2019 Annual Report

Clear Creek / Standley Lake Watershed Agreement

July 16, 2020

2019 Clear Creek Watershed Annual Report

July 16, 2020

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
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

Report photographs contributed by the Cities of Westminster, Thornton, and Northglenn; and the Clear Creek Watershed Foundation.

Prepared by:
Trea Nance, City of Westminster
Reviewed by:
Jean Marie Boyer, Hydros Consulting Inc.

2019

Highlights

- ***Stakeholders continued to focus resources on protecting and enhancing water quality in the Clear Creek and Standley Lake watersheds.***
- ***Nutrient and total suspended solids loads in Clear Creek at CCAS59 (Golden) were once again below the most recent 5-year average.***
- ***Standley Lake nutrient and chlorophyll* a *patterns and magnitudes were within the range of previous years.***
- ***The chlorophyll* a *standard was once again met in 2019.***

CONTENTS

Standley Lake profiler

PURPOSE OF REPORT

This report provides a summary of the accomplishments and collaborative efforts to enhance and protect water quality in the Clear Creek Watershed and Standley Lake in 2019. This document fulfils the reporting requirements set forth in the Clear Creek Standley Lake Watershed Agreement, providing results from best management practices (BMPs) and control efforts, as well as results from the monitoring program in 2019. Additional information pertaining to the agreement, monitoring plan, and in-depth water-quality analyses, are included in the Supplemental Information sections.

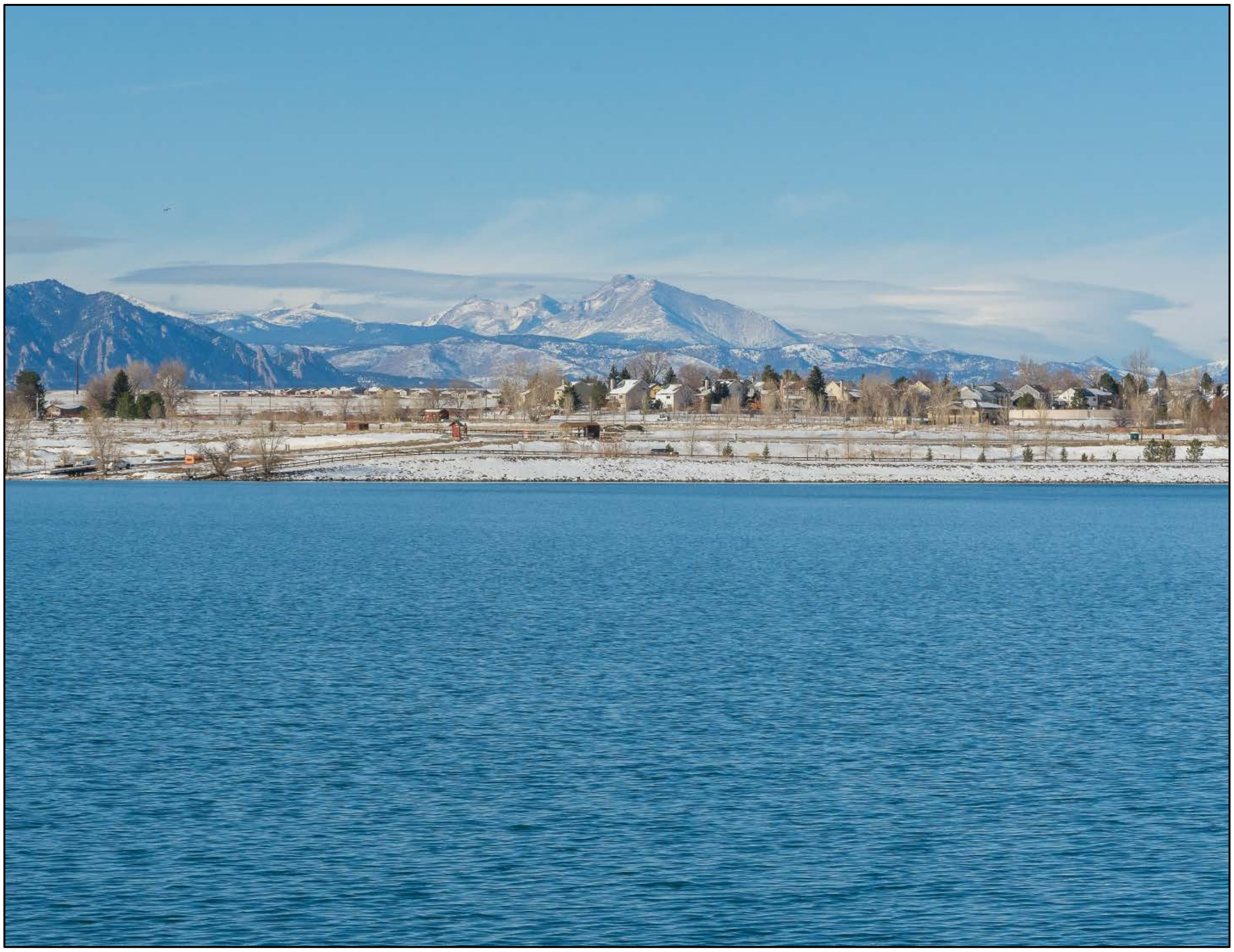
Egrets at Standley Lake

1. THE 1993 AGREEMENT

In 1993, the Clear Creek/Standley Lake Watershed Agreement (1993 Agreement) was signed by a contingent of governmental and private entities to address water-quality issues and concerns within the Clear Creek watershed, specifically as they affect the water quality in Standley Lake. The 1993 Agreement shaped the Watershed Monitoring Program and has resulted in a long term, robust data set that is used to both monitor the success of water-quality actions and to inform future projects. To continue efforts to protect Standley Lake water quality, a numeric chlorophyll *a* standard was implemented in 2009.

Chlorophyll a Standard

In 2009, the Water Quality Control Commission adopted a numeric chlorophyll a standard for Standley Lake. A 4.0 µg/L chlorophyll a *standard was established as a protective measure for this drinking water supply reservoir. The standard is evaluated on an annual basis using the average of the nine monthly averages of observed data for the period from March through November.*



Standley Lake

2. THE SETTING

CLEAR CREEK WATERSHED AND THE UPPER BASIN

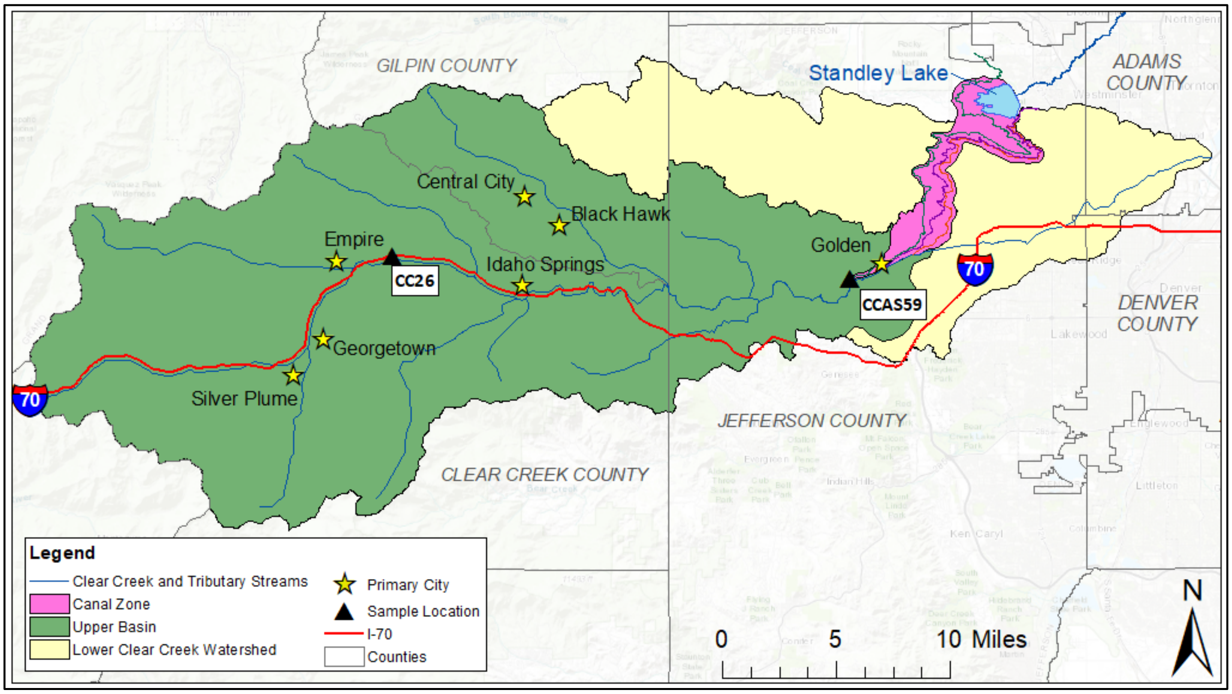


Figure 1. The Standley Lake Watershed: Upper Basin and Canal Zone

Rafters on Clear Creek

The Upper Clear Creek Watershed covers 450 square miles and is located west of Denver, Colorado, with headwaters at the Continental Divide (Figure 1). The Upper Basin of the watershed is the portion above the headgates for the three canals supplying Standley Lake. It extends from the headwaters downstream to near the City of Golden. In addition to supplying drinking water for 350,000 residents in the watershed (including the Cities of Northglenn, Thornton and Westminster), Clear Creek provides water for recreational, agricultural, and industrial purposes.

CANAL ZONE

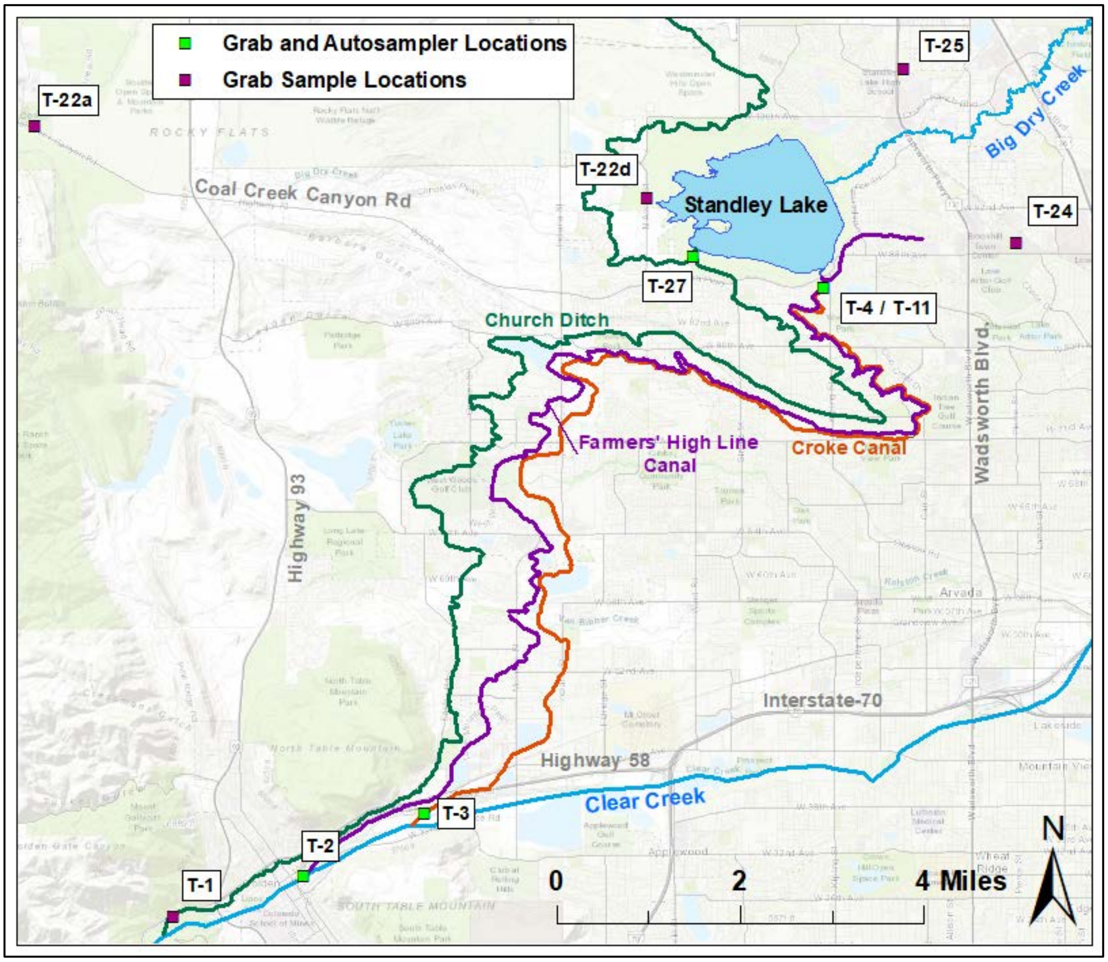


Figure 2. The Canal Zone Showing the Three Canals that Divert Water from Clear Creek to Standley Lake

The Canal Zone is the drainage area that includes three canals that divert water from Clear Creek into Standley Lake: Church Ditch (Church), Farmers' High Line Canal (FHL), and the Croke Canal (Croke) (Figure 2). The three canals are low-gradient, earthen, open, and unlined. In addition, they are subject to nonpoint-source loading from adjacent horse and cattle operations, other agricultural activities, and residential properties (some with on-site wastewater treatment systems, OWTS [septic tanks]). To protect Standley Lake's water quality, efforts have been made since the 1990s to reduce the majority of storm water inputs/runoff into the delivery canals. As a result, ~80% of stormwater inputs have been hydrologically disconnected from the canals. The Kinnear Ditch Pipeline (KDPL), which provides flow from the Fraser River, South Boulder Creek, and Coal Creek, also contributes water to Standley Lake (< 6%). The four inflows and their associated typical diversion seasons are provided in Table 1.

Table 1. Inflow Sources and Diversion Seasons

Inflow	Diversion Season
FHL	April 14 – October 31
Croke	October 31 – April 14
Church Ditch	April 14 – October 31
KDPL	Year Round

2. THE SETTING

Standley Lake

STANDLEY LAKE

Aerial image of Standley Lake

Standley Lake is a municipal and agricultural reservoir located in Jefferson County, Colorado. Construction of the dam was completed in 1912 and in 1963, the City of Westminster expanded the reservoir to its current storage capacity of 43,000 acre-feet. The reservoir is a direct-use drinking water supply for over 300,000 consumers in Northglenn, Thornton, and Westminster. The reservoir also provides recreation opportunities as well as water to farms located in Adams and Weld counties. It is owned and operated by the Farmers' Reservoir and Irrigation Company (FRICO) and is the third largest reservoir in the Denver metropolitan area, covering approximately 1,200 acres. Standley Lake receives the majority of its inflows from the Clear Creek Watershed via three canals. Through the Watershed Monitoring Program, the reservoir is monitored regularly during the ice-free period.

Kayakers enjoying Standley Lake

Pelicans on Standley Lake

MONITORING IN THE UPPER BASIN

Taking a grab sample of Clear Creek at CC26 (Lawson)

Flow measurements are collected at four locations. Water-quality samples are collected at 15 stations throughout the watershed to monitor the concentrations of nutrients, select metals, and other key constituents. Upper Basin monitoring activities have been designed to evaluate the relative contributions of various nutrient sources, the effectiveness of BMPs, wastewater treatment facility (WWTF) operational changes, and nutrient reductions from WWTF upgrades. The Watershed Monitoring Program uses a combination of ambient grab samples, 24-hour ambient composite samples, and the automated collection of composite event samples to assess water quality. In 2019, a total of 65 samples were collected in the Upper Basin of the watershed (Table 2).

Table 2. Samples Taken in the Upper Basin, 2019

Type of Sample	Total Number of Samples Collected
Grab samples	43
Ambient composites	16
Storm-triggered composites	6

Clear Creek at CC26 (Lawson)

Sample Types for the Upper Basin

***Grab samples** provide a water-quality snapshot in time.*

***Composite samples** provide a more complete picture of water-quality fluctuations over the course of the 24-hour sampling period. Two types of composite samples are collected:*

- ***Ambient samples** are collected on a periodic basis over a 24-hour period during base flow.*
- ***Event samples** are collected during storms when elevated turbidity/conductivity triggers the autosamplers.*

WASTEWATER TREATMENT FACILITIES AND REGULATION 85

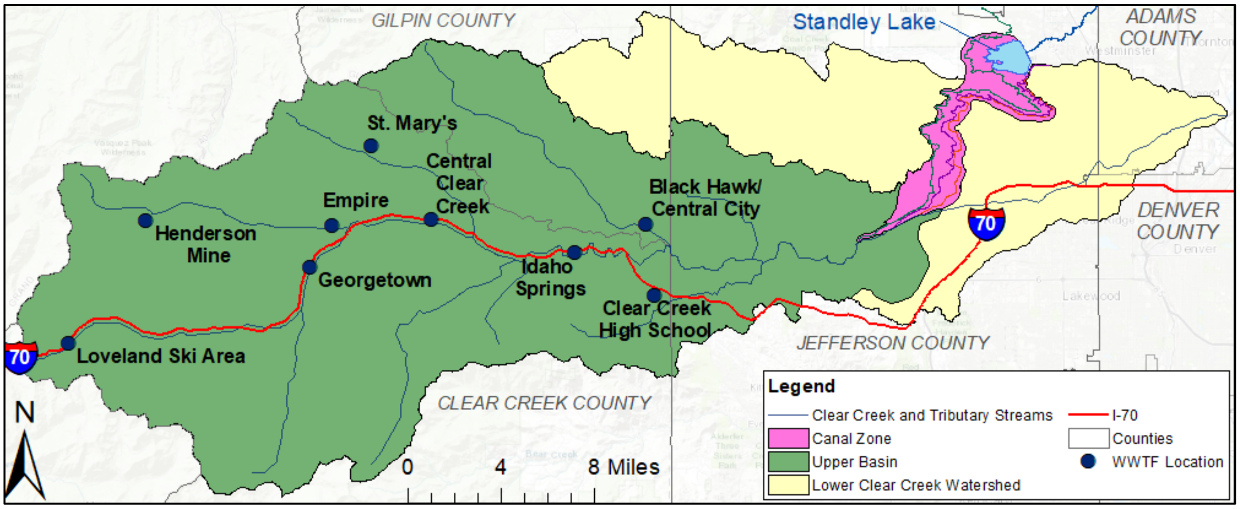


Figure 3. WWTF Locations in the Upper Basin

> ***Regulation 85***
>
> *In 2012, the Water Quality Control Commission (WQCC) adopted Regulation 85 (CDPHE, 2012), the Nutrients Management Control Regulation, which establishes numeric limits for nutrient concentrations in WWTF effluent.*

Of the nine wastewater treatment facilities (WWTFs) in the Upper Basin (Figure 3), only the Black Hawk / Central City Sanitation District facility (design capacity of 2.0 MGD) is subject to Regulation 85 effluent limits and monthly monitoring requirements. Minor dischargers (less than 1 MGD design capacity) are required to sample once every two months at a minimum. This applies to the seven domestic WWTFs in the watershed: Loveland Ski Area, Georgetown, Empire, Central Clear Creek, Idaho Springs, St. Mary's, and Clear Creek High School. Effluent nutrient concentrations for these WWTFs and Henderson Mine (an industrial discharger located above the town of Empire) are summarized in Table 3. WWTFs are required to monitor total inorganic nitrogen and total phosphorus, per Regulation 85. Since this report focuses on total nitrogen (TN) and total phosphorus (TP), TN is reported here.

Table 3. Effluent Nutrient Concentrations and Flows from WWTFs in the Clear Creek Watershed for 2019

Location	WWTF	Average Flow (MGD)	Sample Count	Total Phosphorus (mg/L)			Total Nitrogen (mg/L)		
				Min	Max	Median	Min	Max	Median
Upstream	Loveland Ski Area	0.007	12	0.16	3.67	0.41	5.93	72.59	31.40
↓	Henderson Mine*	1.964	18	0.005	0.005	0.005	1.40	5.92	2.63
↓	Georgetown	0.256	6	0.01	0.05	0.04	1.70	7.30	3.95
↓	Empire	0.025	6	0.07	1.21	0.51	13.45	42.22	19.78
↓	Central Clear Creek	0.028	11	0.08	5.96	4.16	10.06	36.81	25.10
↓	St. Mary's	0.098	10	0.12	2.82	1.47	2.94	27.59	17.65
↓	Idaho Springs	0.248	12**	0.25	1.12	0.58	1.08	4.73	2.30
↓	Black Hawk/Central City	0.322	11	0.09	0.26	0.10	5.60	19.10	7.80
Downstream	Clear Creek High School	0.008	11	6.73	24.60	9.42	0.50	75.45	13.33

*TP data for Henderson Mine were all non-detect and are reported here at ½ the detection limit.

** Idaho Springs TN data summary based on 11 samples.

2019 WWTF Improvements

***Georgetown** replaced three aeration blowers, installed a new uninterruptible power supply, replaced a failed on-site hypochlorite generation with bulk liquid sodium hypochlorite, installed a fourth tertiary filter, and installed a new weir in the secondary clarifier.*

***Idaho Springs Water Resource Reclamation Facility** began construction on Project 1 of the plant expansion. Project 1 includes two new aerobic digesters, new headworks and screening equipment, relocation of the dewatering equipment, installation of a pre-equalization basin, and the installation of a six-disc tertiary filtration system.*

NONPOINT SOURCE CONTROL

This section highlights key accomplishments in 2019 for nonpoint source pollution control and monitoring in the Upper Basin.

The City of Golden operates under a Municipal Separate Storm Sewer System (MS4) permit and is designated a Qualifying Local Program (QLP) by the Water Quality Control Division. In 2019, the City reapplied for QLP designation, incorporating 2018 Division-initiated changes to the Construction General Permit into the City's Stormwater Quality Permitting Program. Under this permit and designation, the City ensures that erosion and sediment controls are implemented on construction sites. In 2019, The City of Golden administered 26 stormwater quality construction permits; conducted 637 erosion and sediment control inspections; issued 339 written notifications of violations; issued 43 verbal notifications of violation; and issued four stop work orders. The City of Golden performs annual inspections of all permanent water-quality BMPs and requires routine cleaning and maintenance be performed by property owners.

In 2019, a project to enlarge and improve a regional extended detention basin was completed in the Lena Gulch watershed. This was a joint project between the City of Golden, Mile High Flood District, Jefferson County, and the Colorado Department of Transportation and is located on the southeast corner of I-70 and the 6^{th} Avenue interchange. The basin was enlarged to provide 18.7 AF of storage which reduced the 100-year flows from 450 cfs to 148.5 cfs. In addition, the upgraded extended detention basin integrates full spectrum detention which will reduce release rates for smaller storms and provide water-quality benefits that were not provided prior to modifications.

EMERGENCY RESPONSE AND ILLICIT DISCHARGES

Clear Creek County Office of Emergency Management uses the Code Red Emergency Call-Down System. This system is used to promptly and effectively notify downstream users of Clear Creek water of any potential contamination from an upstream source. The system is initiated when incidents / spills into Clear Creek or its tributaries occur. In 2019, the call-down system was activated seven times.

Illicit Discharges in The City of Golden

***The City of Golden** responded to 46 reports of illicit discharges to the storm system resulting in:*

- *16 written warnings;*
- *19 verbal warnings;*
- *2 summons; and*
- *3 cases where clean-up costs were levied.*

WILDFIRE PLANNING STUDY

The Upper Clear Creek Watershed Association (UCCWA) is an organization of dischargers, governmental entities, and other organizations, formed to work cooperatively toward the goal of improving water quality in Clear Creek. In August of 2019, UCCWA, in partnership with the City of Golden and the Standley Lake Cities, contracted with Matrix Design Group to complete a wildfire planning study to include pre-fire planning to prepare the watershed for a potential wildfire and post-fire responses. The major goals of this study are:

- Reducing the impact to citizens in a post-fire scenario;
- Improving water and wastewater infrastructure resiliency;
- Crafting a list of risk mitigation projects to undertake before a wildland fire;
- Collaboration to qualify for funding to implement projects pre-fire;
- Building strong relationships for coordination post-fire; and
- Increasing coordination with the United States Forest Service and Colorado State Forest Service.

Study partners also applied for a $40,000 grant (awarded in 2020) from the Colorado Water Conservation Board to conduct sediment and debris flow sensitivity analyses and fluvial hazard zone mapping in the highest priority sub-basins of the watershed. Thus far, a robust GIS database and mapping tool for the Clear Creek watershed was developed, including data layers of wildfire risk, probability and intensity, drinking water risk, forest management, runoff potential, wildland urban interface delineation, and zones of concern. Next steps are to select the highest priority sub-basins for more detailed debris flow analyses and project identification. The target date for the completion of the pre-fire study is December 2020.

PUBLIC EDUCATION AND OUTREACH

In 2019, the **City of Golden** utilized their website, direct mailing, and public events to keep their residents informed on practices to maintain and improve water quality (dog waste, household runoff, fertilizer, etc.).

The City continued its long-standing partnership with ReSource Central to offer three programs: Water-Wise Landscape Seminar, Garden in a Box, and Slow the Flow. Through these three programs, the city provided a Water-Wise Landscape Seminar to 80 attendees, 177 water conserving gardens, and 31 residential sprinkler system inspections. The three programs incentivize water conservation and promote nutrient management through efficient water use in the landscape and a reduction of irrigation overflow to the storm sewer system.

The City of Golden Sustainability Department worked with ReSource Central on a Grass to Garden Turf Replacement Program. Two homes were selected to beautify their landscape and save water by removing their grass and replacing it with a free Garden in a Box landscape. The program equipped residents with the knowledge, resources, plant materials, and landscape design needed to transform a portion of their lawn into a Xeriscape garden.

Rooney Road Recycling Center

The Rooney Road Recycling Center provides critical recycling and disposal services for household hazardous waste and electronics. In 2019, the facility collected over 288 tons of household hazardous waste.

MONITORING IN THE CANAL ZONE

To provide information for evaluation of the nutrient loads from nonpoint sources in the Canal Zone, the Church, Croke, and FHL canals are sampled at the headgates where water is diverted from Clear Creek and again at the inlets to Standley Lake. The KDPL is sampled upstream in Coal Creek and near the inlet into Standley Lake. Figure 2 shows the headgate and inlet monitoring locations for each canal. Routine monitoring for the Canal Zone is described in detail in the Watershed Monitoring Program. A total of 97 samples were collected in the Canal Zone in 2019. Sample types include: grab samples, ambient composites, storm triggered composites (event), and first flush composites (Table 4). These samples are important for assessing how water quality changes along each canal as well as for quantifying loads into the reservoir.

Table 4. Samples Taken in the Canal Zone, 2019

Type of Sample	Number of Samples Collected
Grab samples	76
Ambient	11
Storm-triggered composites	5
First flush	5

First Flush Samples

First flush samples *are collected during the initiation of water delivery to Standley Lake and provide data on the quality of the water entering the reservoir during the seasonal start-up of the canals.*

Croke Canal

CANAL IMPROVEMENTS

Church Ditch – Area 15 lining before (top) and after (bottom)

City of Northglenn Staff completed autosampler housing maintenance in 2019. Sampler boxes were repainted, decking was replaced, hinges were spot welded, and rust was removed. The maintenance guide was updated.

Church Ditch Water Authority (CDWA) continues to focus on maintenance of the ditch and associated easement. This maintenance includes vegetation removal, ditch shaping, and bank repair. Vegetation removal reduces the risk of blockages, increases ditch capacity, and decreases sedimentation from erosion. In 2019, approximately three miles of vegetation was removed along both sides of the ditch. The majority of the ditch was mowed to maintain previous efforts of vegetation removal. Ditch shaping and bank repair are performed to increase ditch capacity, improve flow, and protect water quality by reducing erosion.

Approximately two miles of the Church ditch was reshaped and cleaned in 2019 and CDWA actively oversees any projects within the ditch easement or channel to ensure proper care is taken to maintain water quality by minimizing or eliminating erosion and stopping potential contaminants from entering the ditch. In 2019, such projects included the Area 15 Ditch Lining, Legacy Farms culvert removal, Headgate 47 replacement, and the Lee St. sanitary sewer crossing.

Farmers' High Line Canal and Reservoir Company staff continued activities that support protection of or improvements to water quality. In 2019, staff worked with FRICO staff to install safety equipment at the sampling location where FHL and the Croke Canal enters the reservoir. This included the installation of handrails and a suspended walkway for sampling personnel. A crane placed the suspended walkway in place. Final safety features will include a fence and gate to keep pedestrians off the walkway and away from the autosampler (green structure to the right of the walkway in the photo below). Other activities to enhance and maintain water quality include ditch maintenance, mowing, removal of sediment, and flushing.

In addition to the safety improvements mentioned above, **Croke Canal** activities in 2019 performed by FRICO and the Standley Lake Operating Committee continued to support the protection of water quality. Heavy brush and tree branches were removed or trimmed to improve access to the autosampler at the headgate.

Installation of the new walkway

The finished walkway

New ladder safety features

NONPOINT SOURCE CONTROL

The City of Arvada's most concentrated efforts for protecting water quality in Clear Creek and its tributaries are related to compliance with a MS4 permit and work in waterways conducted by the Mile High Flood Control District. Programs associated with the MS4 permit ensure that erosion and sediment controls are implemented on active construction sites. In 2019, 1,669 erosion and sediment control inspections were conducted on 136 active construction sites. Additionally, the City of Arvada carried out inspection and enforcement related to post-construction permanent BMPs, which includes detention and retention ponds, swales, and underground proprietary devices. In 2019, the City inspected 50 permanent BMPs, which were followed by corresponding reports sent to owners of the stormwater conveyance. The City responds to 40-60 complaints of illicit discharges per year that may result in spill mitigation. City facilities with runoff control plans are inspected twice annually. Employee training on pollution prevention for municipal operations focuses on preventing and mitigating any potential contamination sources from City facilities, and spill response procedures specific to work in the field. Reports are generated and sent to designated facility stormwater administrators to address.

PUBLIC OUTREACH AND EDUCATION

City of Arvada personnel, citizens, and students are provided information to ensure awareness that City storm drains flow directly to waterways and certain activities can produce pollution in those storm drains. Programs such as adopt-a-street or trail program, storm drain marking, household chemical disposal and recycling, and brochures and demonstrations are focused on informing residents about preventing stormwater pollution. Additionally, the City of Arvada hosted their annual Drug Take-Back Event in April 2019.

The City also worked with local stakeholders and Colorado Rural Water Association (CRWA) to complete a Source Water Protection Plan. Key locations identified for protective BMPs include Ralston Reservoir, Arvada Reservoir, Ralston Creek, and the three Clear Creek ditches (Church, Croke, and FHL).

SOURCE WATER PROTECTION PLAN: PHASE 2

The Standley Lake Cities (Westminster, Thornton, and Northglenn), with the aid of CWRA, met with stakeholders to develop Phase 2 of the Source Water Protection Plan (SWPP). This plan builds on the original SWPP, which focused on BMPs to limit nutrient loading in the Upper Clear Creek Watershed and Standley Lake. Public planning meetings with state and local government and agency representatives took place from November 2018 to December 2019. The Standley Lake Cities focused their efforts on the Source Water Protection Area, a 150-foot buffer area surrounding Standley Lake and a 100-foot buffer area surrounding the canals.

Conductivity data for Standley Lake shows an increasing trend the last seven years. Observed spikes in conductivity appear to be correlated to winter storm events. The main focus of Phase 2 of the SWPP is studying increases in chloride concentrations from the mouth of Clear Creek Canyon to Standley Lake. It is hypothesized that the conductivity increases are a result of the application of road salts in winter. The goals of this study include additional monitoring of conductivity in the Croke Canal during winter, implementing BMPs where necessary, and conducting outreach and education to salt applicators. In 2019, additional monitoring stations equipped with conductivity probes helped narrow down the areas where road salts were entering the canal. A visual watershed assessment was conducted to identify the problem areas and assess if impervious surfaces were a contributing factor. After the potential problem areas were identified, the Standley Lake Cities worked with the Cities of Golden and Arvada to implement BMPs where possible.

In addition to the chloride studies, other potential sources of contaminants were investigated in Phase 2 of the SWPP. These included: wildland fire, urban stormwater runoff, security, flooding, and illegal dumping. BMPs for these contaminant sources were established by the SWPP and will be implemented by the participating parties in the future.

MONITORING AT STANDLEY LAKE

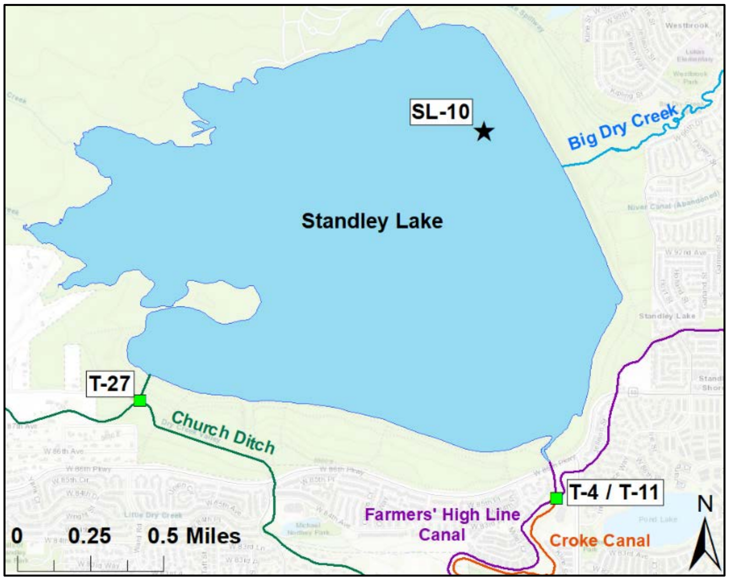


Figure 4. Standley Lake Sampling Location and Locations of Canal Inflows

Standley Lake is monitored throughout the year when ice is not present. The reservoir is sampled in multiple locations, however, SL10 (Figure 4) is most pertinent to this report because it is the deepest site. This site is located near the municipal supply intakes and is the location of the automated profiler. Daily reservoir profiles are taken and biweekly samples are also collected at the surface, through the photic zone, and at the bottom.

The Standley Lake profiler

The Standley Lake Profiler *is equipped with a multi-probe sonde which provides measurements of water temperature, dissolved oxygen, pH, conductivity, turbidity, oxidation/reduction potential (ORP), and chlorophyll* a *concentrations.*

Standley Lake Monitoring 2019

Daily Profiles: *Standley Lake water quality is measured four times per day for approximately 10 months per year using an automated profiler. Measurements are taken every meter, from the surface to within 2 meters of the bottom.*

Water-Quality Sampling: *Samples are collected in the reservoir at three depths. Grab samples are taken at the surface and one meter from the bottom. A composite sample is taken over the extent of the photic zone (at two times the measured Secchi depth). In 2019, 67 water-quality samples were collected on the reservoir.*

Sampling Standley Lake

Zooplankton Samples: *Zooplankton tows are taken once every two weeks.*

AQUATIC INVASIVE SPECIES MANAGEMENT AND PREVENTION

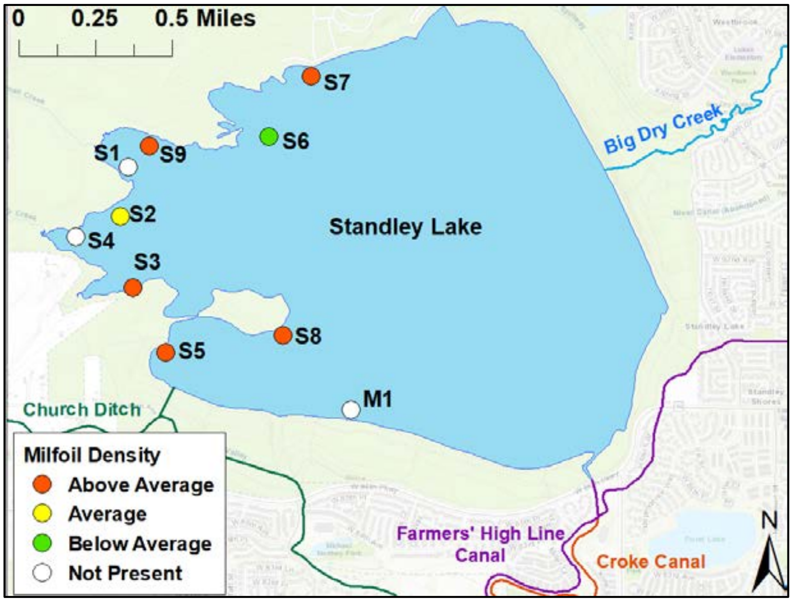


Figure 5. 2019 Standley Lake EWM Density Results, Colors Indicate Comparison to the Average (2014-2017) for the Locations

Eurasian Watermilfoil (EWM) is an aquatic invasive species that established in Standley Lake in 1998 and has been managed with the addition of EWM weevils, an herbivorous insect with a preference for EWM. Weevils have been stocked in Standley Lake on five separate occasions from 2002-2011, leading to observed declines in EWM densities. On August 19, 2019, City of Westminster personnel performed a plant survey of previously established locations (Figure 5). A one-meter wide rake was used to collect aquatic plants from a one-square meter section. When found, a subsample of 25 milfoil stems were collected from each sample for identification and enumeration. The stems were then examined for insect damage and disease using a 40x dissecting scope.

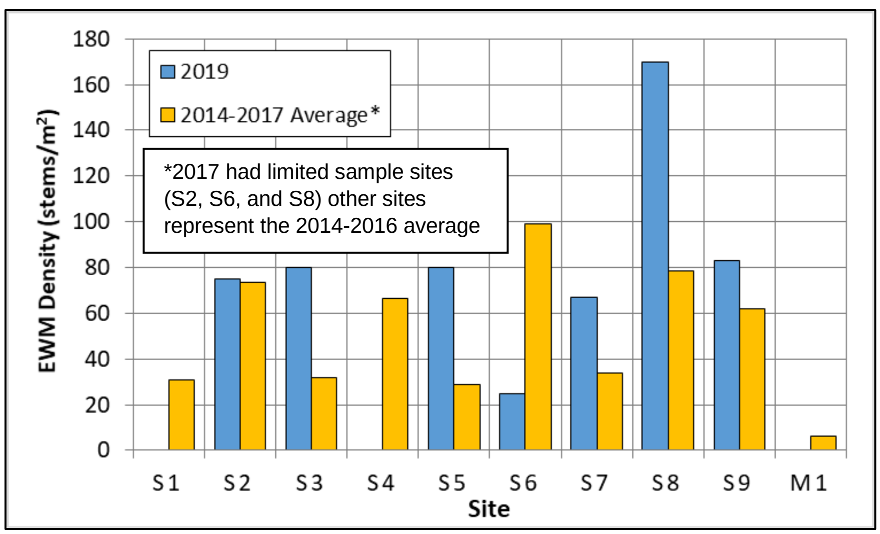


Figure 6. Milfoil Densities at Standley Lake, 2019 and 2014 - 2017 Average

This was the fifth year that City personnel performed the survey. 2017 was an abbreviated survey of only three sites (S2, S6, and S8) and 2018 did not have a survey, therefore 2019 observations are compared to the 2014-2017 average. Milfoil densities (stems/m^2) were above the 2014 -2017 average at sites S3, S5, S7, S8, and S9. Milfoil density was below average at site S6, and no milfoil were present at sites S1, S4, and M1 (control location). Site S2 was comparable to the 2014-2017 average (Figures 5 and 6). The combined average of all the sample sites was 58 stems/m^2 which is slightly below the 2014-2017 average of 64 stems/m^2.

Weevil presence is measured based on milfoil damage/disease. All of the sites that were above average in milfoil densities showed evidence of damage. The two sites that were well above average in density (S5 and S8), also had the highest percentages of weevil damage (Figure 7). All of the other sites with milfoil present were either below average in damage (S3, S7, and S9) or exhibited no damage (S2 and S6). The combined average weevil damage for all sites was 23%. This is lower than the 2014-2017 combined average of 31%.

Water-levels vary from year-to-year. Over winter, weevils hibernate in grasses along the shoreline. When water levels are low in spring, weevil damage to EWM tends to decrease due to mortality. It is hypothesized that when the weevils have to travel farther during their spring migration, they are less likely to survive. 2019 had a large drawdown in winter resulting from dry conditions observed in 2018 (Hydros, 2019). The observed decreases in weevil damage in 2019 may be attributed to the low water levels experienced in winter and spring.

City of Westminster staff during the 2019 survey

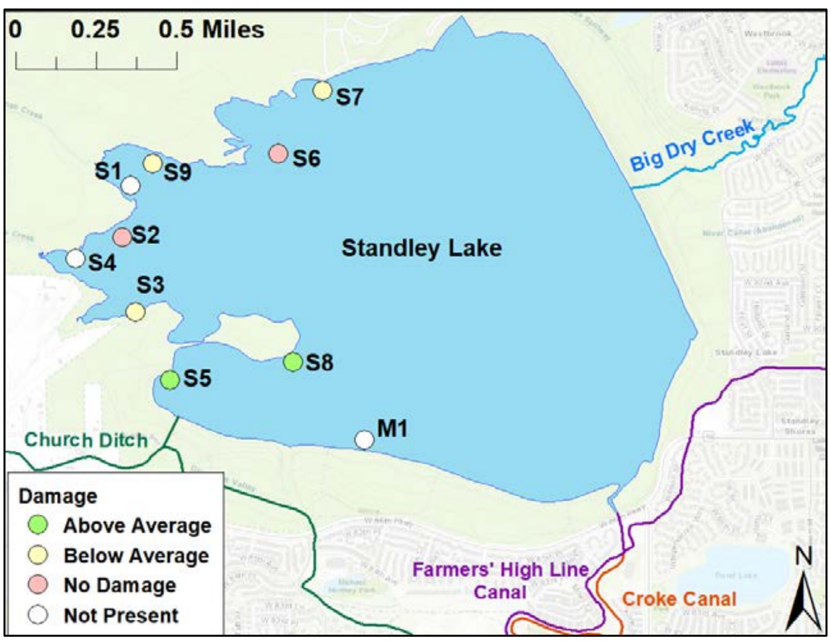


Figure 7. Weevil-Induced Milfoil Damage at Standley Lake, 2019 compared to the 2014 - 2017 Average

Overall, while there is variability between sites on a yearly basis, the density of milfoil in the reservoir appears to be stable and within the range of previous observations since 2011 (Figure 8) indicating that the weevils are still contributing to the observed decreases in EWM densities in Standley Lake.

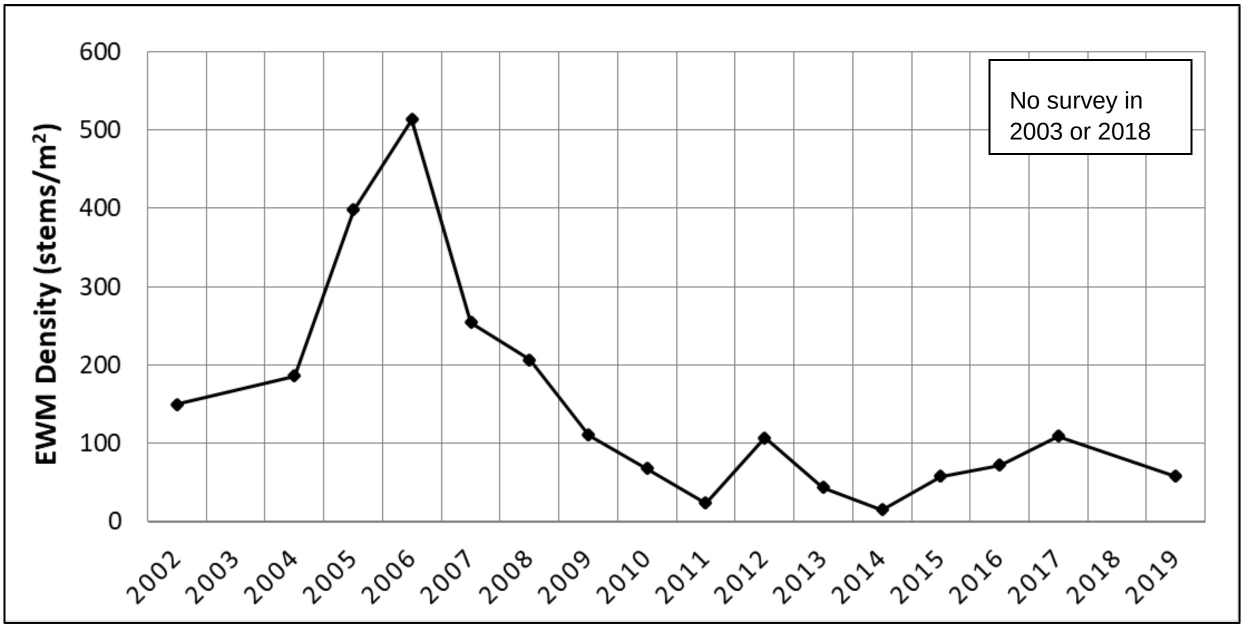


Figure 8. Average EWM Densities in Standley Lake, 2002-2019, Includes All Locations

Zebra mussel (image: Colorado Parks and Wildlife)

Quagga and Zebra Mussels (QZM) are non-native aquatic invasive species that can be introduced to new water bodies by the unintentional transfer of organisms from an infested water body, often via boats or fishing bait. To protect Standley Lake from QZM, an extensive boat inspection, decontamination, and quarantine program, was implemented in 2008. Additionally, no live aquatic baits are allowed in the reservoir. Trailered boats were not permitted on the lake in 2019 due to tagging compliance issues. During this time, additional protocols for boat tagging and tracking were evaluated to protect the lake from invasive mussels.

Standley Lake is monitored for mussels via three methods: zooplankton tows, substrate samplers, and shoreline surveys. Zooplankton tows are performed every two weeks at the reservoir inlets and the boat ramp/outlet area. Substrate samples are monitored by Colorado Parks and Wildlife (CPW) and are placed at several locations in the reservoir. A shoreline survey is performed when water levels are at their lowest. All sampling efforts in 2019 showed that the reservoir continues to remain free of zebra and quagga mussels.

How do we sample for mussels?

Zooplankton tows *target the microscopic larval mussel stage and is an early detection method.*

Substrate samples *help detect juvenile mussels that have started the attachment phase of the life cycle.*

Shoreline surveys *are performed when water levels are low and target adult mussels that may be attached to hard surfaces.*

PUBLIC EDUCATION AND OUTREACH

The 2019 Tri-City Youth Water Festival took place on May 16, 2019. Fourth and fifth graders from the water service areas of Thornton, Northglenn, and Westminster converged to learn about a variety of Colorado water topics. Over 1,000 students, teachers, and parents attended the event at Front Range Community College in Westminster, which offered a day of fun and educational workshops featuring active learning and hands-on activities. 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 thirty students was scheduled to attend five to six workshops on different topics during the day.

2019 Presenters

- CSU Extension
- Adams County Stormwater
- City of Westminster
- City of Northglenn
- City of Thornton
- National Weather Service
- Colorado 811-UNNC
- US Bureau of Reclamation
- Collins Cockrel & Cole, PC
- North Metro Fire Rescue
- Metro Wastewater Reclamation District
- Barr Lake State Park
- Environmental Learning for Kids
- Colorado Water Conservation Board
- Bird Conservancy of the Rockies
- Denver Zoo
- Mad Science of Colorado
- Raptor Education Foundation
- The Mysto Mysto Show

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, rain gauge, a flow bag and an instruction sheet. There is a video 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.

Teachers were encouraged to turn in evaluations at the end of the Water Festival. As in previous years, the evaluations show high presentation ratings and positive comments on event organization and educational value of the experience.

The Mysto Mysto Show

Students attending workshop

TOTAL SUSPENDED SOLIDS, PHOSPHORUS, AND NITROGEN LOADING IN THE UPPER BASIN

Loads of total suspended solids (TSS), TP, and TN in the Upper Basin were quantified for 2019 and compared to the average of the previous five years. Two sampling locations were included in this analysis (Figure 1): the upper station (CC26) and the lower station (CCAS59/60). Additional details about these sampling locations are provided in the Watershed Monitoring Program. Ambient grab and autosampler data from the two stations were used to quantify nutrient loads from upstream to downstream and provide an assessment of water quality in the upper watershed. The results are presented in Figures 9-11. Loads at CC26 in 2019 were 6% and 33% higher for TSS and TN, respectively, but 33% lower for TP. Loads at the upper station for TP were comparable to 2015-2018 loads. TSS, TP, and TN Loads at CCAS59/60 were 15%, 38%, and 13% lower than the average, respectively. This is due to the influence of high flow volumes and resulting high loads in 2014 and 2015 driving the 2014-2018 average. The higher flow volumes in these two years may be related to a response from the 2013 flood. This is explored further in the Data Analysis and Interpretation Supplement.

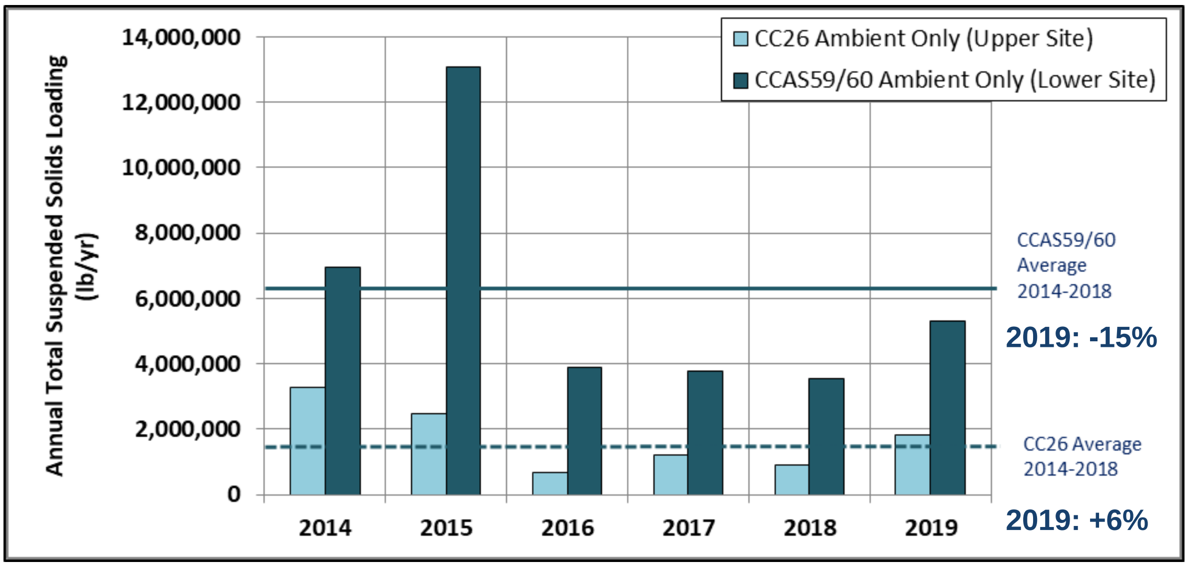


Figure 9. TSS Loads with Percent Change in 2019 for the Upper Station (CC26) and Lower Station (CCAS59/60)

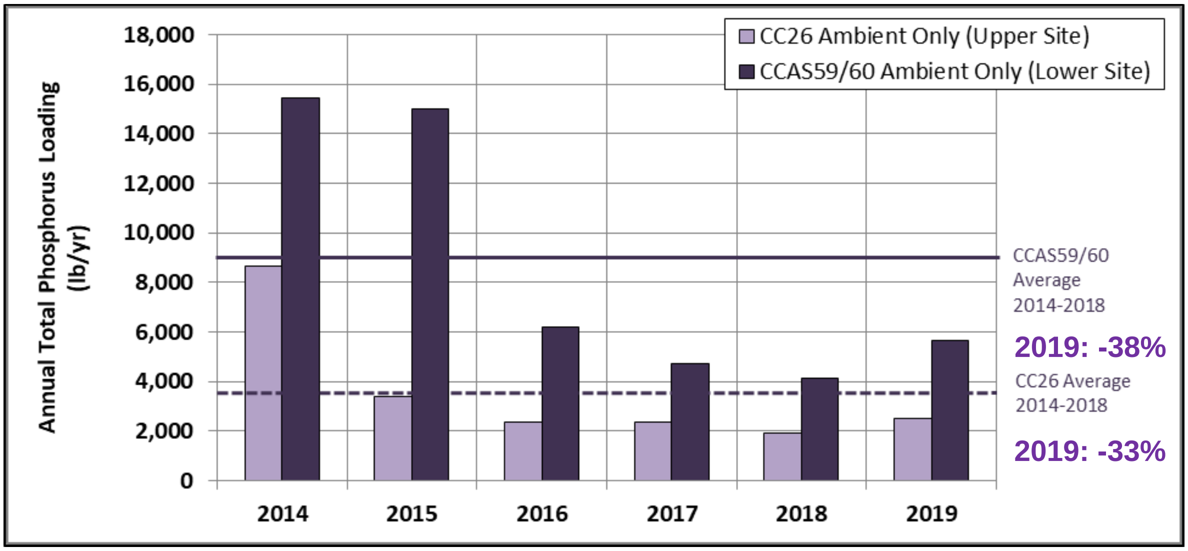


Figure 10. TP Loads with Percent Change in 2019 for the Upper Station (CC26) and Lower Station (CCAS59/60)

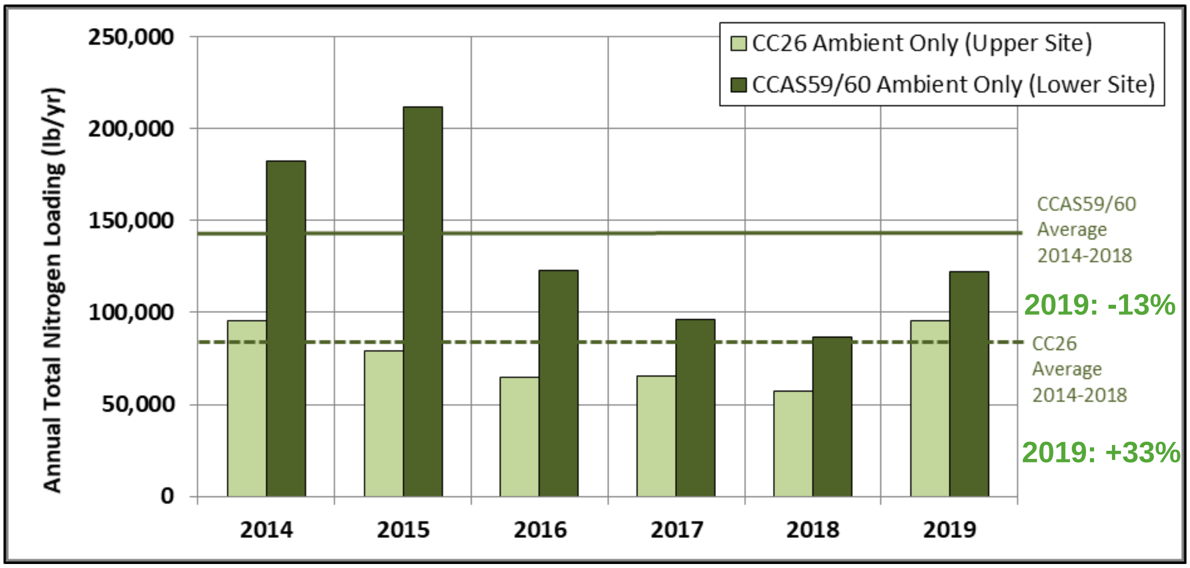


Figure 11. TN Loads with Percent Change in 2019 for the Upper Station (CC26) and Lower Station (CCAS59/60)

TOTAL SUSPENDED SOLIDS, PHOSPHORUS, AND NITROGEN LOADING IN THE CANAL ZONE

Loads for TSS, TP, and TN from the four conveyances entering Standley Lake are presented in Figures 12-14. Percentages of flow contributions are provided in Figure 15. Percentages of TP and TN load contributions by source are provided as an example to compare percentages of loads to flow. The FHL continues to contribute the largest fraction of the total annual loads to the reservoir for TSS, TP, and TN (63%, 55%, and 57%, respectively). This contribution is expected as it is the primary canal used during runoff in spring and provided 58% of the total annual inflow (2019) to the reservoir. The Croke Canal is the second largest contributor of flow (29%) and total annual loads, contributing over a third of the total TSS, TP, and TN loads entering the reservoir (30%, 36%, and 35% respectively). While flow contribution percentages remain relatively similar between years for the Croke Canal, the load percentages tend to be more variable. During some years the Croke has contributed almost half of TP and TSS loads in one-third of the total annual flow to the reservoir (e.g., 2017, Hydros, 2018). Concentrations in the Croke tend to fluctuate more than the FHL regardless of flow volume, this leads to variability in loads each year. Reasons for this variability in the Croke are currently unknown.

