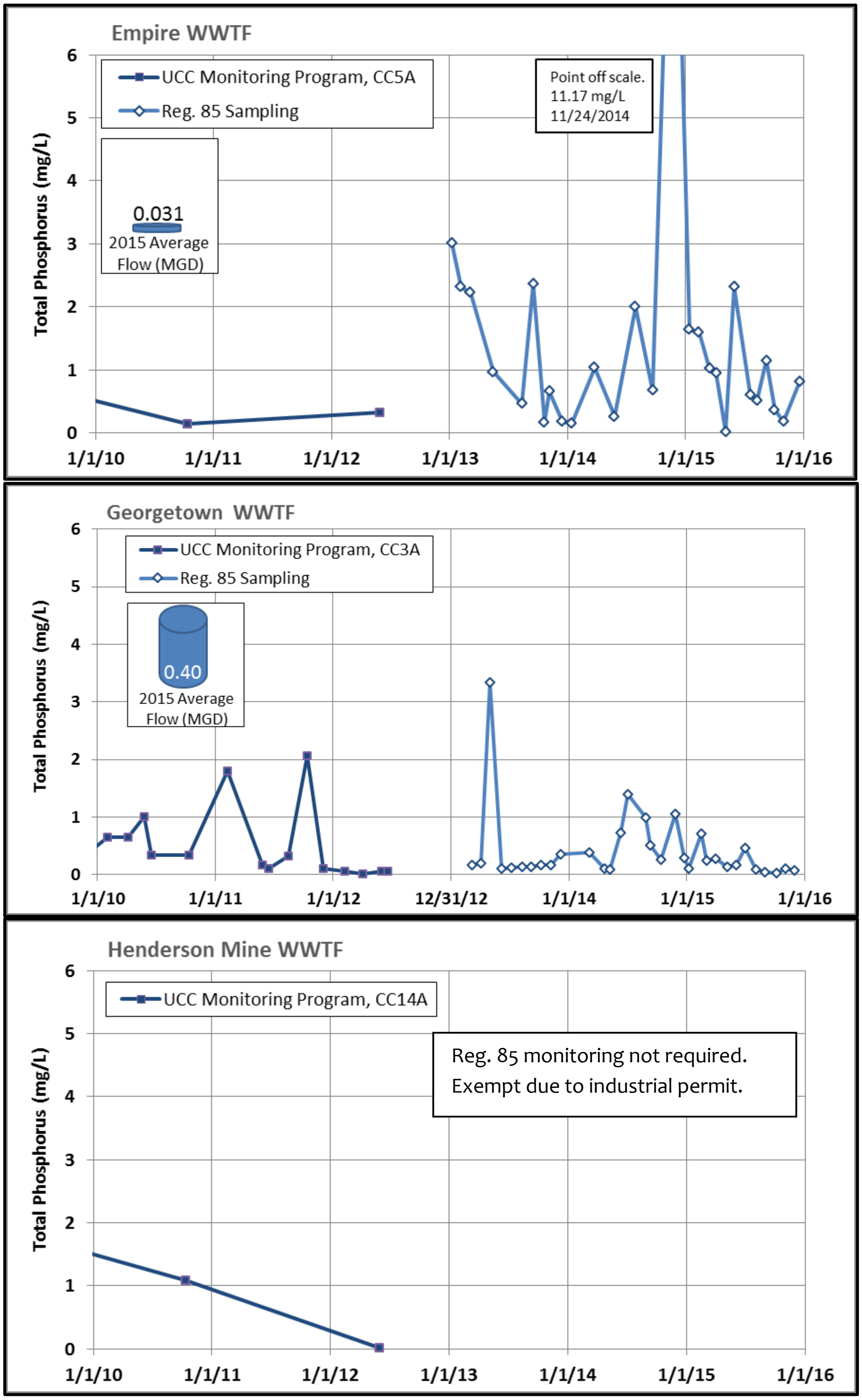


Figure 11. Effluent TP Concentrations (2010-2015) for Empire, Georgetown, and Henderson Mine WWTFs

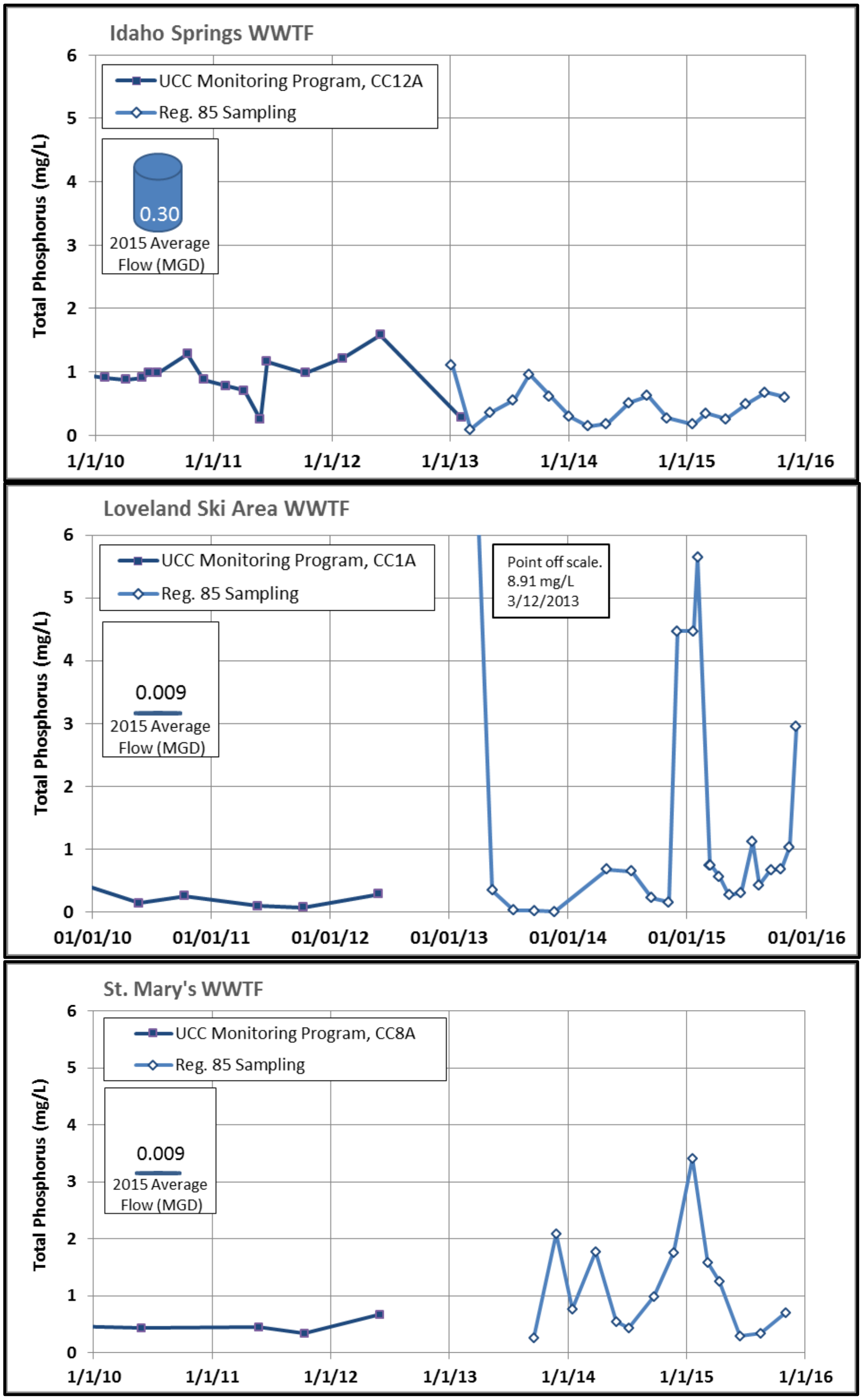


Figure 12. Effluent TP Concentrations (2010-2015) for Idaho Springs, Loveland Ski Area, and St. Mary's WWTFs

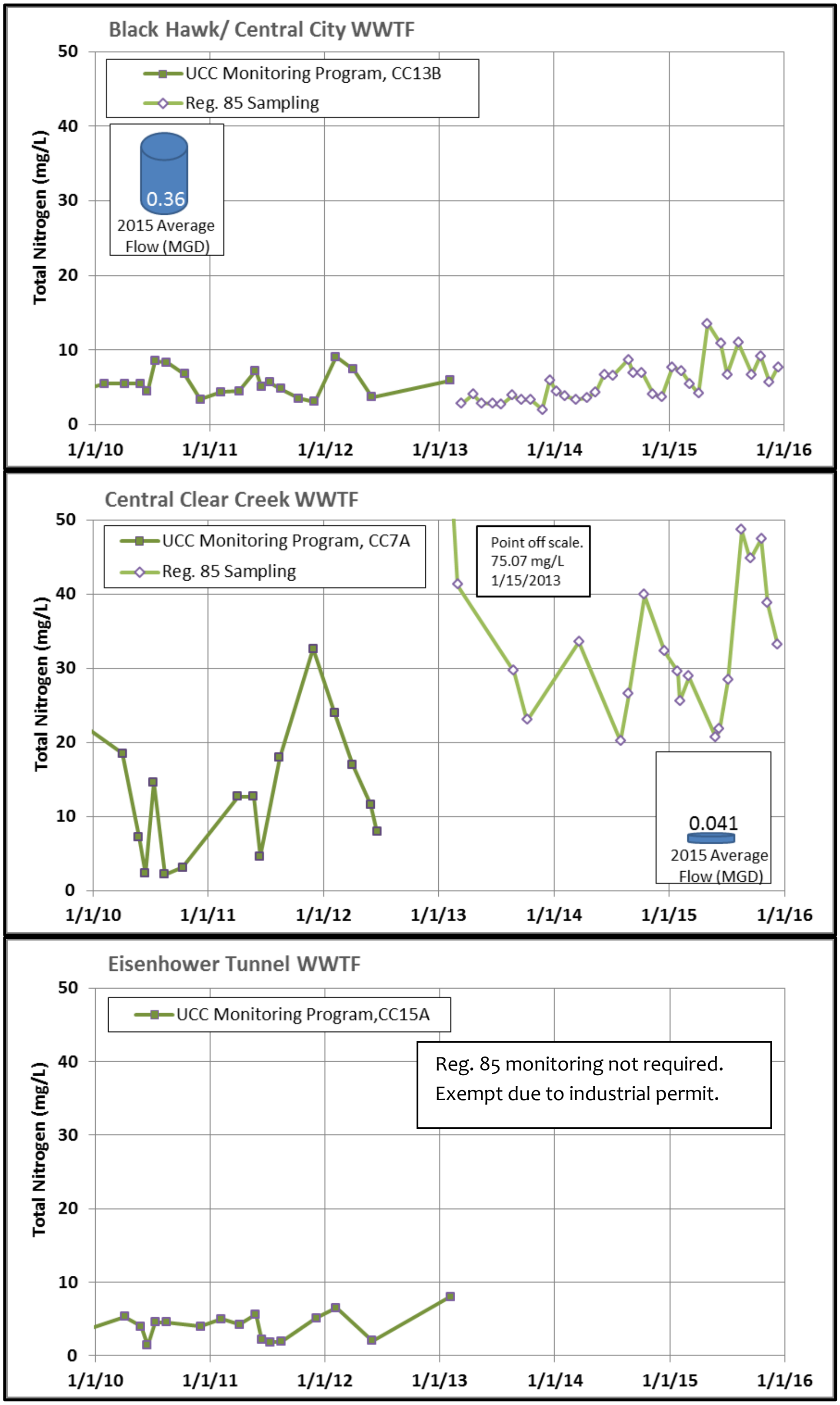
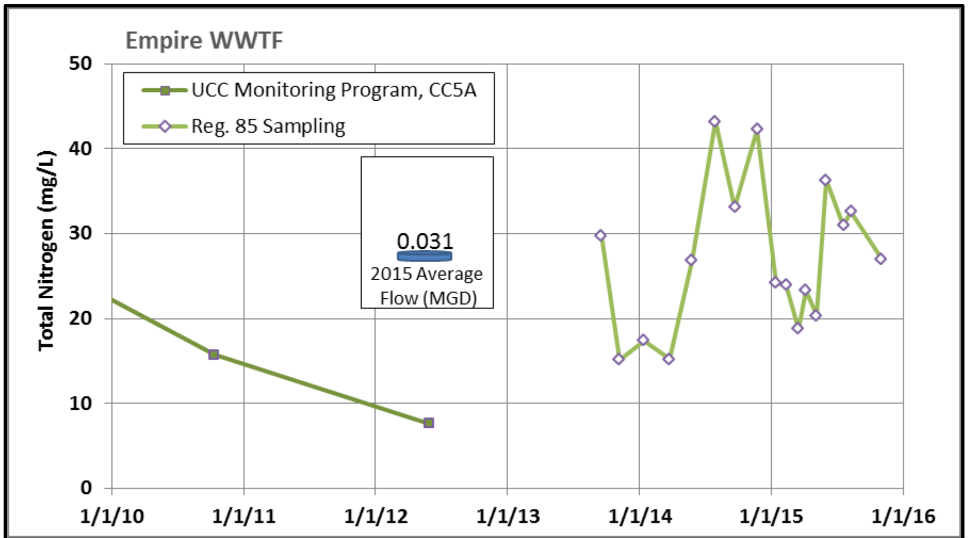
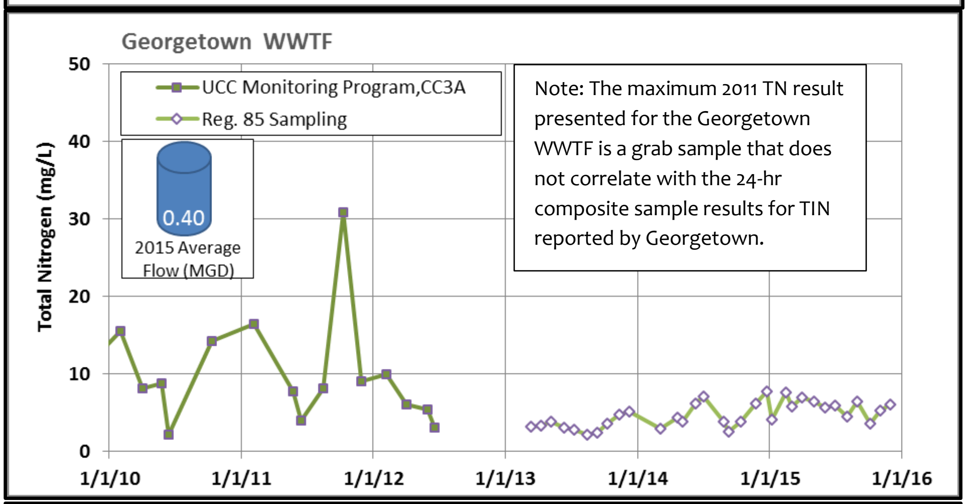


Figure 13. Effluent TN Concentrations (2010-2015) for Black Hawk/Central City, Central Clear Creek, and Eisenhower Tunnel WWTFs





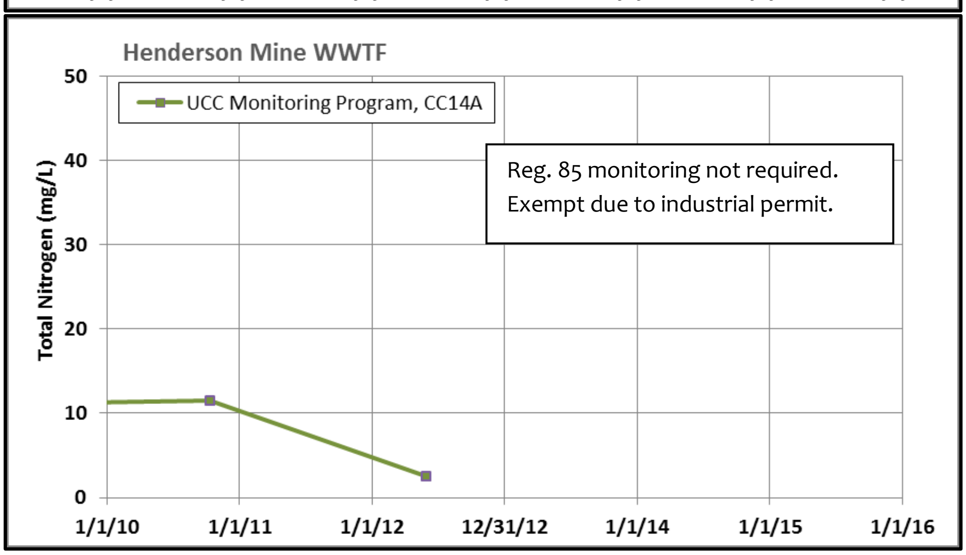


Figure 14. Effluent TN Concentrations (2010-2015) for Empire, Georgetown, and Henderson Mine WWTFs

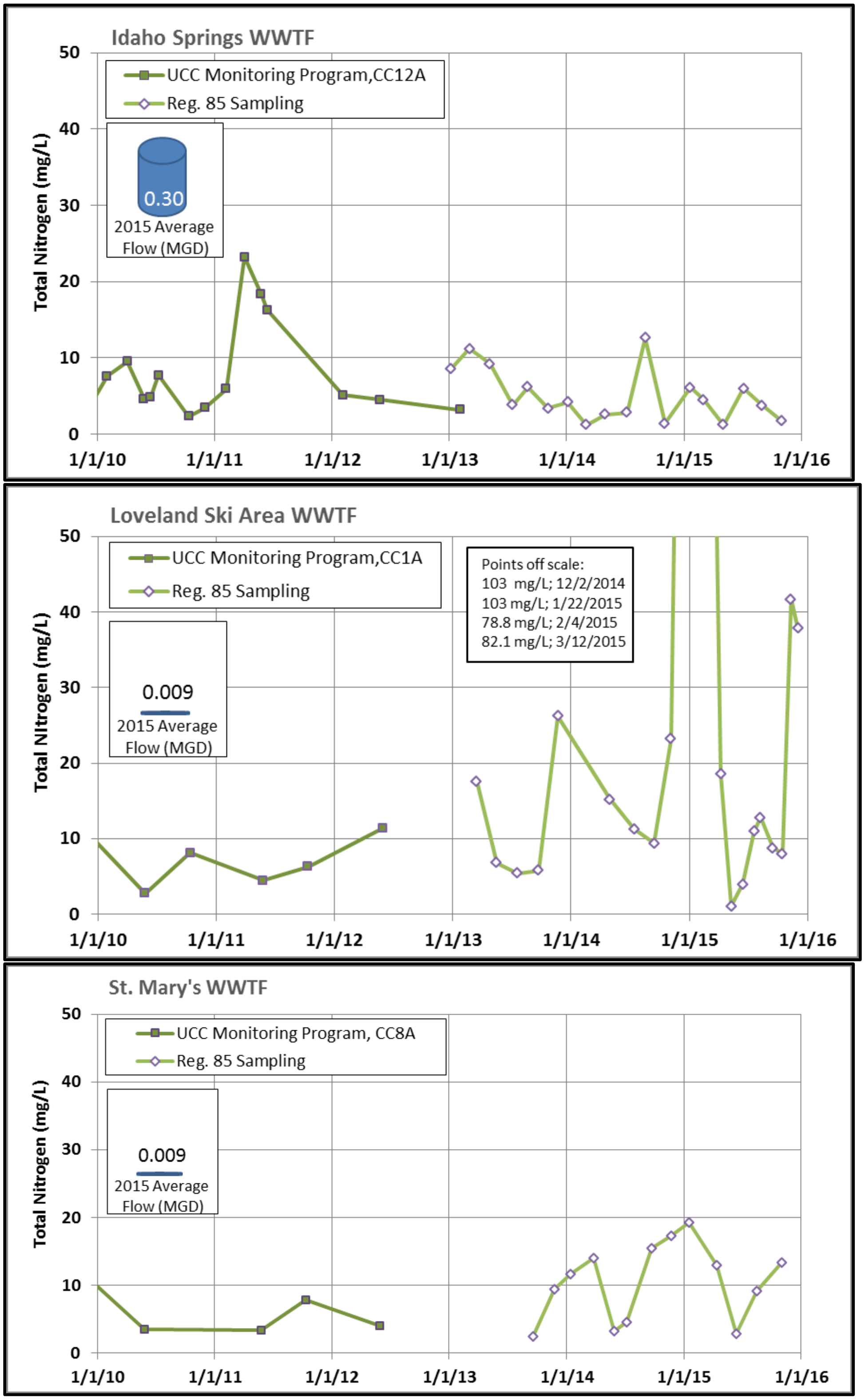


Figure 15. Effluent TN Concentrations (2010-2015) for Idaho Springs, Loveland Ski Area, and St. Mary's WWTFs

D. Illicit Discharges and Emergency Response

Timely response to unexpected upstream releases and limiting illicit discharges are keys to controlling the effects of these incidents on in-stream and reservoir water quality. Programs to address these issues continue to improve and be effective.

1. Illicit Discharges

The City of Golden responded to 34 reports of illicit discharges or potential discharges to the storm sewer system in 2015. This resulted in eight written and 21 verbal warnings being issued. In addition, one fine was issued and in one case clean-up costs were charged. Jefferson County inspected 36 reports of illicit discharges. Twelve of these resulted in permit enforcement actions. The Illicit Discharge Detection and Elimination Program of the City of Arvada issued 17 written Notices of Violation. Further, the City conducted clean-ups on seven spills with no identified responsible party. In addition, Arvada conducted dry-weather screenings of outfalls. These outfall inspections identify and eliminate potential sources of illicit discharges. Further, these screenings evaluate the condition of outfalls and identify those in need of repair. Outfalls found to be in need of repair are listed on a maintenance schedule.

2. Emergency Response

In order to promptly and effectively notify downstream users of Clear Creek water of any potential contamination from an upstream source, Clear Creek County uses the Code Red Emergency Call-Down System. The Clear Creek Office of Emergency Management continues to maintain and update the database for the call lists. The system applies to incidents / spills into Clear Creek and its tributaries that occur in Clear Creek County. In 2015, Clear Creek Dispatch and the City of Golden Dispatch Center launched 11 calls for incidents within its jurisdiction that impacted Clear Creek. The City of Golden launched eight traffic-related calls. Clear Creek County launched two calls related to suspicious mine-water discharge. The remaining call was in response to a plant malfunction.

E. Nonpoint Source Control and Stormwater Management

Additional efforts to reduce pollutant and nutrient loading to Clear Creek in 2015 are discussed in this section. The sources in the previous two sections, WWTFs and illicit discharges, are types of point sources. The sources in this section are primarily non-point sources, including stormwater and erosion. It also includes OWTS monitoring. The following subsections provide selected highlights of such activities.

1. Erosion and Sediment Control

City of Golden: The City of Golden operates under a Municipal Separate Storm Sewer System (MS4) permit and is designated a Qualifying Local Program by the Water Quality Control Division. Under this permit and designation, the City has ensured that erosion and sediment controls are implemented on construction sites. In 2015, the City of Golden administered 22 stormwater-quality construction permits and conducted 709 erosion and sediment control inspections. These inspections resulted in 281 written and 176 verbal notifications. Five stop-work orders were issued, seven permits were withheld, and at one site, performance security for corrections was used.

The Stormwater Maintenance Program of the City of Golden performs yearly inspections on all private systems requiring routine cleaning and maintenance. In 2015, 288 inspections were conducted resulting in 194 letters sent to land owners requesting maintenance. In addition, the City's Stormwater Division inspects and cleans municipal inlets twice per year. This aggressive schedule helps increase the efficiency of system operation and improves the quality of stormwater released to the creek. Stormwater conveyance system improvements have included sumped manholes and sediment traps. The sumped manholes allow for the settling of solids in stormwater. These sumps are cleaned twice per year, yielding an average of 1 cubic yard (CY) per cleaning. The City has also installed sediment traps in ponds and at outfalls. These additions have resulted in a substantial increase in captured sediment and debris relative to previous years. In 2015, sediment traps removed and captured 307 CY of debris that would have otherwise been released to Clear Creek.

Recent changes also include the reconfigured channel and sediment trap in Tucker Gulch, in the area of 7^{th} Place and Highway 58. In 2014, a joint project in cooperation with UDFCD reduced the channel gradient and provided a large sediment trap just upstream of the bridge. The reconstructed channel provides a location for sediment to settle upstream of the bridge where it can be easily removed. Following a very wet spring with several heavy rains, the Stormwater Division removed 28 truckloads of sediment in 2015. The project has already proven to be more maintainable, resulting in a cleaner stream.

Jefferson County: The MS4 Program of the County conducted 2,782 inspections. These resulted in enforcement actions in 28 cases.

City of Arvada: The City of Arvada's most concentrated efforts for the protection of water quality in the Clear Creek basin continue to focus on compliance with the City's MS4 permit. The control of erosion on active construction sites and the inspection of post-construction permanent BMPs are two key components of the MS4 program. In 2015, 1,556 erosion and sediment control inspections were conducted on 140 active construction sites. These inspections resulted in 24 Notices of Violation. Further, 16 builders were subject to additional enforcement. As a consequence, they must now demonstrate compliance prior to receiving building permits.

A second key component of Arvada's stormwater program is inspection and enforcement of permanent BMPs for stormwater. These BMPs include detention and retention ponds, swales, and underground proprietary devices. In 2015, 21 new permanent BMPs were added to the 173 BMPs previously implemented since the program began. The City inspected 31 permanent BMPs in 2015. Inspections are followed by reports identifying areas of non-compliance which need to be addressed. These reports are sent to owners of the stormwater conveyance.

Stormwater Structure Before (Left) and After (Right) Maintenance Activities

Pollution prevention is an ongoing component of the City of Arvada's stormwater protection efforts. All City of Arvada facilities with runoff control plans are inspected twice annually. Employee training on pollution prevention for municipal operations is conducted annually. The training focus is two-fold: 1) preventing and mitigating any potential contamination sources from City facilities, and 2) spill response procedures specific to work in the field. Arvada's spill response hotline is answered after-hours by personnel at the water treatment plant, who then dispatch on-call staff to respond to the spill.

Clear Creek County: As part of the County's efforts to control the releases of sediment to Clear Creek, permits are required for BMPs and floodplain development. The purpose of these permits is to monitor BMP performance and ensure environmental and public safety. In 2015, the County issued six permits for floodplain development and finalized four. In addition, 13 permits were issued for BMPs and five finalized.

Colorado Department of Transportation: CDOT continues to have a number of projects, ongoing and planned, in the Clear Creek Watershed. A major focus of these projects is the control of erosion and the capture of sediments produced during construction and during highway maintenance activities.

CDOT completed most phases of the I-70 Twin Tunnels Project in 2015. This project included the addition of multiple water-quality protections over a four-mile stretch of I-70. Sediment capture was increased through the addition of five sediment basis and three modified shoulder inlets. In addition, two spill containment sites were added. Project-related stream improvements for Clear Creek included a more natural channel and floodplain and new plantings in wetland and riparian areas. A new trailhead and concrete trail was built at the Old Game Check Station.

Eastbound Twin Tunnels After Completion (Photo Credit: CDOT)

Clear Creek Channel After Twin Tunnels Project, Demonstrating Increased Sinuosity and Expanded Floodplain (Photo Credit: CDOT)

Continued progress was made on Peak Period Shoulder Lane Project, with completion expected in 2016. This project involves adding minimal pavement in order to have a managed express lane during specific, peak traffic times. At other times, this lane will serve as a left shoulder. The project includes permanent sediment control facilities (BMPs) that represent a substantial improvement relative to existing conditions. While the paved area will increase by 3%, new BMPs will increase capture volume by more than 20%. As part of replacing the overpass at milepost 241, located near the east end of Idaho Springs, highly-mineralized material near the east end of Idaho Springs will be encapsulated to decrease metals impacts to Clear Creek. The Colorado Department of Public Health and Environment (CDPHE) has provided approval for the management of this metal-rich material.

Clear Creek Tributaries Sediment Control and Metal Removal Project: This project was a cooperative effort between the Clear Creek Watershed Foundation (CCWF) and CDOT. The primary goal of this project was to significantly reduce the loading of particulate metals and particulate phosphate to Clear Creek. Final construction was completed in February 2015. This project was described in detail in the 2014 Clear Creek Watershed Annual Report (Hydros Consulting 2015).

Construction of Detention Basin for Clear Creek Sediment Control Project

2. Onsite Wastewater Treatment Systems

In 2015, Clear Creek County continued implementation of new regulations for OWTS (also known as septic systems) adopted in 2014. Under the new regulations, two new types of OWTS permits are now required in Clear Creek County—Use Permits and Operating Permits. Upon transfer of a property served by an OWTS, the owner is required to obtain a Use Permit. This permit ensures that the system is functioning properly. In 2015, 103 Use Permits were issued. Operating Permits are required for any OWTS that that is designed to provide higher level treatment. The permit verifies that mechanical and/or electrical components are operating as designed. The Operating Permit Program does not go into full effect until 2016 and will result in approximately 300 permits. In 2015, 27 Operating Permits were issued, primarily for new construction.

F. General Public Education, Outreach and Partnerships

Outreach activities, primarily through festivals, seminars, and public meetings, are a key component of educating the public about the protection of water quality.

1. General Public Education and Outreach

Clear Creek Watershed Foundation: The CCWF organized and hosted the seventh annual Clear Creek Watershed Festival in September 2015. Over 600 people attended. This growing, popular event is held at Courtney Riley Cooper Park located along the banks of Clear Creek in central Idaho Springs. The event and creek-side venue provide the opportunity for watershed stakeholders to share their message and educate participants. A focus of this event is the balance between natural resources, recreational activities and sustainable living opportunities in the Clear Creek watershed.

2015 Clear Creek Watershed Festival

City of Golden: The Stormwater Program of the City of Golden continues its public education campaign by distributing educational materials and attending or hosting public events. Events in 2015 included the Water-Wise Seminar and Greener Golden. At these events, Golden distributes Garden-in-a-Box kits to encourage the planting of water-conserving landscapes. In addition, Golden held another successful Public Works Academy in 2015. This 20-hour program educates citizens about the range of facilities and activities of the Public Works department. In 2015, this program was attended by 11 individuals. The City actively participated in the Osher Lifetime Learning Institute through the University of Denver. Thirteen participants attended presentations covering water rights, the water treatment plant, Environmental Services Lab, Distribution, Collection and Asset Management.

Jefferson County: The County participated in a number of public events in 2015. These events reached diverse audiences with information about the County's MS4 and flood plain management programs.

City of Arvada: Public Education and Outreach continues to be a major component of Arvada's Stormwater Program. Education for contractors, City personnel, citizens, and students is provided by the City on an on-going basis. This ensures that the public is aware that City storm drains flow directly to waterways and that certain activities can contaminate those waterways. The City provides the public with various resources to increase their awareness, such as the adopt-a-street or trail program, storm drain marking, household hazardous chemical disposal and recycling, and brochures and demonstrations that are focused on preventing stormwater pollution. In 2015, City stormwater and environmental education staff had a booth at five festivals and spoke one-on-one to attendees about issues concerning water quality.

2015 Youth Water Festival: On May 12, 2015 fourth and fifth graders converged to learn about a variety of Colorado water topics. Kids from the water service areas of the Standley Lake Cities (Northglenn, Thornton, and Westminster) participated in the annual Youth Water Festival at Front Range Community College in Westminster. Over 1,025 students, teachers and parents attended the event, which offered a day of fun and educational workshops featuring active learning and hands-on activities. The 2015 Youth Water Festival was funded by the Standley Lake Cities. Front Range Community College also contributed by providing discounted facility rental rates

Water conservation kits were provided to attending schools prior to the Youth Water Festival. Teachers incorporated water conservation in their curriculum and asked students to use the kit at home with their families. Each kit contains a 5-minute shower timer, toilet leak dye tablets, a rain gauge, a flow bag, a toilet flapper and an instruction sheet. This year a video was posted online to help teachers and students understand how to use the kits. Teachers reported that they created assignments for each piece in the kit and kids and parents learned a lot about their water usage.

2015 Youth Water Festival

The Festival's workshops were designed to teach students about water conservation, water chemistry, the water cycle, local water supplies, water treatment, Colorado water law, aquatic wildlife, ecology and more. For a well-rounded experience, each class of about twenty-eight students was scheduled to attend five to six workshops on different topics during the day.

Seventy three presenters from local, state, federal, non-profit, and private businesses provided the time and energy needed to make this a successful event. Among the 2015 Water Festival presenters were professionals from: City of Thornton, City of Northglenn, City of Westminster, Carlson, Hammond and Paddock, Northern Water, Mad Science of Colorado, Colorado State Forest Service, Colorado School of Mines, North Metro Fire, Westminster Fire Department, Rocky Mountain Bird Observatory, US Bureau of Reclamation, Raptor Education Foundation, Colorado Water Conservation Board, Adams County – Stormwater, University of Denver, Metro Wastewater, Collins

Cockrel & Cole, PC, Earth Force & Denver Public Works, Rocky Mountain Music, Science From CU, Environmental Learning for Kids, Denver Zoo and GarbageBusters.

2. Recycling and Disposal of Household Chemicals and Hazardous Waste

Rooney Road Recycling Center: This facility provides critical recycling and disposal services for household hazardous waste and electronics. In 2015, the facility collected more than 350,000 lbs of household hazardous waste. The City of Golden contributed $7,903 to the Rooney Road Recycling Center. The City actively participates as a member of the Board of Managers for the Rooney Road Recycling Center Authority. It annually serves more than 3,000 Jefferson County residents. Jefferson County also continues to participate with this facility.

Clear Creek County: Clear Creek County operated three waste disposal programs in 2015. This included the year-round Transfer Station, a free-yard waste disposal event, and the Household Hazardous Waste Program.

The year-round operation of the Transfer Station resulted in the diversion of a large amount of material from the watershed. This included nearly 2,000 tons of solid waste and recyclables and 2,850 gallons of motor oil. In addition, the facility shipped 2,180 CY of chipped slash contributing to forest and watershed health.

The free yard-waste disposal event was utilized by a total of 239 residents. The event collected a total of 218 CY of rubble, 59 CY of furniture, 311 tires, 29 appliances, and 29 CY of slash. The total cost to the county for this event was $2,451.

The Clear Creek County Transfer Station sponsored three single-day household hazardous waste collection events for residents of Clear Creek County. These events were provided at a reduced cost to residents thanks to contributions from the Standley Lake Cities and the Clear Creek Local Emergency Planning Committee. At each event two Clear Creek County employees were present in the receiving area. Each employee was Hazardous Waste Operations and Emergency Response (HAZWOPER) trained. In addition, a chemist provided by the disposal contractor (Clean Harbors) assisted with waste classification. The collection events were outlined in our annual flyer, and public notice of the program was published in both local papers. No appointment was necessary to dispose of waste this year.

A total of 121 citizens disposed of waste this year without incident. Among the materials collected were mixed aerosols, liquid and solid pesticides, solvents, flammable liquids and solids, paint, resins and adhesives; totaling nearly 1,000 gallons. Eighty-two citizens were from the Clear Creek Fire Authority District and 39 from the Evergreen Fire Protection District. This represented a substantial drop from the 238 citizens in 2014. This drop (nearly 50%) may be a result of the change to a fee-based system. The year-round PaintCare program may have also decreased the demand for services. That program has collected and disposed of eight Gaylord boxes (4' by 4' by 4') of household paints. This has saved the County and residents more than $7,200.

3. Pharmaceutical Disposal

Drug take-back events provide a safe way to dispose of unwanted medications; preventing their illicit use and diverting them from entering the water supply. In 2015, the City of Arvada and the Arvada Police Department collected 2,276 pounds of medications during a drug take-back event at City Hall on April 11th.

City of Arvada Drug Take-Back Day

G. Other Activities

The following section provides a description of various water-quality related activities that occurred in the watershed in 2015.

1. Clear Creek County Wildfire Protection Plan and Wildfire Mitigation Grant Program

In 2008, the Clear Creek County Community Wildfire Protection Plan was developed in accordance with the guidelines set by the Healthy Forests Restoration Act (2003) and the Colorado State Forest Service's Minimum Standards for Community Wildfire Protections Plans (2004). The plan was collaboratively developed by interested parties and federal land management agencies with responsibility for land in Clear Creek County. The importance of this collaboration is demonstrated by land ownership within the county. Of Clear Creek County's 396 square miles, only 23 percent (93.6 square miles) is in private ownership. The remainder is in public ownership; the United States Forest Service has responsibility for 67 percent of the county (266 square miles). The plan identifies and prioritizes areas for hazardous fuel reduction treatments, recommends the types and methods of these treatments, and recommends measures to reduce the ignitability of structures.

In 2014, a grant program was created to assist implementation of the Community Wildfire Protection Plan. The Clear Creek County Wildfire Risk Mitigation and Preparedness Grant Program (Grant Program) is a community-based cost share program that provides matching grants to eligible neighborhood, subdivision and community homeowner groups. These grants provide financial assistance to reduce wildfire risk in their communities.

Funding for the grants is budgeted under Capital Projects in the County General Fund, and is available through the grant application process set forth by the Wildfire Protection Task Force (WFPTF). The WFPTF advises the Clear Creek County Board of County Commissioners (Board) regarding the expenditure of Wildfire Mitigation Capital Project funds which must be approved by the Board. The focus of the WFPTF is:

- The mitigation of wildfire risk in Clear Creek County through the conceptual endorsement and implementation of the Countywide Community Wildfire Protection Plan (CWPP) and Community Wildfire Protection Implementation Plans (CWPIP);
- To identify areas where the risk and potential community impact of wildfire is greatest;
- To guide and coordinate community efforts to mitigate the impacts and consequences of wildfire through public education, reducing hazardous fuels, and reducing structural ignitability; and
- Evacuation planning, preparedness, response, and recovery planning efforts.

Projects funded by the Grant Program may include the creation of defensible space to reduce the ignitability of structures, hazardous tree removal, the development of emergency water supplies, and improvements to evacuation routes. The projects funded in 2015 are described below.

Echo Hills Wildfire Mitigation Project

This project entails the creation of defensible space zones, fuels reduction, and vegetation treatments to create perimeters around residential structures according to guidance from the Colorado State Forest Service (CSFS, 2012). According to the Clear Creek County CWPP, the community's hazard assessment is ‘extreme’. Mitigation activities include:

- Removal of dead, unhealthy and pine beetle-infested standing trees;
- Targeted thinning of trees that are too densely crowded or too close to road right-of-ways;
- Removal of ladder fuels, which involves the trimming of low branches from live trees; and
- Chipping, mastication or removal of slash. This included both slash generated during mitigation and existing on-ground material.

For those who have already completed thinning, grant funding will be used for creation of shaded fuel breaks along road right-of-ways, continued monitoring and cutting of unhealthy trees and / or work on defensible space around their homes. Focus will be on increasing the protection of properties from the effects of wildfire, enabling safer conditions for evacuation, and egress / ingress by firefighters and first responders.

A total of 23.54 acres are to be treated in this project. This adds to 50 acres mitigated in 2010 through a Federal Emergency Management Agency (FEMA) grant. The area consists of 157 full and part-time residents in six subdivisions with a population of 301-500 and total acreage of 523. Hard cash matching funds will be used for professional marking of trees and hiring contractors to do the work specified. For homeowners who are doing the work themselves, matching funds can be used to pay for supplies (i.e., chainsaw oil and gas, blade sharpening and maintenance, chipper/trailer rental). In-kind contributions will be in the form of volunteer labor/time. The Echo Hills Homeowners Association will continue to apply for grants and to encourage homeowners to work on wildfire mitigation projects. Project cost was $10,780.

Open Space-Beaver Brook

This is an expansion and continuation of the Open Space Beaver Brook project. Clear Creek County Open Space was awarded a Wildfire Risk Reduction Grant (WRRG) from the Department of Natural Resources (DNR) for $20,000. The funds from the WFPTF provided matching funds for the WRRG. The matching funds allowed for an expansion of the existing project area. The project included 10.38 acres of fuel breaks along the north and east side of Beaver Brook Canyon Road to achieve two goals. First, the fuel breaks are intended to help protect primary egress and ingress for many of the 400 homes in the area. The second goal is to protect the watershed in the surrounding area from wildfire damage, and resulting soil erosion and debris runoff into the North Fork of Beaver Brook and Pat Creek. Project cost was $10,000.

County Roads / Right-of-Ways

These funds were spent on wildfire mitigation efforts along County roads. Roadways targeted for mitigation were identified and prioritized by the WFPTF based on the community fire danger rating in the CWPP. Project cost was $9,220.

2. Clear Creek Watershed Wildfire Task Force

The Clear Creek Watershed Foundation participated in the WFPTF in 2015. This participation may result in beneficial watershed protection projects. For example, the North Empire Creek area, which is the location of substantial reforestation by the Foundation, could become a key linkage area in a watershed-scale fire mitigation effort.

3. Georgetown Source Water Protection Plan

The Town of Georgetown completed its Source Water Protection Plan. The purpose of the plan is to prevent contamination of their drinking water supply. The actions identified in the plan to prevent contamination are (Williams 2016):

- Creating an awareness of the community's drinking water sources and the potential risk to them;
- Education and voluntary solutions to alleviate pollution risk;
- Promote management practices to protect and enhance water sources; and
- Providing an action plan in case of an emergency affecting the water supply.

4. City of Golden Source Water Monitoring

The City of Golden Drinking Water Treatment Plant installed analytical instrumentation at the headworks of the plant. This upgrade allows operators to more closely monitor the conductivity, pH, turbidity and temperature of the water in Clear Creek as it is brought into the raw water diversion pipe. Better knowledge of the upstream conditions in Clear Creek provides the operators of the Drinking Water Treatment Plant an early warning system. This system will provide warning of contaminants in Clear Creek that water plant operators would not want in the water plant and allows greater response time to high turbidity water.

5. Green Lake Pipeline Replacement

The City of Black Hawk and Clear Creek County operate Green Lake which receives trans-basin water delivery by way of Vidler Tunnel and Leavenworth Creek. The pipeline delivers water to Green Lake from Leavenworth Creek. The County and City installed an additional 630 linear feet of 18-inch pipe starting where work left off in 2014. The remaining pipe will be replaced in 2016.

Example Section of New Welded Steel Pipe, Green Lake Pipeline

Georgetown Dam, with New Eight-foot Outlet Gate in Operation

6. Georgetown Dam Outlet

The City of Black Hawk and the Town of Georgetown completed the construction of a new outlet to the dam at Georgetown Lake. The new outlet will have a maximum capacity of 500 cfs. The previous outlet was unable to pass flows required by downstream users when reservoir levels were low.

7. Dory Hill Water Treatment Plant

The City of Black Hawk completed construction of the new Dory Hill Water Treatment Plant in 2015. This construction replaced the original diatomaceous earth (DE) filtration system with microfiltration and increased the plant capacity from 0.5 to 1.0 MGD. The new process is able to handle higher turbidity water. This is an improvement compared to the DE system, which was taken offline as a result of high turbidity events during spring runoff.

New Microfiltration System at Dory Hill Plant

8. City of Arvada Engineering Specification Updates

In 2015, the City of Arvada updated its Engineering Specification Book. Guidance related to management of treated water discharges was updated to be consistent with the current best management practices recommended by CDPHE. Updated specifications included guidance on appropriate methods for disinfecting new water mains. This includes appropriate dosing of chlorine and subsequently, chlorine neutralizing agents. It also provides methods to ensure chlorine is completely neutralized prior to discharge.

9. Aquatic Invasive Species Management

Eurasian Watermilfoil - Eurasian watermilfoil (EWM; *Myriophyllum spicatum L)* is a non-native, aquatic, noxious weed that grows rapidly at depths of up to 35 feet. EWM can grow into dense mats that severely interfere with recreation and can 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 positively identified in 2000. EWM weevils, an herbivorous insect specialized to EWM, have been stocked on the west side of the lake on five occasions since 2002. When an adequate weevil population is sustained, the weevils may be able to control the spread of the milfoil. A substantial decrease in milfoil densities was observed over the course of the weevil stocking program. Additional variables that can contribute to declines include other insects, reservoir drawdown and competition from native plants.

Eurasian watermilfoil near Control Site (Location M1) in 2002

The 2015 EWM survey was performed on 8/25/2015 by City of Westminster personnel. Each of the ten sample sites (Figure 16) was surveyed using an electronic depth finder to identify the densest part of the weed bed. A one-square meter (m^2) sample was collected at this location using a 1-meter wide rake. The vegetation samples were then returned to the lab for identification and enumeration. A subsample of 25 randomly chosen milfoil stems were selected for examination. A dissecting scope (40x magnification) was used to evaluate insect populations, insect damage to plants, and disease.

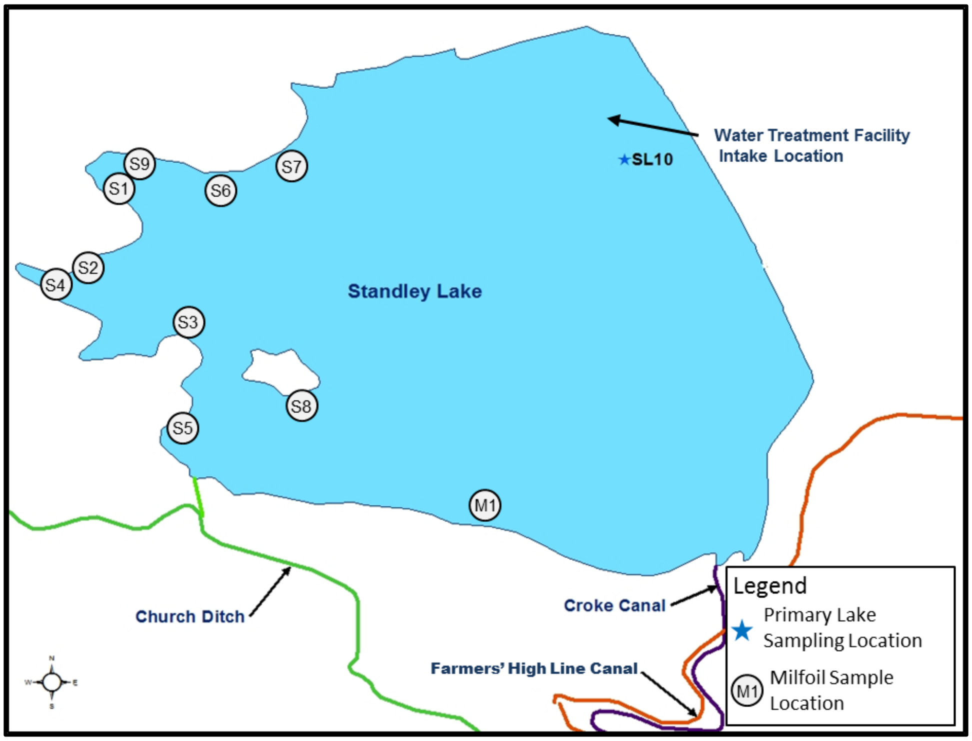


Figure 16. Milfoil Sample Locations

The plant survey underwent a change in methodologies in 2014. Prior to this year, sampling was performed by divers and focused on EWM weevils. Beginning in 2014, the survey method began using a rake for sample collection. The effect of the change in sampling methodologies on milfoil densities is uncertain, given the lack of a direct comparison. However, the milfoil densities measured in 2014-2015 (rake method) are consistent with milfoil densities measured in the preceding years (diver method). Standley Lake experienced a steady decrease in milfoil density from 2006 to 2011, from 450 stems/m^2 to 24 stems/m^2. Since 2011, milfoil densities appeared to have reached a semi-stable condition with an average density of approximately 50 stems/m^2. In 2015, average milfoil densities were 57.9 stems/m^2 (Figure 17). Weevil stocking appears to have played a significant role in the long-term decrease in EWM. However, other factors are likely contributing to the long-term decrease in EWM.

Competition from other aquatic vegetation for the limited pool of available nutrients, minerals, and light provides an additional control on milfoil populations. In 2015, the highest densities of EWM were recorded at locations S2, S4, S6 and S8 (Figure 18). The remaining sites all had much lower densities of EWM. Those sites with the highest milfoil densities were the same sites with the lowest fraction of other plants. This is shown in Figure 19 which provides a comparison of the abundance, expressed as a percentage of the total plant population, of milfoil at each sample site. Many of the sites had strong evidence of weevil damage to EWM. Sites S1, S2 and S4 each had more than 80% of the EWM with weevil damage (Figure 20).

In summary, EWM densities in Standley Lake appear to have plateaued at a density of approximately 50 stems/m^2 at the sampling sites. This represents a nearly 90% decrease from peak densities in 2006. The maintenance of these lower EWM densities results from multiple controlling factors including EWM weevils, other herbivorous insects and competition from other aquatic vegetation.

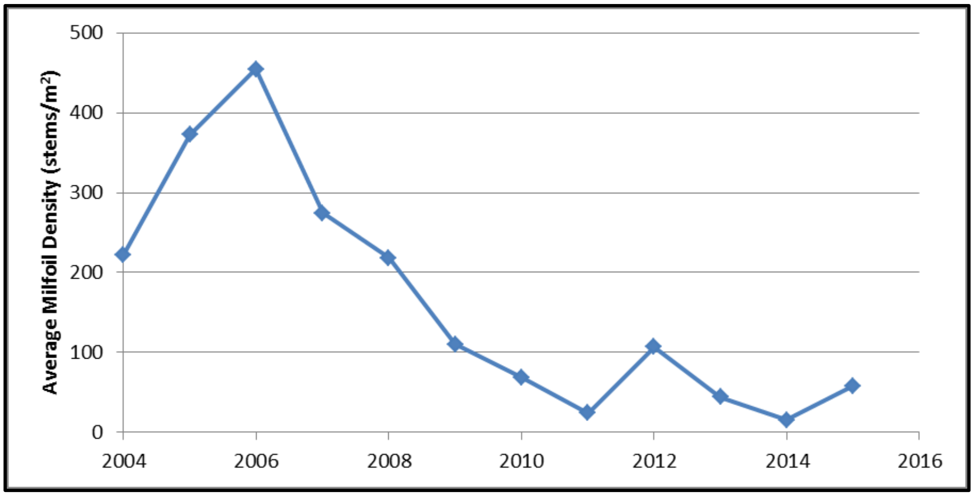


Figure 17. Average Milfoil Densities in Standley Lake (2006-2015) [pre-2014 data from Enviroscience (2013)]

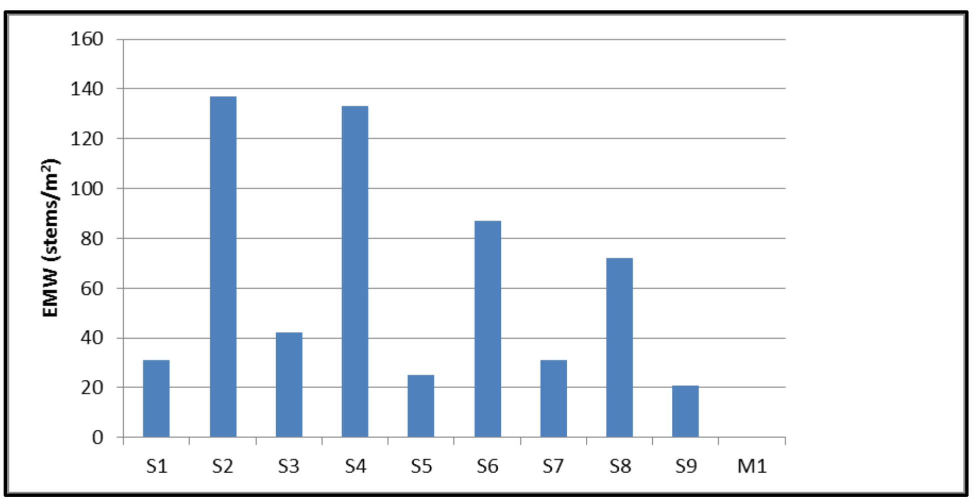


Figure 18. Milfoil Densities by Site, 2015

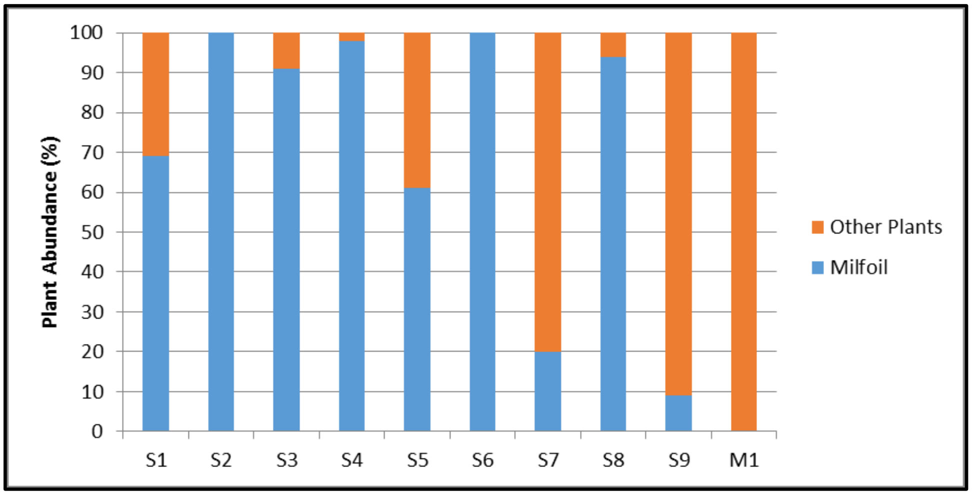


Figure 19. Relative Milfoil Abundance in Standley Lake in 2015

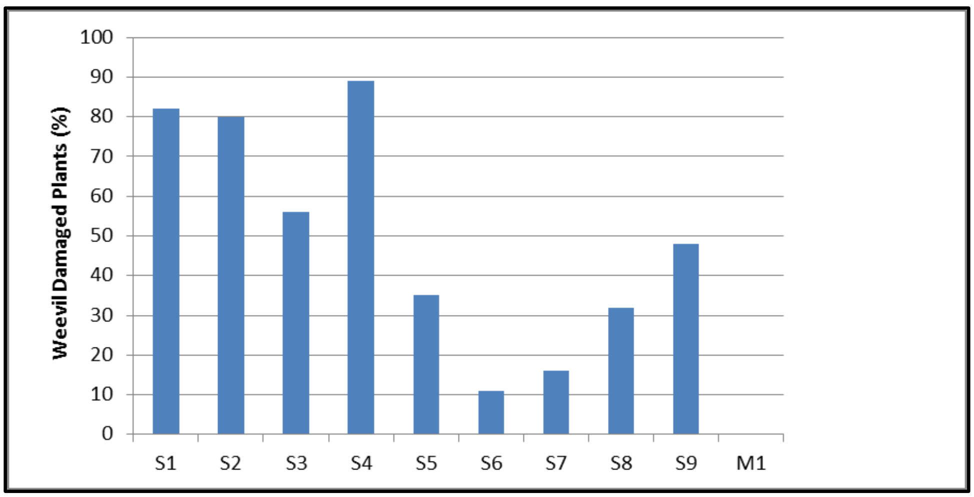


Figure 20. Weevil Damaged Plants by Site, 2015

Zebra and Quagga Mussels - Zebra and quagga mussels are non-native, aquatic invasive species. They can be introduced to new water bodies by the unintentional transfer of organisms from an infested water body via boats or fishing bait. Aquatic mussels cause serious damage to the ecosystem and result in costly control procedures for drinking water treatment facilities. Both zebra and quagga veligers (zebra or quagga mussel larvae) were discovered in a few of Colorado's lakes in 2008. Prevention of aquatic mussel infestation is key to protecting Standley Lake. An intensive boat inspection and decontamination program was initiated in 2008 to protect the lake from new invasive species. Additionally, no live aquatic baits are allowed in the reservoir.