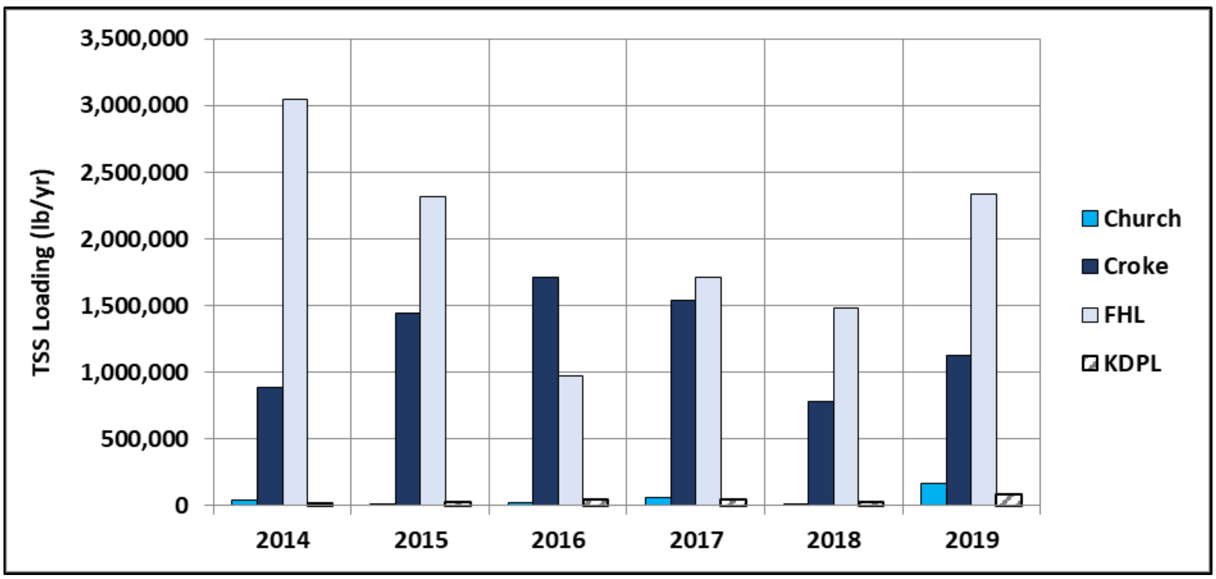


Figure 12. Total Suspended Solids Loading Into Standley Lake by Source, 2014-2019

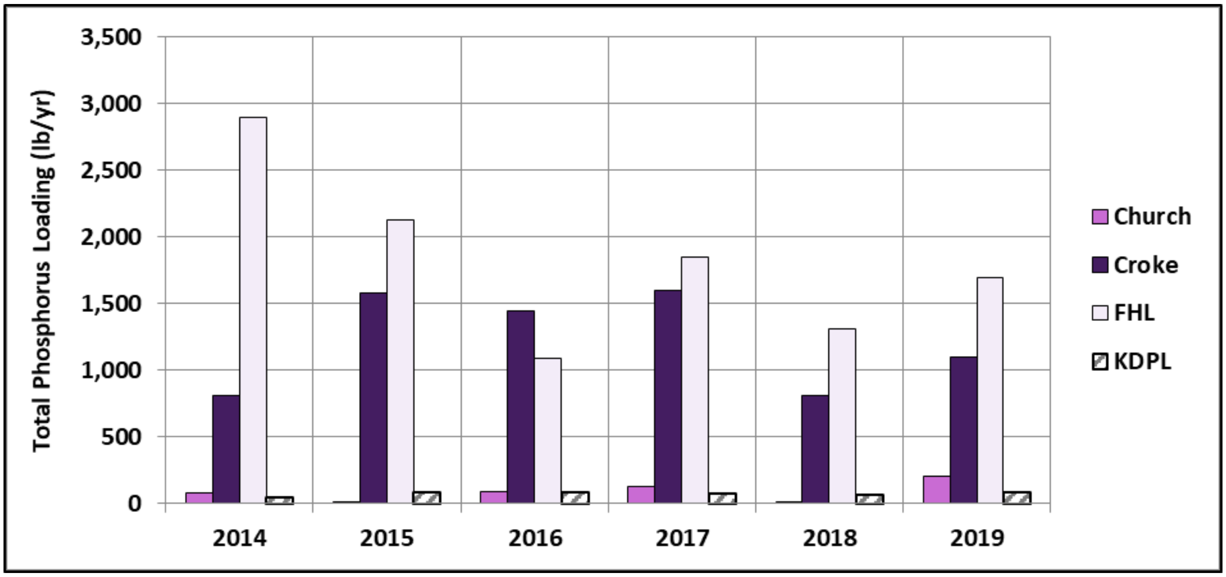


Figure 13. Total Phosphorus Loading Into Standley Lake by Source, 2014-2019

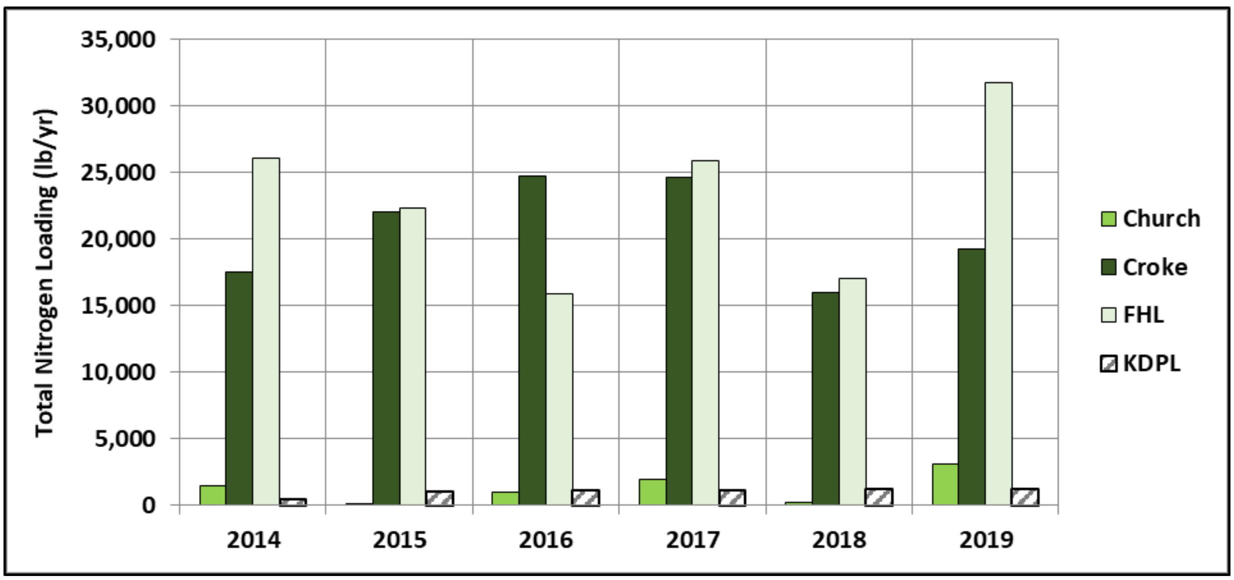


Figure 14. Total Nitrogen Loading Into Standley Lake by Source, 2014-2019

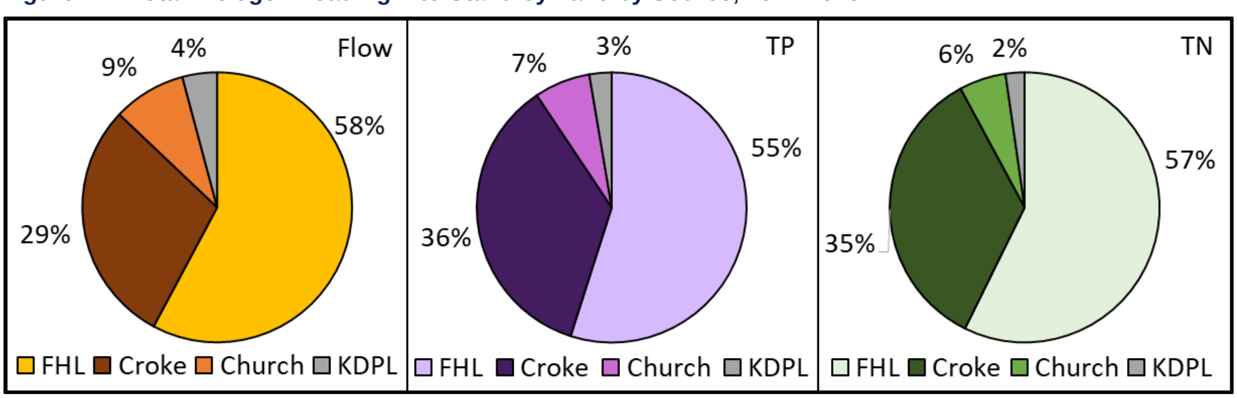


Figure 15. Annual Contributions of Flow, TP, and TN by Each of the Four Sources Entering Standley Lake, 2019

TOTAL SUSPENDED SOLIDS, PHOSPHORUS, AND NITROGEN LOADING INTO AND OUT OF STANDLEY LAKE

Estimated annual TSS, TP, and TN loads into Standley Lake are presented in Figures 16-18. TSS loads into the reservoir in 2019 were 15% higher than the 2014-2018 average. Conversely, TP loads were 4% below average. TN loads were 25% higher than the 2014-2018 average. TSS and TP loads leaving the reservoir were above average (2% and 5% respectively). TN loads leaving the reservoir were 13% below the 2014-2018 average. As with previous years, loads of TSS, TP, and TN into the reservoir were greater than outflow, indicating some level of nutrient and sediment retention.

Nutrient Retention in Reservoirs

Phosphorus *tends to be closely associated with* ***total suspended solids*** *through particle-associated transport and tends to be retained with sediment.*

Nitrogen *can be retained through biological uptake and deposition of particulate organic carbon to the bottom sediment.*

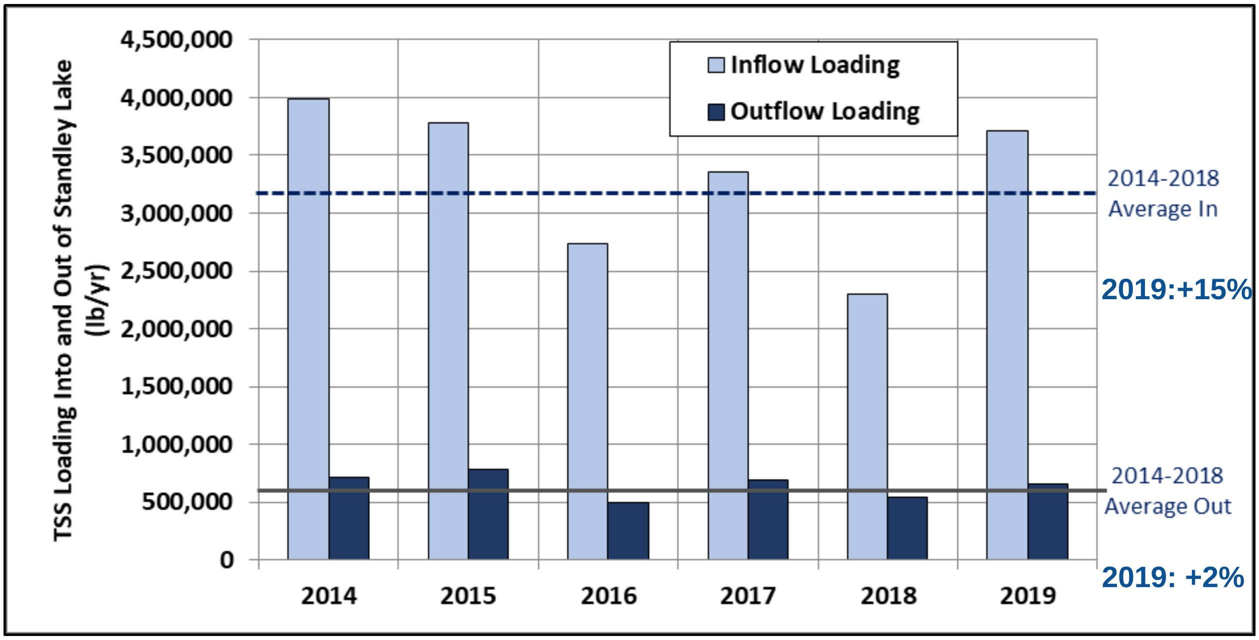


Figure 16. Total Suspended Solids Loading Into and Out of Standley Lake, 2014-2019

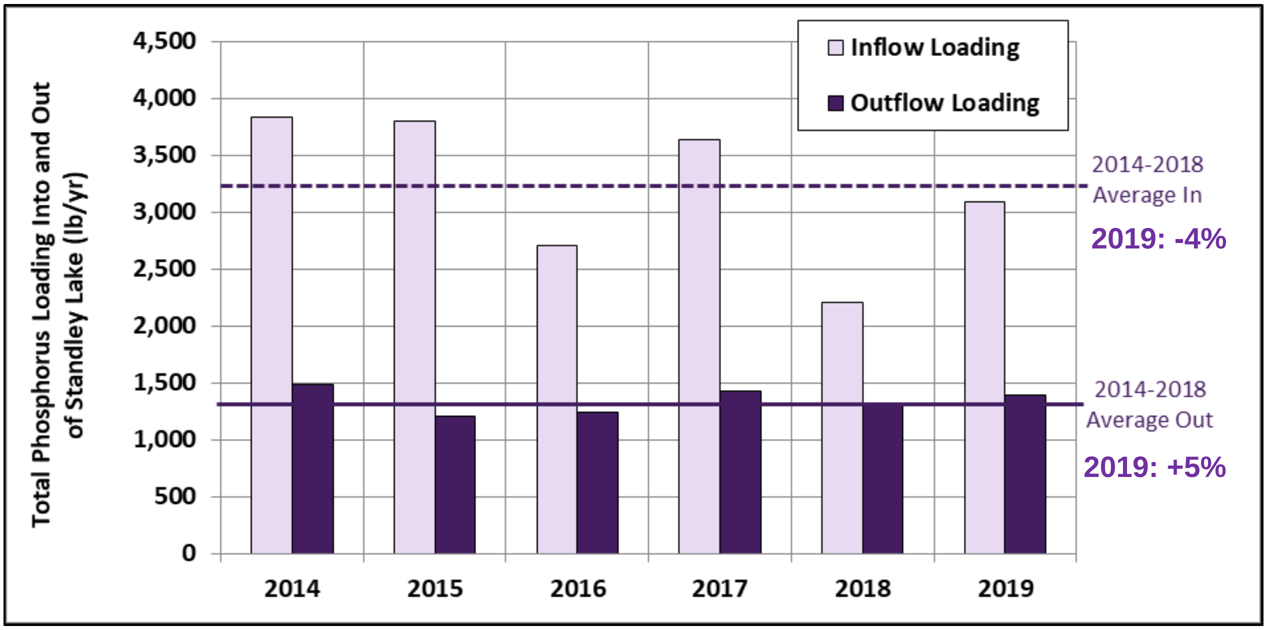


Figure 17. Total Phosphorus Loading Into and Out of Standley Lake, 2014-2019

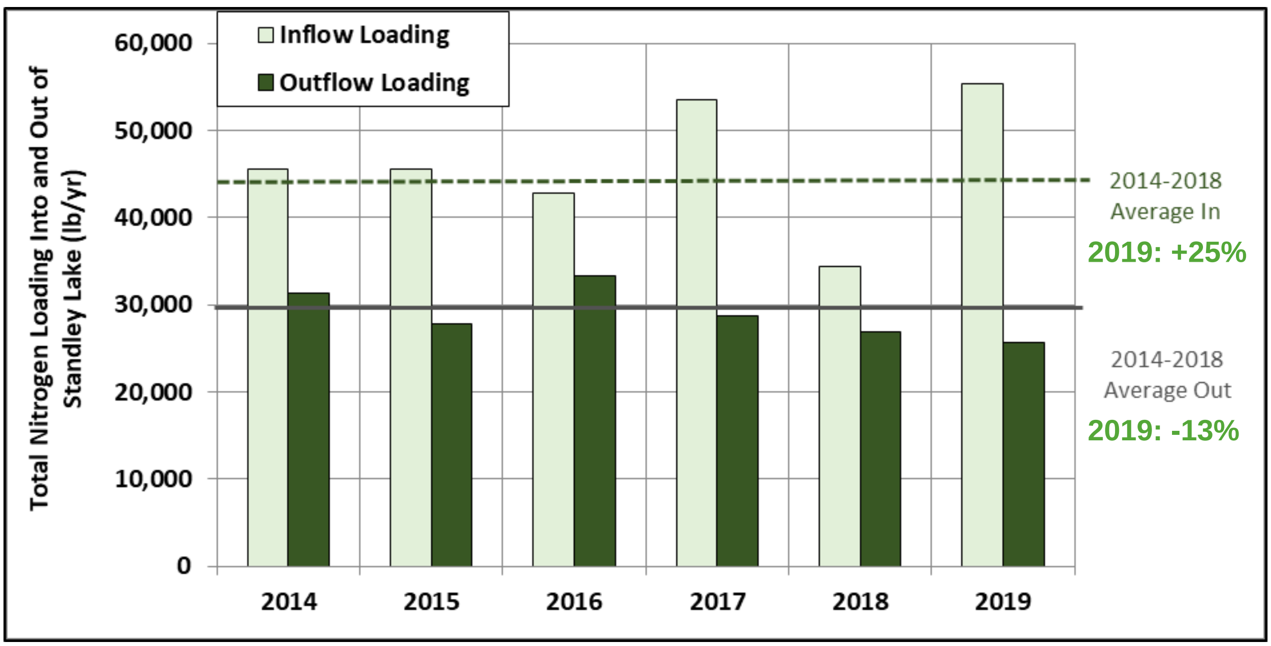


Figure 18. Total Nitrogen Loading Into and Out of Standley Lake, 2014-2019

FLOWS

Snowpack[1] in 2019 was above the average of the previous five years (Figure 19). It is also notable that the snowpack melted later than average (late June).

How does 2019 Snowpack Compare?

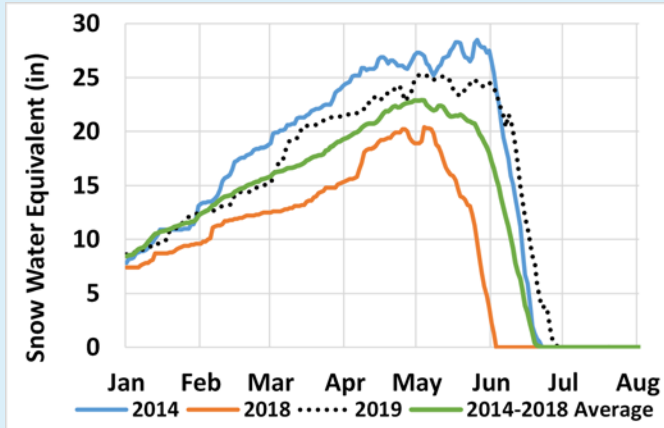


Figure 19. Snow Water Equivalent, 2014, 2018, 2019, and 2014-2018 Average

Hydrographs from Upper Basin locations CC26 (Clear Creek at Lawson Gage) and CC60 (Clear Creek upstream of the Church headgate, Golden, CO) are shown in Figure 19. The snowmelt-dominated pattern is consistent with previous years. The double-peak in the hydrograph is due to abnormal weather patterns in June, lower temperatures over a one week period after runoff started decreased runoff until warmer temperatures resumed in at the end of June. The annual flows at the upper station were 4% higher than the average of the previous five years. The flows at the lower station were 12% below the average of the previous five years. This discrepancy is driven by high flow volumes in 2014 and 2015 due to high precipitation in these years and increases in base flow following the 2013 flood. There is evidence that the base flow has returned to pre-flood conditions after the dry conditions in 2018. This explanation is explored further in the Data Analysis and Interpretation Supplement.

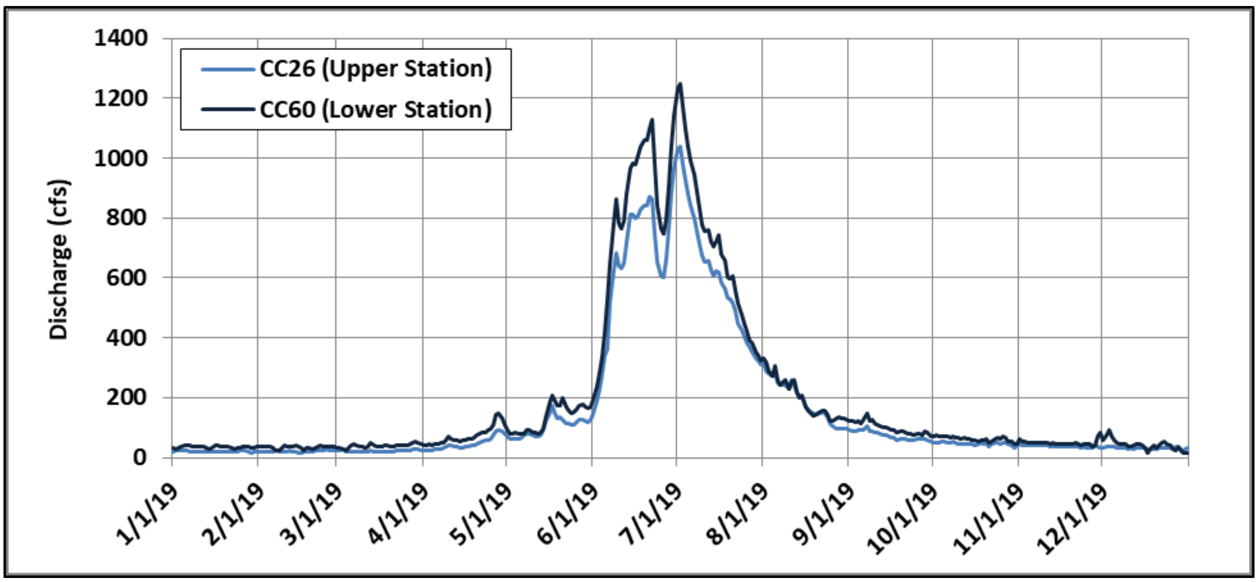


Figure 20. 2019 Clear Creek Hydrographs for the Upper Station (CC26) and the Lower Station (CC60)

[1] Snowpack data from Natural Resources Conservation Service (NRCS) SNOTEL site 602: Loveland Basin (NRCS, 2020

5A. 2019 WATER-QUALITY RESULTS – THE UPPER BASIN

CONCENTRATIONS

Upper Basin concentrations for TSS and TP in 2019 followed typical patterns with higher concentrations during runoff conditions in June. Conversely, TN displayed a pattern opposite of TSS and TP with lower concentrations during runoff conditions due to the dilution of sources during the higher flow periods. At CCAS59 in Golden the monthly TSS concentrations during May-August (when concentrations are typically highest) were all below average with the exception of July, which was above average. The above average values in July are expected as this was the month when peak runoff occurred. TP concentrations were below average in May-August. TN concentrations were above average in June due to the delay in peak runoff. Ranges of observed concentrations, and volume-weighted concentrations are provided in the Data Analysis and Interpretation Supplement.

5B. 2019 WATER-QUALITY RESULTS – THE CANAL ZONE

CANAL ZONE TSS, TP, AND TN CONCENTRATIONS

Results of water-quality analyses for the Canal Zone are highlighted in this section. Constituents for the Farmers' High Line and Croke Canals are the focus because as they are the largest contributors of flow to Standley Lake (62% and 29% on average, respectively). Samples taken in the Canal Zone in 2019 were consistent with previous years. A substantial increase in TSS and TP concentrations from the headgate to the entry point into the reservoir continue to be notable in the Croke Canal (Figure 21 and Figure 22, right). The FHL shows a smaller difference between the two sampling locations. TN for both canals showed less difference between the headgate and entry point to the reservoir (Figure 23)

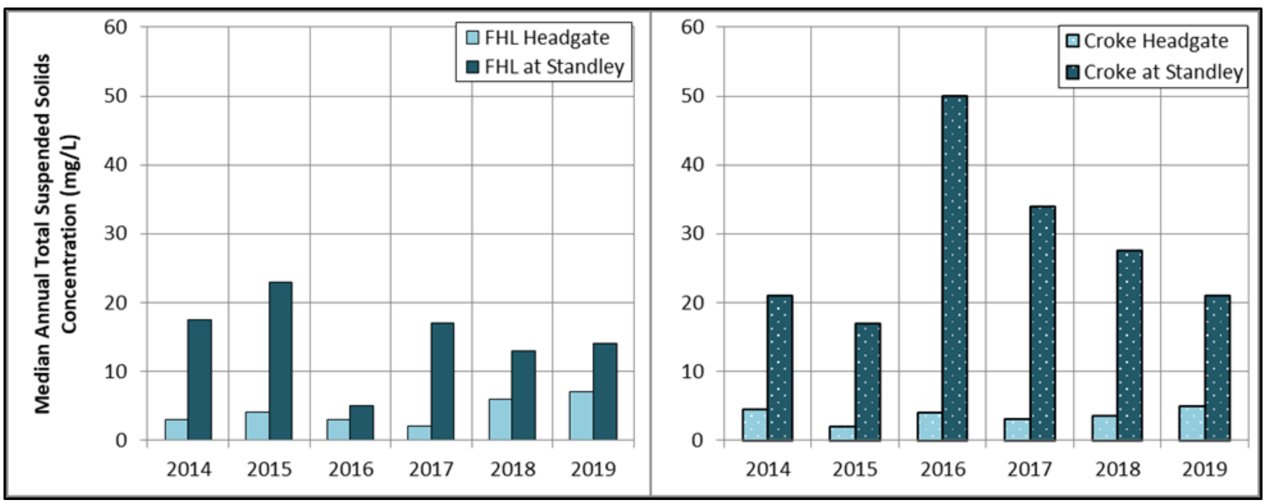


Figure 21. Median Total Suspended Solids in FHL (left) and Croke (right) Canals

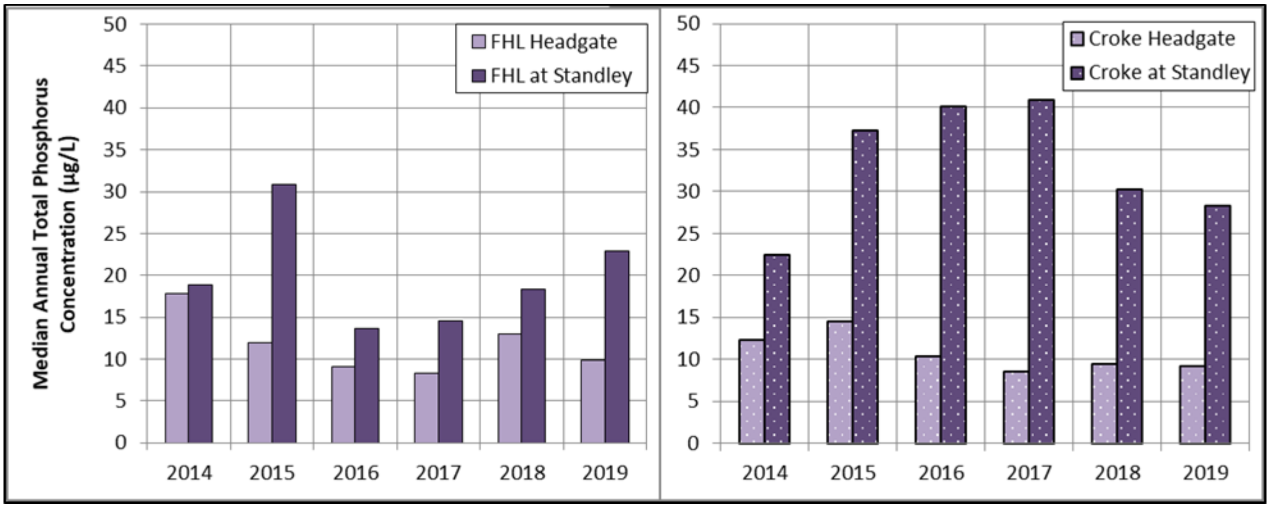


Figure 22. Median Total Phosphorus Concentrations in FHL (left) and Croke (right) Canals

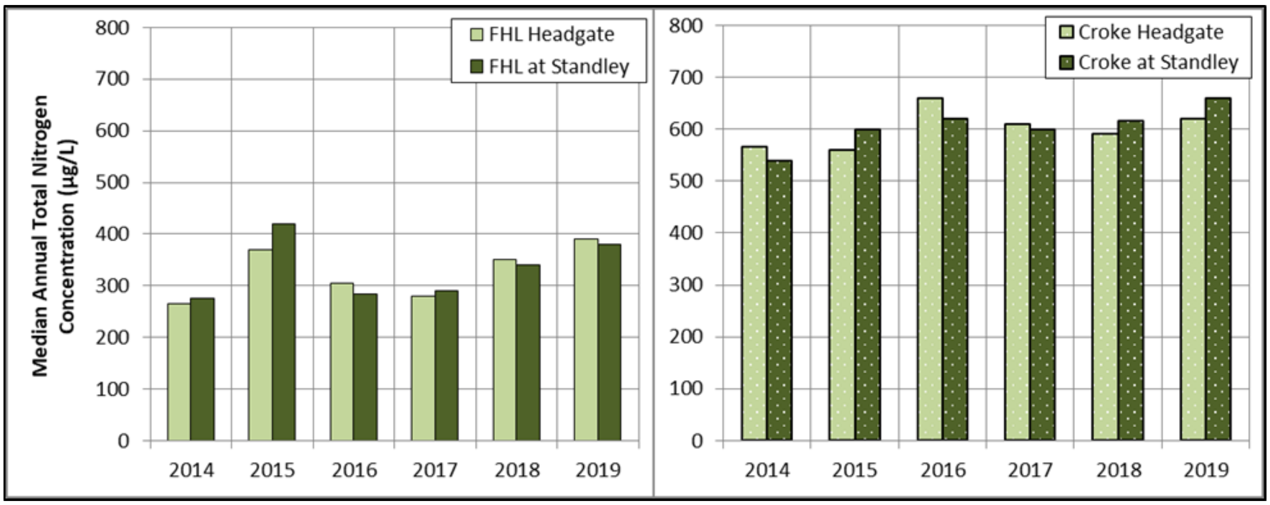


Figure 23. Median Total Nitrogen Concentrations in FHL (left) and Croke (right) Canals

LAKE CONTENTS

Following the dry year in 2018, Standley Lake began 2019 at lower than normal levels. Once water became available, the reservoir was filled to capacity over the course of one month (Figure 24). All three canals were used to fill the reservoir during the free-river[2] period.

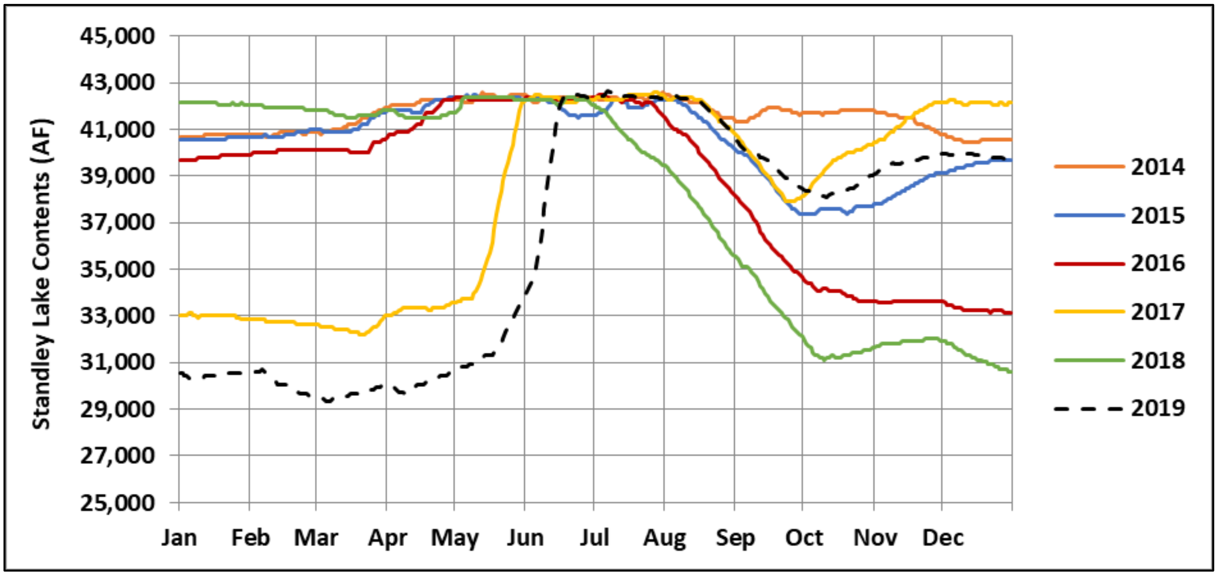


Figure 24. Standley Lake Contents, 2014-2019

Site where the FHL and Croke Canal enter Standley Lake

[2] Free-river is defined as a period of time where there is more water than all water rights on a river (Colorado River District, 2020).

TEMPERATURE

Outlet operations in 2019 were variable compared to previous years. Decisions for outlet changes were driven primarily by filter run times for drinking water treatment operations. Using the upper outlet during the growing season can result in reduced filter run times due to of algae and zooplankton clogging filters. Changes in outlet use first began in 2017 and resulted in reductions in manganese treatment costs, and was continued in 2018 and 2019. Dates where changes in outlet operations occurred are displayed in Figure 25. In years where only the lower outlet was used (e.g. 2016), cooler water is removed from the deeper depths increasing the temperature of the reservoir until turnover. In years where the upper intake is used, warmer water is released from the reservoir, increasing the thermal energy removed, and lowering reservoir temperatures. While the outlet was switched later in the season compared to the last two years and the lower outlet was never fully closed, enough thermal energy was removed from the reservoir to decrease temperatures below the upper outlet (Figure 26). Turnover occurred on October 18, 2019, which is typical.

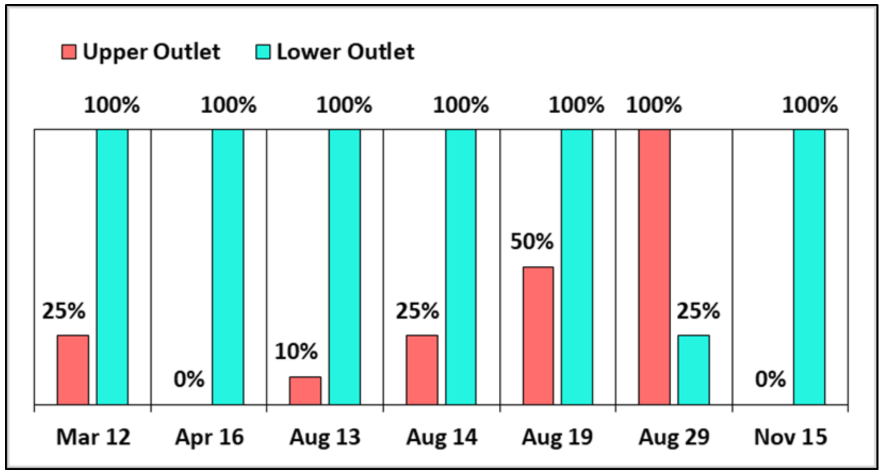


Figure 25. Dates When Operational Changes to the Outlet of Standley Lake Occurred, 2019

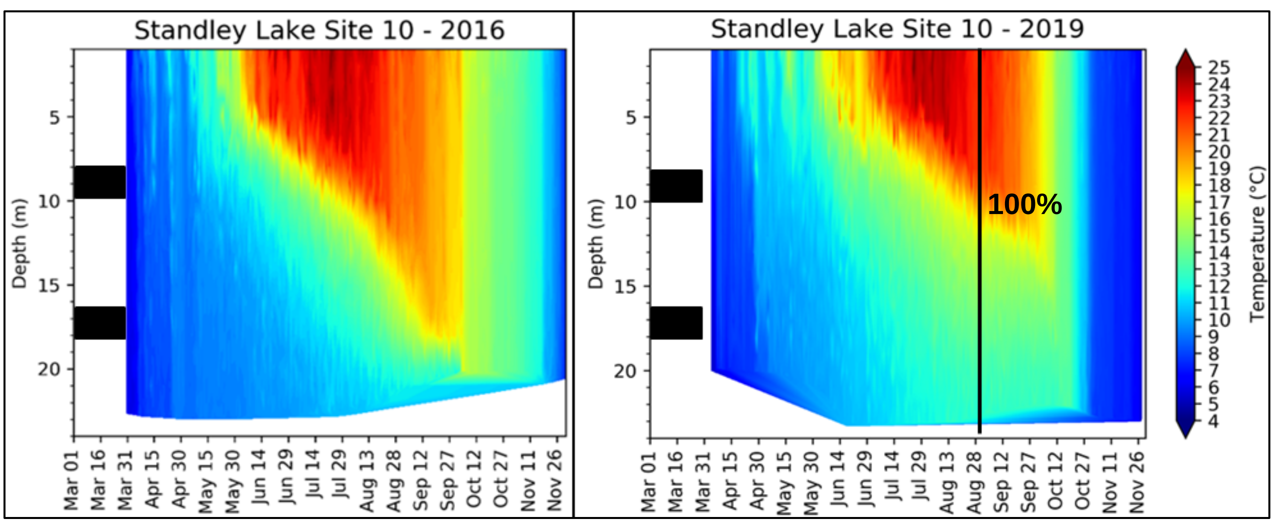


Figure 26. Contour Plots of Temperature in Standley Lake in 2016 and 2019 the Black Line Indicates the Date When the Upper Outlet was 100% Open, the Black Bars Indicate the Range of the Approximate Outlet Depths Based on Water Surface Elevation

DISSOLVED OXYGEN

Data from 2019 show a typical pattern of decreased oxygen concentrations in the hypolimnion with the onset of stratification in late June (Figure 27). Hypoxic conditions began on a typical date (July 3). Turnover occurred on October 18, 2019. The number of days of hypoxia in 2019 (108) were slightly above average (107 days), but was seven days shorter than 2017 and 2018 (115, Figure 28). Longer periods of hypoxia provide the potential for higher anaerobic release of nutrients.

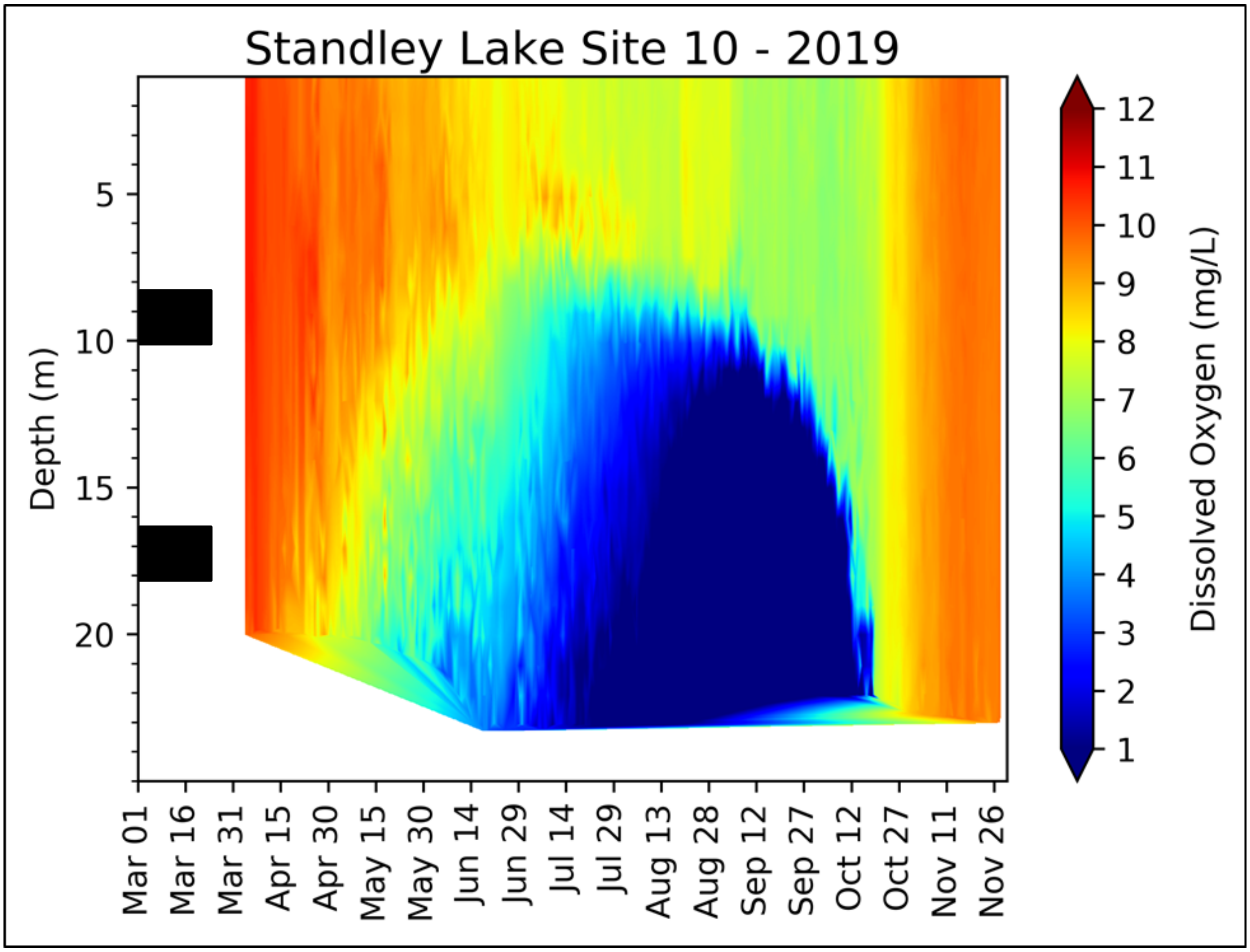


Figure 27. Contour Plot of Dissolved Oxygen in Standley Lake, March-December 2019, the Black Bars Indicate the Range of the Approximate Outlet Depths Based on Water Surface Elevation

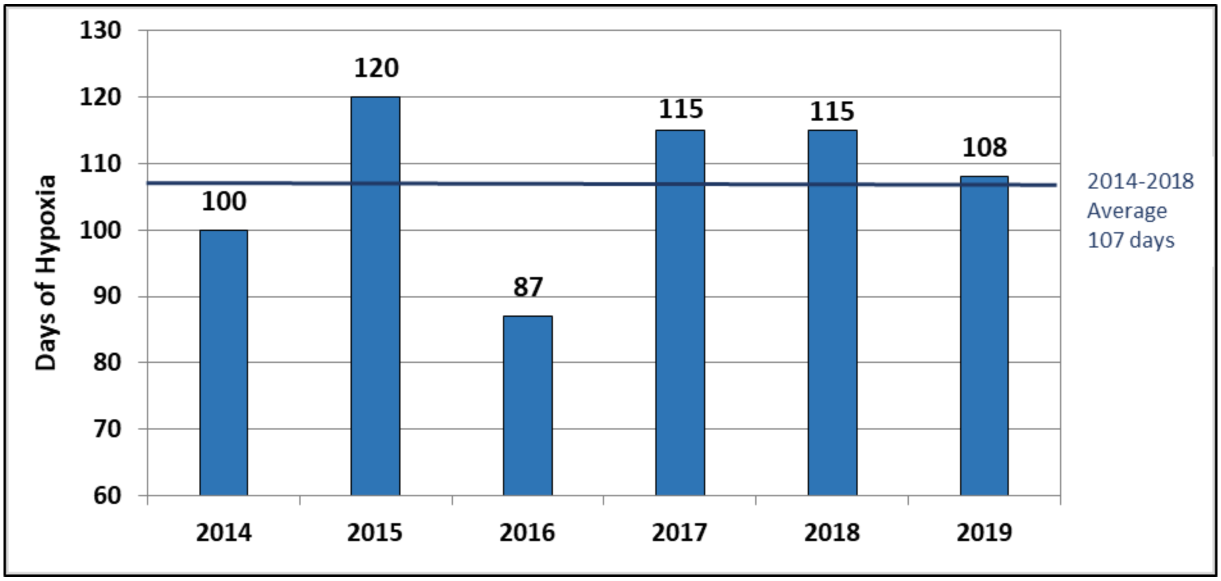


Figure 28. Days of Hypoxia (DO< 2.0 mg/L), 2014-2019

NUTRIENTS

Total Phosphorus

Phosphorus measurements are made in the photic zone and at the bottom of Standley Lake (Figure 29). Photic zone phosphorus concentrations were low and displayed little variation throughout the year. Weekly monitoring, which occurred during the summer/fall in 2019, provided more insight into the patterns of nutrient release during the hypoxic period. The most notable observations were concentrations of 183 µg/L and 158 µg/L at the bottom of the reservoir on September 23 and October 8, respectively. An increase in TP concentrations in the fall is typical and indicative of sediment release of nutrients as a result of hypoxia in the hypolimnion. The long-term record of phosphorus observations at the reservoir bottom is shown in Figure 30 and provides perspective on this year's observations. Though 2019 bottom concentrations were higher than most years, they were within the range of TP releases from the sediment observed in the long-term record and was comparable to the previous two years.

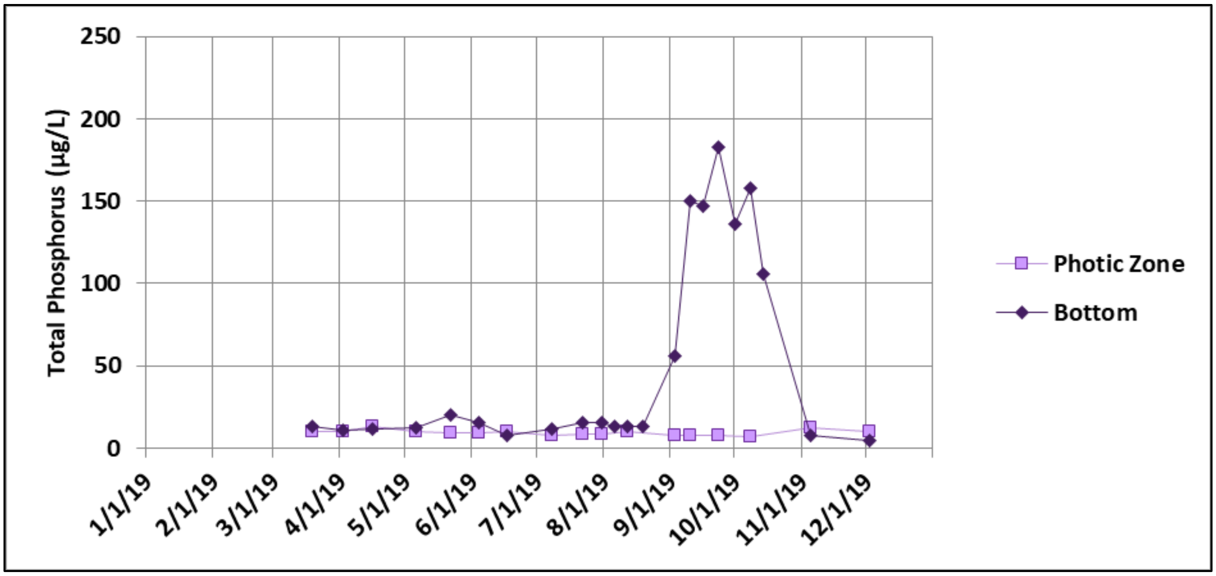


Figure 29. Total Phosphorus Concentrations in Standley Lake, 2019

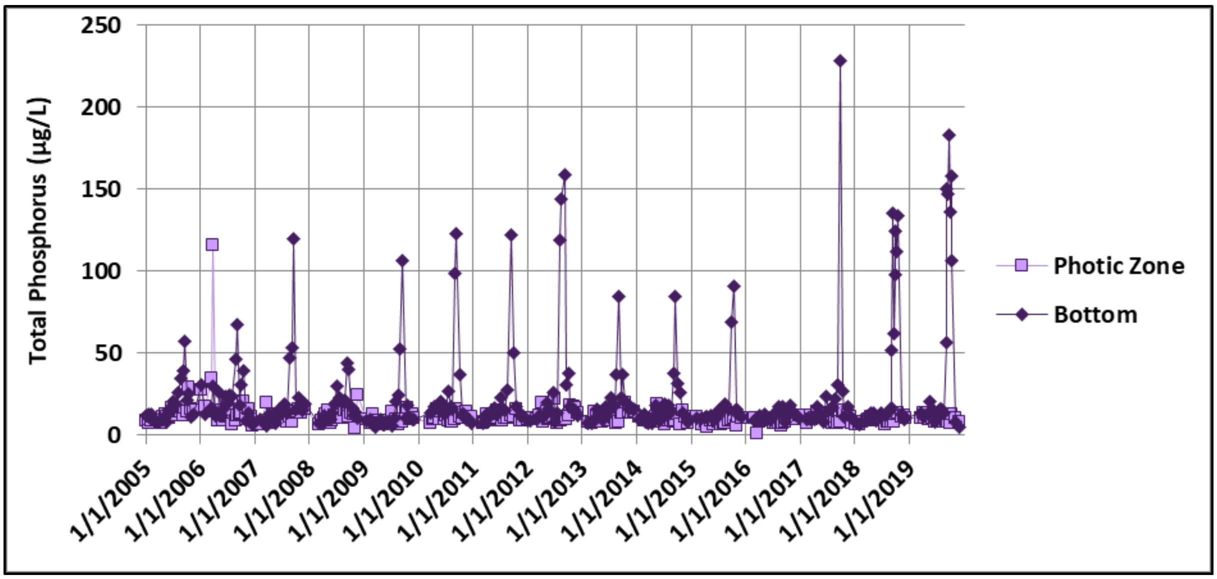


Figure 30. Total Phosphorus Concentrations at the Bottom of Standley Lake, 2005-2019

Total Nitrogen

TN concentrations in Standley Lake are displayed in Figure 31. TN concentrations at the bottom of the reservoir exhibited a peak concentration of 690 µg/L, which occurred on both October 1 and October 8. The photic zone showed smaller amounts of variability. Evidence of nutrient release from the sediment is demonstrated in the fall with elevated concentrations near the bottom corresponding with the TP increases.

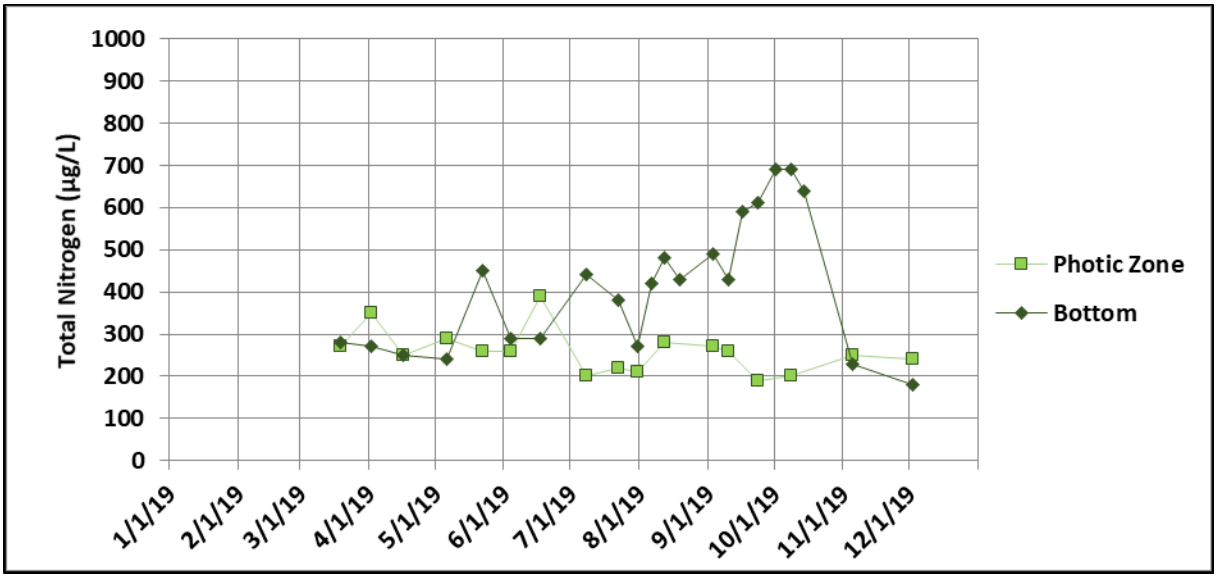


Figure 31. Total Nitrogen Concentrations in Standley Lake, 2019

CHLOROPHYLL *a*

Chlorophyll *a* concentrations measured in the photic zone are shown in Figure 32. March through November is the relevant period for standard assessment and is indicated with the grey box. The maximum concentration measured in 2019 was 7.2 µg/L on May 6, 2019 which corresponded with a bloom of *Stephanodiscus* and *Cryptophyta*. There was a second bloom in the fall that was dominated by Asterionella and *Cryptophyta.* The blooms affected the water treatment process by reducing filter run times.