Standley Lake is monitored for aquatic mussels every two weeks using the zooplankton tow procedure. The tows are performed at the lake inlets, SL-10 (Figure 2), and the boat ramp/outlet area. Several invasive species have a planktonic life stage, and sampling with the plankton nets can provide early warning of infestation. In addition, substrate samplers, constructed and monitored by Colorado Parks and Wildlife, are placed throughout the lake. Substrate samplers are made up of a float, rope, plastic plates, and an anchor weight. A plate is located every 10 feet from the surface to the bottom of the lake. The plates and ropes are checked periodically for aquatic mussel growth. A plate or rope that feels like sand paper will be scraped and examined under the microscope for veligers. Shoreline surveys are performed when the water level is at the lowest for the year. A shoreline survey consists of walking the shoreline in teams looking for adult mussels attached to any hard substrate.

Sampling tows, substrate samplers, and shoreline surveys from 2015 show that Standley Lake continues to be free of zebra and quagga mussels.

IV. Upper Basin Flows and Water Quality

The previous section highlighted activities and accomplishments of various entities to manage, enhance, and protect water quality in the Clear Creek watershed. This section describes an analysis of 2015 water-quality data in the Upper Basin. Constituents described include discharge (flow), total suspended solids, total phosphorus, and total nitrogen. The analysis is based on data from two sampling locations CC26 (Clear Creek at Lawson Gage) and CC59/60 (Clear Creek at Church Ditch headgate) (Figure 6). The data from each location includes both grab samples and composite samples, the latter are collected using autosamplers.

Location CC26 is located on the main stem of Clear Creek (Figure 6) between Georgetown and Idaho Springs and provides information on water quality in the upper portion of the Upper Basin. This location includes samples from stations CC26 (grab) and CCAS26 (autosampler). Location CC59/60 is located on the main stem of Clear Creek. It is just upstream of the headgates of the Croke and FHL canals which feed Standley Lake (Figure 6). This sampling location provides information on water quality in the lower portion of the Upper Basin. This location includes samples from stations CC60 (grab) and CCAS59 (autosampler).

A. Discharge

Annual hydrographs for Upper Basin location (CC26) exhibited a fairly typical pattern in 2015 (Figure 21). This pattern can be described as rising in early April and steeply increasing mid-May, coinciding with snowmelt runoff. The annual hydrograph at the lower location (CC60) followed the same basic pattern. In 2015, however a period of rainfall extending from May through mid-June affected the Plains and lower foothills. At some stations rainfall totaled more than 11 inches during this period (Figure 22). At the lower location (CC60), this rainfall resulted in additional flows during the peak runoff period. At both locations, peak annual flow rates occurred in early June. The falling limb of the snowmelt hydrograph extended through the summer punctuated by occasional increases in stream flow associated with precipitation events.

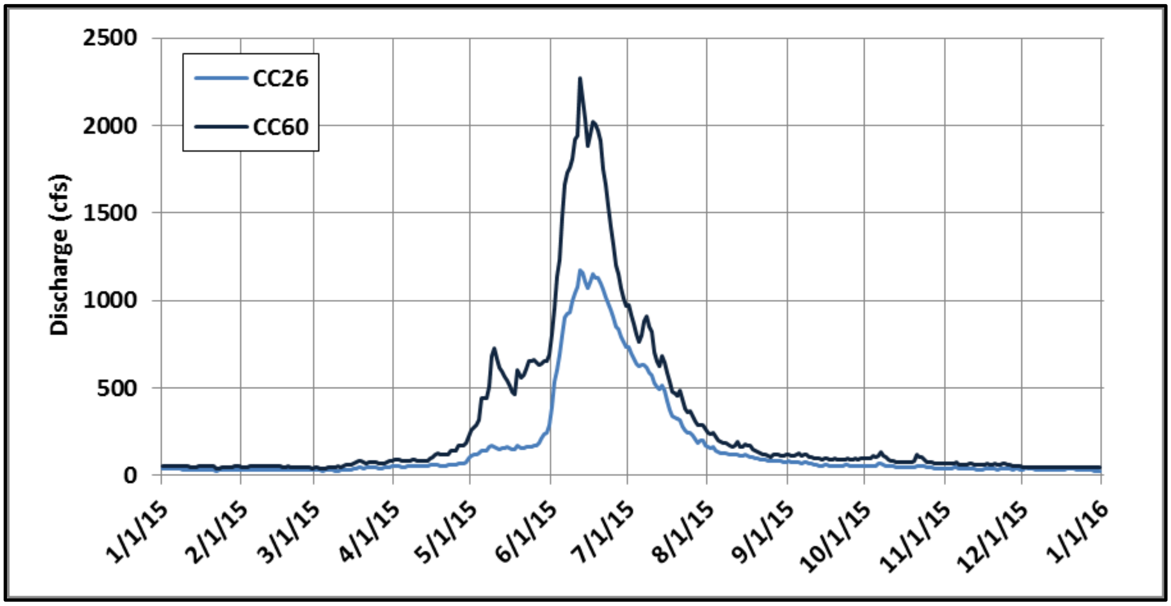


Figure 21. 2015 Clear Creek Hydrographs (CC26, CC60)

Total annual flows at the upper station (CC26) of 119,190 AF were slightly (8%) above the 2010-2014 average of 110,047 AF. The effects of the May-June rainfall in the lower basin are evident in the total annual flow volumes for the lower location. Annual flows at the lower station (CC60) of 209,126 AF were substantially greater (44%) than the 2010-2014 average of 145,484 AF. Compared to the longer-term record (1975-2014), flows in Clear Creek at CC60 were 52% above average. Total annual flow volumes (in AF per year) for 2010-2015 are displayed in Figure 23, which also includes the 2010-2014 average flow volume at each location for reference.

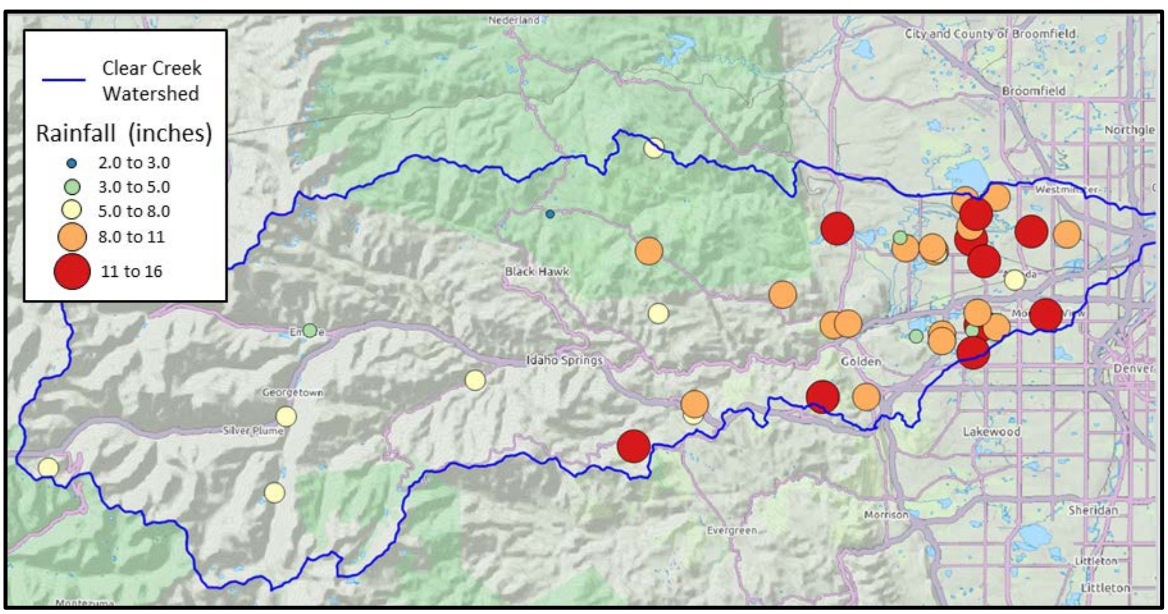


Figure 22. Total May-June Rainfall in 2015 in Clear Creek Watershed

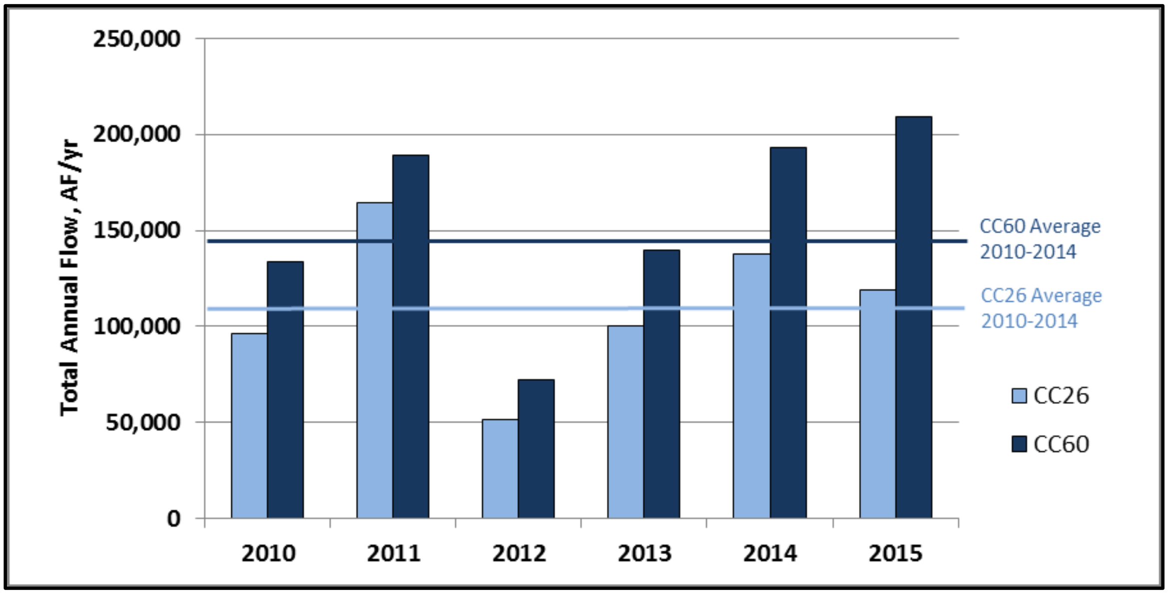


Figure 23. Total Annual Flow in Clear Creek at CC26 and CC60, 2010-2015

Hydrographs from CC60 for 2010-2015 are shown in Figure 24. The 2015 hydrograph was above-average in volume due to the rainfall that occurred in late spring. A difference with previous years is a secondary flow peak in early May 2015. This early peak (May 10th, 726 cfs) appears to be driven by an initial period of rain the first week of May (Figure 25). Following this initial peak, flows are relatively steady until the beginning of June. The beginning of June marks the onset of significant snowmelt, as evidenced by increased flows at CC26 (Figure 21), and additional rain (approximately 4 inches in the first two weeks of June). For the remainder of the year, the overall pattern of flows was similar to previous years.

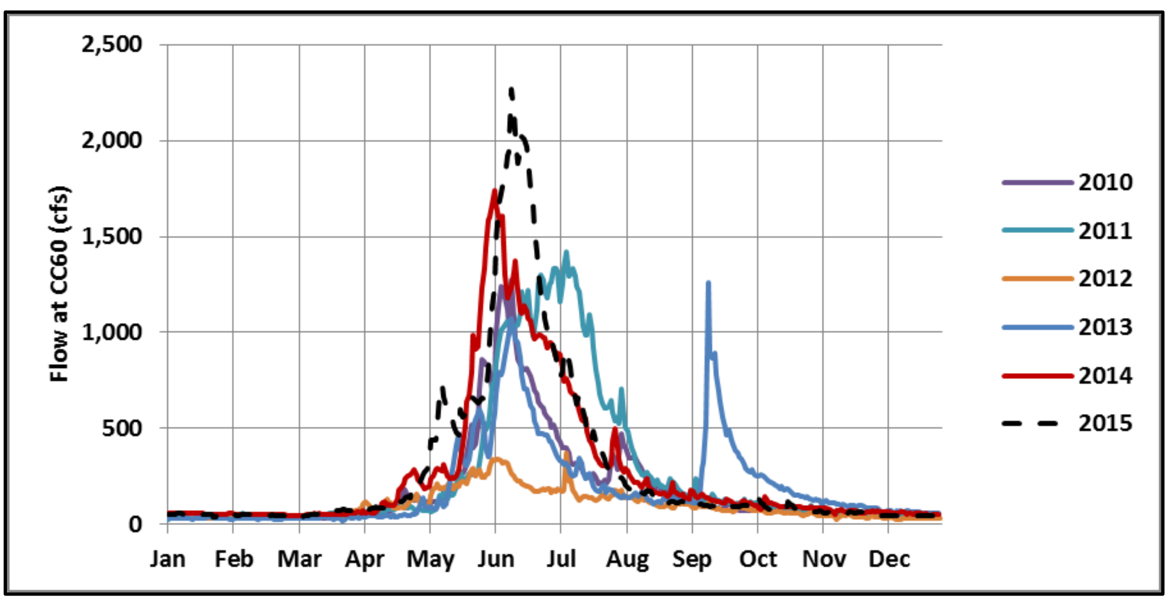


Figure 24. Annual Clear Creek Hydrographs for 2010-2015 (CC60)

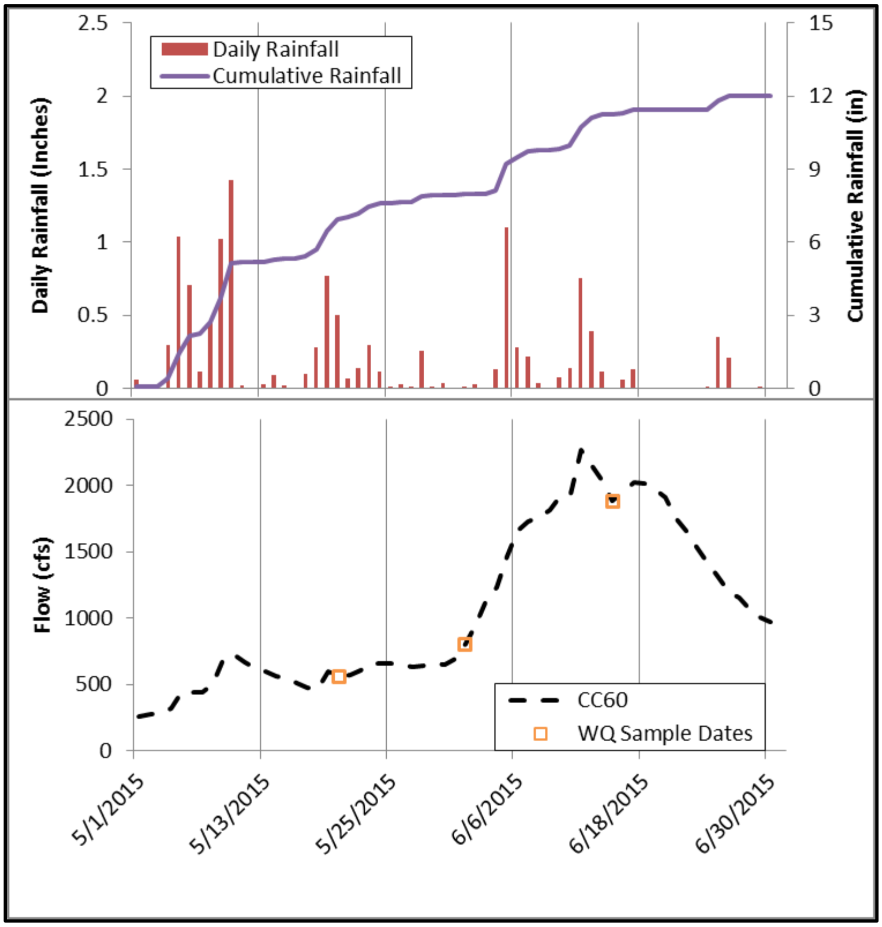


Figure 25. Daily and Cumulative Rainfall in May and June of 2015 at 2.1 miles SW of Golden (upper panel). Stream flow and water-quality sampling dates at station CC60 (lower panel)

B. Total Suspended Solids

Total suspended solids concentrations in 2015 from grab samples and 24-hour composites from autosamplers at CC59/60 and CC26 are displayed in Figure 26. As with previous years, concentrations were higher in the lower part of the basin in comparison to the upper portion. This is consistent with the conceptual understanding of loading patterns. The highest TSS concentration (235 mg/L) was measured at CCAS59 on 6/15/15. This sample was collected at the end of the extended period of rain observed in May and June of 2015. The maximum observed TSS (14 mg/L) for the upper portion of the basin (CCAS26) was also observed on 6/15/2015. Peak TSS concentrations at CC26 were consistent with peak concentrations observed in previous years.

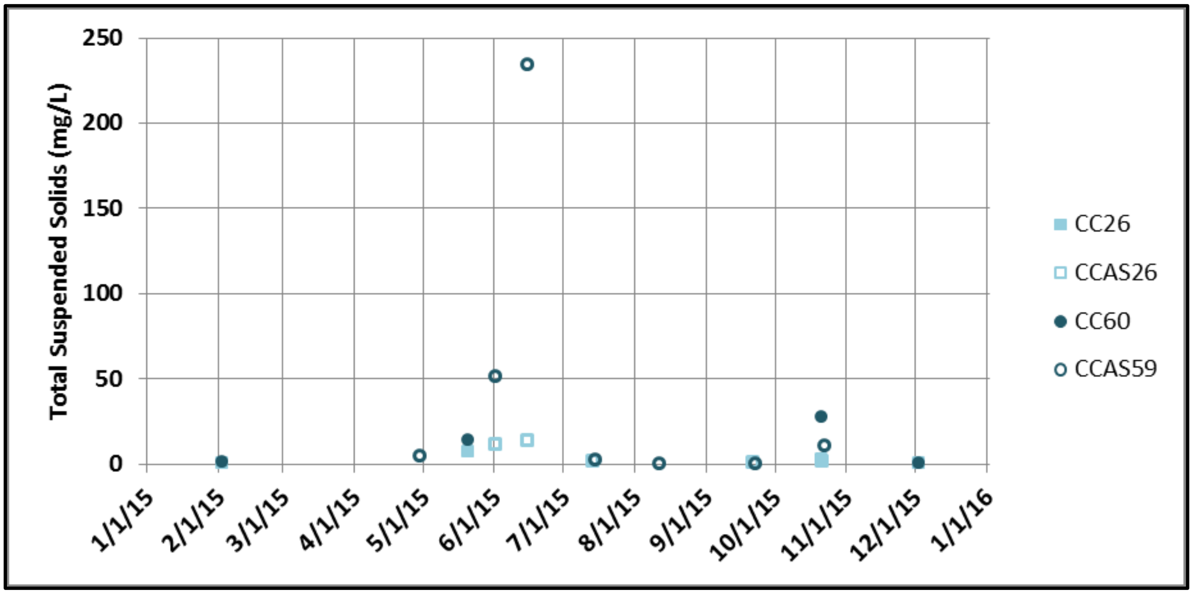


Figure 26. Total Suspended Solids Concentrations (Non-Event) in the Upper Basin, 2015

Non-storm-event TSS sample results in the Upper Basin over the last six years are presented in Figure 27. A pattern of higher concentrations at the lower location (CC59/60) is apparent. The peak 2015 TSS concentration is well above the values observed over the previous five years. This figure presents ambient grab and non-event autosampler results. A review of sample collection and laboratory data associated with the high TSS sample collected in June 2015 at CCAS59 did not identify any irregularities. Considering the antecedent period of rainfall, it is likely that this high TSS sample is associated with high flows due to the heavy spring rains. This observation is supported by the low TSS (14 mg/L) at the upper basin location on the same date. Rainfall totals (Figure 22) indicate that the upper basin was minimally affected by the May-June rainfall event.

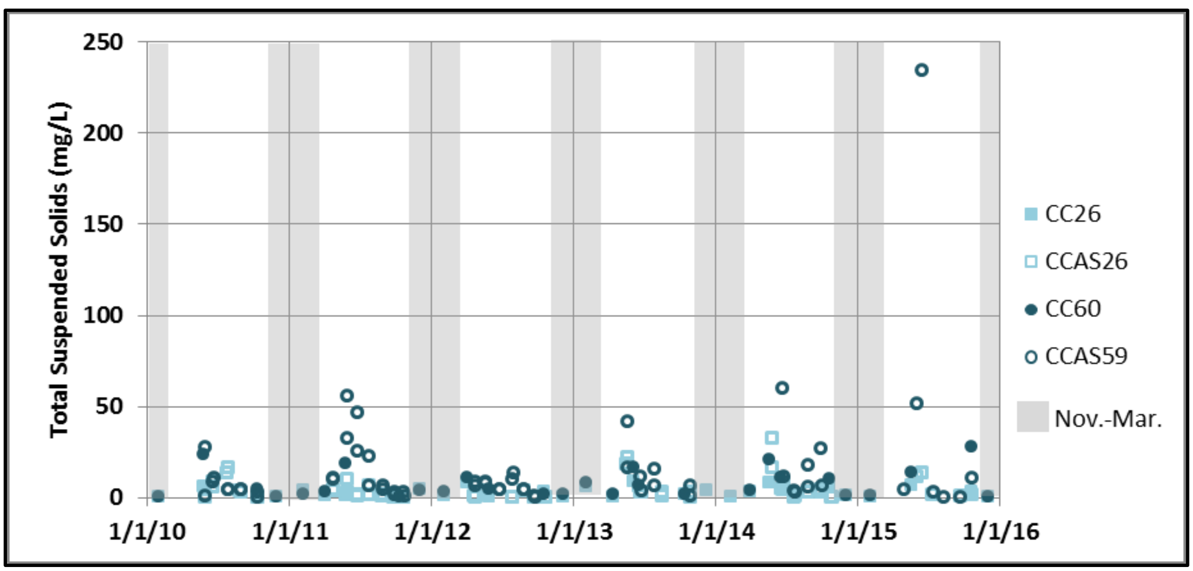


Figure 27. Total Suspended Solids Concentrations (Non-Event) in the Upper Basin, 2010-2015

Average monthly TSS concentrations in the lower portion of the basin in 2015 are compared to the average and range of previous years (2010-2014) in Table 6. For June, comparisons are made both including and excluding the high TSS sample from June 15th. When excluding the June 15th sample, TSS values in 2015 are generally within or near ranges observed from previous years. October and June are exceptions, falling outside previous ranges. For October, the magnitude of the difference is relatively small. For June, TSS concentrations were higher both including and excluding the elevated June 15th sample.

Table 6. Monthly Average Total Suspended Solids Concentrations (Non-Event) in the Upper Basin at CC59/60

Month	2015 TSS Concentrations (mg/L)	2010-2014 Average and Range of TSS (mg/L)	% Difference -- 2015 Versus 2010-2014 Average
February	1.0*	3.4 (0.5-8)	-70%
April	5.0*	7.1 (2.0-11)	-30%
May	14.0*	22.9 (5.0-56)	-39%
June	143.5 (52**)	17.3 (1.0-60)	+728% (+200%**)
July	3.0*	9.4 (3.0-23)	-68%
October	19.5	3.5 (0.5-10)	+457%

* "Average" based on only one observed value.

** Values in parentheses represent June TSS concentrations excluding the June 15th sample.

Analysis of the long-term record (1998-2015) did not find any evident patterns in TSS concentrations in the Upper Basin at either CC26 or CC59/60.

Loads are calculated using daily flows and concentration data, from samples collected as part of the Upper Clear Creek/Standley Lake Watershed Water Quality Monitoring Program. Annual loads are then calculated as the sum of individual daily loads. For the baseline loading estimates, the elevated TSS data from 6/15/2015 was excluded. Non-storm-event TSS loading at CC26 and CC59/60 was calculated for 2015 and compared to estimates from 2010-2014 (Figure 28). At CC26, loads in 2015 were above average, but generally comparable to loads in past years. At CC59/60, loads in 2015 were higher than all but the flood year of 2013.

Volume-weighted concentrations were computed at the two key locations for the past six years (Figure 29). They were calculated by summing the annual load and dividing by the annual flow volume. Volume-weighted concentrations at both stations are above the 2010-2014 average. This pattern is similar to that observed for TSS loadings.

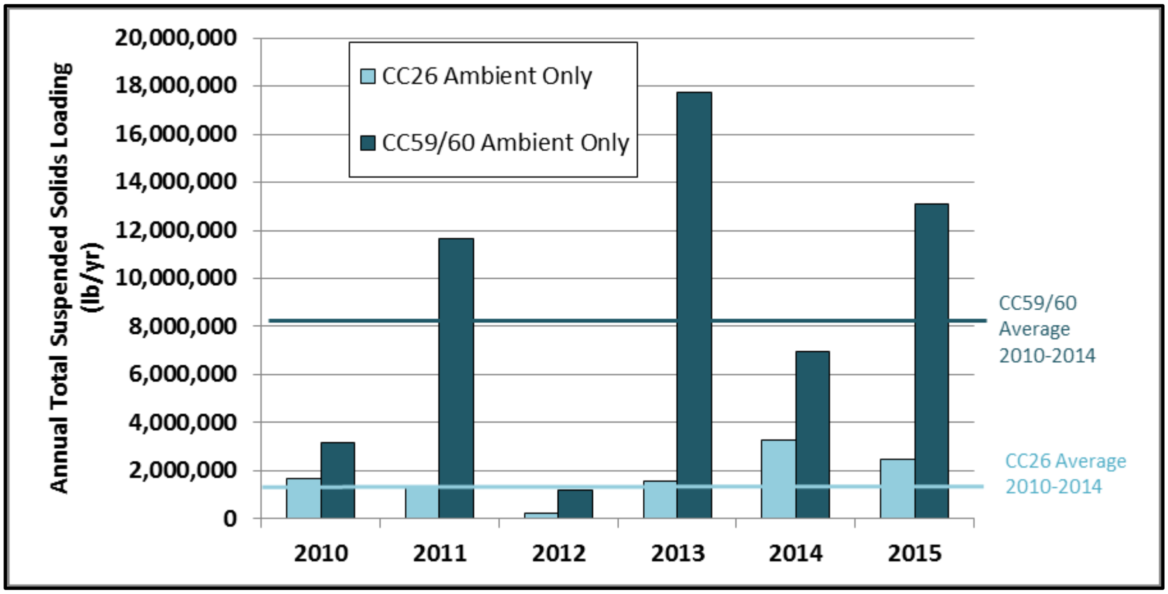


Figure 28. Total Suspended Solids Loading Estimates in the Upper Basin, 2010-2015

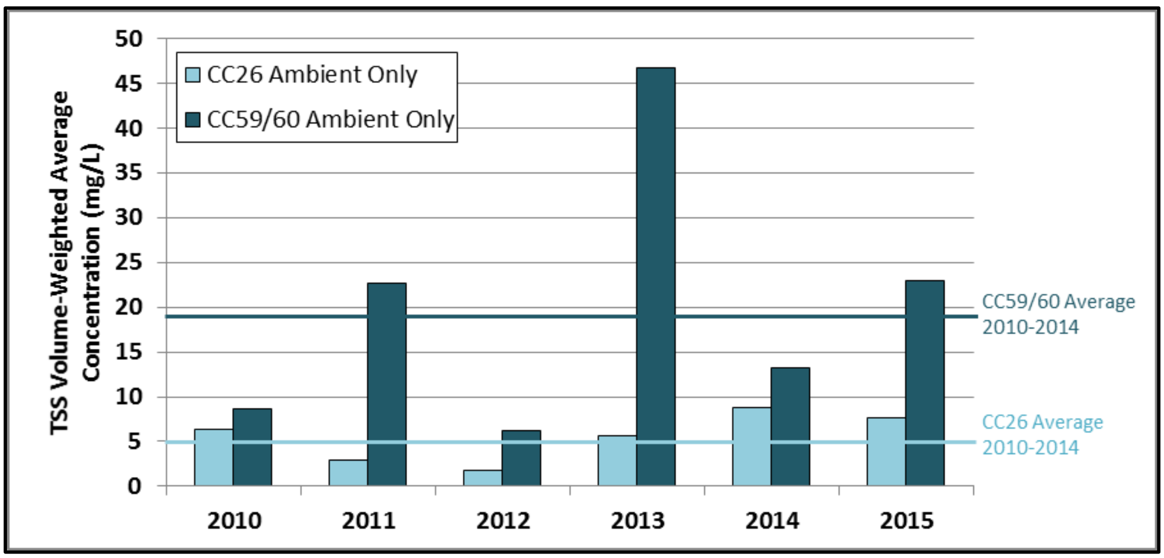


Figure 29. Total Suspended Solids Volume-Weighted Concentration Estimates in the Upper Basin, 2010-2015

In summary, the TSS patterns in 2015 were different for the upstream (CC26) and downstream (CC60) locations. Upstream concentrations, loads, and volume-weighted concentrations were consistent with the ranges observed in recent years. Downstream concentrations, loads, and volume-weighted concentrations showed the effects of the extended rainfall in May and June. This period of rainfall caused increased TSS concentrations and greater than normal flows, resulting in elevated estimated TSS loads at the downstream station.

C. Total Phosphorus

Total phosphorus concentrations from grab samples and ambient autosamplers in 2015 in the Upper Basin are displayed in Figure 30. As observed in previous years, TP concentrations generally increase at both locations during snowmelt runoff. Temporal patterns in total phosphorus concentrations track those for TSS, showing three distinct periods: peak concentrations during snowmelt, decreasing concentrations during the summer, and low concentrations during fall and winter. This similarity in pattern is to be expected given the tendency for phosphorus to adsorb to suspended sediments. The maximum measured concentration of 138 µg/L occurred on 6/15/15 at CC60 at the end of the extended period of rainfall during May-June. As expected, this peak is associated with the peak TSS sample.

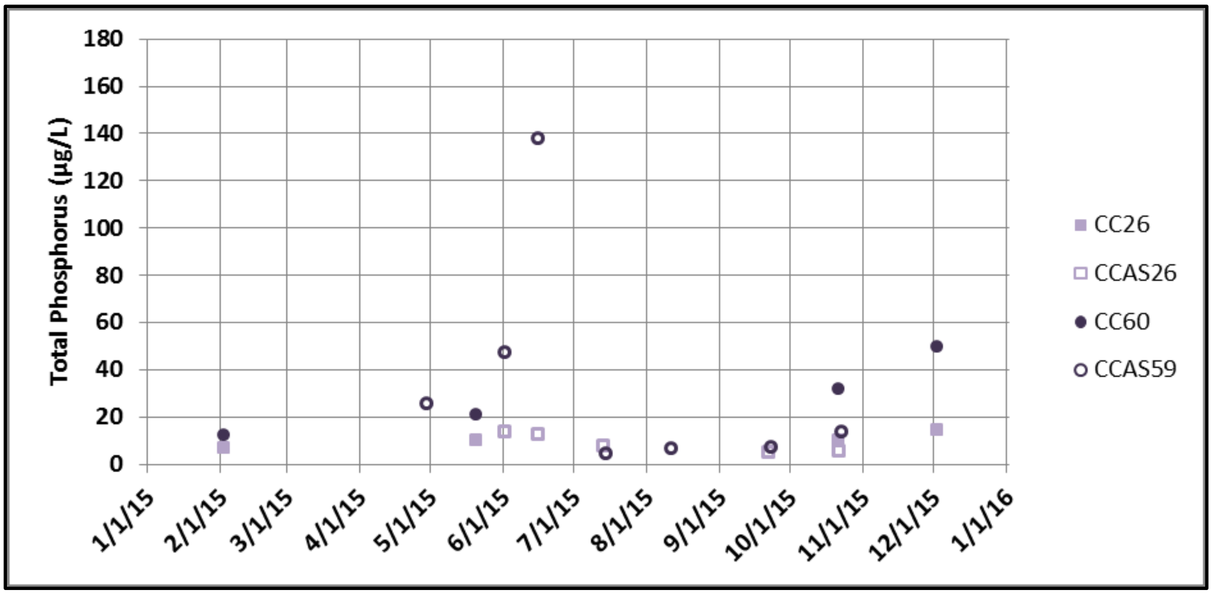


Figure 30. Total Phosphorus Concentrations (Non-Event) in the Upper Basin, 2015

Non-storm-event triggered TP sample results in the Upper Basin for 2010-2015 are presented in Figure 31. The pattern of concentrations in 2015 ambient samples is generally similar to that observed in recent years. However, the peak TP concentration at CCAS59 (138 µg/L) is higher than all but two non-event samples from the 2010-2015 period. As noted above, this figure presents ambient grab and autosampler results and therefore does not reflect storm events.

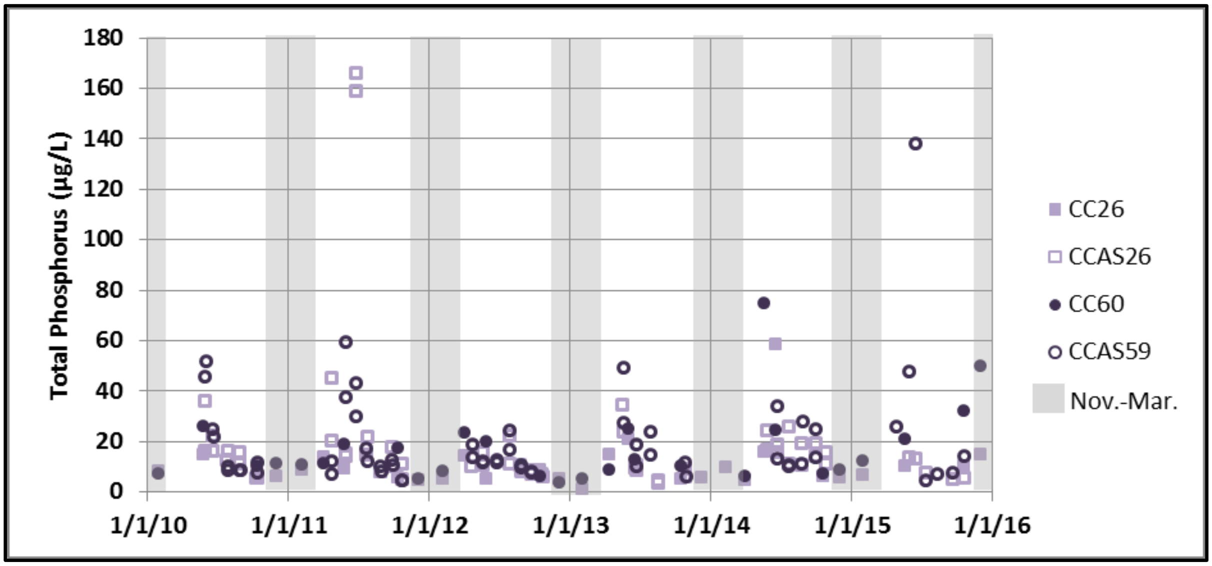


Figure 31. Total Phosphorus Concentrations (Non-Event) in the Upper Basin, 2010-2015

Monthly average TP concentrations for 2015 and the 2010-2014 average and range are shown in Table 7. As with TSS, the 2015 monthly averages are calculated both including and excluding the June 15th sample results. Results from 2015 typically fall within observed ranges from the previous five years. June is an exception, with an average TP values exceeding the 2010-2014 average both including and excluding the June sample.

Table 7. Monthly Average Total Phosphorus Concentrations (Non-Event) in the Upper Basin at CC59/60

Month	2015 Average TP (µg/L)	2010-2014 Average and Range of TP (µg/L)	% Difference -- 2015 Versus 2010-2014 Average
February	12.3*	7.9 (5.3-10.8)	+56
April	25.8*	12.5 (5.9-23.2)	+106%
May	21.0*	34.4 (11.5-74.7)	-39%
June	92.8 (47.6**)	24.8 (10.3-52)	+274% (92%**)
July	4.5	14.9 (8.7-24.5)	-70%
October	23.1	9.2 (4.8-17.1)	+149%

*"Average" based on only one observed value

** Values in parentheses represent June TP concentrations excluding the June 15th sample.

Analysis of the long-term record (1998-2015) did not find any evident patterns in TP concentrations in the Upper Basin at either CC26 or CC59/60.

Non-storm-event TP loading at CC26 and CC59/60 was calculated for 2015 and compared to estimates from 2010-2014 (Figure 32). For the baseline loading estimates, the elevated TP data from 6/15/2015 was excluded. TP loading at CC59/60 in 2015 was above the 2010-2014 average and comparable to loads in the previous two years. Loads at CC26 were below the 2010-2014 average.

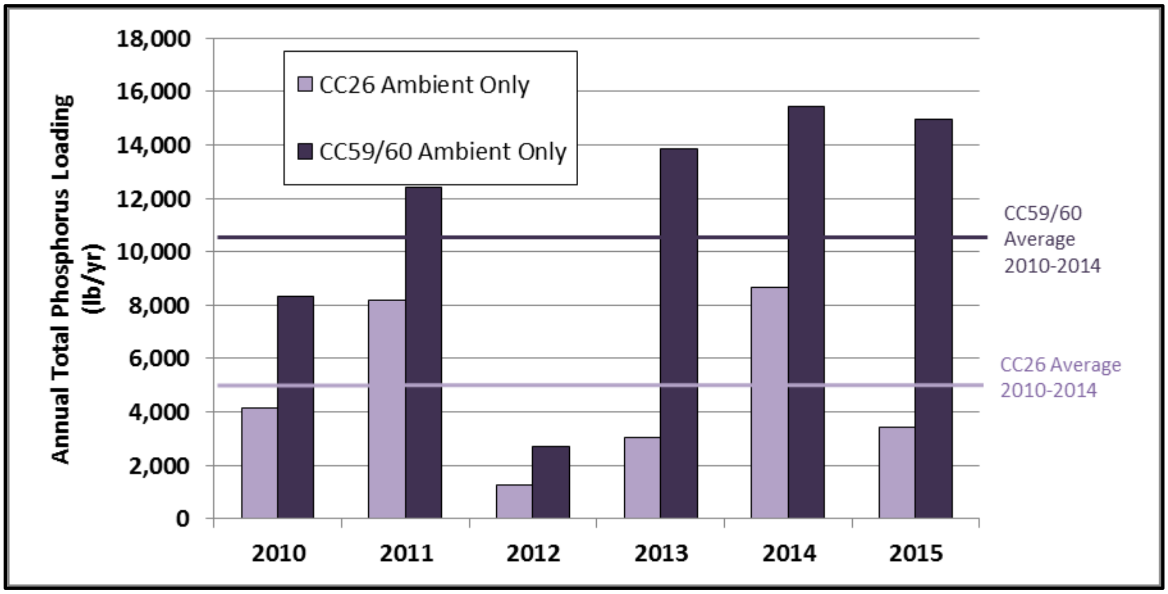


Figure 32. Annual Total Phosphorus Loading Estimates in the Upper Basin, 2010-2015

Volume-weighted concentrations (annual load divided by annual volume) of TP at CC26 and CC59/60 are presented in Figure 33 for 2010-2015. In 2015, volume-weighted concentrations at CC59/60 were similar to the 5-year average, whereas concentrations at CC26 were below average. The results at CC59/60 indicate that increase in TP loading in 2015 was primarily driven by the observed increase in flows.

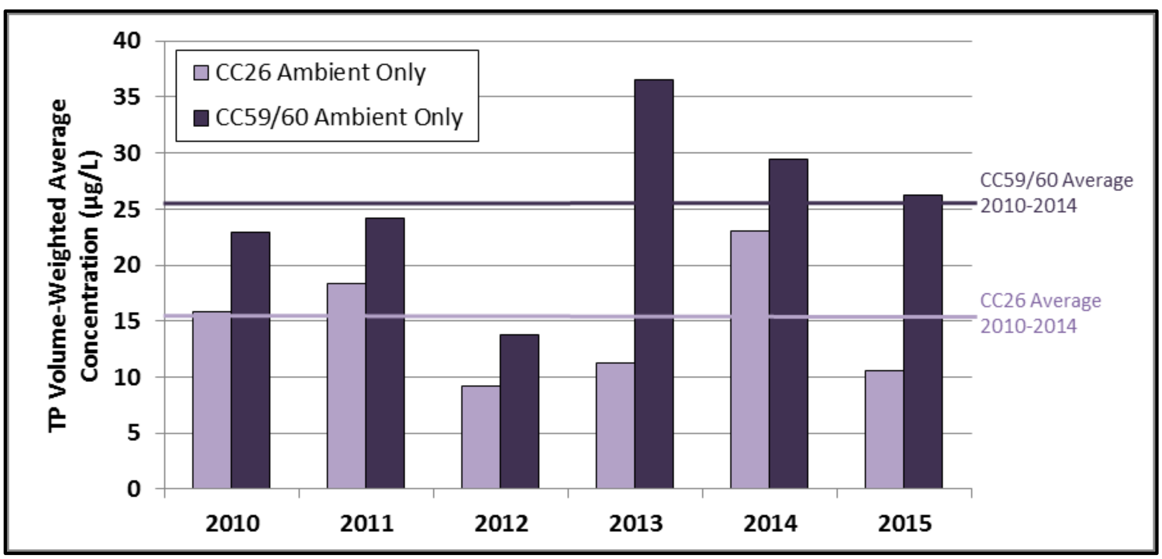


Figure 33. Volume-Weighted Total Phosphorus Concentration Estimates in the Upper Basin, 2010-2015

In summary, TP patterns in 2015 were different for the upstream (CC26) and downstream (CC60) locations and generally consistent with the patterns observed for TSS. Upstream concentrations, loads, and volume-weighted concentrations were consistent with the ranges observed in recent years. Downstream concentrations, loads, and volume-weighted concentrations showed the effects of the extended rainfall in May and June. This period of rainfall caused increased TP concentrations and greater than normal flows, resulting in elevated estimated TP loads at the downstream station. The parallels observed between TSS and TP make conceptual sense as TP is primarily transported sorbed to the particulate phase.

D. Total Nitrogen

Ambient total nitrogen concentrations observed in the Upper Basin for 2015 based on grab samples and 24-hour composite autosampler data are presented in Figure 34. Data from both stations follow the same general seasonal pattern, with lower concentrations during the summer months, and higher concentrations during the winter and early spring. This pattern is inverse to the pattern for TSS and total phosphorus; indicating that the mechanisms of nitrogen loading are different. The maximum non-storm-event concentration observed at CC26 of 280 µg/L was observed on two dates (6/1/15 and 10/21/15). However, these maxima were similar in magnitude to the minimum observed value of 190 µg/L. The maximum concentration at CC60 was observed on 5/20/15. TN concentrations (410 µg/l) for the 6/15/15 sample (which were observed to have elevated TSS and TP) were in the middle of the observed range for 2015.

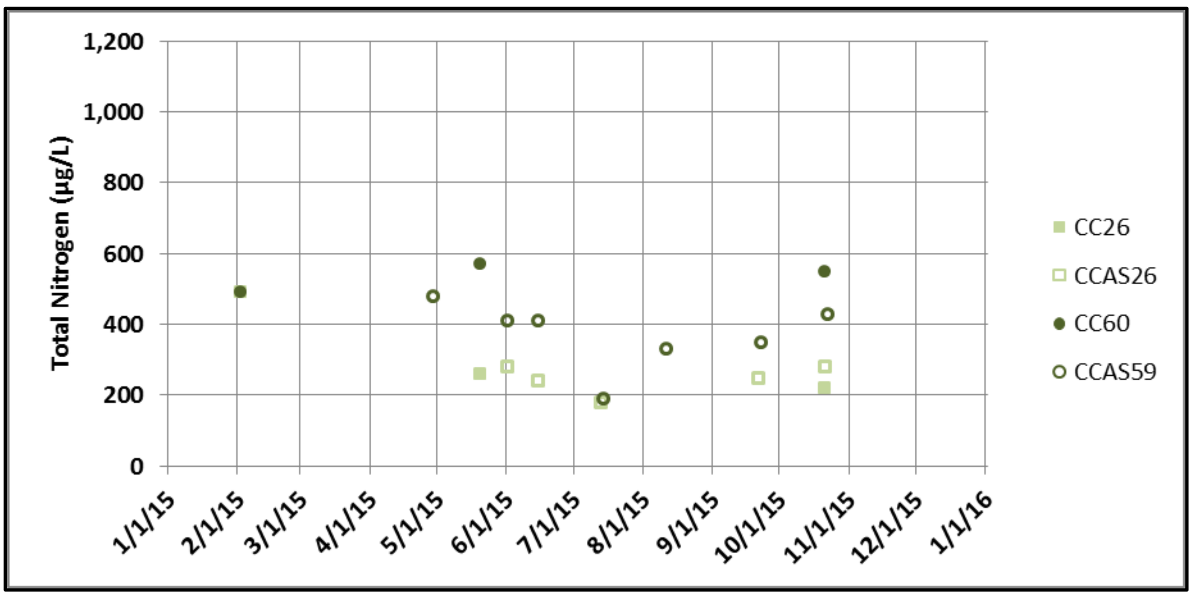


Figure 34. Total Nitrogen Concentrations (Non-Event) in the Upper Basin, 2015

The temporal pattern for 2015 ambient TN concentration data is consistent with previous years (lower in summer and higher in winter), as shown in Figure 35. This pattern is driven by the dilution of sources during periods of higher flow.

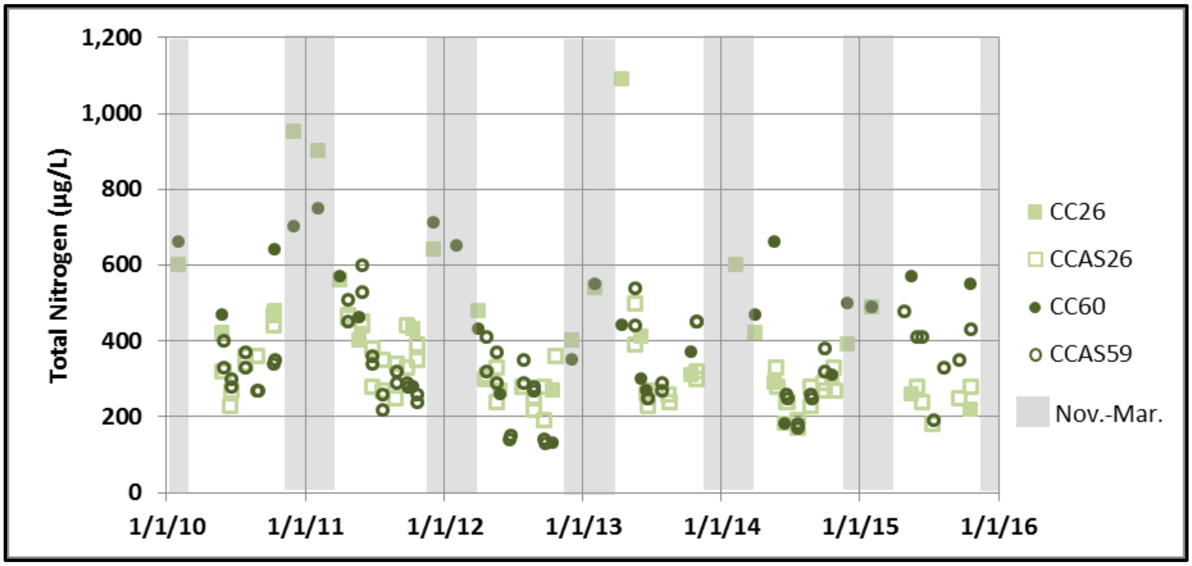


Figure 35. Total Nitrogen Concentrations (Non-Event) in the Upper Basin, 2010-2015

A comparison of monthly average TN concentrations at CC59/60 for 2015 and the 2010-2014 average is provided in Table 8. Consistent with TSS and TP, the 2015 monthly averages are calculated both including and excluding the June 15th samples. These non-storm-event results for TN from 2015 are generally within observed ranges from the previous five years. TN concentrations in May and June, during the extended rainfall event, are slightly higher than the 2010-2014 average but within the observed range of past years.

Table 8. Monthly Average Total Nitrogen Concentrations (Non-Event) in the Upper Basin at CC59/60

Month	2015 TN (µg/L)	2010-2014 Average and Range of TN (µg/L)	% Difference -- 2015 Versus 2010-2014 Average
February	490*	653 (550-750)	-25%
April	480*	450 (320-570)	+7%
May	570*	449 (260-660)	+27%
June	410 (410**)	279 (140-530)	+47% (+47%**)
July	190*	273 (170-370)	-30%
October	490	345 (130-640)	+42%

*Average based on one observed value

**Values in parentheses represent June TN concentrations excluding the June 15th sample.

Analysis of the long-term record (1998-2015) did not find any evident patterns in TN concentrations in the Lower Basin at CC59/60. However, in the Upper Basin (CC26) there appears to be a pattern of sustained lower TN concentrations for the period of 2012-2015 in comparison to the 1998-2011 period (Figure 36). It is likely that this decrease is the result of the 2011 plant upgrades to the Georgetown WWTF. Average effluent TN concentrations at the Georgetown WWTF were 9.5 mg/L prior to the upgrade (2005-2011); dropping to 5.0 mg/L for the period of 2012-2015. Mass-balance mixing calculations estimated that the observed decrease of in-stream TN concentrations could be explained by the decrease in effluent TN at Georgetown. However, it is probable that the observed decrease in TN is the integrated result of facility upgrades at Georgetown, process improvements at other facilities, and the diverse range of other watershed activities undertaken to improve water quality in the Clear Creek basin.

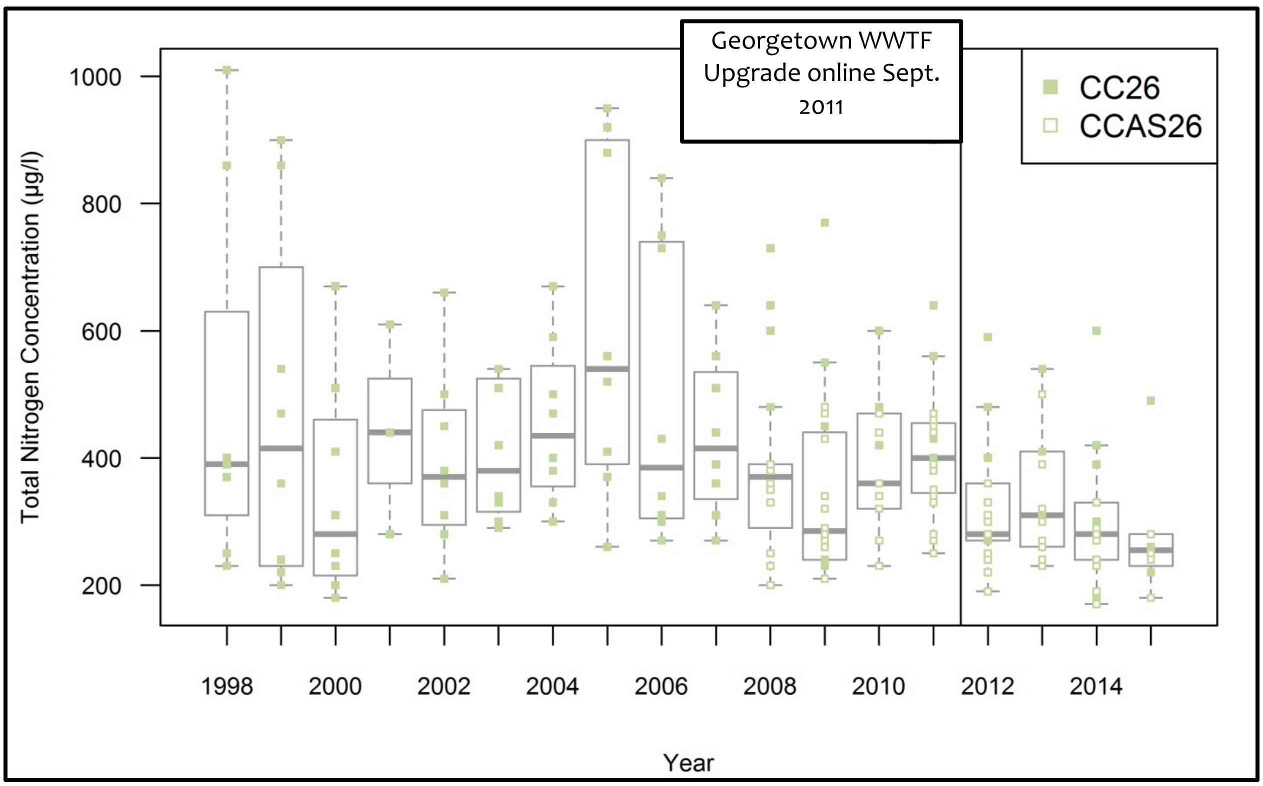


Figure 36. Total Nitrogen Concentrations at CC26 for the period of 1998-2015

Non-storm-event TN loading at CC26 and CC59/60 were calculated for 2015 and compared to estimates from 2010-2014 (Figure 37). For the baseline loading estimates, the data from 6/15/2015 was excluded. Loadings at CC26 are slightly lower than the average for the previous five years. In contrast, the loadings at CC59/60 are greater than the average of the previous five years.

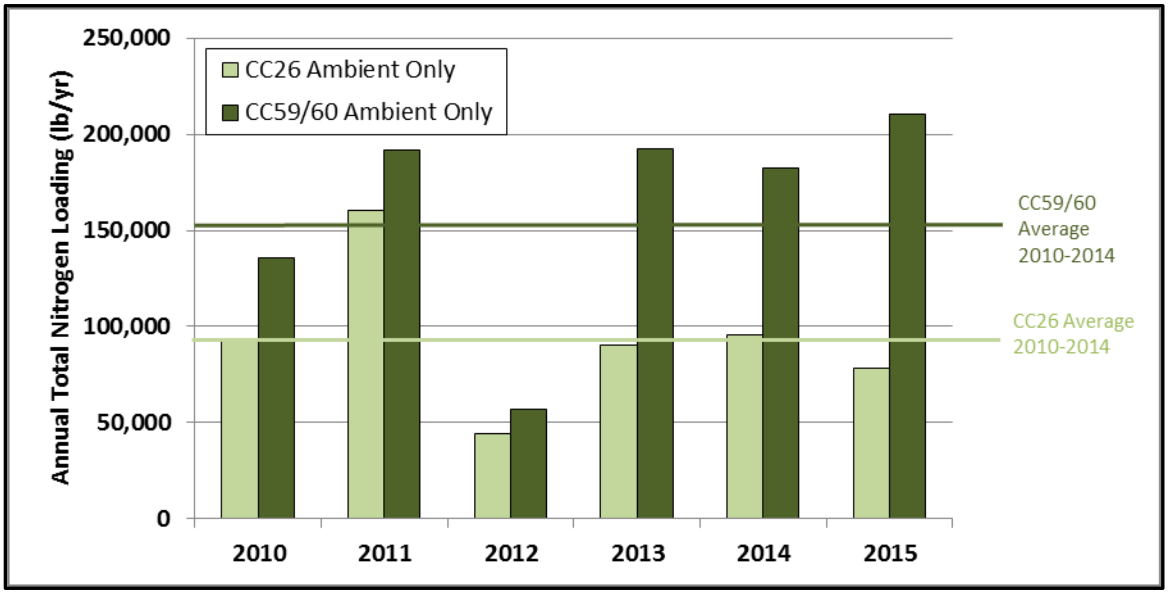


Figure 37. Total Nitrogen Loading Estimates in the Upper Basin, 2010-2015

Volume-weighted concentrations (annual load divided by annual volume) of TN at CC26 and CC59/60 are presented in Figure 38 for 2010-2015. The volume weighted concentrations for CC59/60 are consistent with the average of the previous five years. This consistency in volume-weighted concentrations at CC59/60 demonstrates that the increase in flows heavily influenced the increase in loads. In contrast, at CC26 volume-weighted concentrations are lower than the previous five years.

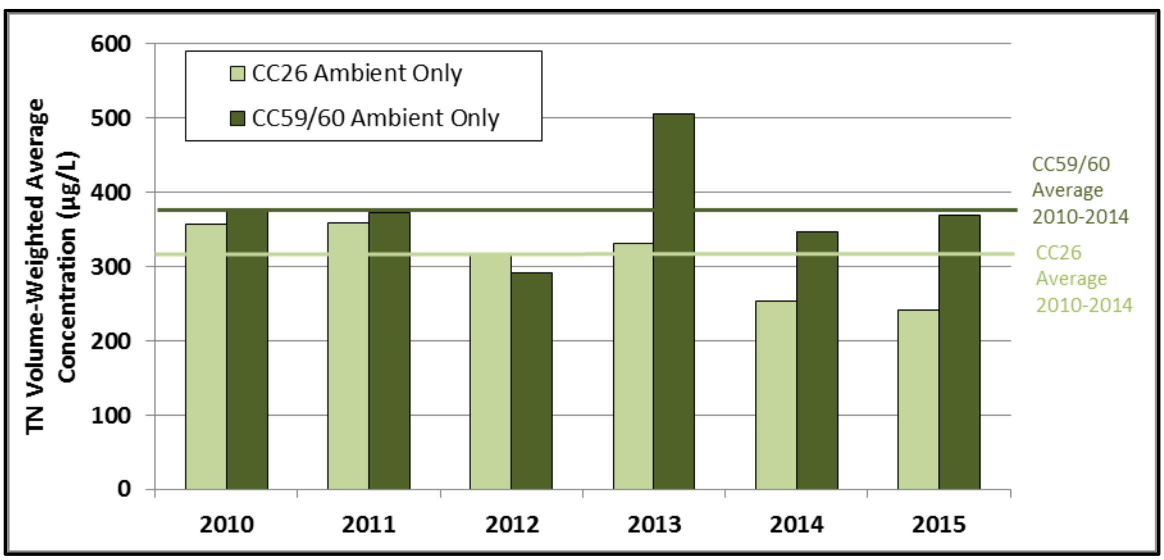


Figure 38. Volume-Weighted Total Nitrogen Concentration Estimates in the Upper Basin, 2010-2015

In summary, TN concentration patterns in 2015 were similar for the upstream (CC26) and downstream (CC60) locations; this is in contrast to the observations for TSS and TP. Upstream concentrations, loads, and volume-weighted concentrations were consistent with the ranges observed in recent years. Downstream loads (but not concentrations or volume-weighted concentrations) showed the effects of the extended rainfall in May and June. This increase in loads at the downstream station was the result of elevated flow volumes.

E. Effects of Storm Events on Loading

The loading calculation results described earlier in this section include grab samples and ambient autosampler data. These types of samples, which are taken at regular intervals, are not intended to capture the water-quality response to storm events. It is widely recognized, however, that precipitation events can result in substantial changes to water quality. As such, since 2006 event-triggered sampling has been conducted and this was continued in 2015 at station CCAS59.

In 2015, five event-triggered samples were collected at CCAS59 between May and early-October. As previously discussed, there was an extended rainfall event in May and June that resulted in heavy rainfall in the foothills and Plains. This rainfall is the likely explanation for the elevated TSS and TP observed in the 6/15/2015 samples. For the purposes of evaluating the effects of storm events on loading, the concentrations of the 6/15/2015 sample were applied to the period from 6/3/2015 to 6/15/2015. This period was selected as corresponding to the peak period of the rainfall.

Incorporating these event samples into the annual loading calculations yields increases of 3% for TN, 88% for TP, and 187% for TSS (Table 9 and Figure 39). The effects are even more apparent in the monthly loading for the months in which the events occurred (Table 9). The greatest relative increase in loading for storm events is for TSS and TP; with TN showing a much smaller difference. This is expected due to the impact of precipitation events on TSS (and associated sorbed phosphorus) concentrations. These general findings about the significance of storm events in annual loads are consistent with the results reported in previous reports. For the five event-triggered samples, the storm-event concentrations were assumed to represent concentrations for the full day of the composite sample, though runoff events can cover longer or shorter periods.

Table 9. Effect of Storm Events on Annual and Monthly Loading at CC59/60

Time Period	Increase in TN Loading with Storm Events	Increase in TP Loading with Storm Events	Increase in TSS Loading with Storm Events
2015 (Annual Load)	3%	88%	187%
May 2015 (Monthly Load)	13%	74%	90%
June 2015 (Monthly Load)	0%	117%	219%

The storm-event samples provide valuable snapshots of the water-quality response to storm events in the Clear Creek basin. Nonetheless, it is important to remember that they do not comprise all the storm events of 2015. As such, estimates of loading including these events estimate a fraction of the additional annual loading attributable to storm events.

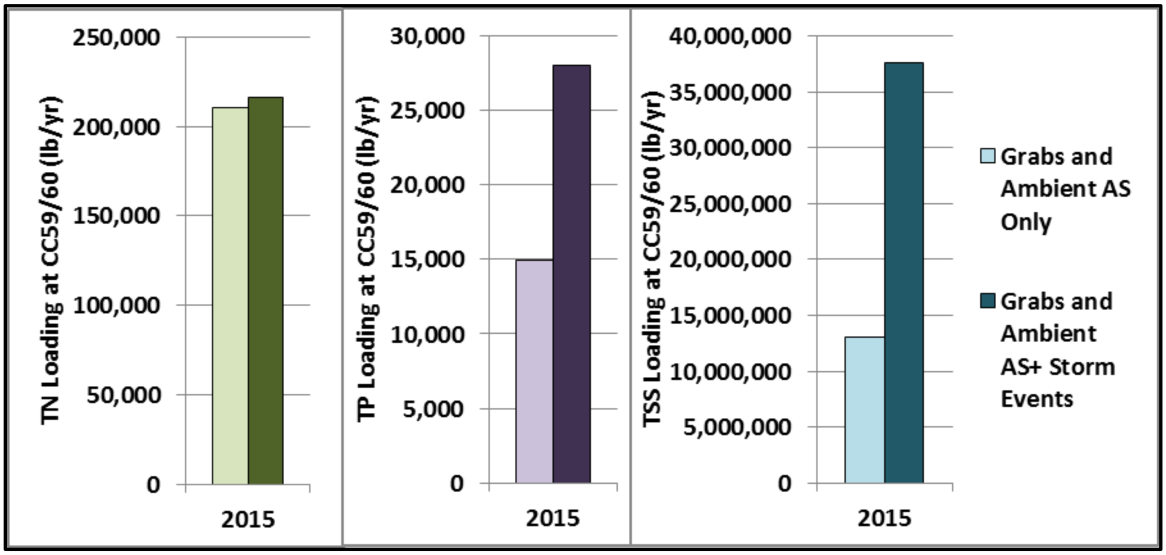


Figure 39. Total Nitrogen, Total Phosphorus, and Total Suspended Solids Loading in 2015, With and Without Storm Events

F. Upper Basin Summary

In summary, flow volumes and the concentrations and loads of TSS, TP and TN demonstrated different patterns at the upstream (CC26) and downstream (CC60) locations. At the upstream station (CC26) flow volumes, concentrations, loads, and volume-weighted concentrations were generally consistent with the ranges and patterns observed in recent years. In contrast, the extended rainfall in May and June that affected the plains and foothills resulted in above average flows at CC60--total flow volumes for 2015 were 44% greater than average. Loading of TSS at C60, based on ambient samples, was well above the 2010-2014 average, while the associated volume-weighted TSS concentrations were near normal. The same pattern in loads and volume-weighted concentrations was observed for TP and TN. This pattern indicates that the increases in non-storm loading were driven by the high flow volumes in 2015. The inclusion of storm events in the loading analysis resulted in minimal changes to TN loads. This indicates that TN sources were diluted during the high flows. In contrast, the inclusion of storm event data resulted in large increases in the estimates of TP and TSS loading. This indicates that the storm events resulted in additional mobilization and transport of TP and TSS source materials.

V. Canal Zone Flows and Water Quality

The Upper Basin is the source for the vast majority of water being diverted into the inflow canals to Standley Lake. This section presents the timing and volume of flows for the inflow canals. In addition, this section provides a description of water-quality changes along the FHL and Croke canals from their points of diversion on Clear Creek to the reservoir.

A. Flows

Water enters Standley Lake via four conveyances (Figure 7): the Church Ditch, the Croke Canal, Farmers' High Line Canal (FHL), and the Kinnear Ditch Pipeline (KDPL). Inflows for 2015 from each of these sources are shown in Figure 40. The Croke Canal has the most senior rights in the Clear Creek Basin during the non-irrigation season (November – March). During 2015, as is typical, the Croke Canal provided the only inflow to Standley Lake during this period. During the irrigation season (April to October), the FHL Canal was the dominant source of inflows. The Church Ditch and the KDPL delivered water later in the irrigation season.

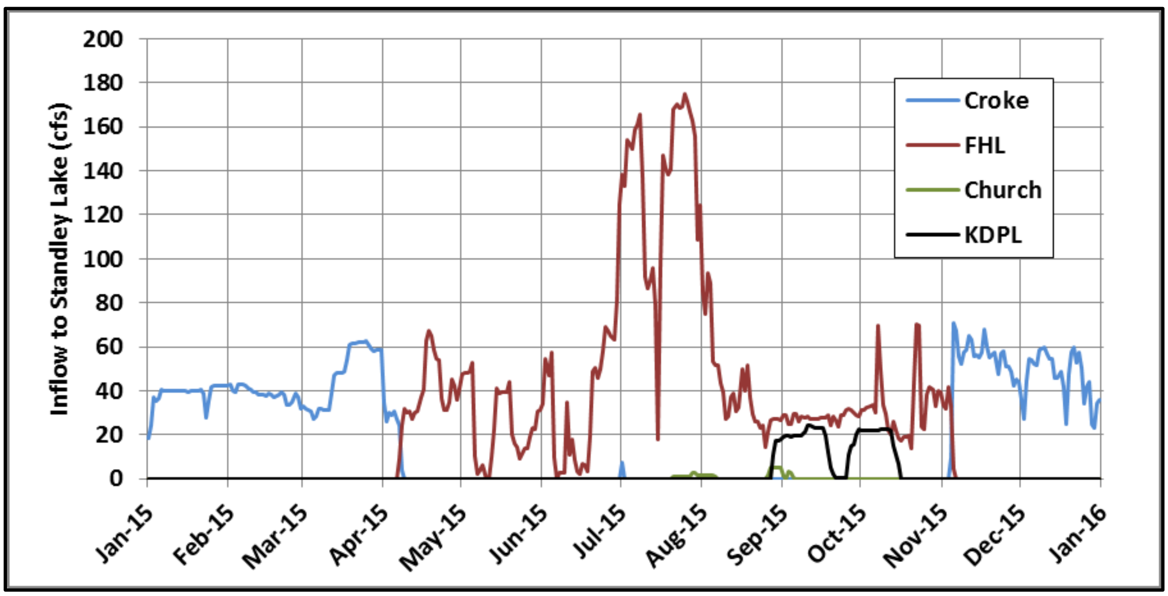


Figure 40. Inflow to Standley Lake, 2015

B. Water Quality

The Croke Canal and the FHL Canal are the dominant sources of water to Standley Lake. Between Clear Creek and Standley Lake these canals follow parallel paths for approximately 15 miles through a diverse range of land uses. When a canal is in use, water-quality samples are collected at both the headgate and at the release point to Standley Lake. To better understand the effects of the Canal Zone on water quality, differences in concentrations between the top and bottom of the canals were investigated. As with the Upper Basin and Standley Lake water quality discussions, this analysis focused on TN, TP and TSS. For Croke and FHL, average annual concentrations were calculated for TN, TP, and TSS. These averages were used for a comparison of concentrations at the canal headgates and at the Standley Lake release locations. In general, there is no change in TN concentrations for either canal across the Canal Zone (Figure 41). The same can generally be said for concentrations of TP (Figure 42, left) and TSS (Figure 43, left) in the FHL. For the Croke Canal, however, there is a substantial increase (> 100%) in both TP and TSS for every year from 2010-2015 (Figure 42 and Figure 43, right). Specific sources of TSS and accompanying TP along the Croke Canal are unknown at this time.

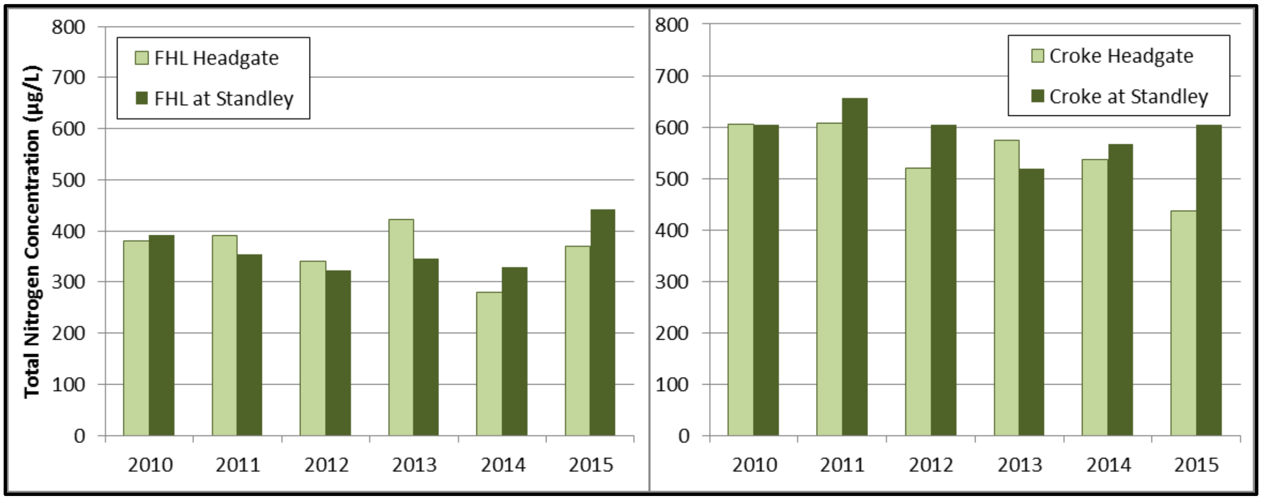


Figure 41. Total Nitrogen Concentrations in FHL (left) and Croke (right) Canals.

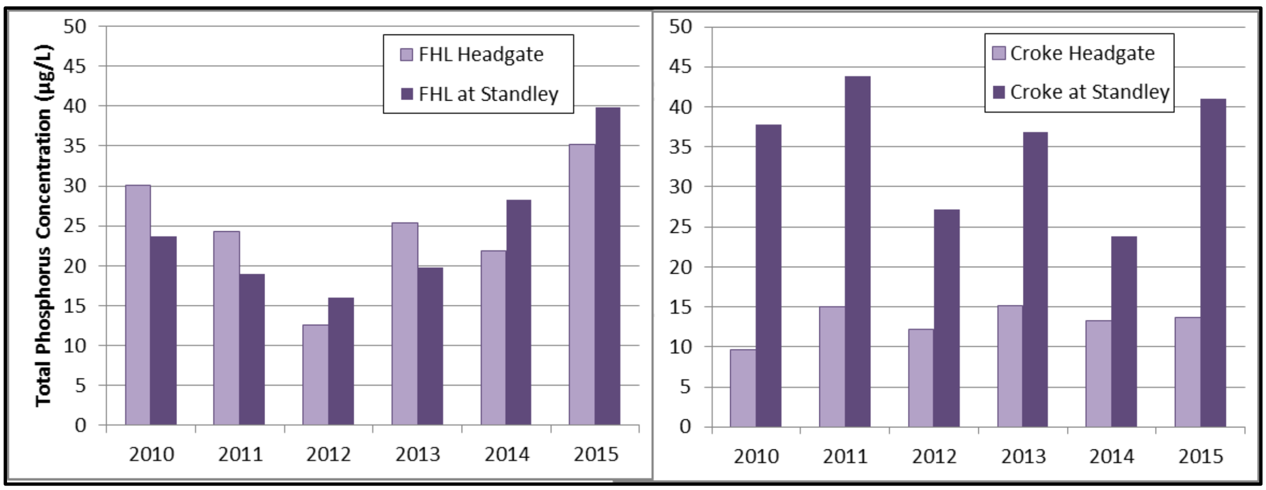


Figure 42. Total Phosphorus Concentrations in FHL (left) and Croke (right) Canals

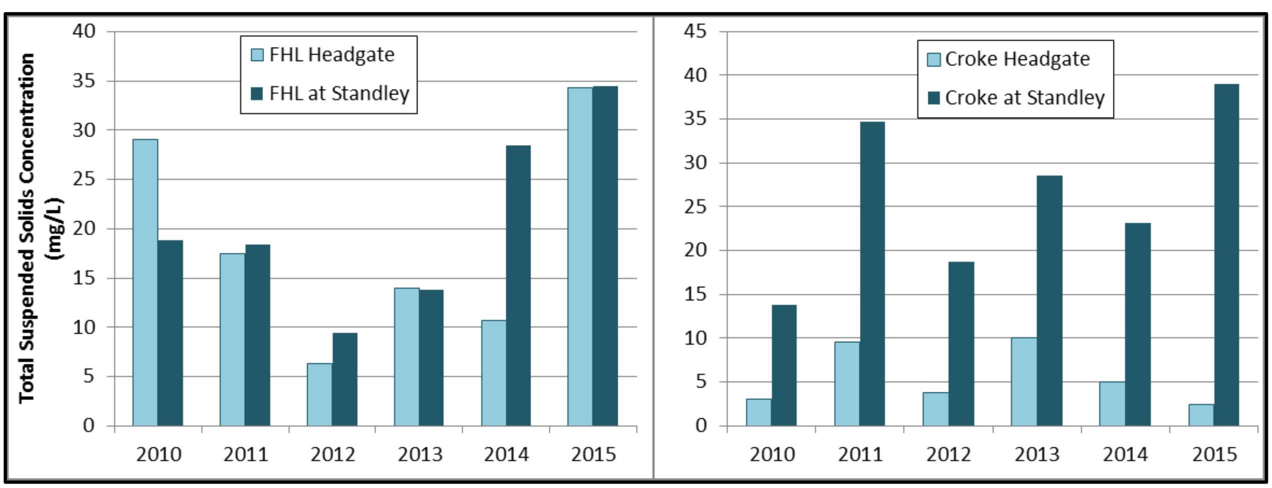


Figure 43. Total Suspended Solids Concentrations in FHL (left) and Croke (right) Canals

VI. Standley Lake Flows, Contents, and Loadings

This section provides a discussion of the quantity and the quality of the inflows to and outflows from Standley Lake.

A. Flows and Contents

The seasonal patterns and flow rates of each of the four conveyances to Standley Lake were presented previously (Figure 40). Annual inflow volume from each source is shown in Figure 44 for the period of 2010 through 2015. The FHL and Croke Canals are the dominant sources of water to Standley Lake, providing, respectively, 57% and 38% of total inflows. Church Ditch and KDPL inflows are much smaller sources, combining to provide 5% of total inflows. Annual contributions from the Church Ditch were very low in 2015. This was due to: 1) ongoing work to repair damage from the 2013 flood, and 2) not having to rely as much on Church Ditch inflows since there was higher-than-normal water availability through the FHL to keep the reservoir full.

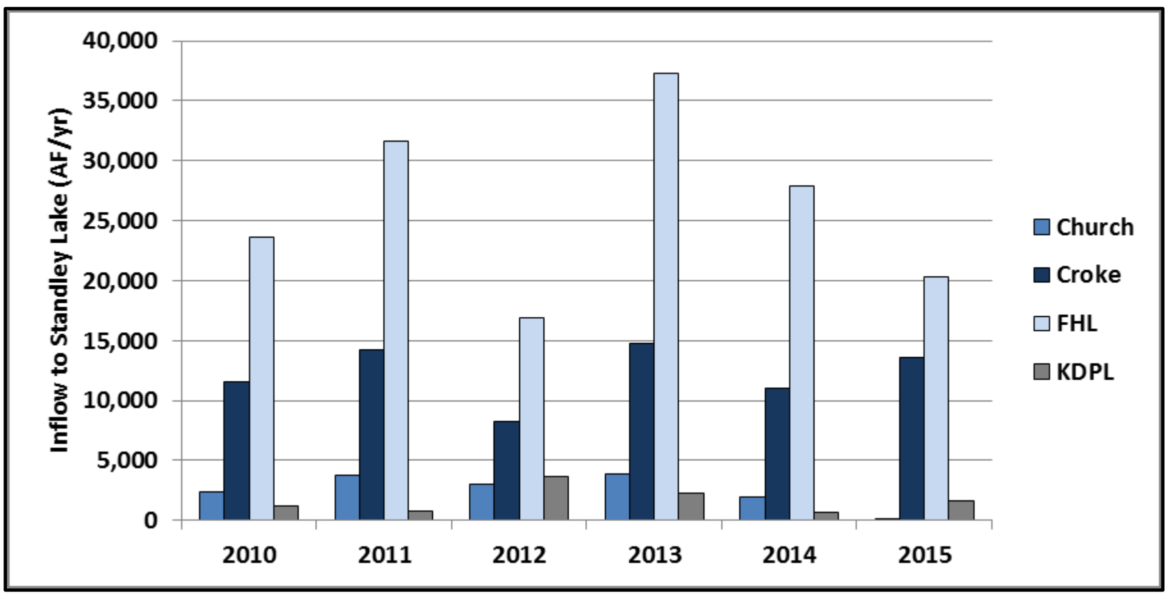


Figure 44. Annual Inflow to Standley Lake by Source, 2010-2015

Outflow from the lake in 2015 is presented in Figure 45. The largest outflows occurred during the summer and fall. The total measured annual inflow (all four sources combined) and outflow volumes for these years are presented in Figure 46. Total inflows were 19% lower than average. Outflows were closer to average, only 5% lower than the previous five years.

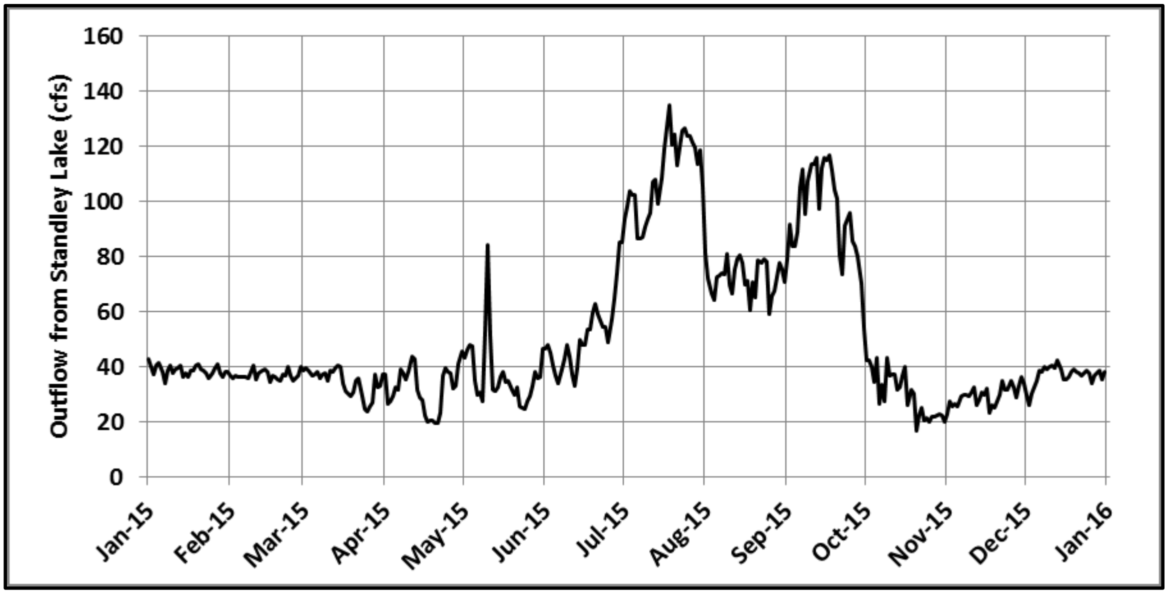


Figure 45. Outflow from Standley Lake, 2015

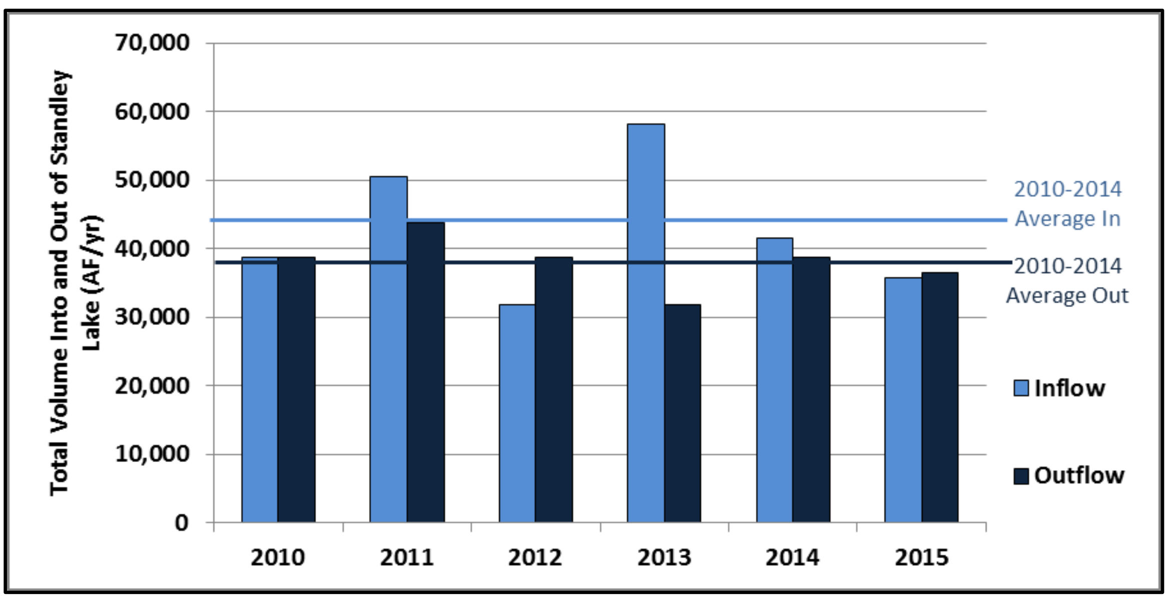


Figure 46. Total Measured Annual Standley Lake Inflow and Outflow, 2010-2015

Daily contents for Standley Lake over the past six years are displayed in Figure 47. Contents were calculated using gage-height measurements and elevation-area-volume relationships for the lake. In 2015, as with 2014, lake contents started out unusually high. In 2014, this was a result of the September 2013 floods. Minimal drawdown was observed in 2014, allowing the reservoir to start 2015 near full capacity. High water levels were maintained through much of 2015, until a period of drawdown extending from August through October. However, Standley Lake ended 2015 with contents only slightly lower than the previous two years. Average lake contents were 8% higher in 2015 relative to the average of the previous five years.

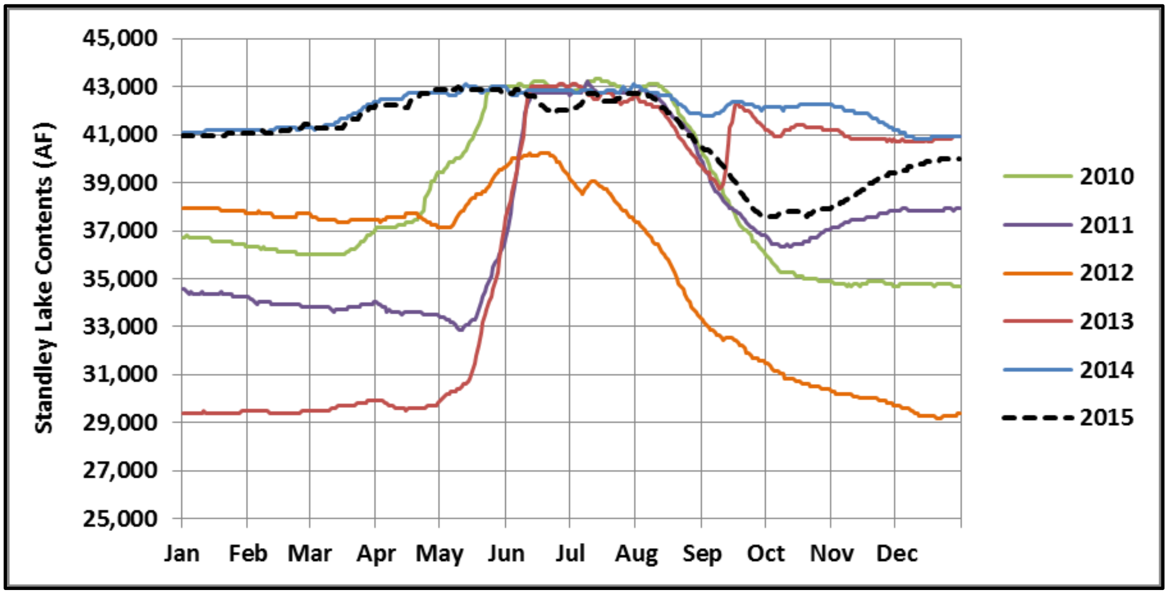


Figure 47. Standley Lake Contents, 2010-2015

B. Loading Into and Out of Standley Lake

Estimates of nutrient loading into and out of the lake are described in this sub-section. Loads are calculated using daily flows and concentration data. The concentration data are from samples collected as part of the Upper Clear Creek/Standley Lake Watershed Water Quality Monitoring Program. The sampling data for inflows includes ambient grab samples and 24-hour ambient autosampler (AS) data. In contrast to past years, no first-flush samples were collected for FHL or Croke at the beginning of deliveries for the year. To compute the loads, a mid-point step function was used to fill daily concentrations between the available sample data. An autosampler on the FHL Canal was used to collect storm-event samples in 2015. These samples provide an indication of the effects of storm events on loading to the reservoir.

1. Total Phosphorus

Total phosphorus loading into Standley Lake is presented by source for 2010-2015 in Figure 48. As noted above, the loading estimates include data from ambient grab and ambient autosampler samples. No first-flush type samples were collected in 2015. The canals which contributed the greatest volumes of water to Standley Lake, the Croke and FHL Canals (Figure 44), delivered the largest TP loads (Figure 48). This pattern is consistent with that seen in previous years.

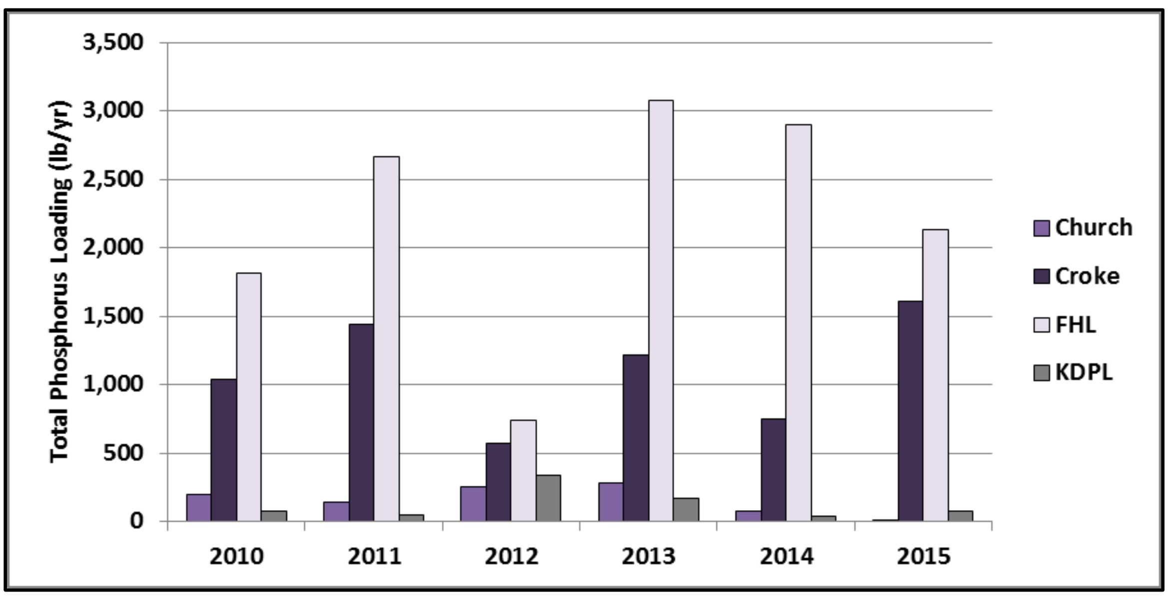


Figure 48. Total Phosphorus Loading into Standley Lake by Source, Using Grab Samples and 24-Hour Ambient Autosampler Data, 2010-2015

Estimated annual TP loadings into and out of Standley Lake for 2010-2015 are shown in Figure 49. Non-storm event loading of total phosphorus in 2015 was slightly (7%) higher than the average of the previous five years. As with previous years, loadings of total phosphorus into the lake were greater than outflow, indicating some level of phosphorus retention.

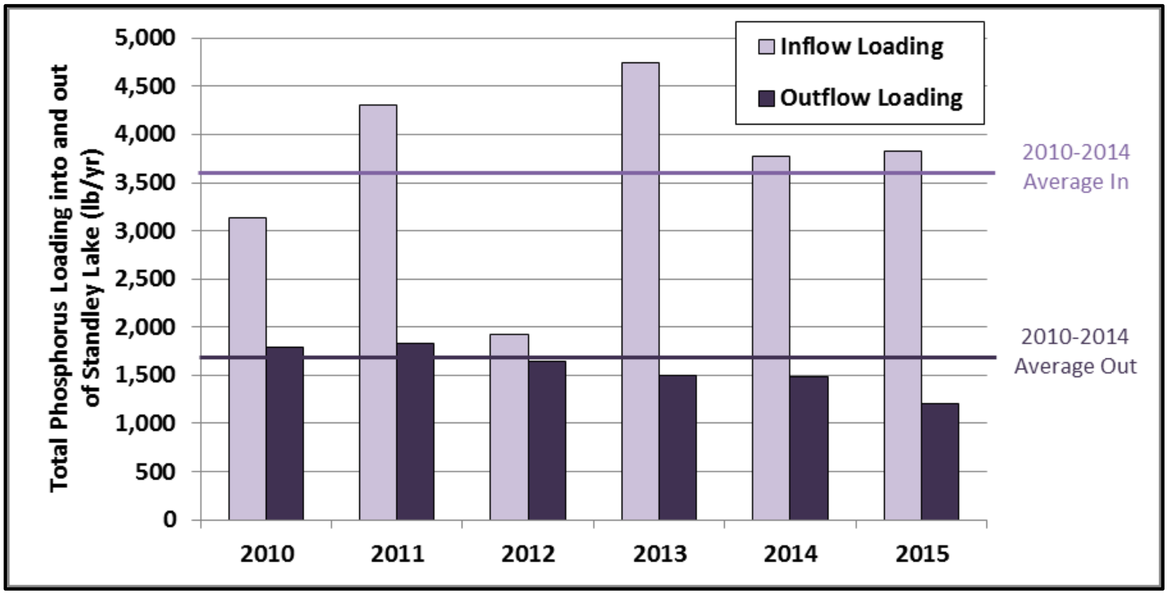


Figure 49. Total Phosphorus Loading into and Out of Standley Lake, 2010-2015

The volume-weighted TP concentrations into Standley Lake are presented in Figure 50 by source. The non-storm-event volume-weighted TP concentrations were variable in the canals in 2015; with Croke having the highest volume-weighted concentration and KDPL the lowest. The combined average of the canals (39 µg/L) in 2015 was 32% higher than the 2010-2014 average.

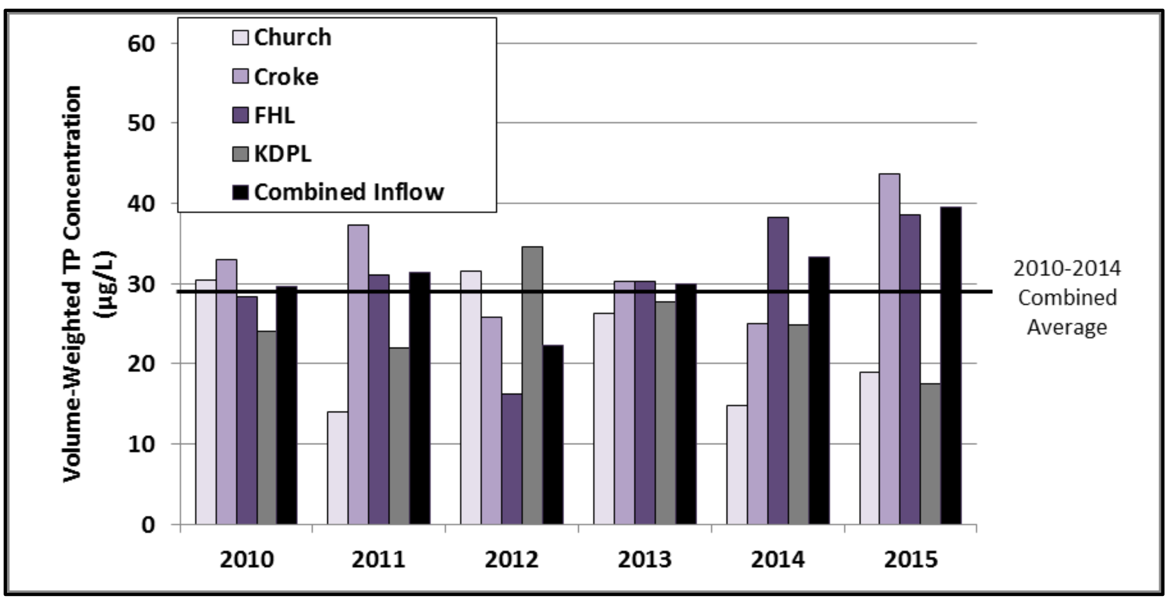


Figure 50. Volume-Weighted Total Phosphorus Concentrations into Standley Lake, 2010-2015

2. Total Nitrogen

Total nitrogen loading into Standley Lake, grouped by source and based on data from ambient grab and ambient autosampler samples, is displayed in Figure 51. Combined TN loading into and out of the lake is presented in Figure 52. The relative pattern of loading by source in 2015 was consistent with those seen in previous years. The mass of total nitrogen entering Standley Lake in 2015 was 17% lower relative to the previous five years. Outflow of total nitrogen in 2015 was 15% lower than the 2010-2014 average. As with previous years, loading into the lake was higher than outflow from the lake, indicating some level of nitrogen retention.

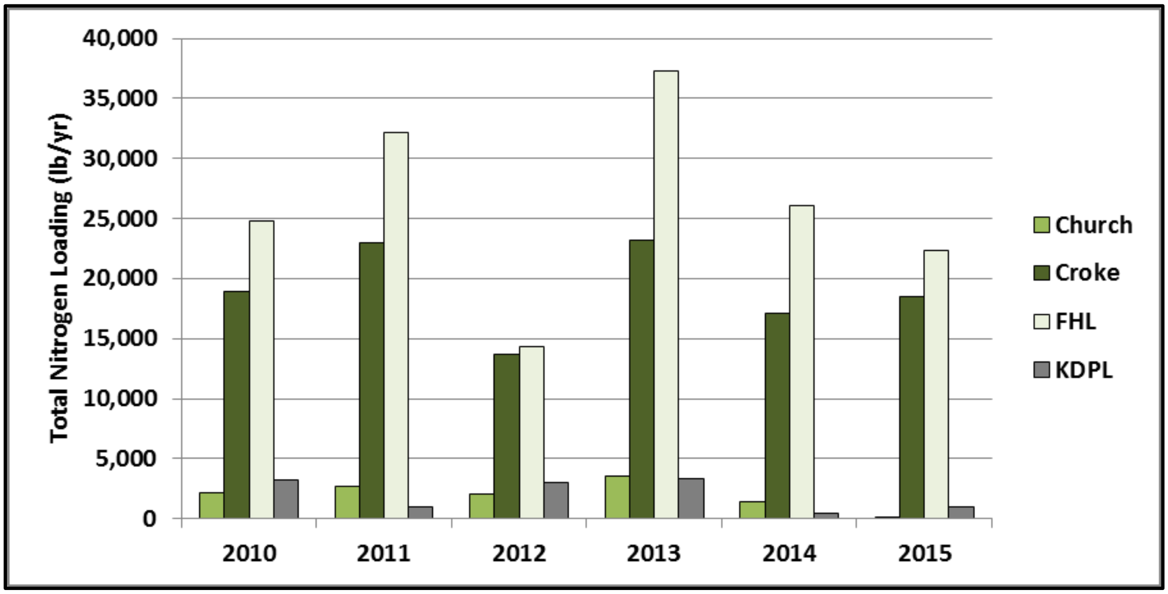


Figure 51. Total Nitrogen Loading into Standley Lake by Source, 2010-2015

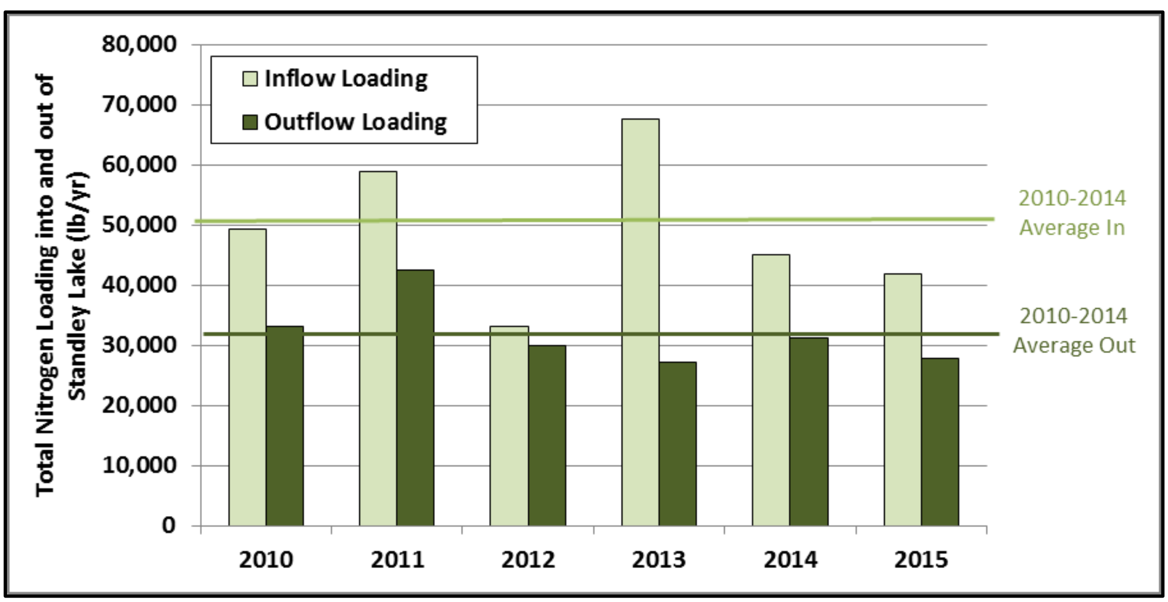


Figure 52. Total Nitrogen Loading into and Out of Standley Lake, 2010-2015

Volume-weighted total nitrogen concentrations into the lake are presented in Figure 53. The combined average from all sources in 2015 (432 µg/L) was consistent with the combined average (421 µg/L) for 2010-2014.

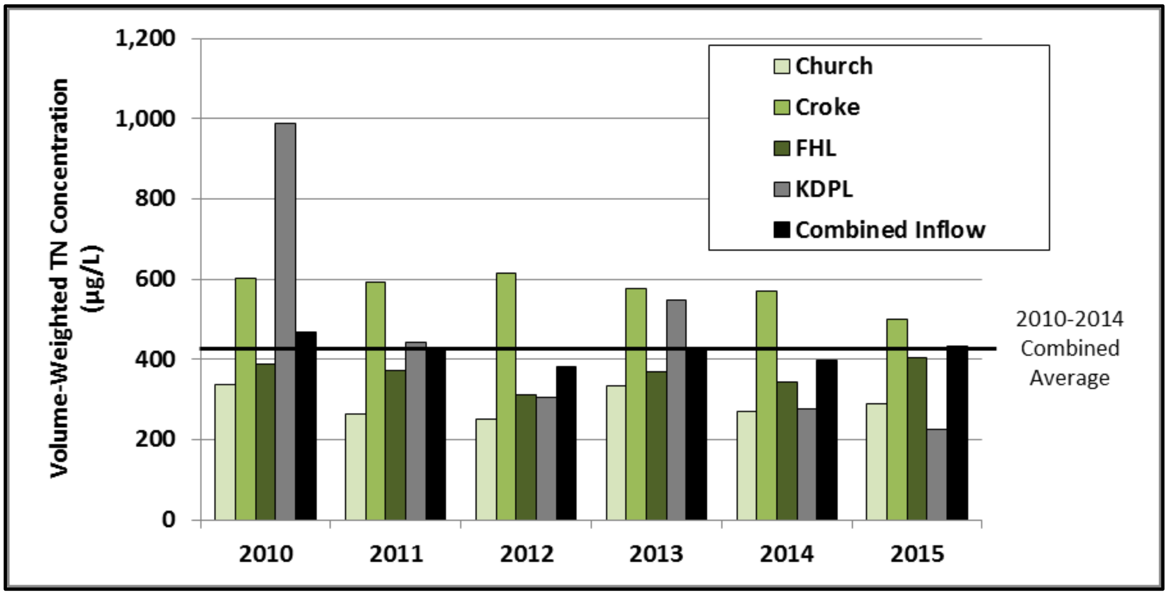


Figure 53. Volume-Weighted Total Nitrogen Concentrations into Standley Lake, 2010-2015

3. Effect of Storm Events on Nutrient Loading

The nutrient loads presented above were calculated using grab samples and ambient autosampler data. Load estimates that include storm-event-triggered autosampler data are described in this section. An autosampler located on the FHL canal at the inflow location to Standley Lake was used to collected storm event samples in 2015. These samples were collected during May (5/6, 5/26), June (6/5) and October (10/4). Storm event samples were assumed to represent conditions for the full 24-hour period on the sample date. Only the events of 5/6 and 10/4 included analyses for TN and TP. As such, the storm event loading estimates discussed below are based on these two samples.

A comparison of nutrient loading into Standley Lake from FHL in 2015 with and without the sampled storm events is shown in Figure 54. The lighter bars in the figure represent the loading estimated excluding storm-event autosampler data. The darker bars include the storm events listed above. Consistent with the storm-event loading analysis for the upper watershed, it should be noted that the storm event estimates only represent the sampled storms. Because of this, the loading estimates presented here are lower-bound estimates of the actual loading. Incorporation of the observed storm events yields a 2% increase in loading of both TN and TP loading from FHL. The small difference in estimates is not unexpected considering the limited number of storm samples. In past years, the results of this analysis have demonstrated that loading from storm events can be a significant fraction of the total annual load to Standley Lake. Considering the observed effects of the spring rainfall on in-stream concentrations in the Upper Basin, it is likely that loading to Standley Lake during this May-June period is underestimated in this analysis. However, given the lack of observed data to characterize the water-quality influent to Standley during this period it is not possible to quantitatively estimate these loads.

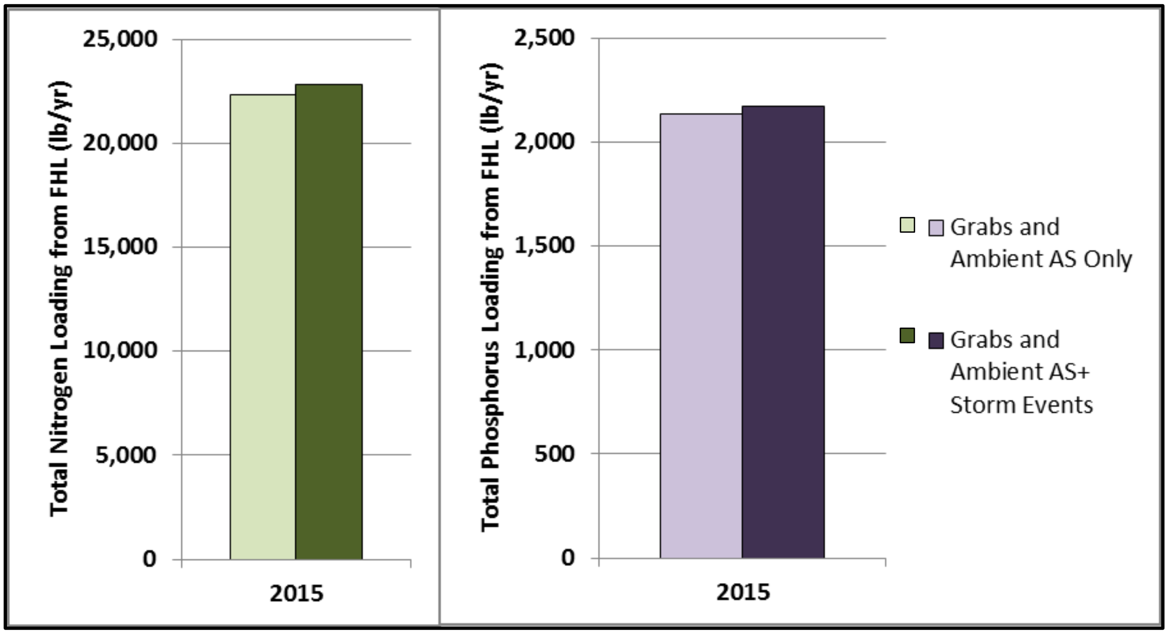


Figure 54. Nutrient Loading to Standley Lake from Farmers' High Line Canal in 2015, With and Without Storm Events

C. Standley Lake Loading Summary

In 2015, Standley Lake was nearly-full for much of the year. Inflows to the reservoir were below average in volume. This water was delivered, as usual, primarily by FHL and Croke. Outflows were near average. The inflow loading of TP to Standley Lake in 2015 was consistent with the 2010-2014 average. As normal, the outflow loading of TP from Standley Lake was less than the inflow loading and somewhat below the 2010-2014 outflow loading average. The inflow loading of TN was somewhat below the recent average. Outflow loading of TN was near average, and consistent with TP, was less than the inflow loading. Loading to Standley Lake was likely not strongly affected by the May-June rainfall event. This is explained by inflows to Standley Lake during these two months only contributing a small fraction (approximately 10%, 3600 AF) of the annual total (35,677 AF).

VII. Standley Lake Water Quality

In this section, the in-reservoir water-quality responses to the hydrology and nutrient loads are discussed. The data considered here were measured at sampling location SL-10 (Figure 2). This sampling location was selected as it has an extensive sampling history, is directly relevant to water treatment plant operations, and is the location of the automatic lake profiler station. The water-quality indicators discussed here include: dissolved oxygen (DO), TP, TN, chlorophyll *a*, and clarity.

A. Dissolved Oxygen

Dissolved oxygen is an important primary water-quality parameter because of its effect on aquatic life and drinking water treatment. Dissolved oxygen at the sediment-water interface (i.e. the bottom of the lake) is of particular relevance. Low DO at this location can result in loading of nutrients and certain metals from the sediment to the water column. These releases can lead to increases in water treatment costs and the potential for taste and odor events in drinking water.

A generally accepted threshold for hypoxic conditions is 2 mg/L or less of DO. Each year, Standley Lake experiences hypoxia in the hypolimnion. This is common for stratified reservoirs in Colorado. In 2015, DO concentrations started dropping at the bottom in mid-May and hypoxic conditions were well developed by the beginning of July. The extent of hypoxic conditions in 2015 began to decrease in September and ended during turnover in late October. A contour plot of dissolved oxygen concentrations in Standley Lake for March through early December 2015 is provided in Figure 55.

Dissolved oxygen concentrations measured at the top and bottom of Standley Lake through 2015 are provided in Figure 56. At the surface, the cyclical patterns in DO concentrations are driven by the decrease in oxygen solubility with increasing temperatures. The onset of stratification is observed to occur in mid-April, as indicated by the divergence of lake-bottom DO concentrations from surface concentrations. This divergence increases in magnitude as dissolved oxygen is depleted in the hypolimnion which remains isolated due to continued stratification. Consistent with the contour plot (Figure 55), the divergence between surface and bottom DO concentrations is rapidly extinguished with turnover in late October.