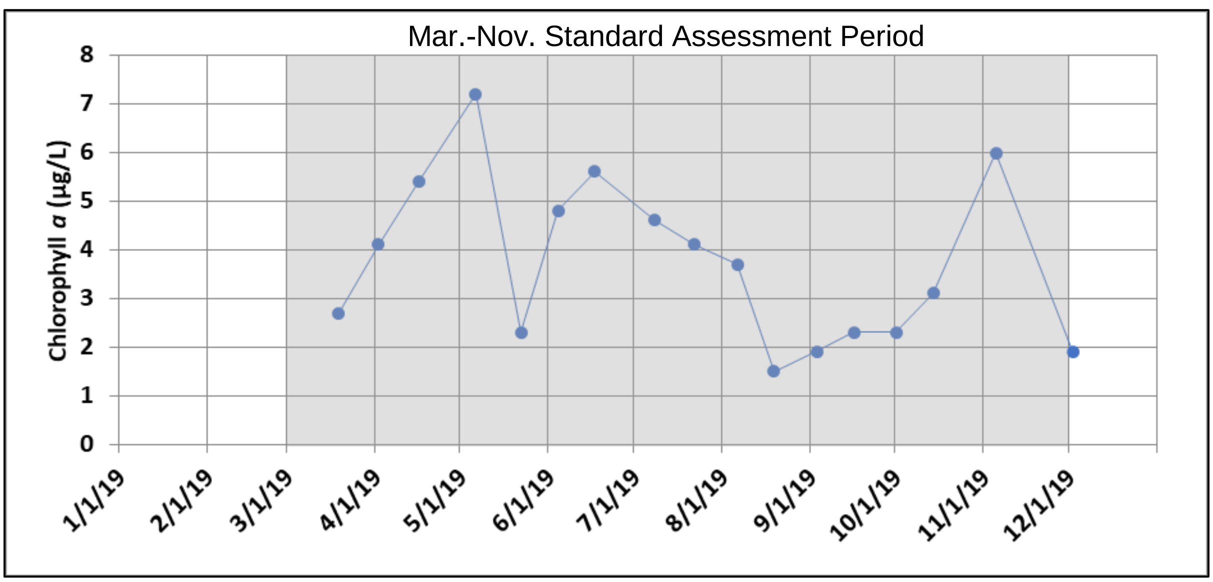


Figure 32. Chlorophyll *a* Concentrations in Standley Lake, 2019 (March-November Assessment Period in Grey)

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 the nine monthly averages of observed data for the 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 with a one in five year allowable exceedance frequency. For 2019, the value of the assessment metric was 3.9 µg/L (Figure 33).

Did we meet the chlorophyll a standard?

Yes, *the standard for chlorophyll* a *in Standley Lake was met in 2019. The 2019 average is compliant 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 4.4 µg/L. Every year in the five-year period from 2015 to 2019 has had a March-November average chlorophyll* a *concentration below 4.0 µg/L.*

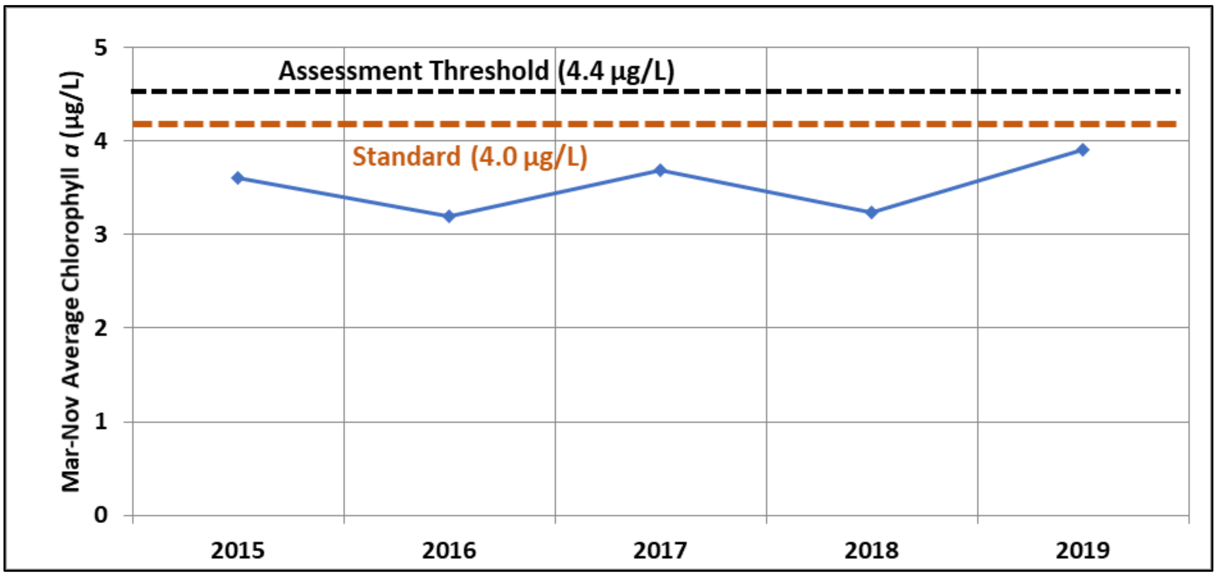


Figure 33. March-November Average Chlorophyll a Concentrations, 2015-2019

6. SUMMARY

Collaborative efforts made by UCCWA members, the Standley Lake Cities, and other parties to the 1993 Agreement continue to be successful in enhancing, protecting, and improving water quality in Standley Lake and Clear Creek. This success is evident based on consistent reservoir and watershed monitoring. Wastewater treatment plant upgrades, canal improvements, illicit discharge responses, public outreach events, and a wide host of other BMPs are all ways that the parties to The Agreement continue to contribute to water-quality protection and enhancement.

The Clear Creek Watershed had acceptable water quality in 2019 and showed no signs of degradation relative to the previous five years for the constituents evaluated. Flow rates at the upper station (CC26) were above average and the lower station (CC60) was below average. This discrepancy is due to large flow volumes in 2014 and 2015 at the lower station. Higher precipitation and higher base flow (due to the 2013 floods), increased the five-year average. The magnitude of peak flow and base flow conditions appear to be returning back to normal.

Water-quality measurements in the Canal Zone indicate that nonpoint sources provide additional TSS and nutrients to the canals before flowing into Standley Lake. While the FHL and the Croke Canal run parallel to each other, the Croke Canal stands out with higher concentrations even during times of steady flow rates. The data again indicate that significant amounts of TSS and phosphorus are added to the canal as water flows from Clear Creek to the reservoir. The Croke canal contributed nutrient loads proportional to flow contributions in 2019. Previous years (e.g. 2017) have not displayed the same proportionality. This highlights the variability in concentrations observed in the Croke Canal.

Standley Lake water quality in 2019 was similar to that of the previous five years. Standley Lake began the year with lower water levels than the previous five years. The reservoir filled quickly over the course of one month with all three canals running simultaneously during the free-river period. Once again, Standley Lake exhibited a period of stratification and hypoxia in the hypolimnion, this period is comparable to the 2014-2018 average. The reservoir utilized both outlets for four weeks in March – April and mid-August through mid-November, and operations were driven by water treatment filter run-times. Use of the upper outlet resulted in a larger, colder, hypolimnion in the reservoir. Increased monitoring during the hypoxic period provided more information on nutrient releases from the sediment, with peak TP concentrations observed in September and October. The peak TP measurement at the bottom of the reservoir was within the range of previous observations, but was the second highest of the historical observations (2005-2019).

This was the third year the upper outlet has been used during the summer and long-term effects require a longer period of record. It is evident that the timing of the outlet changes as well as the proportion of water removed by each outlet have an effect on the temperature of the hypolimnion. Despite two large algae blooms in spring and fall with corresponding higher than typical chlorophyll *a* values, the chlorophyll *a* standard was once again met in 2019, with an average March-November chlorophyll *a* concentration of 3.9 µg/L. These data demonstrate the effectiveness of the efforts to manage, enhance, and protect water quality made by collaborating entities. Further explanations and detailed analyses of 2019 water-quality monitoring results are detailed in the Data Analysis and Interpretation Supplement.

REFERENCES

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.

Colorado River District 2020. Water Glossary. https://www.coloradoriverdistrict.org/waterglossary/.

Hydros Consulting 2018. Clear Creek / Standley Lake Watershed Agreement. 2017 Annual Report. October 1, 2018.

Hydros Consulting 2019. Clear Creek / Standley Lake Watershed Agreement. 2018 Annual Report. July 31, 2019.

Natural Resources Conservation Service (NRCS). 2020. SNOTEL 602: Loveland Basin, CO. March 25, 2020. https://wcc.sc.egov.usda.gov/nwcc/site?sitenum=602.

SUPPLEMENTAL INFORMATION

Supplemental Information 1 - Clear Creek/Standley Lake Watershed Agreement

Supplemental Information 2 - Upper Clear Creek/Standley Lake Watershed Water Quality Monitoring Plan

Supplemental Information 3 - Clear Creek / Standley Lake Data Analysis and Interpretation - 2019

Supplemental Information 4 - Clear Creek, Canal, and Standley Lake Water Quality Monitoring Data - 2019

ACRONYMS

AF - Acre Feet

BEST - Biohydrochemical Enhancements for Streamwater Treatment

BMP - Best Management Practice

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

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

CC59 - Clear Creek Autosampler Station: Clear Creek 2 Miles West of Highway 58/US6 in Golden. Storm Location Operated by City of Golden

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

CC60 - Clear Creek Sampling Station: Clear Creek upstream of the Church Ditch Headgate

CDPHE - Colorado Department of Public Health and Environment

CDWA - Church Ditch Water Authority

Church - Church Ditch

Croke - Croke Canal

CRWA - Colorado Rural Water Association

EWM - Eurasian Water Milfoil

FHL - Farmers' High Line Canal

FRICO - Farmers' Reservoir and Irrigation Company

KDPL - Kinnear Ditch Pipeline

MGD - Millions of Gallons per Day

MS4 - Municipal Separate Storm Sewer System

NRCS - Natural Resources Conservation Service

ORP - Oxidation-Reduction Potential

OWTS - On-site Wastewater Treatment System

QLP - Qualifying Local Program

QZM - Quagga and Zebra Mussels

TN - Total Nitrogen

TP - Total Phosphorus

TSS - Total Suspended Solids

UCCWA - Upper Clear Creek Watershed Association

WQCC - Water Quality Control Commission

WWTF - Wastewater Treatment Facility

SUPPLEMENTAL INFORMATION 1

CLEAR CREEK/STANDLEY LAKE WATERSHED AGREEMENT

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.

SUPPLEMENTAL INFORMATION 2

UPPER CLEAR CREEK/STANDLEY LAKE WATERSHED WATER QUALITY MONITORING PLAN

Upper Clear Creek/Standley Lake Watershed

Water Quality Monitoring Plan

Standley Lake, photo courtesy of Eric Scott

February 2020

TABLE OF CONTENTS

APPENDICES

Abbreviations and Acronyms

BH/CC	Blackhawk/Central City
°C	Degrees 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
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
fDOM	Fluorescent Dissolved Organic Matter
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

Staff from Golden, Northglenn, Thornton, and Westminster at the 2017 Standley Lake Analyst Appreciation Picnic

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 UCC 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 24-hour ambient samples, and
- the automated collection of event samples.

Sampling at CC15 during a Long Schedule

UCC – AMBIENT GRAB SAMPLES

Program Coordination and Sampling Team: Thornton

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 (June and October) and includes 15 stream locations. Laboratory analytical protocols and Thornton's internal sampling programs limit sample collection to only Wednesdays. 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.

Since 2013, Wastewater Treatment Plant (WWTP) effluent samples collected by treatment plant staff 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 *	Feb	Apr	Jun	Oct	Dec
CC05	Staff gage	MSCC at Bakerville			X	X	
CC10	Recording gage	SFCC upstream of Georgetown Reservoir			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	
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 (field)	SM 2550 B	1.0 °C	Thornton
pH (field)	SM 4500-H+ B-2000	1.0 Std Units	Thornton
Conductivity (field)	SM 2510 B-1997	10 µS/cm	Thornton
Turbidity (field)	ASTM D7315	1.0 NTU	Thornton
Dissolved Oxygen (field)	ASTM D888-09 (C)	1.0 mg/L	Thornton
Stream Depth	Staff gage reading	0.1 ft	Thornton

Table Notes:
1) SM refers to the 23rd 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, CC50, CC52, CC53, and CC60 during the Long Schedule events. TOC is analyzed on all four creek grab samples during the Short Schedule events.
4) YSI/Xylem ProDSS or 6-series sondes are used for field measurements.

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), CC15 on the West Fork below Berthoud (staff gage), and CC26 at Lawson (recording gage). The SLC provide financial support for the Department of Natural Resources staff gage at CC30 on Fall River at the mouth. 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 and Sampling Team - 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	500 mL	Rectangular plastic	Phosphorus series	Northglenn	Instructions, COCs and one field data sheet
	4	500 mL	Plastic jug	TSS	Thornton	
	4	125 mL	Rectangular brown 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 field equipment 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 field parameters (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 to exit at Lawson. Travel frontage road through Lawson. Immediately before the I-70 overpass, on your right, is a parking area. Sample creek at gage and USGS sampling station by bridge. [RECORDING GAGE] (39-45-57N/105-37-32W) **Sample TOC**
CC40	Traveling eastbound on I-70 take US 6 exit. Pull off in parking area just east of the off ramp. (Tributary Restaurant is across the road) Sample approx. 100 yards east of stop sign below recording gage. (39-44-47N/105-26-08W) [RECORDING GAGE] **Sample TOC**
CC50	Travel Hwy 119 eastbound toward US 6. Approximately 2 miles downstream of the Black Hawk/Central City WWTP and ¼ mile upstream from intersection is a pullout area to the right immediately before the junction. Sample at the recording gage. (39-44-56N/105-23-57W) [RECORDING GAGE] **Sample TOC**
CC60	Approximately 1 mile west of the intersection of Hwy 58 and US 6. Park in the pullout on the south side of highway and walk down (or drive) downhill to the Church Ditch diversion structure. Go across the bridge and sample from the main stem of Clear Creek. Do not sample from Church Ditch. (39-45-11N/105-14-40W) **Sample TOC**

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

UCC – AMBIENT GRAB SAMPLES

Program Coordination and Sampling Teams - 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.
- Prepare sample kits as directed below. Each sample bottle kit includes the containers for sampling at one location.
- Coordinate with Northglenn to borrow the YSI multiprobe for use on the sampling day.

Prepare sample bottle kits as directed below. Each sample bottle kit contains the prepared sample bottles to collect samples at one location. Prepare 15 bottle kits: 8 kits Creek Team A and 7 kits for Creek Team 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	500 mL	Rectangular plastic	Phosphorus series	Northglenn	One set of: Instructions, COCs and one field data sheet
	8	16 oz	Plastic	TSS	Thornton	
	8	125 mL	Brown plastic	Nitrogen series	Westminster	
	5	40 mL	Glass vial	TOC	Thornton	
Clear Creek Team B (Collects samples at CC15, CC20, CC30, CC40, CC44, CC50 and CC60)	7	500 mL	Rectangular plastic	Phosphorus series	Northglenn	One set of: Instructions, COCs and one field data sheet
	7	16 oz	Plastic	TSS	Thornton	
	7	125 mL	Brown plastic	Nitrogen series	Westminster	
	4	40 mL	Glass vial	TOC	Thornton	
QC	4	Half gallon	1:1 HCl-rinsed plastic	QC spikes and dups for Golden	Thornton	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	Brown 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.

On Clear Creek sampling day (Long Schedule):

- Calibrate field equipment 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), and at least 4 half-gallon 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.

- At each sample location, collect samples and analyze for field parameters (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, CC50, CC52, CC53, and CC60.

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

- Complete the COC for the QC samples.

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

- Thornton's 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 one copy of each team's field data sheet for Westminster to use for logging in the samples to the electronic spreadsheet.

- The field samples and prepared QC 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: Jun, Oct

Sample bottles: Creek sites: One 500mL rectangular (phosphorus series), one 500 mL (TSS), one 125 mL (nitrogen series) and one 40 mL amber glass vial (TOC) as required.

POINT	DIRECTIONS AND DESCRIPTION OF LOCATION
CC05	1-70 westbound to Exit 221 (Bakerville); go south back over Interstate (left). Park at call box. Take sample upstream of parking area, read gage located downstream. [STAFF GAGE] (39-41-31N/105-48-15W) **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 inlet and park on the right side of road. Sample from stream above lake inlet point. [RECORDING GAGE] (39-41-11N/105-42-00W)
CC25	Return towards but do not enter I-70. Instead take the frontage road (Alvarado Road) back towards Empire. Travel on the road approximately 3.3 miles until you see a large dirt pull off on the left, across the road from the cemetery. You'll need to hop the barb wire fence to access the creek. Sample near the culvert under I-70. (39-45-05N/105-39-45W)
CC26	Continue approximately 2.3 miles down Alvarado Road towards and 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] (39-45-57N/105-37-32W) **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. (39-44-26N/105-31-17W)
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. DO NOT PARK BY COVERED WAGON!!! [RECORDING GAGE] (39-42-58N/105-34-15W) **Sample TOC**
CC52	Exit I-70 eastbound at Beaver Brook/Floyd Hill (Exit #247). Turn Left to 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.(39-43-7N/105-22-4W) **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. (39-42-50N/105-21-42W) **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: Jun, Oct

Sample bottles: Creek sites: One 500 mL rectangular (phosphorus series), one 500 mL (TSS), one 125 mL (nitrogen series) and one 40 mL amber glass vial (TOC) as required.

POINT	DIRECTIONS AND DESCRIPTION OF LOCATION
CC15	Travel west on US 40 through Empire. Begin at Empire Dairy King and continue 6.0 miles west on US 40. There is a large pullout on the creek side of highway with a large stump in the middle of the pullout located a ¼ mile past mile marker 250. Sample directly below the stump at the creek. Staff gage is along the north bank of stream next to a tree at the stream's edge. (39-46-05N/105-47-36W) [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 to Westbound I-70. Immediately after turning onto road/ramp, there is a large open space on right side of road\ramp. Park in open space and cross road to the Colorado Dept. of Transportation (CDOT) fence enclosing their maintenance yard. Enter fence and sample approximately 100 feet downstream of bridge at recording gage. (39-45-23N/105-39-34W) [RECORDING GAGE] **Sample TOC**
CC30	East on 1-70. Exit 238 (Fall River Road/St. Mary's Glacier). Approximately 100 yards up Fall River Road, there is a small turnout on right by a wooden support wall. Cross road and sample creek at staff gage. (39-45-23N/105-33-20W) [Read the STAFF GAGE and record on the field data sheet]
CC40	Traveling eastbound on I-70 take US 6 exit. Pull off in parking area just east of the off ramp. (Tributary Restaurant is across the road) Sample approximately 100 yards east of stop sign below recording gage. (39-44-47N/105-26-08W) [RECORDING GAGE] **Sample TOC**
CC44	Continue east on US 6 to 119. Drive west on 119 to Black Hawk. From the Black Hawk intersection travel westbound approximately 1 mile on Hwy 119. There is a small wooden building and parking area on the left side of the road. This is the Black Hawk water intake. Walk approximately 100 feet upstream and sample at staff gage. (39-44-56N/105-23-57W) [STAFF GAGE] Record the staff gage and sample near there.
CC50	Continue on Hwy 119 eastbound toward US 6. Approximately 1 mile downstream of the Black Hawk/Central City WWTP and ¼ mile upstream from intersection is a pullout area to the right immediately before the junction. Sample at the recording gage. (39-44-56N/105-23-57W) [RECORDING GAGE] **Sample TOC**

CC60 Site is approximately 1 mile west of intersection of Hwy 58 and US 6. Park in the pullout on the south side of highway and walk down (or drive) downhill to the Church Ditch diversion structure. Go across the bridge and sample from the main stem of Clear Creek. Do not sample from Church Ditch. (39-45-11N/105-14-40W) **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 Thornton 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 Westminster and Northglenn.

In 2018, Thornton took over preparation of QC samples from the city of Golden. Only commercially prepared, certified of nitrate-N and phosphate stock standards are used. All calculations below are for phosphate as P. Thornton staff will need to remain vigilant of that as all stock standards are phosphate as PO_4. Multiply all concentrations as PO_4 by 0.326 to convert into concentrations as P.

The analytical procedure for QC preparation is detailed below:

- 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 plastic HCl-washed, 16-ounce "milk type" bottles.

- The bottles are marked with (##) corresponding to the date of the sampling (for example, "061419" for June 14, 2019). Mark the 4 bottles with the following information:
  - Northglenn - P(##) - Spike for phosphate-P, Date of sampling.
  - Northglenn - D(##) - Duplicate for phosphate-P, Date of sampling.
  - Westminster - N(##) - Spike for nitrate-N, Date of sampling.
  - Westminster - D(##) - Duplicate for nitrate-N, Date of sampling.

- 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.

- To Prepare Spiked Sample:
  - Rinse out a clean 1-Liter volumetric flask with DI.
  - Then rinse flask with a small portion of the selected QC Creek sample - 2 times.
  - Fill the flask half way with creek sample.
  - Add appropriate amounts of phosphate-P and nitrate-N to the flask:

        - Amounts for phosphate-P are within a total spiked concentration of 0.00875 to 0.015 ppm.
        - Amounts for nitrate-N are within a total spiked concentration of 0.15 to 0.3 ppm.
    - Mix well.
    - Add remaining amount of creek sample to bring the volume up to 1 liter. Use a pipet as pouring accurately from the half-gallon bottle will be difficult.
    - Mix well and pour into 2 bottles labeled for spike samples ("N" and "P").

- <u>To Prepare Duplicate Sample</u>:
    - Thoroughly mix remaining Clear Creek sample.
    - Pour into 2 bottles labeled for duplicates ("D").

- Record the following information:
    - the new (##) number discussed earlier,
    - the Clear Creek sample site number that was selected for preparation of the QC samples, and
    - spike concentrations for phosphorus and nitrogen.

- It is advisable to email QC information (spikes values and identity of QC parent samples) to Westminster and Northglenn at a later date so it is not accidentally lost. Westminster will record QC results and recoveries into the shared database.

- Add the QC samples to the chain of custody forms for the respective labs along with the rest of their creek samples.

Collecting ambient autosampler samples from CC50

UCC AUTOSAMPLER 24-HOUR AMBIENT SAMPLES

Program Coordination and Sampling Team: Westminster

Autosampler sites were selected at strategic locations in the watershed in order to assess diurnal variations and sporadic weather events that would normally not be captured by the discreet, grab sampling. The different autosamplers are set to trigger at specific times based on streamflow as to better characterize changes in water quality from one site to another.

The 24-hour ambient composites are collected with programmable automatic sampling devices. Each of the 12 sample bottles represents a two hour time period, resulting from collecting equal volumes of sample in each of two consecutive hours; therefore, 24 hours of samples are collected in 12 bottles. The 12 discrete samples are composited into one 24-hour sample 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. To assist with sample pick-up logistics between the cities of Northglenn and Thornton, efforts will be made to set these sampling periods to be collected on Monday or Tuesday of the fourth week of the month. This may not always be possible due to weather forecasts, stream flows, or other uncontrollable factors.

Analytical probes and data logging equipment are active at most of the autosampler sites year-round to continuously monitor in-stream conditions for temperature, conductivity, pH, ORP, turbidity and fDOM. From April through October, or as weather conditions permit, a depth/pressure probe may be installed at some locations. YSI/Xylem multi-probe sondes are deployed at each autosampler location. The sample locations are equipped with data loggers and cellular telephone modems for remote monitoring of water quality conditions in the watershed and to remotely control activation of the autosamplers.

UCC AUTOSAMPLER 24-HOUR AMBIENT SAMPLES
Sample Locations

CCAS26	Mainstem of CC at USGS Lawson gage
CCAS49	Mainstem of CC above the confluence with the North Fork
CCAS50	North Fork of CC above confluence with Mainstem of CC at USGS gage
CCAS59*	Mainstem of CC above Golden and Church Ditch diversions

*In 2016, Westminster assumed responsibility for sample collection at and maintenance of the new autosampler location at CCAS59 installed approximately 100 feet upstream of the city of Golden's CC59 station.

UCC AUTOSAMPLER 24-HOUR AMBIENT SAMPLES
Flow Monitoring

USGS gages provide the average daily flow associated with the 24-hour composite samples for the ambient autosamplers. Flow data is obtained directly from the gage stations at CC26 and CC50 to correlate with CCAS26 and CCAS50, respectively. Flow data from the gage at CC40 is used to correlate to CCAS49 because there are rarely significant inflows to or diversions from Clear Creek between CC40 and CCAS49.

The flow data associated with CCAS59 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 CCAS59.

UCC AUTOSAMPLER 24-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 (field)	SM 4500-H+ B-2000	1.0 Std Units	Westminster
Temperature (field)	SM 2550 B	1.0 °C	Westminster
Conductivity (field)	SM 2510 B-1997	10 µS/cm	Westminster
Turbidity (field)	ASTM D7315	1.0 NTU	Westminster
Total and Dissolved Cadmium	EPA 200.8	0.0005 mg/L	Westminster Contract Laboratory
Total and Dissolved Copper	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Iron	EPA 200.7	0.02 mg/L	Westminster Contract Laboratory
Total and Dissolved Lead	EPA 200.8	0.0005 mg/L	Westminster Contract Laboratory
Total and Dissolved Manganese	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Zinc	EPA 200.8	0.02 mg/L	Westminster Contract Laboratory

Table Notes:
1) SM refers to the 23rd 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 may be analyzed by commercial laboratories that have demonstrated proficiency in analyzing complex matrices for nutrients.
5) Metals will be analyzed in May, July and October on the Creek intended to capture low, medium and high ambient canal flows delivered to Standley Lake.
6) YSI/Xylem 6-series or EXO sondes are used for field measurements.

UCC AUTOSAMPLER 24-HOUR AMBIENT SAMPLES

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 sonde with field probes for turbidity, temperature, conductivity and pH
- Depth/pressure sensor
- Recording gage at CC26 – Operated and maintained by USGS
- Staff gage and recording gage at CC50 – Operated and maintained by USGS
- Rain gage at CC59 – Operated and maintained by Clear Creek Consultants for the city of Golden
- 24 discrete HCl or Citric Acid washed and rinsed bottles with caps. Bottles must be numbered and inserted in the designated position in autosampler (positions numbered 1 through 24). Though samples will only be collected in bottles 1-12, a full rack of sample bottles is required to secure sample bottles in place.
- Continuous recording datalogger
- Cellular modem and antenna at CC26, CC50 and CCAS59

UCC AUTOSAMPLER 24-HOUR AMBIENT SAMPLES

Autosampler Operation

On a monthly basis between April and October, autosamplers are set to collect time-weighted discrete samples for a 24-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, activation of 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 or Citric Acid washed and 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. Ensure a full set of clean bottles are deployed or 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 box 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
- 12 pre-cleaned, HCl or Citric Acid washed and 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
- One 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
    - 500mL square plastic – phosphorus series (Northglenn)

  - o 125 mL brown plastic – nitrogen series (Westminster)
  - o 500 mL plastic bottle – TSS (Thornton)
  - o 40 mL amber glass vial with septa cap – TOC (Thornton)
  - o 500 mL round plastic – total metals (Westminster)
  - o 500 mL round plastic – dissolved metals (Westminster)
- 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.
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. Compositing of samples in the field is performed by pouring off equal volumes into a 3-liter (or larger) pre-cleaned bottle. Refer to the Sample Compositing Procedure Step 1 below. Aliquot the composited sample into the individual sample bottles that correspond to the analytes to be tested. Save the remaining volume of any individual high turbidity samples to take back to the lab for possible further testing. Discard remaining sample in the remaining autosampler bottles. Return used autosampler bottles to the lab for cleaning.
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 Westminster Semper Water Quality Laboratory for splitting and distribution.

UCC AUTOSAMPLER 24-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 12 bottles into a composite bottle.
2. Perform turbidity, temperature, pH and conductivity measurements on composited samples. Enter data on the Sampling Form.
3. Use the well mixed composited sample to fill the appropriate sample bottles.
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. 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 city of Westminster for permanent archive.
8. Samples are created in the web-accessible Excel spreadsheet by Westminster for data entry and results archive.

High turbidity at CC26 from a storm event

UCC AUTOSAMPLERS – EVENT SAMPLES
Sample Locations

CCAS49 Event	Mainstem of CC above the confluence with the North Fork
CCAS50 Event	North Fork of CC above confluence with Mainstem of CC at USGS gage
CCAS59 Event	Mainstem of CC above Golden and Church Ditch diversions

UCC AUTOSAMPLERS – EVENT SAMPLES
Flow Monitoring

Westminster will obtain the 15 minute interval flow data from the USGS gage at CC61 (Clear Creek at Golden) to correlate to CCAS59. 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 CCAS49. 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 24-hour ambient samples, plus the additional metals listed in the table below.

Analyte	Analytical Method Reference	Reporting Limit Goal	Responsible Laboratory
Total and Dissolved Arsenic	EPA 200.8	0.001 mg/L	Westminster Contract Lab
Total and Dissolved Barium	EPA 200.8	0.002 mg/L	Westminster Contract Lab
Total and Dissolved Beryllium	EPA 200.8	0.002 mg/L	Westminster Contract Lab
Total and Dissolved Chromium	EPA 200.8	0.001 mg/L	Westminster Contract Lab
Total and Dissolved Molybdenum	EPA 200.8	0.002 mg/L	Westminster Contract Lab
Total and Dissolved Nickel	EPA 200.8	0.002 mg/L	Westminster Contract Lab
Total and Dissolved Selenium	EPA 200.8	0.005 mg/L	Westminster Contract Lab
Total and Dissolved Silver	EPA 200.8	0.002 mg/L	Westminster Contract Lab
Total and Dissolved Strontium	EPA 200.7	0.002 mg/L	Westminster Contract Lab
Total and Dissolved Vanadium	EPA 200.8	0.0005 mg/L	Westminster Contract Lab

Westminster will collect storm samples triggered at CCAS49, CCAS50, and CCAS59 and send them out to their contract laboratory for metals analysis. Independently from this Monitoring Plan, the city of Golden will perform metals analyses collected at CC59 event samples using EPA Method 200.8. Some samples may be analyzed outside the EPA recommended holding time for some parameters based on the random nature of the storm event triggering. Golden and the Standley Lake cities have agreed to share their data. The SLC will submit all other autosampler event samples to a commercial lab for metals testing.

UCC AUTOSAMPLERS – EVENT SAMPLES

Program Coordination: Westminster

Field Sampling Teams: Westminster

The event autosampler program was initiated in 2006 to assess the pollutant concentrations mobilized during significant snow melt (runoff) or rain events at the 24-hour ambient locations CCAS49, CCAS50 and CCAS59. 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 25 minute running average exceeds a predetermined turbidity level (for example, 100 NTU). The autosampler at CCAS50 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. Westminster coordinates sampling at CCAS49, CCAS50 and CCAS59. Golden is in charge of CC59, independently from this Monitoring Plan. Golden and the Standley Lake cities have agreed to share their data.

UCC AUTOSAMPLERS - EVENT SAMPLES

Field Equipment

Storm event sampling utilizes the same equipment listed in the previous section for the 24-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 24-hr ambient sampling.

Sample Compositing

Sample compositing is performed similarly to the procedure described in the previous section for 24-hr ambient sampling; however, fewer or more samples may be composited based on the intensity 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.

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.

TRIB AMBIENT GRAB SAMPLES

Trib ambient grab samples are collected year-round on the first Wednesday of each month. All tributaries flowing at a rate that allows collection of a representative sample are monitored.

The raw water pipeline at Semper (T-24) is monitored monthly to provide lake outflow data used to determine lake outflow loadings. The raw water pipeline at NWWTP (T-25) is monitored only when the Semper facility is offline.

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 AMBIENT GRAB SAMPLES

Analytical Parameters and Analytical Scheme

Analyte	Analytical Method Reference	Reporting Limit Goal	Responsible Laboratory	Monitoring Frequency
Temperature (field)	SM 2550 B	1.0 °C	Northglenn	Monthly
pH (field)	SM 4500-H+ B-2000	1.0 Std Units	Northglenn	Monthly
Conductivity (field)	SM 2510 B-1997	10 µS/cm	Northglenn	Monthly
Turbidity (field)	ASTM D7315	1.0 NTU	Northglenn	Monthly
Dissolved Oxygen (field)	ASTM D888-09 (C)	1.0 mg/L	Northglenn	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	Westminster Contract Lab	Monthly
Total and Dissolved Manganese	EPA 200.8	0.002 mg/L	Westminster Contract Lab	Monthly
Total and Dissolved Zinc	EPA 200.8	0.020 mg/L	Westminster Contract Lab	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 Contract Lab	Quarterly
Total and Dissolved Arsenic	EPA 200.8	0.001 mg/L	Westminster Contract Lab	Quarterly
Total and Dissolved Barium	EPA 200.8	0.002 mg/L	Westminster Contract Lab	Quarterly
Total and Dissolved Beryllium	EPA 200.8	0.002 mg/L	Westminster Contract Lab	Quarterly
Total and Dissolved Cadmium	EPA 200.8	0.0005 mg/L	Westminster Contract Lab	Quarterly
Total and Dissolved Chromium	EPA 200.8	0.001 mg/L	Westminster Contract Lab	Quarterly
Total and Dissolved Copper	EPA 200.8	0.002 mg/L	Westminster Contract Lab	Quarterly
Total and Dissolved Lead	EPA 200.8	0.0005 mg/L	Westminster Contract Lab	Quarterly
Total and Dissolved Molybdenum	EPA 200.8	0.002 mg/L	Westminster Contract Lab	Quarterly
Total and Dissolved Nickel	EPA 200.8	0.002 mg/L	Westminster Contract Lab	Quarterly
Total and Dissolved Selenium	EPA 200.8	0.005 mg/L	Westminster Contract Lab	Quarterly
Total and Dissolved Silver	EPA 200.8	0.002 mg/L	Westminster Contract Lab	Quarterly
Total and Dissolved Strontium	EPA 200.7	0.002 mg/L	Westminster Contract Lab	Quarterly
Total and Dissolved Vanadium	EPA 200.8	0.0005 mg/L	Westminster Contract Lab	Quarterly
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 23rd 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 may be analyzed by commercial laboratories that have demonstrated proficiency in analyzing complex matrices for nutrients.
5) YSI/Xylem ProDSS used for field measurements.

TRIB AMBIENT GRAB SAMPLES
Program Coordination and Sampling Team (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 field equipment.
- Analyze the Trip Blank for field parameters.
- Pack Trip Blank in cooler to monitor field activities for phosphorus contamination.

Sample Bottle Kit – Tribs Monthly and Quarterly

Quantity (Dependent on which canals are delivering water to SL)	**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	125 mL	Plastic	E. coli	Thornton
9	500 mL	Plastic	Total Metals	Westminster
9	500 mL	Plastic	Dissolved Metals	Westminster
9	125 mL	Brown plastic	Nitrogen series	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

- YSI/Xylem ProDSS 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, if necessary.
2. Starting with T-24, collect field samples in the order detailed in the next sectionat 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 field parameters and record data in the field notebook.
8. Repeat the process at each location.
9. Return to Westminster's Semper WTP. Receive T-25 sample from Westminster staff if necessary. 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 Excel spreadsheet 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.
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 AMBIENT GRAB 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-01 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
T-27 is located on the south side of Standley Lake at the Church Ditch delivery structure. From Alkire, take 88th Ave east. Open Standley Lake Park gate number 23-D using a master lock key number 2006. Drive north down the trail; it curves east and intersects with a trail going south. Drive down the south trail to the delivery structure.

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

TRIB CONTINUOUS MONITORING
Program Coordination and Sampling Team (Westminster)

At least one 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. Sondes were installed at the new Church Ditch inlet (T-27) in 2009, the FHL headgate (T-02) in 2014 and the Croke headgate (T-03) in 2015 to provide continuous in-stream monitoring of pH, ORP, turbidity, temperature, conductivity and fDOM during the months when each canal is diverting water to Standley Lake. Remote access to the data logger data facilitates monitoring of water quality at these inflow locations to Standley Lake.

TRIB CONTINUOUS MONITORING
Sample Locations

CCAST02	FHL at Headgate on MSCC
CCAST03	Croke Canal at Headgate on MSCC
CCAST04	Croke Canal approximately 0.5 mile from Standley Lake inlet
CCAST11	Farmers Highline Canal approximately 0.5 mile from Standley Lake inlet
CCAST27	Church Ditch at Standley Lake inlet

Table Note: Limited 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 24-HOUR AMBIENT SAMPLES

Program Coordination: Westminster
Field Sampling Teams: Westminster

Autosampler sites in the Tributary Basin are located at the canal headgates and inlets to Standley Lake. The 24-hour ambient composites are collected with programmable automatic sampling devices as described in the UCC autosampler 24-hr ambient program section of this plan (page 17) in order to assess any water quality impacts introduced to or removed from the canals.

Ambient samples are collected approximately seven times per year on a monthly schedule starting in April and ending in October as a continuation of the UCC autosampler 24-hr ambient sample program. To assist with sample pick-up logistics between the cities of Northglenn and Thornton, efforts will be made to set these sampling periods to be collected on Monday or Tuesday of the fourth week of the month. This may not always be possible due to weather forecasts, stream flows, or other uncontrollable factors.

Time of travel is estimated between CCAS59 and T-02, then a time of travel table is used to set the start time for sample collection at T-11 in order to capture approximately the same slug flow of water collected at the upstream sites. Composite samples are not collected on the Croke Canal or Church Ditch due to season of operation or limited flow volumes.

TRIB AUTOSAMPLER 24-HOUR AMBIENT SAMPLES

Sample Locations

CCAST02	FHL at Headgate on MSCC
CCAST03	Croke Canal at Headgate on MSCC
CCAST04	Croke Canal approximately 0.5 mile from Standley Lake inlet
CCAST11	Farmers Highline Canal approximately 0.5 mile from Standley Lake inlet
CCAST27	Church Ditch at Standley Lake inlet

TRIB AUTOSAMPLER 24-HOUR AMBIENT SAMPLES

Flow Monitoring

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

TRIB AUTOSAMPLER 24-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 Cadmium	EPA 200.8	0.0005 mg/L	Westminster Contract Lab
Total and Dissolved Copper	EPA 200.8	0.002 mg/L	Westminster Contract Lab
Total and Dissolved Iron	EPA 200.7	0.05 mg/L	Westminster Contract Lab
Total and Dissolved Lead	EPA 200.8	0.0005 mg/L	Westminster Contract Lab
Total and Dissolved Manganese	EPA 200.8	0.002 mg/L	Westminster Contract Lab
Total and Dissolved Zinc	EPA 200.8	0.020 mg/L	Westminster Contract Lab
pH (field)	SM 4500-H+ B-2000	1.0 Std Units	Westminster
Temperature (field)	SM 2550 B	1.0 °C	Westminster
Conductivity (field)	SM 2510 B-1997	10 µS/cm	Westminster
Turbidity (field)	ASTM D7315	1.0 NTU	Westminster

Table Notes:

1) SM refers to the 23rd 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 > 100 NTU may be analyzed by commercial laboratories that have demonstrated proficiency in analyzing complex sample matrices for nutrients.
5) Metals will be analyzed in May, July and October on the canals operating at that time intended to capture low, medium and high canal flows delivered to Standley Lake.
6) YSI/Xylem 6-series or EXO sondes are used for field measurements.

TRIB AUTOSAMPLER 24-HOUR AMBIENT SAMPLES

Program Coordination and Sampling Team (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
- Sondes equipped with dedicated field probes for turbidity, temperature, conductivity and pH
- Depth/pressure sensor
- Rain gage at T-02 and T-04/T-11
- 24 discrete HCl or Citric Acid washed and rinsed bottles with caps. Bottles must be numbered and inserted in the designated position in autosampler (positions numbered 1 through 24). Though samples will only be collected in bottles 1-12, a full rack of sample bottles is required to secure sample bottles in place.
- Continuous recording datalogger
- Cellular modem and antenna at T-02, T-03, T-04/T-11 and T-27

TRIB AUTOSAMPLER 24-HOUR AMBIENT SAMPLES

Autosampler Operation

On a monthly basis between April and October, autosamplers are set to collect time-weighted discrete samples for a 24 hour period. The autosamplers are located at the canal head-gates and 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 (CCAS59), 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. Time of travel estimates have not been established for the Croke Canal. The Ditch operators assist in estimating when water will arrive at Standley Lake after the ditch is turned on.

Autosampler Setup:

Equipment required:

- 24 discrete HCl or Citric Acid washed and rinsed autosampler bottles with caps. Though samples will only be collected in bottles 1-12, a full rack of sample bottles is required to secure sample bottles in place.
- 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. Ensure a full set of clean bottles are deployed or 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 or Citric Acid washed and 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
- One 3-liter Nalgene bottle (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
    - 500 mL square plastic – phosphorus series (Northglenn)
    - 125 mL brown plastic – nitrogen series (Westminster)

- 500 mL plastic bottle – TSS (Thornton)
- 40 mL amber glass vial with septa cap – TOC (Thornton)
- 500 mL non-preserved total metals (Westminster)
- 500 mL non-preserved bottle – dissolved metals (Westminster)

- 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.
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 a 3-liter (or larger) pre-cleaned bottle. The 12 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 sample splitting and distribution.

TRIB AUTOSAMPLER 24-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.
2. Perform turbidity, temperature, pH and conductivity field measurements on the composited sample. Enter data on the Sampling Form.
3. Use the well mixed composite sample 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 and metals, 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 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 and Sampling Team (Westminster)

The event autosampler program was initiated on the Tributaries in 2009 at CCAST11 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. Automated collection of storm event samples was initiated in 2014 at the headgates for the FHL and in 2015 in the Croke Canal. These locations trigger sample collection when the turbidity is 200 NTU or greater. The events samples primarily collected on the Croke Canal and Church Ditch are considered first flush samples when water is first delivered to the lake during seasonal startup of the canal/ditch.

TRIB AUTOSAMPLERS EVENT MONITORING

Sample Locations

Localized events may trigger sample collection at any of the Trib Autosampler Continuous Monitoring locations.

CCAST02 Event	FHL at Headgate on MSCC
CCAST03 Event	Croke Canal at Headgate on MSCC
CCAST04 Event	Croke Canal approximately 0.5 mile from Standley Lake inlet
CCAST11 Event	Farmers Highline Canal approximately 0.5 mile from Standley Lake inlet
CCAST27 Event	Church Ditch at Standley Lake inlet

Table Note: Historical data from these locations may be 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 suite of analytical parameters listed below.

Analyte	**Analytical Method Reference**	**Reporting Limit Goal**	**Responsible Laboratory**
Temperature (field)	SM 2550 B	1.0 °C	Westminster
pH (field)	SM 4500-H+ B-2000	1.0 Std Units	Westminster
Conductivity (field)	SM 2510 B-1997	10 µS/cm	Westminster
Turbidity (field)	ASTM D7315	1.0 NTU	Westminster
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 Contract Laboratory
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	Westminster Contract Laboratory
Total and Dissolved Barium	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Beryllium	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Cadmium	EPA 200.8	0.0005 mg/L	Westminster Contract Laboratory
Total and Dissolved Chromium	EPA 200.8	0.001 mg/L	Westminster Contract Laboratory
Total and Dissolved Copper	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Iron	EPA 200.7	0.05 mg/L	Westminster Contract Laboratory
Total and Dissolved Lead	EPA 200.8	0.0005 mg/L	Westminster Contract Laboratory
Total and Dissolved Manganese	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Molybdenum	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Nickel	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Selenium	EPA 200.8	0.005 mg/L	Westminster Contract Laboratory
Total and Dissolved Silver	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Strontium	EPA 200.7	0.001 mg/L	Westminster Contract Laboratory
Total and Dissolved Vanadium	EPA 200.8	0.0005 mg/L	Westminster Contract Laboratory
Total and Dissolved Zinc	EPA 200.8	0.020 mg/L	Westminster Contract Laboratory

Table Notes:

1) SM refers to the 23rd 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.
5) YSI/Xylem 6-series or EXO sondes are used for field measurements.

TRIB AUTOSAMPLER EVENT SAMPLES

Field Equipment

Storm event sampling utilizes the same equipment listed in the previous section for the 24-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 24-hr ambient sampling.

Sample Compositing

Sample compositing is performed similarly to the procedure described in the previous section for 24-hr ambient sampling; however, fewer samples are typically composited based on the intensity and/or duration of a storm event.

Sampling Standley Lake, photo courtesy of Eric Scott

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 225 meters south of the lower lake outlet structure, between the lake outlets and the two main inlets to the lake. 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 near 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 one meter off the bottom and every meter in between. The profiler data is telemetered using a cellular telephone modem 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 2550 B	1.0 °C
pH	SM 4500-H+ B-2000	1.0 Std Units
Conductivity	SM 2510 B-1997	10 µS/cm
Turbidity	ASTM D7315	1.0 NTU
Dissolved Oxygen	ASTM D888-09 (C)	1.0 mg/L
Chlorophyll	YSI (optical probe)	1.0 µg/L
ORP	SM 2580 A	1.0 mv
fDOM	YSI (optical probe)	1.0 µg/L

Table Notes:
1) SM refers to the 23rd Edition of Standard Methods for the Examination of Water and Wastewater.
2) Reporting limits are matrix dependent and may be increased for complex matrices.
3) YSI/Xylem EXO sondes are used for all lake profile measurements.

SL – BIMONTHLY GRAB SAMPLES

Program Coordination and Sampling Team: 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 as long as the lake is not frozen and weather permits. 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 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 one meter above the lake bottom. (The depth of the lake is 23.7 meters (77.75 ft) when the lake is full at gage height 96)
SL 69-00	SL surface at the boat dock
T-24	Raw water line coming into Semper Water Treatment Plant. Comes from either the lower intake, upper intake or a combination of both intakes in Standley Lake. Intake flow is changed seasonally. The upper and lower intakes are approximately located 11 meters and 20 meters below lake surface level when the lake is full (gage height 96).

SL – BIMONTHLY GRAB SAMPLES

Analytical Parameters

Analyte	Analytical Method Reference	Reporting Limit Goal	Responsible Laboratory
Temperature (field)	SM 2550 B	1.0 °C	Westminster
pH (field)	SM 4500-H+ B-2000	1.0 Std Units	Westminster
Conductivity (field)	SM 2510 B-1997	10 µS/cm	Westminster
Turbidity (field)	ASTM D7315	1.0 NTU	Westminster
Dissolved Oxygen (field)	ASTM D888-09 (C)	1.0 mg/L	Westminster
ORP (field)	YSI (electrode)	1 mv	Westminster
Chlorophyll (field)	YSI (electrode)	1.0 µg/L	Westminster
fDOM (field)	YSI optical probe	1.0 µg/L	Westminster
Secchi Depth (field)	Secchi disk	0.1 meter	Westminster
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
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 Hardness (as $CaCO_3$)	EPA 130.2	5 mg/L	Thornton
E. coli	SM 9221 D	1 cfu/100mL	Westminster
BTEX	EPA 524.2	0.0005 mg/L	Thornton
Total and Dissolved Arsenic	EPA 200.8	0.001 mg/L	Westminster Contract Laboratory
Total and Dissolved Barium	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Beryllium	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Cadmium	EPA 200.8	0.0005 mg/L	Westminster Contract Laboratory
Total and Dissolved Chromium	EPA 200.8	0.001 mg/L	Westminster Contract Laboratory
Total and Dissolved Copper	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Iron	EPA 200.7	0.05 mg/L	Westminster Contract Laboratory
Total and Dissolved Lead	EPA 200.8	0.0005 mg/L	Westminster Contract Laboratory
Total and Dissolved Manganese	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Molybdenum	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Nickel	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Selenium	EPA 200.8	0.005 mg/L	Westminster Contract Laboratory
Total and Dissolved Silver	EPA 200.8	0.002 mg/L	Westminster Contract Laboratory
Total and Dissolved Strontium	EPA 200.7	0.001 mg/L	Westminster Contract Laboratory
Total and Dissolved Vanadium	EPA 200.8	0.0005 mg/L	Westminster Contract Laboratory
Total and Dissolved Zinc	EPA 200.8	0.020 mg/L	Westminster Contract Laboratory
Dissolved Silica	EPA 200.8	0.1 mg/L	Westminster Contract Laboratory
Total Mercury	EPA 245.1	0.0002 mg/L	Westminster Contract Laboratory

Table Notes:
1) SM refers to the 23rd 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) YSI/Xylem EXO sondes are used for all lake field measurements except for secchi depth.

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.

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

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

Table notes:

1) Hand Profile includes collecting data using the sonde for temperature, pH, conductivity, turbidity, DO, chlorophyll and ORP at 0.5 meter intervals from the surface of the lake to 10 meters depth, then at 1 meter internals to the bottom of the lake.
2) Rads includes Gross Alpha and Gross Beta.
3) The full list of metals will be analyzed during the first week of Jan, Mar, June, Sept and Dec and the third week in October (after turnover).
4) Only total and dissolved arsenic will be analyzed during the first week of October.
5) 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.
6) 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	500 mL	Rectangular plastic	Northglenn
Nitrogen series, UV-254	125 mL	Rectangular brown plastic	Westminster
Rads	1 L	Plastic	Westminster
Zooplankton	250 mL	Plastic	Westminster
Algae	1 L	Plastic	Westminster
Chlorophyll *a*	1 L	Brown plastic	Westminster
Total metals, Total Hg	500 mL	Plastic	Westminster
Dissolved metals	500 mL	Plastic	Westminster
TOC	40 mL	Glass vial	Thornton
TSS, Total Hardness	16 oz	Plastic	Thornton
E. coli	125 mL	Plastic	Westminster
BTEX	3 x 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 by the laboratory 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 EXO2 Sonde – calibrated for hand profile/swap out
- Handheld anemometer/%Relative humidity meter
- Cellular phone
- GPS unit
- Digital camera
- Boat Tool Kit
- Laptop computer – fully charged with communication cable and Loggernet 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 EXO2 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 a YSI EXO2 sonde for the hand profile. While the Profiler is deployed, swap out the profiler YSI EXO2 sonde with the newly calibrated sonde.

Sampling on Standley Lake

<u>Van Dorn Bottle</u>

- 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.

<u>PZ Tube Sampler</u>

- 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.
- Connect the end of the tube to the hose barb on 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.

<u>Surface Sampling</u>

- 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.

Annual surveys of weevil populations in the lake were performed by contractors until 2013, but beginning in 2014 will be performed by the city of Westminster.

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.

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.

SL – WEATHER STATION

A weather station is located at the northeastern end of the Standley Lake dam. The equipment is located inside the fenced area of the Shaft House. The weather station collects readings every ten minutes and can be accessed remotely through a cellular modem and datalogger.

Weather conditions collected at this location include: Rain rate/accumulation, Air Temperature, Relative Humidity, Barometric Pressure, Wind Speed and Wind Direction.

DATA MANAGEMENT AND REPORTING

The city of Westminster is responsible for management of the data collected in support of the IGA 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 Dropbox. Backups are available as "previous versions" stored historically on the Dropbox system.

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 data entry of the analytical results for their assigned analyses into the spreadsheet. On a semi-annual 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.

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 formats 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.

SUPPLEMENTAL INFORMATION - 3

CLEAR CREEK / STANDLEY LAKE DATA ANALYSIS AND INTERPRETATION - 2019

TABLE OF CONTENTS

I. INTRODUCTION

This document serves as a supplement to the 2019 Clear Creek / Standley Lake Watershed Annual Report. It describes an analysis of 2019 water-quality data in the Upper Basin, Canal Zone, and Standley Lake, and compares data from 2019 to data from the previous five years (2014-2018). Constituents included in this analysis are discharge (flow), total suspended solids (TSS), total phosphorus (TP), and total nitrogen (TN). Constituent concentrations that are below the detection limit are analyzed and reported at ½ the detection limit.

II. UPPER BASIN FLOWS AND WATER QUALITY

This section describes an analysis of water-quality data in the Upper Basin in 2019. The analysis is based on data from two sampling locations (Figure 1) CC26 (the upper station - Clear Creek at Lawson Gage) and CCAS59/60 (the lower station - Clear Creek upstream of the Church Ditch headgate). The data from each location include both grab samples and composite samples. Grab samples represent the conditions at a single point of time. Composite samples, comprised of multiple samples collected over 24 hours, represent conditions occurring over the entire collection period. The data presentation and discussion in this section focus on ambient (non-event) samples. However, load estimates are presented including and excluding the event samples (e.g. storm event samples).

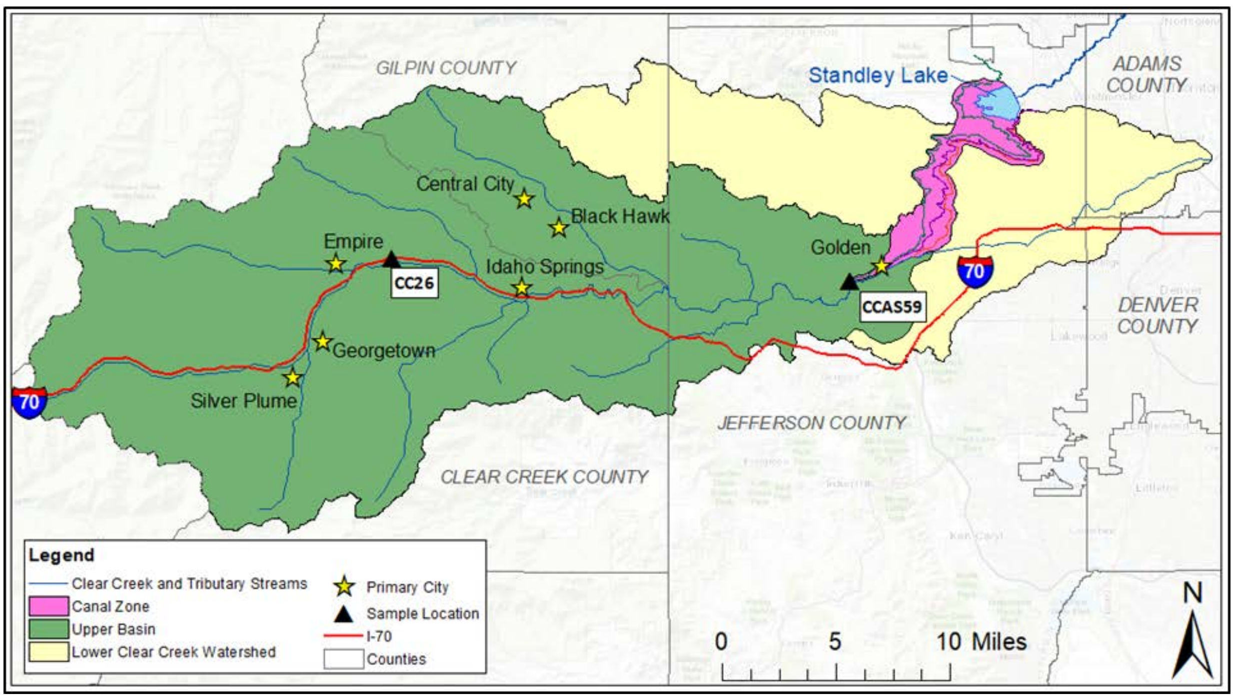


Figure 1. The Standley Lake Watershed: Upper Basin and Canal Zone

DISCHARGE

The annual hydrographs for Upper Basin locations CC26 and CC60 (Figure 2) both show a snowmelt-dominated pattern with the rising limb beginning in early June and the falling limb extending through summer. The hydrographs showed a double-peak resulting from abnormal weather patterns during June[1]. After runoff began, temperatures decreased over a period of one week. Once temperatures began to rise again at the end of June, the remaining snow melted and a second peak in flow occurred.