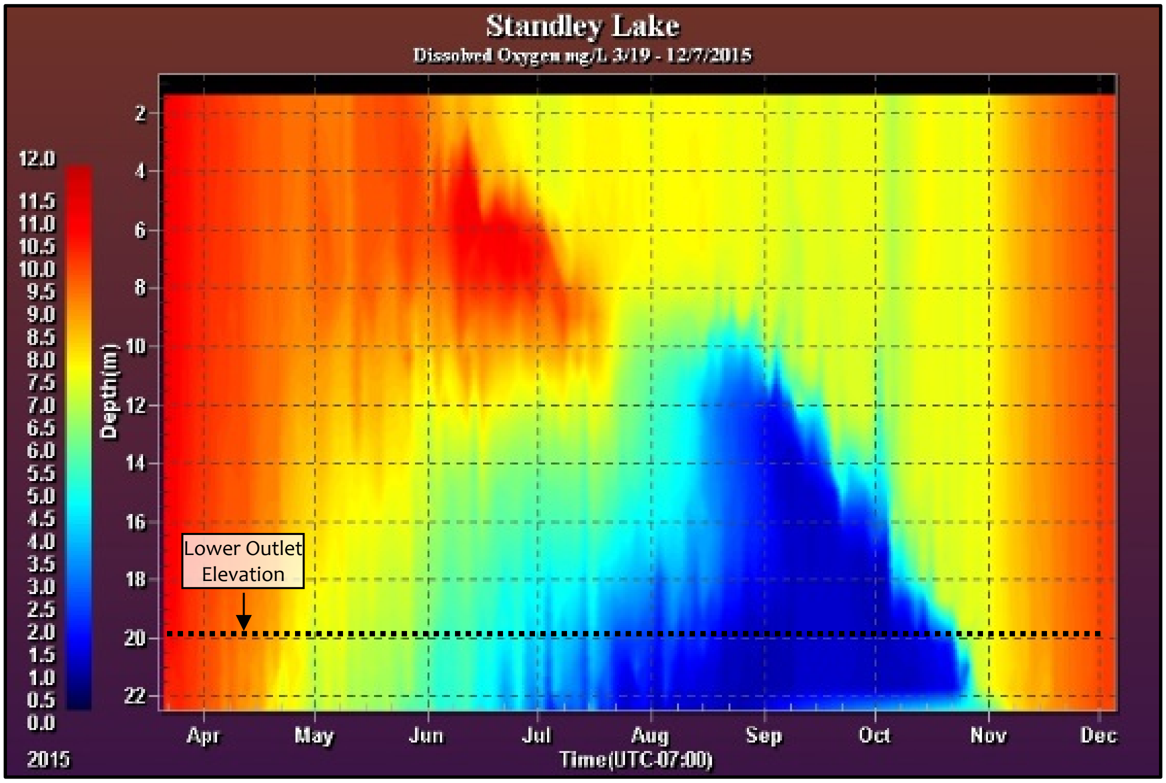


Figure 55. Contour Plot of Dissolved Oxygen in Standley Lake, March-December 2015

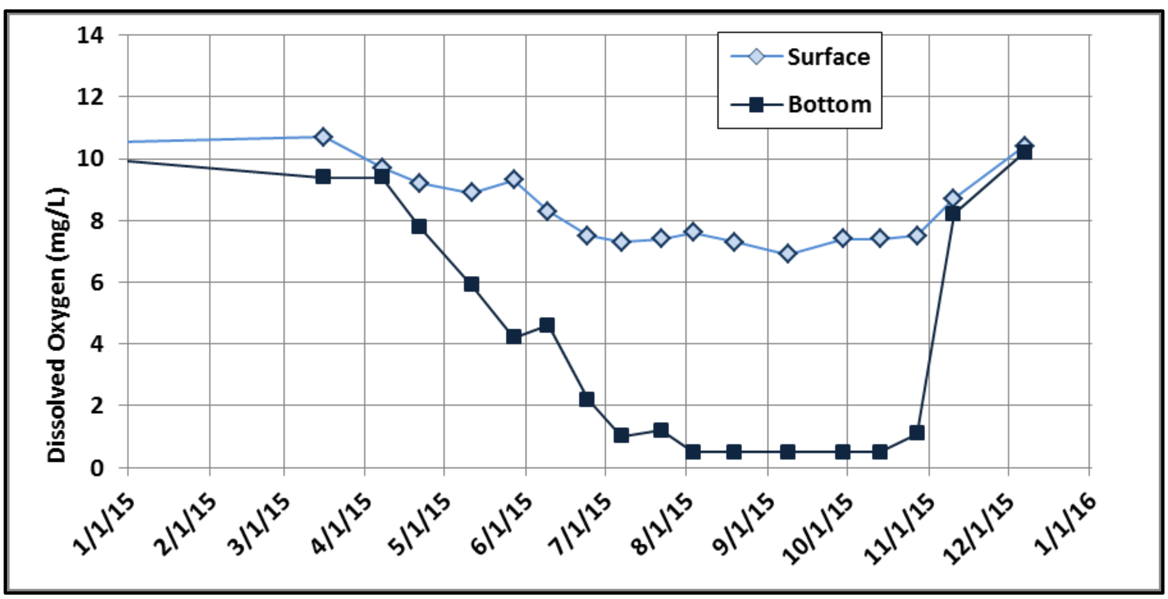


Figure 56. Dissolved Oxygen Concentrations in Standley Lake, 2015

The 2015 seasonal dissolved oxygen patterns closely match those observed in previous years in Standley Lake, as shown in Figure 57.

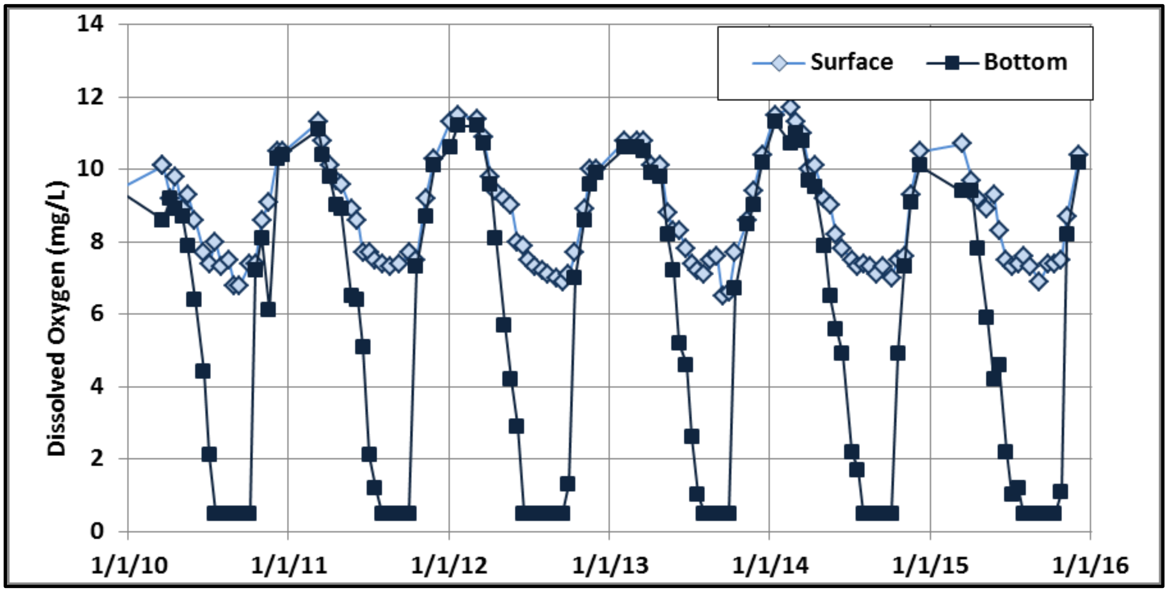


Figure 57. Dissolved Oxygen Concentrations in Standley Lake, 2010-2015

Hypoxia occurs each year in the hypolimnion of Standley Lake, but the start date, end date, and duration varies from year to year. In 2015, the hypoxic period started at the end of June, which is typical. However, hypoxia lasted until turnover on October 27th. This is the latest fall turnover experienced over the last 10 years; more than 15 days later than the previous latest turnover date (October 12th, in 2014). The late turnover was likely due to a combination of unusually warm September/October air temperatures in 2015 and higher reservoir contents. Because turnover was later than typical, the period of hypoxia was higher than the 2010-2014 average of 98 days (Figure 58).

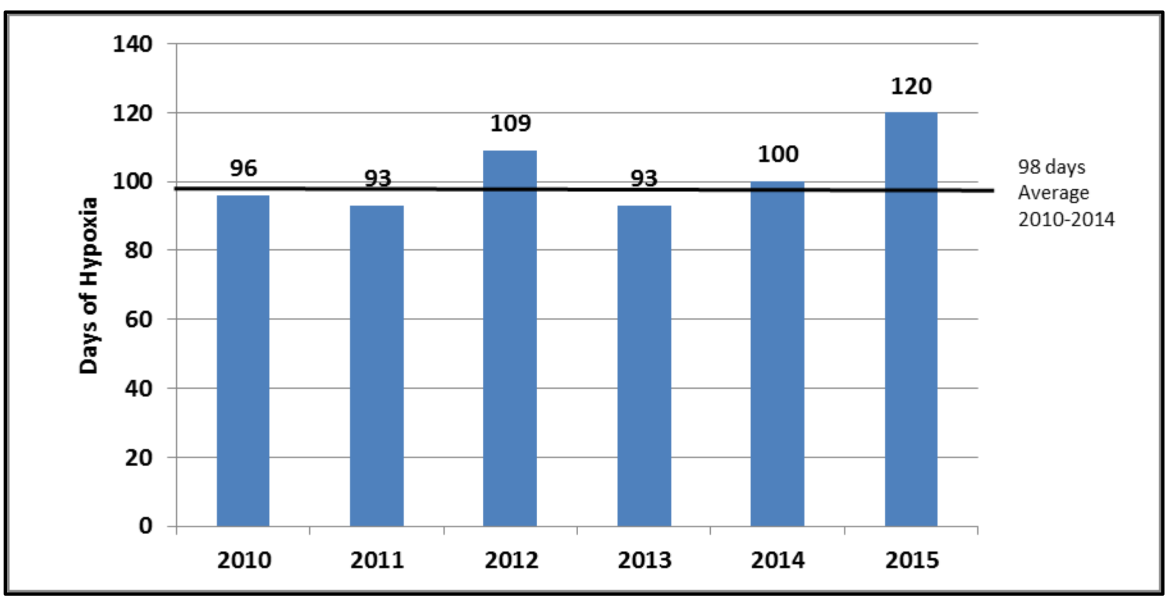


Figure 58. Days of Hypoxia (DO < 2.0 mg/L), 2010-2015

B. Total Phosphorus

Total phosphorus concentrations observed in Standley Lake in 2015 are displayed in Figure 59. Measurements are made in the photic zone, defined as twice the Secchi depth, and at the bottom of Standley Lake. The most pertinent feature of the annual time-series is the spike in phosphorus concentrations in the hypolimnion in late summer/early fall. The maximum TP concentration of 90.8 µg/L was measured on 10/13/15. This pattern of increasing hypolimnetic TP concentrations in late summer/fall is attributable to sediment releases of nutrients as a result of hypoxia in the hypolimnion.

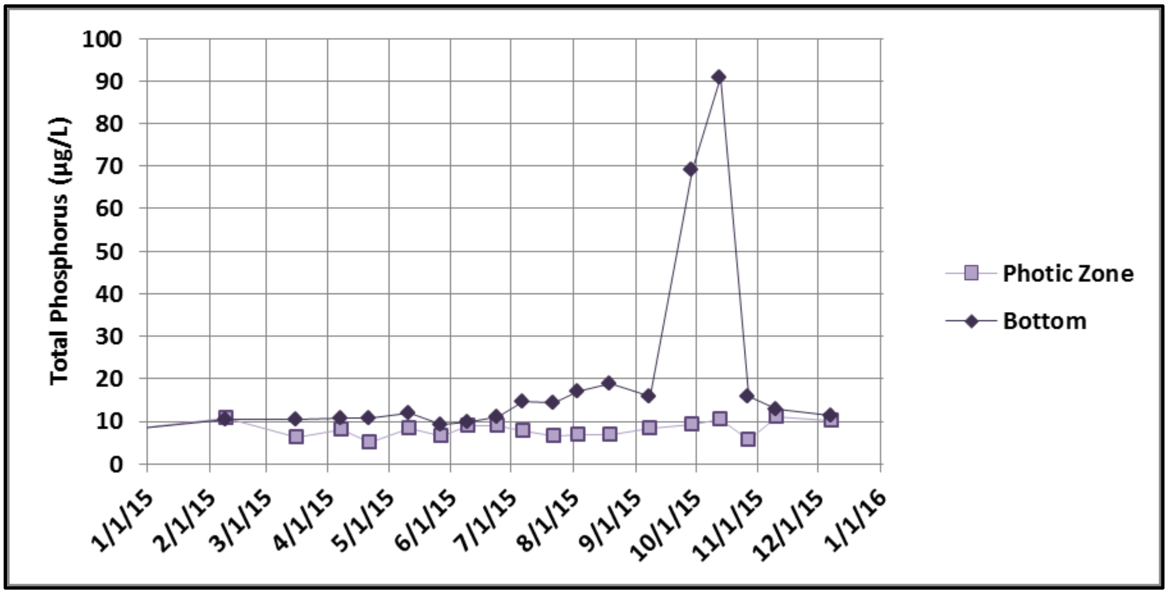


Figure 59. Total Phosphorus Concentrations in Standley Lake, 2015

This observed pattern is typical of previous years, as shown in Figure 60. Relative to the 2010-2014 averages the average TP concentrations in 2015 (20.3 µg/L hypolimnion and 8.1 µg/L photic zone); was 16% lower in the hypolimnion and 26% lower in the photic zone.

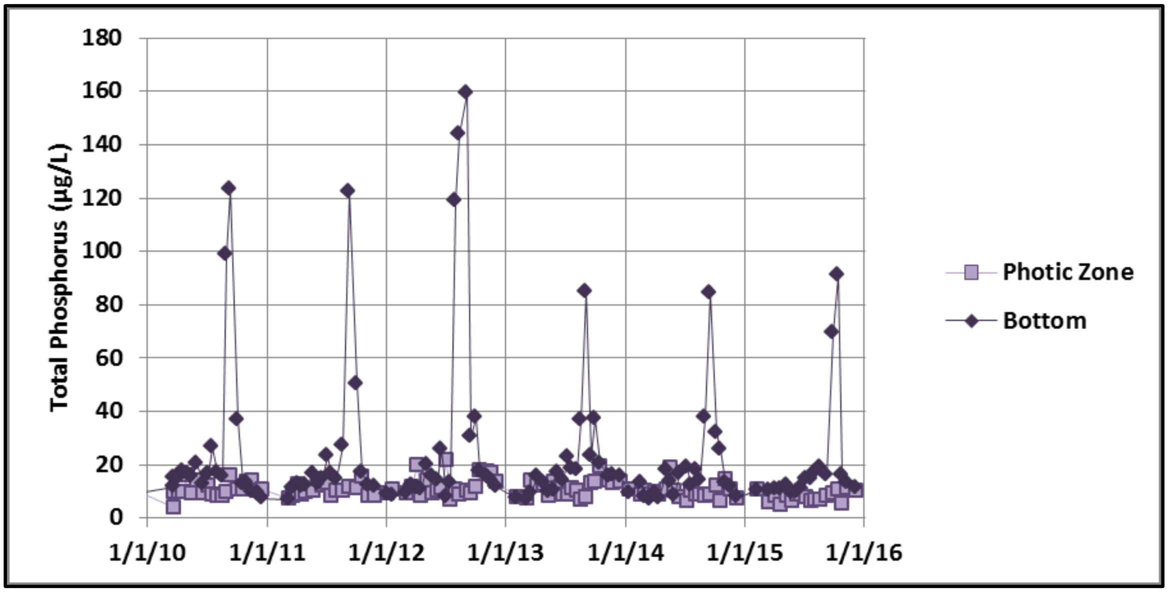


Figure 60. Total Phosphorus Concentrations in Standley Lake, 2010-2015

C. Total Nitrogen

Concentrations of TN observed in Standley Lake in 2015 in the photic zone and hypolimnion are shown in Figure 61. The pattern in the hypolimnion is similar to that seen in other years and is a reflection of external loading during runoff and internal loading in late summer. The maximum 2015 concentration observed in the hypolimnion (890 µg/L), was observed on 8/19/15 and 10/13/15. As in past years, concentrations in the photic zone had smaller fluctuations relative to the hypolimnion.

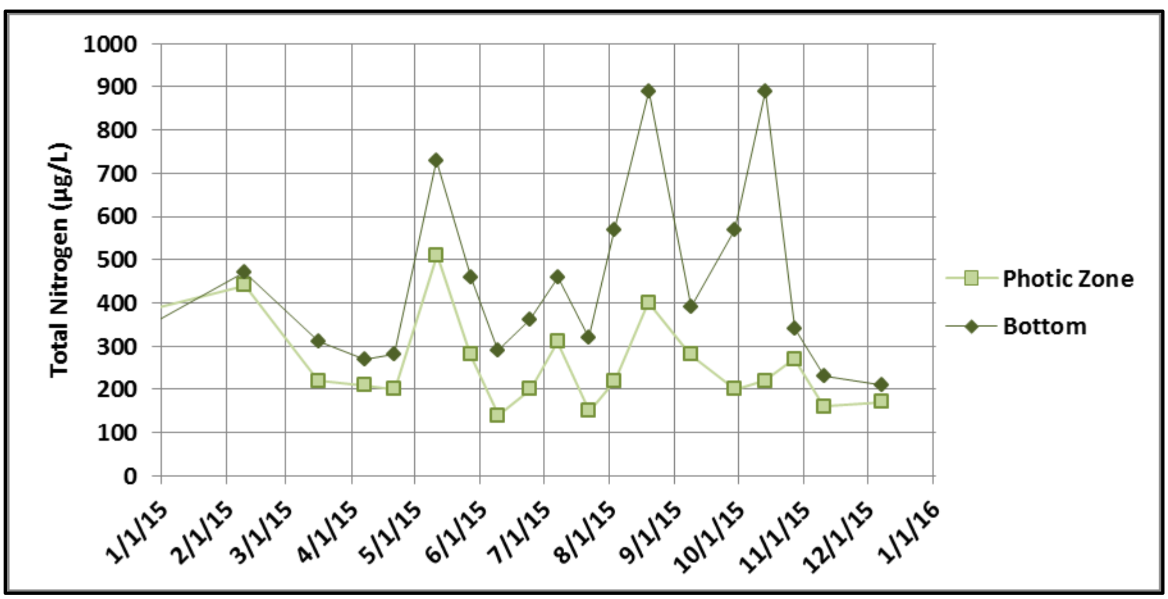


Figure 61. Total Nitrogen Concentrations in Standley Lake, 2015

Concentrations of TN in the lake for 2010-2015 are shown in Figure 62. Overall, TN concentration ranges observed in 2015 at the bottom and in the photic zone were comparable to previous years. When compared with the 2010-2014 annual average concentrations, the 2015 average TN concentrations (447 µg/L hypolimnion, 332 µg/L photic zone) were 19% higher in the hypolimnion and 2% lower in the photic zone.

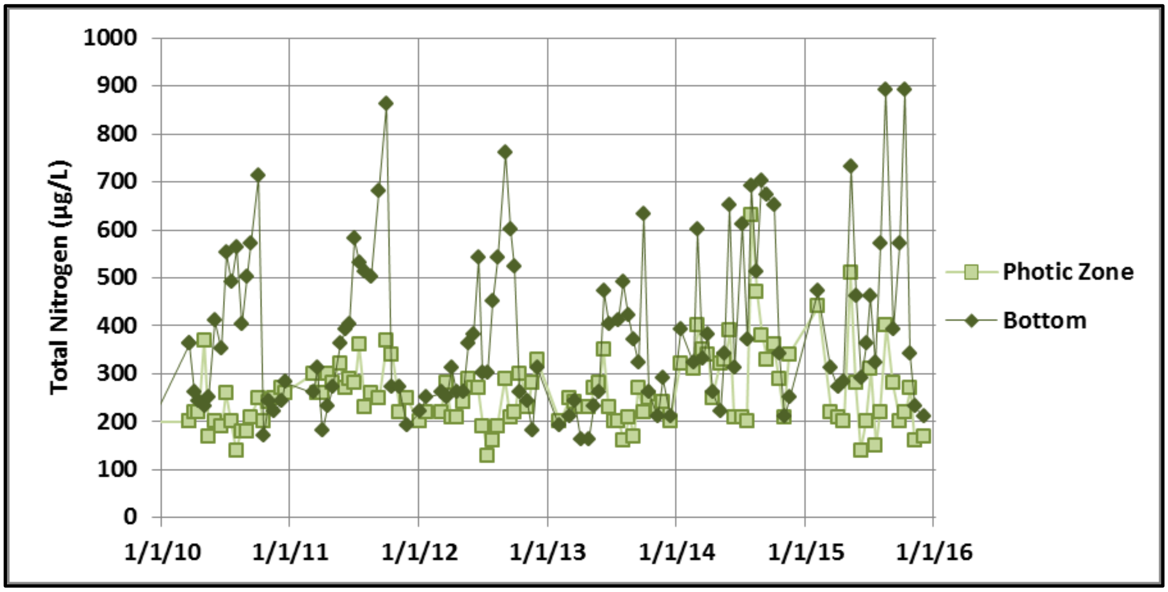


Figure 62. Total Nitrogen Concentrations in Standley Lake, 2010-2015

D. Chlorophyll *a*

A chlorophyll *a* standard of 4.0 µg/L was established in 2009 for Standley Lake. This standard is evaluated on an annual basis using the average of observed data for the nine month period from March through November. To account for the natural variability in chlorophyll *a* concentrations, the standard is assessed using a concentration of 4.4 µg/L. Chlorophyll *a* concentrations observed in Standley Lake in 2015 are presented in Figure 63, with March-November observations outlined in green. The maximum concentration measured in 2015 was 7.0 µg/L and occurred on 11/10/15. In 2015 there was another large peak (6.0 µg/L) on 5/27/2015. The patterns of chlorophyll *a* in 2015 were similar to those in 2014; both years experienced a maximum concentration in late fall with an additional spring peak.

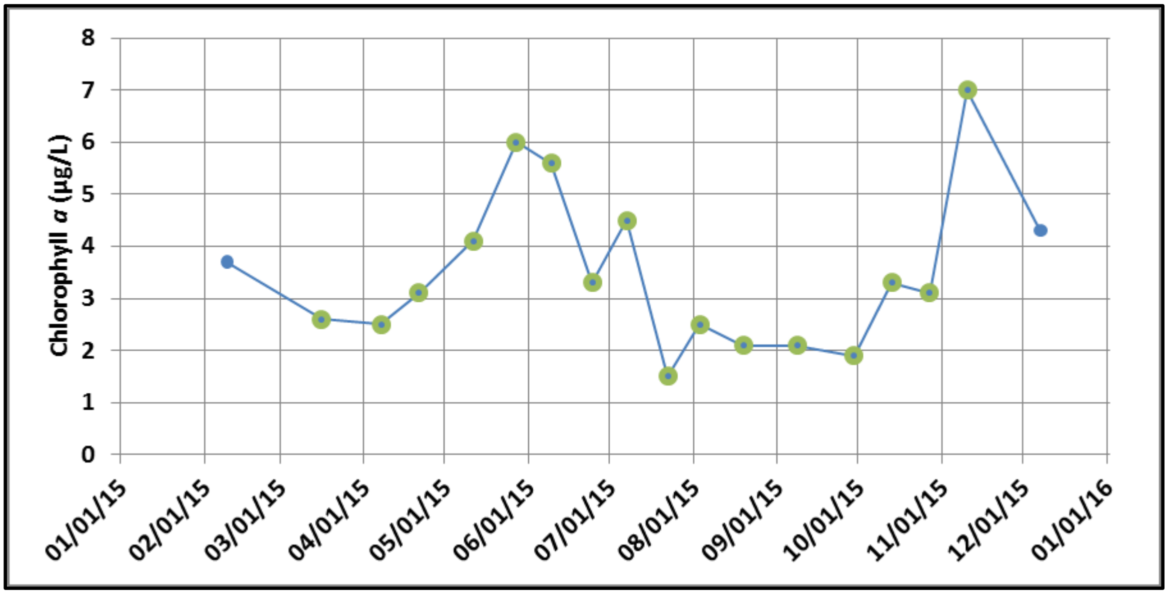


Figure 63. Chlorophyll *a* Concentrations in Standley Lake, 2015 (March-November observations highlighted in green)

Chlorophyll *a* concentrations observed from 2010 through 2015 are shown in Figure 64. Consistent with the previous figure, the green-outlined markers indicate March-November observations used for evaluation of the chlorophyll *a* standard. A seasonal pattern with chlorophyll *a* concentrations peaking after fall turnover is typical for Standley Lake. Peak concentrations in 2015 were lower than the maximum values observed in the previous four years. As in other years, turnover and an increase in concentrations of nutrients in the photic zone led to increasing chlorophyll *a.* The late fall maximum may be related to later-than-normal fall turnover. The spring peak is smaller relative to the fall peak, a pattern consistent with past years. Increasing temperatures in the spring, combined with a well-mixed water column, provide conditions amenable to phytoplankton growth.

A contour plot of chlorophyll *a* concentrations in Standley Lake for March-December 2015 is shown in Figure 65. The spring time bloom is apparent in June concentrated in the mid-depths of the reservoir. An analysis of in-reservoir water temperature found that these depths are approximately isothermal with the temperature of water entering the reservoir. This suggests that interflow in spring acts to deliver nutrients to these mid-depths, helping to fuel the chlorophyll *a* concentrations. In contrast, the fall bloom (associated with peak chlorophyll *a* concentrations) is distributed evenly through the entire reservoir as a result of the fall turnover. Concentrations of chlorophyll *a* remained low for the June through November period.

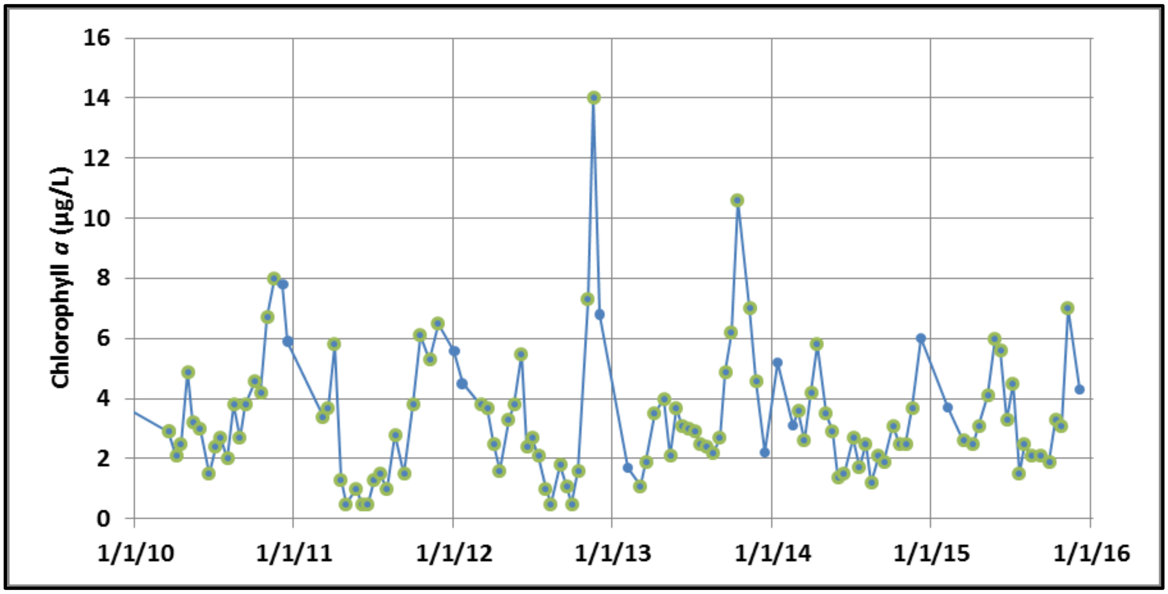


Figure 64. Chlorophyll *a* Concentrations in Standley Lake, 2010-2015 (with March-November observations highlighted)

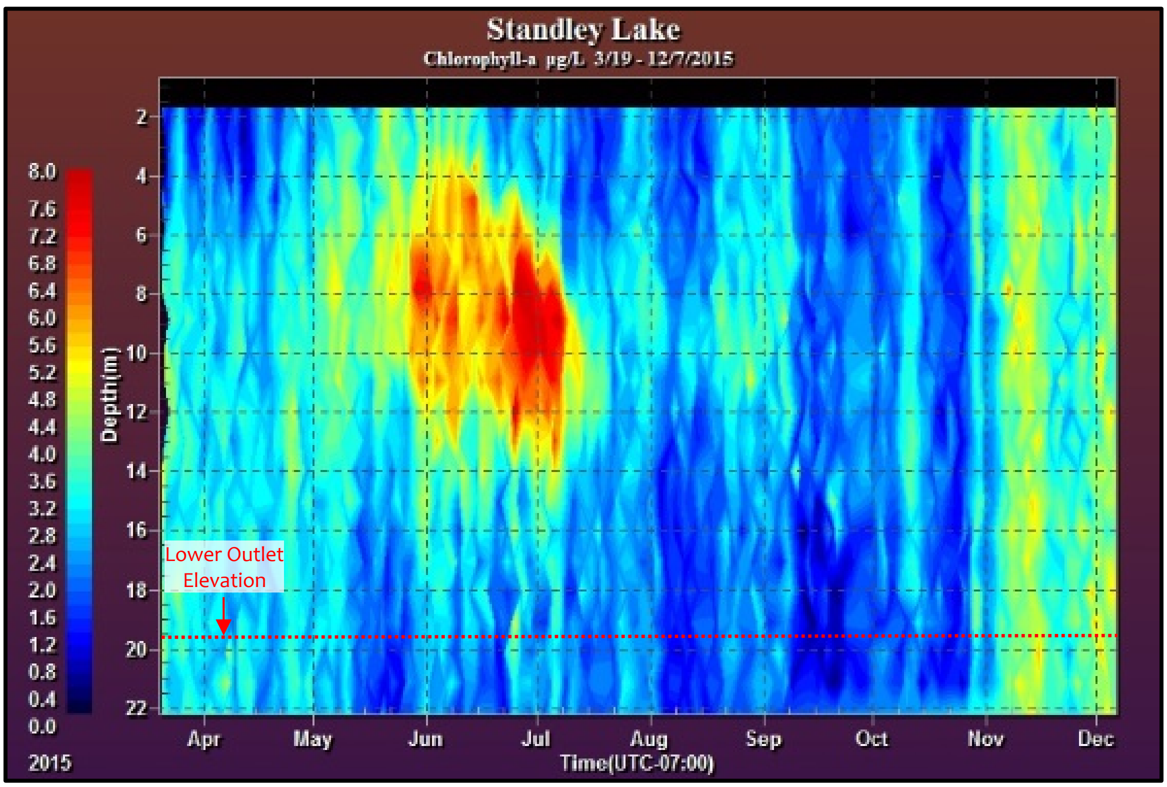


Figure 65. Contour Plot of Chlorophyll *a* Concentrations in Standley Lake, March-December 2015

The chlorophyll *a* standard for Standley Lake was met once again in 2015 (Figure 66). In 2015, the average concentration was 3.5 µg/L. This average is calculated as the average of all measurements from the photic zone for the period of March through November. This complies with both the 4.0

µg/L standard and 4.4 µg/L assessment threshold. The standard is met when four out of the five most recent years have a March-though-November average concentration below 4.0 µg/L. Every year in the five-year period from 2011 to 2015 has had a March-November average concentrations below 4.0 µg/L. Of the last ten years, only one year (2007, at 4.8 µg/L) had a March-November average concentration above 4.0 µg/L.

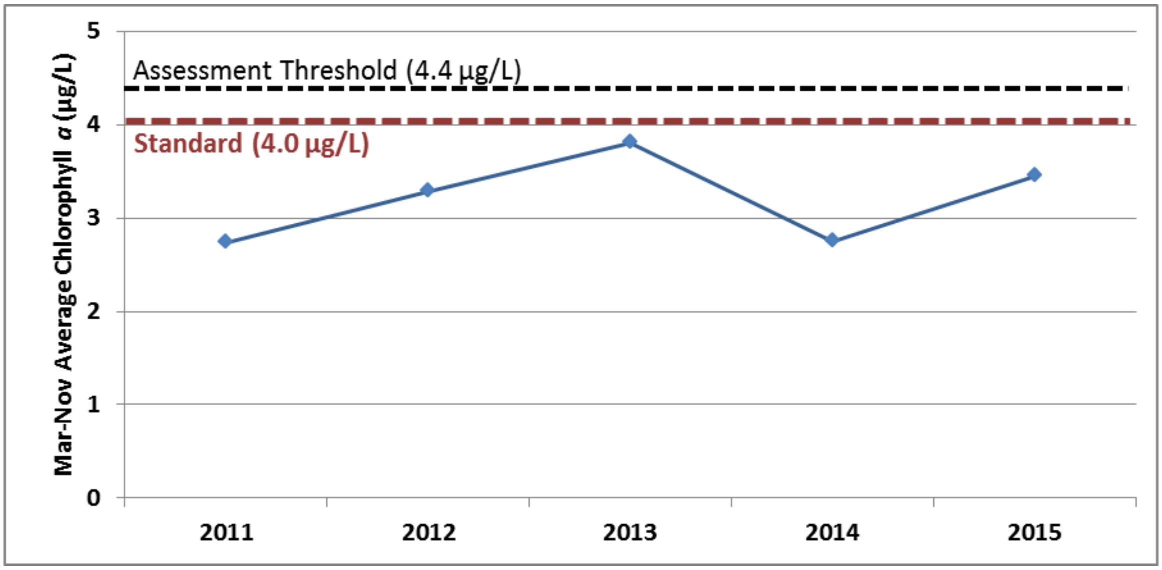


Figure 66. March - November Average Chlorophyll *a* Concentrations for Standard Evaluation, 2011-2015

The seasonal patterns for algal biovolume and observed chlorophyll *a* concentrations in Standley Lake for 2015 are displayed in Figure 67. In 2015, the peaks in chlorophyll *a* concentrations were generally tracked by the peaks in algal biovolume.

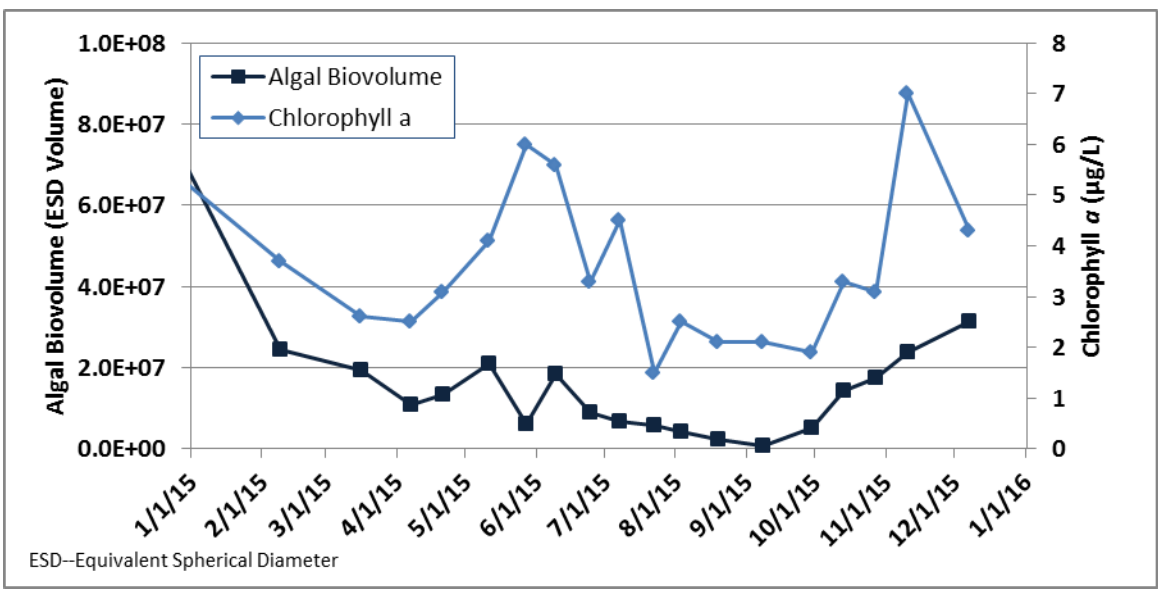


Figure 67. Algal Biovolume and Chlorophyll *a* Concentrations in the Photic Zone of Standley Lake, 2015

E. Secchi Depth

Clarity in Standley Lake is measured using a Secchi disk. When taking this measurement, a black-and-white disk is lowered vertically into the lake until the disk is no longer visible. The resulting depth, termed the Secchi depth, provides a measure of the scattering and absorption of light in the upper portion of the water column. This includes the effects of algae, non-algal organic particulate matter, inorganic suspended solids, dissolved organic matter, and the water molecules themselves. Secchi-depth measurements for Standley Lake in 2015 are shown in Figure 68. The measure of clarity with the greatest depth (6.3 m) occurred on 7/22/15. Throughout the year, clarity is variable, reflecting a combination of effects such as inflowing suspended solids, algal growth, particle settling, and stratification.

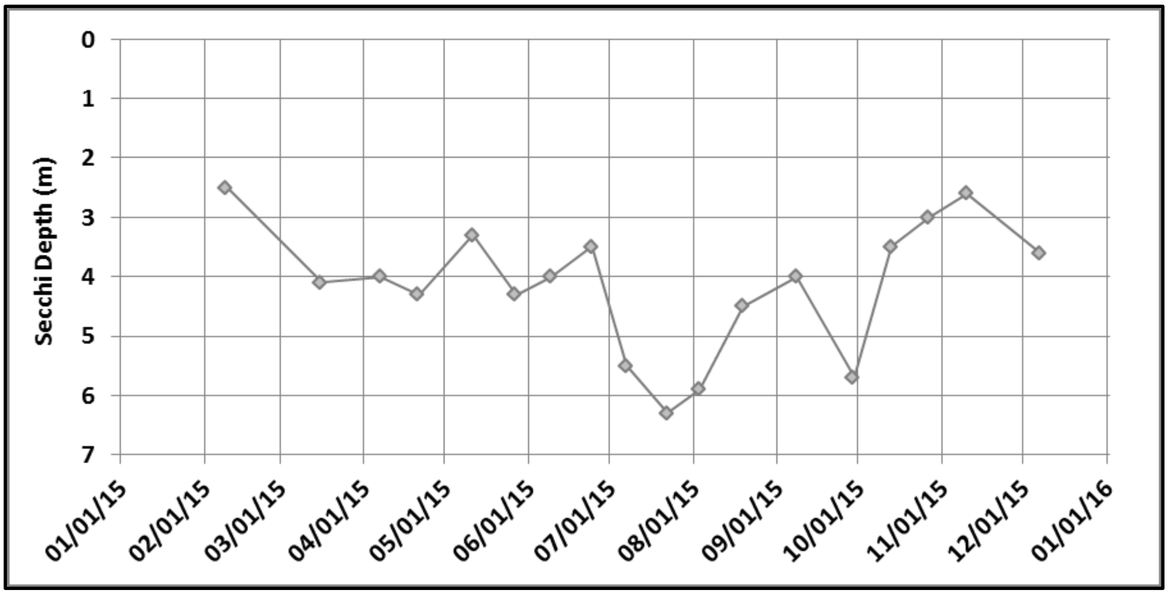


Figure 68. Clarity as Measured by Secchi Depth in Standley Lake, 2015

Individual Secchi-depth measurements for the past six years are shown in Figure 69. Average annual Secchi depths for the same period can be found in Figure 70. The range of Secchi depths observed in 2015 were consistent with the range of those measured in recent years. The 2015 average (4.1 m) was the deepest annual average over the ten year period from 2005 to 2015.

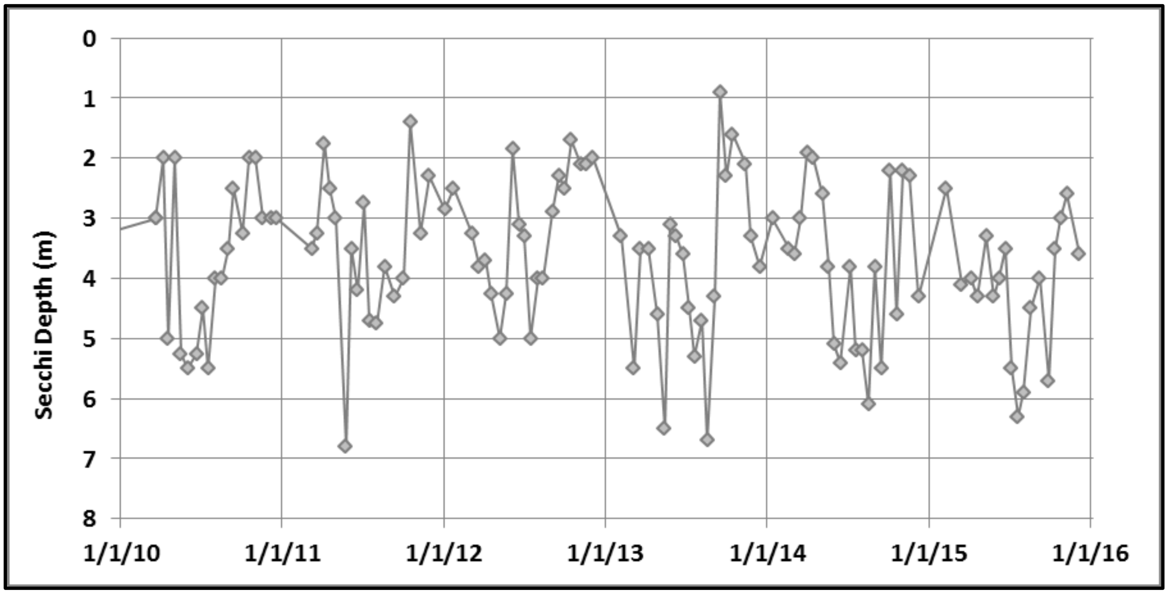


Figure 69. Clarity as Measured by Secchi Depth in Standley Lake, 2010-2015

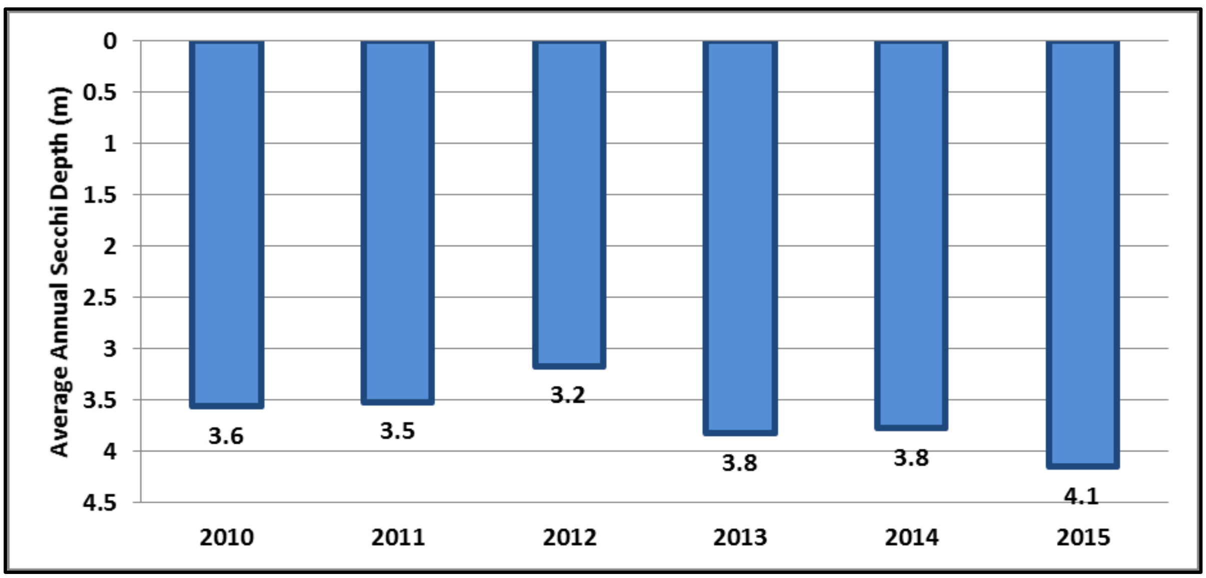


Figure 70. Average Annual Secchi Depth in Standley Lake, 2010-2015

F. Standley Lake Water Quality Summary

Water quality in Standley Lake, as indicated by the water-quality constituents discussed in this section, was good in 2015. Standley Lake demonstrated a typical pattern of summer stratification with associated hypolimnetic hypoxia. The pattern of hypolimnetic hypoxia was consistent with previous years; however the duration of hypoxia persisted for a relatively longer period. The patterns and magnitude of concentrations of TN and TP observed in the lake were consistent with previous years. The average Secchi depth was the highest of the 2010-2015 period. The chlorophyll *a* standard was again met in 2015; no annual average concentration has been greater than the standard since 2007. The long term pattern of these metrics provides a demonstration that good water quality is being maintained in Standley Lake. This, in turn, provides strong evidence of the effectiveness of the efforts to manage, enhance, and protect water quality throughout the Clear Creek and Standley Lake watersheds.

VIII. Conclusions

Members of the UCCWA, the Standley Lake Cities, and other parties to the 1993 Agreement continued efforts in 2015 to monitor, preserve, and improve water quality in Clear Creek and Standley Lake. Across the watershed, these activities included control of sediment and nonpoint sources of pollution, numerous public outreach and educational activities, extensive water-quality monitoring, and advanced planning efforts to support management.

In Clear Creek, Upper Basin annual flows at CC26 in 2015 were near average. The runoff pattern at this upper station was typical, showing a sharp peak associated with snowmelt. In the Lower Basin, flows at CC60 diverged from those at CC26 due to a period of rainfall occurring from mid-May to mid-June which primarily affected the foothills and plains. In some locations, rainfall during this period totaled more than 11 inches. As a result of this rainfall, flows at CC60 were 44% higher than average in 2015. Ambient condition concentrations of TSS, TP, and TN in 2015 were close to conditions observed during 2010-2014 in the Upper Basin at CC26. Loads of TSS, TP, and TN at CC60, the downstream station, were higher than in past years. Loads at CC60 were driven by higher than average flows. Storm loadings at CC60 were further increased by high concentrations of TSS and TP observed for one sampling event at the tail end of the May-June rainfall event. This was driven by an increase in flow and for TP, an increase in volume-weighted concentrations. An analysis of long-term records observed a likely decrease in TN in the Upper Basin; when comparing the post- and pre- 2012 periods

Inflows to Standley Lake were 19% below the 2010-2014 average, primarily driven by a decrease in inflows from the FHL canal. Annual loads of TN delivered to Standley Lake were below the 2010-2014 average. Loads of TP were 7% higher relative to the 2010-2014 average. This increase was primarily driven by increased loads from the Croke Canal, based on higher TP concentrations at that source.

In 2015, water quality in Standley Lake was good throughout the year. Water levels in Standley Lake were above average, likely the combined result of a wet spring and beginning the year at near-full conditions. Stratification patterns and hypoxic conditions in the hypolimnion were typical in 2015, although fall turnover was later than what is typically observed. The late turnover resulted in a longer than average period of hypoxia. Nutrient concentrations at the top and bottom of the lake were within the normal range and followed typical patterns. TN concentrations at the bottom were at the upper end of observed concentrations in recent years. The site-specific March through November chlorophyll *a* standard of 4.0 µg/L was once again met in 2015 with an average value of 3.5 µg/L. The maximum chlorophyll *a* observation (7 µg/L) was low compared to previous years. Of the last ten years, only one year (2007 at 4.8 µg/L) has had a March-November average chlorophyll *a* concentration above 4.0 µg/L. The average 2015 Secchi depth was 4.1 m; this is the deepest annual average Secchi depth value over the ten year period from 2005 to 2015. The long term pattern of these metrics provides a demonstration that good water quality is being maintained in Standley Lake. This, in turn, provides strong evidence of the effectiveness of the efforts to manage, enhance, and protect water quality throughout the Clear Creek and Standley Lake watersheds.

IX. References

CDOT. 2015. http://dtdapps.coloradodot.info/otis/trafficdata.

Colorado State Forest Service (CSFS). 2012. Protecting Your Home from Wildfire: Creating Wildfire-Defensible Zones. Quick Guide Series, Fire 2012-1.

Colorado Department of Public Health and Environment (CDPHE). 2012. Nutrients Management Control Regulation. 5 CCR 1002-85 (Regulation 85). Water Quality Control Commission. Adopted June 11, 2012; Effective September 30, 2012.

Enviroscience. 2013. 2013 Milfoil Weevil Survey at Standley Lake, Westminster, Colorado. Enviroscience, Stowe, Ohio.

Hydros Consulting. 2015. Clear Creek / Standley Lake Watershed Agreement. 2015 Annual Report October 1, 2015.

Williams C. 2015. DRAFT Town of Georgetown Source Water Protection Plan. February 23, 2015.

Appendix A – Clear Creek/Standley Lake Watershed Agreement

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.

Appendix B – Upper Clear Creek/Standley Lake Watershed Water-Quality Monitoring Plan

Upper Clear Creek/Standley Lake Watershed

Water Quality Monitoring Plan

Standley Lake

December 2013

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APPENDICES

Abbreviations and Acronyms

BH/CC	Blackhawk/Central City
C	Centigrade
CC	Clear Creek
cfs	cubic feet per second
COC	chain of custody
CWQCC	Colorado Water Quality Control Commission
DI	Deionized Water
DO	Dissolved Oxygen
DRP	Dissolved Reactive Phosphorus (ortho-Phosphate-P)
EPA	U.S. Environmental Protection Agency
FHL	Farmers Highline Canal
FRICO	Farmers Reservoir and Irrigation Company
HCl	Hydrochloric acid
ISDS	Individual Sewage Disposal System
KDPL	Kinnear Ditch Pipe Line
LDMS	Laboratory Data Management System
µg/L	micrograms per liter
µS/cm	microsiemens per centimeter
m	meter
mgd	million gallons per day
mg/L	milligrams per liter
MSCC	Mainstem Clear Creek
mv	millivolt
N	Nitrogen
NFCC	North Fork Clear Creek
NG	City of Northglenn
NPS	Nonpoint Source
NTU	Nephelometric Turbidity Units
ORP	Oxidation Reduction Potential
OWTS	Onsite Wastewater Treatment System
pCi/L	picocuries per liter
P	Phosphorus
QC	Quality Control
SDWA	Safe Drinking Water Act
SFCC	South Fork Clear Creek
SLC	Standley Lake Cities
SLWQIGA	Standley Lake Water Quality Intergovernmental Agreement
SM	Standard Methods for the Examination of Water and Wastewater
TH	City of Thornton
TOC	Total Organic Carbon
TSS	Total Suspended Solids
TVSS	Total Volatile Suspended Solids
UCC	Upper Clear Creek
USGS	United States Geological Survey
Westy	City of Westminster
WFCC	West Fork Clear Creek
WMA	Upper Clear Creek Watershed Management Agreement
WQIGA	Water Quality Intergovernmental Agreement (Standley Lake)
WQS	Colorado Water Quality Standards (Regs #31 and #38)
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

MONITORING PROGRAMS OVERVIEW

Introduction

The quality of the water in Standley Lake has been monitored for more than two decades. Efforts to protect Standley Lake through state water quality regulations culminated in adoption of the numeric chlorophyll *a* standard for the lake in 2009. The Colorado Water Quality Control Commission ("CWQCC") established the chlorophyll *a* standard at 4.0 µg/L with a statistically derived assessment threshold of 4.4 µg/L. The standard is based on the arithmetic average of the individual monthly average chlorophyll *a* data for samples collected during March through November in each year. Exceedance of the standard would occur if the yearly 9-month average of the monthly chlorophyll *a* average results is greater than 4.4 µg/L more frequently than once in five years. In addition, a version of the narrative standard adopted in 1993 was also retained stating that 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. The voluntary implementation of best management practices clause included in the 1993 version of the standard was eliminated from the 2009 narrative standard.

The Standley Lake Cities ("SLC") of Northglenn, Thornton and Westminster remain committed to effective and efficient water quality monitoring in the watershed as originally agreed to in the 1993 Watershed Management Agreement. The Standley Lake Water Quality Intergovernmental Agreement ("SLWQIGA" or "WQIGA"), entered into between the SLC, details the provisions for costs sharing related to cooperative efforts regarding water quality issues in the Clear Creek Basin and Standley Lake. The WQIGA monitoring program is subdivided into three inter-related programs for which the SLC provide field sampling, laboratory analyses and data management support: the Upper Clear Creek Monitoring Program, the Tributary Basin Monitoring Program and the Standley Lake Monitoring Program.

The Monitoring Committee was formed to periodically evaluate the monitoring programs and propose appropriate modifications as necessary. The proposals are evaluated by the SLWQIGA committee prior to implementation. Representatives from the SLC, Upper Clear Creek Basin and the Tributary Basin are actively involved in committee activities as appropriate. This document details the specific requirements and responsibilities of the SLC and outlines the commitments of additional entities involved in the Standley Lake watershed monitoring programs.

Standley Lake serves as the sole drinking water source for the cities of Northglenn and Westminster and is one of several drinking water sources for the City of Thornton. The monitoring program is designed to collect samples from a variety of locations in the watershed with varying anthropogenic and natural sources of pollutants. The data is used for trend analysis, modeling and for numerous other applications. Interpretation of the results allows the upstream and downstream communities to work cooperatively to minimize impacts to water quality.

Safety Considerations

The personal safety of the sampling team members is paramount in the decision making process for collection of water quality samples. At no time should personal safety be jeopardized in order to collect a sample. Environmental conditions may change suddenly and are variable throughout the watershed.

The following safety measures should be observed during all sampling activities:

- Sample collection should be performed by a two person team whenever possible.
- Weather conditions at the sampling sites should be evaluated prior to leaving the laboratory.
- Personal flotation devices should be worn if the creek water level is greater than twelve inches deep. Hydrostatically triggered, self-inflating personal flotation devices are recommended for non-lake sampling, as the device will automatically inflate if the sensor is submerged below six inches of water.
- Personal flotation devices are mandatory on Standley Lake. Lake sampling team members should be experienced swimmers.
- Wear waterproof gloves and sock liners, as appropriate.
- Exercise caution on slippery rocks, river banks and boat docks.
- Cell phones must be available during sampling, but be aware that cell phone signals are not reliable in all areas of Clear Creek Canyon.
- First aid kits must be available in all sampling vehicles, including boats. It is recommended that sampling team members be trained in basic first aid techniques.
- Supervisors are notified of the sampling team's itinerary and the expected return time to the lab. Sampling teams will notify supervisors of any delay in the expected return time.

UPPER CLEAR CREEK MONITORING PROGRAM

The Upper Clear Creek ("UCC") Monitoring Program is designed to provide water quality information in order to evaluate nutrient loadings from both point sources (discrete) and non-point sources (dispersed) within the Upper Clear Creek Basin.

The Upper Clear Creek Monitoring Program includes three distinct sub-programs, each designed to obtain water quality data during specified conditions:

- ambient grab samples;
- continuous stream monitoring and the automated collection of 48-hour ambient samples, and
- the automated collection of event samples.

UCC – AMBIENT GRAB SAMPLES

Program Coordination: Thornton
Program Participants: Thornton, Westminster, Arvada, Golden, Upper Basin WWTPs

Grab samples are single, point-in-time samples collected in-stream throughout the Upper Clear Creek Basin. 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. Refer to the table below for sample site locations. The rationale for selection of the specific sampling sites is included in Appendix A. A map of the watershed is included in Appendix B.

Grab samples are collected five times during the year to correspond with seasonally varying flow conditions in Clear Creek. The *Short Schedule* is collected three times per year (February, April and December) and includes four stream locations. The *Long Schedule* is collected twice per year (May and October) and includes 16 stream locations. Laboratory analytical protocols limit sample collection to Monday through Thursday. Sampling is performed each year on approximately the same schedule. The specific sampling dates for the year are predetermined at the beginning of the year.

Starting in 2013, Wastewater Treatment Plant (WWTP) effluent samples are collected by treatment plant staff and are analyzed for nutrients (nitrogen and phosphorus) by commercial laboratories in accordance with Colorado Regulation 85. Sampling and analysis plans were developed by each WWTP outlining the monitoring locations, frequency and analytical parameters for testing. The analytical data reported by the WWTPs to the Colorado Water Quality Control Division will be included in the watershed annual reports.

WWTP Effluent Sample ID	Sample Location
CC1A	Loveland WWTP
CC3A	Georgetown WWTP
CC5A	Empire WWTP
CC7A	Central Clear Creek WWTP
CC8A	St Mary's WWTP
CC12A	Idaho Springs WWTP
CC13B	Black Hawk/Central City WWTP
CC14A	Henderson Mine WWTP
CC15A	Eisenhower Tunnel WWTP

UCC – AMBIENT GRAB SAMPLES

Locations and Sample Schedule

Clear Creek Sample ID	Flow Gage	Sample Location *	Early Feb	Early Apr	Late May	Mid Oct	Early Dec
CC05	Staff gage	MSCC at Bakerville			X	X	
CC10	Recording gage	SFCC upstream of the lake			X	X	
CC15	Staff gage	WFCC below Berthoud			X	X	
CC20	Recording gage	WFCC below Empire			X	X	
CC25	Recording gage	MSCC above WFCC			X	X	
CC26	Recording gage	MSCC at Lawson Gage	X	X	X	X	X
CC30	Staff gage	Fall River above MSCC			X	X	
CC34	----	MSCC above Chicago Creek			X	X	
CC35	Recording gage	Chicago Creek above Idaho Springs WTP			X	X	
CC40	Recording gage	MSCC below Idaho Springs WWTP (US 6 and I-70))	X	X	X	X	X
CC44	Staff gage	NFCC above BH/CC WTP intake			X	X	
CC45	----	NFCC above original BH/CC WWTP			X	X	
CC50	Recording gage	NFCC at the mouth	X	X	X	X	X
CC52	----	Beaver Brook at the mouth			X	X	
CC53	----	Soda Creek at the mouth			X	X	
CC60	----	MSCC at Church Ditch Headgate	X	X	X	X	X

* MSCC = Mainstem Clear Creek WFCC = West Fork Clear Creek WTP = Water Treatment Plant
SFCC = South Fork Clear Creek NFCC = North Fork Clear Creek WWTP = Wastewater Treatment Plan

UCC – AMBIENT GRAB SAMPLES

Analytical Parameters for Creek samples – includes parameters for both Short and Long Schedules

Analyte	Analytical Method Reference	Reporting Limit Goal	Responsible Laboratory
Total Nitrogen	SM 4500-NO3 I	0.02 mg/L	Westminster
Nitrate/Nitrite as N	SM 4500-NO3 I	0.01 mg/L	Westminster
Ammonia as N	SM 4500-NH3 H	0.01 mg/L	Westminster
Total Phosphorus	SM 4500-P E	0.0025 mg/L	Northglenn
Ortho-phosphate as P (dissolved) or DRP	SM 4500-P E	0.0025 mg/L	Northglenn
Total Organic Carbon (TOC)	SM 5310 B	0.5 mg/L	Thornton
Total Suspended Solids	SM 2540 D	1 mg/L	Thornton
Temperature	SM 2550 B	1.0 °C	Field Teams/Golden
pH	SM 4500-H+ B	1.0 Std Units	Field Teams/Golden
Conductivity	SM 2510 B	10 µS/cm	Field Teams/Golden
Turbidity	SM 2130 B	1.0 NTU	Field Teams/Golden
Dissolved Oxygen	SM 4500-O G	1.0 mg/L	Field Teams/Golden
Stream Depth	Staff gage reading	0.1 ft	Field Teams

Table Notes:
1) SM refers to the 22^{nd} Edition of Standard Methods for the Examination of Water and Wastewater.
2) Reporting limit goals are matrix dependent and may be increased for complex matrices and may be lower depending on laboratory capability.
3) TOC is analyzed on samples from sites CC05, CC20, CC26, CC35, CC40, CC45, CC50, CC52, CC53, and CC60 during the Long Schedule events. TOC is analyzed on all four creek grab samples during the Short Schedule events.

UCC – AMBIENT GRAB SAMPLES

Flow Monitoring

Various mechanisms are employed throughout the watershed for monitoring the hydrologic conditions at strategic locations. USGS real-time recording gages are installed at CC10, CC20, CC25, CC26, CC35, CC50 and CC61 (Clear Creek at Golden). USGS staff gages are in place at CC05, CC15, CC30 and CC44. The staff gage readings are recorded to the nearest 0.1 foot and may be converted to stream flow using the USGS calibration rating curve established for the location.

The recording gage at CC40 (Clear Creek at US 6 and I-70) is operated and maintained by Clear Creek Consultants on behalf of UCCWA. The SLC provide financial support for the USGS gages at CC05 at Bakerville (staff gage) and CC26 at Lawson (recording gage). The City of Golden provides financial support for the USGS gage on the West Fork of Clear Creek at Empire.

UCC – AMBIENT GRAB SAMPLES

Program Coordination - Short Schedule (Thornton)

Two weeks before the scheduled Clear Creek sampling date:

- Contact Westminster and Northglenn to request adequate supply of sample bottles from each lab.
- Prepare four sample kits as directed below. Each sample bottle kit includes the containers for sampling at one location.

Sample Bottle Kit Prep- Short Schedule

Destination	Quantity	Volume	Bottle Type	Parameter	Laboratory	Additional Documentation
Clear Creek Team – Feb, April and Dec **ONLY** (Collect samples at CC26, CC40, CC50 and CC60)	4	1L	Rectangular plastic	Phosphorus series	Northglenn	Instructions, COCs and one field data sheet
	4	500 mL	Plastic jug	TSS	Thornton	
	4	250 mL	Rectangular plastic	Nitrogen series	Westminster	
	4	40 mL	Glass vial	TOC	Thornton	

Table Notes:
1) Phosphorus series includes total P and dissolved ortho-phosphate-P (also referred to as DRP).
2) Nitrogen series includes total N, ammonia-N and nitrate/nitrite-N.
3) The additional documentation forms are included in Appendix C.

On Clear Creek sampling day (Short Schedule):

- Calibrate turbidity, pH, conductivity, and DO meters in the lab. Ensure all probes and meters are working properly before leaving the lab. Take aliquots of the standards into the field to check instrument calibration if necessary.

- At each sample location, collect samples and analyze for pH, temperature, DO, conductivity, and turbidity. Complete the COC and record all results on the Field Data Sheet (refer to Appendix C).

- The field samples are returned to the Thornton Lab and refrigerated until pickup by Westminster and Northglenn personnel. The samples are relinquished to Westminster (nitrogen) and Northglenn (phosphorus) and the COCs are signed appropriately. The original copies of the COCs are retained by Westminster and Northglenn. Original field data sheets and copies of the COCs are retained by the City of Thornton for permanent archive.

UCC – AMBIENT GRAB SAMPLES

Sampling Locations Directions and Narrative Descriptions - Short Schedule

Sampling Frequency: Feb, April, Dec

POINT	DIRECTIONS AND DESCRIPTION OF LOCATION
CC26	Travel westbound I-70 and exit at Dumont/Downieville. Travel frontage road west towards Lawson. Immediately after the I-70 overpass turn left and park in area just beyond the end of the guardrail. Sample creek at USGS gage and sampling station by bridge. [RECORDING GAGE] **Sample TOC**
CC40	Travel eastbound on I-70 and take US 6 exit. Pull off in parking area just east of the off ramp. (The Tributary at 244 Restaurant is across the road) Sample just below the USGS recording gage. **Sample TOC**
CC50	Travel US 6 eastbound to the intersection of US 6 and CO 119. Turn left up Highway 119 towards Blackhawk/Central City. Approximately 0.2 miles upstream from the intersection is a pullout area on the left with a small red building and cellular antenna pole near a boarded-up tunnel entrance. Sample at the USGS recording gage. [RECORDING GAGE] **Sample TOC**
CC60	Approximately 1 mile west of intersection of Hwy 58 and US 6. Park in the pullout on the south side of highway and walk (or drive) downhill to the Church Ditch diversion structure. Go across the mesh bridge and sample from the main stem of Clear Creek. Do not sample from Church Ditch. **Sample TOC**

Photographs of the sampling locations and GPS coordinates are included in Appendix D.

UCC – AMBIENT GRAB SAMPLES
Program Coordination - Long Schedule (Thornton)

Two weeks before the scheduled Clear Creek sampling date:

- Contact Westminster and Northglenn to request adequate supply of sample bottles from each lab.
- Contact and coordinate the sampling teams. Make sure that there are two samplers available and one set of field meters (turbidity, pH, conductivity and DO) for two Creek Teams. Refer to the Program Participants Contact Information list in Appendix F for sampling personnel who may assist with sampling.
- Prepare sample kits as directed below. Each sample bottle kit includes the containers for sampling at one location.

Prepare sample bottle kits as directed below. Each sample bottle kit contains the prepared sample bottles to collect samples at one location. Prepare 16 bottle kits: 8 kits each for Creek Teams A and B.

Sample Bottle Kit Prep- Long Schedule

Destination	Quantity	Volume	Bottle Type	Parameter	Laboratory	Additional Documentation
Clear Creek Team A (Collects samples at CC25, CC05, CC10, CC26, CC34, CC35, CC52 and CC53)	8	1L	Rectangular plastic	Phosphorus series	Northglenn	One set of: Instructions, COCs and one field data sheet
	8	500 mL	Plastic jug	TSS	Thornton	
	8	250 mL	Rectangular plastic	Nitrogen series	Westminster	
	5	40 mL	Glass vial	TOC	Thornton	
Clear Creek Team B (Collects samples at CC15, CC20, CC30, CC40, CC44, CC45, CC50 and CC60)	8	1L	Rectangular plastic	Phosphorus series	Northglenn	One set of: Instructions, COCs and one field data sheet
	8	500 mL	Plastic jug	TSS	Thornton	
	8	250 mL	Rectangular plastic	Nitrogen series	Westminster	
	5	40 mL	Glass vial	TOC	Thornton	
QC	4	2 L	1:1 HCl rinsed Rectangular plastic	QC spikes and dups for Golden	Golden	QC sampling completed by Team A in May and Team B in October.
	1 (blank)	1 L	Rectangular plastic	Phosphorus series	Northglenn	
	1 (blank)	250 mL	Rectangular plastic	Nitrogen series	Westminster	

Table Notes:
1) Phosphorus series includes total P and dissolved ortho-phosphate-P (also referred to as DRP).
2) Nitrogen series includes total N, ammonia-N and nitrate/nitrite-N.
3) The additional documentation forms are included in Appendix C.

<u>On Clear Creek sampling day (Long Schedule):</u>

- Calibrate turbidity, pH, conductivity, and DO meters in the lab. Ensure all probes and meters are working properly before leaving the lab. Take aliquots of the standards into the field to check instrument calibration if necessary.

- Prepare coolers with ice and sample bottle kits. The Creek Team chosen for QC sampling must also include in the field sample bottle kit: field blank bottles (nitrogen and phosphorus), one field duplicate cubitainer, and at least 4 two-liter bottles for QC samples. Thornton prepares both sample kits for Clear Creek Teams A and B and will provide the extra materials needed for the QC sampling in the appropriate sample kit.

- Meet your sampling team partner at the designated location (usually City of Golden Public Works).

- At each sample location, collect samples and analyze for pH, temperature, DO, conductivity, and turbidity. Complete the COC and record all results on the Field Data Sheet (refer to Appendix C). Samples will be collected at all creek sites for nitrogen series, phosphorus series and TSS. TOC samples are collected only at designated creek sites: CC05, CC20, CC26, CC35, CC40, CC45, CC50, CC52, CC53, and CC60.

- The Clear Creek Team selected for QC sampling will randomly select four creek sites. Collect one sample (2-liter HCl rinsed bottle) at four randomly selected creek sites for preparation of the spike and duplicate nutrient QC samples by Golden Laboratory staff.

- Complete the COC for the QC samples.

- Return to the Golden Lab when sampling is completed. Relinquish the QC samples to the Golden Lab staff.

- Golden Lab staff prepares one duplicate and one spike sample for total nitrogen and total phosphorus from the four QC samples.

- Analyze and complete any missed field parameters as allowable.

- Make two copies of each team's field data sheet: one of each for Golden and one of each for Westminster to use for logging in the samples to the electronic spreadsheet.

- The field samples and prepared QC samples are returned to the Thornton Lab and refrigerated. The samples are relinquished to Westminster (nitrogen) and Northglenn (phosphorus) and the COCs are signed appropriately. The original copies of the COCs are retained by Westminster and Northglenn. Original field data sheets and copies of the COCs are retained by the City of Thornton for permanent archive.

UCC – AMBIENT GRAB SAMPLES

Sampling Locations Directions and Narrative Descriptions - Long Schedule

Clear Creek Team A

Sampling frequency: late May, mid Oct

Sample bottles: Creek sites: One 1 liter rectangular (phosphorus series), one 500 mL (TSS), one 250 mL (nitrogen series) and one 40 mL amber glass vial (TOC) as required.

POINT	DIRECTIONS AND DESCRIPTION OF LOCATION
CC25	Travel west on I-70 approximately 0.8 miles west of mile marker 232. Pull off the highway on the right side immediately beyond the guardrail for the bridge structure. Walk down the hill to the creek. Sample immediately downstream of the box culvert across from the recording gage located downstream. [RECORDING GAGE]
CC05	1-70 westbound to Exit 221 (Bakerville) Exit; go south back over Interstate (left). Park at call box. Take sample upstream of parking area, read gage located downstream. [Read the STAFF GAGE and record on the field data sheet]. **Sample TOC**
CC10	I-70 eastbound to Georgetown. Begin at intersection of 6th and Rose in Georgetown. Go 2.2 miles up Guanella Pass Road (go to the first lake). U-turn by the lake inlet and park on the right side of road. Sample from stream above lake inlet point. [RECORDING GAGE]
CC26	Travel eastbound on I-70 and exit at Lawson. Travel frontage road through Lawson. Immediately before the road curves left under I-70 is a parking area straight ahead through an opening at the end of a guardrail. Sample creek at gage and USGS sampling station by the bridge over the creek. [RECORDING GAGE] **Sample TOC**
CC34	From I-70 (either direction) Exit 240 (Chicago Creek), pull off in the small parking area on the other side of the bridge. Sample the main stem of Clear Creek upstream of Chicago Creek across from the Forest Service Building.
CC35	Continue approx. 3.7 miles on Hwy 103. Pull off on the right shoulder just past the green roofed house that looks like a barn (on the left). Cross road and sample creek at recording gage. [RECORDING GAGE] **Sample TOC**
CC52	Exit I-70 eastbound at Beaver Brook/Floyd Hill (Exit #247). Turn left onto the north frontage road (US Hwy 40). Travel east approximately 2.4 miles. Pull off to the side of road and sample Beaver Brook at this point. **Sample TOC**

CC53 Continue travelling east bound 0.3 miles and cross the second white bridge. Exit immediately on the right to Soda Creek Drive. Park on the right. Sample Soda Creek upstream of the bridge. **Sample TOC**

Photographs of the sampling locations and GPS coordinates are included in Appendix D.

UCC – AMBIENT GRAB SAMPLES
Sampling Locations Directions and Narrative Descriptions - Long Schedule

Clear Creek Team B

Sampling frequency: late May, mid Oct

Sample bottles: Creek sites: One 1 liter rectangular (phosphorus series), one 500 mL (TSS), one 250 mL (nitrogen series) and one 40 mL amber glass vial (TOC) as required.

POINT	DIRECTIONS AND DESCRIPTION OF LOCATION
CC40	Traveling westbound on I-70 take the US 6 exit (#244) at the bottom of Floyd Hill. Turn right at the bottom of the ramp, and pull off to the right in the parking area 150 feet east of the off-ramp. (The Tributary at 244 Restaurant is across the road). Sample below recording gage. [RECORDING/STAFF GAGE] **Sample TOC**
CC30	Drive west on 1-70 to Exit 238 (Fall River Road/St. Mary's Glacier). At the junction of the on/off ramp and Fall River Road is a parking area on the left across from a railing and stairway with USGS equipment. Descend the stairs and sample the creek above the staff gage attached to the bridge. [Read the STAFF GAGE and record on the field data sheet]
CC15	Travel west on I-70 and take US 40 west through Empire. Approximately 6 miles west of Empire there is a large pullout on the creek (left) side of the highway with a large tree in the middle of the pullout. Sample directly below the tree at the creek. Staff gage is along the north bank of stream next to a tree at the stream's edge. [Read the STAFF GAGE and record on the field data sheet]
CC20	Returning back through Empire eastbound, travel along the road/ramp from US 40 towards Westbound I-70. Immediately after turning onto road/ramp, there is a large open space on the right and a Colorado Dept. of Transportation (CDOT) maintenance area on the left. If the gate is open, turn left into the CDOT maintenance yard and sample approx. 150 feet downstream of the bridge at recording gage/staff gage. If the gate is closed, park across the street from the gate and walk into the CDOT maintenance area. [RECORDING/STAFF GAGE] **Sample TOC**
CC44	Return east on I-70 to the Central City Parkway and take the Parkway to Central City. Central Parkway turns into Nevada Street. Nevada Street turns into Spring Street when it crosses over Main Street. Take Spring Street to Gregory Street and turn right. Travel down through Central City into Blackhawk, past Blackhawk's Main Street and turn left on Hwy 119. Travel westbound on 119 approx. 0.9 miles.

There is a small wooden building and parking area on the left side of the road at the Black Hawk water intake. Sample the creek behind the building.

CC45 Turn around and drive east on 119 approx. 1.5 miles and turn right on Mill Street. Take the first left onto Main Street and drive to the east end of the casino and parking garage on the left. At the east end of the building is an alley between the parking garage and a small brown building. Sample the creek at the end of the alley upstream of the old Black Hawk WWTP site. **Sample TOC**

CC50 Continue down Hwy 119 eastbound toward US 6. Approximately 1.4 miles downstream of the new Black Hawk/Central City WWTP and approximately 0.2 miles upstream from the intersection of Hwy 119 and US 6 is a pullout area on the right just past a small red building and cellular antenna pole near a boarded-up tunnel entrance. Sample at the recording gage. [RECORDING GAGE] **Sample TOC**

CC60 Drive east down US 6/Hwy 119. Approximately 0.6 miles east of Tunnel 1 (0.45 miles west of the intersection of Hwy. 58 and US 6) is a pullout/dirt road on the south side of highway. Walk or drive down the hill to the Church Ditch diversion structure. Go across the mesh bridge and sample from the main stem of Clear Creek. Do not sample from Church Ditch. **Sample TOC**

Photographs of the sampling locations and GPS coordinates are included in Appendix D.

UCC – AMBIENT GRAB SAMPLES

QA/QC Program - Long Schedule Only

Duplicate and spike quality control samples are prepared from creek samples collected during the Clear Creek Long Schedule sampling events for selected nutrients and are analyzed by Westminster (total nitrogen) and Northglenn (total phosphorus). The QC samples are prepared by the City of Golden at their laboratory on the day of sampling. Four creek locations are randomly selected for preparation of the QC samples. One duplicate and one spike are submitted to each laboratory. The analytical procedure for QC preparation is detailed below:

SOP - QC Preparation for Clear Creek Studies

Night before:

- Soak 2 1-Liter Class A volumetric flasks with 1:1 HCl. One flask will be used to make up fresh Nitrate standard and the other will be used for spiking the selected Clear Creek sample (with both nitrate and phosphorus spikes).

The Morning of Sampling Day:

- Remove 5 mg/L Phosphorus standard from fridge to warm to room temperature. This standard is prepared by the City of Northglenn and is stable for 3 months. It is usually in a 125 ml brown glass bottle.
- Remove 100 mg/L Nitrate-N standard from fridge. It is stored in a 125 ml brown Nalgene bottle. This standard is prepared fresh by the City of Golden each time. The method to prepare a 100 mg/L NO3-N standard is in Standard Methods, 21st Ed., page 4-120 and described below.

- **To Prepare Fresh Nitrate-N Standard**
  - Thoroughly rinse out one of the HCl acid soaked 1-Liter flasks to prepare the fresh standard in.
  - Fill flask with 200-300 mL DI water.
  - Weigh out 0.7218 grams of KNO3 and add to flask. (KNO3 is stored in the desiccator).
  - Dilute to 1-Liter volume with DI and mix thoroughly.
  - Discard old standard and refill bottle with fresh standard. Rinse bottle out with fresh standard 2-3 times before filling. Record new prep date on bottle.

- Prepare 4 sample bottles for spike and duplicate samples. Bottles used for spike and duplicate prep are provided by the City of Thornton and are the square plastic 16 ounce “milk type” bottle. They are pre HCl washed and stored in the cabinet above the wastewater sink.

  Two labs receive spike and duplicate samples from this program:
  - Northglenn for low level total phosphorus analysis.
  - Westminster for total nitrogen analysis.

  The bottles are marked with consecutive numbers from month to month, year after year. Refer to the last sample set numbers in the brown Clear Creek Quality Control Log Book (above Vicki's desk) and mark new bottles with the next consecutive number set (##). Mark the 4 bottles with the following information:

  - City of Northglenn - P(##) - Spike for Phosphorus, Date of sampling.
  - City of Northglenn - D(##) - Duplicate for Phosphorus, Date of sampling.

  - City of Westminster - N(##) - Spike for Nitrogen, Date of Sampling.
  - City of Westminster - D(##) - Duplicate for Nitrogen, Date of sampling.

When Samples Arrive in Golden's Lab:

Certain 2 Liter samples from Clear Creek sites will have been randomly selected by the sampling team as "QC" samples.

- Select ONE of these as the QC sample (**spike and duplicate)** and set aside. Record which site was chosen in the QC log book.

This sample will be spiked with both Nitrogen and Phosphorus at concentrations within the analytical ranges of Northglenn's and Westminster's labs.

The "**spiked sample"** will be made in the remaining HCl rinsed volumetric flask and will use up 1 liter from the 2 liter bottle.
The remaining 1 liter volume will be split into the "**duplicate sample**" bottles for both labs.

- **To Prepare Spiked Sample**

  - Rinse out the remaining 1-Liter volumetric flask with DI.
  - Then rinse flask with a small portion of the selected QC Creek sample - 2 times.
  - Refer to the last sampling to determine new spike volumes.

  **Spike amounts for Phosphorus are usually within the 1.75 to 3.0 ml volume range for a total spiked concentration of 0.00875 mg/L to 0.015 mg/L, i.e.,*

  1.75 mL of 5 mg/L phosphorus standard in 1 liter = 0.00875 mg/L concentration spiked

  **Spike amounts for Nitrogen are usually within a 1.5 to 3.0 ml volume range for a total spiked concentration of 0.15 mg/L to 0.3 mg/L, i.e.,*

  1.5 mL of 100 mg/L nitrogen-N standard in 1 liter = 0.15 mg/L concentration spiked

- Mix the Clear Creek sample well and pour approximately 500 mL into pre-rinsed flask.
- Add determined spike volumes of both standards to flask. Mix well.
- Dilute to volume with additional Creek sample finalizing volume with a pipet. (It is too hard to bring it to volume by pouring from the 2 liter container!)
- Mix well and pour into 2 bottles labeled for spike samples (“N” and “P”).

To Prepare Duplicate Sample

- Thoroughly mix remaining Clear Creek sample.
- Pour into 2 bottles labeled for duplicates (“D”).

Record the following information in the brown "Clear Creek QC" book:

1. the time the samples arrived at Golden
2. the new consecutive sample numbers
3. the Clear Creek sample site number that was selected for preparation of the QC samples
4. the volumes spiked for phosphorus and nitrogen

Generate new chain of custody forms for the 4 new samples. One form can be filled out for both Westminster and Northglenn labs. Sampling teams will deliver samples to respective labs. Copies of previous chain of custody forms are in the lower file drawer in drinking water cabinet.

UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES

Program Coordination: Westminster and Golden
Field Sampling Teams: Westminster, Thornton, Golden, Arvada

Autosampler sites were selected at strategic locations in the watershed in order to assess diurnal variations in water quality in Clear Creek. The 48-hour ambient composites are collected with programmable automatic sampling devices. Each of the 24 sample bottles represents a two hour time period, resulting from collecting equal volumes of sample in each of two consecutive hours; therefore, 48 hours of samples are collected in 24 bottles. The 24 discrete samples are composited into two 24-hour samples on a time weighted basis (i.e. equal sample volumes are taken from 12 discrete autosampler bottles and combined into a single composite sample). Additional discrete or composite samples may be submitted for analysis based on anomalies noted in field observations for the individual autosampler bottles.

Ambient samples are collected approximately seven times per year on a monthly schedule starting in April and ending in October. The schedule for the ambient sampling is based on clear weather predictions and is staggered at different times during the week, including weekends.

Analytical probes and data logging equipment are active at the autosampler sites year-round to continuously monitor in-stream conditions for temperature and conductivity. From April through October, or as weather conditions permit, additional probes are deployed for pressure (depth), turbidity and pH. YSI multi-probe sondes are deployed at each autosampler location. The sample locations are equipped with data loggers for remote monitoring of water quality conditions in the watershed and to remotely control activation of the autosamplers.

UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES
Sample Locations

CC AS 26	Mainstem of CC at USGS Lawson gage
CC AS 49	Mainstem of CC above the confluence of the North Fork
CC AS 50	North Fork of CC above confluence of Mainstem of CC at USGS gage
CC AS 59	Mainstem of CC above Golden and Church Ditch diversions

UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES
Flow Monitoring

USGS gages provide the average daily flow associated with each of the two 24-hour composite samples for the ambient autosamplers. Flow data is obtained directly from the gage stations at CC26 and CC50 to correlate with CC AS 26 and CC AS 50, respectively. Flow data from the gage at CC40 is used to correlate to CC AS 49 because there are no significant inflows to or diversions from Clear Creek between CC40 and CC AS 49.

The flow data associated with CC AS 59 is considered to be an estimated flow. The flows diverted to the City of Golden water treatment plant and the Church Ditch will be added to the gage flows recorded at the USGS gage at CC61 (Clear Creek at Golden) to estimate the flow at CC AS 59.

UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES

Analytical Parameters

Analyte	Analytical Method Reference	Reporting Limit Goal	Responsible Laboratory
Total Nitrogen	SM 4500-NO3 I	0.02 mg/L	Westminster
Nitrate/Nitrite-N	SM 4500-NO3 I	0.01 mg/L	Westminster
Ammonia-N	SM 4500-NH3 H	0.01 mg/L	Westminster
Total Phosphorus	SM 4500-P E	0.0025 mg/L	Northglenn
Ortho-phosphate-P (dissolved) or DRP	SM 4500-P E	0.0025 mg/L	Northglenn
Total Suspended Solids (TSS)	SM 2540 D	1 mg/L	Thornton
Total Organic Carbon (TOC)	SM 5310 B	0.5 mg/L	Thornton
pH	SM 4500-H+ B	1.0 Std Units	Field Teams
Temperature	SM 2550 B	1.0 °C	Field Teams
Conductivity	SM 2510 B	10 µS/cm	Field Teams
Turbidity	SM 2130 B	1.0 NTU	Field Teams
Total and Dissolved Arsenic	EPA 200.7	0.001 mg/L	Golden
Total and Dissolved Cadmium	EPA 200.7	0.0005 mg/L	Golden
Total and Dissolved Copper	EPA 200.7	0.002 mg/L	Golden
Total and Dissolved Iron	EPA 200.7	0.02 mg/L	Golden
Total and Dissolved Lead	EPA 200.7	0.0005 mg/L	Golden
Total and Dissolved Manganese	EPA 200.7	0.002 mg/L	Golden
Total and Dissolved Molybdenum	EPA 200.7	0.002 mg/L	Golden
Total and Dissolved Zinc	EPA 200.7	0.02 mg/L	Golden

Table Notes:
1) SM refers to the 22nd Edition of Standard Methods for the Examination of Water and Wastewater.
2) Reporting limit goals are matrix dependent and may be increased for complex matrices and may be lower depending on laboratory capability.
3) EPA recommended holding times less than 72 hours may not be met due to the extended sampling routine.
4) Samples collected for nutrients (nitrogen and phosphorus) with a turbidity reading of greater than 100 NTU are analyzed by commercial laboratories that have demonstrated proficiency in analyzing complex matrices for nutrients.

UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES
Program Coordination (Westminster and Golden)

Field Equipment

Equipment Installed At Autosampler Locations

- Permanent and tamper-proof enclosure box with lock
- American Sigma 900, 900 Max or other automated sampler
- Power supply – solar panel, rechargeable battery or direct power
- Sample tubing long enough to reach from the autosampler to the streambed. Probes must be contained in protective piping secured in the creek bed
- Dedicated field probes for turbidity, temperature, conductivity and pH
- Depth/velocity flow sensor
- Recording gage at CC26 – Operated and maintained by USGS
- Staff gage at CC50
- Rain gage at CC59
- 24 discrete HCl rinsed autosampler bottles with caps. Bottles must be numbered and inserted in the designated position in autosampler (positions numbered 1 through 24)
- Continuous recording datalogger
- Cellular modem and antenna at CC26, CC50 and CC59

UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES
Autosampler Operation

On a monthly basis between April and October, autosamplers are set to collect time-weighted discrete samples for a 48-hour period. The autosamplers are strategically located in order to correlate stream flow with the chemical water quality data collected on the samples. In order to associate the relative impacts of the point and nonpoint pollutant sources located between the sample stations, it is advisable to observe the same “slug” of water at both the upstream and downstream locations. Using the “time of travel” study conducted by USGS in 1999, the downstream autosamplers on Clear Creek are delayed for a predetermined time based on in-stream flow at the Lawson stream gage.

The time of travel estimates tables are included in Appendix E.

Autosampler Setup:

Equipment required:

- 24 discrete HCl rinsed autosampler bottles with caps
- Keys and/or tools to access autosampler enclosure
- Field data collection/station audit sheets

Setup Procedure:

1. Unlock sample enclosure and remove sampler head. Set aside without disturbing or bumping the distributor arm.
2. Load uncapped bottles in the correct positions in the bottom of the sampler.
3. Secure bottles in place with the retaining ring. Store caps in a ziplock bag inside the autosampler until sample collection.
4. Program the sampler according to manufacturer's instructions to collect two 450 mL storm samples per bottle, one sample per pulse.
5. After starting the autosampler, ensure that the distributer arm is positioned above bottle #1.
6. Replace sampler head and lock in place.
7. Record station/equipment information on field sheet.
8. Make sure the autosampler program is ***RUNNING*** before locking the enclosure.
9. The autosampler may be set up ahead of a scheduled start time.

Sample Collection

Additional equipment required:

- Keys and/or tools to access autosampler enclosures
- Large cooler with ice to collect sample bottles
- 24 pre-cleaned, HCl rinsed, discrete sample replacement bottles
- Field data sheets/station audit sheets
- Chain of custody forms
- Laptop with Loggernet software and data cable (9 pin serial cable with SC32B adapter) if retrieving data directly from datalogger
- Two 3-liter or larger Nalgene bottles (clean and rinsed with 1:1 hydrochloric acid) for compositing samples
- 250 mL graduated cylinder (clean and rinsed with 1:1 hydrochloric acid) for compositing samples

- Prepared sample bottles provided by participating Cities for nutrients, solids and metals analyses
    - 1 L square plastic – phosphorus series (Northglenn)
    - 250 mL plastic – nitrogen series (Westminster)
    - 500 mL plastic bottle – TSS (Thornton)
    - 45 mL amber glass vial with septa cap – TOC (Thornton)
    - 250 ml round plastic – total and dissolved metals (Golden - for Clear Creek sites)
- Chain of Custody forms – Refer to Appendix C
- Field Sampling form - Refer to Appendix C

Sample Collection Procedure:

1. Unlock enclosure and remove sampler head.
2. Retrieve date/time information from autosampler if required. To collect sample history on American Sigma samplers, press <Change/ Halt> button, press <time/read> button for 5 seconds. The sample collection time for the first sample will appear. Record data on the field sheet. Press <yes> for next sample time to appear. Continue until all data is recorded.
3. Date and time information for samples is also automatically stored in a data file by the dataloggers at all sites except CC59.
4. Record station/equipment information on field sheet.
5. Make note of any samples with high turbidity determined by visual observance or data obtained from the datalogger.
6. Cap bottles and place in a cooler with ice for transport to Golden lab for compositing.

   Optional compositing of samples in the field is performed by pouring off equal volumes into 3-liter (or larger) pre-cleaned bottles. Refer to the Sample Compositing Procedure Step 1. Save remaining volume of any high turbidity samples to take back to the lab. Discard remaining sample.
7. Clean out autosampler base and reload with a new set of pre-cleaned bottles.
8. Reset the autosampler by pressing the START button (Sigma 900 autosampler). Ensure that the distributor arm is parked over bottle #1 and the display reads "Program Running" before closing the autosampler and placing it back in the enclosure. .
9. Take all samples to the Golden Water Quality Laboratory for compositing, splitting, distribution and wet chemistry analysis of pH, turbidity and conductivity.

UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES
Sample Compositing

1. Composite samples in the laboratory if compositing was not performed in field. Shake sample bottles and pour equal volumes of sample from the first 12 bottles into a composite bottle marked "A". Shake sample bottles and pour equal volumes of sample from the remaining 12 bottles into a composite bottle marked "B".
2. Perform turbidity, temperature, pH and conductivity measurements on composited samples. Enter data on the Sampling Form.
3. Use the well mixed composites (A and B) to fill the appropriate bottles for the Northglenn, Thornton, Westminster and Golden labs.
4. If any discrete bottle(s) appears to have an unusually high turbidity and enough sample is available, analyze for turbidity and conductivity. Record on Sampling Form. If there is enough sample, pour the high turbidity discreet samples into separate nutrient and solids bottles for individual analysis.
5. Complete the COCs.
6. Deliver and relinquish to each city their respective samples (Westminster-nitrogen series, Thornton-TSS and TOC, Northglenn-phosphorus series) and sign COCs as appropriate.
7. Original field data sheets and COCs are retained by the Cities of Westminster and Golden for permanent archive.
8. Samples are created in the web-accessible Excel spreadsheet by Westminster for data entry and results archive.

UCC AUTOSAMPLERS – EVENT SAMPLES
Sample Locations

CC AS 49 Event	Mainstem of CC above the confluence of the North Fork
CC AS 50 Event	North Fork of CC above confluence of Mainstem of CC at USGS gage
CC AS 59 Event	Mainstem of CC above Golden and Church Ditch diversions

UCC AUTOSAMPLERS – EVENT SAMPLES
Flow Monitoring

Westminster and Golden will obtain the 15 minute interval flow data from the USGS gage at CC61 (Clear Creek at Golden) to correlate to CC AS 59. The average event flow will be calculated to correspond to the specific time-event composited samples. If the 15 minute interval flow data is not available, the average daily flow will be associated with the event. The average daily flow at UCCWA gage CC40 will be used to correlate with CC AS 49. Flow at CC50 is measured by a USGS gage at that site.

UCC AUTOSAMPLERS – EVENT SAMPLES
Analytical Parameters

Storm event samples are analyzed for the same suite of analytical parameters listed in the previous section for the 48-hour ambient samples. Samples may not be analyzed within the EPA recommended holding time for some parameters based on the random nature of the storm event triggering.

UCC AUTOSAMPLERS – EVENT SAMPLES
Program Coordination (Westminster and Golden)

Field Sampling Teams: Westminster, Thornton, Golden, Arvada

The event autosampler program was initiated in 2006 to assess the pollutant concentrations mobilized during significant snow melt (runoff) or rain events at 48-hour ambient locations CC AS 49, CC AS 50 and CC AS 59. Automated sample collection of stormwater is triggered based on changes in ambient turbidity, conductivity, stage height, or rain gage readings, depending on the autosampler location. The autosamplers are currently set to trigger when the 30 minute running average exceeds a predetermined turbidity level (for example, 100 NTU). The autosampler at CC AS 50 triggers based on a combination of change in stream depth, precipitation and turbidity in order to eliminate triggering autosampler event sampling that might be associated with localized human disturbances in the creek (e.g. sluice mining). Autosamplers trigger independently depending on the localized conditions in the watershed. The autosampler collects discrete samples every 15 minutes until the parameter that triggered the event returns to the ambient condition or until the maximum number of samples is collected. The discrete samples may be analyzed individually or multiple discrete samples may be composited based on the field observations. As necessary, refer to the previous section for instructions on compositing samples from autosamplers. Event sampling can also be started remotely in the event of a spill or other event that might not cause the triggering parameters to be met.

Storm event samples are analyzed for the same suite of analytical parameters listed in the previous section for the 48-hour ambient samples. Samples may not be analyzed within the EPA recommended holding time for some parameters based on the random nature of the storm event triggering.

UCC AUTOSAMPLERS - EVENT SAMPLES

Field Equipment

Storm event sampling utilizes the same equipment listed in the previous section for the 48-hr ambient samples.

Autosampler Operation

Field equipment used for storm event sampling is operated using the same techniques as described in the previous section for 48-hr ambient sampling.

Sample Compositing

Sample compositing is performed similarly to the procedure described in the previous section for 48-hr ambient sampling; however, fewer samples are typically composited based on the severity and duration of a storm event.

TRIBUTARY BASIN MONITORING PROGRAM

The Standley Lake Tributary Basin Monitoring Program is designed to provide water quality information for evaluation of the nutrient loadings from non-point sources in the Standley Lake Tributary Basin. The only point source discharge between CC60 on the main stem of Clear Creek and the canal diversions to Standley Lake is the Coors cooling basin return flow.

Three tributaries (the terms trib and canal are interchangeable) divert Clear Creek water to Standley Lake: the Church Ditch, the Farmers Highline ("FHL") Canal and the Croke Canal. The trib monitoring locations were selected to assess the relative loadings to the canals from areas within unincorporated Jefferson County and the city limits of Golden and Arvada. Denver Water supplies Westminster with a small quantity of water via the Kinnear Ditch Pipeline ("KDPL") which enters Standley Lake after passing through a wetlands area located west of 96th Ave and Alkire Street. The upstream and downstream locations near the wetlands are monitored when there is flow through the pipeline. The Denver Water raw water sources include Gross Reservoir and Coal Creek.

Trib samples are collected year-round on a monthly basis. All tributaries flowing at a rate that allows collection of a representative sample are monitored.

The Church Ditch delivery structure at Standley Lake was relocated in 2008 from the west side of the lake to the south side of the lake in order to avoid the potential for significant stormwater impacts to the lake. The former Church Ditch monitoring location at Standley Lake (T-09) was abandoned in 2009 when the new delivery structure (T-27) became operational.

The raw water pipeline at Semper (T-24) is monitored monthly. The raw water pipeline at NWWTP (T-25) is monitored only when the Semper facility is offline.

TRIB SAMPLES

Locations and Sample Schedule

Sample ID	Sample Location *	Every month of the year when flowing**
T-01	Church Ditch at Headgate on MSCC	X
T-02	FHL at Headgate on MSCC	X
T-03	Croke Canal at Headgate on MSCC	X
T-04	Croke Canal at Standley Lake	X
T-11	FHL at Standley Lake	X
T-22A	Kinnear Ditch Pipeline (KDPL) – at Coal Creek entry point into pipeline	X
T-22D	Kinnear Ditch Pipeline (KDPL) downstream of wetlands	X
T-24	Raw Water Pipeline at Semper	X
T-25	Raw Water Pipeline at NWWTP	X
T-27	Church Ditch delivery structure at SL (est. 2009)	X

*MSCC = Mainstem Clear Creek

** Exceptions noted in paragraph above the table.

TRIB SAMPLES

Analytical Parameters and Analytical Scheme

Analyte	Analytical Method Reference	Reporting Limit Goal	Responsible Laboratory	Monitoring Frequency
Temperature	SM 2550 B	1.0 °C	Field Team	Monthly
pH	SM 4500-H+ B	1.0 Std Units	Field Team	Monthly
Conductivity	SM 2510 B	10 µS/cm	Field Team	Monthly
Turbidity	SM 2130B	1.0 NTU	Field Team	Monthly
Dissolved Oxygen	SM 4500-O G	1.0 mg/L	Field Team	Monthly
Total Phosphorus	SM 4500-P E	0.0025 mg/L	Northglenn	Monthly
Ortho-phosphate as P (dissolved) or DRP	SM 4500-P E	0.0025 mg/L	Northglenn	Monthly
Total Suspended Solids (TSS)	SM 2540 D	1 mg/L	Thornton	Monthly
Total Organic Carbon	SM 5310	0.5 mg/L	Thornton	Monthly
E. coli	SM 9221 D	1 cfu/100mL	Thornton	Monthly
Total and Dissolved Iron	EPA 200.7	0.05 mg/L	Thornton	Monthly
Total and Dissolved Manganese	EPA 200.8	0.002 mg/L	Thornton	Monthly
Total and Dissolved Zinc	EPA 200.8	0.020 mg/L	Thornton	Monthly
Total Nitrogen	SM 4500-NO3 I	0.02 mg/L	Westminster	Monthly
Nitrate/Nitrite as N	SM 4500-NO3 I	0.01 mg/L	Westminster	Monthly
Ammonia as N	SM 4500-NH3 H	0.01 mg/L	Westminster	Monthly
Gross Alpha and Gross Beta	EPA 901.1	0.1 pCi/L	Westminster	Quarterly
Total and Dissolved Arsenic	EPA 200.8	0.001 mg/L	Thornton	Quarterly
Total and Dissolved Barium	EPA 200.8	0.002 mg/L	Thornton	Quarterly
Total and Dissolved Cadmium	EPA 200.8	0.0005 mg/L	Thornton	Quarterly
Total and Dissolved Chromium	EPA 200.8	0.001 mg/L	Thornton	Quarterly
Total and Dissolved Copper	EPA 200.8	0.002 mg/L	Thornton	Quarterly
Total and Dissolved Iron	EPA 200.7	0.05 mg/L	Thornton	Quarterly
Total and Dissolved Lead	EPA 200.8	0.0005 mg/L	Thornton	Quarterly
Total and Dissolved Manganese	EPA 200.8	0.002 mg/L	Thornton	Quarterly
Total and Dissolved Molybdenum	EPA 200.8	0.002 mg/L	Thornton	Quarterly
Total and Dissolved Selenium	EPA 200.8	0.005 mg/L	Thornton	Quarterly
Total and Dissolved Zinc	EPA 200.8	0.020 mg/L	Thornton	Quarterly
Bromide	SM 4110 A	0.1 mg/L	Thornton	Monthly
Chloride	SM 4110 A	5 mg/L	Thornton	Quarterly
Sulfate	SM 4110 A	10 mg/L	Thornton	Quarterly
Total Hardness (as $CaCO_3$)	EPA 130.2	5 mg/L	Thornton	Quarterly

Table Notes:
1) SM refers to the 22nd Edition of Standard Methods for the Examination of Water and Wastewater.
2) Reporting limit goals are matrix dependent and may be increased for complex matrices and may be lower depending on laboratory capability.
3) Quarterly parameters are analyzed in March, June, September and December at all sampled locations.
4) Samples collected for nutrients (nitrogen and phosphorus) with a turbidity reading of greater than 100 NTU are analyzed by commercial laboratories that have demonstrated proficiency in analyzing complex matrices for nutrients.

TRIB SAMPLES

Program Coordination (Northglenn)

Before the scheduled Tributary sampling date:

- Ensure an adequate supply of sample containers is available from Thornton. Westminster's bottles will be picked up at Westminster on sampling day before the start of sampling at T-24.
- Label the Trip blank bottle and fill with laboratory DI water.
- Calibrate the multimeter for conductivity, pH and DO.
- Analyze the Trip Blank for conductivity, pH and DO.
- Pack Trip Blank in cooler to monitor field activities for phosphorus contamination.

Sample Bottle Kit – Tribs Monthly and Quarterly

Quantity	**Volume**	**Bottle Type**	**Parameter**	**Laboratory**
9	500 mL	Rectangular plastic	Phosphorus series	Northglenn
1 (Trip blank)	500 mL	Rectangular plastic	Phosphorus series	Northglenn
9	500 mL	Plastic	TSS, Total Hardness, Chloride, Sulfate	Thornton
9	40 mL	Glass vial	TOC	Thornton
9	250 mL	Glass	E. coli	Thornton
9	250 mL	Plastic	Total Metals	Thornton
9	125 mL	Plastic	Dissolved Metals	Thornton
9	250 mL	Plastic	Quarterly Total Metals	Thornton
9	125 mL	Plastic	Quarterly Dissolved Metals	Thornton
9	250 mL	Plastic	Nitrogen series, UV-254	Westminster
9	1 L	Plastic	Rads	Westminster

Sample Collection

Equipment required:

- Key to access T-2
- Key to access T-27
- Gate Code for access at T-22A
- Field data book
- Cooler with blue ice or ice
- Trip blank filled with DI
- Sample bottles as detailed above

- Bucket for sample collection
- pH and DO meters and probes
- Ballpoint pen
- Waterproof marker
- Chain of custody forms
- NOTE – Four wheel drive vehicle recommended for sampling due to steep inclines at some locations and potentially rugged or muddy conditions.

Sample collection procedure:

1. Meet with Westminster staff at Semper. Drop off bottles for Westminster staff to collect sample at T-25.
2. Starting with T-24, collect field samples in the order detailed below for each location where water is flowing.
3. Rinse the sample bucket with the field sample water repeatedly at each location before collecting the sample.
4. Collect enough volume of the field sample in the bucket to fill all sample bottles for the location.
5. Fill the appropriate sample bottles from the bucket.
6. Label the sample bottles with location, date and time of collection.
7. Analyze the sample in the field for conductivity, pH, DO and temperature. Record data in the field notebook.
8. Repeat the process at each location.
9. Return to Westminster's Semper WTP to receive T-25 sample from Westminster staff. Sign COC and keep the original copy of the COC.
10. Leave an unsigned copy of the Thornton COC at Westminster so the samples can be logged into the Tribal database by Westminster staff.
11. Complete the COCs and relinquish custody of the samples to Westminster staff. Sign COC and keep a copy of the COC. Leave the original COC with the samples.
12. Return to Northglenn Lab and analyze samples for turbidity on a calibrated meter. Record data in the field notebook.
13. Contact Thornton to pick up collected field samples. Request replenishment of bottles for the next sampling event as needed.
14. Relinquish samples to Thornton and sign COCs. Retain a copy of the COC. Thornton takes possession of the original COC.
15. Northglenn retains a copy of all COCs and field documentation for permanent archive.

TRIB SAMPLES

Sampling Locations Directions and Narrative Descriptions

Tributary sampling occurs generally in an upstream to downstream fashion. Samples are collected at designated locations when water is flowing.

Trib 24
T-24 is located at Westminster's Semper Water Treatment Plant at 8900 Pierce Street. The sample is collected from the RAW water tap in the Operator's Laboratory. Do **NOT** increase the flow at the tap at this location. First tap on the left labeled 24.

Trib 22A
T-22A is the upstream sample point on the Kinnear Ditch pipeline. It is accessed through a gate located at Hwy. 72 and Plainview Rd. A key is required to access the location. The sample point is approximately 0.2 miles from Plainview Rd. Sample is taken at the flume where Coal Creek enters the pipeline.

Trib 1
T-1 is located at the Church Ditch headgate on Clear Creek. This site is accessed via Hwy 6 approximately 0.5 miles west of Hwy 93. There is a diversion from Clear Creek above this location which diverts water from Clear Creek and runs it parallel to the Creek. There are two gates at this location one sends water back into Clear Creek and the other is the Church Ditch headgate. Sample is taken from the bridge just above both gates.

Trib 2
T-2 is located at the Farmers Highline headgate on Clear Creek.
The site is accessed behind the Coors office building at the end of Archer St. Sample is taken from the bridge just inside the gate. Sample the downstream side of the headgate if it is open or on the upstream side if the headgate is closed (Clear Creek side).

Trib 3
T-3 is located at the Croke Canal headgate on Clear Creek.
This site is on Coors property. It is along the frontage road through Coors, on the east side of a small "pond". Sample the downstream side of the headgate if it is open or on the upstream side if the headgate is closed (Clear Creek side).

Trib 22D
T-22D is on the Kinnear Ditch Pipeline between 96th Ave and 88th Ave on Alkire St.
The sample is taken just downstream of the culvert on the east side of Alkire St.

Trib 04 and Trib 11
The Croke Canal (T-04) passes UNDER the Farmers Highline (T-11) in the area just west of 86th and Kipling prior to entering Standley Lake. The Farmers Highline passes OVER the Croke in a concrete structure. Sample the Croke on the south side of the Farmers Highline concrete structure. Sample the Farmers next to the white autosampler housing box.

Trib 25
Located at Westminster's Northwest Water Treatment Plant located at 104th & Wadsworth. The sample is collected by Westminster from the raw water tap on the west wall in the membrane filter gallery. Sample only if T-24 is not running.

Trib 27
Located on the south side of Standley Lake at the Church Ditch delivery structure. This sampling location was activated in 2009.

Photographs of the sampling locations and GPS coordinates are included in Appendix D.

TRIB CONTINUOUS MONITORING
Program Coordination (Westminster)

Field sampling team: Westminster

A YSI multi-parameter sonde and data logging equipment are deployed year-round at the trib location where the Farmers Highline Canal (T-11) crosses over the Croke Canal (T-04), provided there is sufficient flow in one of the canals. A sonde was also installed at the new Church Ditch inlet (T-27) in 2009 and operates under similar conditions. The probes provide continuous in-stream monitoring of pH, ORP, temperature, depth (pressure transducer), conductivity and turbidity. Remote access to the data logger data facilitates monitoring of water quality at these inflow locations to Standley Lake. The FHL/Croke station is also equipped with a tipping-bucket rain gauge.

TRIB CONTINUOUS MONITORING
Sample Locations

CC AS T04	Croke Canal approximately 0.5 mile from Standley Lake inlet
CC AS T11	Farmers Highline Canal approximately 0.5 mile from Standley Lake inlet
CC AS T27	Church Ditch at Standley Lake inlet

Table Note: Historical data from these locations are available as part of the Clear Creek Canal Program that was eliminated in 2008. The sample location identifications associated with the Clear Creek Canal Program have been retained.

TRIB AUTOSAMPLER 48-HOUR AMBIENT SAMPLES

Program Coordination: Westminster
Field Sampling Teams: Westminster

Autosampler sites in the Tributary Basin are located at the canal inlets to Standley Lake. The 48-hour ambient composites are collected with programmable automatic sampling devices as described in the UCC autosampler 48-hr ambient program section of this plan in order to assess any water quality impacts introduced by the canals.

Ambient samples are collected approximately seven times per year on a monthly schedule starting in April and ending in October to coincide with the UCC autosampler 48-hr ambient sample program.

TRIB AUTOSAMPLER 48-HOUR AMBIENT SAMPLES

Sample Locations

CC AS T04	Croke Canal approximately 0.5 mile from Standley Lake inlet
CC AS T11	Farmers Highline Canal approximately 0.5 mile from Standley Lake inlet
CC AS T27	Church Ditch at Standley Lake inlet

TRIB AUTOSAMPLER 48-HOUR AMBIENT SAMPLES

Flow Monitoring

Flow in the canals is tracked by the ditch operators and water accountants.

TRIB AUTOSAMPLER 48-HOUR AMBIENT SAMPLES

Analytical Parameters

Analyte	Analytical Method Reference	Reporting Limit Goal	Responsible Laboratory
Total Nitrogen	SM 4500-NO3 I	0.02 mg/L	Westminster
Nitrate/Nitrite-N	SM 4500-NO3 I	0.01 mg/L	Westminster
Ammonia-N	SM 4500-NH3 H	0.01 mg/L	Westminster
Total Phosphorus	SM 4500-P E	0.0025 mg/L	Northglenn
Ortho-phosphate-P (dissolved) or DRP	SM 4500-P E	0.0025 mg/L	Northglenn
Total Suspended Solids (TSS)	SM 2540 D	1 mg/L	Thornton
Total Organic Carbon (TOC)	SM 5310 B	0.5 mg/L	Thornton
Total and Dissolved Arsenic	EPA 200.8	0.001 mg/L	Thornton
Total and Dissolved Barium	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Cadmium	EPA 200.8	0.0005 mg/L	Thornton
Total and Dissolved Chromium	EPA 200.8	0.001 mg/L	Thornton
Total and Dissolved Copper	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Iron	EPA 200.7	0.05 mg/L	Thornton
Total and Dissolved Lead	EPA 200.8	0.0005 mg/L	Thornton
Total and Dissolved Manganese	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Molybdenum	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Selenium	EPA 200.8	0.005 mg/L	Thornton
Total and Dissolved Zinc	EPA 200.8	0.020 mg/L	Thornton
pH	SM 4500-H+ B	1.0 Std Units	Field Teams
Temperature	SM 2550 B	1.0 °C	Field Teams
Conductivity	SM 2510 B	10 µS/cm	Field Teams
Turbidity	SM 2130 B	1.0 NTU	Field Teams

Table Notes:
1) SM refers to the 22nd Edition of Standard Methods for the Examination of Water and Wastewater.
2) Reporting limit goals are matrix dependent and may be increased for complex matrices and may be lower depending on laboratory capability.
3) EPA recommended holding times less than 72 hours may not be met due to the extended sampling routine.
4) Samples collected for nutrients (nitrogen and phosphorus) with a turbidity reading of greater than 100 NTU are analyzed by commercial laboratories that have demonstrated proficiency in analyzing complex matrices for nutrients.