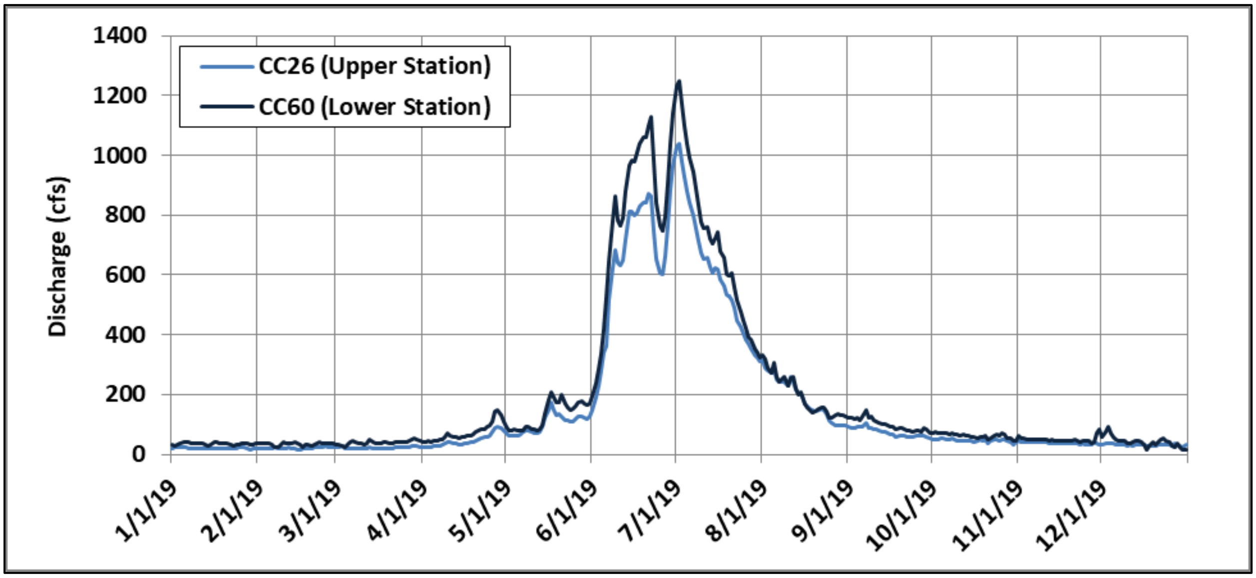


Figure 2. 2019 Clear Creek Hydrographs for the Upper Station (CC26) and the Lower Station (CC60)

Total annual flows at the upper station (CC26) of 111,786 AF were 4% above the 2014-2018 average of 107,171 AF. Total annual flows at the lower station (CC60) of 137,699 AF were 12% below the 2014-2018 average of 155,712 AF. The differences in flows compared to the average at the two stations may be driven by a response to the 2013 flood. Pre-flood, the lower station total annual flows were on average (2005-2012) 34% higher than the upper station. In the three years following the flood (2014-2016) the lower station total annual flows were 55% higher than the upper station. Additionally, the long term hydrograph record shows that there is a clear difference in the three years post-flood (Figure 3) between the two stations; 2015 is the highest of these three years due to additional rainfall during the summer (Hydros, 2016). It is possible that there was additional groundwater storage post-flood in the lower watershed that increased flows in Clear Creek the three years after the flood. This is evidenced by an increase in base flow in 2014 that has been decreasing over the past five years (Figure 4). The Big Thompson Watershed also experienced higher base flows in the lower watershed post-flood (Hydros, 2015). Both base flow and the difference between the two stations has been decreasing the last few years. The lower station total annual flows for 2017-2019 were 27% higher than the

[1] Weather and snowpack data from Natural Resources Conservation Service (NRCS) SNOTEL site 602: Loveland Basin (NRCS, 2020)

upper station. This gives evidence that flows in Clear Creek may be normalizing back to pre-flood conditions. Because the average of the previous five years is heavily weighted towards 2014 and 2015, flows at the lower station in 2019 are calculated as below average, however when examining the long term trends (Figure 3), 2019 appears to be a relatively average year for flows.

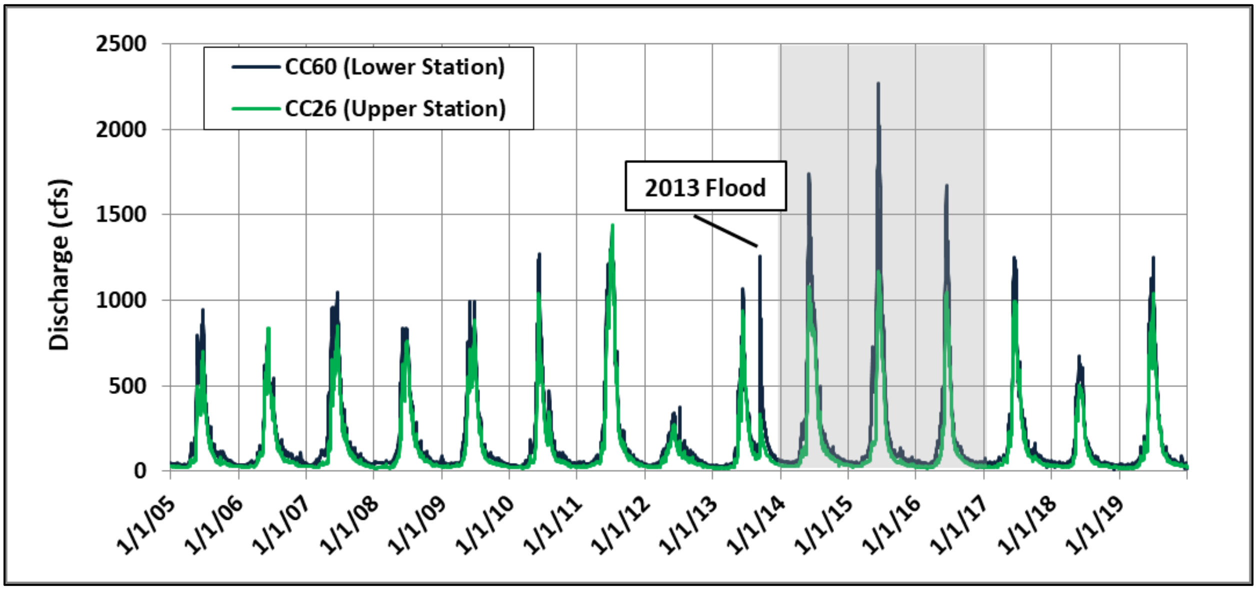


Figure 3. Clear Creek Hydrographs for the Upper Station (CC26) and the Lower Station (CC60), Long Term Record (2005-2019)

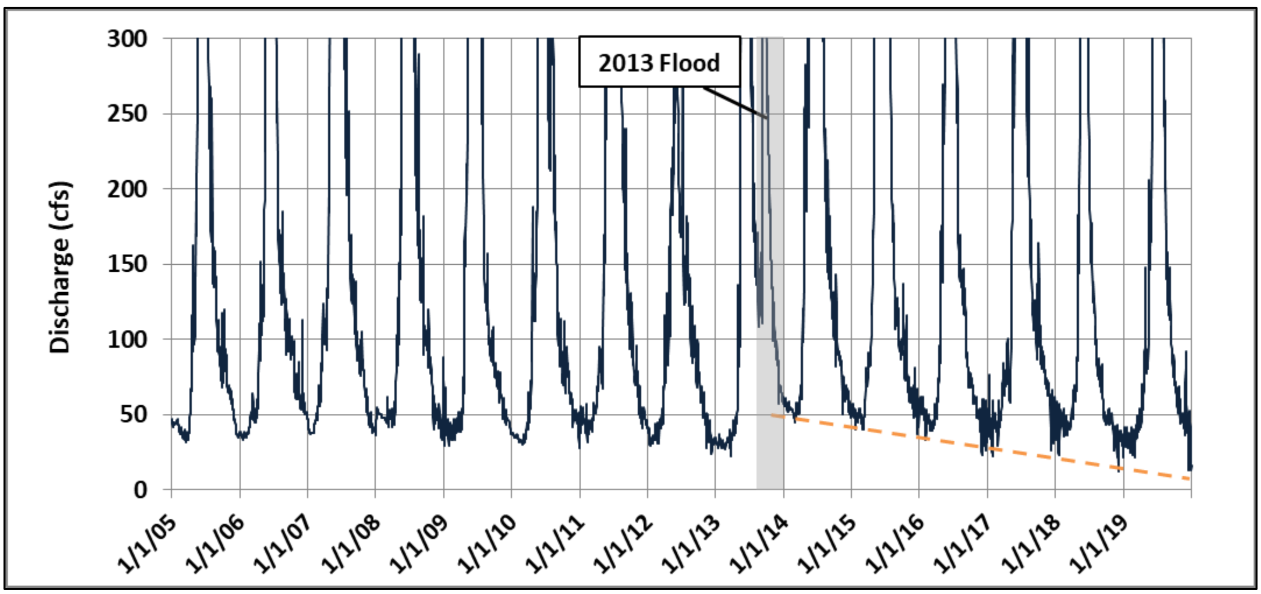


Figure 4. Clear Creek Hydrographs at CC60 Scaled to Show Changes in Baseflow, 2005 - 2019

Total annual flow volumes for the two locations (2014-2019) are presented in Figure 5. The 2014-2018 average flow volume is included for reference. Once again 2014 and 2015 stand out compared to the last three years. 2019 is similar to 2016 and 2017 in terms of total annual flows.

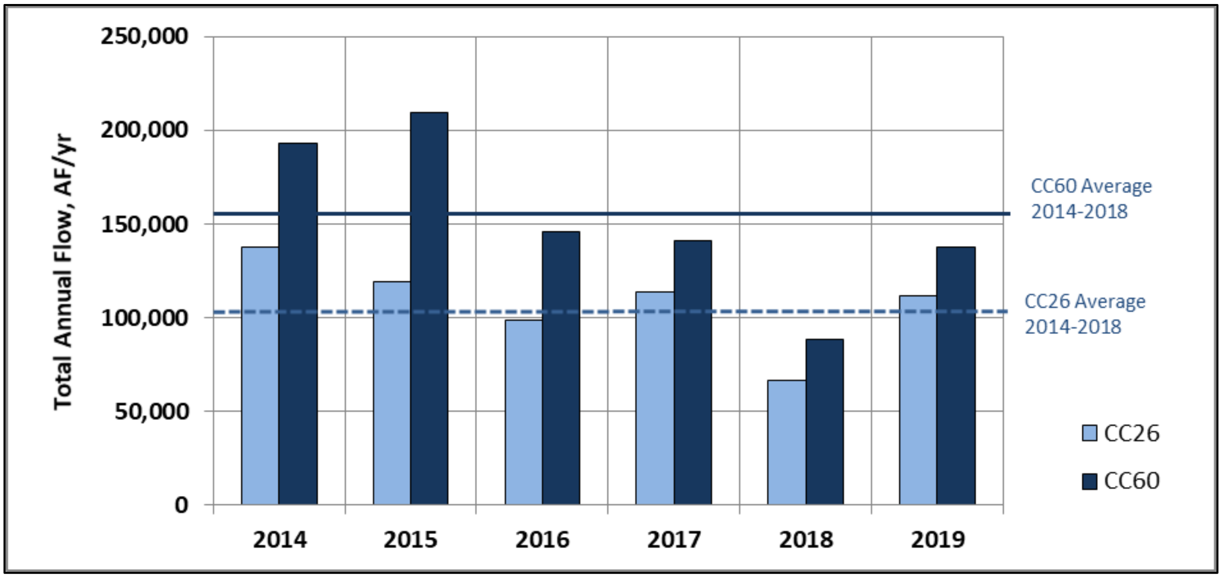


Figure 5. Total Annual Flow in Clear Creek at CC26 and CC60, 2014-2019

Hydrographs from CC60 for 2014-2019 are shown in Figure 6. The patterns and timing of yearly snowmelt-driven flows were later this year than previous years. This is primarily due to the weather patterns described previously. The second and larger peak during runoff occurred later than the previous five years peaking at the beginning of July. The duration of the runoff period was consistent with the previous five years.

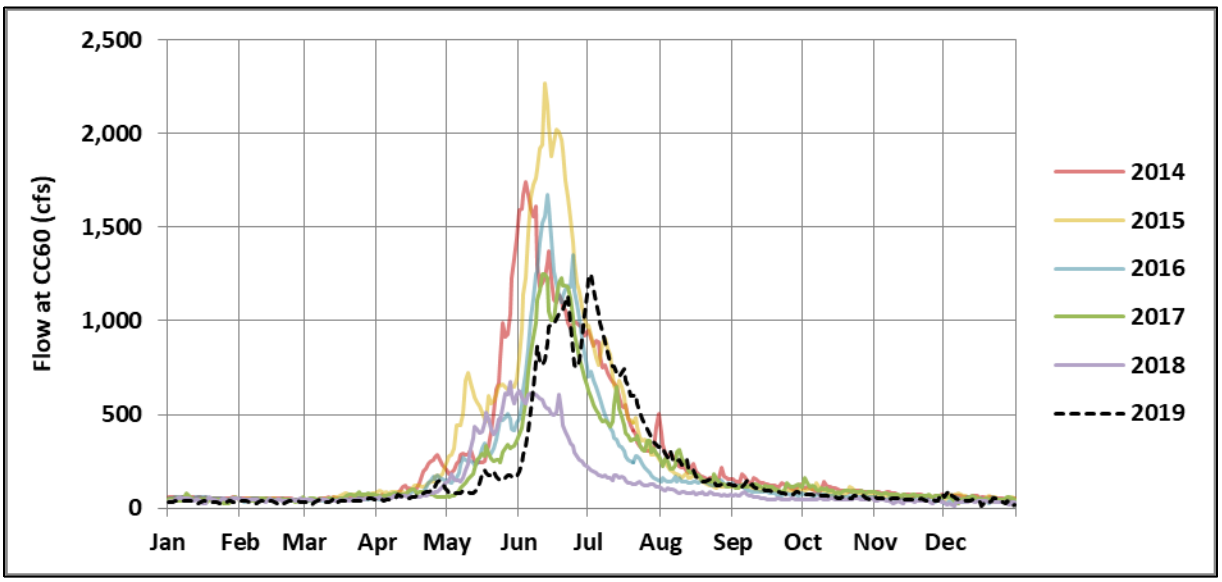


Figure 6. Annual Clear Creek Hydrographs for 2014-2019 (CC60)

WATER QUALITY AND NUTRIENT LOADING

Total Suspended Solids

Total suspended solids concentrations from 2019 ambient composite and grab samples for CCAS59/60 and CC26 are displayed in Figure 7. The maximum observed concentration for the upper station (CC26) was 10 mg/L on June 5. The maximum observed concentration of TSS was 47 mg/L at the lower station (CCAS59) on the same day. Consistent with previous years, TSS concentrations at the upper station were lower than concentrations observed at the lower station.

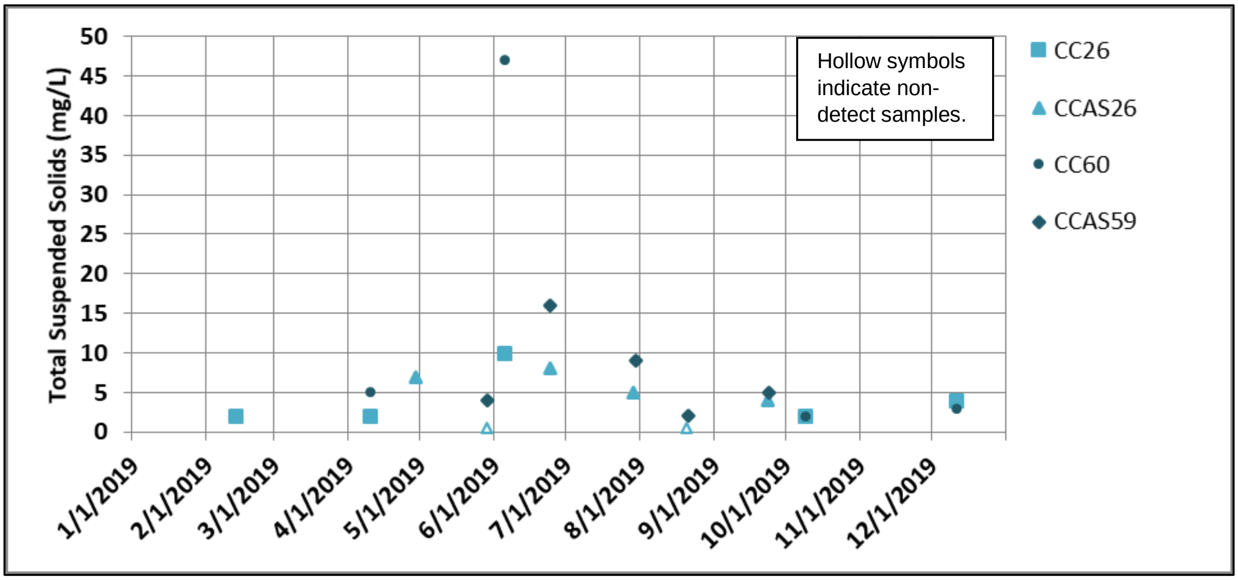


Figure 7. Total Suspended Solids Concentrations (Non-Event) in the Upper Basin, 2019

TSS sample results from the previous six years are presented in Figure 8. In this figure and in subsequent related figures for TP and TN, the November to March period is highlighted in grey. This is done to emphasize the seasonality of the observed water-quality patterns. Peak concentrations in 2019 for CC26 and CCAS59/60 were similar to previous years with higher concentrations corresponding to the runoff period in spring and early summer.

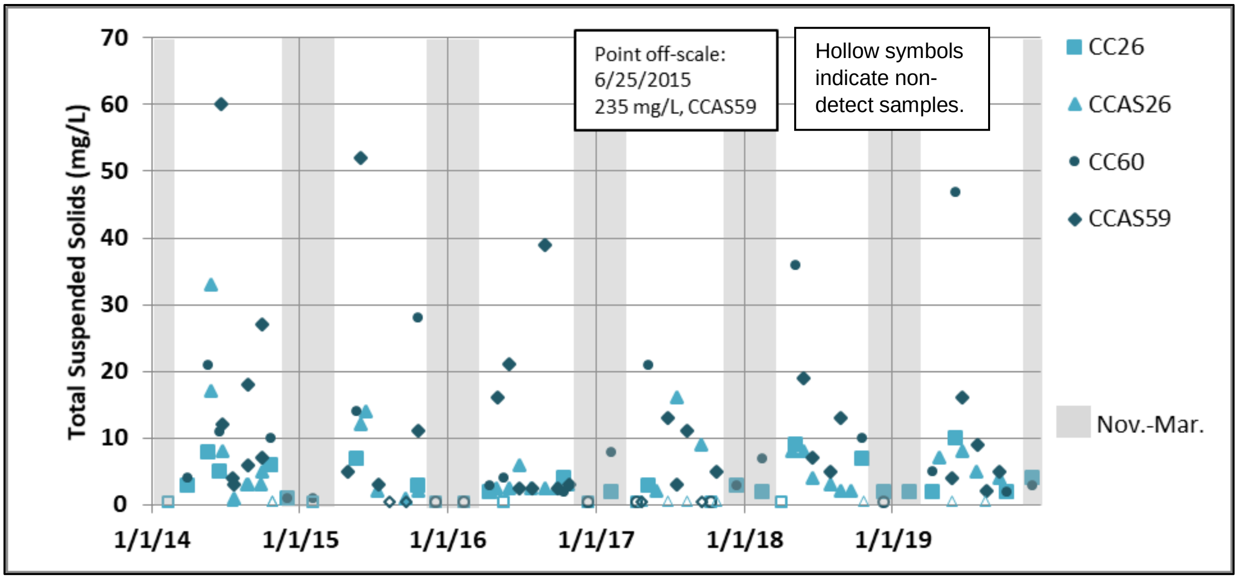


Figure 8. Total Suspended Solid Concentrations (Non-Event) in the Upper Basin, 2014-2019

Average monthly TSS concentrations at the lower station in 2019 are compared to the average and range of the previous five years (2014-2018) for all months sampled (Table 1). Runoff began later and extended into early July 2019. The only concentration observed in July was above the average and the range of values observed in the previous five years. All other months were within the average and range of observed concentrations in the previous five years.

Table 1. Monthly Average Total Suspended Solids Concentrations (Non-Event) in the Upper Basin at CCAS59/60, Red Values are Below Detection Limit and are Reported as ½ the Detection Limit (0.5 mg/L)

Month	2019 Average TSS (mg/L)	2014-2018 Average TSS (mg/L)	2014-2018 Range of TSS (mg/L)
April	5.0*	2.6	0.5 – 5.0
May	4.0*	18.7	4.0 – 36.0
June	31.5	45.9	2.5 – 235.0
July	9.0*	3.1	2.5 – 4.0
August	2.0*	13.2	0.5 – 39.0
September	5.0*	7.6	0.5 – 27.0
October	2.0*	8.5	0.5 – 28.0
December	3.0*	1.1	0.5 – 3.0

* Based on one observed value

Loads were calculated using daily flows from USGS gage measurements and concentration data from samples collected as part of the Upper Clear Creek/Standley Lake Watershed Water Quality Monitoring Program. Consistent with previous analyses, a mid-point step function was used to fill in daily concentrations between available sample data. Annual loads are then calculated as the sum of individual daily loads. Non-storm-event TSS loads at CC26 and CCAS59/60 were calculated for 2019 and compared to estimates from 2014-2018 (Figure 9).

Loads at the upper station were 6% higher than the average of the previous five years. Loads at the lower station were 15% below average.

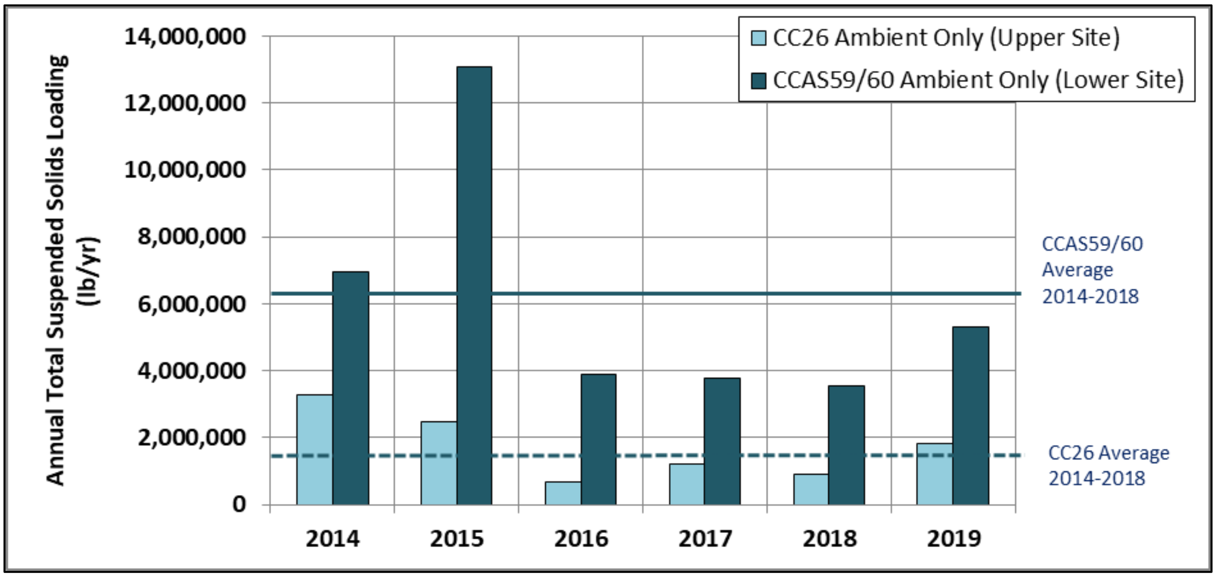


Figure 9. Total Suspended Solids Load Estimates in the Upper Basin, 2014-2019

Volume-weighted concentrations were computed at the two key locations for the past six years (Figure 10). They were calculated by dividing the annual load by the annual flow volume. Volume-weighted concentrations in 2019 were comparable to 2018 at both sites.

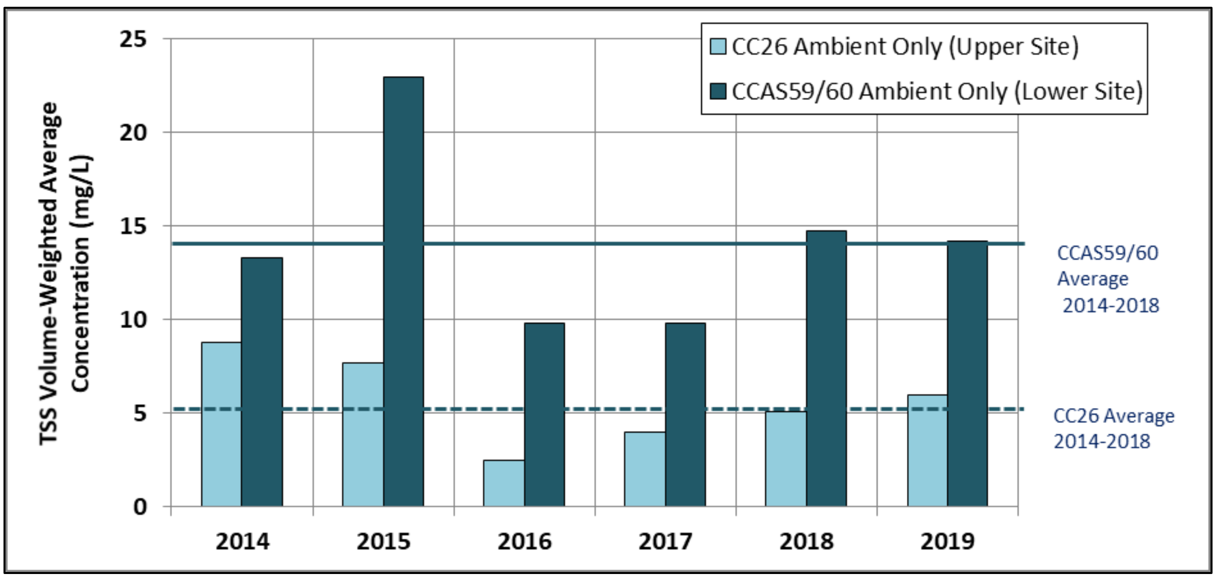


Figure 10. Total Suspended Solids Volume-Weighted Concentration Estimates in the Upper Basin, 2014-2019

Sample timing has proven to be insightful to loading patterns. Figure 11 shows the sample timing in relation to the hydrograph. It is apparent that samples were not collected during peak flow. As such, loading calculations may be underestimated. Samples on the rising limb of the hydrograph are crucial to improving the accuracy of loading estimates as the rising limb often has higher concentrations.

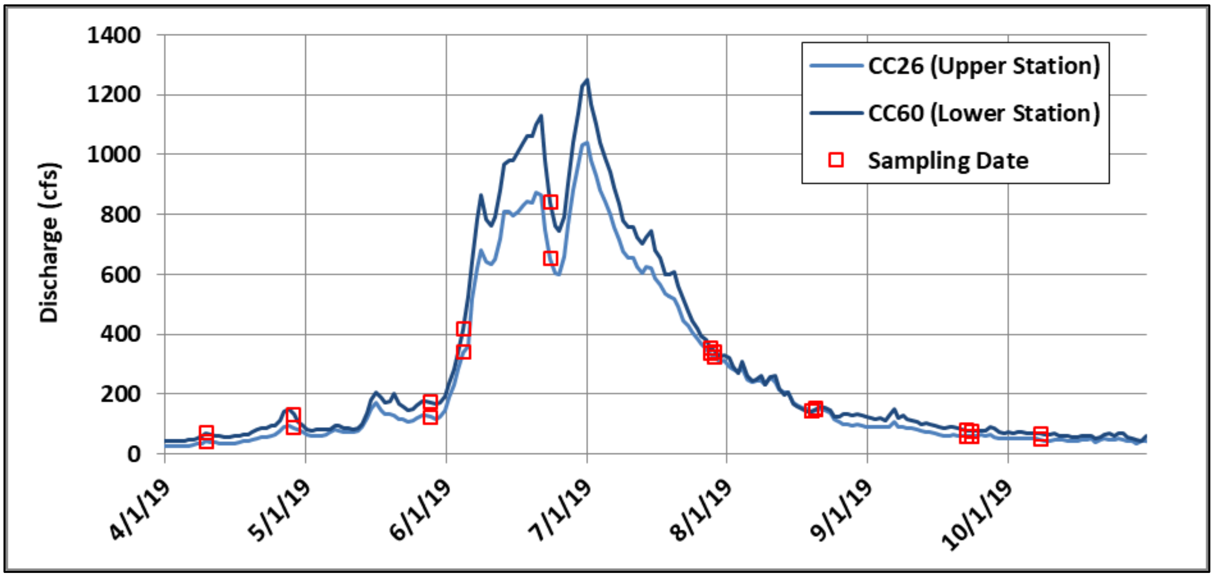


Figure 11. Sample Timing and Flow at CC26 and CC60, 2019

Total Phosphorus

Total phosphorus concentrations from grab samples and ambient composites in the Upper Basin are displayed in Figure 12. For both stations, peak concentrations occurred on the rising limb of the hydrograph with the highest concentration for the upper and lower stations occurring on June 5 (17.2 µg/L and 51.1 µg/L, respectively).

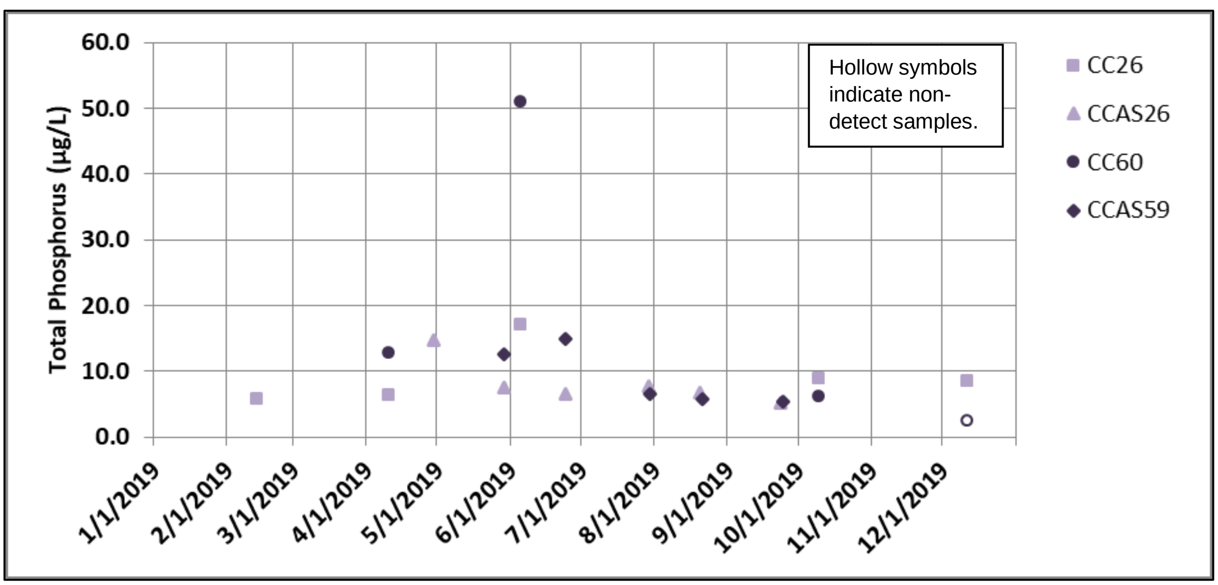


Figure 12. Total Phosphorus Concentrations (Non-Event) in the Upper Basin, 2019

Total phosphorus concentrations from ambient and grab samples for the period of 2014-2019 are displayed in Figure 13. Previous years (2014-2015) have shown TP concentrations increasing during spring runoff, while this pattern was not strongly observed in 2016 and 2017. Samples taken in 2018 and 2019 were higher and more closely correspond with the runoff period, although were still lower overall. Sample results fell within the range of the previous three years due to comparable flows.

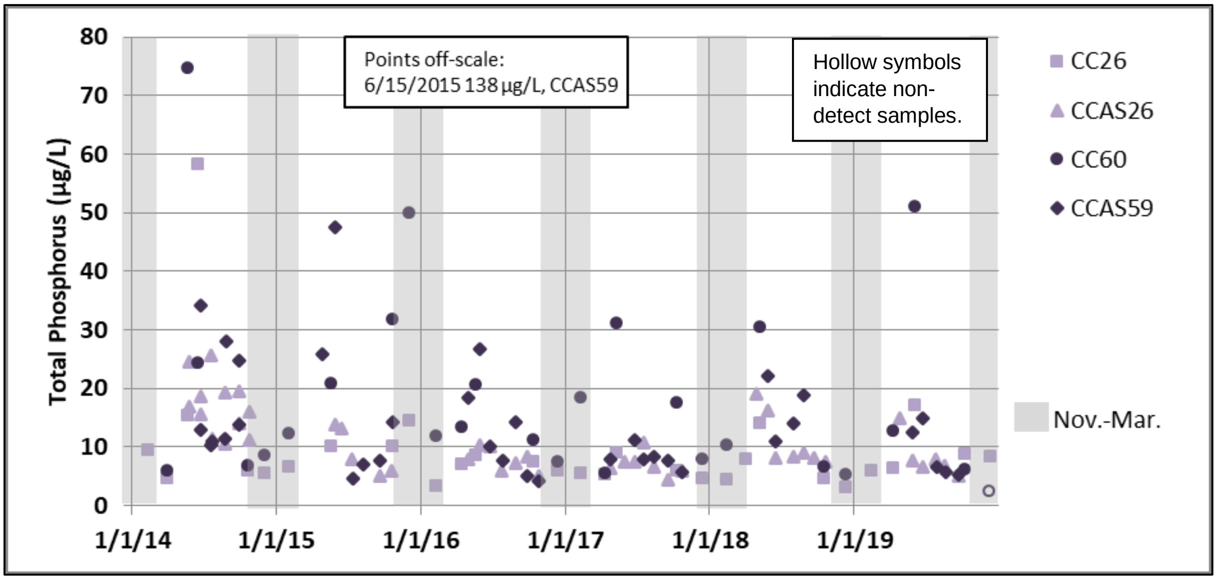


Figure 13. Total Phosphorus Concentrations (Non-Event) in the Upper Basin, 2014-2019

Monthly average TP concentrations for May through August 2019 and the 2014-2018 average and range are shown in Table 2. All months were within the observed range of the last five years with the exception of May and August which were below the range of observed values. May values are lower due to the later start of runoff. The trend of lower variability in phosphorus values the last four years may be related to sample timing, three of the last four years (2016, 2017, and 2019) have missed the peak of the hydrograph. Sampling in 2018 was well spread over the hydrograph, but was a dry year so TP and TSS concentrations were low due to low flows.

Table 2. Monthly Average Total Phosphorus Concentrations (Non-Event) in the Upper Basin at CCAS59/60, Red Values are Below Detection Limit and are Reported as ½ the Detection Limit (2.5 µg/L)

Month	2019 Average TP (µg/L)	2014-2018 Average TP (µg/L)	2014-2018 Range of TP (µg/L)
April	12.9*	11.7	5.6 – 25.8
May	12.5*	31.2	18.4 – 74.7
June	33.0	35.1	10.1 – 138.0
July	6.5*	8.3	4.5 – 10.9
August	5.7*	14.6	7.1 – 28.1
September	5.3*	11.3	5.1 – 24.8
October	6.3*	12.5	4.1 – 31.9
December	2.5*	15.9	5.3 – 50.0

∗Based on one observed value

Non-storm event TP loads at CC26 and CCAS59/60 were calculated for 2019 and compared to estimates from 2014-2018 (Figure 14). Loads in 2019 were lower than the 2014-2018 average. Loads for CC26 and CCAS59/60 were 33% and 38% below average, respectively.

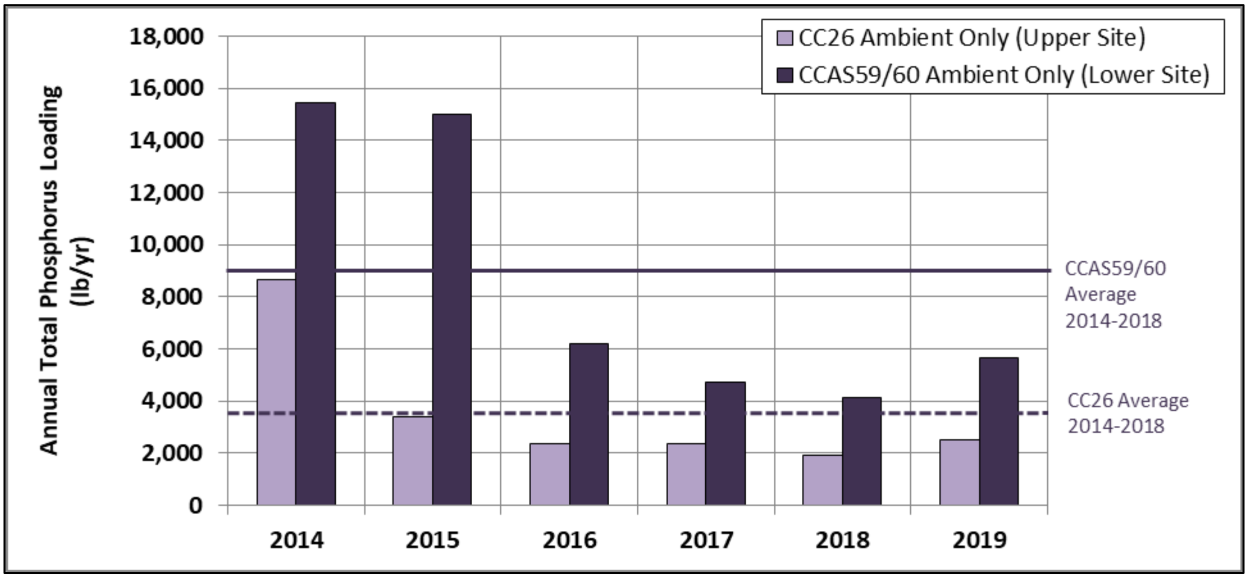


Figure 14. Annual Total Phosphorus Loading Estimates in the Upper Basin, 2014-2019

Volume-weighted concentrations (annual load divided by annual volume) of TP at CC26 and CCAS59/60 are presented in Figure 15 for 2014-2019. In 2019, volume-weighted concentrations at CCAS59/60 were lower than the average of the previous five years.

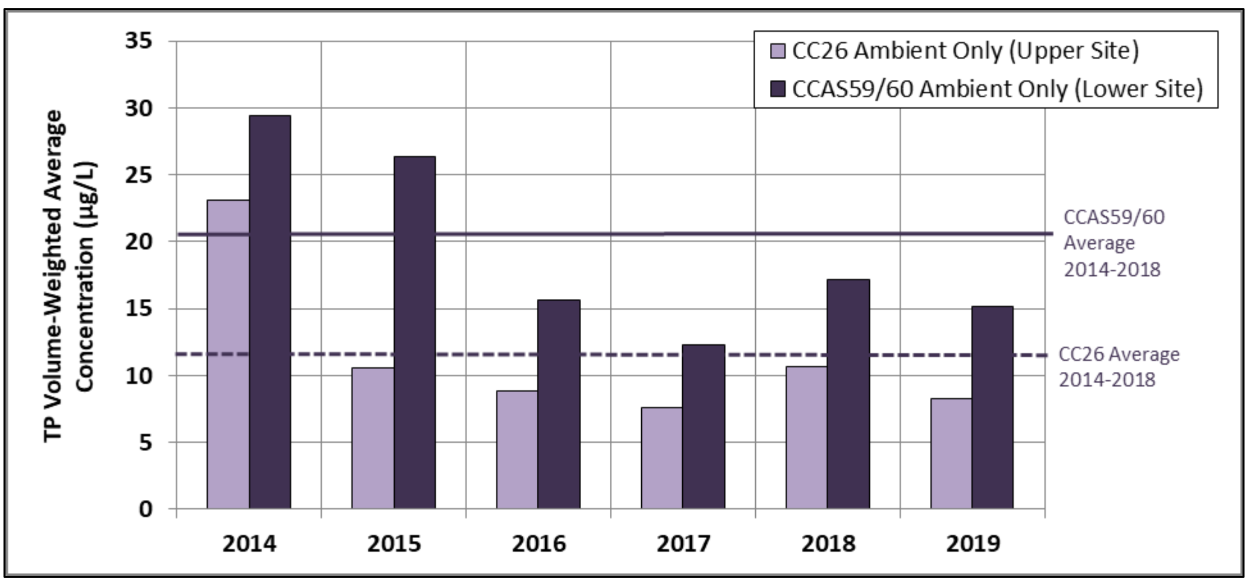


Figure 15. Volume-Weighted Total Phosphorus Concentration Estimates in the Upper Basin, 2014-2019

Total Nitrogen

Total nitrogen concentrations from grab and composite sample data collected in the Upper Basin for 2019 are presented in Figure 16. Both stations follow a seasonal pattern with higher concentrations in the winter and early spring months. This pattern is the opposite of patterns observed in TSS and TP and is related to the higher proportion of flow from WWTPs in winter months. The maximum concentration at the upper station was 580 µg/L and was observed on April 10. The maximum ambient concentration at the lower station was 650 µg/L and was observed on December 11 at CC60.

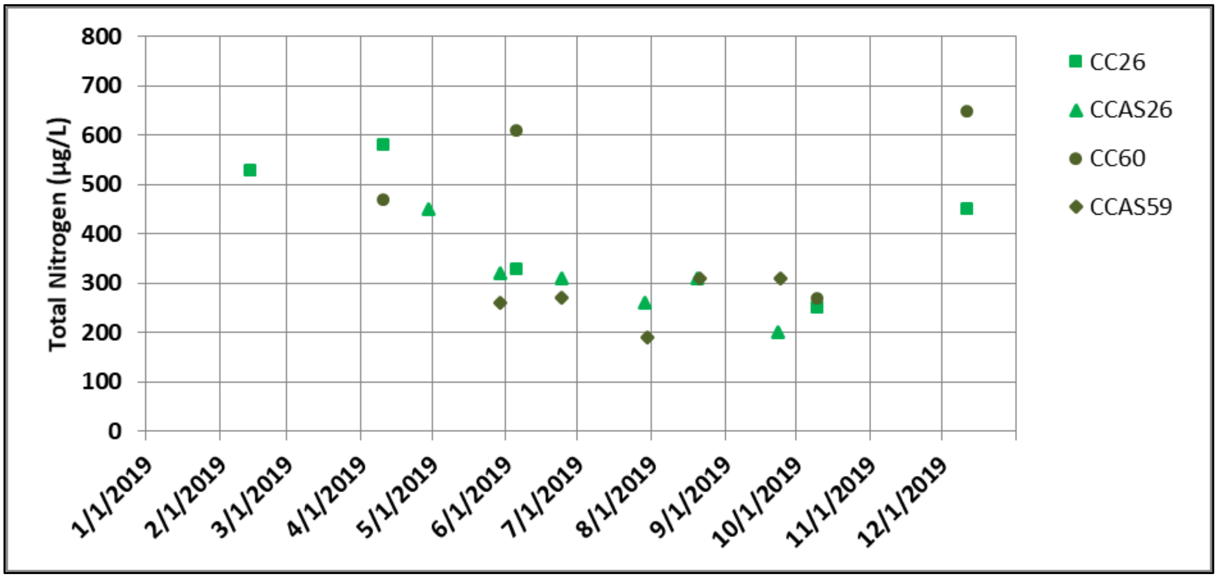


Figure 16. Total Nitrogen Concentrations (Non-Event) in the Upper Basin, 2019

A temporal pattern of lower TN concentrations in summer and higher concentrations during the winter low-flow period (typically November to March) is observed each year for both stations (Figure 17). This pattern is driven by the dilution of sources during periods of higher flow, this pattern is once again evident in 2019, with the highest concentrations for the upper and lower stations occurring in April and December, respectively.

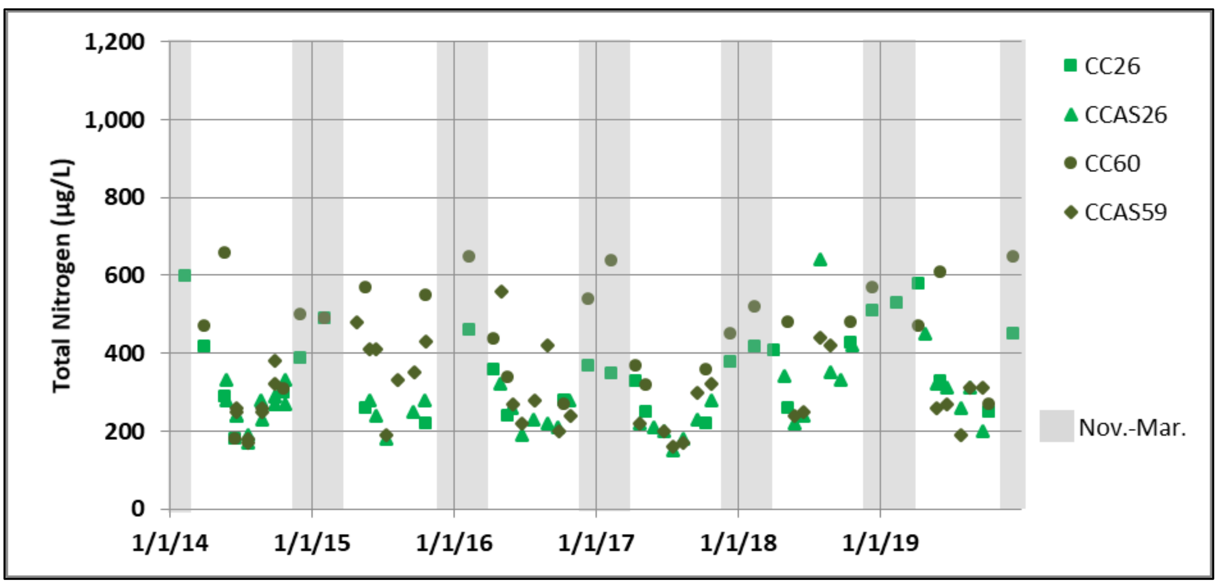


Figure 17. Total Nitrogen Concentrations (Non-Event) in the Upper Basin, 2014-2019

A comparison of monthly average TN concentrations at CCAS59/60 for 2019 and the 2014-2018 averages for all sampled months is displayed in Table 3. The ambient results for TN were within the range of historic observations for most of the months sampled. June had higher than average concentrations due to flow patterns. Typically, the peak of the hydrograph occurs in June. The later peak this year (July) resulted in less dilution due to the delay in runoff flows. The concentration observed in December was above average. December typically has the highest concentration of all the months sampled and this is the second year in a row that the December value has been above the range of historic December values.

Table 3. Monthly Average Total Nitrogen Concentrations (Non-Event) in the Upper Basin at CCAS59/60

Month	2019 Average TN (µg/L)	2014-2018 Average of TN (µg/L)	2014-2018 Range of TN (µg/L)
April	470*	396	220 – 480
May	260*	453	240 – 660
June	440	272	180 – 410
July	190*	196	160 – 280
August	310*	327	170 – 440
September	310*	308	200 – 380
October	270*	364	240 – 550
December	650*	515	450 – 570

* Based on one observed value

Loads in 2019 were 33% above the 2014-2018 average for CC26 and 13% below the 2014-2018 average for CCAS59/60 (Figure 18). This is expected given the same discrepancy between flows at the upper station and the lower station.

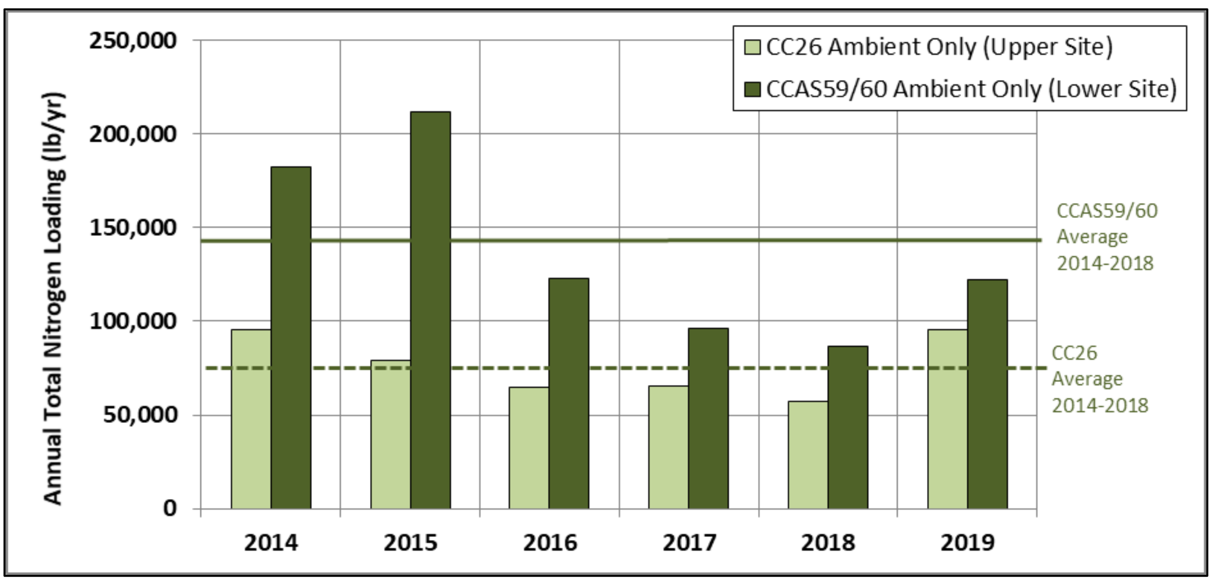


Figure 18. Total Nitrogen Loading Estimates in the Upper Basin, 2014-2019

Volume-weighted concentrations (annual load divided by annual volume) of TN at CC26 and CCAS59/60 are presented in Figure 19. Volume-weighted average concentrations for CC26 were 24% above the 2014-2018 average, and is comparable to the five-year average for CCAS59/60.

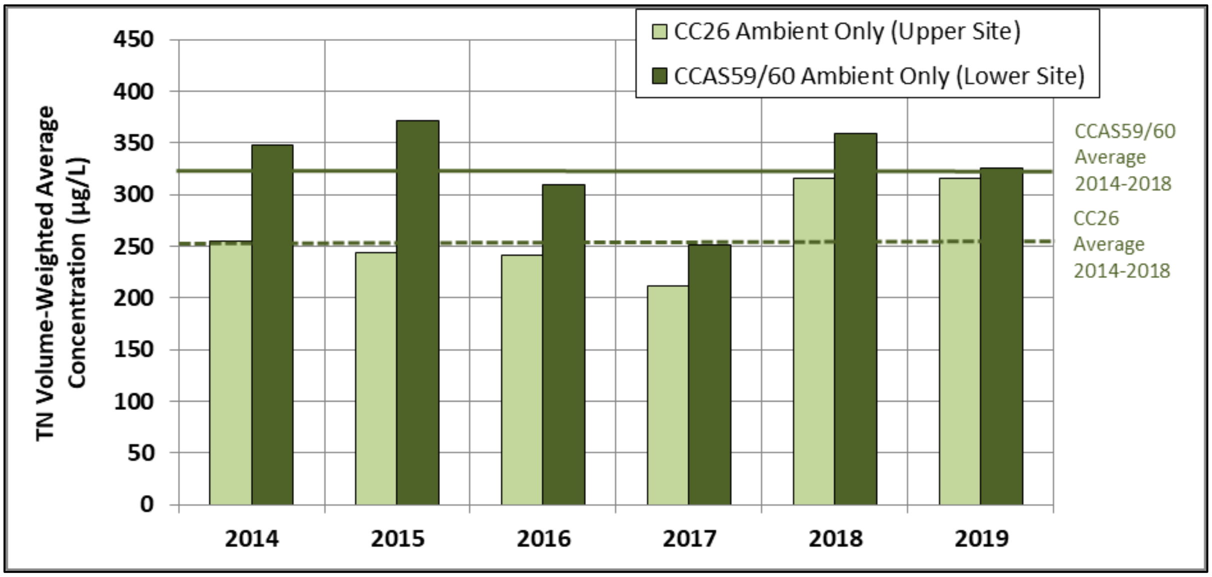


Figure 19. Volume-Weighted Total Nitrogen Concentration Estimates in the Upper Basin, 2014-2019

STORM EVENT LOADING

The loading results in the previous section include grab samples and ambient composite samples. These types of samples are taken at regular intervals. They do not capture water-quality response to storm events. Precipitation events can result in substantial changes to water quality compared to ambient conditions. Event-triggered sampling results at station CCAS59 in Golden are summarized in this section. 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.

In June 2019, one event-triggered sample was collected at CCAS59. Effects of these storms on loading estimates are presented in Figure 20. Incorporating samples from this event into the loading calculations increases the annual loads of TN by 2%, TP by 19%, and TSS by 8%. The effects of storm events on loading estimates are highly dependent on the number of storm events captured by sampling and by the concentrations observed during each individual event. There can also be large amounts of variability between storm events.

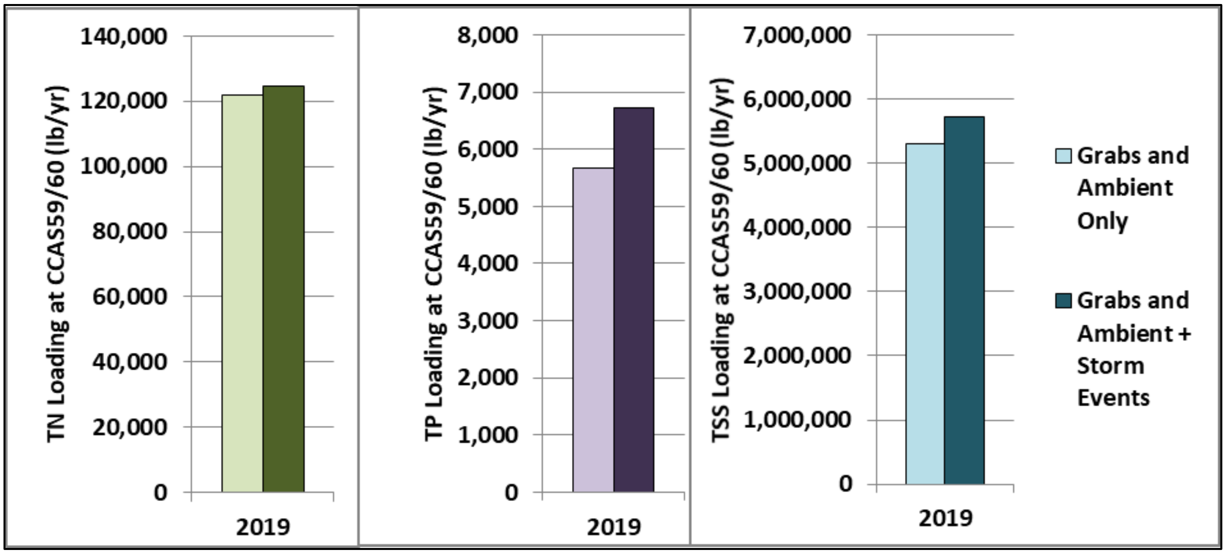


Figure 20. Total Nitrogen, Total Phosphorus, and Total Suspended Solids Loading in 2019 With and Without Storm Events

III. CANAL ZONE FLOWS AND WATER QUALITY

Clear Creek is the raw water source for Standley Lake. Water is delivered by three earthen ditches and one pipeline (KDPL; Figure 21). This section presents the timing and volume of flows for the inflows to Standley Lake. A more detailed description of water-quality changes along the two major (FHL and Croke) canals from their points of diversion on Clear Creek to the reservoir is included.

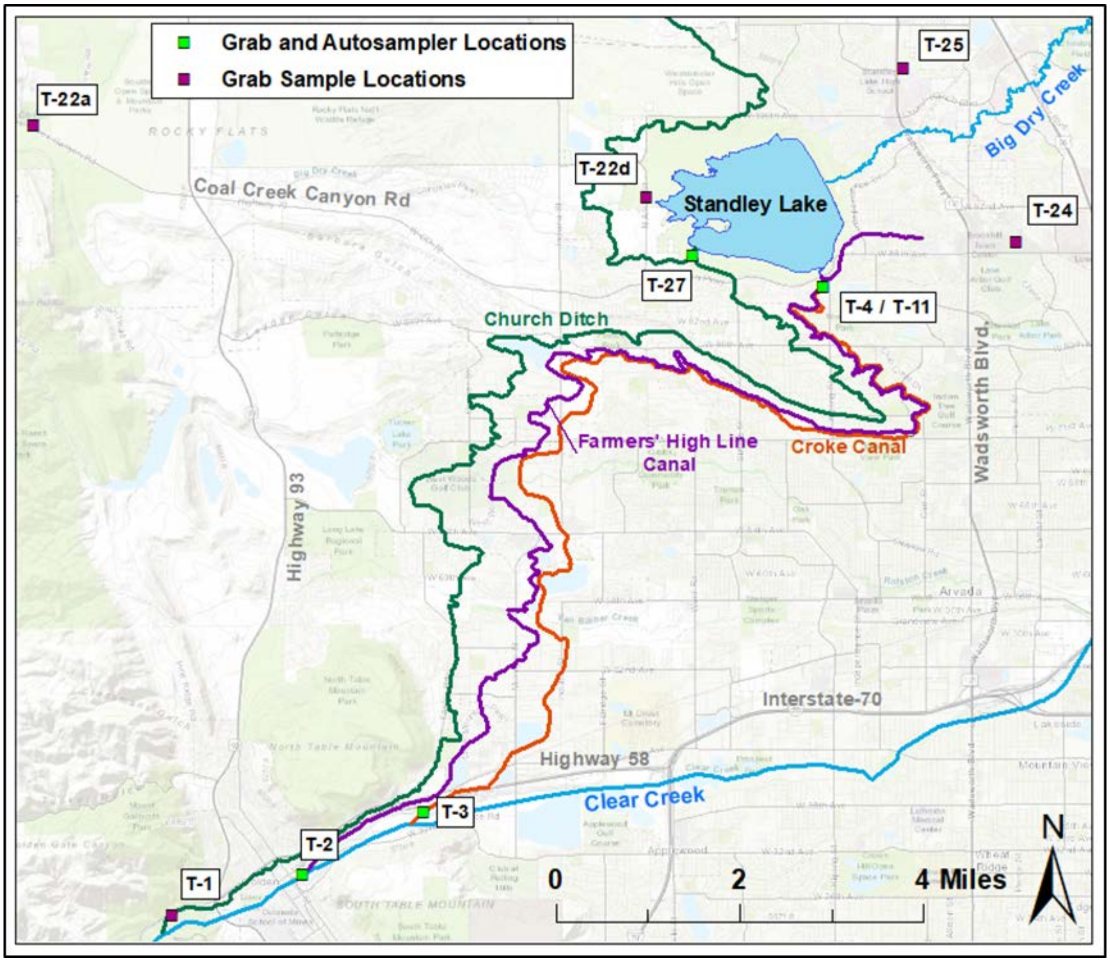


Figure 21. The Canal Zone Showing the Three Canals that Divert Water from Clear Creek to Standley Lake

FLOWS FROM CANALS AND KDPL

Water enters Standley Lake via four conveyances: Church Ditch, Croke Canal, Farmers' High Line Canal (FHL), and Kinnear Ditch Pipeline (KDPL). Inflows for 2019 from each of these sources are shown in Figure 22. During the irrigation season (April to October), the FHL was the dominant source of inflow. When reservoir contents are low at the beginning of the year, which occurred in 2019, filling the reservoir becomes a top priority. Runoff in 2019 allowed for a free-river[2] period, in which the FHL, Croke, and Church Ditch ran simultaneously. Standley Lake received 31% of the total annual flow for the year between May 15 and June 15. In 2019, the Church Ditch ran from May through August, and the KDPL ran from September to early November. The Croke Canal has the most senior rights in the Clear Creek Basin during the non-irrigation season (November – March). As is typical, following the cessation of flows from FHL, the Croke Canal provided the only inflow to Standley Lake from November 1 to mid-April.

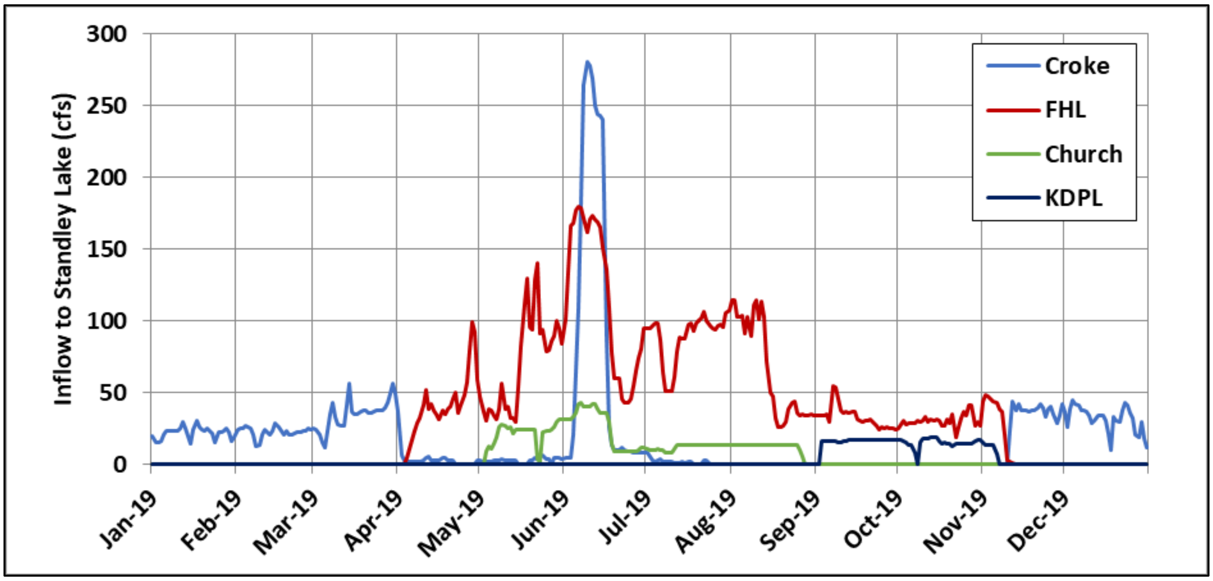


Figure 22. Inflow to Standley Lake, 2019

CHANGES IN WATER QUALITY FOR THE FHL AND CROKE CANALS

The Croke and the FHL are the dominant water delivery structures to Standley Lake. These canals follow parallel paths for approximately 15 miles between their headgates at Clear Creek and their inlet to Standley Lake. Over this distance, the canals pass 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, as with the Upper Basin and Standley Lake water-quality discussions, median annual concentrations were calculated for TSS, TP, and TN at canal headgates and lake inlets. An increase in TSS and TP concentrations was observed in the Croke (Figure 23 and Figure 24, right). However, TN does not show the same pattern (Figure 25, right). The specific sources of TSS and TP along the Croke have not been identified. The magnitude of the difference for these constituents is less in the FHL (Figures 23-25, left).

[2] Free-river is defined as a period of time where there is more water than all water rights on a river (Colorado River District, 2020).

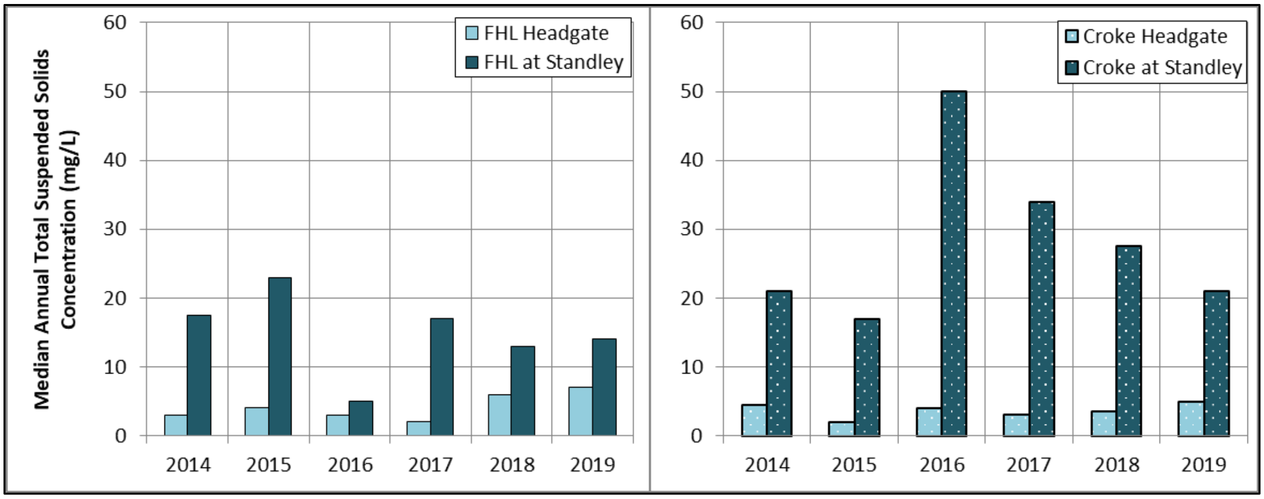


Figure 23. Median Total Suspended Solids Concentrations in FHL (left) and Croke (right)

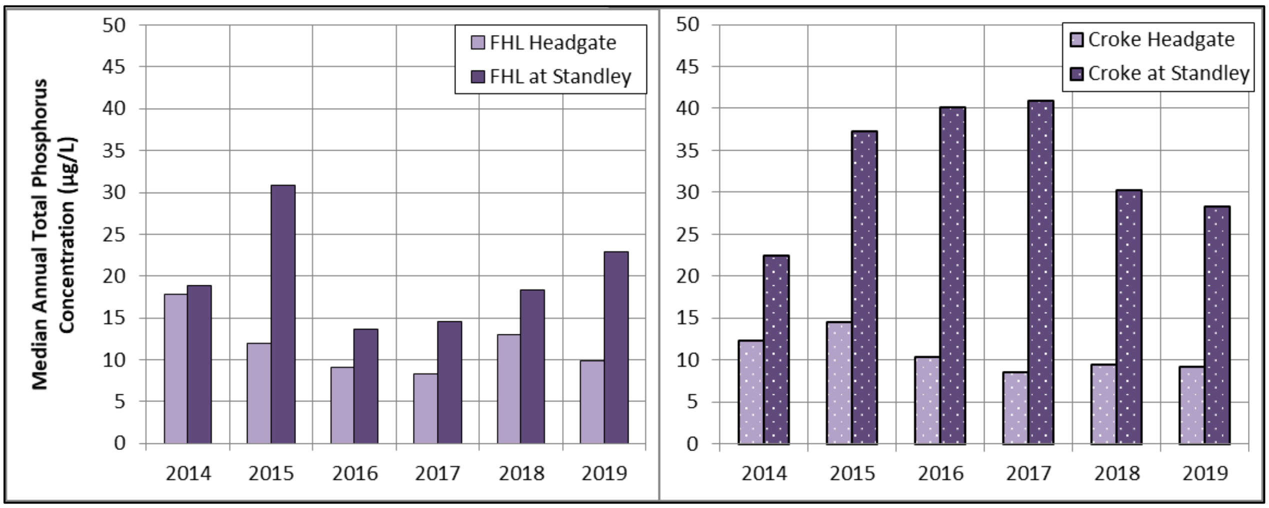


Figure 24. Median Total Phosphorus Concentrations in FHL (left) and Croke (right)

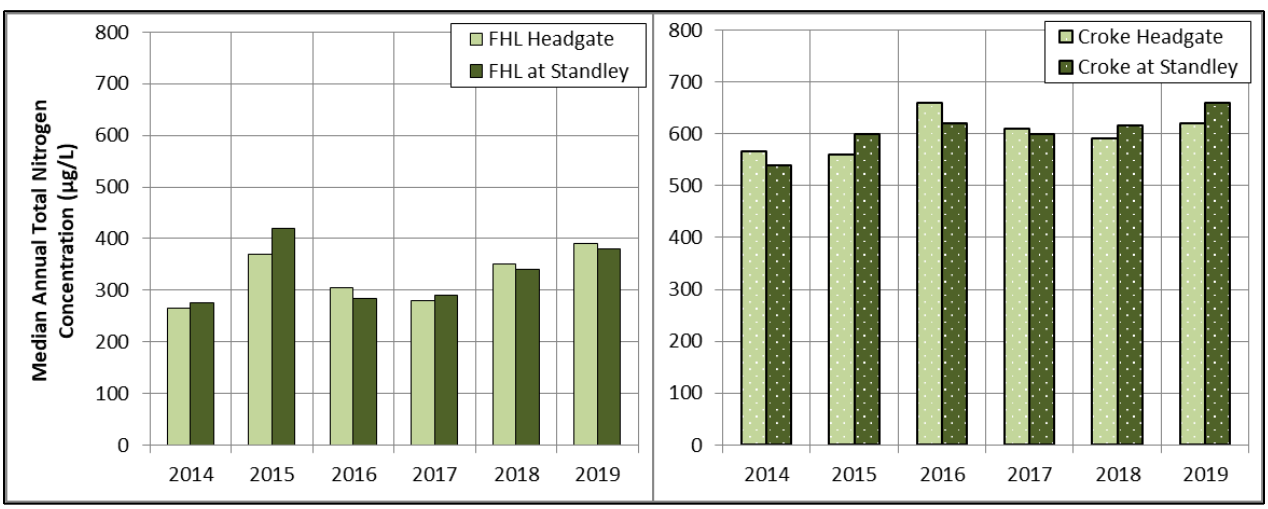


Figure 25. Median Total Nitrogen Concentrations in FHL (left) and Croke (right)

The Croke Canal delivers water predominantly during the winter, with relatively consistent flow. Changes in loads are highly dependent on concentrations. Consistent with previous years, phosphorus concentrations in the Croke were higher than those observed in the FHL and appear to increase independently of changes in flow (Figure 26). This is especially evident in the first three months of the year, where TP concentrations increased, but flows remained below 50 cfs. TSS concentrations follow a similar pattern as TP, with consistently higher concentrations at lower flow rates. TN is also higher than the FHL, but this is due to the Croke running primarily in winter when TN concentrations in Clear Creek tend to be higher. Reasons for higher baseline TSS and TP concentrations in the Croke Canal remain unknown.

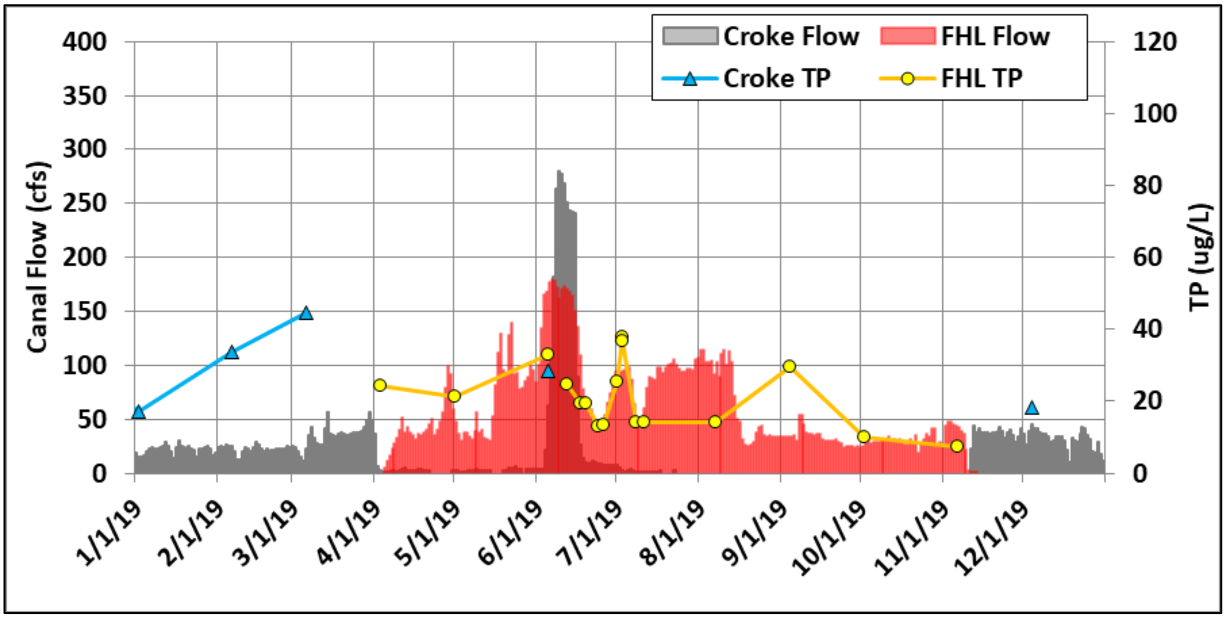


Figure 26. Flow and Total Phosphorus Concentrations in the Croke and FHL Canals, 2019

IV. STANDLEY LAKE FLOWS, CONTENTS, AND LOADINGS

Standley Lake is monitored throughout the year when ice is not present. The reservoir is sampled in multiple locations, however, SL10 (Figure 27) is the most pertinent to this report because it is the deepest site. This site is located near the municipal supply intakes and is the location of the automated profiler. Daily reservoir profiles are taken and biweekly samples are also collected at the surface, through the photic zone (twice the Secchi depth), and at the bottom. This section provides a discussion of the quantity and quality of the inflows to and outflows from Standley Lake. Loads of TSS, TN, and TP are described, as well as lake contents.

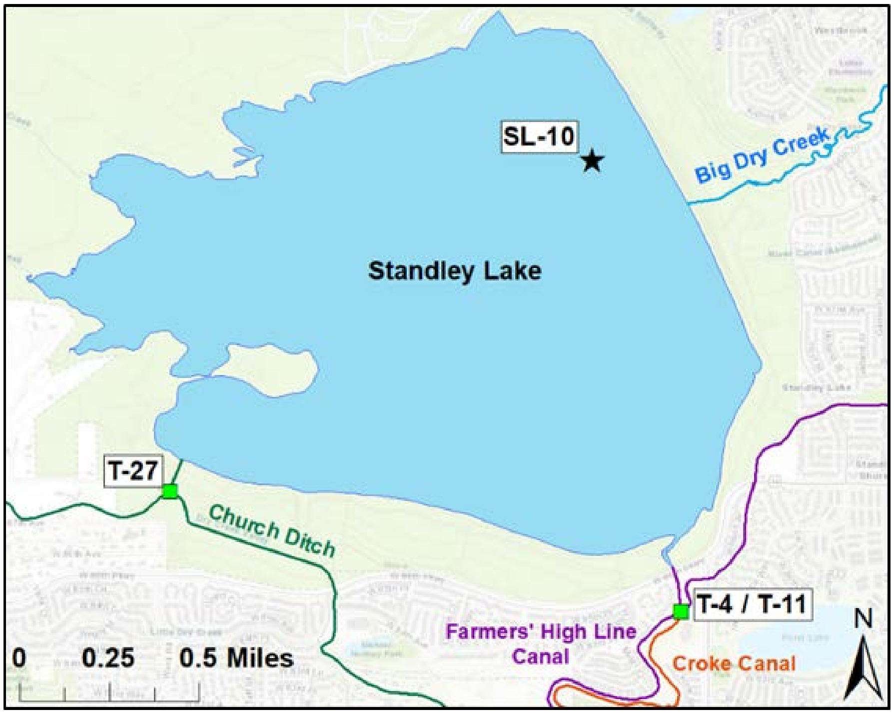


Figure 27. Standley Lake Sampling Location and Locations of Canal Inflows

FLOWS AND CONTENTS

Seasonal patterns and daily flow rates for the four inflows to Standley Lake were presented in Figure 22. Annual flow volumes for each source for the period 2014 to 2019 are shown in Figure 28. The FHL and Croke Canals are the largest inflows of water to Standley Lake providing 58% and 29%, respectively, of the total inflows in 2019. Church Ditch and KDPL inflows were 9% and 4%, respectively.

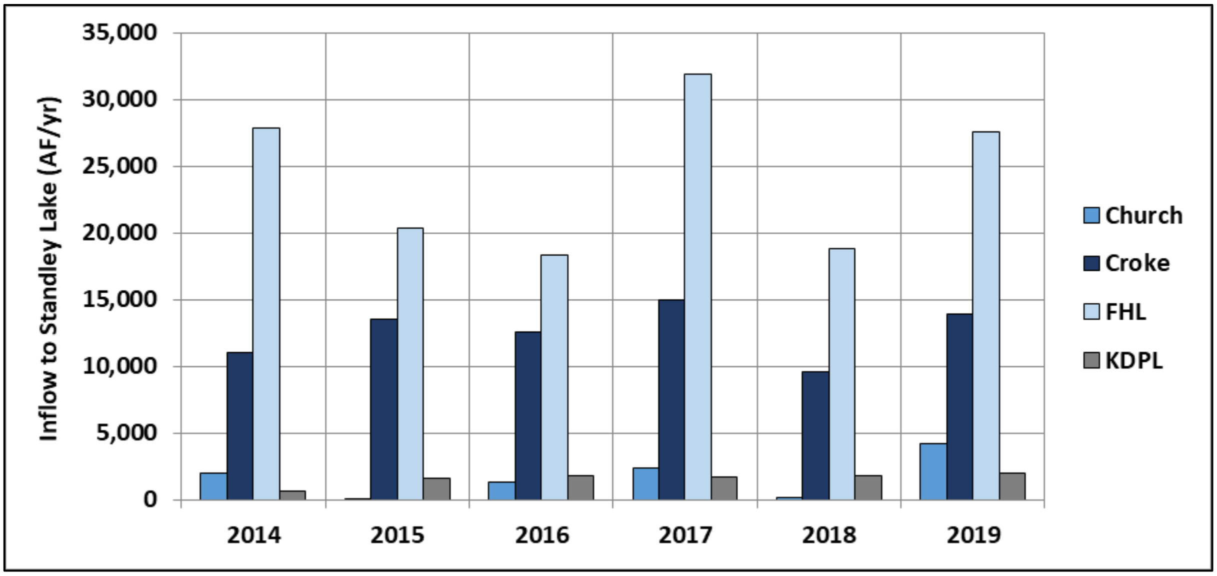


Figure 28. Inflow Volumes to Standley Lake by Source, 2014-2019

Standley Lake contents for the period of 2014-2019 are displayed in Figure 29. Contents were calculated from gage-height measurements using the elevation-area-volume relationship for the lake. In the beginning of 2019, lake contents were lower than normal and were the fourth lowest over the last 27-year period. The free-river period allowed the lake to fill to capacity over the course of one month.

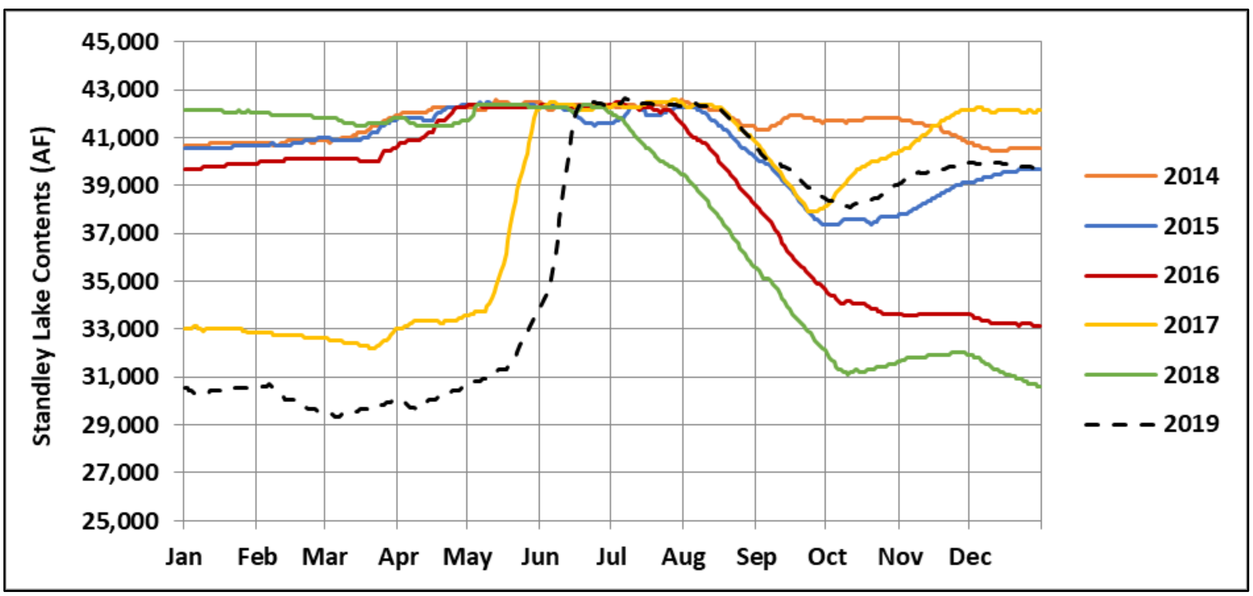


Figure 29. Standley Lake Contents, 2014-2019

Total inflow and outflow rates are presented in Figure 30. Inflows were less than outflows from the beginning of the year until late March when inflows increased during precipitation events, followed by the start of runoff in May. Due to lower lake levels and the free-river period, a substantial amount of water (~ 10,000 AF) came into the reservoir in one month. As such, inflows to Standley Lake were 24% higher than the previous 5 years. Outflow is dependent on potable water demands and is relatively consistent over the years, barring unusual weather patterns. In 2019, outflows in Standley Lake were 5% lower than the previous five years.

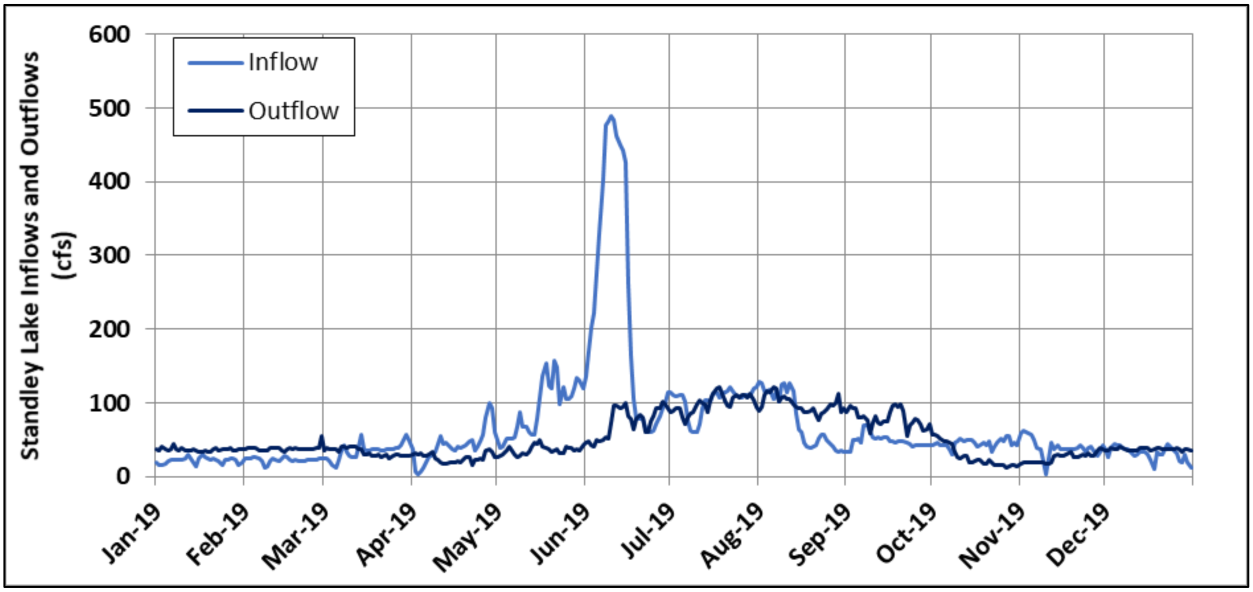


Figure 30. Inflows to and Outflows from Standley Lake, 2019

The largest outflows occur during the summer and fall. Total measured annual inflow (the sum of all four sources) and outflow for 2014-2019 are presented in Figure 31.

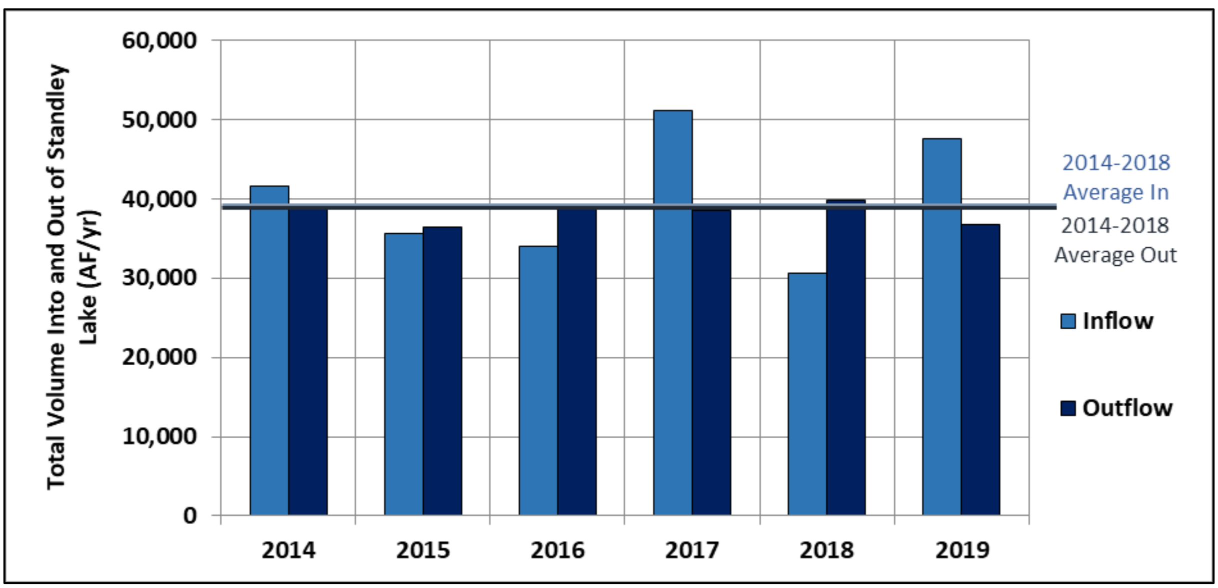


Figure 31. Total Measured Annual Standley Lake Inflow and Outflow, 2014-2019

LOADING INTO/OUT OF STANDLEY LAKE AND INFLOW WATER QUALITY

Estimates of nutrient loads into and out of the lake are described in this section. Sampling data used for inflows includes ambient grab samples and 24-hour ambient composites. Loads are calculated using flows and concentrations on a daily basis. To compute daily concentrations, a mid-point function was used to fill concentrations between the available sample data. Event samples collected on the canals include storm event samples and first flush samples.

Total Suspended Solids

Total suspended solids loads for the individual inflows into Standley Lake for the 2014-2019 period are presented by source in Figure 32. The Croke and FHL, the largest contributors of water to the reservoir, delivered the largest TSS loads. The FHL contributed 63% of the annual TSS load and 58% of the total annual inflow. The Croke Canal contributed 30% of the annual TSS load and 29% of the total annual inflow.

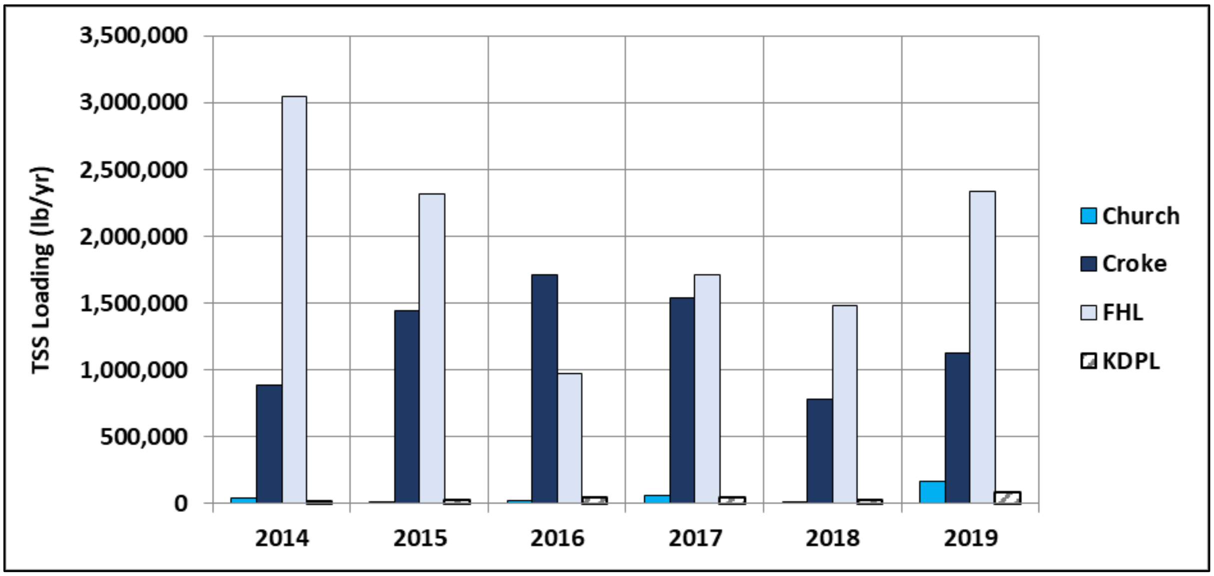


Figure 32. Total Suspended Solids Loading Into Standley Lake by Source, 2014-2019

Estimated annual TSS loads into and out of Standley Lake for 2014-2019 are shown in Figure 33. Non-storm event loads of total suspended solids in 2019 were 15% above the average of the past five years. This is driven by the above average inflows into the reservoir. Loads of TSS into the lake were greater than outflow, indicating some level of solids retention. Loads leaving the reservoir were 2% higher than the previous five years.

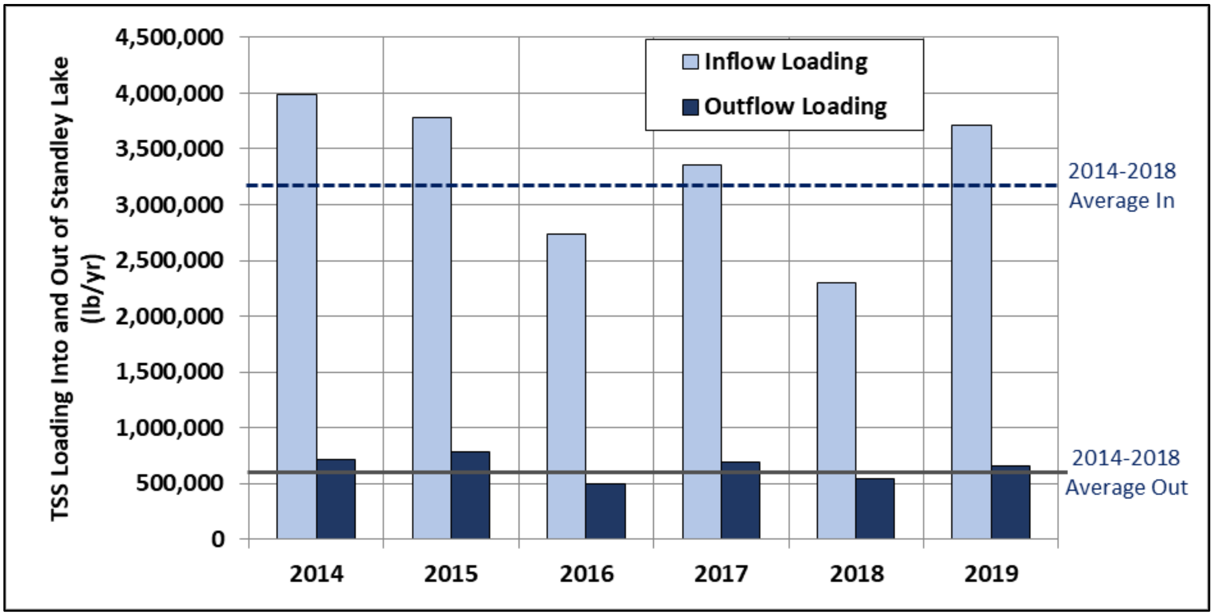


Figure 33. Total Suspended Solids Loading Into and Out of Standley Lake, 2014-2019

Volume-weighted TSS concentrations by source are presented in Figure 34. The FHL had the highest volume-weighted concentration, but was only slightly higher than the Croke. The KDPL was the lowest, but was higher than the previous five years. The combined average concentration of the canals (29 mg/L) in 2019 was 8% lower than the 2014-2018 average (31 mg/L).

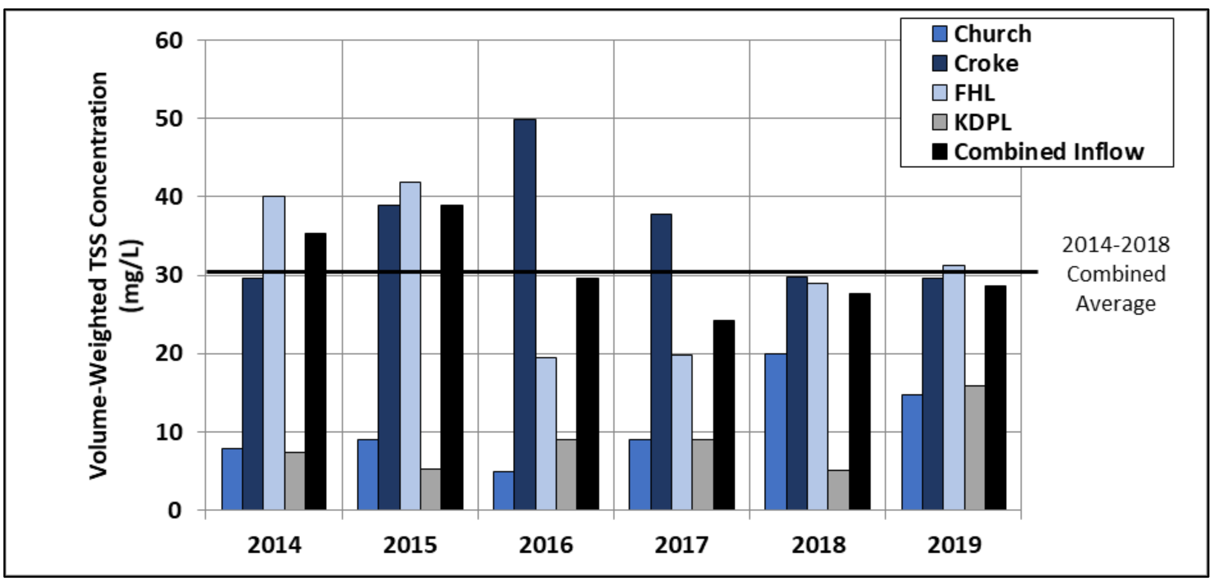


Figure 34. Volume-Weighted Total Suspended Solids Concentrations Into Standley Lake by Source, 2014-2019

Total Phosphorus

Total phosphorus loads for the 2014-2019 time period are presented by source in Figure 35. Similar to TSS loads, the FHL and Croke contributed the largest TP loads (55% and 36% respectively).

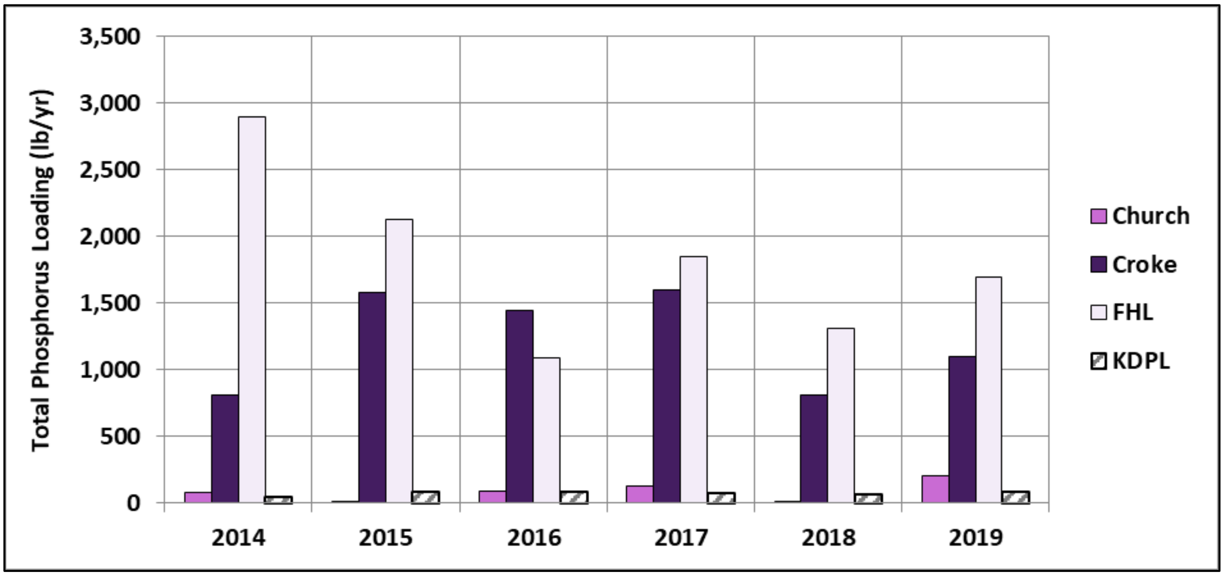


Figure 35. Total Phosphorus Loading Into Standley Lake by Source, 2014-2019

Estimated annual TP loads into and out of Standley Lake for 2014-2019 are shown in Figure 36. Non-storm event loads of total phosphorus in 2019 were 4% below the 2014-2018 average. Loads of total phosphorus into the lake were greater than outflow, indicating some level of phosphorus retention. TP loads leaving the lake were 5% higher than the 2014-2018 average.

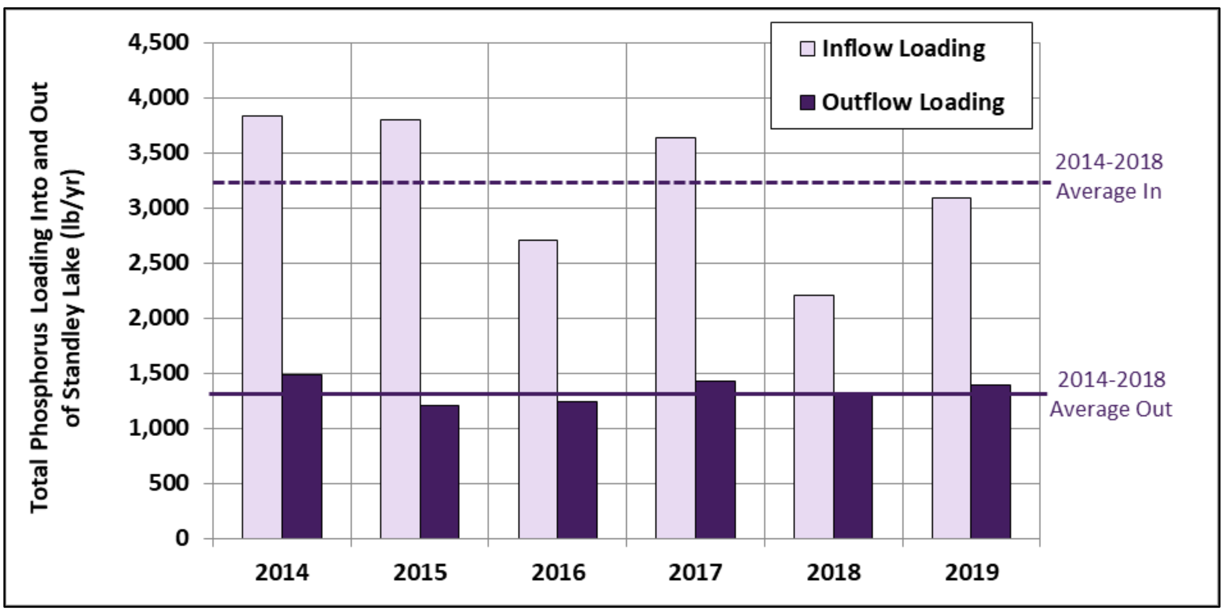


Figure 36. Total Phosphorus Loading Into and Out of Standley Lake, 2014-2019

The volume-weighted TP concentrations by source are presented in Figure 37. The Croke had the highest volume-weighted concentration and KDPL the lowest. The combined average concentration of the canals (24 µg/L) in 2019 was 23% lower than the 2014-2018 average (31 µg/L).

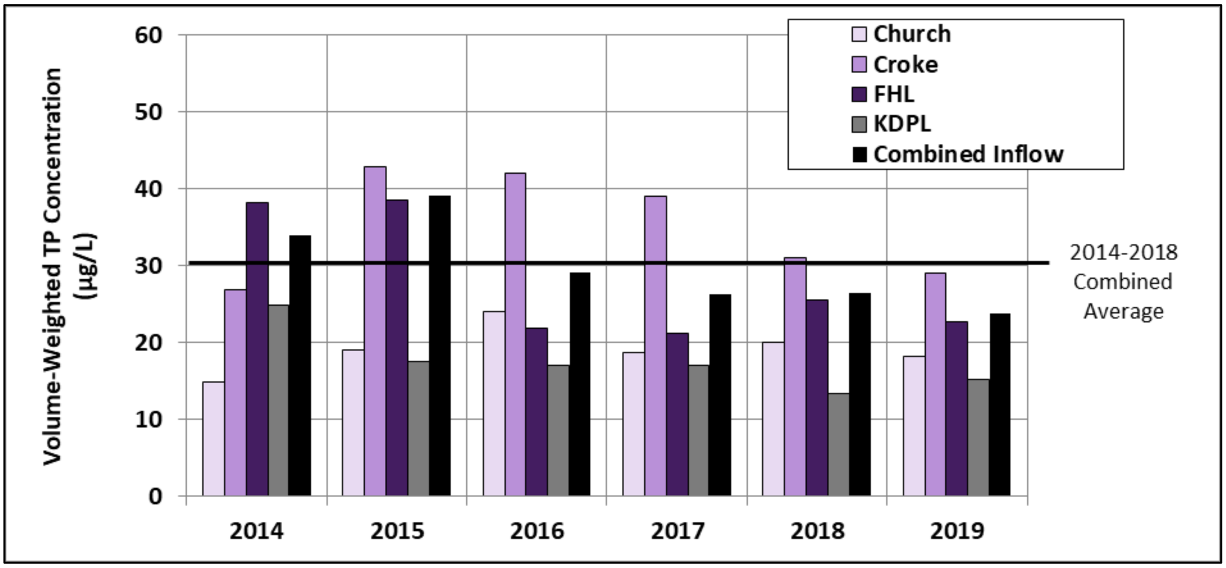


Figure 37. Volume-Weighted Total Phosphorus Concentrations Into Standley Lake by Source, 2014-2019

Total Nitrogen

Total nitrogen loads into Standley Lake, based on ambient grab and ambient composite samples, are grouped by source and displayed in Figure 38. Combined TN loads into and out of the lake are presented in Figure 39. The FHL contributed the largest portion of the annual TN load (57%). The Croke contributed 35% of the annual TN load to the reservoir. TN loads to the reservoir in 2019 were 25% higher than the 2014-2018 average. The outflow TN load in 2019 was 13% lower than the 2014-2018 average. Loads into the reservoir were higher than loads leaving the reservoir, as the reservoir contents at the end of the year were much higher than the start of the year.

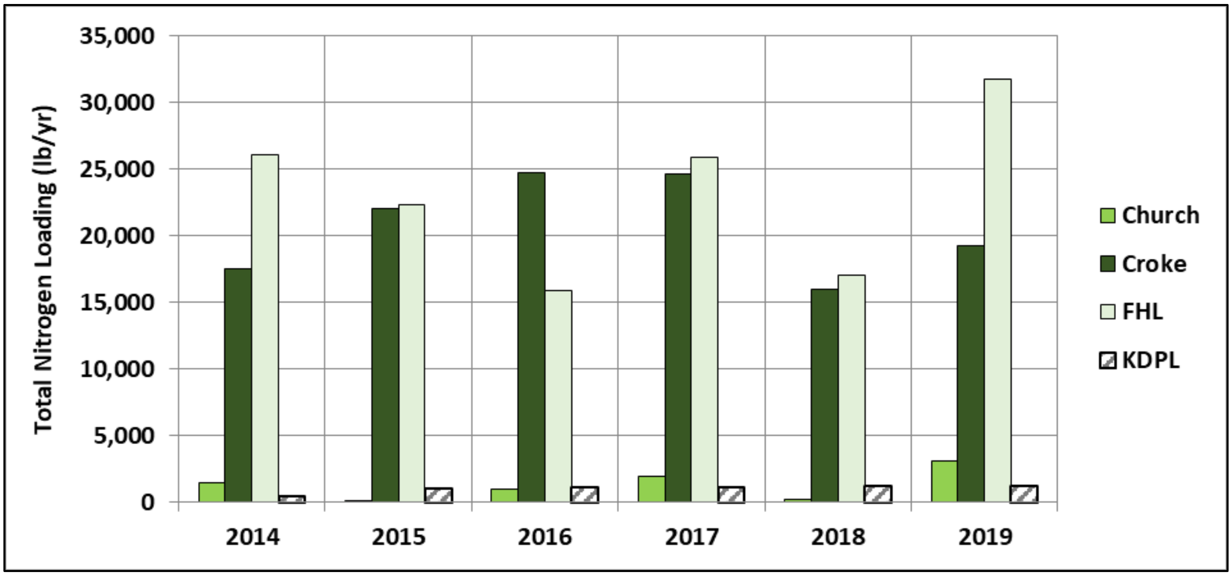


Figure 38. Total Nitrogen Loading Into Standley Lake by Source, 2014-2019

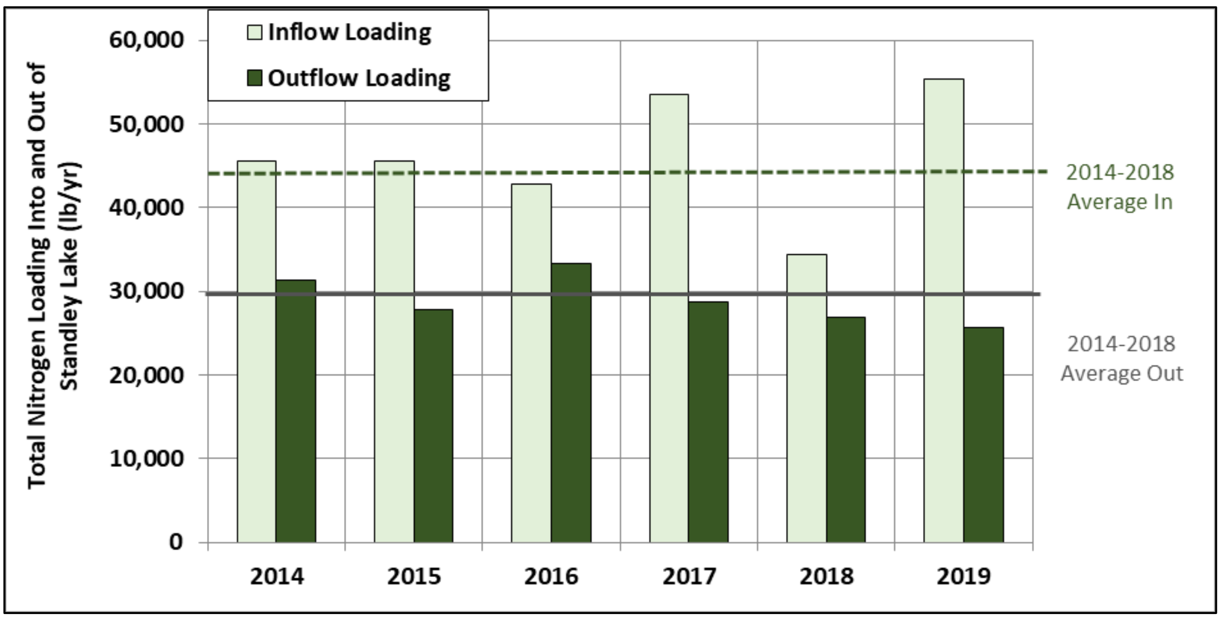


Figure 39. Total Nitrogen Loading Into and Out of Standley Lake, 2014-2019

Volume-weighted total nitrogen concentrations are presented in Figure 40. The combined average from all sources in 2019 (428 µg/L) was comparable to the 2014-2018 average of 427 µg/L.

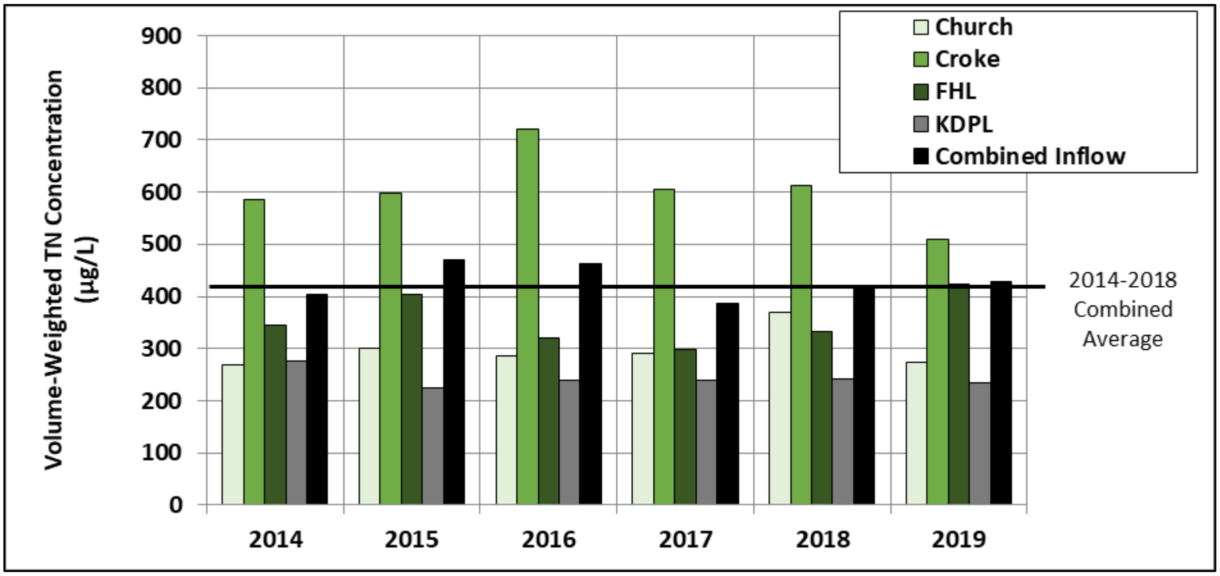


Figure 40. Volume-Weighted Total Nitrogen Concentrations Into Standley Lake by Source, 2014-2019

STORM EVENT LOADS TO THE LAKE

Load estimates from storm-event-triggered autosampler data are described in this section. In 2019, there were three storm events. They occurred on July 21, July 22, and September 7, on the FHL. Samples were assumed to represent conditions for the full 24-hour period on the sample date.