TRIB AUTOSAMPLER 48-HOUR AMBIENT SAMPLES
Program Coordination (Westminster)

Field Equipment

Equipment Installed At Autosampler Locations

- Permanent and tamper-proof enclosure box with lock
- American Sigma 900, 900 Max or other automated sampler
- Power supply – solar panel, rechargeable battery or direct power
- Sample tubing long enough to reach from the autosampler to the streambed. Probes must be contained in protective piping secured in the creek bed
- Dedicated field probes for turbidity, temperature, conductivity and pH
- Depth/velocity flow sensor
- Rain gage at T4/T11
- 24 discrete HCl rinsed autosampler bottles with caps. Bottles must be numbered and inserted in the designated position in autosampler (positions numbered 1 through 24)
- Continuous recording datalogger
- Cellular modem and antenna at T4/T11 and T27

TRIB AUTOSAMPLER 48-HOUR AMBIENT SAMPLES
Autosampler Operation

On a monthly basis between April and October, autosamplers are set to collect time-weighted discrete samples for a 48 hour period. The autosamplers are located at the canal inlets to Standley Lake. In order to associate the relative impacts of the point and nonpoint pollutant sources located between the last autosampler location on Clear Creek (CC AS 59), it is advisable to observe the same "slug" of water at the canal inlets to Standley Lake. The time of travel in the Farmer's Highline canal is calculated from the inflows to the canal at the headgate on Clear Creek.

The time of travel estimates table for the Farmer's Highline Canal is included in Appendix E.

Autosampler Setup:

Equipment required:

- 24 discrete HCl rinsed autosampler bottles with caps
- Keys and/or tools to access autosampler enclosure.
- Field data collection/station audit sheets.

Setup Procedure:

1. Unlock sample enclosure and remove sampler head. Set aside without disturbing or bumping the distributor arm.
2. Load uncapped bottles in the correct positions in the bottom of the sampler.
3. Secure bottles in place with the retaining ring. Store caps in a ziplock bag inside the autosampler until sample collection.
4. Program the sampler according to manufacturer's instructions to collect two 450 ml storm samples per bottle, one sample per pulse.
5. After starting the autosampler, ensure that the distributer arm is positioned above bottle #1.
6. Replace sampler head and lock in place.
7. Record station/equipment information on field sheet.
8. Make sure the autosampler program is ***RUNNING*** before locking the enclosure.
9. The autosampler may be set up ahead of a scheduled start time.

Sample Collection

Additional equipment required:

- Keys and/or tools to access autosampler enclosures
- Large cooler with ice to collect sample bottles
- 24 pre-cleaned, HCl rinsed, discrete sample replacement bottles
- Field data sheets/station audit sheets
- Chain of custody forms
- Laptop with Loggernet software and data cable (9 pin serial cable with SC32B adapter) if retrieving data directly from datalogger
- Two 3-liter Nalgene bottles (clean and rinsed with 1:1 hydrochloric acid) for compositing samples
- 250 mL graduated cylinder (clean and rinsed with 1:1 hydrochloric acid) for compositing samples
- Prepared sample bottles provided by participating Cities for nutrients, solids and metals analyses
    - 1 L square plastic – phosphorus series (Northglenn)
    - 250 mL plastic – nitrogen series (Westminster)
    - 500 mL plastic bottle – TSS (Thornton)
    - 45 mL amber glass vial with septa cap – TOC (Thornton)
    - 500 ml non-preserved metals bottle and 500 ml preserved metals bottle (Thornton)
- Chain of Custody forms – Refer to Appendix C
- Field Sampling form - Refer to Appendix C

Sample Collection Procedure:

1. Unlock enclosure and remove sampler head.
2. Retrieve date/time information from autosampler if required. To collect sample history on American Sigma samplers, press <Change/ Halt> button, press <time/read> button for 5 seconds. The sample collection time for the first sample will appear. Record data on the field sheet. Press <yes> for next sample time to appear. Continue until all data is recorded.
3. Date and time information for samples is also automatically stored in a data file by the dataloggers at all sites except CC59.
4. Record station/equipment information on field sheet.
5. Make note of any samples with high turbidity determined by visual observance or data obtained from the datalogger.
6. Optional compositing of samples in the field is performed by pouring off equal volumes into three-liter (or larger) pre-cleaned bottles. The 24 sample bottles may also be brought back to a laboratory for compositing. Refer to the Sample Compositing Procedure Step 1. Save remaining volume of any high turbidity samples to take back to the lab. Discard remaining sample.
7. Clean out autosampler base and reload with a new set of pre-cleaned bottles.
8. Reset the autosampler by pressing the START button (Sigma 900 autosampler). Ensure that the distributor arm is parked over bottle #1 and the display reads “Program Running” before closing the autosampler and placing it back in the enclosure.
9. Return to the Westminster Water Quality Laboratory for compositing, splitting, distribution and wet chemistry analysis of pH, turbidity and conductivity.

TRIB AUTOSAMPLER 48-HOUR AMBIENT SAMPLES

Sample Compositing

1. Composite samples in the laboratory if compositing was not performed in field. Shake sample bottles and pour equal volumes of sample from the first 12 bottles into a composite bottle marked "A". Shake sample bottles and pour equal volumes of sample from the remaining 12 bottles into a composite bottle marked "B".
2. Perform turbidity, temperature, pH and conductivity measurements on composited samples. Enter data on the Sampling Form.
3. Use the well mixed composites (A and B) to fill the appropriate bottles for the Northglenn, Thornton and Westminster labs.
4. If any discreet bottle(s) appears to have an unusually high turbidity and enough sample is available, analyze for turbidity and conductivity. Record on Sampling Form. If there is enough sample, pour the high turbidity discreet samples into separate nutrient and solids bottles for individual analysis.
5. Complete the COCs.
6. Relinquish to each city their respective samples (Westminster-nitrogen series, Thornton-TSS, metals and TOC, Northglenn-phosphorus series) and sign COCs as appropriate.
7. Original field data sheets and COCs are retained by the Cities of Westminster for permanent archive.
8. Samples are created in the web-accessible Excel spreadsheet by Westminster for data entry and results archive.

TRIB AUTOSAMPLER EVENT SAMPLES
Program Coordination (Westminster)

Field Sampling Team: Westminster

The event autosampler program was initiated on the Tributaries in 2009 at CC AS T11 to assess the pollutant concentrations mobilized during significant snow melt (runoff) or rain events at the location closest to Standley Lake. Automated sample collection of stormwater is triggered based on a turbidity reading of 100 NTU. The autosampler may also be activated remotely to begin sampling immediately or programmed to start sampling at a designated time in an attempt to capture the downstream effects of a storm in the upper watershed based on time of travel. The autosampler collects discrete samples every 15 minutes until the ambient condition drops below the trigger level or until the maximum number of samples is collected. The discrete samples may be analyzed individually or multiple discrete samples may be composited based on the field observations.

TRIB AUTOSAMPLERS EVENT MONITORING
Sample Locations

Trib Autosampler Event Samples are only collected at CC AS T11. First flush samples may be collected at all three Trib Autosampler Continuous Monitoring locations.

CC AS T11 Event	Farmers Highline Canal approximately 0.5 mile from Standley Lake inlet

Table Note: Historical data from this location is available as part of the Clear Creek Canal Program which was eliminated in 2008. The sample location identifications associated with the Clear Creek Canal Program have been retained.

TRIB AUTOSAMPLER EVENT SAMPLES
Flow Monitoring

Flow in the canals is tracked by the ditch operators and water accountants. The average daily flow data corresponding with the time-event composited samples will be used for loadings calculations for storm events.

Refer to Appendix E for the time of travel data for the Farmers Highline Canal. Time of travel studies have not been performed from the canal headgates on Clear Creek to Standley Lake for the Croke Canal or the relocated Church Ditch inlet structure.

TRIB AUTOSAMPLER EVENT SAMPLES
Analytical Parameters

Storm event samples are analyzed for the same suite of analytical parameters listed in the previous section for the 48-hour ambient samples. Samples may not be analyzed within the EPA recommended holding time for some parameters based on the random nature of the storm event triggering.

TRIB AUTOSAMPLER EVENT SAMPLES

Field Equipment

Storm event sampling utilizes the same equipment listed in the previous section for the 48-hr ambient samples.

Autosampler Operation

Field equipment used for storm event sampling is operated using the same techniques as described in the previous section for 48-hr ambient sampling.

Sample Compositing

Sample compositing is performed similarly to the procedure described in the previous section for 48-hr ambient sampling; however, fewer samples are typically composited based on the severity and/or duration of a storm event.

STANDLEY LAKE MONITORING PROGRAM

Standley Lake is a storage reservoir that serves as the raw drinking water source for the SLC. Over 250,000 consumers rely on Standley Lake for their drinking water. The Standley Lake ("SL") Monitoring Program is designed to provide water quality information in order to evaluate internal loadings in Standley Lake and the effects of nutrient reduction measures and best management practices on the trophic status of Standley Lake. Regularly spaced and frequent sampling is necessary to provide sufficient data for monitoring trends for the analytes used to evaluate trophic status including dissolved oxygen, chlorophyll and nutrients.

The main water quality monitoring efforts on Standley Lake include:

- Daily top to bottom lake profiles
- Bimonthly grab samples
- Zooplankton tows
- Invasive species monitoring and control

SL – DAILY LAKE PROFILES

Program Coordination (Westminster)

The sampling location in Standley Lake (Site 10-00) is situated near the outlet structure. The lake site was selected based on the lengthy historical record of water quality monitoring data and because the water is drawn from the lake at this location via pipelines to the SLC's water treatment plants. Sampling at varying depths in the lake provides extensive information for use in drinking water treatment process decisions and evaluating water resource management options.

Standley Lake is monitored at Site 10-00 using an automated profiler equipped with a multi-probe sonde four times each day from early spring to late fall for the analytes listed in the following table. The profiler is removed from the lake prior to freezing of the lake surface. Refer to the watershed map in Appendix B for the location of the SL monitoring location. The solar powered unit collects data from the surface of the lake to within five feet off the bottom and every meter in between. The profiler data is accessible via the internet and provides a depth-integrated profile of the lake water quality.

SL – DAILY LAKE PROFILES

Analytical Parameters

Analyte	Analytical Method Reference	Reporting Limit Goal
Temperature	SM 2560 A	1.0 °C
pH	SM 4500-H+ B	1.0 Std Units
Conductivity	SM 2510 B	10 µS/cm
Turbidity	SM 2130 B	1.0 NTU
Dissolved Oxygen	YSI (optical probe)	1.0 mg/L
Chlorophyll	YSI (electrode)	1.0 µg/L
ORP	SM 2580 A	1.0 mv

Table Notes: 1) SM refers to the 22nd Edition of Standard Methods for the Examination of Water and Wastewater.
2) Reporting limits are matrix dependent and may be increased for complex matrices.

SL – BIMONTHLY GRAB SAMPLES

Program Coordination: Westminster

The same sampling location in Standley Lake (Site 10-00) is used for both the daily lake profiles and the bimonthly grab samples. Sampling at varying depths in the lake provides extensive information for use in drinking water treatment process decisions and evaluating water resource management options. Refer to the watershed map in Appendix B for the location of the SL monitoring location.

SL – BIMONTHLY GRAB SAMPLES

Locations

Grab samples are collected twice each month from March through November, but the sampling may be extended during the winter if the lake is not frozen. The raw water pipeline at Semper (T-24) may be sampled for a subset of the routine analytical parameters when the lake is frozen or when safety of the sampling team is a concern (i.e. high winds, frozen boat dock ramp, etc.).

Sample Identification	**Sample Location**
SL 10-00	SL surface
SL 10-PZ	SL at two times the Secchi depth
SL 10-70	SL at five feet off the bottom. (Approximate depth of 60 ft when lake is full at gage height 96)
SL 69-00	SL surface at the boat dock
T-24	Semper raw water pipeline. T-24 is approximately 10 ft higher than SL 10-70

SL – BIMONTHLY GRAB SAMPLES

Analytical Parameters

Analyte	Analytical Method Reference	Reporting Limit Goal	Responsible Laboratory
Temperature	SM 2550 B	1.0 °C	Field Team
pH	SM 4500-H+ B	1.0 Std Units	Field Team
Conductivity	SM 2510 B	10 µS/cm	Field Team
Turbidity	SM 2130 B	1.0 NTU	Field Team
Dissolved Oxygen	YSI (optical probe)	1.0 mg/L	Field Team
ORP	YSI (electrode)	1 mv	Field Team
Chlorophyll	YSI (electrode)	1.0 µg/L	Field Team
Secchi Depth	Secchi disk	0.1 meter	Field Team
Total Nitrogen	SM 4500-NO3 I	0.02 mg/L	Westminster
Nitrate/Nitrite as N	SM 4500-NO3 I	0.01 mg/L	Westminster
Ammonia as N	SM 4500-NH3 H	0.01 mg/L	Westminster
Gross Alpha and Gross Beta	EPA 900.0	0.1 pCi/L	Westminster
Zooplankton	SM 10900	1 per L	Westminster
Algae	SM 10900	1 per mL	Westminster
Chlorophyll *a*	SM 10200-H	1.0 µg/L	Westminster
UV-254	SM 5910 B	0.001 cm^{-1}	Westminster
Total Phosphorus	SM 4500-P E	0.0025 mg/L	Northglenn
Ortho-phosphate as P (dissolved) or DRP	SM 4500-P E	0.0025 mg/L	Northglenn
Total Organic Carbon	SM 5310 B	0.5 mg/L	Thornton
Total Suspended Solids	SM 2540 D	1 mg/L	Thornton
Total and Dissolved Arsenic	EPA 200.8	0.001 mg/L	Thornton
Total and Dissolved Barium	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Cadmium	EPA 200.8	0.0005 mg/L	Thornton
Total and Dissolved Chromium	EPA 200.8	0.001 mg/L	Thornton
Total and Dissolved Copper	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Iron	EPA 200.7	0.05 mg/L	Thornton
Total and Dissolved Lead	EPA 200.8	0.0005 mg/L	Thornton
Total and Dissolved Manganese	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Molybdenum	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Selenium	EPA 200.8	0.005 mg/L	Thornton
Dissolved Silicon	EPA 200.7	0.02 mg/L	Westminster
Total and Dissolved Zinc	EPA 200.8	0.020 mg/L	Thornton
Total Mercury	EPA 245.1	0.0002 mg/L	Thornton
Total Hardness (as $CaCO_3$)	EPA 130.2	5 mg/L	Thornton
E. coli	SM 9221 D	1 cfu/100mL	Thornton
BTEX	EPA 524.2	0.0005 mg/L	Thornton

Table Notes: 1) SM refers to the 22nd Edition of Standard Methods for the Examination of Water and Wastewater.
2) Reporting limit goals are matrix dependent and may be increased for complex matrices and may be lower depending on laboratory capability.

SL – BIMONTHLY GRAB SAMPLES

Analytical Scheme

The analytical scheme for Standley Lake was designed to capture the biological, physical and chemical changes occurring in the lake ecosystem throughout the year. Seasonality plays an important role in lake dynamics and subsequently, on the water treatment processes. The table below details the variable analytical scheme, with the caveat that weather patterns may require modification to the plan. Rads (Gross Alpha and Gross Beta) and metals are collected before and after run-off, and before and after lake turnover, which are both subject to annual fluctuation.

Month	Lake Sample Location	Analytes														
		Hand Profile	Secchi depth	Rads	E coli	Zooplankton	Nutrients	Metals	Algae	Chlorophyll *a*	TOC	TSS	Total Hardness	BTEX	UV-254	Dissolved Silicon
January 1st week	10-00	X	X	X	X	X										
	10-PZ			X			X	X	X	X	X	X	X		X	X
	10-70	X		X	X		X	X			X	X	X		X	X
	T-24								X						X	
January 3rd week	10-00	X	X			X										
	10-PZ						X		X	X					X	X
	10-70	X					X								X	X
	T-24								X						X	
February 1st week	10-00	X	X		X	X										
	10-PZ						X		X	X	X	X	X		X	X
	10-70	X			X		X				X	X	X		X	X
	T-24								X						X	
February 3rd week	10-00	X	X			X										
	10-PZ						X		X	X					X	X
	10-70	X					X								X	X
	T-24								X						X	
March 1st week	10-00	X	X	X	X	X										
	10-PZ			X			X		X	X	X	X	X		X	X
	10-70	X		X	X		X				X	X	X		X	X
	T-24								X						X	
March 3rd week	10-00	X	X			X										
	10-PZ						X		X	X					X	X
	10-70	X					X								X	X
	T-24								X						X	
April 1st week	10-00	X	X		X	X										
	10-PZ						X		X	X	X	X	X		X	X
	10-70	X			X		X				X	X	X		X	X
	69-00													X		
	T-24								X						X	
April 3rd week	10-00	X	X			X										
	10-PZ						X		X	X					X	X
	10-70	X					X								X	X
	T-24								X						X	

Month	**Lake Sample Location**	**Analytes**														
		Hand Profile	Secchi depth	Rads	E coli	Zooplankton	Nutrients	Metals	Algae	Chlorophyll *a*	TOC	TSS	Total Hardness	BTEX	UV-254	Dissolved Silicon
May 1st week	10-00	X	X		X	X										
	10-PZ						X		X	X	X	X	X		X	X
	10-70	X			X		X				X	X	X		X	X
	T-24								X						X	
May 3rd week	10-00	X	X			X										
	10-PZ						X		X	X					X	X
	10-70	X					X								X	X
	69-00													X		
	T-24								X						X	
June 1st week	10-00	X	X	X	X	X										
	10-PZ			X			X	X	X	X	X	X	X		X	X
	10-70	X		X	X		X	X			X	X	X		X	X
	T-24								X						X	
June 3rd week	10-00	X	X			X										
	10-PZ						X		X	X					X	X
	10-70	X					X								X	X
	69-00													X		
	T-24								X						X	
July 1st week	10-00	X	X		X	X										
	10-PZ						X		X	X	X	X	X		X	X
	10-70	X			X		X				X	X	X		X	X
	T-24								X						X	
July 3rd week	10-00	X	X			X										
	10-PZ						X	**X**	X	X			X		X	X
	10-70	X					X	**X**					X		X	X
	69-00													X		
	T-24								X						X	
August 1st week	10-00	X	X		X	X										
	10-PZ						X		X	X	X	X			X	X
	10-70	X			X		X				X	X			X	X
	T-24								X						X	
August 3rd week	10-00	X	X	X		X										
	10-PZ			X			X	X	X	X			X		X	X
	10-70	X		X			X	X					X		X	X
	69-00													X		
	T-24								X						X	
September 1st week	10-00	X	X		X	X										
	10-PZ						X		X	X	X	X			X	X
	10-70	X			X		X				X	X			X	X
	T-24								X						X	

Month	Lake Sample Location	Hand Profile	Secchi depth	Rads	E coli	Zooplankton	Nutrients	Metals	Algae	Chlorophyll *a*	TOC	TSS	Total Hardness	BTEX	UV-254	Dissolved Silicon
September 3rd week	10-00	X	X	X		X										
	10-PZ			X			X	X	X	X			X		X	X
	10-70	X		X			X	X					X		X	X
	69-00													X		
	T-24								X						X	
October 1st week	10-00	X	X		X	X										
	10-PZ						X	**X**	X	X	X	X	X		X	X
	10-70	X			X		X	**X**			X	X	X		X	X
	T-24								X						X	
October 3rd week	10-00	X	X	X		X										
	10-PZ			X			X	X	X	X			X		X	X
	10-70	X		X			X	X					X		X	X
	69-00													X		
	T-24								X						X	
November 1st week	10-00	X	X		X	X										
	10-PZ						X		X	X	X	X	X		X	X
	10-70	X			X		X				X	X	X		X	X
	T-24								X						X	
November 3rd week	10-00	X	X			X										
	10-PZ						X		X	X					X	X
	10-70	X					X								X	X
	T-24								X						X	
December 1st week	10-00	X	X	X	X	X										
	10-PZ			X			X		X	X	X	X	X		X	X
	10-70	X		X	X		X				X	X	X		X	X
	T-24								X						X	
December 3rd week	10-00	X	X			X										
	10-PZ						X		X	X					X	X
	10-70	X					X								X	X
	T-24								X						X	

Table notes:

1) Hand Profile includes analysis of temperature, pH, conductivity, turbidity, DO, chlorophyll and ORP at the surface of the lake and at the bottom of the lake using the sonde.
2) Rads includes Gross Alpha and Gross Beta.
3) Metals includes the total and dissolved forms of As, Ba, Cd, Cr, Cu, Fe, Pb, Mn, Mo, Se and Zn, dissolved Si and total Hg. **Metals for the 3rd week of July and the 1st week of October consist of ONLY total and dissolved arsenic.**
4) Nutrients include the phosphorus series and the nitrogen series analytes. Phosphorus series includes total P and dissolved ortho-phosphate-P (also referred to as DRP). Nitrogen series includes total N, ammonia-N and nitrate/nitrite-N.
5) Total Hardness is reported as $CaCO_3$.

SL – BIMONTHLY GRAB SAMPLES
Program Coordination (Westminster)

SL Sample bottle kit

The sample containers required for each monitoring event varies depending on the parameters to be analyzed. Westminster will assemble sample bottle kits for each event. The following table details the sample containers for various parameters.

Parameter	**Volume**	**Bottle Type**	**Laboratory**
Phosphorus series	1L	Rectangular plastic	Northglenn
Nitrogen series, UV-254	250 mL	Rectangular plastic	Westminster
Rads	1 L	Plastic	Westminster
Zooplankton	250 mL	Plastic	Westminster
Algae	1 L	Plastic	Westminster
Chlorophyll *a*	1 L	Brown plastic	Westminster
Dissolved Silica	250 mL	Rectangular Plastic	Westminster
Total metals, Total Hg	500 mL	Plastic	Thornton
Dissolved metals	500 mL	Plastic	Thornton
TOC	40 mL	Glass vial	Thornton
TSS, Total Hardness	500 mL	Plastic jug	Thornton
E. coli	250 mL	Glass	Thornton
BTEX	40 mL	Glass vial	Thornton
BTEX trip blank	40 mL	Glass vial	Thornton

Table Notes:

1) A trip blank is required to be prepared when field samples are collected for BTEX. The trip blank is comprised of a pre-cleaned glass vial filled with DI and is used to monitor for volatile organic contamination during transport and lab storage prior to analysis. Analysis of the trip blank is only required when any of the BTEX analytes are detectable in the field samples.
2) Phosphorus series includes total P and dissolved ortho-phosphate-P (also referred to as DRP).
3) Nitrogen series includes total N, ammonia-N and nitrate/nitrite-N.
4) Rads includes: Gross Alpha and Gross Beta
5) BTEX includes: benzene, toluene, ethyl benzene and total xylenes

SL – BIMONTHLY GRAB SAMPLES

Sample Collection

Equipment

Pontoon Boat
Marking Pen – Waterproof
Depth Finder
Secchi Disk
Log book and pen
Van Dorn bottle
Labeled sample bottles (refer to individual monitoring plans)
Churn sample splitter
PZ tube sampler
Ice packs
Coolers
Chain of custody forms
YSI 6600 Sonde - calibrated
YSI 650 Meter and cable
Handheld anemometer/%Relative humidity meter
Cellular phone
GPS unit
Digital camera
Boat Tool Kit
Laptop computer – fully charged with communication cable and “console” application installed
Water pitcher and wide bristle brush for cleaning sonde cage
Jackets, hats, gloves or other protective clothing as appropriate for the weather conditions
First aid kit
Personal flotation devices (one per person)
Survival Suits – yellow (1 hr protection) and orange (1/2 hr protection) -as appropriate
Profiler enclosure key
Boat Anchor(s)
Key for boat ramp during off-season
Zooplankton tow net – 63 µm

Sample collection procedure

At Laboratory

- Prepare and label all required sampling containers.
- Complete basic information on the chain of custody (COC) forms.
- Update the YSI 6600 file names using the format XXMMDDYY, where XX denotes the field sampling program identification (e.g. SL, CC, RC, etc.), MM denotes the month, DD denotes the day and YY denotes the year.
- Notify laboratories about the sampling event and schedule sample pickup.
- Assemble the sampling equipment and load into the truck.
- Calibrate the sonde.

Sampling on Standley Lake

Van Dorn Bottle

- The Van Dorn bottle provides a means of collecting water samples at selected depths below the surface. It is made of an open-ended plastic cylinder that is attached to a rope, and lowered to any desired depth.
- Each end of the cylinder is fitted with a rubber cover. The Van Dorn bottle is attached to the length of rope, marked in 0.1 m increments, with the covers pulled out and attached to the trigger device.
- The depth of the lake is determined using the sonde. The bottle is lowered to a depth one meter above the bottom of the lake.
- A metal weight called a "messenger" is attached to the rope above the bottle. The water sample is taken by dropping a weighted “messenger" down the rope. When the weight hits the triggering device on the upper Van Dorn bottle, the catch releases the rubber end covers. The two covers are pulled together and seal off the ends.
- When the bottle has been closed, it is pulled to the surface.
- Water samples from the Van Dorn bottle are transferred to the appropriate sample containers.
- The Van Dorn sampler has a four liter capacity. If the volume of sample required is greater than the Van Dorn sampler can hold, multiple sample volumes can be collected and combined in the churn. The churn and churn spigot should be rinsed out with new sample water prior to sample collection in order to prevent cross-contamination from prior samples. Once the churn contains enough sample, it is thoroughly mixed and the sample is dispensed into the required sample containers.
- Sample containers are labeled with sample location, date and time of sample collection and the sampler’s initials. The label should indicate any preservative in the sample container.
- Full sample containers are placed in coolers with ice packs until they are returned to the laboratory.

PZ Tube Sampler

- The PZ (photic zone) sampler is used to sample a column of water from the surface of the lake to the depth of the photic zone. Photic zone is defined as twice the secchi depth. The PZ sampler is comprised of a churn sample splitter connected to a polypropylene tube equipped with a quick release connector on one end and a check valve on the other end.
- Measure the secchi depth through the floor port on the pontoon boat. Do not wear sunglasses. Record data in the logbook.
- Hook up the quick release connector end of the tube to the churn.
- The tube is marked in 0.5 meter lengths. Lower the end of the tube with the check valve into the water until it is at the depth of the photic zone.
- Pull the tube up out of the water and hold the end with the check valve upside-down at a height over your head, until the tube drains down to floor level, then quickly drop the check-valve end of the tube back into the water vertically to the depth of the photic zone. The water entering the end of the tube will push the air bubble and prior sample into the churn as the tube is lowered into the water. Use the first collected volume of sample to rinse the tube and churn. Waste the sample back to

the lake. Start collecting the second volume of sample. Repeat this step until sufficient quantity of sample has been collected in the churn. The capacity of the churn is 12 liters.

- Once the churn contains enough sample, it is thoroughly mixed and the sample is dispensed into the required sample containers.
- Sample containers are labeled with sample location, date and time of sample location and the sampler's initials. The label should indicate any preservative in the sample container.
- Sample containers are placed in a cooler with ice packs until they are returned to the laboratory.

Surface Sampling

- Surface sampling is accomplished through the floor port of the pontoon boat. Sample containers are dipped into the water until full to collect samples.
- Sample containers are labeled with sample location, date and time of sample collection and the sampler's initials. The label should indicate any preservative in the sample container.
- Sample containers are placed in a cooler with ice packs until they are returned to the laboratory.

Zooplankton Tows

- Zooplankton samples are collected at SL-10 using a 63 µm tow net.
- A vertical tow sampling methodology involves lowering the tow net to the bottom of the lake and retrieving it at a slow speed of approximately one foot per second up to the surface.
- The zooplankton collected in the net are washed into a 250 mL sample bottle using multiple DI water rinses to ensure all organisms in the net are transferred to the sample container. The final volume in the bottle is not required to be consistent.
- The sample depth is recorded on the sample bottle along with date and location.

SL – AQUATIC INVASIVE SPECIES MANAGEMENT

Eurasian Watermilfoil

Eurasian Watermilfoil ("EWM"), *Myriophyllum spicatum L*, is a non-native, aquatic, noxious weed that grows rapidly and to a depth of 35 feet. EWM grows in dense mats that severely interfere with recreation and has been known to provide a substrate for blue-green algae growth. Blue-green algae blooms can ultimately cause taste and odor events in drinking water supplies. EWM was first observed in Standley Lake in 1998. It was positively identified in 2000. In 2012, it was confirmed that the Eurasian watermilfoil hybridized with a native Colorado species Northern watermilfoil (Myriophillum sibiricum). The hybrid species is more robust and grows even quicker than the Eurasian watermilfoil.

Eurasian milfoil weevils have been stocked in the lake (on the west side) on four occasions from 2004 through 2011. The weevil larva bore into the stem of the milfoil which damages the plant. When an adequate weevil population is sustained, the weevils may be able to control the spread of the milfoil. Annual surveys of weevil populations in the lake are performed by contractors. Standley Lake experienced a steady milfoil density decline from 2006, of 500 stems/m^2 to 26 stems/m^2 in 2011. Unfortunately with the appearance of the hybrid milfoil, the density again increased in 2012 to 106 stems/m^2.

In 2007 the SLC initiated a pilot study on Standley Lake using two solar pond aerators to investigate the theory that continuous aeration will oxidize the sediment and deprive the milfoil of nutrients. Samples were collected and analyzed for nutrients to assess nutrient reduction at the aerator sites compared to other sites in the lake. The solar aerators were removed in the fall of 2009. The results of the study were inconclusive as there was an overall reduction in milfoil growth throughout the lake in 2009.

As lake conditions permit, bathymetric studies are performed on Standley Lake during the early summer for mapping the submerged aquatic vegetation in order to assess milfoil growth and the effectiveness of the remedies.

Zebra and Quagga Mussels

Zebra and quagga mussels are non-native, aquatic invasive species that are introduced to new water bodies by the unintentional transfer of organisms from an infested water body via boats or fishing bait. Aquatic mussels cause serious damage to the ecosystem and result in costly control procedures for drinking water treatment facilities. Both zebra and quagga mussels were discovered in 2008 in a few of Colorado's lakes. Prevention of aquatic mussel infestation is key to protecting Standley Lake. An intensive boat inspection and decontamination program was initiated in 2008 to protect the lake from new invasive species. No live aquatic baits are allowed at Standley Lake.

Standley Lake is monitored for aquatic mussels every two weeks using the zooplankton tow procedure described previously. The tows are performed at the lake inlets, SL-10, and the boat ramp/outlet area. Several invasive species have a planktonic life stage and sampling with the plankton nets will provide early warning of infestation. In addition, substrate samplers, constructed and monitored by Colorado Parks and Wildlife are placed throughout the lake. Substrate samplers are made up of a float, rope, plastic plates and an anchor weight. A plate is located at every 10 feet of depth from the surface to the bottom of the lake at various locations. The plates and ropes are checked periodically for aquatic mussel growth. A plate or rope that feels like sand paper will be scraped and examined under the microscope for veligers (zebra or quagga mussel larvae).

Shoreline surveys are performed when the water level is at the lowest for the year. A shoreline survey consists of walking the shoreline in teams looking for adult mussels attached to any hard substrate.

DATA MANAGEMENT AND REPORTING

The City of Westminster is responsible for management of the data collected in support of the monitoring efforts. A Microsoft Excel spreadsheet is used for archival of monitoring data collected for all programs detailed in this document except the lake profile data. The IGA partners have access to the system via an internet host site which also provides backup protection for the data.

The City of Westminster logs in all samples collected by the various sampling teams. The coordinated sample creation effort reduces interpretation errors and subsequent reporting inconsistencies. Each IGA partner is responsible for analytical results entry for their assigned analyses into the spreadsheet. On a quarterly basis, a peer review team, comprised of at least one representative from each of the SLC, evaluates the data and identifies possible errors or data anomalies. Each city makes corrections to the spreadsheet and submits a final version of the data. The spreadsheet is current to within six months.

Data results from this program, along with other reporting requirements as stated in the Joint Agreement, will be reported to the Colorado Water Quality Control Commission on an annual basis. Only data collected during the normal sampling schedule is included in the annual report. The data is reported in tabular and graphic formats.

Each laboratory must retain all records (i.e. field notebooks and logs, instrument logs, bench sheets, instrument printouts, electronic data files, chain of custody forms, etc.) pertaining to the monitoring programs until the SLC IGA representatives jointly, in writing, authorize disposal of the records.

The periods of record for monitoring data are summarized in the following table:

Program	Period of Record	Available Format
Clear Creek Grabs	1994 – 2001	MS Access/Excel
	2002 – current	MS Excel
Clear Creek Grabs - EPA Metals Data	1994 – current	MS Excel
Clear Creek Autosamplers Ambient	2006 – current	MS Excel
Clear Creek Autosamplers Event	2006 – current	MS Excel
Standley Lake Tributaries – grabs and autosamplers (includes data for the program formerly called Clear Creek Canals)	1988 – 2001	MS Access/Excel
	2002 - current	MS Excel
Standley Lake	1988 – 2001	MS Access/Excel
	2002 - current	MS Excel

Table Notes: The data archive includes phosphorus data from 1999-current, all Thornton data from 2001-current and all Westminster data from 2002-current.

Appendix C – Clear Creek, Canal, and Standley Lake Water-Quality Monitoring Data – 2015

APPENDIX C1 CLEAR CREEK GRAB SAMPLES

APPENDIX C2 TRIBUTARY GRAB SAMPLES

APPENDIX C3 AMBIENT AUTOSAMPLERS

APPENDIX C4 EVENT AUTOSAMPLERS

APPENDIX C5 CLEAR CREEK EVENT AUTOSAMPLERS—METALS (GOLDEN)

APPENDIX C6 STANDLEY LAKE SAMPLES

Clear Creek Grabs

Method				SM2550B	SM4500H+B	SM2510B	SM4500OG	SM2130B	SM5310B	SM2540D	SM4500NH3H	SM4500NO3I	SM4500NO3I	SM4500PE	SM4500PE				
DL				1.0	1.0	10	1.0	1	0.5	1	0.01	0.01	0.02	0.0025	0.0025				
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	3				
Max decimals				1	1	0	1	1	1	0	2	2	2	4	4				
Reporting Units				°C	s.u.	µS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L				
Sample Date	Sample Time	Sample Type	Location ID	Temp	pH	Conductivity, Specific	Oxygen, Dissolved	Turbidity	Carbon, Total Organic	Solids, Total Suspended	Nitrogen, Ammonia (Salicylate)	Nitrogen, Nitrate+Nitrite	Nitrogen, Total Nitrogen	Phosphorus, Dissolved (DRP)	Phosphorus, Total	Notes	Conclusion	Field Notes	Lab Notes
02/02/15	10:20	G	CC 26	<1	8.2	424	7.72	1.1	0.9	<1	0.03	0.45	0.49	0.0046	0.0067				
02/02/15	10:40	G	CC 40	<1	8	451	8.67	<1	0.9	2	0.02	0.44	0.48	0.0046	0.0088				
02/02/15	10:53	G	CC 50	2.5	7.9	820	8.72	54.1	1.7	18	0.03	0.8	0.94	0.0032	0.0271				
02/02/15	11:17	G	CC 60	<1	8.1	470	8.98	1.7	0.9	1	0.01	0.48	0.49	0.0026	0.0123				
05/20/15	9:53	G	CC 05	3.6	7.7	300	9.4	<1	3.7	<1	0.01	0.09	0.22	0.004	0.0059			Staff gage = 4.1 ft	
05/20/15	10:15	G	CC 10	5.6	8	124	8.8	1.4		2	< 0.01	0.1	0.18	0.0036	0.0046				
05/20/15	9:58	G	CC 15	4.1	6.9	406	9.3	3.6		2	< 0.01	0.19	0.35	0.0049	0.0091			Staff gage = 4.0 ft	
05/20/15	10:14	G	CC 20	4.4	7.2	293	9.3	4.9	2.6	4	< 0.01	0.14	0.27	0.0038	0.0104				
05/20/15	9:33	G	CC 25	7.4	7.7	247	9.2	3.3		4	< 0.01	0.15	0.29	< 0.0025	0.0109				
05/20/15	10:33	G	CC 26	6.7	7.9	254	9	3.7	3	7	< 0.01	0.15	0.26	< 0.0025	0.0101				
05/20/15	9:33	G	CC 30	3.6	7.1	160	10.1	5		9	< 0.01	0.1	0.36	0.0049	0.0171			Staff gage = 4.25 ft	
05/20/15	11:10	G	CC 34	6.5	7.7	239	9.4	5		4	< 0.01	0.16	0.28	< 0.0025	0.0098				
05/20/15	10:53	G	CC 35	4.8	8.1	84	9.6	5.8	4.1	4	< 0.01	0.08	0.25	0.0085	0.0194				
05/20/15	10:35	G	CC 40	5.1	6.9	284	9.7	9	3.7	7	< 0.01	0.18	0.36	0.0054	0.0213			Staff gage = 4.80 ft	
05/20/15	11:03	G	CC 44	4.8	7.2	120	9.3	6		<1	< 0.01	0.06	0.23	0.0061	0.0153				
NS	NS	G	CC 45													Not sampled			
05/20/15	11:23	G	CC 50	6.3	6.9	313	9.3	12.2	4.5	9	< 0.01	0.28	0.53	0.0035	0.024				
05/20/15	11:32	G	CC 52	5.9	7.8	176	9.8	21.2	8	46	< 0.01	0.26	0.64	0.0098	0.039				
05/20/15	11:40	G	CC 53	5.5	7.7	245	9.8	32.9	8.5	111	< 0.01	0.45	0.86	0.0131	0.0546				
05/20/15	11:52	G	CC 60	5.8	7.2	309	9.9	14.2	4.6	14	< 0.01	0.33	0.57	0.005	0.021				
05/20/15		QC	CCP106												0.0181	Blind QC sample			
05/20/15		QC	CCD106										0.37		0.0282	Blind QC sample			
05/20/15		QC	CCN106										0.58			Blind QC sample			
10/21/15	9:52	G	CC 05	2.4	7.02	176	9.32	<1	1	2	< 0.01	0.21	0.24	< 0.0025	0.0046			Staff gage = 3.6 ft	
10/21/15	10:13	G	CC 10	5	7.3	132	9.3	2.1		2	< 0.01	0.13	0.16	< 0.0025	0.0047				
10/21/15	10:15	G	CC 15	4.6	7.3	932	9.7	1.8		2	0.15	0.32	0.52	< 0.0025	0.0059				
10/21/15	10:31	G	CC 20	6.6	7.8	401	9.6	3.1	1.4	4	0.04	0.18	0.28	< 0.0025	0.0125				
10/21/15	10:34	G	CC 25	7.4	7.2	187	8.7	1.8		2	< 0.01	0.1	0.2	< 0.0025	0.0081				
10/21/15	10:44	G	CC 26	6.7	7.2	271	9.1	2.7	1.3	3	< 0.01	0.14	0.22	< 0.0025	0.0102				
10/21/15	9:46	G	CC 30	5.2	8.3	62	10.2	4.7		3	< 0.01	0.05	0.15	< 0.0025	0.0125			Staff gage = 4.0 ft	
10/21/15	11:20	G	CC 34	6.5	7.1	221	8.6	4		4	< 0.01	0.17	0.29	< 0.0025	0.0134				
10/21/15	11:06	G	CC 35	3.5	7.4	77	10.3	3.6	2.2	3	< 0.01	0.07	0.19	0.0048	0.0107				
10/21/15	9:30	G	CC 40	7.7	8.2	263	9.8	17	2	14	< 0.01	0.21	0.36	0.0032	0.0225			Staff gage = 3.8 ft	
10/21/15	11:04	G	CC 44	5.7	8	157	9.7	5.9		4	< 0.01	0.02	0.12	0.0027	0.0108				
NS	NS	G	CC 45													Site eliminated July 2015			

Clear Creek Grabs

Method				SM2550B	SM4500H+B	SM2510B	SM4500OG	SM2130B	SM5310B	SM2540D	SM4500NH3H	SM4500NO3I	SM4500NO3I	SM4500PE	SM4500PE				
DL				1.0	1.0	10	1.0	1	0.5	1	0.01	0.01	0.02	0.0025	0.0025				
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	3				
Max decimals				1	1	0	1	1	1	0	2	2	2	4	4				
Reporting Units				°C	s.u.	µS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L				
Sample Date	Sample Time	Sample Type	Location ID	Temp	pH	Conductivity, Specific	Oxygen, Dissolved	Turbidity	Carbon, Total Organic	Solids, Total Suspended	Nitrogen, Ammonia (Salicylate)	Nitrogen, Nitrate+Nitrite	Nitrogen, Total Nitrogen	Phosphorus, Dissolved (DRP)	Phosphorus, Total	Notes	Conclusion	Field Notes	Lab Notes
10/21/15	11:24	G	CC 50	8.3	7.6	495	9.7	168	4.7	81	0.12	0.62	1.01	< 0.0025	0.074				
10/21/15	11:38	G	CC 52	7.4	7.1	424	8.3	360	6.3	238	< 0.01	0.23	0.81	0.008	0.155				
10/21/15	11:44	G	CC 53	9.4	7.1	624	8.2	16.3	3.9	72	0.04	0.58	0.94	0.0114	0.0436				
10/21/15	11:51	G	CC 60	9	7.7	328	10.1	30.7	2	28	< 0.01	0.28	0.55	< 0.0025	0.0319				
10/21/15	13:55	QC	CCP107												0.0201	Blind QC sample			
10/21/15	13:55	QC	CCD107										0.17		0.0309	Blind QC sample			
10/21/15	13:55	QC	CCN107										0.42			Blind QC sample			
12/02/15	9:40	G	CC 26	<1	7.6	198	11.5	<1	0.9	<1	0.02	0.28	LE	0.0036	0.0146		Had issues with the TN digestion.		
12/02/15	9:59	G	CC 40	<1	7.4	196	12.1	1.2	1	1	0.03	0.38	LE	< 0.0025	0.0082		Had issues with the TN digestion.	Staff gage = 4.2 ft	
12/02/15	10:13	G	CC50	1.4	7.4	413	8.3	38	1.5	15	0.02	0.51	LE	< 0.0025	0.0111		Had issues with the TN digestion.		
12/02/15	10:37	G	CC 60	<1	7.5	254	12.8	1.9	1.2	<1	0.02	0.51	LE	< 0.0025	0.05		Had issues with the TN digestion.		

Tribs

Method				SM2510B	SM4500OG	SM4500H+B	SM2550B	SM2130B	SM4500PE	SM4500PE	SM4500NH3H	SM4500NO3I	SM4500NO3I	SM7110B	SM7110B	SM7110B	SM7110B	SM5310B
Reporting Limit Goal				10	1.0	1.0	1.0	1	0.0025	0.0025	0.01	0.01	0.02	variable	variable	variable	variable	0.5
Max Sig figs				3	3	3	3	3	3	3	3	3	3	2	2	2	2	3
Max decimals				0	1	1	1	1	4	4	2	2	2	1	1	1	1	1
Reporting Units				µS/cm	mg/L	s.u.	°C	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L	pCi/L	mg/L
Sample Date	Sample Time	Sample Type	Location ID	Conductivity, Specific	Oxygen, Dissolved	pH	Temp	Turbidity	Phosphorus, Dissolved (DRP)	Phosphorus, Total	Nitrogen, Ammonia (Salicylate)	Nitrogen, Nitrate+Nitrite	Nitrogen, Total Nitrogen	Gross Alpha	Gross Alpha, Uncertainty	Gross Beta	Gross Beta, Uncertainty	Carbon, Total Organic
NS	NS	G	Trib 01															
01/07/15	9:40	G	Trib 02	416	11	7.7	2.8	1.3	0.003	0.007	0.03	0.43	0.54					2
01/07/15	9:50	G	Trib 03	430	8.9	7.6	4.8	1.6	0.0032	0.0074	0.05	0.44	0.59					1.7
01/07/15	10:35	G	Trib 04	564	9	7.8	3.7	19.5	0.0068	0.0373	0.05	0.46	0.69					1.9
NS	NS	G	Trib 11															
NS	NS	G	Trib 22a															
NS	NS	G	Trib 22d															
01/07/15	8:45	G	Trib 24	286	8.9	7.5	7.7	1.3	< 0.0025	0.007	0.02	0.07	0.21					2.1
NS	NS	G	Trib 25															
NS	NS	G	Trib 27 (New Church Ditch Inlet)															
02/04/15	9:50	G	Trib 01	379	13.3	7.6	2	3.1	0.0026	0.0098	0.03	0.39	0.53					1
02/04/15	10:05	G	Trib 02	567	11.3	7.2	1.5	4.1	0.0034	0.0138	0.02	0.43	0.57					1.1
02/04/15	10:20	G	Trib 03	427	8.8	7.7	7.3	4.6	0.0048	0.0145	0.01	0.42	0.56					1.2
02/04/15	11:15	G	Trib 04	437	9.6	7.9	6.3	11.3	0.0063	0.0213	0.01	0.41	0.55					1.1
NS	NS	G	Trib 11															
NS	NS	G	Trib 22a															
NS	NS	G	Trib 22d															
02/04/15	9:05	G	Trib 24	289	11	7.1	6.8	1.2	< 0.0025	0.0084	0.01	0.07	0.23					1.9
NS	NS	G	Trib 25															
NS	NS	G	Trib 27 (New Church Ditch Inlet)															
NS	NS	G	Trib 01															
03/04/15	9:20	G	Trib 02	570	10.3	7.3	4.4	1.5	< 0.0025	0.0074	0.02	0.52	0.7	3.3	2.8	1.9	3.3	1.2
03/04/15	9:35	G	Trib 03	543	8.6	7.4	6.8	4.5	0.0061	0.0201	0.01	0.49	0.64	3.8	3	3.8	3.6	1.4
03/04/15	10:10	G	Trib 04	539	10.1	7.5	2	43	0.0074	0.0597	0.04	0.45	0.77	7.4	3.7	0.2	3.1	1.6
03/04/15	NS	G	Trib 11															
03/04/15	NS	G	Trib 22a															
03/04/15	NS	G	Trib 22d															
03/04/15	8:30	G	Trib 24	326	10.6	7.2	6.6	1.5	< 0.0025	0.0091	0.02	0.1	0.33	1.4	1.8	0	3.1	1.7
NS	NS	G	Trib 25															
NS	NS	G	Trib 27 (New Church Ditch Inlet)															
04/01/15	9:05	G	Trib 01	393	10.5	7.4	9	4.2	0.0081	0.0132	< 0.01	0.24	0.34					1.5
04/01/15	9:15	G	Trib 02	399	7.7	7.7	15.6	3.7	0.0072	0.0132	< 0.01	0.25	0.35					1.5
04/01/15	9:30	G	Trib 03	434	7.4	7.8	15.7	3.6	0.0074	0.0152	0.01	0.27	0.39					1.6
04/01/15	10:00	G	Trib 04	429	8.1	7.9	14.4	20.1	0.0108	0.0353	0.02	0.23	0.41					1.6
NS	NS	G	Trib 11															
NS	NS	G	Trib 22a															
NS	NS	G	Trib 22d															
04/01/15	8:20	G	Trib 24	317	7.2	8.9	10.7	2.8	0.0039	0.0127	< 0.01	0.08	0.21					1.7
NS	NS	G	Trib 25															
NS	NS	G	Trib 27 (New Church Ditch Inlet)															
05/06/15	9:20	G	Trib 01	261	10.6	7	9	36.4	0.009	0.0575	< 0.01	0.26	0.6					4.5
05/06/15	9:40	G	Trib 02	307	9.9	7	9.3	30.9	0.0109	0.0476	< 0.01	0.31	0.62					4.7
05/06/15	9:55	G	Trib 03	274	9.6	7.2	9.9	39.7	0.0102	0.062	< 0.01	0.27	0.57					4.6
NS	NS	G	Trib 04															
05/06/15	10:30	G	Trib 11	348	8.9	7.5	11.3	62.3	0.025	0.0944	0.05	0.39	0.85					2.8
NS	NS	G	Trib 22a															
NS	NS	G	Trib 22d															
05/06/15	8:35	G	Trib 24	324	7.7	7.1	11.5	4.2	0.0041	0.0121	0.02	0.12	0.3					1.9

Tribs

Method				SM2510B	SM4500OG	SM4500H+B	SM2550B	SM2130B	SM4500PE	SM4500PE	SM4500NH3H	SM4500NO3I	SM4500NO3I	SM7110B	SM7110B	SM7110B	SM7110B	SM5310B
Reporting Limit Goal				10	1.0	1.0	1.0	1	0.0025	0.0025	0.01	0.01	0.02	variable	variable	variable	variable	0.5
Max Sig figs				3	3	3	3	3	3	3	3	3	3	2	2	2	2	3
Max decimals				0	1	1	1	1	4	4	2	2	2	1	1	1	1	1
Reporting Units				µS/cm	mg/L	s.u.	°C	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L	pCi/L	mg/L
Sample Date	Sample Time	Sample Type	Location ID	Conductivity, Specific	Oxygen, Dissolved	pH	Temp	Turbidity	Phosphorus, Dissolved (DRP)	Phosphorus, Total	Nitrogen, Ammonia (Salicylate)	Nitrogen, Nitrate+Nitrite	Nitrogen, Total Nitrogen	Gross Alpha	Gross Alpha, Uncertainty	Gross Beta	Gross Beta, Uncertainty	Carbon, Total Organic
NS	NS	G	Trib 25															
NS	NS	G	Trib 27 (New Church Ditch Inlet)															
06/03/15	9:10	G	Trib 01	172	9.6	7.3	11.3	26.7	0.005	0.0435	< 0.01	0.16	0.45	3.5	2.2	2	3.5	4.7
06/03/15	9:30	G	Trib 02	184	9.7	7.3	10.6	29.6	0.0045	0.0499	< 0.01	0.19	0.46	3.4	2.3	0	2.9	4.4
06/03/15	9:40	G	Trib 03	173	9	7.4	10.7	30.9	0.0054	0.051	< 0.01	0.17	0.5	3.3	2.3	0	3.4	4.2
NS	10:10	G	Trib 04															
06/03/15	10:10	G	Trib 11	233	7.1	7.4	14.6	15.7	0.0078	0.0309	0.01	0.22	0.45	2.1	1.9	0	2.8	4.2
NS	NS	G	Trib 22a															
NS	NS	G	Trib 22d															
06/03/15	8:30	G	Trib 24	338	5.4	7.1	13	3.8	0.004	0.0105	0.01	0.18	0.32	1.4	1.9	0	2.8	NT
NS	NS	G	Trib 25															
NS	NS	G	Trib 27 (New Church Ditch Inlet)															
07/01/15	9:05	G	Trib 01	120	7.8	7.1	15.1	4	0.0027	0.011	0.02	0.13	0.29					3
07/01/15	9:20	G	Trib 02	129	7.7	7.6	16.3	4.3	0.0028	0.0119	< 0.01	0.14	0.24					2.2
07/01/15	9:35	G	Trib 03	122	7	7.6	15.7	4.2	0.0033	0.0107	< 0.01	0.13	0.19					2.6
NS	NS	G	Trib 04															
07/01/15	10:05	G	Trib 11	139	6.6	7.4	18.1	45.3	0.0114	0.0698	0.01	0.16	0.42					2.5
NS	NS	G	Trib 22a															
NS	NS	G	Trib 22d															
07/01/15	8:20	G	Trib 24	329	5.3	7.4	14.2	2.5	< 0.0025	0.0117	< 0.01	0.12	0.24					NT
NS	NS	G	Trib 25															
NS	NS	G	Trib 27 (New Church Ditch Inlet)															
08/05/15	9:25	G	Trib 01	219	7.5	7.4	15.2	2.2	< 0.0025	0.0073	< 0.01	0.16	0.25					1.8
08/05/15	9:40	G	Trib 02	225	7.3	7.6	15.6	2.2	< 0.0025	0.0078	< 0.01	0.13	0.29					1.6
08/05/15	9:50	G	Trib 03	245	6.2	7	19.6	2.4	< 0.0025	0.0088	< 0.01	0.17	0.28					1.7
NS	NS	G	Trib 04															
08/05/15	10:40	G	Trib 11	231	6.6	7.4	18.4	7.8	0.0037	0.014	< 0.01	0.16	0.28					2
NS	NS	G	Trib 22a															
NS	NS	G	Trib 22d															
08/05/15	8:40	G	Trib 24	340	1.6	7.3	14.1	5.8	0.003	0.0105	< 0.01	0.13	0.39					2.2
NS	NS	G	Trib 25															
08/05/15	10:20	G	Trib 27 (New Church Ditch Inlet)	220	7.2	7.3	18	7.5	0.0063	0.019	< 0.01	0.11	0.3					1.9
09/02/15	9:10	G	Trib 01	264	6.72	7.7	15.8	2.1	< 0.0025	0.0087	< 0.01	0.21	0.3	1.5	2.1	0	3.4	1.8
09/02/15	9:30	G	Trib 02	310	6.6	7.9	17.5	1.7	< 0.0025	0.0067	< 0.01	0.27	0.37	3.2	2.3	0	3	2.1
09/02/15	9:30	G	Trib 03	300	5.8	8	20.5	1.6	< 0.0025	0.0094	< 0.01	0.23	0.32	0.2	1.6	0	3.2	1.3
NS	NS	G	Trib 04															
09/02/15	10:35	G	Trib 11	302	6.5	8	19.5	3.4	< 0.0025	0.0142	< 0.01	0.21	0.31	0.7	1.8	0	2.8	2.2
NS	NS	G	Trib 22a															
09/02/15	10:20	G	Trib 22d	81	8.4	7.5	13.9	3.3	0.0085	0.0181	< 0.01	0.05	0.21	0.8	1.3	0	2.8	4.1
09/02/15	8:20	G	Trib 24	332	1.1	7.2	15.6	5.8	0.0028	0.0161	0.01	0.15	0.3	1.2	1.9	0	3.1	2.3
NS	NS	G	Trib 25															
NS	NS	G	Trib 27 (New Church Ditch Inlet)															
10/07/15	9:00	G	Trib 01	271	8.8	7	11.6	126	0.006	0.0763	< 0.01	0.21	0.51					2.4
10/07/15	9:15	G	Trib 02	282	8.6	7.4	11.9	166	0.0072	0.1142	< 0.01	0.22	0.61					2.1
10/07/15	9:25	G	Trib 03	361	6.9	7.7	15.3	30.5	0.0062	0.0361	< 0.01	0.27	0.55					2.3
NS	NS	G	Trib 04															
10/07/15	10:10	G	Trib 11	292	7.5	7.5	14.4	25.8	0.0032	0.0446	< 0.01	0.2	0.5					1.8
NS	NS	G	Trib 22a															