A comparison of nutrient loads from FHL in 2019 with and without the sampled storm events is shown in Figure 41. The lighter bars in the figure represent the estimated loading, excluding storm-event autosampler data. The darker bars include the storm events listed above. Incorporation of storm events yields an 11% increase for TSS loads, a 14% increase in TP loads, and a 4% increase in TN loads. These estimates are based on only three storm events and are likely underestimates of the actual loads.

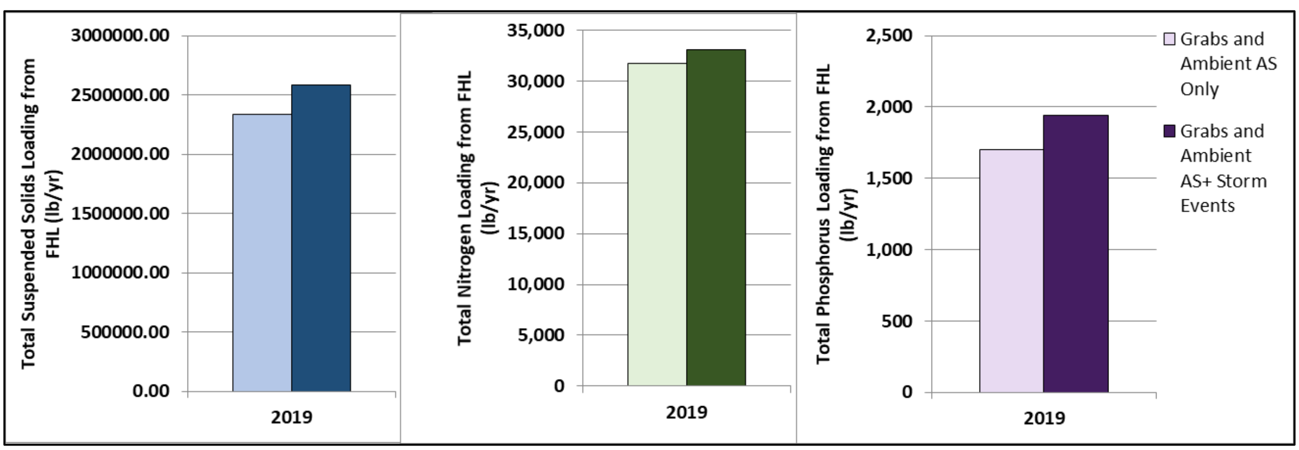


Figure 41. Total Suspended Solids, Total Nitrogen, and Total Phosphorus Loading in 2019 With and Without Storm Events

V. STANDLEY LAKE WATER QUALITY

In this section, in-reservoir water-quality responses at sampling location SL-10 to hydrology, meteorology, reservoir operations, and watershed conditions are discussed. This sampling location has an extensive sampling history, is directly relevant to water treatment plant operations, and is the location of the automated lake profiler station. Water-quality indicators discussed here include temperature, dissolved oxygen (DO), TP, TN, chlorophyll *a*, and water clarity (Secchi depth).

TEMPERATURE

Temperature is important as it drives stratification patterns, reduction potential, and has biological implications for fish and other aquatic species. It is typical for deep reservoirs to experience stratification during the summer and this stratification can lead to lowered dissolved oxygen levels in the hypolimnion. Standley Lake has two outlet gates and until recently (2017), the lower outlet was used exclusively. Outlet operations in 2019 were variable compared to those in 2017 or 2018. Dates when the outlets were open and closed in 2019 are displayed in Figure 42. Decisions for outlet changes were driven primarily by filter run times for drinking water treatment operations. Using the upper outlet during the growing season can result in reduced filter run times due to algae and zooplankton. In years where only the lower intake was used (e.g. 2016), cooler water was removed from the bottom of the reservoir increasing temperatures in the reservoir until fall turnover (Figure 43). While the outlet was switched later in the season compared to the last two years and the lower outlet was never fully closed, enough thermal energy was removed from the warmer upper layers to once again decrease reservoir temperatures in the hypolimnion (Figure 43). Turnover occurred on October 18, 2019, which is typical.

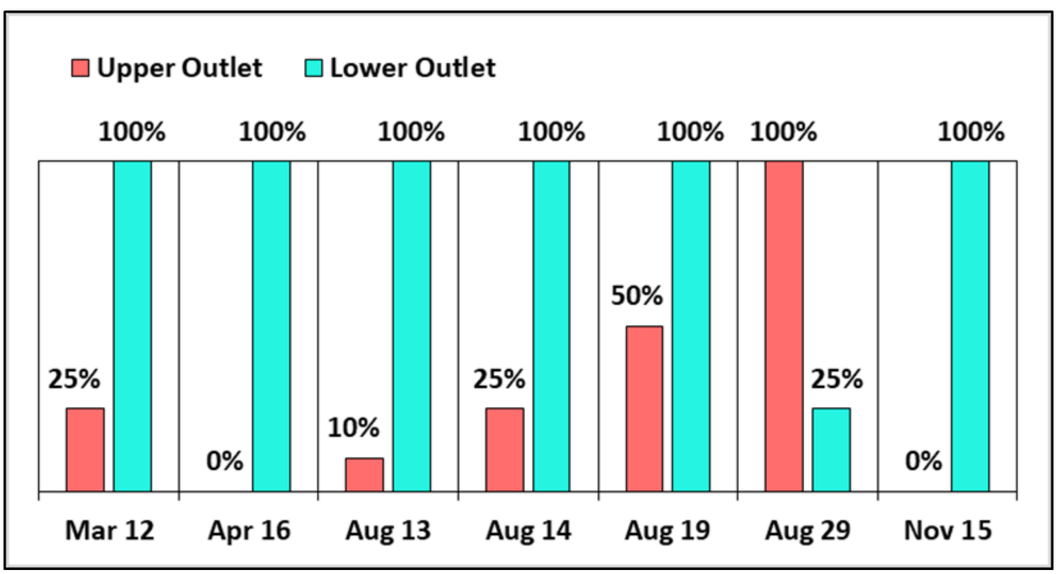


Figure 42. Dates When Operational Changes to the Outlet of Standley Lake Occurred, 2019

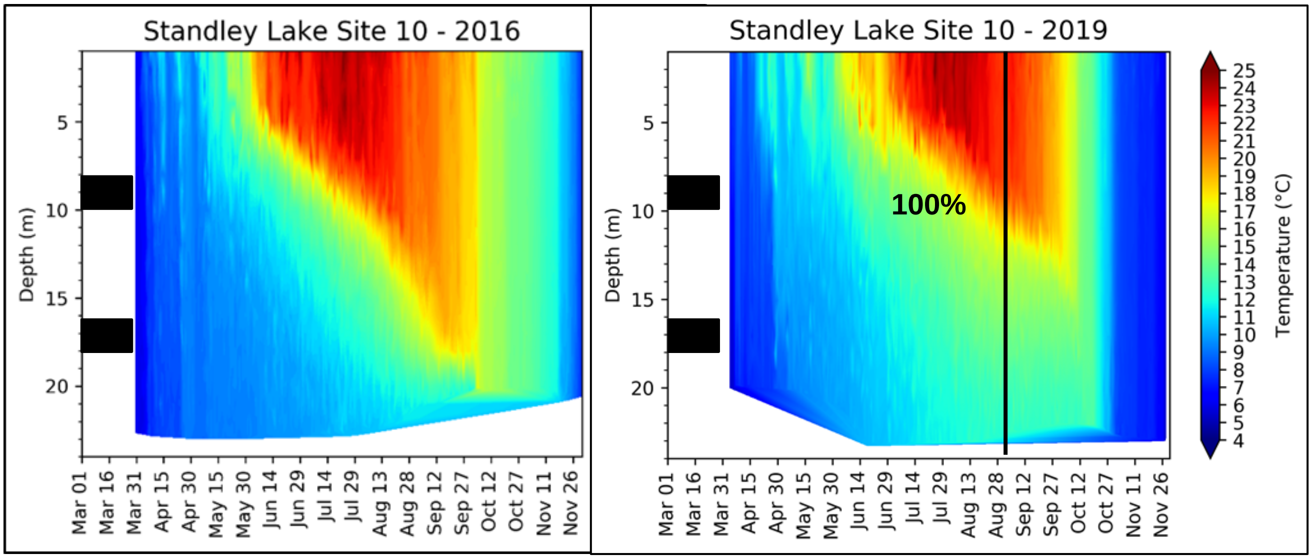


Figure 43. Contour Plots of Temperature in Standley Lake in 2016 and 2019 the Black Lines Indicate the Dates When the Outlet Depth was Switched 100% to the Upper Outlet, the Black Bars Indicate the Range of the Approximate Outlet Depths Based on Water Surface Elevation

DISSOLVED OXYGEN (DO)

DO affects 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 results in the release 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 issues in drinking water.

Each year, Standley Lake experiences hypoxia (DO concentrations ≤ 2.0 mg/L) at the bottom. In 2019, DO concentrations started dropping quickly mid-May and hypoxic conditions were well developed by the middle of July. Hypoxic conditions were maintained until turnover in the middle of October. A contour plot of dissolved oxygen concentrations in Standley Lake for March through November 2019 is provided in Figure 44.

Dissolved oxygen concentrations measured at the top and bottom of Standley Lake through 2019 are displayed in Figure 45. At the surface, the cyclical patterns in DO concentrations are driven by the decrease in oxygen solubility with increasing temperatures. On May 6th, an algae bloom likely increased the oxygen levels at the top of the reservoir. This date coincides with the highest chlorophyll *a* value for the year (see the chlorophyll *a* section below). The onset of stratification occurred in late June, 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 and is maintained by continued stratification. Consistent with the contour plot (Figure 44), the divergence between surface and bottom DO concentrations is extinguished with turnover in the middle of October.

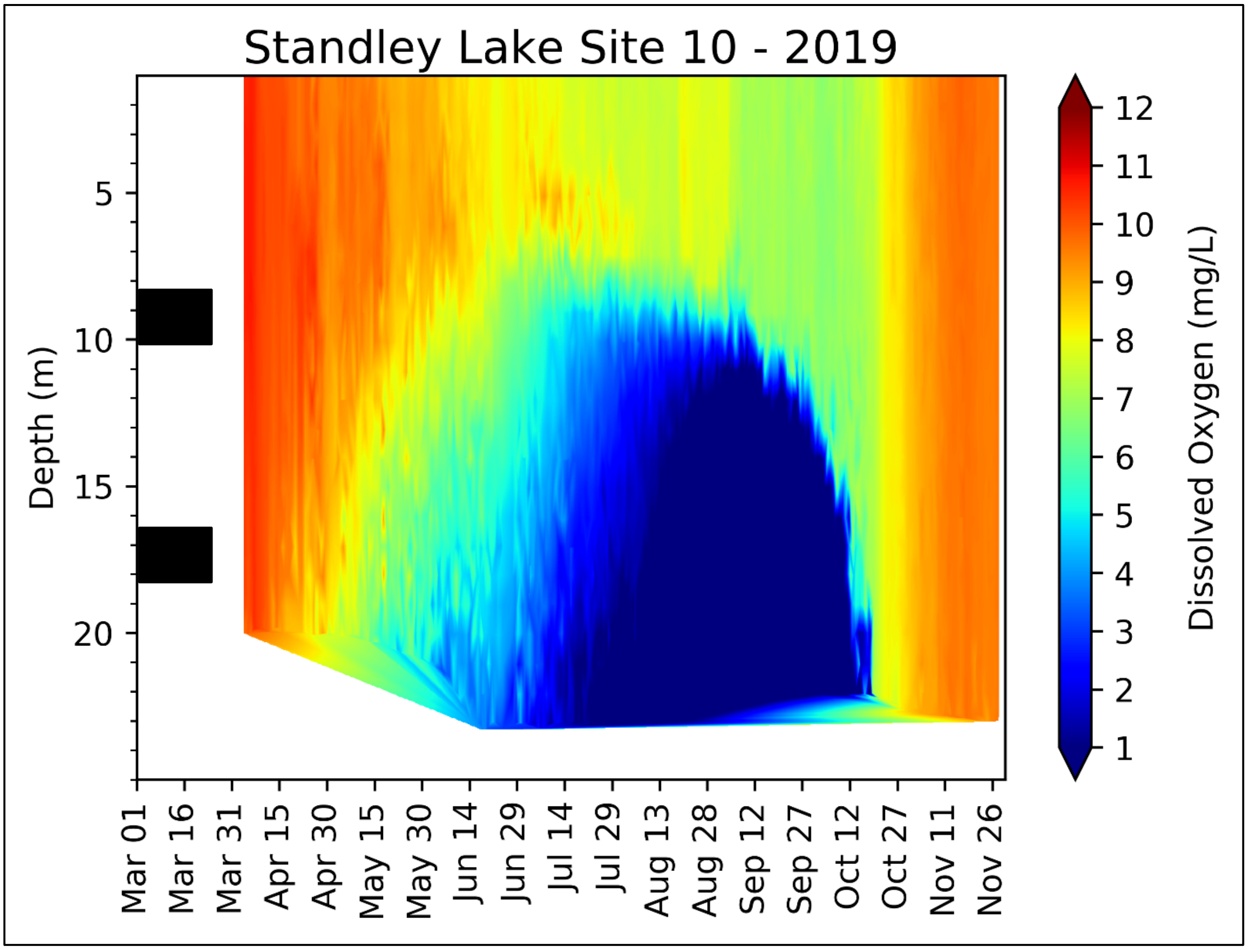


Figure 44. Contour Plot of Dissolved Oxygen in Standley Lake, March-December 2019, the Black Bars Indicate the Range of the Approximate Outlet Depths Based on Water Surface Elevation

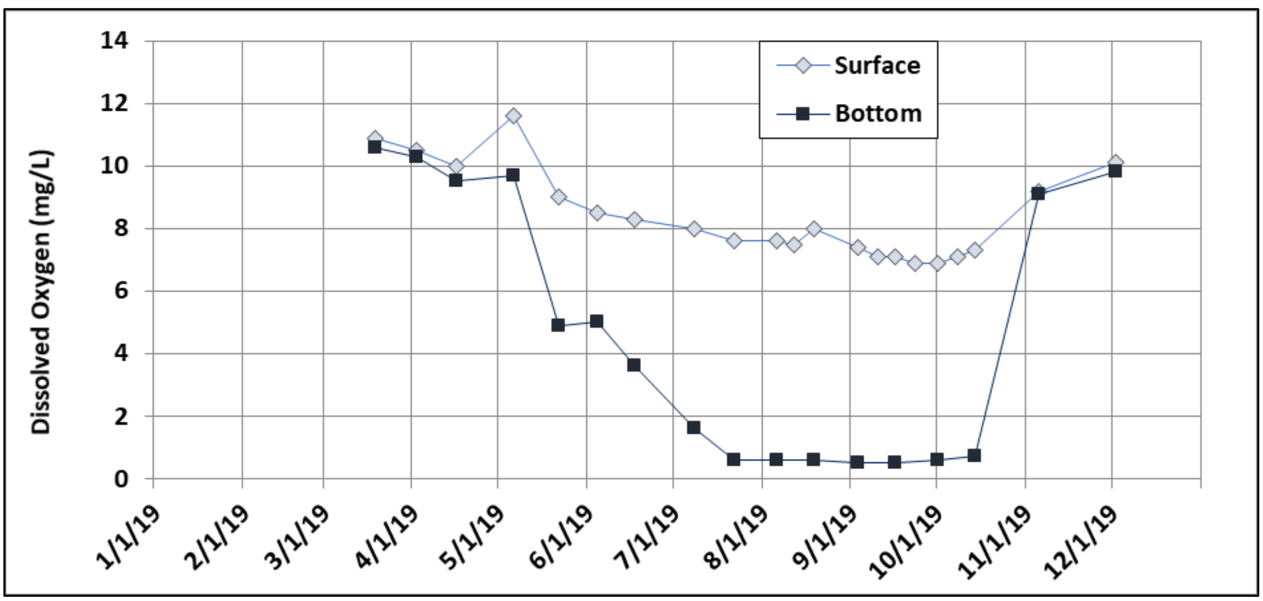


Figure 45. Dissolved Oxygen Concentrations in Standley Lake from Manual Profiles, 2019

Hypoxic conditions began on July 3rd. The 2019 seasonal dissolved oxygen patterns closely match those observed in previous years (Figure 46).

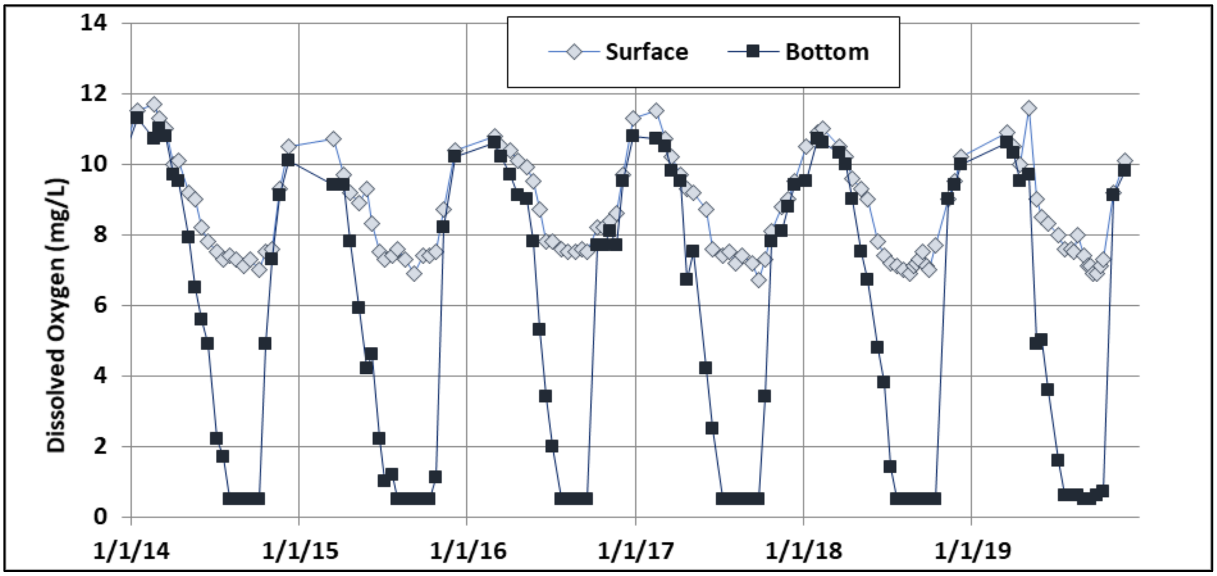


Figure 46. Dissolved Oxygen Concentrations in Standley Lake from Manual Profiles, 2014-2018

DAYS OF HYPOXIA

While hypoxia occurs each year, the start date, end date, and duration vary from year-to-year. In 2019, the hypoxic period began on July 3 and ended October 18. The days of hypoxia (108 days) were comparable to the 2014-2018 average of 107 days (Figure 47). Longer periods of hypoxia provide the potential for increased anaerobic release of nutrients and metals.

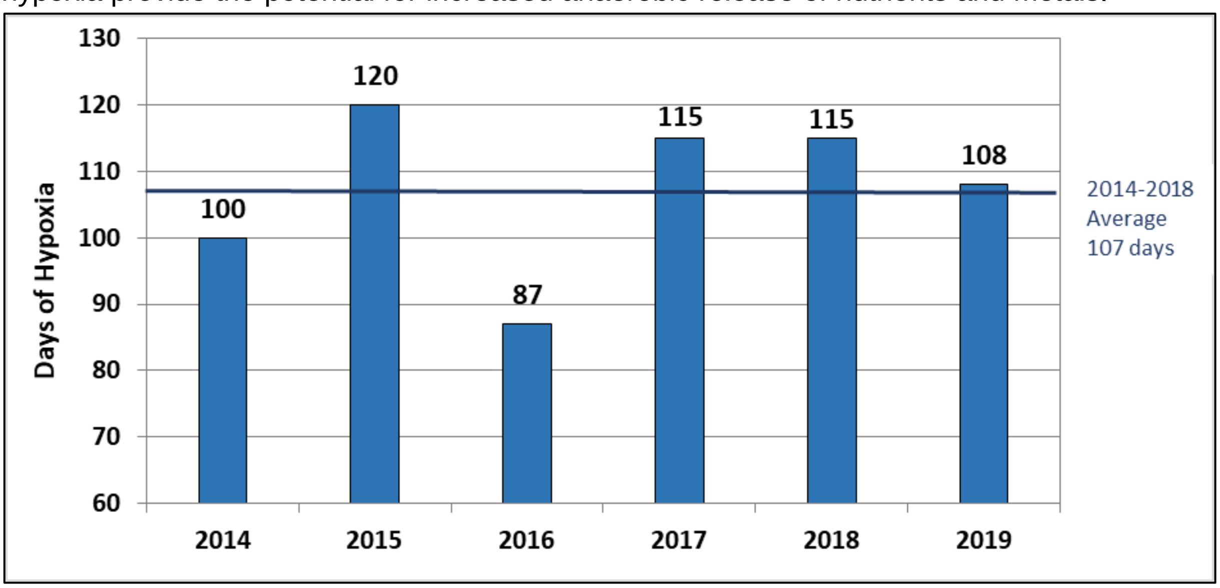


Figure 47. Days of Hypoxia (DO< 2.0 mg/l), 2014-2019

NUTRIENTS

Total Phosphorus

Total phosphorus concentrations for 2019 are displayed in Figure 48. Measurements are made in the photic zone and at the bottom of Standley Lake. In 2018, monitoring was increased from bi-weekly to weekly during late summer, targeting the time period when sediment release of nutrients typically occurs. This additional sampling was repeated in 2019. The highest TP observations during this period were from the bottom of the lake (183 µg/L and 158 µg/L on September 23 and October 8, respectively). This increase in TP concentrations in fall is indicative of sediment release of nutrients during hypoxic conditions. The additional sampling helped define the extent and magnitude of nutrient releases. Dissolved phosphorus (DP) data compared to TP data collected on the same dates are displayed in Figure 49 and reinforce sediment releases as the dominant source. The photic zone displayed little variation throughout the year.

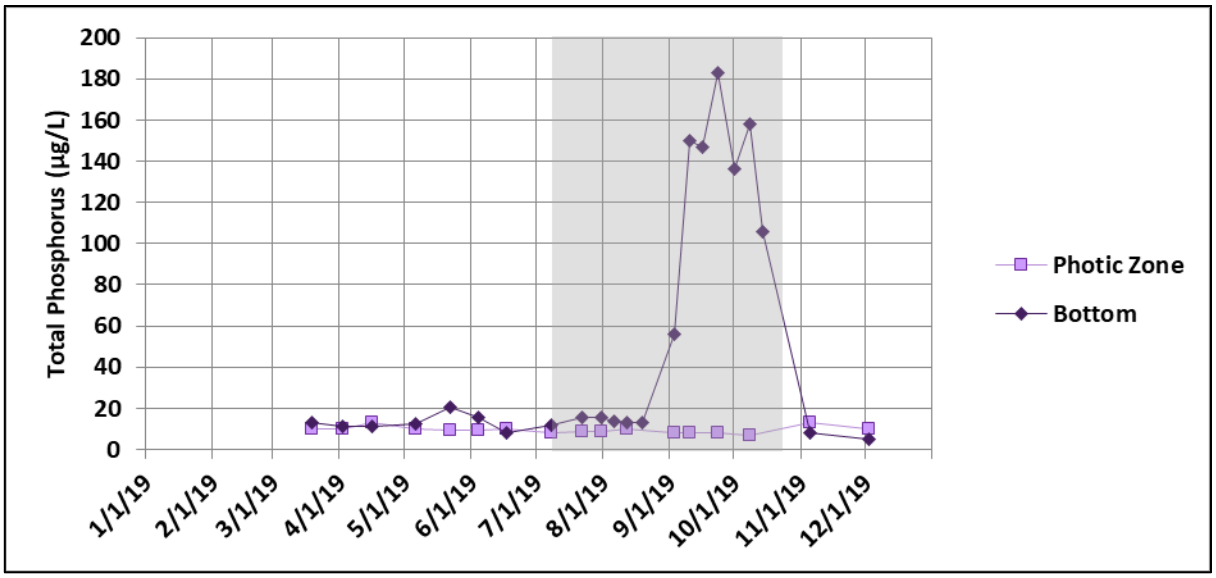


Figure 48. Total Phosphorus Concentrations in Standley Lake, 2019 (Hypoxic Period in Grey)

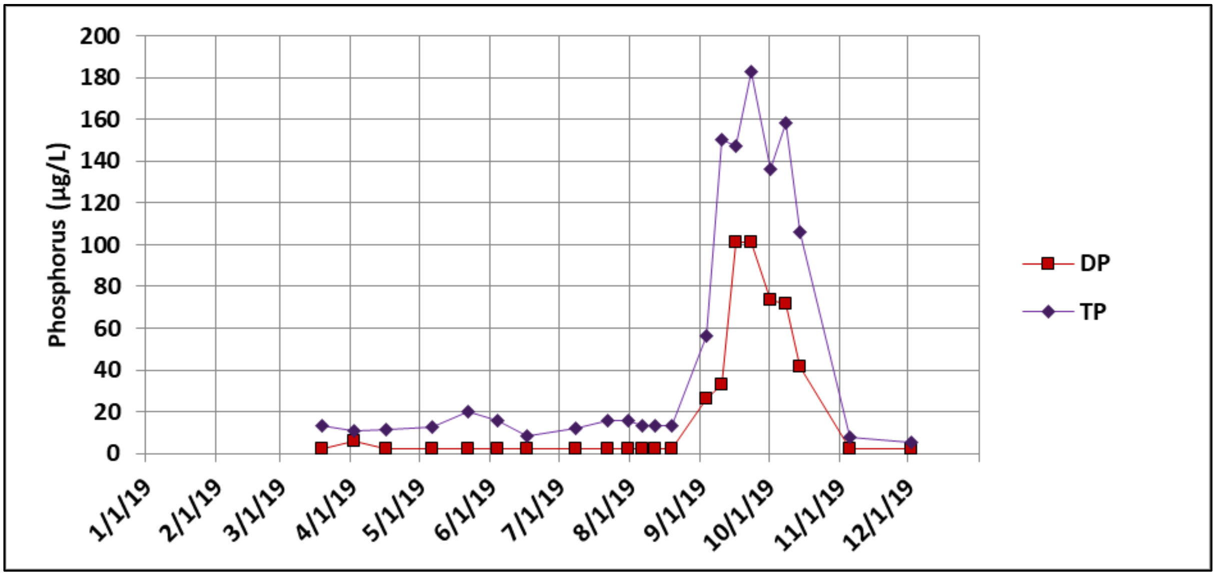


Figure 49. Total and Dissolved Phosphorus Concentrations in Standley Lake, Bottom, 2019

The observed pattern of sediment releases in late summer/fall is typical of previous years. For perspective, TP observations since 2005 are shown in Figure 50. While 2019 concentrations were higher than most years, they were within the range of concentrations observed over the long-term record. Bottom TP concentrations in 2019 were the second highest over the 2005-2019 period.

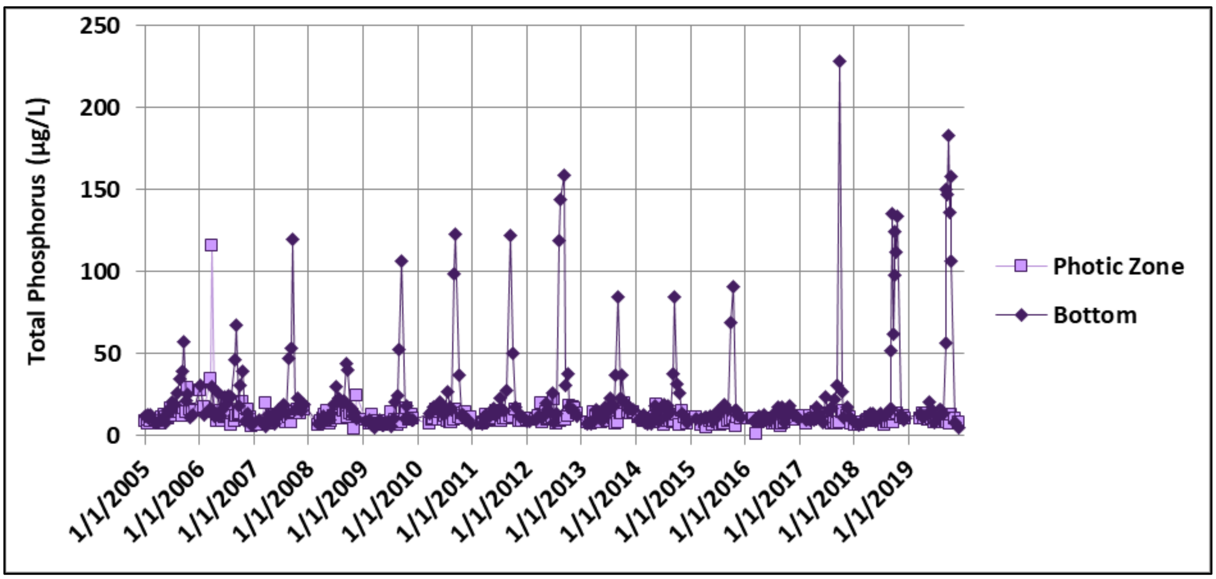


Figure 50. Total Phosphorus Concentrations in Standley Lake, Photic Zone and Bottom, 2005-2019

Total Nitrogen

Total nitrogen concentrations are displayed in Figure 51. TN concentrations at the bottom of the lake exhibited a maximum of 690 µg/L, which occurred on both October 1 and October 8. The photic zone data showed less variability. Evidence of sediment release of nitrogen is demonstrated in the fall with elevated concentrations near the bottom corresponding with the TP increases.

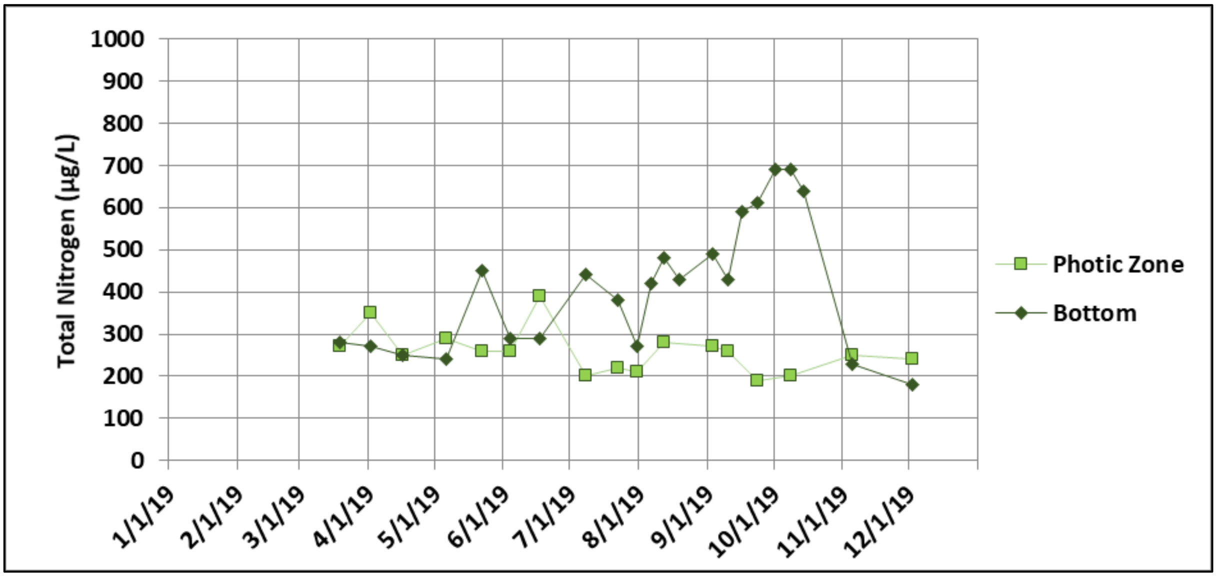


Figure 51. Total Nitrogen Concentrations in Standley Lake, 2019

Concentrations of TN in the lake for 2014-2019 are shown in Figure 52. Overall, TN concentration ranges observed in 2019 at the bottom and in the photic zone were comparable to previous years.

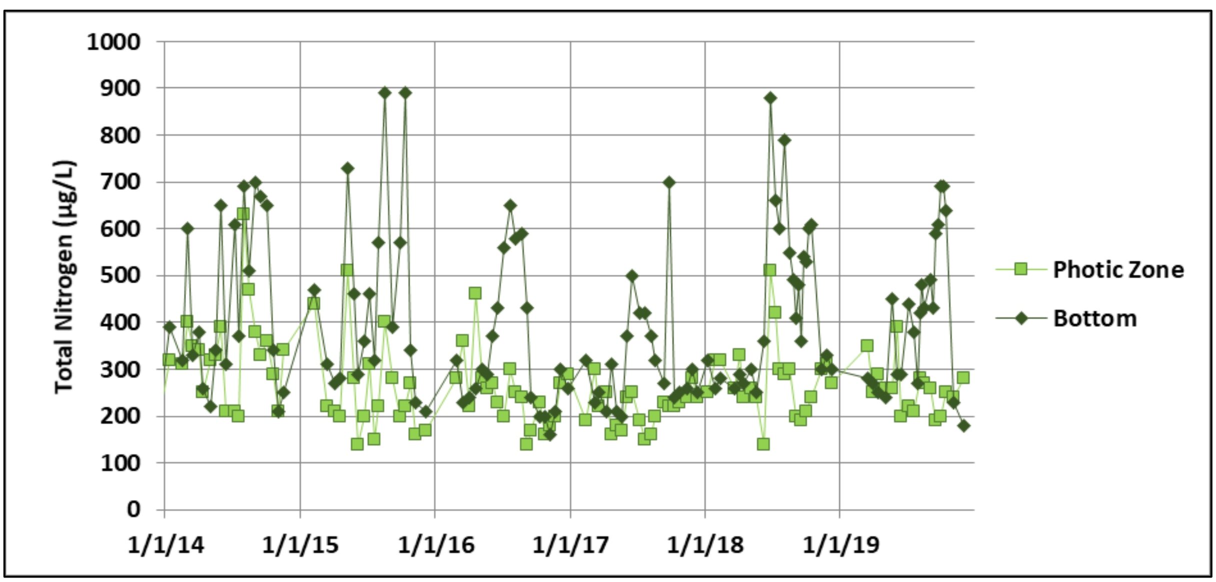


Figure 52. Total Nitrogen Concentrations in Standley Lake, 2014-2019

CHLOROPHYLL *a*

Chlorophyll *a* concentrations for 2019 are presented in Figure 53. March through November is the relevant period for standard assessment. This period is indicated by the grey box. The maximum concentration measured in 2019 was 7.2 µg/L on May 6, 2019.

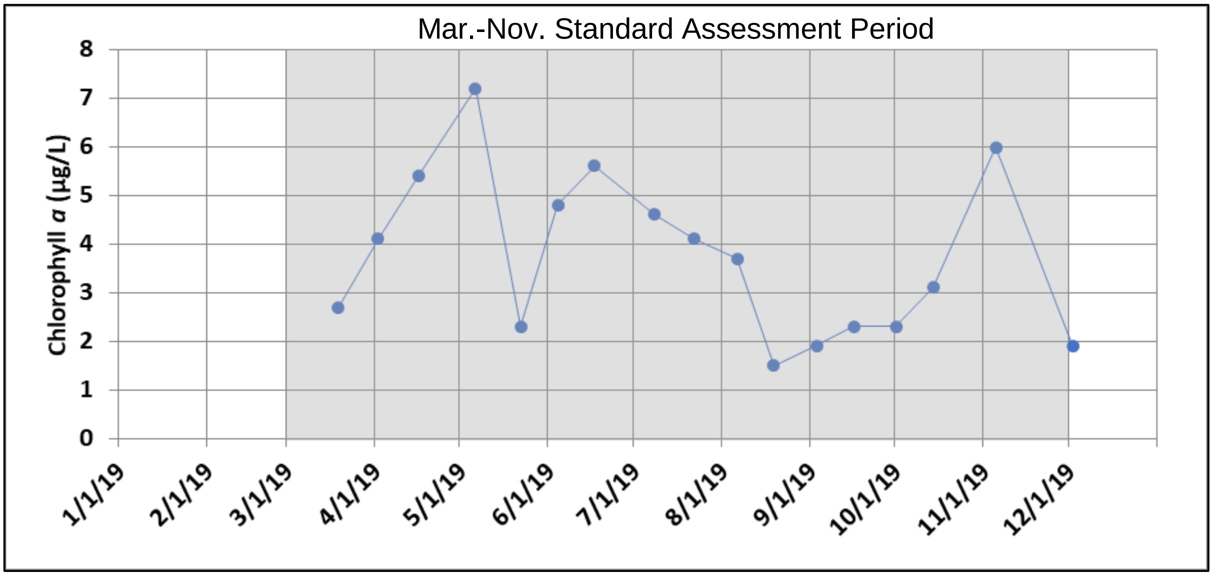


Figure 53. Chlorophyll *a* Concentrations in Standley Lake, 2019 (March-November Assessment Period in Grey)

Chlorophyll *a* observations from 2014-2019 are shown in Figure 54. A contour plot of profiler chlorophyll *a* concentrations in Standley Lake for March to December 2019 is shown in Figure 55. Temporally, the patterns were consistent with previous years with a peak in the spring and increased concentrations after fall turnover. The spring bloom was dominated by *Stephanodiscus* and *Cryptophyta,* and the fall bloom was dominated by *Asterionella* and *Cryptophyta*. The blooms impacted the water treatment process by reducing filter run times. The contour plot shows the duration of both algae blooms and the extent of chlorophyll *a* throughout the water column.

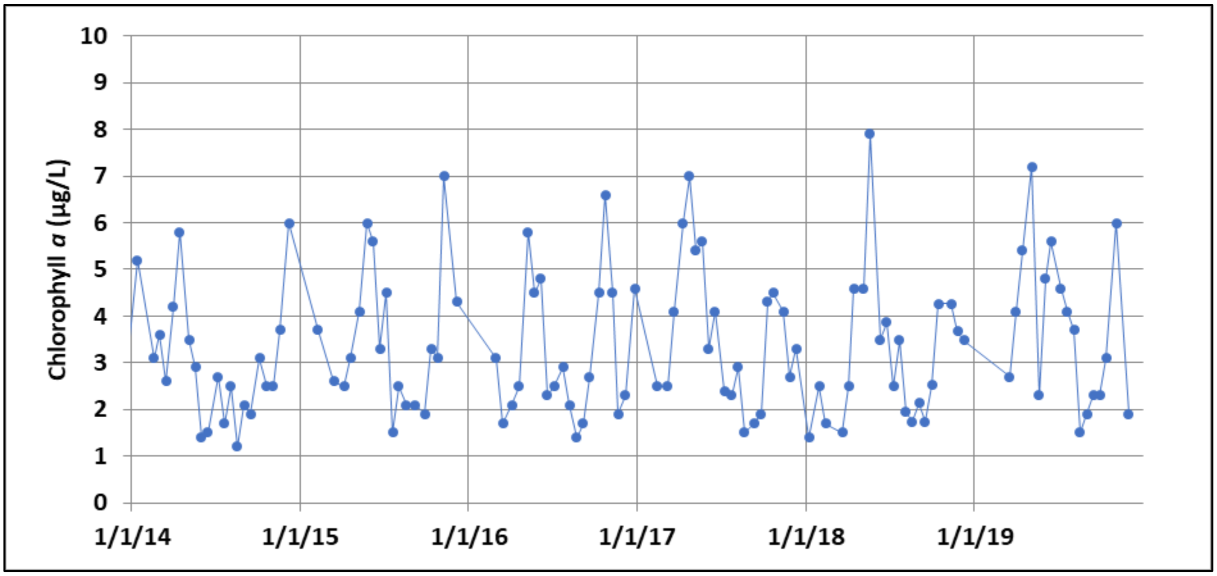


Figure 54. Chlorophyll *a* Concentrations in Standley Lake, 2014-2019

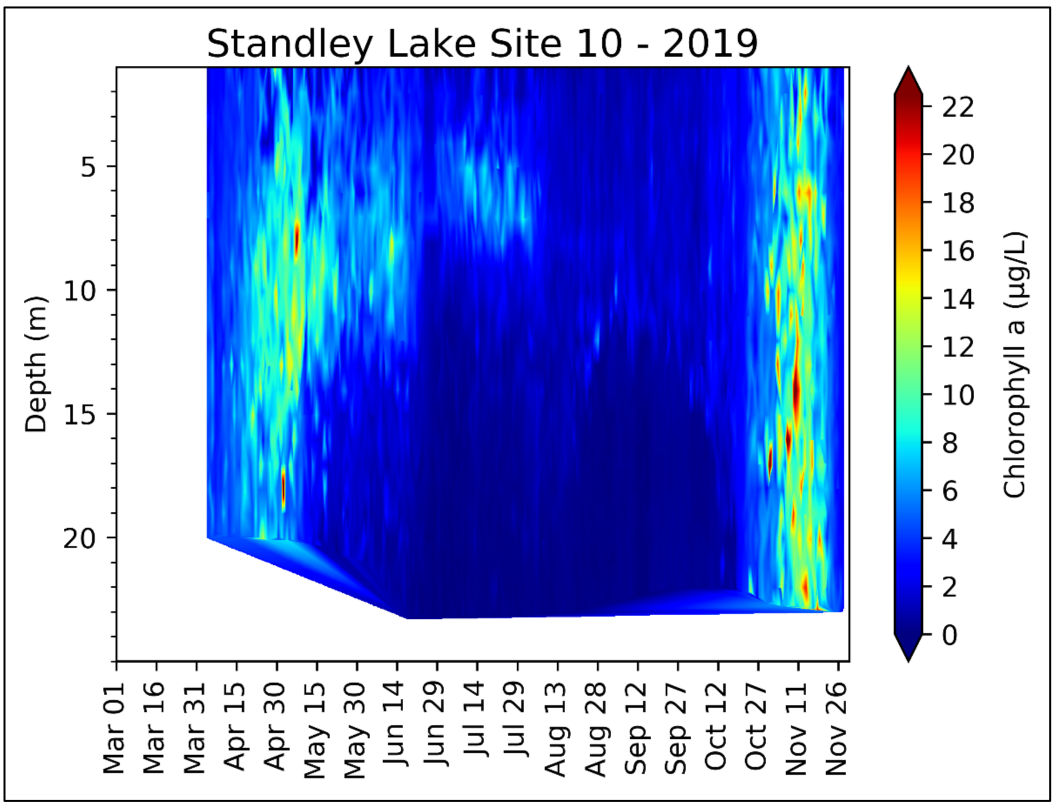


Figure 55. Contour Plot of Chlorophyll *a* Concentrations in Standley Lake, 2019

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 the nine monthly averages of observed data for period from March through November. To account for the natural variability in chlorophyll *a* concentrations, the standard is assessed using an assessment threshold of 4.4 µg/L. The 2019 average was 3.9 µg/L (Figure 56).

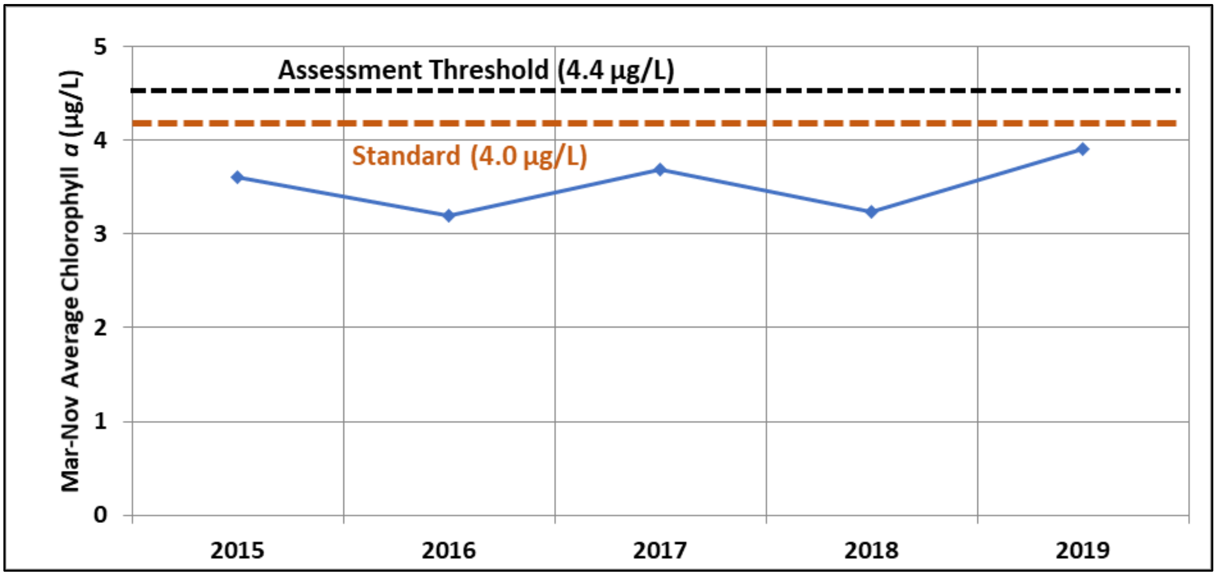


Figure 56. March-November Average Chlorophyll *a* Concentrations, 2015-2019

The standard for chlorophyll *a* in Standley Lake was met in 2019. The standard is met when four out of the five most recent years have a March-though-November average concentration below 4.4 µg/L.

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, provides a measure of the scattering and absorption of light in the upper portion of the water column. This measurement assesses the effects of algae, non-algal organic particulate matter, inorganic suspended solids, dissolved organic matter, and the water molecules themselves. Secchi-depth measurements in 2019 are shown in Figure 57. The measure of clarity with the greatest depth (7.0 m) occurred on September 3, 2019. Through the year clarity is variable, reflecting a combination of effects such as inflowing suspended solids, algal growth, particle settling, and stratification.

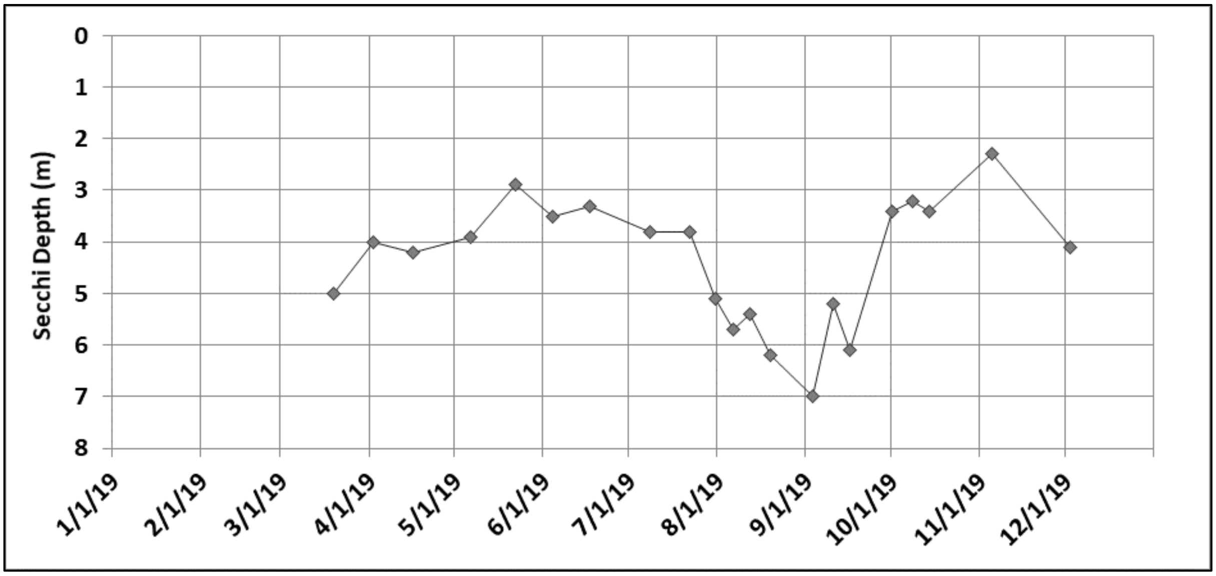


Figure 57. Clarity as Measured by Secchi Depth in Standley Lake, 2019

Individual Secchi-depth measurements for the past six years are shown in Figure 58. Average annual Secchi depths for 2014-2019 can be found in Figure 59. The annual average (4.4 m) and range of Secchi depths observed in 2019 were consistent with the range of those observed in recent years, though 2019 had the highest average of the previous five years.

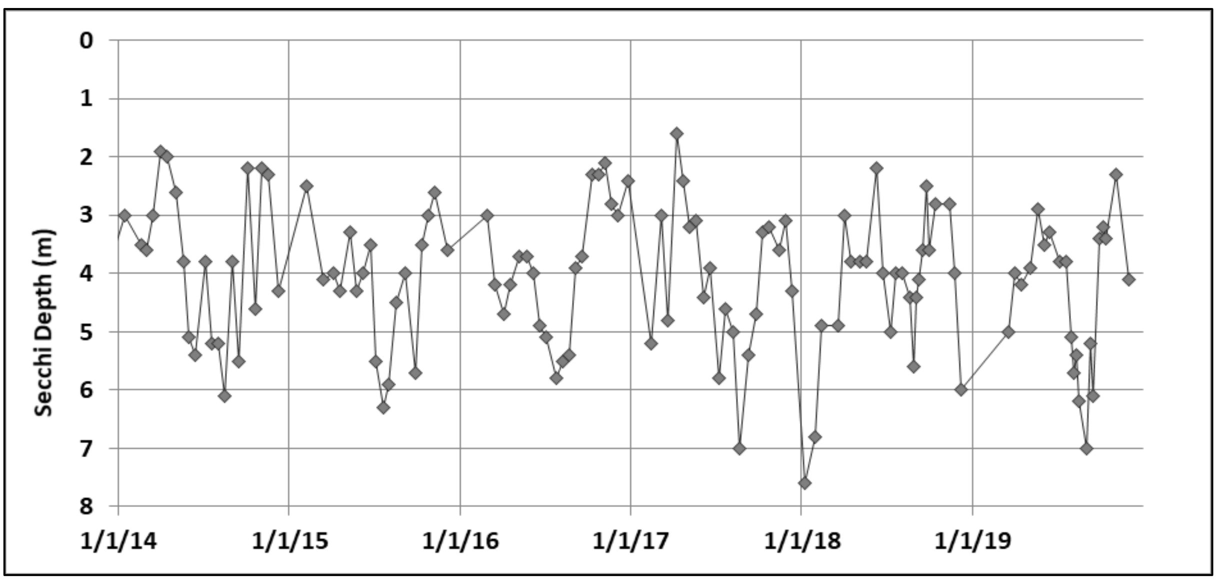


Figure 58. Clarity as Measured by Secchi Depth in Standley Lake, 2014-2019

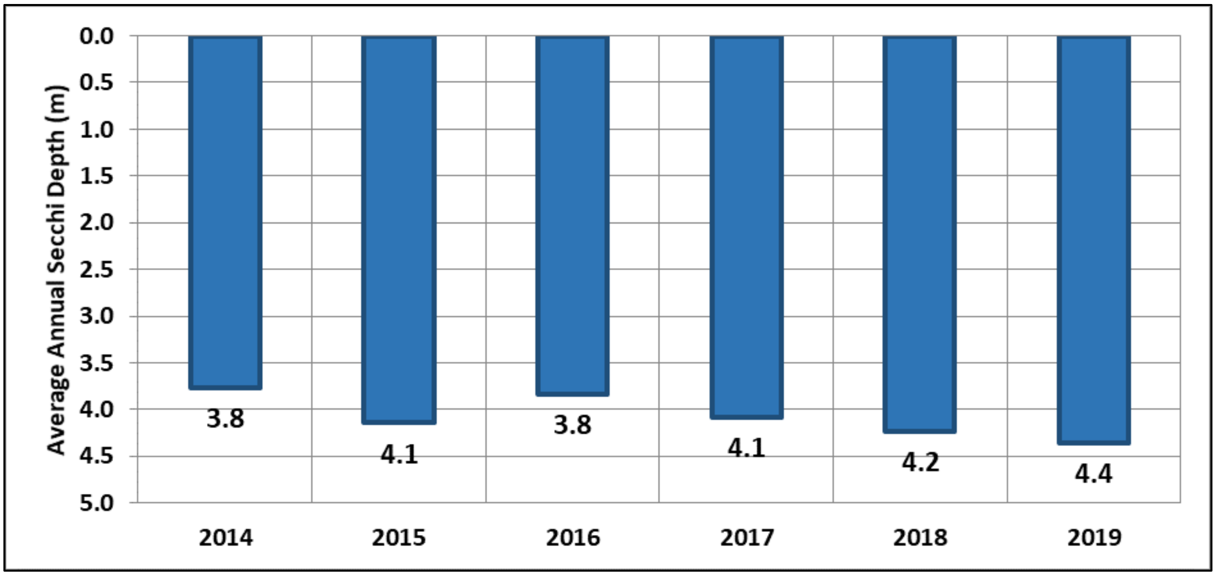


Figure 59. Average Annual Secchi Depth in Standley Lake, 2014-2019

REFERENCES

Colorado River District 2020. Water Glossary. https://www.coloradoriverdistrict.org/waterglossary/.

Hydros Consulting 2015. Big Thompson State of the Watershed. 2015 Report. September 21, 2015.

Hydros Consulting 2016. Clear Creek / Standley Lake Watershed Agreement. 2015 Annual Report. September 9, 2016.

Natural Resources Conservation Service (NRCS). 2020. SNOTEL 602: Loveland Basin, CO. March 25, 2020. https://wcc.sc.egov.usda.gov/nwcc/site?sitenum=602.

ACRONYMS

AF - Acre Feet

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

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

CC59 - Clear Creek Autosampler Station: Clear Creek 2 Miles West of Highway 58/US6 in Golden. Storm water-Only Location Operated by City of Golden

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

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

CFS - Cubic Feet per Second

FHL - Farmers' Highline Canal

Church - Church Ditch

Croke - Croke Canal

DO - Dissolved Oxygen

DP - Dissolved Phosphorus

KDPL - Kinnear Ditch Pipeline

NRCS – Natural Resources Conservation Service

ORP - Oxidation-Reduction Potential

TN - Total Nitrogen

TP - Total Phosphorus

ADDITIONAL INFORMATION

TSS - Total Suspended Solids

USGS - United States Geological Survey

SUPPLEMENTAL INFORMATION 4

CLEAR CREEK, CANAL, AND STANDLEY LAKE WATER QUALITY MONITORING DATA - 2019

Clear Creek Grabs

Method				SM2550B	SM4500H+B	SM2510B	SM4500OG	SM2130B	SM5310B	SM2540D	SM4500NH3H	SM4500NO3I	SM4500NO3I	SM4500PE
DL				1.0	1.0	10	1.0	1	0.5	1	0.01	0.01	0.02	0.0025
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3
Max decimals				1	1	0	1	1	1	0	2	2	2	4
Reporting Units				°C	s.u.	µS/cm	mg/L	NTU	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)
2/13/2019	9:45	G	CC 26	2.8	7.5	416	10.2	1	0.9	2	0.02	0.43	0.53	< 0.0050
NS	NS	G	CC 40											
2/13/2019	10:45	G	CC 50	3.1	7.3	929	10.7	<1	1.9	4	0.04	0.85	1.07	< 0.0050
NS	NS	G	CC 60											
4/10/2019	9:20	G	CC 26	5.2	6.7	629	10.2	<1	1.2	2	0.03	0.45	0.58	< 0.0050
4/10/2019	9:49	G	CC 40	5.7	7.1	526	10.3	<1	1.4	5	0.01	0.36	0.51	0.0053
4/10/2019	10:15	G	CC 50	4.5	7.1	621	10.6	3.3	2.2	8	0.01	0.24	0.42	0.0061
4/10/2019	10:43	G	CC 60	7.4	7.4	567	10.6	8.3	1.6	5	0.02	0.29	0.47	0.0057
06/05/19	9:45	G	CC 05	4.9	8.5	204	9.2	1.9	5.1	5	<0.01	0.1	0.3	< 0.0050
06/05/19	10:15	G	CC 10	5.9	8.5	101	9	<1		2	<0.01	0.06	0.2	< 0.0050
06/05/19	9:26	G	CC 15	4.8	7.2	250	9.3	5.6		4	0.02	0.16	0.35	< 0.0050
06/05/19	9:41	G	CC 20	5.9	7.3	212	9.6	9	3.5	10	0.01	0.15	0.4	< 0.0050
06/05/19	10:35	G	CC 25	9.3	8.1	248	8.7	5.5		4	<0.01	0.09	0.28	< 0.0050
06/05/19	10:50	G	CC 26	8.2	8.2	238	9	6.5	3.7	10	<0.01	0.12	0.33	< 0.0050
06/05/19	9:06	G	CC 30	5.4	7.4	51	9.8	8.5		12	<0.01	0.03	0.31	< 0.0050
06/05/19	11:30	G	CC 34	8.9	8.1	217	9.1	5.1		14	<0.01	0.11	0.35	< 0.0050
06/05/19	11:11	G	CC 35	6.7	8.4	59	9.2	3.3	5	7	0.01	0.05	0.32	< 0.0050
06/05/19	8:50	G	CC 40	8.3	7.1	225	9.5	17.7	4.1	22	0.01	0.11	0.48	< 0.0050
06/05/19	10:15	G	CC 44	6.4	7.5	60	9.4	8.8		12	<0.01	<0.01	0.18	< 0.0050
NS	NS		CC 45											
06/05/19	10:37	G	CC 50	9	7.3	189	9.2	19.3	3.1	23	0.03	0.09	0.33	< 0.0050
06/05/19	11:52	G	CC 52	13.2	8	335	8.5	6.9	3.8	7	0.02	0.11	0.36	< 0.0050
06/05/19	12:12	G	CC 53	14.2	8	483	8.1	<1	3.5	3	0.01	0.29	0.51	< 0.0050
06/05/19	11:01	G	CC 60	10.8	7.4	220	9.3	32.9	4	47	<0.01	0.11	0.61	< 0.0050
10/09/19	9:49	G	CC 05	3.3	7.5	213	10	<1	1.1	1	<0.01	0.22	0.29	< 0.005
10/09/19	10:11	G	CC 10	5.9	7.2	125	9	<1		<1	<0.01	0.11	0.17	< 0.005
10/09/19	10:35	G	CC 15	4.6	7.9	796	9.1	<1		1	0.3	0.67	1.09	< 0.005
10/09/19	10:59	G	CC 20	5.5	8.1	366	9.3	<1	1	1	0.03	0.31	0.45	< 0.005
10/09/19	10:35	G	CC 25	6.6	2.1	221	9	1		1	0.02	0.1	0.27	< 0.005
10/09/19	10:47	G	CC 26	5.9	7.2	291	9.4	<1	1.2	2	0.01	0.19	0.25	< 0.005
10/09/19	10:05	G	CC 30	5.1	8.8	55	9.6	<1		2	<0.01	0.12	0.26	< 0.005
10/09/19	11:22	G	CC 34	6.2	7.3	244	9.6	<1		1	0.01	0.2	0.19	< 0.005
10/09/19	11:12	G	CC 35	4.5	7.6	84	9.8	<1	1.7	3	<0.01	0.05	0.11	< 0.005
10/09/19	9:40	G	CC 40	6.6	8.5	276	9.7	<1	1.3	<1	<0.01	0.19	0.16	< 0.005
10/09/19	11:40	G	CC 44	5.6	8.2	113	9.2	1.7		<1	<0.01	<0.01	0.02	< 0.005
NS	NS		CC 45											
10/09/19	12:00	G	CC 50	10.4	7.8	775	8.8	<1	2.3	1	<0.01	1.3	1.82	< 0.005
10/09/19	11:38	G	CC 52	7.2	7.2	858	9.7	2.1	2.8	3	<0.01	0.31	0.44	< 0.005
10/09/19	11:45	G	CC 53	7.3	7.4	1124	9.3	1.3	2	1	0.01	0.38	0.45	< 0.005
10/09/19	12:30	G	CC 60	9.4	8.2	301	9.6	<1	1.3	2	<0.01	0.17	0.27	< 0.005
12/11/19	10:30	G	CC 26	3.7	8.2	352	9.6	<1	1	4	0.01	0.33	0.45	< 0.005
12/11/19	11:00	G	CC 40	1.4	8.1	386	11.1	<1	1	4	<0.01	0.36	0.53	< 0.005
12/11/19	11:30	G	CC 50	2.9	7.9	953	10.7	<1	1.9	3	0.11	1.28	1.6	< 0.005
12/11/19	12:00	G	CC 60	1.3	8.2	453	11.2	<1	1.1	3	0.03	0.5	0.65	< 0.005

Clear Cre

Method	**SM4500PE**				
DL	**0.0025**				
Max Sig figs	**3**				
Max decimals	**4**				
Reporting Units	**mg/L**				
Sample Date	**Phosphorus, Total**	**Notes**	**Conclusion**	**Field Notes**	**Lab Notes**
2/13/2019	0.0059				
NS		Not sampled		Frozen	
2/13/2019	0.0075				
NS		Not sampled		No Access	
4/10/2019	0.0065				
4/10/2019	0.0063				
4/10/2019	0.0155				
4/10/2019	0.0129				
06/05/19	0.0103			Staff gage = 4.78 ft	
06/05/19	0.0088				
06/05/19	0.0124				
06/05/19	0.0166				
06/05/19	0.0157				
06/05/19	0.0172				
06/05/19	0.0246				
06/05/19	0.0217				
06/05/19	0.0199				
06/05/19	0.0261				
06/05/19	0.0195				
NS		Not sampled			
06/05/19	0.0228				
06/05/19	0.0233				
06/05/19	0.0159				
06/05/19	0.0511				
10/09/19	< 0.005			Staff gage = 3.2 ft	
10/09/19	< 0.005				
10/09/19	< 0.005				
10/09/19	0.0067				
10/09/19	0.009				
10/09/19	0.0089				
10/09/19	0.0077				
10/09/19	0.0097				
10/09/19	0.005				
10/09/19	0.0073				
10/09/19	< 0.005				
NS		Not sampled			
10/09/19	0.008				
10/09/19	0.008				
10/09/19	0.0087				
10/09/19	0.0063				
12/11/19	0.0085				
12/11/19	0.0072				
12/11/19	0.0079				
12/11/19	< 0.005				

Tribs

Method				SM2510B	SM4500OG	SM4500H+B	SM2550B	SM2130B	SM4500PE	SM4500PE	SM4500NH3H	SM4500NO3I	SM4500NO3I	SM7110B	SM7110B
Reporting Limit Goal				10	1.0	1.0	1.0	1	0.0025	0.0025	0.01	0.01	0.02	variable	variable
Max Sig figs				3	3	3	3	3	3	3	3	3	3	2	2
Max decimals				0	1	1	1	1	4	4	2	2	2	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
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**
01/02/19	9:15	G	Trib 01	487	11.9	7.8	1.9	< 1	< 0.005	< 0.005	0.06	0.56	0.62		
01/02/19	9:30	G	Trib 02	511	11.5	7.8	2.8	< 1	0.0054	0.0104	0.07	0.56	0.7		
01/02/19	9:45	G	Trib 03	530	10.8	8	4.9	< 1	< 0.005	0.0086	0.04	0.6	0.7		
01/02/19	10:20	G	Trib 04	577	12.1	7.9	< 1	9	0.0054	0.017	0.02	0.56	0.7		
NS	NS	G	Trib 11												
NS	NS	G	Trib 22a												
NS	NS	G	Trib 22d												
01/02/19	8:30	G	Trib 24	355	10.7	7.8	9.4	< 1	< 0.005	0.0072	0.02	0.04	0.25		
NS	NS	G	Trib 25												
NS	NS	G	Trib 27 (New Church Ditch Inlet)												
02/06/19	9:40	G	Trib 01	516	11.5	7.7	1.9	< 1	< 0.005	0.0063	0.02	0.48	0.53		
02/06/19	9:55	G	Trib 02	572	10.7	7.7	3.8	< 1	0.0079	0.0117	0.04	0.5	0.63		
02/06/19	10:15	G	Trib 03	570	9.5	7.9	7.6	1.1	< 0.005	0.0092	0.02	0.5	0.6		
02/06/19	11:00	G	Trib 04	591	10.3	7.9	1.9	11.9	0.0052	0.0336	0.02	0.46	0.66		
NS	NS	G	Trib 11												
NS	NS	G	Trib 22a												
NS	NS	G	Trib 22d												
02/06/19	8:45	G	Trib 24	435	10	7.8	8.7	< 1	< 0.005	0.0102	0.02	0.08	0.25		
NS	NS	G	Trib 25												
NS	NS	G	Trib 27 (New Church Ditch Inlet)												
03/06/19	9:15	G	Trib 01	624	11.7	7.7	2	< 1	< 0.005	0.0075	0.01	0.55	0.63	2.2	2.4
03/06/19	9:35	G	Trib 02	698	10.9	7.8	5.3	1.2	0.0055	0.0124	0.03	0.53	0.66	5	3.2
03/06/19	9:50	G	Trib 03	720	9.8	8	9.1	1	< 0.005	0.0136	0.01	0.52	0.62	4	3
03/06/19	10:30	G	Trib 04	1000	10.6	8	5	19.4	0.0064	0.0447	0.03	0.46	0.77	5.3	4.9
NS	NS	G	Trib 11												
NS	NS	G	Trib 22a												
NS	NS	G	Trib 22d												
03/06/19	8:30	G	Trib 24	439	10.3	7.7	8.5	< 1	< 0.005	0.0262	0.02	0.07	0.24	2.1	1.8
NS	NS	G	Trib 25												
NS	NS	G	Trib 27 (New Church Ditch Inlet)												
04/03/19	9:05	G	Trib 01	594	10.9	7.8	5.7	< 1	0.0058	0.0104	0.02	0.41	0.54		
04/03/19	10:00	G	Trib 02	667	9.9	8.3	11.1	< 1	0.0058	0.0101	0.01	0.33	0.46		
04/03/19	10:15	G	Trib 03	690	8.7	7.9	11.6	1.1	0.0061	0.0181	0.04	0.33	0.52		
NS	NS	G	Trib 04												
04/03/19	10:50	G	Trib 11	655	9	7.9	10.8	3.5	0.0076	0.0243	0.04	0.37	0.6		
NS	NS	G	Trib 22a												
NS	NS	G	Trib 22d												
04/03/19	8:25	G	Trib 24	407	9.9	7.9	10	1	0.0136	0.0139	NT	NT	NT		
NS	NS	G	Trib 25												
NS	NS	G	Trib 27 (New Church Ditch Inlet)												
05/01/19	9:15	G	Trib 01	533	10.3	7.6	6.5	3.3	< 0.005	0.0195	<0.01	0.23	0.4		
05/01/19	9:35	G	Trib 02	545	9.8	7.7	9.3	5	< 0.005	0.0201	<0.01	0.24	0.38		
NS	NS	G	Trib 03												
NS	NS	G	Trib 04												
05/01/19	10:20	G	Trib 11	568	9.8	7.7	7.9	5.4	< 0.005	0.0214	<0.01	0.28	0.41		
NS	NS	G	Trib 22a												
NS	NS	G	Trib 22d												
05/01/19	8:35	G	Trib 24	415	8.2	7.6	13.2	2.4	< 0.005	0.0131	0.02	0.06	0.15		
NS	NS	G	Trib 25												
NS	NS	G	Trib 27 (New Church Ditch Inlet)												
06/05/19	9:45	G	Trib 01	222	9.3	7.7	12.7	11.3	< 0.005	0.0614	<0.01	0.11	0.53	6.1	2.5
06/05/19	10:05	G	Trib 02	219	9.4	7.7	12.7	13.2	< 0.005	0.0621	<0.01	0.12	0.73	5.7	2.4
06/05/19	10:15	G	Trib 03	235	8.8	7.7	15.2	14.3	< 0.005	0.058	<0.01	0.12	0.71	3.9	2.1
06/05/19	11:20	G	Trib 04	323	7.8	8	17.9	7.2	0.006	0.0283	<0.01	0.04	0.27	2.9	2
06/05/19	11:15	G	Trib 11	255	8.5	7.6	15.9	8.9	< 0.005	0.033	<0.01	0.1	0.34	1.4	1.9

Tribs

Method	SM7110B	SM7110B	SM5310B	SM2540D	SM9221D	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA130.2	SM4110A	SM4110A	SM4110A	EPA200.8	EPA200.8
Reporting Limit	variable	variable	0.5	1	1	0.01	0.01	0.00025	0.00025	0.0025	0.0025	5	5	10	0.1	0.00015	0.00015
Max Sig figs	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals	1	1	1	0	0	3	3	5	5	4	4	0	0	0	1	5	5
Reporting Units	pCi/L	pCi/L	mg/L	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
Sample Date	Gross Beta	Gross Beta, Uncertainty	Carbon, Total Organic	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
01/02/19			1.4	<1	<1	NT	0.025	NT	0.025	NT	0.15		45				
01/02/19			1.4	2	LE	NT	0.043	NT	0.035	NT	0.14		52				
01/02/19			1.2	3	LE	NT	0.065	NT	0.037	NT	0.12		59				
01/02/19			1.5	14	33	NT	0.69	NT	0.12	NT	0.075		61				
NS																	
NS																	
NS																	
01/02/19			1.9	1	LE	NT	0.02	NT	0.0093	NT	0.0067		33				
NS																	
NS																	
02/06/19			1	2	<1	0.0082	0.038	0.046	0.052	0.14	0.14		LE				
02/06/19			1.3	2	16	0.013	0.058	0.053	0.058	0.16	0.14		LE				
02/06/19			1.2	5	56	0.01	0.079	0.035	0.055	0.11	0.13		LE				
02/06/19			1.5	36	140	0.021	1.4	0.07	0.16	0.058	0.16		LE				
NS																	
NS																	
NS																	
02/06/19			1.8	1	1	0.0038	0.029	0.0039	0.022	0.014 S	0.0095 S		LE				
NS																	
NS																	
03/06/19	<3.8	2.4	1.2	3	<1	0.0082	0.028	0.036	0.042	0.15	0.15	188	64	109			
03/06/19	5.9	2.5	1.3	5	30	0.019	0.06	0.029	0.049	0.13	0.15	208	85	110			
03/06/19	4.8	2.5	1.3	5	144	0.0083	0.065	0.024	0.049	0.1	0.15	214	93	109			
03/06/19	<5.3	3.7	1.9	66	99	0.011	1.9	0.0079	0.16	0.035	0.14	232	162	113			
NS																	
NS																	
NS																	
03/06/19	<3.7	2.3	1.9	6	<1	<0.0026	0.028	0.00016	0.052	0.0093	0.022	156	36	66			
NS																	
NS																	
04/03/19			1.3	NA	<1	0.0075	0.044	0.056	0.061	0.13	0.13		82				
04/03/19			1.7	NA	>2420		NT		NT		NT		97				
04/03/19			2.1	NA	59		NT		NT		NT		101				
NS													91				
04/03/19			2.2	NA	136	0.01	0.31	0.048	0.076	0.094	0.11						
NS																	
NS																	
04/03/19			1.9	NA	2	<0.0026	0.064	0.0004	0.027	0.009	0.0083		40				
NS																	
NS																	
05/01/19			2.6	6	4	0.034	0.41	0.079	0.15	0.12	0.16		93				
05/01/19			2.4	12	22	0.03	0.36	0.071	0.14	0.099	0.15		98				
NS																	
NS																	
05/01/19			2.5	10	140	0.026	0.33	0.019	0.074	0.054	0.092		103				
NS																	
NS																	
05/01/19			2	3	<1	<0.0026	0.13	0.0044	0.037	0.0079	0.014		43				
NS																	
NS																	
06/05/19	5	2.6	4	56	25	0.069	2.4	0.043	0.74	0.066	0.38	122	26	31		0.00019	0.0015
06/05/19	6.9	2.5	4.1	59	25	0.066	3.6	0.048	1	0.068	0.52	136	26	32		0.00021	0.002
06/05/19	4.5	2.6	4.1	60	48	0.066	2.6	0.036	0.68	0.061	0.37	100	28	33		0.0002	0.0014
06/05/19	<3.5	2.1	3.6	21	276	0.056	0.6	0.0019	0.067	0.011	0.055	164	40	42		0.0011	0.0016
06/05/19	<4.1	2.5	3.4	36	129	0.059	1.6	0.019	0.24	0.048	0.17	128	32	36		0.00028	0.00092

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
Reporting Limit (	0.0001	0.0001	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
Max Sig figs	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	5	5	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
Sample Date	Barium, Dissolved	Barium, Total	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
01/02/19	[redacted]														
01/02/19	[redacted]														
01/02/19	[redacted]														
01/02/19	[redacted]														
NS	[redacted]														
NS	[redacted]														
NS	[redacted]														
01/02/19	[redacted]														
NS	[redacted]														
NS	[redacted]														
02/06/19	[redacted]														
02/06/19	[redacted]														
02/06/19	[redacted]														
02/06/19	[redacted]														
NS	[redacted]														
NS	[redacted]														
NS	[redacted]														
02/06/19	[redacted]														
NS	[redacted]														
NS	[redacted]														
03/06/19	[redacted]														
03/06/19	[redacted]														
03/06/19	[redacted]														
03/06/19	[redacted]														
NS	[redacted]														
NS	[redacted]														
NS	[redacted]														
03/06/19	[redacted]														
NS	[redacted]														
NS	[redacted]														
04/03/19	[redacted]														
04/03/19	[redacted]														
04/03/19	[redacted]														
NS	[redacted]														
04/03/19	[redacted]														
NS	[redacted]														
NS	[redacted]														
04/03/19	[redacted]														
NS	[redacted]														
NS	[redacted]														
05/01/19	[redacted]														
05/01/19	[redacted]														
NS	[redacted]														
NS	[redacted]														
05/01/19	[redacted]														
NS	[redacted]														
NS	[redacted]														
05/01/19	[redacted]														
NS	[redacted]														
NS	[redacted]														
06/05/19	0.033	0.055	<0.000054	0.0002	0.00025	0.0013	<0.000088	0.0021	0.0041	0.026	0.00049	0.019	0.0025	0.036	0.00068
06/05/19	0.035	0.038	<0.000054	0.00031	0.00026	0.0018	<0.000088	0.0033	0.0042	0.037	0.0005	0.027	0.0026	0.004	0.001
06/05/19	0.036	0.056	<0.000054	0.00021	0.00018	0.0013	<0.000088	0.0019	0.0041	0.028	0.00049	0.018	0.0027	0.0031	0.00079
06/05/19	0.041	0.045	<0.000054	<0.000054	0.000017	0.00022	<0.000088	0.00053	0.0029	0.0082	0.00071	0.0063	0.003	0.0028	0.00079
06/05/19	0.037	0.05	<0.000054	0.000092	0.00017	0.00068	<0.000088	0.0012	0.0039	0.015	0.00045	0.0085	0.0026	0.0026	0.00078

Tribs

Method	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8			
Reporting Limit (	0.005	0.00050	0.00050	0.0005	0.0005	0.0020	0.0020	0.00003	0.00003	0.040			
Max Sig figs	3	3	3	3	3	3	3	3	3	3			
Max decimals	4	5	5	5	5	5	5	5	5	3			
Reporting Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L			
Sample Date	Nickel, Total	Selenium, Dissolved	Selenium, Total	Silver, Dissolved	Silver, Total	Strontium, Dissolved ICAP	Strontium, Total	Vanadium, Dissolved ICAP/MS	Vanadium, Total ICAP/MS	Aluminum, Total	Notes	Conclusion	Field Notes
01/02/19													
01/02/19													
01/02/19													
01/02/19													
NS											Not sampled		
NS											Not sampled		
NS											Not sampled		
01/02/19													
NS											Not sampled		
NS											Not sampled		
02/06/19													
02/06/19													
02/06/19													
02/06/19													
NS											Not sampled		
NS											Not sampled		
NS											Not sampled		
02/06/19													
NS											Not sampled		
NS											Not sampled		
03/06/19													
03/06/19													
03/06/19													
03/06/19													
NS											Not sampled		
NS											Not sampled		
NS											Not sampled		
03/06/19													
NS											Not sampled		
NS											Not sampled		
04/03/19													
04/03/19											Labeling error - diss metals not tested		
04/03/19											Labeling error - diss metals not tested		
NS											Not sampled		
04/03/19													
NS											Not sampled		
NS											Not sampled		
04/03/19													
NS											Not sampled		
NS											Not sampled		
05/01/19													
05/01/19													
NS											Not sampled		
NS											Not sampled		
05/01/19													
NS											Not sampled		
NS											Not sampled		
05/01/19													
NS											Not sampled		
NS											Not sampled		
06/05/19	0.0032	0.00024	0.00029	0.00028	0.00026	0.1	0.12	0.00013	0.0025				
06/05/19	0.0048	0.00033 S	0.00026 S	<0.000014	0.00047	0.1	0.12	0.00013	0.0041				
06/05/19	0.0032	0.00021	0.00031	<0.000014	0.00018	0.11	0.14	0.00017	0.0022				
06/05/19	0.0013	0.0003 S	0.00024 S	<0.000014	0.00006	0.18	0.2	0.00063	0.0014				
06/05/19	0.0021	0.00026	0.00034	<0.000014	0.000093	0.13	0.15	0.00026	0.0021				

Tribs

Method	
Reporting Limit	
Max Sig figs	
Max decimals	
Reporting Units	
Sample Date	**Lab Notes**
01/02/19	NG chloride data reported
01/02/19	NG chloride data reported
01/02/19	NG chloride data reported
01/02/19	NG chloride data reported
NS	
NS	
NS	
01/02/19	NG chloride data reported
NS	
NS	
02/06/19	
02/06/19	
02/06/19	
02/06/19	
NS	
NS	
NS	
02/06/19	
NS	
NS	
03/06/19	NG chloride data reported
03/06/19	NG chloride data reported
03/06/19	NG chloride data reported
03/06/19	NG chloride data reported
NS	
NS	
NS	
03/06/19	NG chloride data reported
NS	
NS	
04/03/19	NG chloride data reported
04/03/19	NG chloride data reported
04/03/19	NG chloride data reported
NS	NG chloride data reported
04/03/19	
NS	
NS	
04/03/19	NG chloride data reported
NS	
NS	
05/01/19	NG chloride data reported
05/01/19	NG chloride data reported
NS	
NS	
05/01/19	NG chloride data reported
NS	
NS	
05/01/19	NG chloride data reported
NS	
NS	
06/05/19	NG chloride data reported
06/05/19	NG chloride data reported
06/05/19	NG chloride data reported
06/05/19	Alumnium = 0.42 mg/L; NG chloride data r
06/05/19	Alumnium = 1.0 mg/L; NG chloride data re

Tribs

Method				**SM2510B**	**SM4500OG**	**SM4500H+B**	**SM2550B**	**SM2130B**	**SM4500PE**	**SM4500PE**	**SM4500NH3H**	**SM4500NO3I**	**SM4500NO3I**	**SM7110B**	**SM7110B**
Reporting Limit Goal				**10**	**1.0**	**1.0**	**1.0**	**1**	**0.0025**	**0.0025**	**0.01**	**0.01**	**0.02**	**variable**	**variable**
Max Sig figs				**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
Max decimals				**0**	**1**	**1**	**1**	**1**	**4**	**4**	**2**	**2**	**2**	**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**
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**
NS	NS	**G**	**Trib 22a**												
NS	NS	**G**	**Trib 22d**												
06/05/19	11:35	**G**	**Trib 24**	420	5.9	7.4	15.1	2.5	< 0.005	0.0106	0.01	0.08	0.23	2.2	2.2
NS	NS	**G**	**Trib 25**												
06/05/19	10:55	**G**	**Trib 27 (New Church Ditch Inlet)**	250	8.4	7.6	15.7	9.9	< 0.005	0.022	0.01	0.09	0.29	1.6	1.6
6/10/2019	12:00	G	**Trib 11**						NT	NT	0.01	0.12	0.67		
6/12/2019	11:50	G	**Trib 11**						0.0051	0.0248	0.03	0.11	0.7		
6/17/2019	13:30	G	**Trib 11**						0.005	0.0196	<0.01	0.12	0.46		
6/19/2019	10:00	G	**Trib 11**						0.005	0.0194	0.03	0.11	0.68		
6/24/2019	10:20	G	**Trib 11**						< 0.0050	0.0132	0.02	0.12	0.53		
6/26/2019	9:50	G	**Trib 11**						0.0051	0.0135	0.02	0.12	0.56		
7/1/2019	9:52	G	**Trib 11**						0.0053	0.0255	0.02	0.12	0.72		
7/3/2019	9:30	G	**Trib 11**						< 0.0050	0.0379	0.01	0.14	0.56		
07/03/19	9:10	**G**	**Trib 01**	114	9.2	7.6	12.8	6.3	< 0.0050	0.0147	<0.01	0.13	0.32		
07/03/19	9:30	**G**	**Trib 02**	103	9.3	7.6	17.7	5.4	0.0164	0.0307	<0.01	0.12	0.3		
07/03/19	9:50	**G**	**Trib 03**	104	9.2	7.8	16.7	6.7	< 0.0050	0.016	<0.01	0.12	0.29		
NS	NS	**G**	**Trib 04**												
07/03/19	10:55	**G**	**Trib 11**	114	8.6	7.6	18.7	11.9	0.0129	0.0368	<0.01	0.12	0.35		
NS	NS	**G**	**Trib 22a**												
NS	NS	**G**	**Trib 22d**												
07/03/19	8:15	**G**	**Trib 24**	421	3.5	7.1	16.5	2.1	< 0.0050	0.011	0.02	0.16	0.34		
NS	NS	**G**	**Trib 25**												
07/03/19	10:35	**G**	**Trib 27 (New Church Ditch Inlet)**	109	8.4	7.7	18	5.5	0.0051	0.0122	0.01	0.1	0.31		
7/8/2019	12:45	G	**Trib 11**						< 0.0050	0.0142	0.03	0.09	0.55		
7/11/2019	10:00	G	**Trib 11**						0.0055	0.0142	0.02	0.08	0.48		
08/07/19	9:00	**G**	**Trib 01**	169	7.8	7.7	16.6	< 1	< 0.0050	0.0062	<0.01	0.13	0.22		
08/07/19	9:10	**G**	**Trib 02**	168	8	7.8	17.4	< 1	< 0.0050	0.0074	<0.01	0.13	0.24		
08/07/19	9:25	**G**	**Trib 03**	180	7.6	7.7	19.3	< 1	< 0.0050	0.009	<0.01	0.14	0.27		
NS	NS	**G**	**Trib 04**												
08/07/19	10:15	**G**	**Trib 11**	165	7.8	7.8	20	3.7	< 0.0050	0.0143	<0.01	0.09	0.26		
NS	NS	**G**	**Trib 22a**												
NS	NS	**G**	**Trib 22d**												
08/07/19	8:15	**G**	**Trib 24**	390	1.6	7.2	17	4	< 0.0050	0.0098	<0.01	0.17	0.3		
NS	NS	**G**	**Trib 25**												
08/07/19	10:00	**G**	**Trib 27 (New Church Ditch Inlet)**	168	7.8	7.8	19	6.5	< 0.0050	0.0123	<0.01	0.07	0.2		
09/04/19	9:30	**G**	**Trib 01**	223	8.7	7.9	15.7	< 1	< 0.0050	0.0072	<0.01	0.16	0.32	0.8	1.2
09/04/19	9:50	**G**	**Trib 02**	228	8.5	8	18.9	< 1	< 0.0050	0.0057	0.01	0.17	0.4	1.5	1.2
09/04/19	10:10	**G**	**Trib 03**	249	8.2	7.8	20.7	1	0.0088	0.0097	0.02	0.17	0.4	0.9	1.6
NS	NS	**G**	**Trib 04**												
09/04/19	11:05	**G**	**Trib 11**	233	8.5	8	21.6	1.7	0.0055	0.0296	0.01	0.16	0.35	<0.1	1.3
NS	NS	**G**	**Trib 22a**												
09/04/19	10:45	**G**	**Trib 22d**	86	9	7.5	17.7	2.4	0.0199	0.0312	0.01	0.06	0.34	0.5	1.1
09/04/19	8:50	**G**	**Trib 24**	321	3.2	7.2	20.9	1.2	0.0125	0.0166	0.02	0.08	0.29	<0.1	1.4
NS	NS	**G**	**Trib 25**												
NS	NS	**G**	**Trib 27 (New Church Ditch Inlet)**												
10/02/19	9:05	**G**	**Trib 01**	284	9	7.9	11.8	< 1	< 0.005	< 0.005	<0.01	0.21	0.3		
10/02/19	9:25	**G**	**Trib 02**	282	8.4	7.9	16	< 1	< 0.005	0.006	<0.01	0.26	0.36		
10/02/19	9:40	**G**	**Trib 03**	375	8.2	7.8	13.7	2.1	0.0067	0.0162	0.03	0.31	0.54		
NS	NS	**G**	**Trib 04**												
10/02/19	10:35	**G**	**Trib 11**	272	7.7	7.7	13.1	1.6	< 0.005	0.01	<0.01	0.22	0.35		
NS	NS	**G**	**Trib 22a**												
10/02/19	10:20	**G**	**Trib 22d**	72	9.3	7.6	10.1	1.3	0.0069	0.0102	<0.01	0.07	0.2		
10/02/19	8:25	**G**	**Trib 24**	306	5.2	7.4	18.9	3.2	0.017	0.0304	<0.01	0.07	0.21		
NS	NS	**G**	**Trib 25**												
NS	NS	**G**	**Trib 27 (New Church Ditch Inlet)**												

Tribs

Method	SM7110B	SM7110B	SM5310B	SM2540D	SM9221D	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA130.2	SM4110A	SM4110A	SM4110A	EPA200.8	EPA200.8
Reporting Limit	variable	variable	0.5	1	1	0.01	0.01	0.00025	0.00025	0.0025	0.0025	5	5	10	0.1	0.00015	0.00015
Max Sig figs	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals	1	1	1	0	0	3	3	5	5	4	4	0	0	0	1	5	5
Reporting Units	pCi/L	pCi/L	mg/L	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
Sample Date	Gross Beta	Gross Beta, Uncertainty	Carbon, Total Organic	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
NS																	
NS																	
06/05/19	<4.0	2.3	1.9	2	<1	<0.0026	0.12	0.0021	0.084	0.011	0.015	176	47	71		0.00039	0.00046
NS																	
06/05/19	5.2	2.5	3.6	17	167	0.058	0.59	0.021	0.099	0.062	0.1	132	31	34		0.00032	0.00063
6/10/2019				43			2		0.35		0.21		15				0.0012
6/12/2019				38			1.6		0.25		0.15		15				0.00092
6/17/2019				NT		0.053	1.1	0.024	0.14	0.048	0.094		12			0.00023	0.0006
6/19/2019				NT		0.045	1	0.022	0.16	0.048	0.1		13			0.00026	0.00044
6/24/2019				12		0.043	0.55	0.018	0.087	0.046	0.078		13			0.00018	0.00031
6/26/2019				13		0.033	0.36	0.0061	0.09	0.038	0.07		13			0.0002	0.00046
7/1/2019				27		0.033	0.41	0.003	0.095	0.092	0.17		9			0.00015	0.00042
7/3/2019				59			2.3		0.28		0.18		12				0.0014
07/03/19			2.6	25	14		0.3		0.18		0.099		7				
07/03/19			2.6	29	22		0.63		0.16		0.096		8				
07/03/19			2.6	25	15		0.7		0.17		0.098		7				
NS																	
07/03/19			2.6	39	126		1.6		0.2		0.11		8				
NS																	
NS																	
07/03/19			1.8	11	<1		0.12		0.083		0.021		49				
NS																	
07/03/19			2.9	20	163		0.38		0.066		0.052		7				
7/8/2019				13		0.031	0.4	0.015	0.066	0.087	0.14		8			0.00014	0.00024
7/11/2019						0.023	0.52	0.0026	0.066	0.03	0.059		9			0.00021 S	0.00016 S
08/07/19			2	3	9	0.023	0.12	0.022	0.04	0.055	0.069		10				
08/07/19			1.5	3	30	0.021	0.12	0.022	0.042	0.051	0.066		10				
08/07/19			1.6	3	58	0.025	0.13	0.04	0.067	0.044	0.06		12				
NS																	
08/07/19			1.6	18	78	0.023	0.58	0.0066	0.099	0.021	0.073		10				
NS																	
NS																	
08/07/19			1.9	5	13	<0.0026	0.21	0.0016	0.11	0.0088	0.018		40				
NS																	
08/07/19			1.7	5	345	0.045	0.2	0.0076	0.027	0.018	0.028		10				
09/04/19	<3.9	2.1	1.3	2	3	0.017	0.057	0.0074	0.024	0.05	0.063	102	15	44		0.00018	0.00017
09/04/19	<3.8	2.2	1.4	2	16	0.018	0.06	0.0098	0.027	0.048	0.057	96	16	46		0.00019	18
09/04/19	<3.7	2.2	1.5	2	33	0.02	0.065	0.026	0.052	0.041	0.052	108	20	47		0.00024	0.00022
NS																	
09/04/19	<3.6	2.1	1.4	5	37	0.015	0.14	0.004	0.029	0.017	0.03	108	17	46		0.00008	0.0003
NS																	
09/04/19	<4.2	2.2	4.6	3	147	0.051	0.21	0.012	0.026	0.0066	0.0084	60	5	<10		<0.00006	0.0002
09/04/19	<4.0	2.3	2.1	3	6	<0.0026	0.091	0.026	0.034	0.036 S	0.026 S	120	36	47		0.00044	0.00054
NS																	
NS																	
10/02/19			1.4	6	6	0.028	0.06	0.012	0.024	0.06	0.07		20				
10/02/19			1.4	11	248	0.016	0.072	0.013	0.033	0.055	0.068		21				
10/02/19			2.6	6	1300	0.022	0.22	0.03	0.07	0.049	0.071		37				
NS																	
10/02/19			1.6	25	204	0.015	0.094	0.0054	0.031	0.024	0.034		21				
NS																	
10/02/19			3.8	20	27	0.063	0.13	0.0025	0.014	0.0026	0.002		5				
10/02/19			2	24	11	0.0078	0.18	0.00064	0.17	0.0065	0.016		32				
NS																	
NS																	

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
Reporting Limit	0.0001	0.0001	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
Max Sig figs	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	5	5	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
Sample Date	Barium, Dissolved	Barium, Total	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
NS															
NS															
06/05/19	0.058	0.057	<0.000054	<0.000054	<0.000012	0.000018	<0.000088	0.000098	0.0049	0.008	<0.000038	0.00066	0.0026	0.0025	0.00084
NS															
06/05/19	0.039	0.041	<0.000054	0.000065	0.00022	0.00041	<0.000088	0.00052	0.0044	0.008	0.00044	0.0036	0.0027	0.0024	0.00081
6/10/2019		0.04		0.00014		0.00069		0.0019		0.017		0.011		0.0027	
6/12/2019		0.037		0.00011		0.0006		0.0013		0.014		0.0077		0.0023	
6/17/2019	0.021	0.028	<0.000054	0.000067	0.00012	0.00036	0.00014	0.00084	0.0047	0.0097	0.00046	0.005	0.0018	0.002	0.00066
6/19/2019	0.021	0.029	<0.000054	0.00006	0.00013	0.0004	<0.000088	0.00052	0.0044	0.0099	0.00042	0.0053	0.0016	0.0017	0.00066
6/24/2019	0.022	0.027	<0.000054	0.000054	0.0001	0.00027	<0.000088	0.0013	0.0039	0.0072	0.00032	0.003	0.0017	0.0018	0.00055
6/26/2019	0.023	0.026	<0.000054	<0.000054	0.00013	0.00026	<0.000088	0.00069	0.0036	0.0071	0.00026	0.003	0.0018	0.0018	0.00054
7/1/2019	0.02	0.026	<0.000054	<0.000054	0.00012	0.00031	<0.000088	0.00054	0.0034	0.0072	0.00026	0.0034	0.0016	0.0018	0.00047
7/3/2019		0.043		0.00012		0.00049		0.0028		0.015		0.016		0.0021	
07/03/19															
07/03/19															
07/03/19															
NS															
07/03/19															
NS															
NS															
07/03/19															
NS															
07/03/19															
7/8/2019	0.018	0.023	<0.000054	<0.000054	0.00011	0.00021	<0.000088	0.00047	0.0037	0.0068	0.0003	0.0024	0.0017	0.0018	0.00048
7/11/2019	0.02	0.024	<0.000054	<0.000054	0.000081	0.00022	<0.000088	0.0017	0.0028	0.0058	0.0002	0.0028	0.0018 S	0.0017 S	0.00041
08/07/19															
08/07/19															
08/07/19															
NS															
08/07/19															
NS															
NS															
08/07/19															
NS															
08/07/19															
09/04/19	0.032	0.033	<0.000054	<0.000054	0.00017	0.00024	<0.000088	<0.000088	0.0019	0.0028	0.00012	0.00049	0.0022	0.0021	0.00054
09/04/19	0.034	0.033	<0.000054	<0.000054	0.00015	0.0002	<0.000088	<0.000088	0.0027	0.0027	0.00012	0.00048	0.0021	0.0021	0.00062 S
09/04/19	0.035	0.035	<0.000054	<0.000054	0.00034	0.00053	0.00026 S	<0.000088 S	0.0023	0.0035	0.00012	0.00052	0.0023	0.0023	0.00068
NS															
09/04/19	0.033	0.036	<0.000054	<0.000054	0.000063	0.00015	<0.000088	0.00054	0.0017	0.003	0.00013	0.00091	0.0023	0.0024	0.0004
NS															
09/04/19	0.015	0.016	<0.000054	<0.000054	0.000022	0.000032	<0.000088	0.00022	0.0011	0.0013	0.000063	0.00023	0.00077	0.00078	0.00042
09/04/19	0.044	0.044	<0.000054	<0.000054	0.000084 S	0.000018 S	<0.000088	<0.000088	0.012	0.013	0.0013 S	0.00062 S	0.0026	0.0025	0.0018 S
NS															
NS															
10/02/19															
10/02/19															
10/02/19															
NS															
10/02/19															
NS															
10/02/19															
10/02/19															
NS															
NS															

Tribs

Method	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8			
Reporting Limit (	**0.005**	**0.00050**	**0.00050**	**0.0005**	**0.0005**	**0.0020**	**0.0020**	**0.00003**	**0.00003**	**0.040**			
Max Sig figs	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**			
Max decimals	**4**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**3**			
Reporting Units	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**			
Sample Date	**Nickel, Total**	**Selenium, Dissolved**	**Selenium, Total**	**Silver, Dissolved**	**Silver, Total**	**Strontium, Dissolved ICAP**	**Strontium, Total**	**Vanadium, Dissolved ICAP/MS**	**Vanadium, Total ICAP/MS**	**Aluminum, Total**	**Notes**	**Conclusion**	**Field Notes**
NS											Not sampled		
NS											Not sampled		
06/05/19	0.001	0.00049 S	<0.00015 S	<0.000014	<0.000014	0.22	0.25	0.00026	0.0004				
NS											Not sampled		
06/05/19	0.0013	0.00041	0.00021	0.000016	0.000043	0.12	0.13	0.00025	0.001				
6/10/2019	0.0027		<0.00015		0.00016		0.095		0.0028	1	Peak Flow study		
6/12/2019	0.0023		<0.00015		0.00011		0.094		0.0023	1.2	Peak Flow study		
6/17/2019	0.0013	0.00017 S	<0.00015 S	<0.000014	0.00014	0.074	0.082	0.00017	0.0012	0.78	Peak Flow study		
6/19/2019	0.0011	0.00025 S	<0.00015 S	0.000016	0.000056	0.072	0.086	0.00019	0.00085	0.58	Peak Flow study		
6/24/2019	0.00071	<0.00015	0.00038	0.000017	0.00013	0.085	0.086	0.00019	0.00053	0.28	Peak Flow study		
6/26/2019	0.001	<0.00015	<0.00015	<0.000014	0.000024	0.085	0.091	0.00023	0.00086	0.29	Peak Flow study		
7/1/2019	0.00055	<0.00015	0.00048	0.000039	0.000056	0.0024	0.074	0.00018	0.00077	0.42	Peak Flow study		
7/3/2019	0.0028		<0.00015		0.00018		0.083		0.0035	1.6	Peak Flow study		
07/03/19													
07/03/19													
07/03/19													
NS											Not sampled		
07/03/19													
NS											Not sampled		
NS											Not sampled		
07/03/19													
NS											Not sampled		
07/03/19													
7/8/2019	0.001	<0.00015	<0.00015	<0.000014	0.000048	0.073	0.08	0.0002	0.00058	0.28	Peak Flow study		
7/11/2019	0.001	<0.00015	<0.00015	<0.000014	0.000076	0.081	0.08	0.00017	0.00051	0.23	Peak Flow study		
08/07/19													
08/07/19													
08/07/19													
NS											Not sampled		
08/07/19													
NS											Not sampled		
NS											Not sampled		
08/07/19													
NS											Not sampled		
08/07/19													
09/04/19	0.00051	0.00031 S	0.00022 S	<0.000014	0.000016	0.13	0.14	0.000099	0.00014				
09/04/19	0.00052 S	0.00029 S	<0.00015 S	<0.000014	<0.000014	0.13	0.15	0.000065	0.00016				
09/04/19	0.00069	0.00033 S	0.00020 S	<0.000014	0.000014	0.16	0.16	0.00014	0.00019				
NS											Not sampled		
09/04/19	0.00061	<0.00015	<0.00015	<0.000014	<0.000014	0.14	0.16	0.000086	0.0004	NT			
NS											Not sampled		
09/04/19	0.00051	<0.00015	<0.00015	<0.000014	<0.000014	0.054	0.06	0.00045	0.00073	NT			
09/04/19	0.00066 S	<0.00015	<0.00015	<0.000014	<0.000014	0.017	0.019	0.00023	0.00038				
NS											Not sampled		
NS											Not sampled		
10/02/19													
10/02/19													
10/02/19													
NS											Not sampled		
10/02/19													
NS											Not sampled		
10/02/19													
10/02/19													
NS											Not sampled		
NS											Not sampled		

Tribs

Method	
Reporting Limit	
Max Sig figs	
Max decimals	
Reporting Units	
Sample Date	**Lab Notes**
NS	
NS	
06/05/19	NG chloride data reported
NS	
06/05/19	NG chloride data reported
6/10/2019	EEA chloride data reported
6/12/2019	EEA chloride data reported
6/17/2019	EEA chloride data reported
6/19/2019	EEA chloride data reported
6/24/2019	EEA chloride data reported
6/26/2019	EEA chloride data reported
7/1/2019	EEA chloride data reported
7/3/2019	EEA chloride data reported
07/03/19	NG chloride data reported
07/03/19	NG chloride data reported
07/03/19	NG chloride data reported
NS	
07/03/19	NG chloride data reported
NS	
NS	
07/03/19	NG chloride data reported
NS	
07/03/19	NG chloride data reported
7/8/2019	
7/11/2019	
08/07/19	NG chloride data reported
08/07/19	NG chloride data reported
08/07/19	NG chloride data reported
NS	
08/07/19	NG chloride data reported
NS	
NS	
08/07/19	NG chloride data reported
NS	
08/07/19	NG chloride data reported
09/04/19	NG chloride data reported
09/04/19	NG chloride data reported
09/04/19	NG chloride data reported
NS	
09/04/19	NG chloride data reported
NS	
09/04/19	NG chloride data reported
09/04/19	NG chloride data reported
NS	
NS	
10/02/19	NG chloride data reported
10/02/19	NG chloride data reported
10/02/19	NG chloride data reported
NS	
10/02/19	NG chloride data reported
NS	
10/02/19	NG chloride data reported
10/02/19	NG chloride data reported
NS	
NS	

Tribs

Method				**SM2510B**	**SM4500OG**	**SM4500H+B**	**SM2550B**	**SM2130B**	**SM4500PE**	**SM4500PE**	**SM4500NH3H**	**SM4500NO3I**	**SM4500NO3I**	**SM7110B**	**SM7110B**
Reporting Limit Goal				**10**	**1.0**	**1.0**	**1.0**	**1**	**0.0025**	**0.0025**	**0.01**	**0.01**	**0.02**	**variable**	**variable**
Max Sig figs				**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
Max decimals				**0**	**1**	**1**	**1**	**1**	**4**	**4**	**2**	**2**	**2**	**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**
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**
11/06/19	9:00	**G**	**Trib 01**	401	11.2	7.8	3.5	< 1	< 0.005	< 0.005	<0.01	0.34	0.51		
11/06/19	9:15	**G**	**Trib 02**	388	10.3	7.8	8.2	< 1	0.005	0.0097	<0.01	0.34	0.44		
11/06/19	9:38	**G**	**Trib 03**	545	9.9	7.8	7.2	< 1	< 0.005	0.0079	0.01	0.35	0.53		
NS	NS	**G**	**Trib 04**												
11/06/19	10:00	**G**	**Trib 11**	398	10.1	7.9	7.6	< 1	< 0.005	0.0074	<0.01	0.32	0.44		
NS	NS	**G**	**Trib 22a**												
NS	NS	**G**	**Trib 22d**												
11/06/19	8:15	**G**	**Trib 24**	311	8.8	7.8	13.6	1.6	< 0.005	0.0093	<0.01	0.03	0.21		
NS	NS	**G**	**Trib 25**												
NS	NS	**G**	**Trib 27 (New Church Ditch Inlet)**												
12/04/19	9:15	**G**	**Trib 01**	406	11.4	7.8	4	LE	< 0.005	0.0057	<0.01	0.46	0.55	3.4	2.2
12/04/19	9:30	**G**	**Trib 02**	423	10.6	7.8	6.2	LE	< 0.005	0.005	0.02	0.44	0.4 S	2.9	2.9
12/04/19	9:50	**G**	**Trib 03**	461	10.1	8	7.9	LE	< 0.005	0.0071	0.01	0.43	0.55	2.3	2.3
12/04/19	10:25	**G**	**Trib 04**	619	9.8	7.9	6.3	LE	0.0056	0.0183	<0.1	0.43	0.59	3.8	3.4
NS	NS	**G**	**Trib 11**												
NS	NS	**G**	**Trib 22a**												
NS	NS	**G**	**Trib 22d**												
12/04/19	8:30	**G**	**Trib 24**	316	9.4	7.8	11.3	LE	< 0.005	0.01	0.03	0.04	0.17	1.8	2
NS	NS	**G**	**Trib 25**												
NS	NS	**G**	**Trib 27 (New Church Ditch Inlet)**												

Tribs

Method	SM7110B	SM7110B	SM5310B	SM2540D	SM9221D	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA130.2	SM4110A	SM4110A	SM4110A	EPA200.8	EPA200.8
Reporting Limit (	variable	variable	0.5	1	1	0.01	0.01	0.00025	0.00025	0.0025	0.0025	5	5	10	0.1	0.00015	0.00015
Max Sig figs	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals	1	1	1	0	0	3	3	5	5	4	4	0	0	0	1	5	5
Reporting Units	pCi/L	pCi/L	mg/L	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
Sample Date	Gross Beta	Gross Beta, Uncertainty	Carbon, Total Organic	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
11/06/19			1.1	2	1	0.017	0.052	0.044	0.053	0.12	0.13		38				
11/06/19			1.1	2	9	0.015	0.058	0.028	0.046	0.099	0.11		39				
11/06/19			1.6	<1	167	0.022	0.072	0.029	0.094	0.077	0.092		75				
NS																	
11/06/19			1.2	3	16	0.014	0.06	0.0061	0.032	0.069	0.08		39				
NS																	
NS																	
11/06/19			2.1	5	28	0.0048	0.087	0.00031	0.019	0.0058	0.011		30				
NS																	
NS																	
12/04/19	3.9	2.3	2	4	<1	0.012	0.064	0.048	0.072	0.13	0.14	152	47	75		0.00011 S	<0.00006 S
12/04/19	<3.4	2.2	1.4	3	36	0.014	0.052	0.041	0.053	0.12	0.13	144	52	74		0.00011 S	<0.00006 S
12/04/19	<3.7	2.3	1.6	3	58	0.017	0.064	0.028	0.053	0.096	0.11	160	65	75		0.00019 S	<0.00006 S
12/04/19	<4.1	2.5	2.3	15	144	0.018	0.5	0.0041	0.055	0.065	0.1	164	110	79	<0.1	0.00053	0.001
NS																	
NS																	
NS																	
12/04/19	<4.3	2.3	2.3	5	8	0.0049	0.047	0.00022	0.0067	0.0089	0.012	124	33	47		0.00036	0.00047
NS																	
NS																	

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
Reporting Limit (	0.0001	0.0001	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
Max Sig figs	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	5	5	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
Sample Date	Barium, Dissolved	Barium, Total	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
11/06/19	[redacted]														
11/06/19															
11/06/19															
NS															
11/06/19															
NS															
NS															
11/06/19															
NS															
NS															
12/04/19	0.047	0.05	<0.000054	<0.000054	0.00044 S	0.00025	0.001 S	<0.000088 S	0.0026	0.0039	0.000086	0.00022	0.048	0.072	0.0014
12/04/19	0.05	0.052	<0.000054	<0.000054	0.00037 S	0.00011	<0.000088	<0.000088	0.0024	0.0032	0.0001	0.0001	0.002	0.0018	0.0013 S
12/04/19	0.048	0.05	<0.000054	<0.000054	0.00033 S	0.000099	<0.000088	<0.000088	0.0021	0.0031	0.000099	0.00025	0.002	0.0017	0.0012 S
12/04/19	0.054	0.057	<0.000054	<0.000054	0.00016	0.00027	<0.000088	0.00032	0.0022	0.0063	0.0002	0.0037	0.0022	0.0022	0.0013
NS	[redacted]														
NS															
NS															
12/04/19	0.044	0.045	<0.000054	<0.000054	<0.000012	<0.000012	<0.000088	<0.000088	0.0032	0.0041	0.000044	0.00035	0.0025	0.0026	0.00081
NS	[redacted]														
NS															

Tribs

Method	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8			
Reporting Limit (	0.005	0.00050	0.00050	0.0005	0.0005	0.0020	0.0020	0.00003	0.00003	0.040			
Max Sig figs	3	3	3	3	3	3	3	3	3	3			
Max decimals	4	5	5	5	5	5	5	5	5	3			
Reporting Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L			
Sample Date	Nickel, Total	Selenium, Dissolved	Selenium, Total	Silver, Dissolved	Silver, Total	Strontium, Dissolved ICAP	Strontium, Total	Vanadium, Dissolved ICAP/MS	Vanadium, Total ICAP/MS	Aluminum, Total	Notes	Conclusion	Field Notes
11/06/19													
11/06/19													
11/06/19													
NS											Not sampled		
11/06/19													
NS											Not sampled		
NS											Not sampled		
11/06/19													
NS											Not sampled		
NS											Not sampled		
12/04/19	0.0011	0.00037	0.00059	<0.000014	<0.000014	0.24	0.23	0.00016 S	<0.000034 S				
12/04/19	0.00097	0.00016	0.00016	<0.000014	<0.000014	0.23	0.24	0.00018 S	<0.000034 S				
12/04/19	0.00092	0.00042 S	<0.00015 S	<0.000014	<0.000014	0.26	0.24	0.00023 S	<0.000034 S				
12/04/19	0.0017	0.0002 S	<0.00015 S	0.000045	0.00018	0.28	0.29	0.00043	0.00092				
NS											Not sampled		
NS											Not sampled		
NS											Not sampled		
12/04/19	0.00091	0.00025 S	<0.00015 S	0.000047	0.00029	0.17	0.18	0.00032 S	0.00025 S				
NS											Not sampled		
NS											Not sampled		

Tribs

Method	
Reporting Limit	
Max Sig figs	
Max decimals	
Reporting Units	
Sample Date	**Lab Notes**
11/06/19	NG chloride data reported
11/06/19	NG chloride data reported
11/06/19	NG chloride data reported
NS	
11/06/19	NG chloride data reported
NS	
NS	
11/06/19	NG chloride data reported
NS	
NS	
12/04/19	NG chloride data reported
12/04/19	NG chloride data reported
12/04/19	NG chloride data reported
12/04/19	NG chloride data reported
NS	
NS	
NS	
12/04/19	NG chloride data reported
NS	
NS	

Ambient Autosamplers

Method				SM2550B	SM4500H+B	SM2510B	SM2130B	SM4500NH3H	SM4500NO3I	SM4500NO3I	SM4500PE	SM4500PE	SM5310B	SM2540D	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
Max Sig figs				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
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
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
04/29/19	3:00	24C	CC AS 26	5.1	7.8	367	5.6	<0.01	0.32	0.45	< 0.0050	0.0148	2.6	7			
04/29/19	12:20	24C	CC AS 49	4.5	7.7	308	9.1	<0.01	0.25	0.5	< 0.0050	0.0084	3	16			
04/29/19	12:20	24C	CC AS 50	5	7.7	225	17	<0.01	0.21	0.52	< 0.0050	0.0351	3.6	30			
NS	NS	NA	CC AS 59														
04/30/19	2:40	24C	CC AS T2	8.6	7.7	495	7.6	<0.01	0.26	0.49	< 0.0050	0.0249	2.8	11			
04/30/19	11:45	24C	CC AS T11	5.1	7.7	517	18	<0.01	0.24	0.49	< 0.0050	0.0273	2.7	40			
05/29/19	4:00	24C	CC AS 26	8.3	7.5	379	1.9	<0.01	0.16	0.32	< 0.0050	0.0076	2.9	<1			
05/29/19	11:05	24C	CC AS 49	10.5	7.5	244	10	0.01	0.12	0.42	< 0.0050	0.0318	3.1	25			
05/29/19	11:05	24C	CC AS 50	10.2	7.4	243	3.3	<0.01	0.12	0.26	< 0.0050	0.0119	3.2	3			
05/29/19	19:20	24C	CC AS 59	16.1	7.8	280	2.4	<0.01	0.11	0.26	< 0.0050	0.0125	3.5	4			
05/29/19	21:50	24C	CC AS T2	16.9	7.8	290	3.8	<0.01	0.11	0.25	< 0.0050	0.0152	3.2	2			
05/30/19	5:30	24C	CC AS T11	14.1	7.8	285	13.8	0.01	0.12	0.35	< 0.0050	0.0307	2.9	52			
06/24/19	12:45	G	CC AS 26	7	7.5	159	2.5	<0.01	0.14	0.31	0.0063	0.0065	2.8	8			
06/24/19	8:50	24C	CC AS 49	13.5	7.5	118	8.8	<0.01	0.13	0.31	< 0.005	0.0259	3.3	38			
06/24/19	8:50	24C	CC AS 50	12.9	7.4	160	8.7	<0.01	0.09	0.29	< 0.005	0.0185	3.7	15			
06/24/19	14:30	G	CC AS 59	8.6	7.4	127	4.9	<0.01	0.13	0.27	< 0.005	0.0149	2.8	16			
06/24/19	13:15	24C	CC AS T2	22.5	7.5	134	6.6	<0.01	0.13	0.33	< 0.0050	0.0166	3.2	25			
06/24/19	21:45	24C	CC AS T11	20.6	7.5	145	29.6	<0.01	0.13	0.43	< 0.0050	0.0417	NA	100			
07/29/19	0:00	24C	CC AS 26	19.3	7.6	133	2.1	<0.01	0.11	0.26	< 0.0050	0.0078	1.9	5	0.000087	0.00013	0.025
07/29/19	10:20	24C	CC AS 49	21.1	7.6	133	13.3	<0.01	0.09	0.26	< 0.0050	0.0144	2.2	49	0.00016	0.002	0.025
07/29/19	10:20	24C	CC AS 50	22.2	7.6	377	10.5	<0.01	0.81	0.99	< 0.0050	0.0433	2.5	21	0.00029	0.00037	0.027

Ambient

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
Reporting Li	0.00010	0.00005	0.00005	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
Max Sig figs	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimal	5	5	5	5	5	5	5	5	5	3	3	5	5	5	5	5	5
Reporting Ur	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	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
04/29/19				NT	NT			NT	NT	NT	NT	NT	NT	NT	NT		
04/29/19				NT	NT			NT	NT	NT	NT	NT	NT	NT	NT		
04/29/19				NT	NT			NT	NT	NT	NT	NT	NT	NT	NT		
NS																	
04/30/19				NT	NT			NT	NT	NT	NT	NT	NT	NT	NT		
04/30/19				NT	NT			NT	NT	NT	NT	NT	NT	NT	NT		
05/29/19				0.00029	0.00039			0.0021	0.0045	0.066	0.26	0.00071	0.0027	0.12	0.190		
05/29/19				0.0003	0.001			0.0037	0.021	0.048	1.4	0.00042	0.012	0.038	0.600		
05/29/19				0.00061	0.00065			0.01	0.018	0.06	0.34	0.00027	0.002	0.12	0.180		
05/29/19				0.00032	0.00042			0.004	0.0075	0.039	0.27	0.00034	0.0021	0.047	0.130		
05/29/19				0.00032	0.00043			0.0042	0.0094	0.039	0.24	0.00029	0.002	0.038	0.120		
05/30/19				0.00014	0.00077			0.0033	0.016	0.034	1.2	0.00024	0.0093	0.002	0.240		
06/24/19				NT	NT			NT	NT	NT	NT	NT	NT	NT	NT		
06/24/19				NT	NT			NT	NT	NT	NT	NT	NT	NT	NT		
06/24/19				0.00044	0.00059			0.0088	0.016	0.057	0.9	0.00033	0.006	0.078	0.130		
06/24/19				0.00019	0.00032			0.003	0.0057	0.041	0.55	0.00031	0.0035	0.029	0.120		
06/24/19				0.00017	0.0005			0.0032	0.011	0.038	1	0.00027	0.007	0.02	0.260		
06/24/19				0.000087	0.001			0.0034	0.022	0.04	3.1	0.00026	0.0015	0.0052	0.390		
07/29/19	0.027	<0.000054	<0.000054	0.000098	0.00021	<0.000088	0.00019	0.00098	0.0014	0.034	0.16	0.00043	0.0021	0.03	0.074	0.002	0.002
07/29/19	0.046	<0.000054	0.0001	0.00012	0.00094	<0.000088	0.0023	0.0021	0.013	0.027	1.6	0.00028	0.018	0.0049	0.370	0.0019	0.0026
07/29/19	0.03	<0.000054	<0.000054	0.00053	0.00067	<0.000088	0.00034	0.0067	0.013	0.036	0.42	0.00025	0.0027	0.13	0.170	0.0015	0.0016

Ambient

Method	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA 300.0		
Reporting Li	0.00032	0.00032	0.00050	0.00050	0.00001	0.00001	0.00200	0.00200	0.00003	0.00003	0.0025	0.0025	10		
Max Sig figs	3	3	3	3	3	3	3	3	3	3	3	3	3		
Max decimal	5	5	5	5	5	5	5	5	5	5	4	4	0		
Reporting Ur	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	Nickel, Dissolved	Nickel, Total	Selenium, Dissolved	Selenium, Total	Silver, Dissolved	Silver Total	Strontium, Dissolved ICAP	Strontium, Total ICAP	Vanadium, Dissolved	Vanadium, Total	Zinc, Dissolved	Zinc, Total	Chloride	Notes	Conclusion
04/29/19											NT	NT	110	Start time 0400 on 4/28/19, end time 0300 on 04/29/19.	
04/29/19											NT	NT	88	Start time 1320 on 04/28/19, end time 1220 on 04/29/19.	
04/29/19											NT	NT	49	Start time 1320 on 04/28/19, end time 1220 on 04/29/19.	
NS														Not sampled	
04/30/19											NT	NT	85	Start time 0340 on 04/29/19, end time 0240 on 04/30/19.	
04/30/19											NT	NT	88	Start time 1245 on 04/29/19, end time 1145 on 04/30/19.	
05/29/19											0.11	0.15	64	Start time 0500 on 5/28/19, end time 0400 on 5/29/19	
05/29/19											0.084	0.34	53	Start time 1205 on 5/28/19, end time 1105 on 5/29/19.	
05/29/19											0.13	0.16	33	Start time 1205 on 5/28/19, end time 1105 on 5/29/19.	
05/29/19											0.08	0.13	52	Start time 2020 on 5/28/19, end time 1920 on 5/29/19.	
05/29/19											0.075	0.12	53	Start time 2250 on 5/28/19, end time 2150 on 5/29/19.	
05/30/19											0.038	0.18	56	Start time 0630 on 5/29/19, end time 0530 on 5/30/19.	
06/24/19											NT	NT	NT	Grab sample collected	
06/24/19											NT	NT	NT	Start time 0950 on 6/23/19, end time 0850 on 6/24/19.	
06/24/19											0.099	0.12	NT	Start time 0950 on 6/23/19, end time 0850 on 6/24/19.	
06/24/19											0.053	0.089	NT	Grab sample collected	
06/24/19											0.042	0.13	NT	Start time 1415 on 6/23/19, end time 1315 on 6/24/19.	
06/24/19											0.027	0.24	NT	Start time 2245 on 6/23/19, end time 2145 on 6/24/19.	
07/29/19	0.00036	0.00036	<0.00015	<0.00015	<0.000014	0.000085	0.088	0.095	0.000068	0.00012	0.042	0.059	NT	Start time 0700 on 07/28/19; end time 0600 on 07/29/19	
07/29/19	0.00038	0.0028	0.00015	<0.00015	<0.000014	0.00018	0.084	0.096	0.00012	0.0028	0.032	0.2	NT	Start time 1120 on 7/28/19, end time 1020 on 7/29/19.	
07/29/19	0.0021	0.0026	0.00028 S	<0.00015	<0.000014	0.000021	0.18	0.2	0.00017	0.00056	0.12	0.15	NT	Start time 1120 on 7/28/19, end time 1020 on 7/29/19.	