Tribs

Method				SM2510B	SM4500OG	SM4500H+B	SM2550B	SM2130B	SM4500PE	SM4500PE	SM4500NH3H	SM4500NO3I	SM4500NO3I	SM7110B	SM7110B	SM7110B	SM7110B	SM5310B
Reporting Limit Goal				10	1.0	1.0	1.0	1	0.0025	0.0025	0.01	0.01	0.02	variable	variable	variable	variable	0.5
Max Sig figs				3	3	3	3	3	3	3	3	3	3	2	2	2	2	3
Max decimals				0	1	1	1	1	4	4	2	2	2	1	1	1	1	1
Reporting Units				µS/cm	mg/L	s.u.	°C	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L	pCi/L	mg/L
Sample Date	Sample Time	Sample Type	Location ID	Conductivity, Specific	Oxygen, Dissolved	pH	Temp	Turbidity	Phosphorus, Dissolved (DRP)	Phosphorus, Total	Nitrogen, Ammonia (Salicylate)	Nitrogen, Nitrate+Nitrite	Nitrogen, Total Nitrogen	Gross Alpha	Gross Alpha, Uncertainty	Gross Beta	Gross Beta, Uncertainty	Carbon, Total Organic
10/07/15	10:00	G	Trib 22d	82	8.8	7.9	12.9	4.9	0.006	0.017	< 0.01	0.04	0.24					3.1
10/07/15	8:20	G	Trib 24	305	1.3	7.4	17.2	5.2	0.0055	0.0178	0.04	0.1	0.34					2.1
NS	NS	G	Trib 25															
NS	NS	G	Trib 27 (New Church Ditch Inlet)															
11/04/15	9:10	G	Trib 01	356	11.1	7.6	6.1	3.4	0.0045	0.0106	0.01	0.31	Le					2.7
11/04/15	9:20	G	Trib 02	374	8	7.8	11.3	3.3	0.0031	0.0082	<0.01	0.3	Le					1.6
11/04/15	9:30	G	Trib 03	407	6.7	7.9	12	18.4	0.0037	0.0484	< 0.01	0.33	0.44					2
NS	NS	G	Trib 04															
11/04/15	10:05	G	Trib 11	391	8.9	7.9	11.3	2.8	< 0.0025	0.0114	< 0.01	0.26	0.29					1.9
NS	NS	G	Trib 22a															
NS	NS	G	Trib 22d															
11/04/15	8:25	G	Trib 24	298	6.9	7.9	15.1	2.4	< 0.0025	0.0129	< 0.01	0.04	0.14					2.5
NS	NS	G	Trib 25															
NS	NS	G	Trib 27 (New Church Ditch Inlet)															
12/02/15	9:15	G	Trib 01	491	11.8	7.4	2.6	1.6	0.0034	0.0052	0.01	0.48	Le	2.6	2.4	2.2	2.4	1.2
12/02/15	9:30	G	Trib 02	892	10.3	7.9	2.9	1.8	0.0041	0.0101	0.01	0.99	1.1	15	6	1.9	2.5	2.2
12/02/15	9:45	G	Trib 03	533	7.4	8.1	10.3	2.8	0.0073	0.0111	< 0.01	0.52	Le	2.4	2.7	3	2.2	1.4
12/02/15	10:25	G	Trib 04	561	9.2	7.9	4.3	39.6	0.0064	0.0514	< 0.01	0.5	0.6	4.3	3.6	2.4	2.4	1.8
NS	NS	G	Trib 11															
NS	NS	G	Trib 22a															
NS	NS	G	Trib 22d															
12/02/15	8:20	G	Trib 24	318	8.9	7.6	9.5	2.1	0.0032	0.0106	< 0.01	0.04	0.14	1	1.9	1	2.1	1.7
NS	NS	G	Trib 25															
NS	NS	G	Trib 27 (New Church Ditch Inlet)															

Tribs

Sample Date	Sample Time	Sample Type	Location ID	Solids, Total Suspended	E. coli,	Iron, Dissolved	Iron, Total	Manganese, Dissolved	Manganese, Total	Zinc, Dissolved	Zinc, Total	Hardness, Total	Chloride	Sulfate	Bromide	Arsenic, Dissolved	Arsenic, Total	Barium, Dissolved	Barium, Total
Method				SM2540D	SM9221D	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA130.2	SM4110A	SM4110A	SM4110A	EPA200.8	EPA200.8	EPA200.8	EPA200.8
Reporting Limit Goal				1	1	0.01	0.01	0.00025	0.00025	0.0025	0.0025	5	5	10	0.1	0.00015	0.00015	0.0001	0.0001
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals				0	0	3	3	5	5	4	4	0	0	0	1	5	5	5	5
Reporting Units				mg/L	cfu/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
NS	NS	G	Trib 01																
01/07/15	9:40	G	Trib 02	1	7	<0.01	0.109	0.179	0.2	0.153	0.193								
01/07/15	9:50	G	Trib 03	2	6	<0.01	0.141	0.148	0.183	0.147	0.187								
01/07/15	10:35	G	Trib 04	55	127	<0.01	0.42	0.0804	0.149	0.0693	0.151								
NS	NS	G	Trib 11																
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
01/07/15	8:45	G	Trib 24	1	2	<0.01	0.041	0.00581	0.0158	0.011	0.011								
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
02/04/15	9:50	G	Trib 01	4	<1	<0.01	0.39	0.19	0.238	0.151	0.209								
02/04/15	10:05	G	Trib 02	2	9	<0.01	0.409	0.124	0.221	0.0622	0.2								
02/04/15	10:20	G	Trib 03	5	19	<0.01	0.439	0.157	0.215	0.133	0.203								
02/04/15	11:15	G	Trib 04	17	31	<0.01	0.444	0.177	0.183	0.13	0.13								
NS	NS	G	Trib 11																
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
02/04/15	9:05	G	Trib 24	1	2	<0.01	0.045	0.00625	0.0254	0.0107	0.0137								
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
NS	NS	G	Trib 01																
03/04/15	9:20	G	Trib 02	<1	4	<0.1	0.13	0.18	0.18	0.17	0.17	186	85	109	0.1	<0.005	<0.005	0.06	0.06
03/04/15	9:35	G	Trib 03	<1	29	<0.1	0.25	0.17	0.18	0.17	0.18	184	64	103	<0.1	<0.005	<0.005	0.053	0.053
03/04/15	10:10	G	Trib 04	1S	30	<0.1	2.7	0.24	0.33	0.077	0.26	180	63	98	<0.1	<0.005	<0.005	0.08	0.08
03/04/15	NS	G	Trib 11																
03/04/15	NS	G	Trib 22a																
03/04/15	NS	G	Trib 22d																
03/04/15	8:30	G	Trib 24	<1	3	<0.1	<0.1	0.0035	0.021	0.016	0.016	114	28	56	<0.1	<0.00015	<0.00015	0.048	0.048
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
04/01/15	9:05	G	Trib 01	2	<1	<0.1	0.63	0.17	0.22	0.14	0.17								
04/01/15	9:15	G	Trib 02	3	5	<0.1	0.43	0.14	0.19	0.13	0.16								
04/01/15	9:30	G	Trib 03	<1	22	<0.1	0.39	0.14	0.19	0.1	0.13								
04/01/15	10:00	G	Trib 04	15	26	<0.1	1.4	0.096	0.22	0.06	0.14								
NS	NS	G	Trib 11																
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
04/01/15	8:20	G	Trib 24	3	18	<0.1	0.1	<0.002	0.095	0.017	0.017								
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
05/06/15	9:20	G	Trib 01	52	10	0.27	3.6	0.29	0.59	0.16	0.38								
05/06/15	9:40	G	Trib 02	37	131	0.22	3.4	0.22	0.46	0.1	0.29								
05/06/15	9:55	G	Trib 03	53	27	0.27	3.6	0.25	0.6	0.13	0.37								
NS	NS	G	Trib 04																
05/06/15	10:30	G	Trib 11	53	641	0.21	4.3	0.0051	0.27	0.074	0.22								
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
05/06/15	8:35	G	Trib 24	6	1	0.0053	0.22	0.0019	0.053	0.0082	0.013								

Tribs

Method				SM2540D	SM9221D	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA130.2	SM4110A	SM4110A	SM4110A	EPA200.8	EPA200.8	EPA200.8	EPA200.8
Reporting Limit Goal				1	1	0.01	0.01	0.00025	0.00025	0.0025	0.0025	5	5	10	0.1	0.00015	0.00015	0.0001	0.0001
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals				0	0	3	3	5	5	4	4	0	0	0	1	5	5	5	5
Reporting Units				mg/L	cfu/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Date	Sample Time	Sample Type	Location ID	Solids, Total Suspended	E. coli,	Iron, Dissolved	Iron, Total	Manganese, Dissolved	Manganese, Total	Zinc, Dissolved	Zinc, Total	Hardness, Total	Chloride	Sulfate	Bromide	Arsenic, Dissolved	Arsenic, Total	Barium, Dissolved	Barium, Total
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
06/03/15	9:10	G	Trib 01	45	23	0.19	2	0.15	0.67	0.16	0.4	68	22	37		0.00015	0.0012	0.024	0.049
06/03/15	9:30	G	Trib 02	55	31	0.18	2.8	0.14	0.69	0.13	0.39	76	13	28		0.00016	0.0012	0.026	0.053
06/03/15	9:40	G	Trib 03	51	25	0.18	3.2	0.14	0.73	0.2	0.42	76	13	28		0.00016	0.0012	0.024	0.049
NS	10:10	G	Trib 04																
06/03/15	10:10	G	Trib 11	23	214	0.67	1.1	0.033	0.19	0.072	0.17	96	17	33		0.00024	0.00064	0.029	0.041
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
06/03/15	8:30	G	Trib 24	NT	<1	0.0062	0.18	0.00091	0.07	0.01	0.014	NT	26	55		0.0002	0.00038	0.048	0.054
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
07/01/15	9:05	G	Trib 01	8	11	0.091	0.35	0.058	0.11	0.088	0.11								
07/01/15	9:20	G	Trib 02	<1	16	0.094	0.39	0.063	0.11	0.083	0.1								
07/01/15	9:35	G	Trib 03	8	43	0.094	0.39	0.056	0.11	0.08	0.1								
NS	NS	G	Trib 04																
07/01/15	10:05	G	Trib 11	99	1203	0.09	3.7	0.0028	0.45	0.045	0.29								
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
07/01/15	8:20	G	Trib 24	5	1	0.0035	0.11	0.00025	0.098	0.0059	0.017								
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
08/05/15	9:25	G	Trib 01	2	8	0.043	0.34	0.17	0.18	0.18	0.15								
08/05/15	9:40	G	Trib 02	<1	24	0.042	0.25	0.16	0.18	0.15	0.17								
08/05/15	9:50	G	Trib 03	2	20	0.042	0.24	0.12	0.15	0.13	0.14								
NS	NS	G	Trib 04																
08/05/15	10:40	G	Trib 11	12	185	0.043	0.71	0.014	0.076	0.077	0.08								
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
08/05/15	8:40	G	Trib 24	3	9	0.0028	0.28	0.00051	0.14	0.059	0.016								
NS	NS	G	Trib 25																
08/05/15	10:20	G	Trib 27 (New Church Ditch Inlet)	9	517	0.053	0.5	0.0019	0.035	0.058	0.04								
09/02/15	9:10	G	Trib 01	2	33	0.029	0.21	0.0098	0.015	0.082	0.12	112	15	54	< 0.1	ND	0.00015	0.035	0.038
09/02/15	9:30	G	Trib 02	1	23	0.024	0.19	0.088	0.082	0.077	0.073	116	21	58	< 0.1	0.00024	0.00011	0.044	0.043
09/02/15	9:30	G	Trib 03	1	59	0.018	0.17	0.051	0.097	0.05	0.078	120	20	57	< 0.1	0.00022	0.00028	0.041	0.038
NS	NS	G	Trib 04																
09/02/15	10:35	G	Trib 11	4	210	0.021	0.24	0.0014	0.022	0.016	0.025	120	20	59	< 0.1	0.00015	0.00043	0.042	0.04
NS	NS	G	Trib 22a																
09/02/15	10:20	G	Trib 22d	2	185	0.092	0.26	0.0017	0.02	0.004	0.0033	44	5	10	< 0.1	ND	0.00016	0.017	0.019
09/02/15	8:20	G	Trib 24	8	5	0.014	0.25	0.004	0.15	0.0071	0.013	120	26	51	< 0.1	0.00019	0.000091	0.046	0.05
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
10/07/15	9:00	G	Trib 01	117	148	0.092	3.8	0.25	0.59	0.052	0.21								
10/07/15	9:15	G	Trib 02	142	158	0.061	4.2	0.28	0.66	0.053	0.24								
10/07/15	9:25	G	Trib 03	24	649	0.032	1	0.039	0.24	0.042	0.12								
NS	NS	G	Trib 04																
10/07/15	10:10	G	Trib 11	46	1414	0.018	0.21	0.00092	0.033	0.04	0.066								
NS	NS	G	Trib 22a																

Tribs

Method				SM2540D	SM9221D	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA130.2	SM4110A	SM4110A	SM4110A	EPA200.8	EPA200.8	EPA200.8	EPA200.8
Reporting Limit Goal				1	1	0.01	0.01	0.00025	0.00025	0.0025	0.0025	5	5	10	0.1	0.00015	0.00015	0.0001	0.0001
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals				0	0	3	3	5	5	4	4	0	0	0	1	5	5	5	5
Reporting Units				mg/L	cfu/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Date	Sample Time	Sample Type	Location ID	Solids, Total Suspended	E. coli,	Iron, Dissolved	Iron, Total	Manganese, Dissolved	Manganese, Total	Zinc, Dissolved	Zinc, Total	Hardness, Total	Chloride	Sulfate	Bromide	Arsenic, Dissolved	Arsenic, Total	Barium, Dissolved	Barium, Total
10/07/15	10:00	G	Trib 22d	9	30	0.07	0.23	0.0013	0.02	0.0017	0.003								
10/07/15	8:20	G	Trib 24	11	206	0.02	0.23	0.005	0.21	0.0025	0.011								
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
11/04/15	9:10	G	Trib 01	5	1	0.047	0.46	0.28	0.3	0.18	0.2								
11/04/15	9:20	G	Trib 02	4	1	0.049	0.45	0.28	0.3	0.17	0.2								
11/04/15	9:30	G	Trib 03	2	20	0.042	3.4	0.18	0.67	0.08	0.39								
NS	NS	G	Trib 04																
11/04/15	10:05	G	Trib 11	4	58	0.026	0.29	0.049	0.072	0.081	0.081								
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
11/04/15	8:25	G	Trib 24	5	37	0.0055	0.15	0.00031	0.062	0.042	LE								
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
12/02/15	9:15	G	Trib 01	1	<1	0.01	0.14	<0.000056	0.36	<0.0012	0.27	NT				0.00039	0.00008	0.0016	0.05
12/02/15	9:30	G	Trib 02	4	12	0.0038	0.071	0.041	0.064	0.044	0.044	NT				0.00027	0.001	0.098	0.11
12/02/15	9:45	G	Trib 03	4	31	0.02	0.18	0.18	0.24	0.13	0.17	NT				0.0001	0.00046	0.051	0.056
12/02/15	10:25	G	Trib 04	69	96	0.0092	2.9	0.023	0.4	0.034	0.24	NT				0.001	0.0037	0.059	0.08
NS	NS	G	Trib 11																
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
12/02/15	8:20	G	Trib 24	2	14	0.0089	0.096	0.00047	0.022	0.028 S	0.012	NT				0.00034	0.001	0.043	0.047
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																

Tribs

Method				EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8
Reporting Limit Goal				0.001	0.001	0.00010	0.00010	0.00050	0.00050	0.00025	0.00025	0.00020	0.00020	0.00050	0.00050	0.005	0.005	0.00050	0.00050
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals				5	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5
Reporting Units				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Date	Sample Time	Sample Type	Location ID	Beryllium, Dissolved	Beryllium, Total	Cadmium, Dissolved	Cadmium, Total	Chromium, Dissolved	Chromium, Total	Copper, Dissolved	Copper, Total	Lead, Dissolved	Lead, Total	Molybdenum, Dissolved	Molybdenum, Total	Nickel, Dissolved	Nickel, Total	Selenium, Dissolved	Selenium, Total
NS	NS	G	Trib 01																
01/07/15	9:40	G	Trib 02																
01/07/15	9:50	G	Trib 03																
01/07/15	10:35	G	Trib 04																
NS	NS	G	Trib 11																
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
01/07/15	8:45	G	Trib 24																
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
02/04/15	9:50	G	Trib 01																
02/04/15	10:05	G	Trib 02																
02/04/15	10:20	G	Trib 03																
02/04/15	11:15	G	Trib 04																
NS	NS	G	Trib 11																
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
02/04/15	9:05	G	Trib 24																
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
NS	NS	G	Trib 01																
03/04/15	9:20	G	Trib 02			<0.001	<0.001	<0.003	<0.003	0.0036	0.0036	<0.001	<0.001	0.0025	0.0025			<0.005	<0.005
03/04/15	9:35	G	Trib 03			<0.001	<0.001	<0.003	<0.003	0.0033	0.0055	<0.001	0.0013	0.0021	0.0023			<0.005	<0.005
03/04/15	10:10	G	Trib 04			<0.001	0.0012	<0.003	<0.003	0.0026	0.035	<0.001	0.034	0.0025	0.0027			<0.005	<0.005
03/04/15	NS	G	Trib 11																
03/04/15	NS	G	Trib 22a																
03/04/15	NS	G	Trib 22d																
03/04/15	8:30	G	Trib 24			<0.001	<0.001	<0.003	<0.003	0.0027	0.0027	<0.001	<0.001	0.0027	0.0027			<0.005	<0.005
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
04/01/15	9:05	G	Trib 01																
04/01/15	9:15	G	Trib 02																
04/01/15	9:30	G	Trib 03																
04/01/15	10:00	G	Trib 04																
NS	NS	G	Trib 11																
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
04/01/15	8:20	G	Trib 24																
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
05/06/15	9:20	G	Trib 01																
05/06/15	9:40	G	Trib 02																
05/06/15	9:55	G	Trib 03																
NS	NS	G	Trib 04																
05/06/15	10:30	G	Trib 11																
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
05/06/15	8:35	G	Trib 24																

Tribs

Method				EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8
Reporting Limit Goal				0.001	0.001	0.00010	0.00010	0.00050	0.00050	0.00025	0.00025	0.00020	0.00020	0.00050	0.00050	0.005	0.005	0.00050	0.00050
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals				5	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5
Reporting Units				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Date	Sample Time	Sample Type	Location ID	Beryllium, Dissolved	Beryllium, Total	Cadmium, Dissolved	Cadmium, Total	Chromium, Dissolved	Chromium, Total	Copper, Dissolved	Copper, Total	Lead, Dissolved	Lead, Total	Molybdenum, Dissolved	Molybdenum, Total	Nickel, Dissolved	Nickel, Total	Selenium, Dissolved	Selenium, Total
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
06/03/15	9:10	G	Trib 01	<0.000054	0.00018	0.0007	0.0018	0.00014	0.0023	0.012	0.045	0.00088	0.018	0.0019	0.0035	0.0022	0.0044	0.00028	<0.000153
06/03/15	9:30	G	Trib 02	<0.000054	0.00016	0.00061	0.0016	0.00013	0.0025	0.012	0.045	0.00089	0.018	0.0019	0.0035	0.002	0.0046	0.00041	<0.000153
06/03/15	9:40	G	Trib 03	<0.000054	0.00013	0.00084	0.0016	0.00012	0.0017	0.012	0.046	0.00078	0.017	0.0017	0.003	0.0022	0.0047	0.00032	0.00074
NS	10:10	G	Trib 04																
06/03/15	10:10	G	Trib 11	<0.000054	0.0001	0.00034	0.00059	0.00015	0.0011	0.0095	0.024	0.00067	0.0059	0.0022	0.0026	0.0018	0.0022	0.00034	<0.000153
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
06/03/15	8:30	G	Trib 24	<0.000054	<0.000054	0.000018	<0.000012	<0.000012	0.0002	0.004	0.0067	0.00075	0.00091	0.0025	0.0028	0.0017	0.00098	0.00038	<0.000153
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
07/01/15	9:05	G	Trib 01																
07/01/15	9:20	G	Trib 02																
07/01/15	9:35	G	Trib 03																
NS	NS	G	Trib 04																
07/01/15	10:05	G	Trib 11																
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
07/01/15	8:20	G	Trib 24																
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
08/05/15	9:25	G	Trib 01																
08/05/15	9:40	G	Trib 02																
08/05/15	9:50	G	Trib 03																
NS	NS	G	Trib 04																
08/05/15	10:40	G	Trib 11																
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
08/05/15	8:40	G	Trib 24																
NS	NS	G	Trib 25																
08/05/15	10:20	G	Trib 27 (New Church Ditch Inlet)																
09/02/15	9:10	G	Trib 01	<0.000054	<0.000054	0.00041	0.00048	<0.000012	<0.000012	0.0038	0.0076	0.00013	0.0011	0.0022	0.0021	0.0012	0.0017	<0.000153	<0.000153
09/02/15	9:30	G	Trib 02	<0.000054	<0.000054	0.00037	0.0004	<0.000012	<0.000012	0.0044	0.0038	0.00023	0.0001	0.0025	0.0024	0.0014	0.0015	0.00069	0.00017
09/02/15	9:30	G	Trib 03	<0.000054	<0.000054	0.00031	0.00041	<0.000012	<0.000012	0.0039	0.0067	0.00013	0.00089	0.0025	0.0025	0.0011	0.0018	<0.000153	0.00024
NS	NS	G	Trib 04																
09/02/15	10:35	G	Trib 11	<0.000054	<0.000054	0.000075	0.00012	<0.000012	0.0002	0.0026	0.0041	0.0001	0.00053	0.0025	0.0024	0.00049	0.00053	<0.000153	<0.000153
NS	NS	G	Trib 22a																
09/02/15	10:20	G	Trib 22d	<0.000054	<0.000054	<0.000012	<0.000012	<0.000012	0.0003	0.00097	0.0018	0.00008	0.000048	0.00092	0.001	0.00041	0.00053	<0.000153	<0.000153
09/02/15	8:20	G	Trib 24	<0.000054	<0.000054	<0.000012	<0.000012	<0.000012	0.00018	0.0024	0.0042	<0.000038	0.00038	0.0024	0.0027	0.00065	0.00092	0.00024	<0.000153
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
10/07/15	9:00	G	Trib 01																
10/07/15	9:15	G	Trib 02																
10/07/15	9:25	G	Trib 03																
NS	NS	G	Trib 04																
10/07/15	10:10	G	Trib 11																
NS	NS	G	Trib 22a																

Tribs

Method				EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8
Reporting Limit Goal				0.001	0.001	0.00010	0.00010	0.00050	0.00050	0.00025	0.00025	0.00020	0.00020	0.00050	0.00050	0.005	0.005	0.00050	0.00050
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals				5	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5
Reporting Units				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Date	Sample Time	Sample Type	Location ID	Beryllium, Dissolved	Beryllium, Total	Cadmium, Dissolved	Cadmium, Total	Chromium, Dissolved	Chromium, Total	Copper, Dissolved	Copper, Total	Lead, Dissolved	Lead, Total	Molybdenum, Dissolved	Molybdenum, Total	Nickel, Dissolved	Nickel, Total	Selenium, Dissolved	Selenium, Total
10/07/15	10:00	G	Trib 22d																
10/07/15	8:20	G	Trib 24																
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
11/04/15	9:10	G	Trib 01																
11/04/15	9:20	G	Trib 02																
11/04/15	9:30	G	Trib 03																
NS	NS	G	Trib 04																
11/04/15	10:05	G	Trib 11																
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
11/04/15	8:25	G	Trib 24																
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																
12/02/15	9:15	G	Trib 01	<0.000054	<0.000054	<0.000012	0.00084	0.00092	<0.000012	<0.0002	0.0036	<0.000038	0.00042	0.00029	0.002	<0.00032	0.0036	0.00018	0.0003
12/02/15	9:30	G	Trib 02	<0.000054	<0.000054	0.00011	0.00018	<0.000012	<0.000012	0.0015	0.00064	0.00005	0.00038	0.003	0.0029	0.0014	0.0025	0.0014	0.0012
12/02/15	9:45	G	Trib 03	<0.000054	<0.000054	0.00052	0.00065	<0.000012	<0.000012	0.0034	0.0055	0.00024	0.0012	0.0021	0.0019	0.0025	0.0036	0.00033	0.00044
12/02/15	10:25	G	Trib 04	<0.000054	<0.000054	0.00008	0.0011	<0.000012	0.0025	0.0017	0.031	0.00028	0.03	0.0029	0.0027	0.0019	0.0055	0.00046	0.0006
NS	NS	G	Trib 11																
NS	NS	G	Trib 22a																
NS	NS	G	Trib 22d																
12/02/15	8:20	G	Trib 24	<0.000054	<0.000054	<0.000012	<0.000012	<0.000012	0.00013	0.0042	0.0099	0.00018	0.00081	0.0026	0.0028	0.00065	0.0013	0.00031	0.00034
NS	NS	G	Trib 25																
NS	NS	G	Trib 27 (New Church Ditch Inlet)																

Tribs

Method				EPA200.8	EPA200.8	EPA200.7	EPA200.7	EPA200.8	EPA200.8				
Reporting Limit Goal				0.0005	0.0005	0.0020	0.0020	0.0000	0.0000				
Max Sig figs				3	3	3	3	3	3				
Max decimals				5	5	5	5	5	5				
Reporting Units				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L				
Sample Date	Sample Time	Sample Type	Location ID	Silver, Dissolved	Silver, Total	Strontium Dissolved ICAP	Strontium Total	Vanadium Dissolved ICAP/MS	Vanadium Total ICAP/MS	Notes	Conclusion	Field Notes	Lab Notes
NS	NS	G	Trib 01							Not sampled			
01/07/15	9:40	G	Trib 02										
01/07/15	9:50	G	Trib 03										
01/07/15	10:35	G	Trib 04										
NS	NS	G	Trib 11							Not sampled			
NS	NS	G	Trib 22a							Not sampled			
NS	NS	G	Trib 22d							Not sampled			
01/07/15	8:45	G	Trib 24										
NS	NS	G	Trib 25							Not sampled			
NS	NS	G	Trib 27 (New Church Ditch Inlet)							Not sampled			
02/04/15	9:50	G	Trib 01										
02/04/15	10:05	G	Trib 02										
02/04/15	10:20	G	Trib 03										
02/04/15	11:15	G	Trib 04										
NS	NS	G	Trib 11							Not sampled			
NS	NS	G	Trib 22a							Not sampled			
NS	NS	G	Trib 22d							Not sampled			
02/04/15	9:05	G	Trib 24										
NS	NS	G	Trib 25							Not sampled			
NS	NS	G	Trib 27 (New Church Ditch Inlet)							Not sampled			
NS	NS	G	Trib 01							Not sampled			
03/04/15	9:20	G	Trib 02										
03/04/15	9:35	G	Trib 03										
03/04/15	10:10	G	Trib 04										
03/04/15	NS	G	Trib 11							Not sampled			
03/04/15	NS	G	Trib 22a							Not sampled			
03/04/15	NS	G	Trib 22d							Not sampled			
03/04/15	8:30	G	Trib 24										
NS	NS	G	Trib 25							Not sampled			
NS	NS	G	Trib 27 (New Church Ditch Inlet)							Not sampled			
04/01/15	9:05	G	Trib 01										
04/01/15	9:15	G	Trib 02										
04/01/15	9:30	G	Trib 03										
04/01/15	10:00	G	Trib 04										
NS	NS	G	Trib 11							Not sampled			
NS	NS	G	Trib 22a							Not sampled			
NS	NS	G	Trib 22d							Not sampled			
04/01/15	8:20	G	Trib 24										
NS	NS	G	Trib 25							Not sampled			
NS	NS	G	Trib 27 (New Church Ditch Inlet)							Not sampled			
05/06/15	9:20	G	Trib 01										
05/06/15	9:40	G	Trib 02										
05/06/15	9:55	G	Trib 03										
NS	NS	G	Trib 04							Not sampled			
05/06/15	10:30	G	Trib 11										
NS	NS	G	Trib 22a							Not sampled			
NS	NS	G	Trib 22d							Not sampled			
05/06/15	8:35	G	Trib 24										

Tribs

Method				EPA200.8	EPA200.8	EPA200.7	EPA200.7	EPA200.8	EPA200.8				
Reporting Limit Goal				0.0005	0.0005	0.0020	0.0020	0.0000	0.0000				
Max Sig figs				3	3	3	3	3	3				
Max decimals				5	5	5	5	5	5				
Reporting Units				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L				
Sample Date	Sample Time	Sample Type	Location ID	Silver, Dissolved	Silver, Total	Strontium Dissolved ICAP	Strontium Total	Vanadium Dissolved ICAP/MS	Vanadium Total ICAP/MS	Notes	Conclusion	Field Notes	Lab Notes
NS	NS	G	Trib 25							Not sampled			
NS	NS	G	Trib 27 (New Church Ditch Inlet)							Not sampled			
06/03/15	9:10	G	Trib 01	<0.000014	0.00024	0.089	0.096	0.0002	0.003				
06/03/15	9:30	G	Trib 02	<0.000014	0.00024	0.099	0.1	0.00023	0.0031				
06/03/15	9:40	G	Trib 03	<0.000014	0.00019	0.096	0.1	0.00019	0.0025				
NS	10:10	G	Trib 04							Not sampled			
06/03/15	10:10	G	Trib 11	<0.000014	<0.000014	0.13	0.14	0.00032	0.0019				
NS	NS	G	Trib 22a							Not sampled			
NS	NS	G	Trib 22d							Not sampled			
06/03/15	8:30	G	Trib 24	<0.000014	0.000036	0.2	0.2	0.0002	0.00058				
NS	NS	G	Trib 25							Not sampled			
NS	NS	G	Trib 27 (New Church Ditch Inlet)							Not sampled			
07/01/15	9:05	G	Trib 01										
07/01/15	9:20	G	Trib 02										
07/01/15	9:35	G	Trib 03										
NS	NS	G	Trib 04							Not sampled			
07/01/15	10:05	G	Trib 11										
NS	NS	G	Trib 22a							Not sampled			
NS	NS	G	Trib 22d							Not sampled			
07/01/15	8:20	G	Trib 24										
NS	NS	G	Trib 25							Not sampled			
NS	NS	G	Trib 27 (New Church Ditch Inlet)							Not sampled			
08/05/15	9:25	G	Trib 01										
08/05/15	9:40	G	Trib 02										
08/05/15	9:50	G	Trib 03										
NS	NS	G	Trib 04							Not sampled			
08/05/15	10:40	G	Trib 11										
NS	NS	G	Trib 22a							Not sampled			
NS	NS	G	Trib 22d							Not sampled			
08/05/15	8:40	G	Trib 24										
NS	NS	G	Trib 25							Not sampled			
08/05/15	10:20	G	Trib 27 (New Church Ditch Inlet)										
09/02/15	9:10	G	Trib 01	<0.000014	<0.000014	0.16	0.16	0.000079	0.00015				
09/02/15	9:30	G	Trib 02	0.000023	<0.000014	0.2	0.2	0.00013	0.000097		d-Al =36 ppb		
09/02/15	9:30	G	Trib 03	<0.000014	0.000043	0.19	0.19	0.00017	0.00029				
NS	NS	G	Trib 04							Not sampled			
09/02/15	10:35	G	Trib 11	0.000019	0.00021	0.19	0.2	0.0002	0.00034				
NS	NS	G	Trib 22a							Not sampled			
09/02/15	10:20	G	Trib 22d	<0.000014	0.00012	0.055	0.058	0.00029	0.0005				
09/02/15	8:20	G	Trib 24	<0.000014	0.000085	0.21	0.22	0.00016	0.0005				
NS	NS	G	Trib 25							Not sampled			
NS	NS	G	Trib 27 (New Church Ditch Inlet)							Not sampled; no flow			
10/07/15	9:00	G	Trib 01										
10/07/15	9:15	G	Trib 02										
10/07/15	9:25	G	Trib 03										
NS	NS	G	Trib 04							Not sampled			
10/07/15	10:10	G	Trib 11										
NS	NS	G	Trib 22a							Not sampled			

Tribs

Method				EPA200.8	EPA200.8	EPA200.7	EPA200.7	EPA200.8	EPA200.8				
Reporting Limit Goal				0.0005	0.0005	0.0020	0.0020	0.0000	0.0000				
Max Sig figs				3	3	3	3	3	3				
Max decimals				5	5	5	5	5	5				
Reporting Units				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L				
Sample Date	Sample Time	Sample Type	Location ID	Silver, Dissolved	Silver, Total	Strontium Dissolved ICAP	Strontium Total	Vanadium Dissolved ICAP/MS	Vanadium Total ICAP/MS	Notes	Conclusion	Field Notes	Lab Notes
10/07/15	10:00	G	Trib 22d										
10/07/15	8:20	G	Trib 24										
NS	NS	G	Trib 25							Not sampled			
NS	NS	G	Trib 27 (New Church Ditch Inlet)							Not sampled			
11/04/15	9:10	G	Trib 01										
11/04/15	9:20	G	Trib 02										
11/04/15	9:30	G	Trib 03										
NS	NS	G	Trib 04							Not sampled			
11/04/15	10:05	G	Trib 11										
NS	NS	G	Trib 22a							Not sampled			
NS	NS	G	Trib 22d							Not sampled			
11/04/15	8:25	G	Trib 24										
NS	NS	G	Trib 25							Not sampled			
NS	NS	G	Trib 27 (New Church Ditch Inlet)							Not sampled			
12/02/15	9:15	G	Trib 01	<0.000014	0.000039	0.25	0.26	0.0055	0.00013				
12/02/15	9:30	G	Trib 02	0.000069	0.000018	0.54	0.56	0.00083	0.0012				
12/02/15	9:45	G	Trib 03	0.000089	0.000026	0.29	0.28	0.00019	0.00045				
12/02/15	10:25	G	Trib 04	<0.000014	0.00037	0.34	0.35	0.00058	0.0044				
NS	NS	G	Trib 11										
NS	NS	G	Trib 22a							Not sampled			
NS	NS	G	Trib 22d							Not sampled			
12/02/15	8:20	G	Trib 24	<0.000014	<0.000014	0.2	0.2	0.00035	0.00032	Not sampled			
NS	NS	G	Trib 25										
NS	NS	G	Trib 27 (New Church Ditch Inlet)							Not sampled			

Ambient Autosamplers (with TH metals)

Method				SM2550B	SM4500H+B	SM2510B	SM2130B	SM4500NH3H	SM4500NO3I	SM4500NO3I	SM4500PE	SM4500PE	SM5310B	SM2540D	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8
Reporting Limit Goal				1.0	1.0	10	1.0	0.01	0.01	0.02	0.0025	0.0025	0.5	1	0.00015	0.00015	0.00010	0.00010	0.00005	0.00005	0.00010	0.00010	0.00050	0.00050	0.00025	0.00025
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals				1	1	0	1	2	2	2	4	4	1	0	5	5	5	5	5	5	5	5	5	5	5	5
Reporting Units				°C	s.u.	μS/cm	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Date	Sample Time	Sample Type	Location ID	Temp	pH	Conductivity, Specific	Turbidity	Nitrogen, Ammonia (Salicylate)	Nitrogen, Nitrate+Nitrite	Nitrogen, Total Nitrogen	Phosphorus, Dissolved (DRP)	Phosphorus, Total	Carbon, Total Organic	Solids, Total Suspended	Arsenic, Dissolved	Arsenic, Total	Barium, Dissolved	Barium, Total	Beryllium dissolved	Beryllium Total	Cadmium, Dissolved	Cadmium, Total	Chromium, Dissolved	Chromium, Total	Copper, Dissolved	Copper, Total
NS	NS	24C	CC AS 26																							
04/29/15	1:02	24C	CC AS 49	14.9	7.8	350	7.9	0.01	0.24	0.39	0.0032	0.0248	2.3	5							0.0018	0.0021			0.012	0.039
04/29/15	1:02	24C	CC AS 50	14.2	7.8	445	31.2	0.02	0.4	0.6	0.0035	0.0473	3.5	15							0.0029	0.0044			0.013	0.14
04/29/15	11:41	24C	CC AS 59	16.3	7.8	386	13.4	< 0.01	0.3	0.48	0.0037	0.0258	3.1	5							0.0014	0.0019			0.01	0.049
04/29/15	15:06	24C	CC AS T2	17.4	7.9	396	11.6	0.01	0.28	0.44	0.0035	0.021	2.4	6							0.0009	0.0011			0.0069	0.024
04/30/15	0:56	24C	CC AS T11	16.8	8.2	418	11.8	0.01	0.24	0.45	0.0037	0.0229	2.8	3							0.00027	0.00083			0.0056	0.02
06/01/15	8:00	24C	CC AS 26	21.5	8.1	274	23.8	< 0.01	0.13	0.28	0.005	0.0137	3.1	12							0.00033	0.00069			0.0035	0.0079
06/01/15	13:15	24C	CC AS 49	18.4	7.4	181	19.9	< 0.01	0.14	0.34	0.0035	0.0345	3.7	41							0.00091	0.0019			0.012	0.045
06/01/15	13:15	24C	CC AS 50	16.3	7.4	187	17.8	< 0.01	0.17	0.34	0.005	0.0251	4.2	27							0.0025	0.0039			0.046	0.12
06/01/15	19:30	24C	CC AS 59	22.7	7.9	197	29.1	< 0.01	0.18	0.41	0.0052	0.0476	4.6	52							0.0011	0.0022			0.014	0.061
06/01/15	21:30	24C	CC AS T2	25.2	8.1	237	19.9	< 0.01	0.27	0.51	0.0035	0.0529	4.2	60	0.00022	0.0015	0.033	0.081	<0.000054	0.00017	0.00072	0.0022	0.00015	0.0034	0.012	0.062
06/02/15	10:00	24C	CC AS T11	21.5	8.1	274	23.8	0.02	0.25	0.56	0.0069	0.0411	4.3	34		0.0011		0.053		0.0001	Le	0.00098		0.0015	Le	0.03
06/15/15	10:00	24C	CC AS 26	12.7	7.9	85	8.1	< 0.01	0.12	0.24	0.0076	0.0131	2.9	14							NT	NT			NT	NT
06/15/15	12:30	24C	CC AS 49	13.1	7.7	88	15.2	< 0.01	0.12	0.25	0.0032	0.0171	3.4	30							NT	NT			NT	NT
06/15/15	12:30	24C	CC AS 50	15.4	7.6	167	14.5	< 0.01	0.15	0.33	0.0043	0.0236	4.1	29							NT	NT			NT	NT
06/15/15	15:30	24C	CC AS 59	17	7.6	101	44.2	< 0.01	0.13	0.41	0.004	0.138	4.4	235							NT	NT			NT	NT
06/15/15	16:30	24C	CC AS T2	22.6	8	225	18.2	0.04	0.04	0.25	< 0.0025	0.0328	3.4	42							NT	NT			NT	NT
06/16/15	7:15	24C	CC AS T11	21.4	8.25	430	12	0.07	0.26	0.42	0.0202	0.0448	5	16							NT	NT			NT	NT
07/13/15	8:00	24C	CC AS 26	16.7	7.3	122	2.7	0.01	0.12	0.18	< 0.0025	0.0078	1.9	2							0.00011	0.00013			0.0018	0.0018
07/13/15	11:30	24C	CC AS 49	18.3	7.7	127	3.7	< 0.01	0.13	0.19	< 0.0025	0.0095	1.9	<1							0.00048	0.00053			0.0054	0.0086
07/13/15	11:30	24C	CC AS 50	19.4	7.4	288	11.8	< 0.01	0.47	0.53	< 0.0025	0.017	3.3	14							0.0022	0.0032			0.016	0.12
07/14/15	12:50	G	CC AS 59	14.4	7.1	144	4.6	< 0.01	0.14	0.19	< 0.0025	0.0045	2.1	3							0.00049	0.00067			0.0086	0.017
07/13/15	16:50	24C	CC AS T2	25.6	7.6	177	1.8	< 0.01	0.23	0.29	< 0.0025	0.0077	2	<1							0.00013	0.00022			0.0076	0.012
07/14/15	1:45	24C	CC AS T11	23.3	7.3	179	24.6	< 0.01	0.19	0.34	0.0044	0.0413	2.1	62							0.00015	0.001			0.0042	0.029
NS	NS	24C	CC AS 26																							
08/10/15	11:45	24C	CC AS 49	18.3	7.8	190	1.9	< 0.01	0.12	0.21	< 0.0025	0.0078	1.6	<1							NT	NT			NT	NT
08/10/15	11:45	24C	CC AS 50	18.2	7.6	502	41.7	0.01	1.18	1.34	< 0.0025	0.0182	2.7	20							NT	NT			NT	NT
08/11/15	12:00	G	CC AS 59	15.9	7.5	219	2.1	0.04	0.2	0.33	< 0.0025	0.0071	1.5	<1							NT	NT			NT	NT
08/10/15	22:00	24C	CC AS T2	25.3	8	238	2.5	< 0.01	0.19	0.29	< 0.0025	0.0065	1.6	1							NT	NT			NT	NT
08/11/15	6:15	24C	CC AS T11	23.2	8	252	21.9	< 0.01	0.19	0.36	0.0025	0.0382	1.6	41							NT	NT			NT	NT
09/21/15	13:50	G	CC AS 26	12.2	7.1	271	0.9	< 0.01	0.16	0.25	< 0.0025	0.0051	1.5	1							NT	NT			NT	NT
09/21/15	11:45	24C	CC AS 49	20.1	7.4	258	1.8	0.01	0.18	0.32	< 0.0025	0.0129	1.2	1							NT	NT			NT	NT
09/21/15	11:45	24C	CC AS 50	20.7	7.5	769	752	0.01	1.88	2.45	< 0.0025	0.042	3.7	49							NT	NT			NT	NT
09/22/15	13:30	G	CC AS 59	13.3	7.1	293	1.3	< 0.01	0.22	0.35	< 0.0025	0.0076	1.4	<1							NT	NT			NT	NT
09/22/15	2:40	24C	CC AS T2	24.8	8	306	3.5	< 0.01	0.24	0.43	< 0.0025	0.0147	1.5	7							NT	NT			NT	NT
09/22/15	14:30	24C	CC AS T11	21.9	7.8	317	3.1	< 0.01	0.22	0.43	< 0.0025	0.0186	1.6	9							NT	NT			NT	NT
10/21/15	0:00	24C	CC AS 26	7.3	7.7	276	1.5	0.01	0.13	0.28	< 0.0025	0.0058	1.2	2							0.00015	0.00018			0.0012	0.0022
10/21/15	11:00	24C	CC AS 49	8.1	7.6	260	8.7	< 0.01	0.15	0.33	< 0.0025	0.0164	1.6	8							0.00071	0.00098			0.0055	0.016
10/21/15	11:00	24C	CC AS 50	8.2	7.5	689	161	0.05	1.05	1.42	< 0.0025	0.0528	3.9	77							0.0022	0.0053			0.0091	0.28
10/22/15	12:15	G	CC AS 59	7.3	7.7	318	7.6	< 0.01	0.28	0.43	0.0035	0.0142	2.1	11							0.00065	0.00095			0.0048	0.013
10/22/15	4:00	24C	CC AS T2	10.7	7.8	315	33.2	< 0.01	0.27	0.55	0.003	0.0408	2.1	32							0.00051	0.0011			0.008	0.051
10/22/15	14:30	24C	CC AS T11	9.7	7.8	329	32.1	< 0.01	0.27	0.58	0.0033	0.0551	2.5	68							0.00098	0.0014			0.0061	0.034

Ambient Autosamplers (with TH metals)

Sample Date	Sample Time	Sample Type	Location ID	Iron, Dissolved	Iron, Total	Lead, Dissolved	Lead, Total	Manganese, Dissolved	Manganese, Total	Molybdenum, Dissolved	Molybdenum, Total	Nickel dissolved	Nickel Total	Selenium, Dissolved	Selenium, Total	Silver dissolved	Silver Total	Strontium Dissolved ICAP	Strontium ICAP	Vanadium Dissolved	Vanadium Total	Zinc, Dissolved	Zinc, Total
Method				EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8	EPA200.8
Reporting Limit Goal				0.01	0.01	0.00020	0.00020	0.00025	0.00025	0.00050	0.00050	0.00032	0.00032	0.00050	0.00050	0.00001	0.00001	0.00200	0.00200	0.00003	0.00003	0.0025	0.0025
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals				3	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4
Reporting Units				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
NS	NS	24C	CC AS 26																				
04/29/15	1:02	24C	CC AS 49	0.059	0.59	0.00032	0.0052	0.77	0.81													0.32	0.46
04/29/15	1:02	24C	CC AS 50	0.081	5.1	0.00013	0.015	1.3	1.4													0.51	0.92
04/29/15	11:41	24C	CC AS 59	0.11	1.6	0.00034	0.0086	0.58	0.75													0.22	0.45
04/29/15	15:06	24C	CC AS T2	0.044	0.61	0.00016	0.003	0.37	0.49													0.14	0.26
04/30/15	0:56	24C	CC AS T11	0.054	0.64	0.00018	0.0045	0.016	0.27													0.045	0.18
06/01/15	8:00	24C	CC AS 26	0.11	0.79	0.00086	0.0054	0.12	0.36													0.13	0.21
06/01/15	13:15	24C	CC AS 49	0.15	2.6	0.00068	0.013	0.23	0.69													0.18	0.43
06/01/15	13:15	24C	CC AS 50	0.58	2.6	0.0015	0.0086	0.51	0.71													0.63	0.8
06/01/15	19:30	24C	CC AS 59	0.23	2.6	0.00087	0.016	0.2	0.71													0.18	0.5
06/01/15	21:30	24C	CC AS T2	0.21	4.1	0.00078	0.018	0.17	0.73	0.0019	0.0027	0.0023	0.0064	0.00041	<0.000054	<.000014	0.00019	ND	0.14	0.00032	0.0046	0.12	0.49
06/02/15	10:00	24C	CC AS T11	Le	1.9	Le	0.0075	Le	0.28		0.0026		0.0031		<0.000054		0.000076		0.16		0.0027	Le	0.22
06/15/15	10:00	24C	CC AS 26	NT	NT	NT	NT	NT	NT													NT	NT
06/15/15	12:30	24C	CC AS 49	NT	NT	NT	NT	NT	NT													NT	NT
06/15/15	12:30	24C	CC AS 50	NT	NT	NT	NT	NT	NT													NT	NT
06/15/15	15:30	24C	CC AS 59	NT	NT	NT	NT	NT	NT													NT	NT
06/15/15	16:30	24C	CC AS T2	NT	NT	NT	NT	NT	NT													NT	NT
06/16/15	7:15	24C	CC AS T11	NT	NT	NT	NT	NT	NT													NT	NT
07/13/15	8:00	24C	CC AS 26	0.043	0.21	0.00034	0.0021	0.01	0.078													0.065	0.063
07/13/15	11:30	24C	CC AS 49	0.054	0.32	0.00045	0.0022	0.093	0.16													0.14	0.13
07/13/15	11:30	24C	CC AS 50	0.15	3.9	0.00019	0.0074	0.98	1.1													0.54	0.75
07/14/15	12:50	G	CC AS 59	0.0062	0.16	0.00005	0.00049	0.0054	0.093													0.067	0.058
07/13/15	16:50	24C	CC AS T2	0.13	0.62	0.00058	0.0023	0.11	0.17													0.14	0.14
07/14/15	1:45	24C	CC AS T11	0.066	2.7	0.00033	0.013	0.0019	0.31													0.058	0.25
NS	NS	24C	CC AS 26																				
08/10/15	11:45	24C	CC AS 49	NT	NT	NT	NT	NT	NT													NT	NT
08/10/15	11:45	24C	CC AS 50	NT	NT	NT	NT	NT	NT													NT	NT
08/11/15	12:00	G	CC AS 59	NT	NT	NT	NT	NT	NT													NT	NT
08/10/15	22:00	24C	CC AS T2	NT	NT	NT	NT	NT	NT													NT	NT
08/11/15	6:15	24C	CC AS T11	NT	NT	NT	NT	NT	NT													NT	NT
09/21/15	13:50	G	CC AS 26	NT	NT	NT	NT	NT	NT													NT	NT
09/21/15	11:45	24C	CC AS 49	NT	NT	NT	NT	NT	NT													NT	NT
09/21/15	11:45	24C	CC AS 50	NT	NT	NT	NT	NT	NT													NT	NT
09/22/15	13:30	G	CC AS 59	NT	NT	NT	NT	NT	NT													NT	NT
09/22/15	2:40	24C	CC AS T2	NT	NT	NT	NT	NT	NT													NT	NT
09/22/15	14:30	24C	CC AS T11	NT	NT	NT	NT	NT	NT													NT	NT
10/21/15	0:00	24C	CC AS 26	0.048	0.2	0.00022	0.00087	0.055	0.12													0.096	0.065
10/21/15	11:00	24C	CC AS 49	0.041	0.63	0.00025	0.0038	0.23	0.33													0.12	0.2
10/21/15	11:00	24C	CC AS 50	0.023	26	ND	0.022	2.6	3.4													0.71	1.8
10/22/15	12:15	G	CC AS 59	0.034	0.79	0.00015	0.0015	0.24	0.31													0.14	0.2
10/22/15	4:00	24C	CC AS T2	0.073	4	0.00019	0.0079	0.12	0.39													0.1	0.3
10/22/15	14:30	24C	CC AS T11	0.033	3.9	0.00057	0.015	0.4	0.33													ND	0.29

Ambient Autosamplers (with TH metals)

Method							
Reporting Limit Goal							
Max Sig figs							
Max decimals							
Reporting Units							
Sample Date	Sample Time	Sample Type	Location ID	Notes	Conclusion	Field Notes	Lab Notes
NS	NS	24C	CC AS 26	Autosampler failure			
04/29/15	1:02	24C	CC AS 49	Start time 0202 on 04/28/15, end time 0102 on 04/29/15.			Metals analyzed by EEA.
04/29/15	1:02	24C	CC AS 50	Start time 0202 on 04/28/15, end time 0102 on 04/29/15.			Metals analyzed by EEA.
04/29/15	11:41	24C	CC AS 59	Start time 1241 on 04/28/15, end time 1141 on 04/29/15.			Metals analyzed by EEA.
04/29/15	15:06	24C	CC AS T2	Start time 1606 on 04/28/15, end time 1506 on 04/29/15.			Metals analyzed by EEA.
04/30/15	0:56	24C	CC AS T11	Start time 0156 on 04/28/15, end time 0056 on 04/30/15.			Metals analyzed by EEA.
06/01/15	8:00	24C	CC AS 26	Start time 0900 on 5/31/15, end time 0800 on 6/1/15.			Metals analyzed by EEA.
06/01/15	13:15	24C	CC AS 49	Start time 1415 on 5/31/15, end time 1315 on 6/1/15.			Metals analyzed by EEA.
06/01/15	13:15	24C	CC AS 50	Start time 1415 on 5/31/15, end time 1315 on 6/1/15.			Metals analyzed by EEA.
06/01/15	19:30	24C	CC AS 59	Start time 2030 on 5/31/15, end time 1930 on 6/1/15			Metals analyzed by EEA.
06/01/15	21:30	24C	CC AS T2	Start time 2230 on 5/31/15, end time 2130 on 6/1/15.			Metals analyzed by EEA.
06/02/15	10:00	24C	CC AS T11	Start time 1100 on 6/1/15, end time 1000 on 6/2/15.	Metals preserved before they were filtered..LE on Diss.		Metals analyzed by EEA.
06/15/15	10:00	24C	CC AS 26	Start time 1100 on 06/14/15, end time 1000 on 6/15/15.			Metals analyzed by EEA.
06/15/15	12:30	24C	CC AS 49	Start time 1330 on 6/14/15, end time 1230 on 6/15/15.			Metals analyzed by EEA.
06/15/15	12:30	24C	CC AS 50	Start time 1330 on 6/14/15, end time 1230 on 6/15/15.			Metals analyzed by EEA.
06/15/15	15:30	24C	CC AS 59	Start time 1630 on 6/14/15, end time 1530 on 6/15/15			Metals analyzed by EEA.
06/15/15	16:30	24C	CC AS T2	Start time 1730 on 6/14/15, end time 1630 on 6/15/15.			Metals analyzed by EEA.
06/16/15	7:15	24C	CC AS T11	Start time 0815 on 6/15/15, end time 0715 on 6/16/15.			Metals analyzed by EEA.
07/13/15	8:00	24C	CC AS 26	Start time 0900 on 07/12/15, end time 0800 on 7/13/15.			Metals analyzed by EEA.
07/13/15	11:30	24C	CC AS 49	Start time 1230 on 7/12/15, end time 1130 on 7/13/15.			Metals analyzed by EEA.
07/13/15	11:30	24C	CC AS 50	Start time 1230 on 7/12/15, end time 1130 on 7/13/15.			Metals analyzed by EEA.
07/14/15	12:50	G	CC AS 59	Grab sample			Metals analyzed by EEA.
07/13/15	16:50	24C	CC AS T2	Start time 1750 on 7/12/15, end time 1650 on 7/13/15.			Metals analyzed by EEA.
07/14/15	1:45	24C	CC AS T11	Start time 0245 on 7/13/15, end time 0145 on 7/14/15.			Metals analyzed by EEA.
NS	NS	24C	CC AS 26	Autosampler failure			
08/10/15	11:45	24C	CC AS 49	Start time 1245 on 8/09/15, end time 1145 on 8/10/15.			
08/10/15	11:45	24C	CC AS 50	Start time 1245 on 8/09/15, end time 1145 on 8/10/15.			
08/11/15	12:00	G	CC AS 59	Grab sample			
08/10/15	22:00	24C	CC AS T2	Start time 2300 on 8/09/15, end time 2200 on 8/10/15.			
08/11/15	6:15	24C	CC AS T11	Start time 0715 on 8/10/15, end time 0615 on 8/11/15.			
09/21/15	13:50	G	CC AS 26	Grab sample			
09/21/15	11:45	24C	CC AS 49	Start time 1245 on 9/20/15, end time 1145 on 9/21/15.			
09/21/15	11:45	24C	CC AS 50	Start time 1245 on 9/20/15, end time 1145 on 9/21/15.		The first two sample bottles were highly turbid, but not due to precipitation.	
09/22/15	13:30	G	CC AS 59	Grab sample			
09/22/15	2:40	24C	CC AS T2	Start time 0340 on 9/21/15, end time 0240 on 9/22/15.			
09/22/15	14:30	24C	CC AS T11	Start time 1530 on 9/21/15, end time 1430 on 9/22/15.			
10/21/15	0:00	24C	CC AS 26	Start time 0100 on 10/20/15, end time 0000 on 10/21/15.			
10/21/15	11:00	24C	CC AS 49	Start time 1200 on 10/20/15, end time 1100 on 10/21/15.			
10/21/15	11:00	24C	CC AS 50	Start time 1200 on 10/20/15, end time 1100 on 10/21/15.		The composite includes an event that occurred between 0500 and 0700 on 10/21/15. Limited volume prohibited also testing as an event.	
10/22/15	12:15	G	CC AS 59	Grab sample			
10/22/15	4:00	24C	CC AS T2	Start time 0500 on 10/21/15, end time 0400 on 10/22/15.			
10/22/15	14:30	24C	CC AS T11	Start time 1530 on 10/21/15, end time 1430 on 10/22/15.			

Event Autosamplers (with TH metals)

Method				SM2550B	SM4500H+B	SM2510B	SM2130B	SM4500NH3H	SM4500NO3I	SM4500NO3I	SM4500PE	SM4500PE	SM4500NH3H	EPA 300.0	SM4500NorgB	Calc	SM4500PE	SM4500PE	SM5310B	SM2540D	EPA200.8	EPA200.8	EPA200.8
DL				1.0	1.0	10	1.0	0.01	0.01	0.02	0.0025	0.0025	0.05	0.02	0.01	0.10	0.01	0.01	0.5	1	0.00015	0.00015	0.00010
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals				1	1	0	1	2	2	2	4	4	2	2	2	2	2	2	1	0	5	5	5
Reporting Units				°C	s.u.	µS/cm	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Date	Sample Time	Sample Type	Location ID	Temp	pH	Conductivity, Specific	Turbidity	Nitrogen, Ammonia (Salicylate)	Nitrogen, Nitrate+Nitrite	Nitrogen, Total Nitrogen	Phosphorus, Dissolved (DRP)	Phosphorus, Total	Nitrogen, Ammonia	Nitrogen, Nitrate+Nitrite	Nitrogen, Total Kjeldahl	Nitrogen, Total Nitrogen	Phosphorous, Dissolved (SRP)	Phosphorous, Total	Carbon, Total Organic	Solids, Total Suspended	Arsenic, Dissolved	Arsenic, Total	Barium, Dissolved
05/05/15	2:02	CE	CC AS 49	9.7	7.8	242	454	<0.01	0.25	1.1	0.0106	0.796							4.2	615	NT	NT	NT
05/05/15	4:44	CE	CC AS 59	8.6	7.8	260	430	<0.01	0.3	1.14	[redacted]	[redacted]	NT	0.07	2.9	3	NT	1.3	5.5	772	NT	NT	NT
05/05/15	3:12	CE	CC AS T2	12.2	8	277	212	0.04	0.33	1.38	0.0159	0.707							5	430	0.00024	0.0055	0.044
05/06/15	2:34	CE	CC AS T11	13.3	7.8	322	187	0.05	0.43	1.26	0.0387	0.49	NT	0.2	1.6	1.8	NT	0.44	5.4	53	0.00051	0.0049	0.042
05/26/15	11:18	CE	CC AS T11	15.6	7.8	408	134	[redacted]			NT	NT							9.1	251	0.0018	0.0038	0.043
06/05/15	0:38	CE	CC AS T2	24.4	8	206	409	NT	NT	NT	NT	NT							4.2	648	0.00058	0.0033	0.038
06/05/15	18:50	CE	CC AS T11	20.7	8	243	162	NT	NT	NT	NT	NT							5.7	213	0.00094	0.0029	0.034
07/07/15	21:59	CE	CC AS 50	16.3	7.2	234	811	<0.01	0.3	1.27	0.0098	0.59	NT	NT	NT	NT	NT	NT	5.4	775	NT	NT	NT
08/14/15	19:52	CE	CC AS 49	21.9	7.4	202	156	<0.01	0.17	1.43	0.0056	0.335							2.1	569	NT	NT	NT
08/15/15	3:26	CE	CC AS T2	23.8	7.6	242	71.5	<0.01	0.18	1.11	0.0038	0.36							2.2	122	0.00041	LE	0.033
10/03/15	22:17	CE	CC AS 50	13	7.7	648	1360	0.01	1.49	13.5	< 0.0025	6.99							12.3	12572	0.00035	0.015	0.14
10/03/15	22:36	CE	CC AS T2	16.4	7.6	334	802	0.04	0.38	4.95	< 0.0025	0.478							4.9	680	0.00037	0.0034	0.053
10/04/15	21:51	CE	CC AS T11	14.9	7.6	374	196	0.02	0.39	3	< 0.0025	0.129							3.9	92	0.0005	0.012	0.083
10/07/15	0:21	CE	CC AS 49	12.4	7.3	236	306	0.01	0.17	1.13	< 0.0025	0.2							2.4	316	0.00093	0.051	0.036
10/22/15	21:47	CE	CC AS 50	9.2	7.3	1441	158	0.01	0.53	1.28	NT	0.071							4.4	89	NT	NT	NT
11/05/15	19:37	CE	CC AS 50	5.4	7.2	1380	43.5	NT	NT	NT	< 0.0025	0.0168							3.9	33	[redacted]	0.0016	[redacted]

Event Autosamplers (with TH metals)

Method				EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8
DL				0.00010	0.00010	0.00010	0.00010	0.00010	0.00050	0.00050	0.00025	0.00025	0.01	0.01	0.00020	0.00020	0.00025	0.00025	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050		
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		
Max decimals				5	5	5	5	5	5	5	5	5	3	3	5	5	5	5	5	5	5	5	5	5		
Reporting Units				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Date	Sample Time	Sample Type	Location ID	Barium, Total	Beryllium, Dissolved	Beryllium, Total	Cadmium, Dissolved	Cadmium, Total	Chromium, Dissolved	Chromium, Total	Copper, Dissolved	Copper, Total	Iron, Dissolved	Iron, Total	Lead, Dissolved	Lead, Total	Manganese, Dissolved	Manganese, Total	Molybdenum, Dissolved	Molybdenum, Total	Nickel, Dissolved	Nickel, Total	Selenium, Dissolved	Selenium, Total	Silver, Dissolved	Silver, Total
05/05/15	2:02	CE	CC AS 49	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
05/05/15	4:44	CE	CC AS 59	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
05/05/15	3:12	CE	CC AS T2	0.22	ND	0.00085	0.00014	0.0032	0.00027	0.016	0.006	0.12	0.23	25	0.00049	0.058	0.0083	1.8	0.0019	0.0028	0.0011	0.018	0.00023	0.0046	ND	0.0006
05/06/15	2:34	CE	CC AS T11	0.15	ND	0.00055	0.00019	0.0017	0.00028	0.011	0.01	0.08	0.23	17	0.00068	0.052	0.0052	0.74	0.0021	0.0027	0.0016	0.012	0.00029	0.0018	0.000027	0.00055
05/26/15	11:18	CE	CC AS T11	0.12	ND	0.00061	0.00018	0.0012	0.00032	0.0082	0.011	0.041	0.24	11	0.00052	0.019	0.0048	0.39	0.0027	0.0026	0.0029	0.0088	0.0011	0.0022	ND	0.00022
06/05/15	0:38	CE	CC AS T2	0.22	ND	0.00084	0.00005	0.0015	0.00011	0.0097	0.0034	0.055	0.12	42	0.00027	0.027	0.0049	1.1	0.0021	0.0027	0.0009	0.014	0.00031	0.00081	0.000037	0.00038
06/05/15	18:50	CE	CC AS T11	0.096	ND	0.00038	0.00016	0.0013	0.00016	0.0068	0.0093	0.043	0.094	9.2	0.00036	0.02	0.0047	0.47	0.0024	0.0027	0.0015	0.0078	0.00049	0.0015	0.000026	0.00028
07/07/15	21:59	CE	CC AS 50	NT	NT	NT	<0.004	0.016	NT	NT	0.01	0.55	0.106	52.52	<0.01	0.91	0.69	1.94	NT	NT	NT	NT	NT	NT	NT	NT
08/14/15	19:52	CE	CC AS 49	NT	NT	NT	<0.004	0.01	NT	NT	0.004	0.275	0.031	43.09	<0.01	1.7	0.51	1.57	NT	NT	NT	NT	NT	NT	NT	NT
08/15/15	3:26	CE	CC AS T2	LE	ND	LE	0.00031	LE	0.00025	LE	0.0044	LE	0.038	LE	0.0013	LE	0.0022	LE	0.002	LE	0.00054	LE	ND	LE	0.00051	LE
10/03/15	22:17	CE	CC AS 50	7.2	ND	0.011	0.00023	0.029	ND	0.72	0.01	2.9	0.066	840	0.00007	0.39	1.7	25	0.004	0.0019	0.0054	0.38	0.0006	0.0032	ND	0.0036
10/03/15	22:36	CE	CC AS T2	0.12	ND	0.00059	0.00015	0.0011	0.00058	0.014	0.0038	0.032	0.26	11	0.00061	0.017	0.0078	0.34	0.0025	0.0028	0.0014	0.011	0.00022	0.00072	ND	0.00016
10/04/15	21:51	CE	CC AS T11	0.48	ND	0.0028	0.00006	0.0014	ND	0.082	0.003	0.099	0.37	59	0.0005	0.052	0.014	1.3	0.0027	0.0029	0.0012	0.055	0.00031	ND	ND	0.00062
10/07/15	0:21	CE	CC AS 49	0.2	ND	0.0006	0.0011	0.0034	0.00037	0.027	0.0048	0.16	0.16	28	0.0065	0.96	0.52	1.7	0.0023	0.0051	0.0017	0.021	ND	0.00057	ND	0.0085
10/22/15	21:47	CE	CC AS 50	NT	NT	NT	<0.004	0.006	NT	NT	0.008	0.21	0.018	14.26	<0.01	0.031	1.62	1.814	NT	NT	NT	NT	NT	NT	NT	NT
11/05/15	19:37	CE	CC AS 50	0.048		0.00074		0.0051		0.0011		0.15		8.9		0.0093		3		0.00076		0.03		0.00053		0.000045

Event Autosamplers (with TH metals)

Method				EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8	EPA200.8	SM9221D				
DL								0.0025	0.0025	1				
Max Sig figs								3	3	3				
Max decimals								4	4	0				
Reporting Units				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	cfu/100mL				
Sample Date	Sample Time	Sample Type	Location ID	Strontium, Dissolved	Strontium, Total	Vanadium, Dissolved	Vanadium, Total	Zinc, Dissolved	Zinc, Total	E. coli,	Notes	Conclusion	Field Notes	Lab Notes
05/05/15	2:02	CE	CC AS 49	NT	NT	NT	NT	NT	NT	NT	Bottles 1-5. Start time 23:02 on 5/4/15, end time 00:02 on 5/5/15.			
05/05/15	4:44	CE	CC AS 59	NT	NT	NT	NT	NT	NT	NT	Bottles 4-14. Start time 0217 on 5/5/15, end time 0444 on 5/5/15.			Nutrients analyzed by SGS. TP by ICP = 0.85 mg/L.
05/05/15	3:12	CE	CC AS T2	0.14	0.18	0.00069	0.027	0.038	0.84	131	Botttles 1-12. Start time 0027 on 05/05/15, end time 0312 on 05/05/15.			Metals analyzed by EEA.
05/06/15	2:34	CE	CC AS T11	0.16	0.19	0.00079	0.019	0.046	0.49	641	Botttles 1-24. Start time 2049 on 05/05/15, end time 0234 on 05/06/15.			Nutrients analyzed by SGS. TP by ICP = 0.35 mg/L. Metals analyzed by EEA.
05/26/15	11:18	CE	CC AS T11	0.25	0.27	0.0026	0.018	0.036	0.29	NT	Bottles 1-23. Start time 05:48 on 5/26/15, end time 11:18 on 5/26/15.			Metals analyzed by EEA.
06/05/15	0:38	CE	CC AS T2	0.1	0.17	0.0013	0.022	0.016	0.38	31	Bottles 1-6. Start time 2323 on 06/04/15, end time 0038 on 06/05/15.			Metals analyzed by EEA.
06/05/15	18:50	CE	CC AS T11	0.14	0.17	0.0013	0.014	0.04	0.32	214	Bottles 1-24. Start time 0538 on 06/05/15, end time 1850 on 06/05/15.			Metals analyzed by EEA.
07/07/15	21:59	CE	CC AS 50	NT	NT	NT	NT	0.035	0.69	NT	Bottles 2-10. Start time 1935 on 07/07/15, end time 2159 on 07/07/15.			Metals analyzed by EEA.
08/14/15	19:52	CE	CC AS 49	NT	NT	NT	NT	0.033	1.05	NT	Bottles 1-5. Start time 1852 on 08/14/15, end time 1952 on 08/14/15.			Metals analyzed by EEA.
08/15/15	3:26	CE	CC AS T2	0.14	LE	0.000039	LE	2.1	LE	NT	Bottles 1-5. Start time 0226 on 08/15/15, end time 0326 on 08/15/15.	LE-Labfiltered all the sample so no sample left for Total metals		Metals analyzed by EEA.
10/03/15	22:17	CE	CC AS 50	0.38	1.5	0.00053	0.66	0.063	9.8	NT	Bottles 1-10. Start time 2002 on 10/03/15, end time 2217 on 10/03/15.			Metals analyzed by EEA.
10/03/15	22:36	CE	CC AS T2	0.18	0.2	0.0013	0.016	0.032	0.23	NT	Bottles 3-7. Start time 2136 on 10/03/15, end time 2236 on 10/03/15.			Metals analyzed by EEA.
10/04/15	21:51	CE	CC AS T11	0.18	0.25	0.0014	0.076	0.013	0.34	NT	Bottles 1-8. Start time 2006 on 10/04/15, end time 2151 on 10/04/15.			Metals analyzed by EEA.
10/07/15	0:21	CE	CC AS 49	0.13	0.15	0.00037	0.033	0.084	0.79	NT	Bottles 1-5. Start time 2321 on 10/06/15, end time 0021 on 10/07/15.			
10/22/15	21:47	CE	CC AS 50	NT	NT	NT	NT	0.588	1.349	NT	Bottles 1-10. Start time 1932 on 10/22/15, end time 2147 on 10/22/15.			
11/05/15	19:37	CE	CC AS 50		0.44		0.00082		1.5	NT	Bottles 1-22. Start time 1422 on 11/05/15, end time 1937 on 11/05/15.			Metals analyzed by Golden and EEA. Bromide = 0.07 mg/L, Chloride = 260 mg/L, Hardness = 250 mg/L as CaCO3.

Clear Creek Event Autosamplers - Metals (Golden)

Method				**EPA200.7**	**EPA200.7**	**EPA200.7**	**EPA200.7**	**EPA200.7**	**EPA200.7**	**EPA200.7**	**EPA200.7**
DL				**variable**	**variable**	**variable**	**variable**	**variable**	**variable**	**0.004**	**0.004**
Reporting Units				**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Sample Date	**Sample Time**	**Sample Type**	**Location ID**	**Cadmium, Dissolved**	**Cadmium, Total**	**Chromium, Dissolved**	**Chromium, Total**	**Copper, Dissolved**	**Copper, Total**	**Iron, Dissolved**	**Iron, Total**
5/5/2015		CE	CC 49 Event	<0.004	0.007	NT	NT	0.006	0.117	0.06	30.45
5/5/2015		CE	CC 59 Event	<0.004	0.009	NT	NT	0.005	0.172	0.06	38.04
7/7/2015		CE	CC 50 Event	<0.004	0.016	NT	NT	0.01	0.55	0.106	52.52
8/12/2015		CE	CC 59 Event	<0.004	0.003	NT	NT	<0.003	0.063	0.04	14.57
8/14/2015		CE	CC 49 Event	<0.004	0.01	NT	NT	0.004	0.275	0.031	43.09
8/15/2015		CE	CC 59 Event	<0.004	0.006	NT	NT	0.004	0.194	0.017	25.16
10/3/2015		CE	CC 50 Event	<0.004	0.092	NT	NT	0.007	2.19	0.046	235.18
10/4/2015		CE	CC 59 Event	<0.004	<0.004	NT	NT	0.004	0.067	0.028	13.84
10/7/2015		CE	CC 49 Event	<0.004	0.006	NT	NT	0.005	0.14	0.053	21.65
10/7/2015		CE	CC 59 Event	<0.004	<0.004	NT	NT	0.005	0.102	0.037	13.56
10/22/2015		CE	CC 50 Event	<0.004	0.006	NT	NT	0.008	0.21	0.018	14.26
11/5/2015		CE	CC 50 Event	<0.004	0.005	NT	NT	0.008	0.134	0.016	7.547

Clear Creek Event Autosamplers - Metals (Golden)

Method				EPA200.7	EPA200.7	EPA200.7	EPA200.7	EPA200.7	EPA200.7	SM5310B	Contractor
DL				0.01	0.01	0.001	0.001	0.030	0.030	0.5	
Reporting Units				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Date	Sample Time	Sample Type	Location ID	Lead, Dissolved	Lead, Total	Manganese, Dissolved	Manganese, Total	Zinc, Dissolved	Zinc, Total	Carbon, Total Organic	Nitrogen - Ammonia (Auto. Phenate)
5/5/2015		CE	CC 49 Event	<0.01	0.05	0.19	1.52	0.035	0.69	NT	
5/5/2015		CE	CC 59 Event	<0.01	0.087	0.026	2.2	<0.02	0.969	NT	0.08
7/7/2015		CE	CC 50 Event	<0.01	0.91	0.69	1.94	0.12	1.83	NT	
8/12/2015		CE	CC 59 Event	<0.01	0.028	0.188	0.42	0.047	0.312	NT	<0.05
8/14/2015		CE	CC 49 Event	<0.01	1.7	0.51	1.57	0.033	1.05	NT	
8/15/2015		CE	CC 59 Event	<0.01	0.823	0.366	0.916	0.033	0.77	NT	<0.05
10/3/2015		CE	CC 50 Event	<0.01	0.296	1.15	14.66	0.036	6.93	NT	
10/4/2015		CE	CC 59 Event	<0.01	0.015	0.06	0.537	0.029	0.362	NT	<0.05
10/7/2015		CE	CC 49 Event	<0.01	0.83	0.656	1.17	0.099	0.708	NT	
10/7/2015		CE	CC 59 Event	<0.01	0.38	0.503	0.86	0.122	0.58	NT	0.07
10/22/2015		CE	CC 50 Event	<0.01	0.031	1.62	1.814	0.588	1.349	NT	
11/5/2015		CE	CC 50 Event	<0.01	<0.01	2.327	2.159	0.862	1.248	NT	

Clear Creek Event Autosamplers - Metals (Golden)

Method				Contractor	Contractor	Contractor	Contractor				
DL											
Reporting Units				mg/L	mg/L	mg/L	mg/L				
Sample Date	Sample Time	Sample Type	Location ID	Nitrogen - TKN Kjeldahl	NO2/NO3 as N. 353.2	Phosphorus - Total, Auto Asc. Acid Red.	Solids - Total Suspended, 105	Notes	Conclusion	Field Notes	Lab Notes
5/5/2015		CE	CC 49 Event								
5/5/2015		CE	CC 59 Event	2.8	0.31	0.83	746				
7/7/2015		CE	CC 50 Event								
8/12/2015		CE	CC 59 Event	0.4	0.18	0.22	236				
8/14/2015		CE	CC 49 Event								
8/15/2015		CE	CC 59 Event	0.3	0.23	0.28	360				
10/3/2015		CE	CC 50 Event								
10/4/2015		CE	CC 59 Event	0.7	0.22	0.2	201				
10/7/2015		CE	CC 49 Event								
10/7/2015		CE	CC 59 Event	0.7	0.15	0.11	182				
10/22/2015		CE	CC 50 Event								
11/5/2015		CE	CC 50 Event								

Standley Lake															
Method				**electrode**	**SM2510B**	**electrode**	**SM4500OG**	**SM4500H+B**	**SM2550B**	**SM2130B**	**Secchi Disk**	**SM4500NH3H**	**SM4500NO3I**	**SM4500NO3I**	**FlowCAM**
DL				**1.0**	**10**	**1**	**1.0**	**1.0**	**1.0**	**1.0**	**0.1**	**0.01**	**0.01**	**0.02**	**1**
Max Sig figs				**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**4**
Max decimals				**1**	**0**	**0**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**0**
Reporting Units				**µg/L**	**µS/cm**	**mv**	**mg/L**	**s.u.**	**°C**	**NTU**	**m**	**mg/L**	**mg/L**	**mg/L**	**ct/mL**
Sample Date	**Sample Time**	**Sample Type**	**Location ID**	**Chlorophyll a, Field**	**Conductivity, Specific**	**ORP Oxidation Reduction Potential**	**Oxygen, Dissolved**	**pH**	**Temp**	**Turbidity**	**Secchi Depth,**	**Nitrogen, Ammonia (Salicylate)**	**Nitrogen, Nitrate+Nitrite**	**Nitrogen, Total Nitrogen**	**Algae**
02/09/15		G	SL 10-00	LE	LE	LE	LE	LE	LE	LE	2.5				
02/09/15		C	SL 10-PZ									0.04	0.05	0.44	161
02/09/15		G	SL 10-70	LE	LE	LE	LE	LE	LE	LE		0.04	0.05	0.47	
03/16/15		G	SL 10-00	< 1	308	336	10.7	8.1	6.7	< 1	4.1				
03/16/15		C	SL 10-PZ									0.01	0.06	0.22	223
03/16/15		G	SL 10-70	2.8	372	314	9.4	7.9	4	2.7		0.06	0.1	0.31	
04/07/15		G	SL 10-00	1.3	319	362	9.7	8.1	9.6	1.3	4				
04/07/15		C	SL 10-PZ									0.02	0.06	0.21	95
04/07/15		G	SL 10-70	4.4	317	301	9.4	8	8	3.9		0.03	0.06	0.27	
04/21/15		G	SL 10-00	< 1	322	307	9.2	8.1	11.5	1.6	4.3				
04/21/15		C	SL 10-PZ									0.03	0.04	0.2	111
04/21/15		G	SL 10-70	2.8	319	280	7.8	7.9	8.4	5.2		0.08	0.06	0.28	
05/11/15		G	SL 10-00	1.1	322	292	8.9	8.3	11.9	1.7	3.3				
05/11/15		C	SL 10-PZ									0.07	0.07	0.51	165
05/11/15		G	SL 10-70	1.4	322	283	5.9	7.5	9.1	9		0.18	0.13	0.73	
05/11/15		G	69-00												
05/27/15		G	SL 10-00	< 1	326	131	9.3	8.6	15	< 1	4.3				
05/27/15		C	SL 10-PZ									0.03	< 0.01	0.28	422
05/27/15		G	SL 10-70	< 1	327	143	4.2	7.4	9.4	9.1		0.13	0.1	0.46	
06/09/15		G	SL 10-00	1.2	331	290	8.3	8.6	20.6	< 1	4				
06/09/15	10:50	C	SL 10-PZ									< 0.01	< 0.01	0.14	437
06/09/15	11:00	G	SL 10-70	1.8	331	274	4.6	7.4	9.9	2.7		0.09	0.12	0.29	
06/24/15		G	SL 10-00	< 1	324	282	7.5	8.4	23.5	1.2	3.5				
06/24/15		C	SL 10-PZ									< 0.01	< 0.01	0.2	216
06/24/15		G	SL 10-70	< 1	236	271	2.2	7.5	10	3.9		0.05	0.16	0.36	
06/24/15		G	69-00												
07/07/15		G	SL 10-00	1.7	302	344	7.3	8.2	22.2	< 1	5.5				
07/07/15		C	SL 10-PZ									0.02	< 0.01	0.31	360
07/07/15		G	SL 10-70	< 1	236	323	1	7.4	10.2	5.1		0.04	0.29	0.46	
07/22/15		G	SL 10-00	< 1	313	322	7.4	8.3	22.2	< 1	6.3				
07/22/15		C	SL 10-PZ									0.02	0.01	0.15	77
07/22/15		G	SL 10-70	1.4	334	310	1.2	7.5	10.7	8.7		0.01	0.21	0.32	
07/22/15		G	69-00												
08/03/15		G	SL 10-00	1.3	311	343	7.6	8.4	23.3	< 1	5.9				
08/03/15		C	SL 10-PZ									0.02	0.02	0.22	65
08/03/15		G	SL 10-70	< 1	341	337	< 1	7.4	11	7.8		0.09	0.17	0.57	
08/03/15		G	69-00												
08/19/15		G	SL 10-00	1.7	304	330	7.3	8.4	22.4	< 1	4.5				
08/19/15		C	SL 10-PZ									0.03	0.01	0.4	82
08/19/15		G	SL 10-70	< 1	347	249	< 1	7.3	11	6.4		0.27	0.08	0.89	
08/19/15		G	69-00												
09/08/15		G	SL 10-00	1.2	304	194	6.9	8.1	20.9	1.1	4				
09/08/15		C	SL 10-PZ									0.02	< 0.01	0.28	99
09/08/15		G	SL 10-70	< 1	345	149	< 1	7.2	11.8	5.9		0.12	0.1	0.39	
09/29/15		G	SL 10-00	< 1	307	319	7.4	8.2	19	< 1	5.7				
09/29/15		C	SL 10-PZ									0.04	< 0.01	0.2	248
09/29/15		G	SL 10-70	< 1	354	10	< 1	7.4	11.1	7.6		0.36	< 0.01	0.57	
10/13/15		G	SL 10-00	1.6	305	282	7.4	8	16.6	1.6	3.5				
10/13/15		C	SL 10-PZ									0.01	0.01	0.22	125
10/13/15		G	SL 10-70	< 1	356	9.2	< 1	7.6	11.1	5.3		0.57	< 0.01	0.89	
10/27/15		G	SL 10-00	1.7	307	337	7.5	7.9	14.1	2	3				
10/27/15		C	SL 10-PZ									0.03	0.02	0.27	193
10/27/15		G	SL 10-70	< 1	355	42	1.1	7.7	11.4	3.7		0.1	0.02	0.34	
11/10/15		G	SL 10-00	4.4	327	270	8.7	7.6	9.9	2.2	2.6				
11/10/15		C	SL 10-PZ									0.01	0.02	0.16	210
11/10/15		G	SL 10-70	4.2	354	271	8.2	7.8	9.2	8.3		0.03	0.08	0.23	
12/07/15		G	SL 10-00	2.3	353	390	10.4	8	3.1	1.5	3.6				
12/07/15		C	SL 10-PZ									0.02	0.03	0.17	378
12/07/15		G	SL 10-70	6.1	353	374	10.2	8.1	3	1.5		0.02	0.03	0.21	

Standley Lake

Sample Date	Sample Time	Sample Type	Location ID	Chlorophyll a, Lab (Methanol)	UV 254	Gross Alpha	Gross Alpha, Uncertainty	Gross Beta	Gross Beta, Uncertainty	Phosphorus, Dissolved (DRP)	Phosphorus, Total	Arsenic, Dissolved	Arsenic, Total	Barium, Dissolved	Barium, Total	Beryllium, Dissolved	Beryllium, Total	BTEX, Benzene
Method				**SM10200H**	**SM5910B**	**SM7110B**	**SM7110B**	**SM7110B**	**SM7110B**	**SM4500PE**	**SM4500PE**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA524.2**
DL				**1.0**	**0.001**	**variable**	**variable**	**variable**	**variable**	**0.0025**	**0.0025**	**0.00015**	**0.00015**	**0.00010**	**0.00010**	**0.00015**	**0.00015**	**0.0005**
Max Sig figs				**3**	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Max decimals				**1**	**3**	**1**	**1**	**1**	**1**	**4**	**4**	**5**	**5**	**5**	**5**	**4**	**4**	**4**
Reporting Units				**µg/L**	**$10\ cm^{-1}$**	**pCi/L**	**pCi/L**	**pCi/L**	**pCi/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
02/09/15		G	SL 10-00															
02/09/15		C	SL 10-PZ	3.7	0.366					< 0.0025	0.0109							
02/09/15		G	SL 10-70		0.34					< 0.0025	0.0104							
03/16/15		G	SL 10-00			1.5	1.8	0.4	3.1									
03/16/15		C	SL 10-PZ	2.6	0.316	1.1	2	0.6	3.2	< 0.0025	0.0061							
03/16/15		G	SL 10-70		0.319	0.9	2	0	2.9	< 0.0025	0.0104							
04/07/15		G	SL 10-00															
04/07/15		C	SL 10-PZ	2.5	0.308					< 0.0025	0.0082							
04/07/15		G	SL 10-70		0.304					< 0.0025	0.0109							
04/21/15		G	SL 10-00															
04/21/15		C	SL 10-PZ	3.1	0.315					< 0.0025	0.0049							
04/21/15		G	SL 10-70		0.313					0.0037	0.0108							
05/11/15		G	SL 10-00															
05/11/15		C	SL 10-PZ	4.1	Le					< 0.0025	0.0085							
05/11/15		G	SL 10-70		Le					0.0033	0.0121							
05/11/15		G	69-00															<0.0005
05/27/15		G	SL 10-00															
05/27/15		C	SL 10-PZ	6	0.389					< 0.0025	0.0066							
05/27/15		G	SL 10-70		0.303					< 0.0025	0.0093							
06/09/15		G	SL 10-00			0.7	1.9	0	3.3									
06/09/15	10:50	C	SL 10-PZ	5.6	0.391	0	1.4	0	2.8	< 0.0025	0.0089	0.00035	0.00047	0.048	0.05	ND	ND	
06/09/15	11:00	G	SL 10-70		0.326	2.2	2.1	0.2	3.1	< 0.0025	0.0098	0.00028	0.00032	0.051	0.051	ND	ND	
06/24/15		G	SL 10-00															
06/24/15		C	SL 10-PZ	3.3	0.403					< 0.0025	0.0089							
06/24/15		G	SL 10-70		0.332					< 0.0025	0.0111							
06/24/15		G	69-00															<0.0005
07/07/15		G	SL 10-00															
07/07/15		C	SL 10-PZ	4.5	0.406					< 0.0025	0.0078							
07/07/15		G	SL 10-70		0.326					0.0031	0.0146							
07/22/15		G	SL 10-00															
07/22/15		C	SL 10-PZ	1.5	0.4					< 0.0025	0.0066							
07/22/15		G	SL 10-70		0.333					< 0.0025	0.0144							
07/22/15		G	69-00															<0.0005
08/03/15		G	SL 10-00															
08/03/15		C	SL 10-PZ	2.5	0.397					< 0.0025	0.007							
08/03/15		G	SL 10-70		0.343					0.003	0.0172							
08/03/15		G	69-00															NT
08/19/15		G	SL 10-00															
08/19/15		C	SL 10-PZ	2.1	0.39					< 0.0025	0.0068							
08/19/15		G	SL 10-70		0.379					0.0062	0.0188							
08/19/15		G	69-00															NT
09/08/15		G	SL 10-00			2.2	2.2	0	3.3									
09/08/15		C	SL 10-PZ	2.1	0.368	1.1	1.8	0	2.9	< 0.0025	0.0084	0.00044	0.00067	0.047	0.047	ND	ND	
09/08/15		G	SL 10-70		0.38	1.8	2	0	3.3	0.0028	0.0159	0.00023	0.00022	0.046	0.051	ND	ND	
09/29/15		G	SL 10-00															
09/29/15		C	SL 10-PZ	1.9	0.362					< 0.0025	0.0094							
09/29/15		G	SL 10-70		0.415					0.0383	0.0691							
10/13/15		G	SL 10-00															
10/13/15		C	SL 10-PZ	3.3	0.36					< 0.0025	0.0105	0.00045	0.00032					
10/13/15		G	SL 10-70		0.479					0.0664	0.0908	0.002	0.0018					
10/27/15		G	SL 10-00															
10/27/15		C	SL 10-PZ	3.1	0.352					< 0.0025	0.0056	0.00036	0.00078	0.046	0.048	ND	ND	
10/27/15		G	SL 10-70		0.365					< 0.0025	0.016	0.00061	0.00054	0.046	0.051	ND	ND	
11/10/15		G	SL 10-00															
11/10/15		C	SL 10-PZ	7	0.348					< 0.0025	0.0112							
11/10/15		G	SL 10-70		0.336					< 0.0025	0.0129							
12/07/15		G	SL 10-00			1.4	2	0	2.8									
12/07/15		C	SL 10-PZ	4.3	0.322	1.4	1.8	0	3.3	0.0044	0.0101	0.00039	0.003	0.0016	0.046	ND	ND	
12/07/15		G	SL 10-70		0.318	2	2	0	2.8	0.0052	0.0114	0.0004	0.0026	0.0019	0.048	ND	ND	

Standley Lake																	
Method				**EPA524.2**	**EPA524.2**	**EPA524.2**	**EPA200.8**	**EPA200.8**	**SM5310B**	**EPA200.8**	**EPA200.8**	**SM9221D**	**EPA200.8**	**EPA200.8**	**EPA130.2**	**EPA200.7**	**EPA200.7**
DL				**0.0005**	**0.0005**	**0.0005**	**0.00010**	**0.00010**	**0.5**	**0.00050**	**0.00050**	**1**	**0.00025**	**0.00025**	**5**	**0.01**	**0.01**
Max Sig figs				**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Max decimals				**4**	**4**	**4**	**5**	**5**	**1**	**5**	**5**	**0**	**5**	**5**	**0**	**3**	**3**
Reporting Units				**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**cfu/100mL**	**mg/L**	**mg/L**	**mg/L as CaCO3**	**mg/L**	**mg/L**
Sample Date	**Sample Time**	**Sample Type**	**Location ID**	**BTEX, Ethylbenzene**	**BTEX, Toluene**	**BTEX, Xylenes**	**Cadmium, Dissolved**	**Cadmium, Total**	**Carbon, Total Organic**	**Chromium, Dissolved**	**Chromium, Total**	**E. coli,**	**Copper, Dissolved**	**Copper, Total**	**Hardness, Total**	**Iron, Dissolved**	**Iron, Total**
02/09/15		G	SL 10-00									1					
02/09/15		C	SL 10-PZ						1.7						106		
02/09/15		G	SL 10-70						2.5			<1			104		
03/16/15		G	SL 10-00									<1					
03/16/15		C	SL 10-PZ						1.7						108		
03/16/15		G	SL 10-70						1.7			23			120		
04/07/15		G	SL 10-00									3					
04/07/15		C	SL 10-PZ						1.8						104		
04/07/15		G	SL 10-70						1.7			6			104		
04/21/15		G	SL 10-00														
04/21/15		C	SL 10-PZ														
04/21/15		G	SL 10-70														
05/11/15		G	SL 10-00									1					
05/11/15		C	SL 10-PZ						1.9						124		
05/11/15		G	SL 10-70						1.6			<1			116		
05/11/15		G	69-00	<0.0005	<0.0005	<0.0005											
05/27/15		G	SL 10-00														
05/27/15		C	SL 10-PZ														
05/27/15		G	SL 10-70														
06/09/15		G	SL 10-00									<1					
06/09/15	10:50	C	SL 10-PZ				ND	ND	2.3	ND	ND		0.0014	0.0023	120	0.0014	0.0023
06/09/15	11:00	G	SL 10-70				ND	ND	1.7	ND	0.00021		0.00082	0.0024	120	0.0043	0.15
06/24/15		G	SL 10-00														
06/24/15		C	SL 10-PZ														
06/24/15		G	SL 10-70														
06/24/15		G	69-00	<0.0005	<0.0005	<0.0005											
07/07/15		G	SL 10-00									1					
07/07/15		C	SL 10-PZ						3.8						112		
07/07/15		G	SL 10-70						3			3			112		
07/22/15		G	SL 10-00														
07/22/15		C	SL 10-PZ														
07/22/15		G	SL 10-70														
07/22/15		G	69-00	<0.0005	<0.0005	<0.0005											
08/03/15		G	SL 10-00														
08/03/15		C	SL 10-PZ														
08/03/15		G	SL 10-70														
08/03/15		G	69-00	NT	NT	NT											
08/19/15		G	SL 10-00														
08/19/15		C	SL 10-PZ														
08/19/15		G	SL 10-70														
08/19/15		G	69-00	NT	NT	NT											
09/08/15		G	SL 10-00									<1					
09/08/15		C	SL 10-PZ				ND	0.000022	2.3	ND	0.00012		0.0017	0.0089		ND	0.08
09/08/15		G	SL 10-70				ND	ND	1.9	ND	ND	26	0.00099	0.0019		0.0056	0.24
09/29/15		G	SL 10-00														
09/29/15		C	SL 10-PZ														
09/29/15		G	SL 10-70														
10/13/15		G	SL 10-00									7					
10/13/15		C	SL 10-PZ						2.1								
10/13/15		G	SL 10-70						2.3			NT					
10/27/15		G	SL 10-00														
10/27/15		C	SL 10-PZ				ND	0.000015		ND	0.000097		0.0014	0.0025	112	0.0042	0.13
10/27/15		G	SL 10-70				ND	0.000045		ND	0.00016		0.00096	0.0018	128	0.0078	0.32
11/10/15		G	SL 10-00									34					
11/10/15		C	SL 10-PZ						1.4								
11/10/15		G	SL 10-70						1.4			93					
12/07/15		G	SL 10-00									16					
12/07/15		C	SL 10-PZ				ND	ND	1.7	0.0009	0.00025		ND	0.0016	120	0.0037	0.093
12/07/15		G	SL 10-70				0.00002	ND	1.8	0.00086	0.0002	11	ND	0.0014	128	0.0032	0.083

Standley Lake																	
Method				**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA245.1**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**
DL				**0.00020**	**0.00020**	**0.00025**	**0.00025**	**0.0002**	**0.00050**	**0.00050**	**0.005**	**0.005**	**0.00050**	**0.00050**	**0.0005**	**0.0005**	**0.0005**
Max Sig figs				**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Max decimals				**5**	**5**	**5**	**5**	**5**	**5**	**5**	**4**	**4**	**5**	**5**	**5**	**5**	**5**
Reporting Units				**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Sample Date	**Sample Time**	**Sample Type**	**Location ID**	**Lead, Dissolved**	**Lead, Total**	**Manganese, Dissolved**	**Manganese, Total**	**Mercury, Total**	**Molybdenum, Dissolved**	**Molybdenum, Total**	**Nickel, Dissolved**	**Nickel, Total**	**Selenium, Dissolved**	**Selenium, Total**	**Silver, Dissolved**	**Silver, Total**	**Strontium, Dissolved**
02/09/15		G	SL 10-00														
02/09/15		C	SL 10-PZ														
02/09/15		G	SL 10-70														
03/16/15		G	SL 10-00														
03/16/15		C	SL 10-PZ														
03/16/15		G	SL 10-70														
04/07/15		G	SL 10-00														
04/07/15		C	SL 10-PZ														
04/07/15		G	SL 10-70														
04/21/15		G	SL 10-00														
04/21/15		C	SL 10-PZ														
04/21/15		G	SL 10-70														
05/11/15		G	SL 10-00														
05/11/15		C	SL 10-PZ														
05/11/15		G	SL 10-70														
05/11/15		G	69-00														
05/27/15		G	SL 10-00														
05/27/15		C	SL 10-PZ														
05/27/15		G	SL 10-70														
06/09/15		G	SL 10-00														
06/09/15	10:50	C	SL 10-PZ	ND	0.00041	0.00008	0.0079	ND	0.0025	0.0029	0.0016	0.00091	0.0004	0.0019	ND	0.000024	0.2
06/09/15	11:00	G	SL 10-70	ND	0.00015	0.00033	0.0032	ND	0.0026	0.003	0.0017	0.0008	0.00039	ND	0.000035	0.000014	0.2
06/24/15		G	SL 10-00														
06/24/15		C	SL 10-PZ														
06/24/15		G	SL 10-70														
06/24/15		G	69-00														
07/07/15		G	SL 10-00														
07/07/15		C	SL 10-PZ														
07/07/15		G	SL 10-70														
07/22/15		G	SL 10-00														
07/22/15		C	SL 10-PZ														
07/22/15		G	SL 10-70														
07/22/15		G	69-00														
08/03/15		G	SL 10-00														
08/03/15		C	SL 10-PZ														
08/03/15		G	SL 10-70														
08/03/15		G	69-00														
08/19/15		G	SL 10-00														
08/19/15		C	SL 10-PZ														
08/19/15		G	SL 10-70														
08/19/15		G	69-00														
09/08/15		G	SL 10-00														
09/08/15		C	SL 10-PZ	ND	0.0014	0.00009	0.008	ND	0.0028	0.003	0.00095	0.0022	0.00024	ND	ND	0.000036	0.2
09/08/15		G	SL 10-70	ND	0.00038	0.13	0.54	ND	0.0035	0.0029	0.0011	0.0012	0.00018	ND	ND	0.00013	0.22
09/29/15		G	SL 10-00														
09/29/15		C	SL 10-PZ														
09/29/15		G	SL 10-70														
10/13/15		G	SL 10-00														
10/13/15		C	SL 10-PZ														
10/13/15		G	SL 10-70														
10/27/15		G	SL 10-00														
10/27/15		C	SL 10-PZ	ND	0.00032	0.00033	0.025	ND	0.0027	0.003	0.00086	0.00087	0.00022	ND	ND	0.00005	0.2
10/27/15		G	SL 10-70	ND	0.00071	0.4	0.77	ND	0.0032	0.0033	0.00095	0.0011	0.00025	ND	ND	0.000052	0.2
11/10/15		G	SL 10-00														
11/10/15		C	SL 10-PZ														
11/10/15		G	SL 10-70														
12/07/15		G	SL 10-00														
12/07/15		C	SL 10-PZ	ND	0.00039	ND	0.018	ND	0.00029	0.0025	ND	0.0013	ND	0.00025	ND	ND	0.2
12/07/15		G	SL 10-70	ND	0.00035	0.00041	0.018	ND	0.00029	0.0028	ND	0.0013	0.00019	ND	0.000067	ND	0.2

Standley Lake														
Method				**EPA200.8**	**EPA200.8**	**EPA200.8**	**SM2540D**	**EPA200.8**	**EPA200.8**	**EPA200.7**				
DL				**0.0005**	**0.0005**	**0.0005**	**1**	**0.0025**	**0.0025**	**0.050**				
Max Sig figs				**3**	**3**	**3**	**3**	**3**	**3**	**3**				
Max decimals				**5**	**5**	**5**	**0**	**4**	**4**	**2**				
Reporting Units				**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**				
Sample Date	**Sample Time**	**Sample Type**	**Location ID**	**Strontium, Total**	**Vanadium, Dissolved**	**Vanadium, Total**	**Solids, Total Suspended**	**Zinc, Dissolved**	**Zinc, Total**	**Silicon, Dissolved**	**Notes**	**Conclusion**	**Field Notes**	**Lab Notes**
02/09/15		G	SL 10-00											
02/09/15		C	SL 10-PZ				5			1.6				Silicon analyzed by SGS
02/09/15		G	SL 10-70				4			1.6				Silicon analyzed by SGS
03/16/15		G	SL 10-00											
03/16/15		C	SL 10-PZ				2			1.6				Silicon analyzed by SGS
03/16/15		G	SL 10-70				3			2				Silicon analyzed by SGS
04/07/15		G	SL 10-00											
04/07/15		C	SL 10-PZ				3			1.6				Silicon analyzed by SGS
04/07/15		G	SL 10-70				4			1.6				Silicon analyzed by SGS
04/21/15		G	SL 10-00											
04/21/15		C	SL 10-PZ							1.4				Silicon analyzed by EEA
04/21/15		G	SL 10-70							1.7				Silicon analyzed by EEA
05/11/15		G	SL 10-00											
05/11/15		C	SL 10-PZ							1				
05/11/15		G	SL 10-70							1.9				
05/11/15		G	69-00											
05/27/15		G	SL 10-00											
05/27/15		C	SL 10-PZ							0.41				Silicon analyzed by EEA
05/27/15		G	SL 10-70							2				Silicon analyzed by EEA
06/09/15		G	SL 10-00											
06/09/15	10:50	C	SL 10-PZ	0.21	0.00033	0.00053	5	0.0039	0.01	0.18				All metals analyzed by EEA
06/09/15	11:00	G	SL 10-70	0.21	0.00017	0.00045	2	0.01	0.0056	1.8				All metals analyzed by EEA
06/24/15		G	SL 10-00											
06/24/15		C	SL 10-PZ							0.045				All metals analyzed by EEA
06/24/15		G	SL 10-70							2.1				All metals analyzed by EEA
06/24/15		G	69-00											
07/07/15		G	SL 10-00											
07/07/15		C	SL 10-PZ				2			0.33				All metals analyzed by EEA
07/07/15		G	SL 10-70				2			2.2				All metals analyzed by EEA
07/22/15		G	SL 10-00											
07/22/15		C	SL 10-PZ							0.64				All metals analyzed by EEA
07/22/15		G	SL 10-70							1.7				All metals analyzed by EEA
07/22/15		G	69-00											
08/03/15		G	SL 10-00											
08/03/15		C	SL 10-PZ							1				All metals analyzed by EEA
08/03/15		G	SL 10-70							1.8				All metals analyzed by EEA
08/03/15		G	69-00											
08/19/15		G	SL 10-00											
08/19/15		C	SL 10-PZ							2.4				All metals analyzed by EEA
08/19/15		G	SL 10-70							1.1				All metals analyzed by EEA
08/19/15		G	69-00											
09/08/15		G	SL 10-00											
09/08/15		C	SL 10-PZ	0.19	0.00054	0.00068	2	0.0066	0.012	1.1				All metals analyzed by EEA
09/08/15		G	SL 10-70	0.22	0.00011	0.00037	4	0.0083	0.015	1.8				All metals analyzed by EEA
09/29/15		G	SL 10-00											
09/29/15		C	SL 10-PZ							1.3				All metals analyzed by EEA
09/29/15		G	SL 10-70							2.4				All metals analyzed by EEA
10/13/15		G	SL 10-00											
10/13/15		C	SL 10-PZ				4			1.4				
10/13/15		G	SL 10-70				8			3				
10/27/15		G	SL 10-00											
10/27/15		C	SL 10-PZ	0.2	0.00036	0.00056	5	0.0033	0.0076	1.4				
10/27/15		G	SL 10-70	0.22	0.00042	0.00093	10	0.0045	0.011	1.9				
11/10/15		G	SL 10-00											
11/10/15		C	SL 10-PZ				4			1.1				
11/10/15		G	SL 10-70				9			1.8				
12/07/15		G	SL 10-00											
12/07/15		C	SL 10-PZ	0.2	0.0054	0.00019	<1	ND	0.0092	0.95				All metals analyzed by EEA
12/07/15		G	SL 10-70	0.21	0.0054	0.00012	1	ND	0.0086	0.96				All metals analyzed by EEA

Appendix D – Regulation 85 Water-Quality Monitoring Data – 2015

Appendix D. Regulation 85 Data for WWTP Effluent in Clear Creek Watershed

Facility	Date	Flow (MGD)	Ammonia	Total Kjeldahl Nitrogen	Nitrate	Nitrite	Nitrate + Nitrite	Total Inorganic Nitrogen	Total Nitrogen	Total Phosphorus
			(mg/L)							
Blackhawk Central City Sewerage District										
	1/13/2015	0.324	0.25	2				5.95	7.7	0.14
	2/10/2015	0.363	ND	1.9				5.3	7.2	0.22
	3/10/2015	0.304	ND	1.5				3.94	5.47	0.09
	4/7/2015	0.282	0.16	1.8				2.56	4.19	0.24
	5/5/2015	0.376	ND	1.8				11.75	13.55	0.23
	6/16/2015	0.471	ND	1.3				9.61	10.9	0.1
	7/7/2015	0.455	ND	1.3				5.43	6.73	0.11
	8/11/2015	0.429	ND	0.99				10	10.99	0.08
	9/22/2015	0.42	ND	1				5.72	6.72	0.09
	10/20/2015	0.316	ND	1.2				8	9.2	0.1
	11/17/2015	0.299	ND	0.77				4.9	5.67	0.06
	12/15/2015	0.243	ND	1.1				6.6	7.7	0.04
Central Clear Creek Sanitation District										
	1/28/2015	0.033	0.21	0.3	29.2	ND	29.2	29.4	29.5	1.1
	2/4/2015	0.026	0.05	ND	25.42	ND	25.42	25.5	25.5	0.87
	3/4/2015	0.039	0.24	2.4	24.36	2.04	26.4	26.6	28.8	4.4
	5/29/2015	0.0592	0.31	1.4	19.27	ND	19.27	19.6	20.62	0.92
	6/9/2015	0.052	0.45	0.6	21.11	ND	21.11	21.6	21.69	1.44
	7/7/2015	0.0578	0.43	0.6	27.69	ND	27.69	28.1	28.28	2.33
	8/18/2015	0.0358	4.97	8.1	40.44	ND	40.44	45.4	48.53	4.48
	9/16/2015	0.0392	4.3	4.8	39.9	ND	39.9	44.2	44.71	4.71
	10/20/2015	0.0476	0.37	1.6	45.78	ND	45.78	46.2	47.37	3.63
	11/9/2015	0.032	0.12	1.4	37.25	ND	37.25	37.4	38.69	1.45
	12/11/2015	0.0306	0.5	0.6	32.48	ND	32.48	32.99	33.08	1.15

Appendix D. Regulation 85 Data for WWTP Effluent in Clear Creek Watershed

Facility	Date	Flow (MGD)	Ammonia	Total Kjeldahl Nitrogen	Nitrate	Nitrite	Nitrate + Nitrite	Total Inorganic Nitrogen	Total Nitrogen	Total Phosphorus
			(mg/L)							
Town of Empire										
	1/14/2015	0.36	4.32	4.8	19.17	0.27	19.45	23.8	24.2	1.64
	2/12/2015	0.31	4.64	4.7	19.15	0.14	19.29	23.9	24	1.6
	3/17/2015	0.34	1.09	4.1	14.53	0.15	14.68	15.8	18.8	1.02
	4/7/2015	0.29	0.78	4.5	18.82	ND	18.82	19.6	23.33	0.95
	5/6/2015	0.27	1.66	2.2	18.16	ND	18.16	19.8	20.32	0.024
	6/2/2015	0.27	6.07	7.8	28.49	0.04	28.53	34.6	36.29	2.32
	7/21/2015	0.28	3.53	6.4	24.5	ND	24.5	28	30.95	0.61
	8/11/2015	0.31	0.84	3	29.61	ND	29.61	30.5	32.63	0.51
	9/10/2015	0.3	5.15		26.13	ND	26.13	31.27		1.15
	10/5/2015	0.32	7.42		26.66	ND	26.66	34.09		0.37
	11/2/2015	0.3	3.29	3.6	23.35	ND	23.35	26.6	26.98	0.18
	12/21/2015	0.31	8.73		15.3	ND	15.3	24.03		0.81
Town of Georgetown										
	3/4/2015	0.367	0.13	0.7			5.34	5.5	5.8	0.25
	4/1/2015	0.376	0.14	0.8			6.17	6.3	6.94	0.28
	5/6/2015	0.393	0.13	0.4			6.1	6.2	6.4	0.13
	6/3/2015	0.828	0.29	0.8			5.42	5.59	5.7	0.17
	7/1/2015	0.631	0.38	2			4.9	5.05	5.9	0.47
	8/5/2015	0.383	0.15	1.2			3.58	3.7	4.46	0.09
	9/2/2015	0.315	0.68	1.1			5.41	6.06	6.4	0.05
	10/7/2015	0.298	0.3	0.9			3.08	3.11	3.6	0.02
	11/4/2015	0.262	0.28	0.6			5.25	5.23	5.23	0.1
	12/2/2015	0.343	2.2	3			4.34	5.43	6	0.07
	1/6/2016	0.308	2.28	3.3			3.24	3.75	4.8	0.15
	2/3/2016	0.300995	6.75	7.5			8.17	14.11	15.6	0.18

Appendix D. Regulation 85 Data for WWTP Effluent in Clear Creek Watershed

Facility	Date	Flow (MGD)	Ammonia	Total Kjeldahl Nitrogen	Nitrate	Nitrite	Nitrate + Nitrite	Total Inorganic Nitrogen	Total Nitrogen	Total Phosphorus
			(mg/L)							
Town of Idaho Springs										
	1/22/2015	0.15	3.73	4.6	1.5	0.01	1.5	5.2	6.1	0.17
	3/3/2015	0.164	1.91	3.7	0.72	0.01	0.72	2.6	4.5	0.34
	5/4/2015	0.483	0.4	1.2	0.05	0.03	0.05	0.4	1.19	0.25
	7/6/2015	0.476	0.96	3.2	2.81	0.03	2.81	3.8	5.97	0.49
	9/2/2015	0.278	0.26	2.7	1.06	0.03	1.06	1.3	3.78	0.67
	11/2/2015	0.24	0.32	1.6	0.08	0.03	0.08	0.4	1.7	0.6
Loveland Ski Area										
	1/22/2015	0.00767	64.5	103	ND	ND	ND	64.5	103	4.47
	2/4/2015	0.01261	66.97	78.7	ND	ND	ND	67	78.8	5.64
	3/12/2015	0.00874	62.85	80.7	0.56	0.83	1.39	64.2	82.1	0.75
	4/10/2015	0.00685	1.83	9.7	8.5	0.38	8.88	10.7	18.6	0.57
	5/11/2015	0.01071	0.19	0.8	0.2	ND	0.2	0.4	1.04	0.27
	6/16/2015	0.02659	0.18	0.7	3.29	ND	3.29	3.5	3.99	0.31
	7/21/2015	0.004837	0.16	1.1	9.83	ND	9.83	10	10.94	1.12
	8/10/2015	0.00488	0.12	0.2	12.58	ND	12.58	12.7	12.79	0.43
	9/16/2015	0.003955	0.5	2.1	6.7	ND	6.7	7.2	8.75	0.67
	10/16/2015	0.005375	0.3	1.4	6.64	ND	6.64	6.9	8.03	0.68
	11/12/2015	0.0106	5.86	6.2	35.47	ND	35.47	41.3	41.69	1.04
	12/3/2015	0.00808	36.08	37.8	ND	ND	ND	36.08	37.81	2.95
St. Marys Glacier W&S District										
	1/19/2015	0.0095	0.91	10.3	9.02	ND	9.02	9.9	19.3	3.41
	3/9/2015	0.0095	0.14							1.59
	4/13/2015	0.0072	0.1	2.5	10.53	ND	10.53	10.6	13	1.25
	6/15/2015	0.0031	0.59	2.4	0.43	ND	0.43	1	2.82	0.29
	8/18/2015	0.0166	5.89	8.8	0.39	ND	0.39	6.3	9.2	0.34
	11/3/2015	0.0075	0.1	0.2	13.12	ND	13.12	13.2	13.33	0.71

ND-Not Detected