Ambient

Method		
Reporting Li		
Max Sig figs		
Max decimal		
Reporting Ui		
Sample Date	**Field Notes**	**Lab Notes**
04/29/19		
04/29/19		
04/29/19		
NS		
04/30/19		
04/30/19		
05/29/19		
05/29/19		
05/29/19		
05/29/19		
05/29/19		
05/30/19		
06/24/19	AS malfunction	
06/24/19		
06/24/19		
06/24/19	AS malfunction	
06/24/19		
06/24/19		
07/29/19		
07/29/19		
07/29/19		

Ambient Autosamplers

Method				SM2550B	SM4500H+B	SM2510B	SM2130B	SM4500NH3H	SM4500NO3I	SM4500NO3I	SM4500PE	SM4500PE	SM5310B	SM2540D	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
Max Sig figs				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
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
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
07/30/19	11:35	G	CC AS 59	21	7.6	145	2.6	<0.01	0.1	0.19	< 0.0050	0.0065	1.5	9	0.000086 S	<0.00006 S	0.026
07/29/19	16:55	24C	CC AS T2	27	7.1	166	14.6	Interference	Interference	0.34	0.0168	0.0404	8.4	9	0.00038	0.00034	0.083
07/30/19	0:35	24C	CC AS T11	26.2	7.7	152	10.3	<0.01	0.09	0.33	< 0.0050	0.0285	1.9	56	0.00019	0.00094	0.025
08/20/19	0:00	24C	CC AS 26	19.2	7.5	190	4.1	<0.01	0.13	0.31	< 0.005	0.0067	1.5	<1			
08/20/19	11:50	24C	CC AS 49	24.1	7.6	182	9.2	<0.01	0.12	0.35	< 0.005	0.0181	1.9	35			
08/20/19	11:50	24C	CC AS 50	23.1	7.7	533	2.2	<0.01	1.43	1.85	< 0.005	0.0076	2.6	<1			
08/21/19	8:45	G	CC AS 59	16.9	7.4	193	2.4	0.01	0.15	0.31	< 0.005	0.0057	1.3	2			
08/20/19	20:50	24C	CC AS T2	25.6	7.6	202	1.7	<0.01	0.14	0.31	< 0.005	0.0076	2	<1			
08/21/19	5:30	24C	CC AS T11	23.5	7.6	212	5	0.02	0.1	0.33	< 0.005	0.0199	1.8	6			
09/23/19	10:50	G	CC AS 26	13	7.8	266	4.2	0.02	0.18	0.2	< 0.005	0.0051	1.1	4	<0.00006	<0.00006	0.04
09/23/19	10:40	24C	CC AS 49	15.9	8	248	6	<0.01	0.15	0.26	< 0.005	0.0175	1.5	17	0.000096	0.00024	0.034
09/23/19	12:10	G	CC AS 50	16	7.9	706	4	<0.01	1.71	1.93	< 0.005	0.0095	2	7	0.00022	0.00048	0.037
09/24/19	11:10	G	CC AS 59	17.6	8	274	1.9	<0.01	0.17	0.31	< 0.005	0.0053	1.5	5	0.000066	<0.00006	0.039
09/24/19	10:30	G	CC AS T2	18.9	7.9	278	2.4	<0.01	0.16	0.22	< 0.005	< 0.0050	1.9	5	0.00013	0.00014	0.038
09/24/19	11:49	24C	CC AS T11	22	8	280	4.8	<0.01	0.14	0.25	< 0.005	0.0125	1.7	9	0.000062	0.00032	0.04

Ambient

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
Reporting Li	0.00010	0.00005	0.00005	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
Max Sig figs	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimal	5	5	5	5	5	5	5	5	5	3	3	5	5	5	5	5	5
Reporting Ur	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	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
07/30/19	0.027	<0.000054	<0.000054	0.00014	0.00023	<0.000088	0.00013	0.002	0.003	0.027	0.1	0.00029	0.0012	0.028	0.049	0.0018	0.0018
07/29/19	0.086	<0.000054	<0.000054	0.000026	0.0002	<0.000088	<0.000088	0.0012	0.012	0.76	1.1	0.00048	0.0016	5	4.700	0.0076	0.0077
07/30/19	0.04	<0.000054	0.00007	0.000054	0.00048	<0.000088	0.0014	0.002	0.011	0.022	1.8	0.00019	0.0084	0.0022	0.160	0.002	0.0021
08/20/19																	
08/20/19																	
08/20/19																	
08/21/19																	
08/20/19																	
08/21/19																	
09/23/19	0.042	<0.000054	<0.000054	0.00013	0.00021	<0.000088	<0.000088	0.00093	0.00092	0.06	0.13	0.00037	0.00092	0.05	0.064	0.0034	0.0033
09/23/19	0.043	<0.000054	0.000055	0.00021	0.00048	<0.000088	0.0014	0.0024	0.0068	0.024	0.74	0.00016	0.0031	0.0093	0.160	0.0024	0.0024
09/23/19	0.038	<0.000054	<0.000054	0.0007 S	0.00065 S	<0.000088	0.0002	0.0024	0.0078	0.011	0.22	0.00011	0.00071	0.051	0.058	0.0013	0.0013
09/24/19	0.04	<0.000054	<0.000054	0.00019	0.00023	<0.000088	<0.000088	0.0022	0.003	0.016	0.072	0.00016	0.00058	0.02	0.032	0.0025	0.0025
09/24/19	0.041	<0.000054	<0.000054	0.00022	0.00022	<0.000088	<0.000088	0.002	0.0031	0.018	0.072	0.00018	0.00062	0.018	0.033	0.00025	0.00025
09/24/19	0.043	<0.000054	<0.000054	0.000079	0.00018	<0.000088	0.00038	0.0021	0.0039	0.012	0.35	0.00012	0.0015	0.0031	0.045	0.0025	0.0024

Ambient

Method	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.7	EPA200.7	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA 300.0		
Reporting Li	0.00032	0.00032	0.00050	0.00050	0.00001	0.00001	0.00200	0.00200	0.00003	0.00003	0.0025	0.0025	10		
Max Sig figs	3	3	3	3	3	3	3	3	3	3	3	3	3		
Max decimal	5	5	5	5	5	5	5	5	5	5	4	4	0		
Reporting U	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	Nickel, Dissolved	Nickel, Total	Selenium, Dissolved	Selenium, Total	Silver, Dissolved	Silver Total	Strontium, Dissolved ICAP	Strontium, Total ICAP	Vanadium, Dissolved	Vanadium, Total	Zinc, Dissolved	Zinc, Total	Chloride	Notes	Conclusion
07/30/19	0.00048	0.00054	<0.00015	<0.00015	<0.000014	<0.000014	0.085	0.092	0.00012	0.00019	0.05	0.06	NT	Grab sample collected	
07/29/19	0.0024	0.0026	<0.00015	<0.00015	<0.000014	<0.000014	0.1	0.12	0.00023	0.0003	0.014	0.041	NT	Start time 1755 on 7/28/19, end time 1655 on 7/29/19.	
07/30/19	0.00034	0.0021	<0.00015	<0.00015	<0.000014	0.000057	0.092	0.11	0.00019	0.0026	0.017	0.12	NT	Start time 0135 on 7/29/19; end time 0035 on 7/30/19	
08/20/19														Start time 0700 on 08/19/19; end time 0600 on 08/20/19	
08/20/19														Start time 1250 on 8/19/19, end time 1150 on 8/20/19.	
08/20/19														Start time 1250 on 8/19/19, end time 1150 on 8/20/19.	
08/21/19														Grab sample collected	
08/20/19														Start time 2150 on 8/19/19, end time 2050 on 8/20/19.	
08/21/19														Start time 0630 on 8/20/19; end time 0530 on 8/21/19	
09/23/19	0.00068 S	0.00046 S	<0.00015	<0.00015	<0.000014	0.000063	0.17	0.17	<0.000034	0.00016	0.052	0.063	NT	Start time 0700 on 08/19/19; end time 0600 on 08/20/19	
09/23/19	0.00084	0.0013	0.00022 S	<0.00015	<0.000014	0.000054	0.14	0.16	<0.000034	0.00013	0.058	0.12	NT	Start time 1140 on 09/22/19; end time 1040 on 09/23/19	
09/23/19	0.0028 S	0.0021 S	0.00036	0.0007	<0.000014	0.000025	0.39	0.4	0.00022	0.00018	0.15	0.15	NT	Grab sample collected	
09/24/19	0.0009 S	0.00082 S	<0.00015	0.00032	<0.000014	<0.000014	0.15	0.16	<0.000034	0.00023	0.06	0.069	NT	Grab sample collected	
09/24/19	0.00081	0.00085	0.00024	0.00047	<0.000014	<0.000014	0.16	0.17	<0.000034	0.0002	0.057	0.069	NT	Grab sample collected	
09/24/19	0.00056 S	0.00045 S	<0.00015	<0.00015	0.000032 S	0.000019 S	0.15	0.18	<0.000034	0.00048	0.019	0.041	NT	Start time 1249 on 9/23/19; end time 1149 on 9/24/19	

Ambient

Method		
Reporting Li		
Max Sig figs		
Max decimal		
Reporting Ur		
Sample Date	**Field Notes**	**Lab Notes**
07/30/19	AS malfunction	
07/29/19		
07/30/19		
08/20/19		
08/20/19		
08/20/19		
08/21/19	AS malfunction	
08/20/19		
08/21/19		
09/23/19		
09/23/19		
09/23/19	AS malfunction	
09/24/19	AS malfunction	
09/24/19	AS malfunction	
09/24/19		

Event Autosamplers

Method				SM2550B	SM4500H+B	SM2510B	SM2130B	SM4500NH3H	SM4500NO3I	SM4500NO3I	SM4500PE	SM4500PE	SM4500NH3H	EPA 300.0	SM4500NorgB	Calc
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
Max Sig figs				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
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
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
04/05/19	2:00	CE	CC AS T2	19.7	8	600	1	<0.01	0.34	0.46	0.0079	0.0115				
04/05/19	15:00	CE	CC AS T11	18.5	8	305	4.1	0.17	0.26	0.65	0.0173	0.0335				
05/04/19	8:00	CE	CC AS T27	17.1	7.7	518	18.6	0.02	0.14	0.52	0.0055	0.0386				
06/17/19	22:24	CE	CC AS 59	16.5	7.5	147	110	<0.01	0.13	0.74	0.0105	0.208				
07/20/19	23:18	CE	CC AS 50	21	7.3	250	630	0.01	0.24	1.18	0.0079	0.277				
07/20/19	11:31	CE	CC AS T2	22.6	7.7	184	20	Interference	Interference	0.68	0.0151	0.059				
07/21/19	9:24	CE	CC AS T11	22.6	7.5	149	140	0.04	0.3	1.3	0.0086	0.176				
07/22/19	12:52	CE	CC AS T11	21.6	7.6	162	138	0.04	0.27	1	0.0147	0.139				
09/06/19	16:51	CE	CC AS 50	21	7.6	652	2350	0.04	1.47	2.54	0.0222	2.925				
09/07/19	4:26	CE	CC AS T2	23.4	7.4	313	551	0.05	0.54	2.52	< 0.0050	0.693				
09/07/19	23:51	CE	CC AS T11	21.5	7.5	303	416	0.04	0.49	1.98	< 0.0050	0.37				
11/12/19	6:00	CE	CC AS T3	6.6	7.2	534	2	0.01	0.33	0.49	< 0.0050	0.0093				
11/12/19	9:15	CE	CC AS T4	19.4	7.8	483	10	<0.01	0.27	0.48	< 0.0050	0.0318				

Event Au

Method	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	EPA200.7
DL	0.01	0.01	0.5	1	0.00015	0.00015	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00050	0.00050	0.00025	0.00025	0.01
Max Sig figs	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals	2	2	1	0	5	5	5	5	5	5	5	5	5	5	5	5	3
Reporting Un	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	Phosphorous, Dissolved (SRP)	Phosphorous, 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	Iron, Dissolved
04/05/19	[redacted]	[redacted]	1.7	<1	0.00024	0.00037	0.064	0.065	<0.000054	<0.000054	0.00037	0.00046	<0.000088	<0.000088	0.0031	0.0044	0.0083
04/05/19	[redacted]	[redacted]	2.3	6	0.00034	0.00042	0.058	0.069	<0.000054	0.000089	0.00022	0.0004	<0.000088	0.00028	0.0026	0.0054	0.0064
05/04/19	[redacted]	[redacted]	7.2	39	0.00045	0.0011	0.056	0.071	<0.000054	0.00009	0.0003	0.00063	0.00014	0.0012	0.0052	0.013	0.018 S
06/17/19	[redacted]	[redacted]	4.4	92	0.00027	0.0065	0.028	0.12	<0.000054	0.0004	0.00014	0.0015	0.00011	0.013	0.0061	0.066	0.1
07/20/19	[redacted]	[redacted]	4.3	315	0.00035	0.012	0.039	0.35	<0.000054	0.001	0.0009	0.0039	0.00038	0.037	0.0088	0.25	0.08
07/20/19	[redacted]	[redacted]	16.6	22	0.00088	0.0012	0.11	0.12	<0.000054	<0.000054	0.00018	0.001	<0.000088	0.00067	0.0048	0.022	0.81
07/21/19	[redacted]	[redacted]	3.9	134	0.00044	0.0044	0.028	0.13	<0.000054	0.00059	0.000058	0.0022	0.00026	0.011	0.0034	0.05	0.078
07/22/19	[redacted]	[redacted]	3.8	125	0.00051	0.0032	0.025	0.11	<0.000054	0.00058	0.000038	0.0012	<0.000088	0.0077	0.0032	0.034	0.055
09/06/19	[redacted]	[redacted]	9.4	4270	0.00057	0.0052	0.1	4.4	<0.000054	0.0078	0.00015	0.0048	<0.000088	0.45	0.0068	0.79	0.013
09/07/19	[redacted]	[redacted]	5.4	1130	0.00036	0.0078	0.074	0.53	<0.000054	0.0014	0.000052	0.0015	<0.000088	0.076	0.0032	0.11	0.033
09/07/19	[redacted]	[redacted]	4.4	572	0.00035	0.0058	0.06	0.29	<0.000054	0.00086	0.000099	0.0016	<0.000088	0.041	0.0047	0.084	0.038
11/12/19	[redacted]	[redacted]	1.6	5	NT	0.00034	NT	0.052	NT	<0.000054	NT	0.00037	NT	<0.000088	NT	0.0045	NT
11/12/19	[redacted]	[redacted]	2.3	27	NT	0.0013	NT	0.065	NT	0.000056	NT	0.00029	NT	0.0011	NT	0.01	NT

Event Au

Method	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
DL	0.01	0.00020	0.00020	0.00025	0.00025	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050							0.0025
Max Sig figs	3	3	3	3	3	3	3	3	3	3	3							3
Max decimals	3	5	5	5	5	5	5	5	5	5	5							4
Reporting Ur	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	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	Strontium, Total	Vanadium, Dissolved	Vanadium, Total	Zinc, Dissolved
04/05/19	0.041	0.000059	0.00038	0.022	0.047	0.0023	0.0023	0.0013	0.0014	0.00028	0.0014	0.000028	0.00015	0.33	0.35	0.00017	0.00019	0.082
04/05/19	0.2	0.000057	0.001	0.0023	0.048	0.0026	0.003	0.0013	0.0016	0.00046	0.00043	<0.000014	0.000028	0.35	0.36	0.00031	0.00063	0.051
05/04/19	0.0012 S	0.00012	0.0048	0.0022	0.1	0.0026	0.0027	0.0013	0.0023	0.00066	0.00022	<0.000014	0.000085	0.26	0.27	0.00031	0.0024	0.084
06/17/19	14	0.00084	0.1	0.0065	0.9	0.0017	0.003	0.00066	0.012	<0.00015	0.00019	0.000024	0.0011	0.075	0.098	0.00026	0.016	0.042
07/20/19	28	0.00041	0.2	0.1	1.4	0.0013	0.0021	0.0017	0.041	0.00023	0.00062	0.00014	0.0032	0.14	0.2	0.00033	0.045	0.072
07/20/19	1.4	0.0018	0.0065	8.8 S	8.4 S	0.02	0.02	0.0036	0.0036	0.0002	0.00053	0.000039	0.000064	0.14	0.15	0.00039	0.00085	0.035
07/21/19	10	0.00023	0.04	0.0018	0.98	0.0022	0.0027	0.00054	0.011	0.00018	0.00033	0.00002	0.0005	0.085	0.12	0.00074	0.018	0.021
07/22/19	11	0.0002	0.029	0.0016	0.53	0.0023 S	0.0018 S	0.00051	0.0078	0.00016	0.00033	<0.000014	0.00031	0.084	0.14	0.0012	0.021	0.012
09/06/19	520	0.000072	0.089	0.23	11	0.0042 S	0.0035 S	0.0034	0.35	0.00074	0.0026	0.000019	0.0013	0.31	0.74	0.0014	0.6	0.011
09/07/19	62	0.00015	0.07	0.0026	1.6	0.0022	0.0027	0.00099	0.052	0.00039	0.00055	0.000016	0.00052	0.16	0.24	0.00076	0.093	0.02
09/07/19	37	0.00018	0.045	0.0017	0.99	0.0022	0.0025	0.00094	0.03	0.00053 S	0.00042 S	0.000016	0.00037	0.17	0.22	0.0006	0.052	0.036
11/12/19	0.11	NT	0.0008	NT	0.078	NT	0.0024	NT	0.0014	NT	<0.00015	NT	<0.000014	NT	0.24	NT	0.00036	NT
11/12/19	1.2	NT	0.0078	NT	0.08	NT	0.0028	NT	0.0022	NT	<0.00015	NT	0.00012	NT	0.29	NT	0.0021	NT

Event Au

Method	EPA200.8	SM9221D	SM7110B	SM7110B	SM7110B	SM7110B	EPA 300.0				
DL	0.0025	1	variable	variable	variable	variable	10				
Max Sig figs	3	3	2	2	2	2	3				
Max decimals	4	0	1	1	1	1	0				
Reporting Ur	mg/L	cfu/100mL	pCi/L	pCi/L	pCi/L	pCi/L	mg/L				
Sample Date	Zinc, Total	E. coli	Gross Alpha	Gross Alpha, Uncertainty	Gross Beta	Gross Beta, Uncertainty	Chloride	Notes	Conclusion	Field Notes	Lab Notes
04/05/19	0.097							FHL First Flush. Bottles 1-12. Start time 03:00 on 4/4/19, end time 02:00 on 4/5/19.			
04/05/19	0.07							FHL First Flush. Bottles 1-12. Start time 15:00 on 4/4/19, end time 15:00 on 4/5/19.			
05/04/19	0.15							Church Ditch First Flush. Botttles 1-12. Start time 0900 on 05/03/19, end time 0800 on 05/04/19.			
06/17/19	0.4							Bottles 1-8. Start time 2039 on 06/17/19, end time 2224 on 06/17/19.			Chloride analyzed by EEA by Method 300.0. Result = 16 mg/L.
07/20/19	0.9							Bottles 1-4. Start time 2233 on 07/20/19; end time 2318 on 07/20/19			
07/20/19	0.15							Bottles 1-3. Start time 1818 on 07/20/19; end time 1848 on 07/20/19.			
07/21/19	0.53							Bottles 1-4. Start time 0839 on 07/21/19; end time 0924 on 07/21/19.			
07/22/19	0.29							Bottles 5-8. Start time 1107 on 07/22/19; end time 1252 on 07/22/19.			
09/06/19	1.6							Bottles 1-6. Start time 1536 on 09/06/19; end time 1651 on 09/06/19			
09/07/19	0.5							Bottles 1-22 Start time 2311 on 09/06/19; end time 0426 on 09/07/19.			
09/07/19	0.46		23	8	26	5		Bottles 1-24. Start time 1806 on 09/07/19; end time 2351 on 09/07/19.			Due to large amount of total or dissolved solids, reduced aliquots used for GAB testing.
11/12/19	0.11	NT	1.1	2.1	<3.7	2.4	83	Bottles 1-12. Start time 0700 on 11/11/19; end time 0600 on 11/12/19. Dissolved metals not tested due to frozen samples.			
11/12/19	0.09	NT	3.7	3	5.2	2.6	60	Bottles 1-12. Start time 1015 on 11/11/19; end time 0915 on 11/12/19. Dissolved metals not tested due to frozen samples.			

Clear Creek Event Autosamplers - Golden)

Method				EPA200.7	EPA200.7	EPA200.7	EPA200.7	EPA200.7	EPA200.7	EPA200.7	EPA200.7	EPA200.7	EPA200.7	EPA200.7	EPA200.7	EPA200.7	EPA200.7	SM5310B	Contractor
DL				variable	variable	variable	variable	variable	variable	0.004	0.004	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	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	Lead, Dissolved	Lead, Total	Manganese, Dissolved	Manganese, Total	Zinc, Dissolved	Zinc, Total	Carbon, Total Organic	Nitrogen - Ammonia (Auto. Phenate)
06/17/19		CE	CC59 Event	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	3.79	<0.05
07/08/19		CE	CC 59 Event	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	3.05	<0.05
09/07/19		CE	CC 59 Event	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	9.52	0.06

Clear Cr

Method	Contractor	Contractor	Contractor	Contractor			EPA200.7	EPA200.7						
DL														
Reporting U	mg/L	mg/L	mg/L	mg/L	C	NTU	mg/L	mg/L	umho/cm2	SU				
Sample Date	Nitrogen - TKN Kjeldahl	NO2/NO3 as N. 353.2	Phosphorus - Total, Auto Asc. Acid Red.	Solids - Total Suspended, 105	Temperature	Turbidity - Nephelometric	Aluminum, Sol. - ICP	Aluminum, Total - ICP	Conductivity	pH	Notes	Conclusion	Field Notes	Lab Notes
06/17/19	1.1	0.13	0.29	356	10.1	304	NT	NT	128	7.5				
07/08/19	0.4	1.58	0.14	152	NT	147	NT	NT	111	7.59				
09/07/19	6	0.75	1.25	2960	12.3	4613	NT	NT	337	7.62				

STANDLEY LAKE																
Method				**electrode**	**SM2510B**	**electrode**	**SM4500OG**	**SM4500H+B**	**SM2550B**	**SM2130B**	**Secchi Disk**	**SM4500NH3H**	**SM4500NO3I**	**SM4500NO3I**	**FlowCAM**	**SM10200H**
DL				**1.0**	**10**	**1**	**1.0**	**1.0**	**1.0**	**1.0**	**0.1**	**0.01**	**0.01**	**0.02**	**1**	**1.0**
Max Sig figs				**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**4**	**3**
Max decimals				**1**	**0**	**0**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**0**	**1**
Reporting Units				**µg/L**	**µS/cm**	**mv**	**mg/L**	**s.u.**	**°C**	**NTU**	**m**	**mg/L**	**mg/L**	**mg/L**	**ct/mL**	**µg/L**
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**	**Chlorophyll a, Lab (Methanol)**
03/19/19		G	SL 10-00	<1	397	239	10.9	8.1	3.9	1.6	5					
03/19/19	12:15	C	SL 10-PZ									0.03	0.11	0.35	232	2.7
03/19/19	12:30	G	SL 10-70	2.9	420	243	10.6	8	3.8	2.5		0.04	0.07	0.28		
04/02/19		G	SL 10-00	<1	401	263	10.5	8.1	7.3	NT	4					
04/02/19	12:20	C	SL 10-PZ									0.03	0.05	0.25	300	4.1
04/02/19	13:00	G	SL 10-70	4.3	397	263	10.3	7.9	5.5	NT		0.03	0.08	0.27		
04/16/19		G	SL 10-00	<1	410	310	10	8.3	9.3	1.7	4.2					
04/16/19	11:10	C	SL 10-PZ									0.04	0.02	0.29	242	5.4
04/16/19	11:25	G	SL 10-70	5	408	313	9.5	8	7.8	4.3		0.04	0.02	0.25		
05/06/19		G	SL 10-00	<1	413	292	11.6	8.5	13.1	<1	3.9					
05/06/19	11:00	C	SL 10-PZ									0.01	<0.01	0.26	407	7.2
05/06/19	11:15	G	SL 10-70	4.3	406	303	9.7	7.8	9.4	3.7		0.06	0.01	0.24		
05/22/19		G	SL 10-00	1.6	422	288	9	8.4	12	1.5	2.9					
05/22/19	11:45	C	SL 10-PZ									<0.01	<0.01	0.26	325	2.3
05/22/19	12:00	G	SL 10-70	<1	420	308	4.9	7.4	9.7	8.7		0.18	0.02	0.45		
06/04/19		G	SL 10-00	<1	411	343	8.5	8.4	17.7	1.6	3.5					
06/04/19	11:00	C	SL 10-PZ									0.02	0.02	0.39	247	4.8
06/04/19	10:50	G	SL 10-70	<1	424	375	5	7.4	10.1	4.7		0.12	0.02	0.29		
06/17/19		G	SL 10-00	1.8	345	231	8.3	8.4	18.7	1.2	3.3					
06/17/19	11:00	C	SL 10-PZ									<0.01	<0.01	0.2	115	5.6
06/17/19	11:30	G	SL 10-70	2.9	423	281	3.6	7.2	10.4	8		0.08	0.02	0.29		
07/08/19		G	SL 10-00	<1	328	277	8	8.6	22.2	1.1	3.8					
07/08/19	11:00	C	SL 10-PZ									0.01	0.01	0.22	168	4.6
07/08/19	11:15	G	SL 10-70	<1	423	334	1.6	7	11	8		0.14	0.1	0.44		
07/22/19		G	SL 10-00	<1	313	211	7.6	8.6	23.6	<1	3.8					
07/22/19	10:50	C	SL 10-PZ									<0.01	<0.01	0.21	168	4.1
07/22/19	11:00	G	SL 10-70	<1	417	259	< 1	6.9	11.6	9		0.01	0.19	0.38		
07/22/19	13:00	G	69-00													
07/31/19		G	SL 10-00	NT	NT	NT	NT	NT	NT	NT	5.1					
07/31/19		C	SL 10-PZ													
07/31/19		G	SL 10-70									0.02	0.08	0.27		
08/06/19		G	SL 10-00	1	299	240	7.6	8.6	24	<1	5.7					
08/06/19	10:30	C	SL 10-PZ									0.01	0.09	0.28	142	3.7
08/06/19	10:45	G	SL 10-70	<1	407	275	< 1	6.9	12.1	6.2		0.04	0.22	0.42		
08/12/19		G	SL 10-00	<1	290	241	7.5	8.6	23.6	<1	5.4					
08/12/19		C	SL 10-PZ													
08/12/19	11:30	G	SL 10-70									0.06	0.18	0.48		
08/19/19		G	SL 10-00	<1	287	210	8	8.5	23	<1	6.2					
08/19/19	10:20	C	SL 10-PZ									0.03	<0.01	0.27	72	1.5
08/19/19	10:30	G	SL 10-70	<1	400	128	< 1	6.9	12.4	3.7		0.11	0.11	0.43		
09/03/19		G	SL 10-00	<1	284	283	7.4	8.4	22.6	<1	7					
09/03/19	11:45	C	SL 10-PZ									0.02	0.01	0.26	60	1.9
09/03/19	12:00	G	SL 10-70	<1	402	31	< 1	7.1	12.3	3.1		0.2	0.05	0.49		
09/10/19		G	SL 10-00	<1	288	220	7.1	8.2	22.3	<1	5.2					
09/10/19		C	SL 10-PZ													
09/10/19	11:30	G	SL 10-70									0.19	0.02	0.43		
09/16/19		G	SL 10-00	<1	288	324	7.1	8.1	20.9	<1	6.1					
09/16/19	11:00	C	SL 10-PZ									0.01	0.01	0.19	100	2.3
09/16/19	11:15	G	SL 10-70	<1	402	-17	< 1	7	12.5	3.4		0.4	<0.01	0.59		
09/23/19		G	SL 10-00	<1	289	251	6.9	7.8	19.7	<1	NT					
09/23/19		C	SL 10-PZ													
09/23/19	10:15	G	SL 10-70									0.5	<0.01	0.61		
10/01/19		G	SL 10-00	1	289	328	6.9	7.8	18.3	1.3	3.4					
10/01/19	10:30	C	SL 10-PZ									0.02	0.01	0.2	107	2.3

STANDLEY																		
Method	SM5910B	SM7110B	SM7110B	SM7110B	SM7110B	SM4500PE	SM4500PE	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA524.2	EPA524.2	EPA524.2	EPA524.2	EPA200.8
DL	0.001	variable	variable	variable	variable	0.0025	0.0025	0.00015	0.00015	0.00010	0.00010	0.00015	0.00015	0.0005	0.0005	0.0005	0.0005	0.00010
Max Sig figs	3	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3
Max decimals	3	1	1	1	1	4	4	5	5	5	5	4	4	4	4	4	4	5
Reporting Units	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	mg/L	mg/L	mg/L	mg/L
Sample Date	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	BTEX, Ethylbenzene	BTEX, Toluene	BTEX, Xylenes	Cadmium, Dissolved
03/19/19		4	2.4	<3.7	2.3													
03/19/19	0.28	0.5	1.4	4.9	2.4	< 0.005	0.0102	0.00041	0.00044	0.051	0.058	<0.000054	<0.000054					<0.000012
03/19/19	0.297	0.8	1.7	<3.9	2.4	< 0.005	0.0131	0.0005	<0.00006	0.059	0.059	<0.000054	<0.000054					0.00005
04/02/19																		
04/02/19	0.282					0.0063	0.0131											
04/02/19	0.287					0.0061	0.0112											
04/16/19																		
04/16/19	0.277					< 0.005	0.0103											
04/16/19	0.271					< 0.005	0.0115											
05/06/19																		
05/06/19	0.296					< 0.005	0.0092											
05/06/19	0.278					< 0.005	0.0127											
05/22/19																		
05/22/19	0.322					< 0.005	0.0094											
05/22/19	0.289					< 0.005	0.0203											
06/04/19		1.1	1.8	<3.6	2.4													
06/04/19	0.368	1.8	2	<3.9	2.4	< 0.005	0.0099	0.00042	0.00059	0.056	0.056	<0.000054	<0.000054					0.000024
06/04/19	0.289	1.6	1.8	4.5	2.5	< 0.005	0.0158	0.00038	0.00061	0.061	0.063	<0.000054	<0.000054					0.000021
06/17/19																		
06/17/19	0.59					< 0.005	0.0082											
06/17/19	0.451					< 0.005	0.0082											
07/08/19																		
07/08/19	0.577					< 0.0050	0.009											
07/08/19	0.309					< 0.0050	0.0121											
07/22/19																		
07/22/19	0.538					< 0.0050	0.0088											
07/22/19	0.358					< 0.0050	0.0156											
07/22/19														<0.0005	<0.0005	0.00006	<0.0005	
07/31/19																		
07/31/19																		
07/31/19	0.429					< 0.0050	0.0157											
08/06/19																		
08/06/19	0.495					< 0.0050	0.0101											
08/06/19	0.343					< 0.0050	0.0136											
08/12/19																		
08/12/19																		
08/12/19	0.352					< 0.0050	0.0134											
08/19/19																		
08/19/19	0.46					< 0.0050	0.0081											
08/19/19	0.372					< 0.0050	0.0134											
09/03/19		0.7	1.2	<3.8	2.4													
09/03/19	0.433	2.1	1.6	<3.7	2.3	< 0.0050	0.0079	0.00039	0.00046	0.042	0.043	<0.000054	<0.000054					<0.000012
09/03/19	0.471	0.8	1.7	<3.7	2.4	0.0261	0.0563	0.00039	0.00088	0.051	0.051	<0.000054	<0.000054					<0.000012
09/10/19																		
09/10/19																		
09/10/19	0.505					0.0331	0.15											
09/16/19																		
09/16/19	0.411					< 0.0050	0.0079											
09/16/19	0.545					0.101	0.147											
09/23/19																		
09/23/19																		
09/23/19	NT					0.101	0.183											
10/01/19																		
10/01/19	0.399					< 0.005	0.007	0.00048 S	0.00041 S									

STANDLEY																
Method	**EPA200.8**	**SM5310B**	**EPA200.8**	**EPA200.8**	**SM9221D**	**EPA200.8**	**EPA200.8**	**EPA130.2**	**EPA200.7**	**EPA200.7**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA245.1**	**EPA200.8**
DL	**0.00010**	**0.5**	**0.00050**	**0.00050**	**1**	**0.00025**	**0.00025**	**5**	**0.01**	**0.01**	**0.00020**	**0.00020**	**0.00025**	**0.00025**	**0.0002**	**0.00050**
Max Sig figs	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Max decimals	**5**	**1**	**5**	**5**	**0**	**5**	**5**	**0**	**3**	**3**	**5**	**5**	**5**	**5**	**5**	**5**
Reporting Units	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**cfu/100mL**	**mg/L**	**mg/L**	**mg/L as CaCO3**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Sample Date	**Cadmium, Total**	**Carbon, Total Organic**	**Chromium, Dissolved**	**Chromium, Total**	**E. coli**	**Copper, Dissolved**	**Copper, Total**	**Hardness, Total**	**Iron, Dissolved**	**Iron, Total**	**Lead, Dissolved**	**Lead, Total**	**Manganese, Dissolved**	**Manganese, Total**	**Mercury, Total**	**Molybdenum, Dissolved**
03/19/19					<1											
03/19/19	0.000014	2	<0.000088	<0.000088		0.0014	0.0015	142	<0.0026	0.032	<0.000038	0.00024	0.0074	0.023	<0.000042	0.0025
03/19/19	0.000027	2	<0.000088	<0.000088	5	0.0012	0.0017	136	<0.0026	0.089	<0.000038	0.00046	0.01	0.033	<0.000042	0.0028
04/02/19					1											
04/02/19		2.1														
04/02/19		2.1			5											
04/16/19																
04/16/19																
04/16/19																
05/06/19					<1											
05/06/19		2.5														
05/06/19		2.3			1											
05/22/19																
05/22/19																
05/22/19																
06/04/19					<1											
06/04/19	0.000043	2.4	<0.000088	0.00013		0.0013	0.0018	156	0.0028	0.084	<0.000038	0.00033	0.00054	0.014	<0.000042	0.0027
06/04/19	0.000026	1.9	<0.000088	0.0001	1	0.00087	0.0016	154	<0.0026	0.16	<0.000038	0.00049	0.18	0.28	<0.000042	0.0026
06/17/19																
06/17/19																
06/17/19																
07/08/19					1											
07/08/19		3														
07/08/19		2			2											
07/22/19																
07/22/19																
07/22/19																
07/22/19																
07/31/19																
07/31/19																
07/31/19														0.1		
08/06/19					<1											
08/06/19		2.8														
08/06/19		2			26								0.0034	0.31		
08/12/19																
08/12/19																
08/12/19														0.51		
08/19/19																
08/19/19																
08/19/19														0.79		
09/03/19					5											
09/03/19	0.000021	2.4	<0.000088	<0.000088		0.0012	0.0017	112	<0.0026	0.086	<0.000038	0.0003	0.015	0.042	NT	0.0026
09/03/19	0.000021	2.3	<0.000088	<0.000088	41	0.00041	0.00088	140	0.0075	0.43	<0.000038	0.00027	0.84	0.9	NT	0.0034 S
09/10/19																
09/10/19																
09/10/19													0.71	0.75		
09/16/19																
09/16/19																
09/16/19													1.2	1.2		
09/23/19																
09/23/19																
09/23/19													1.5 S	1.3 S		
10/01/19					24											
10/01/19		2.6														

STANDLEY																	
Method	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	SM2540D	EPA200.8	EPA200.8	EPA200.7	EPA 300.0	
DL	0.00050	0.005	0.005	0.00050	0.00050	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	1	0.0025	0.0025	0.050	0.5	
Max Sig figs	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Max decimals	5	4	4	5	5	5	5	5	5	5	5	0	4	4	2	1	
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	Molybdenum, Total	Nickel, Dissolved	Nickel, Total	Selenium, Dissolved	Selenium, Total	Silver, Dissolved	Silver, Total	Strontium, Dissolved	Strontium, Total	Vanadium, Dissolved	Vanadium, Total	Solids, Total Suspended	Zinc, Dissolved	Zinc, Total	Silicon, Dissolved	Chloride	Notes
03/19/19																	
03/19/19	0.0027	0.00089	0.0011	0.00028	0.00019	<0.000014	<0.000014	0.23	0.24	0.0003	0.0003	4	0.011	0.012	0.87		
03/19/19	0.0029	0.0016	0.019	0.00053 S	0.00042 S	<0.000014	<0.000014	0.22	0.25	0.00028	0.00036	7	0.014	0.017	1.1		
04/02/19																	
04/02/19												5			0.78		
04/02/19												7			0.8	42	
04/16/19																	
04/16/19															0.55		
04/16/19															0.59	46	
05/06/19																	
05/06/19												7			0.36		
05/06/19												3			0.052	250	
05/22/19																	
05/22/19															0.094		
05/22/19															0.65	47	
06/04/19																	
06/04/19	0.0026	0.00081	0.0011	0.00043	0.00045	<0.000014	<0.000014	0.22	0.25	0.00035	0.00047	4	0.0057	0.0098	0.28		
06/04/19	0.0028	0.0011	0.0012	0.00038	0.00031	0.00002	<0.000014	0.22	0.25	0.00027	0.00045	6	0.0086	0.012	0.54	48	
06/17/19																	
06/17/19															0.92		
06/17/19															0.75	44	
07/08/19																	
07/08/19												10			0.47		
07/08/19												11			0.75	NT	
07/22/19																	
07/22/19															0.21		
07/22/19															0.95	NT	
07/22/19																	
07/31/19																	Lake Lite
07/31/19																	Lake Lite
07/31/19																	Lake Lite
08/06/19																	
08/06/19												3			0.48		
08/06/19												6			1.2	NT	
08/12/19																	Lake Lite
08/12/19																	Lake Lite
08/12/19																	Lake Lite
08/19/19																	
08/19/19															0.65		
08/19/19															1.4	46	
09/03/19																	
09/03/19	0.0026	0.0007	0.00075	0.0002 S	<0.00015 S	<0.000014	<0.000014	0.17	0.17	0.00038	0.00075	4	0.00062	0.0095	0.8		
09/03/19	0.003 S	0.00098	0.001	<0.00015	0.00015	<0.000014	<0.000014	0.21	0.23	0.0001	0.00046	4	0.0087	0.014	1.6	NT	
09/10/19																	Lake Lite
09/10/19																	Lake Lite
09/10/19																	Lake Lite
09/16/19																	
09/16/19															0.77		
09/16/19															1.9	44	
09/23/19																	Lake Lite
09/23/19																	Lake Lite
09/23/19																	Lake Lite
10/01/19																	
10/01/19												1			2		

STANDLEY

Method			
DL			
Max Sig figs			
Max decimals			
Reporting Units			
Sample Date	**Conclusion**	**Field Notes**	**Lab Notes**
03/19/19			
03/19/19			
03/19/19			
04/02/19			
04/02/19			
04/02/19			Chloride analyzed by EEA
04/16/19			
04/16/19			
04/16/19			Chloride analyzed by EEA
05/06/19			
05/06/19			
05/06/19			Chloride analyzed by EEA
05/22/19			
05/22/19			
05/22/19			Chloride analyzed by EEA
06/04/19			
06/04/19			
06/04/19			
06/17/19			
06/17/19			
06/17/19			Chloride analyzed by EEA
07/08/19			
07/08/19			
07/08/19			Chloride analyzed by EEA
07/22/19			
07/22/19			
07/22/19			Chloride analyzed by EEA
07/22/19			
07/31/19			
07/31/19			
07/31/19			
08/06/19			
08/06/19			
08/06/19			Chloride analyzed by EEA
08/12/19			
08/12/19			
08/12/19			
08/19/19			
08/19/19			
08/19/19			Chloride analyzed by EEA
09/03/19			
09/03/19			
09/03/19			
09/10/19			
09/10/19			
09/10/19			
09/16/19			
09/16/19			
09/16/19			Chloride analyzed by EEA
09/23/19			
09/23/19			
09/23/19			
10/01/19			
10/01/19			

STANDLEY LAKE																
Method				electrode	SM2510B	electrode	SM4500OG	SM4500H+B	SM2550B	SM2130B	Secchi Disk	SM4500NH3H	SM4500NO3I	SM4500NO3I	FlowCAM	SM10200H
DL				1.0	10	1	1.0	1.0	1.0	1.0	0.1	0.01	0.01	0.02	1	1.0
Max Sig figs				3	3	3	3	3	3	3	3	3	3	3	4	3
Max decimals				1	0	0	1	1	1	1	2	2	2	2	0	1
Reporting Units				µg/L	µS/cm	mv	mg/L	s.u.	°C	NTU	m	mg/L	mg/L	mg/L	ct/mL	µg/L
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	Chlorophyll a, Lab (Methanol)
10/01/19	10:45	G	SL 10-70	<1	392	-100	< 1	7	12.8	4.6		0.39	0.1	0.69		
10/08/19		G	SL 10-00	1.4	289	318	7.1	7.8	16.6	1.8	3.2					
10/08/19		C	SL 10-PZ													
10/08/19	10:30	G	SL 10-70									0.47	0.03	0.69		
10/14/19		G	SL 10-00	1.3	296	214	7.3	7.8	14.6	1.3	3.4					
10/14/19	10:40	C	SL 10-PZ									0.03	<0.01	0.25	112	3.1
10/14/19	10:50	G	SL 10-70	<1	381	-30	< 1	7.2	13	4.3		0.36	<0.01	0.64		
11/05/19		G	SL 10-00	1.2	304	278	9.2	7.9	8.2	2.1	2.3					
11/05/19	11:00	C	SL 10-PZ									0.02	0.01	0.24	443	6
11/05/19	11:15	G	SL 10-70	7.9	304	293	9.1	7.9	7.8	2.6		0.02	0.01	0.23		
12/02/19		G	SL 10-00	1.2	312	202	10.1	7.9	4.5	1.8	4.1					
12/02/19	13:25	C	SL 10-PZ									0.04	<0.01	0.28	115	1.9
12/02/19	13:40	G	SL 10-70	1.7	313	215	9.8	7.9	4.2	2.3		0.03	<0.01	0.18		

STANDLEY																		
Method	**SM5910B**	**SM7110B**	**SM7110B**	**SM7110B**	**SM7110B**	**SM4500PE**	**SM4500PE**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA524.2**	**EPA524.2**	**EPA524.2**	**EPA524.2**	**EPA200.8**
DL	**0.001**	**variable**	**variable**	**variable**	**variable**	**0.0025**	**0.0025**	**0.00015**	**0.00015**	**0.00010**	**0.00010**	**0.00015**	**0.00015**	**0.0005**	**0.0005**	**0.0005**	**0.0005**	**0.00010**
Max Sig figs	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Max decimals	**3**	**1**	**1**	**1**	**1**	**4**	**4**	**5**	**5**	**5**	**5**	**4**	**4**	**4**	**4**	**4**	**4**	**5**
Reporting Units	**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**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Sample Date	**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**	**BTEX, Ethylbenzene**	**BTEX, Toluene**	**BTEX, Xylenes**	**Cadmium, Dissolved**
10/01/19	0.619					0.0738	0.136	0.0008	0.0013									
10/08/19																		
10/08/19																		
10/08/19	0.601					0.0718	0.158											
10/14/19																		
10/14/19	0.394					< 0.005	0.0129	0.00063 S	0.00044 S	0.043	0.042	<0.000054	<0.000054					<0.000012
10/14/19	0.528					0.0414	0.106	0.00097 S	0.0009 S	0.05	0.063	<0.000054	<0.000054					<0.000012
11/05/19																		
11/05/19	0.378					< 0.005	0.01											
11/05/19	0.373					< 0.005	0.0081											
12/02/19		0.9	2	<4.1	2.3													
12/02/19	0.361	1.1	1.8	<4.1	2.4	< 0.005	0.0079	0.00033	0.00038	0.046	0.049	<0.000054	<0.000054					<0.000012
12/02/19	0.363	2.1	1.6	<3.9	2.4	< 0.005	0.0051	0.00039	0.00013	0.046	0.049	<0.000054	<0.000054					<0.000012

STANDLEY																
Method	**EPA200.8**	**SM5310B**	**EPA200.8**	**EPA200.8**	**SM9221D**	**EPA200.8**	**EPA200.8**	**EPA130.2**	**EPA200.7**	**EPA200.7**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA200.8**	**EPA245.1**	**EPA200.8**
DL	**0.00010**	**0.5**	**0.00050**	**0.00050**	**1**	**0.00025**	**0.00025**	**5**	**0.01**	**0.01**	**0.00020**	**0.00020**	**0.00025**	**0.00025**	**0.0002**	**0.00050**
Max Sig figs	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Max decimals	**5**	**1**	**5**	**5**	**0**	**5**	**5**	**0**	**3**	**3**	**5**	**5**	**5**	**5**	**5**	**5**
Reporting Units	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**cfu/100mL**	**mg/L**	**mg/L**	**mg/L as CaCO3**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Sample Date	**Cadmium, Total**	**Carbon, Total Organic**	**Chromium, Dissolved**	**Chromium, Total**	**E. coli**	**Copper, Dissolved**	**Copper, Total**	**Hardness, Total**	**Iron, Dissolved**	**Iron, Total**	**Lead, Dissolved**	**Lead, Total**	**Manganese, Dissolved**	**Manganese, Total**	**Mercury, Total**	**Molybdenum, Dissolved**
10/01/19		2.6			85								1.1	1.1		
10/08/19																
10/08/19																
10/08/19													1.2	1.3		
10/14/19																
10/14/19	<0.000012		<0.000088	0.00017		0.0013 S	0.0011 S	97	0.0041	0.094	0.000072	0.00026	0.00029	0.051	<0.000042	0.00025
10/14/19	<0.000012		<0.000088	0.00015		0.0004	0.00066	NT	0.0064	0.62	<0.000038	0.00035	0.91	1	<0.000042	0.0029
11/05/19																
11/05/19																
11/05/19																
12/02/19					16											
12/02/19	<0.000012	2.3	<0.000088	<0.000088		0.00089	0.00088	124	0.0059	0.08	0.000045	0.000059	0.0054	0.012	<0.000042	0.0026
12/02/19	<0.000012	2.2	0.00041	<0.000088	10	0.00082	0.0009	124	0.0079	0.088	0.000043	0.000091	0.0042	0.012	<0.000042	0.0025

STANDLEY																	
Method	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	EPA200.8	SM2540D	EPA200.8	EPA200.8	EPA200.7	EPA 300.0	
DL	0.00050	0.005	0.005	0.00050	0.00050	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	1	0.0025	0.0025	0.050	0.5	
Max Sig figs	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Max decimals	5	4	4	5	5	5	5	5	5	5	5	0	4	4	2	1	
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	Molybdenum, Total	Nickel, Dissolved	Nickel, Total	Selenium, Dissolved	Selenium, Total	Silver, Dissolved	Silver, Total	Strontium, Dissolved	Strontium, Total	Vanadium, Dissolved	Vanadium, Total	Solids, Total Suspended	Zinc, Dissolved	Zinc, Total	Silicon, Dissolved	Chloride	Notes
10/01/19												3			4.5	45	
10/08/19																	Lake Lite
10/08/19																	Lake Lite
10/08/19																	Lake Lite
10/14/19																	
10/14/19	0.00024	0.00074 S	<0.00032 S	0.00052 S	0.00018 S	0.00004 S	<0.000014 S	0.17	0.18	0.00046 S	0.00024 S		0.0076 S	0.0067 S	1.1		
10/14/19	0.0028	0.00096 S	0.00087 S	0.00041 S	<0.00015	0.000018 S	<0.000014	0.2	0.22	0.00042	0.00043		0.0058	0.014	2.1	41	
11/05/19																	
11/05/19												4			0.92		
11/05/19												4			0.91	32	
12/02/19																	
12/02/19	0.0025	0.00087	0.00082	0.00026	<0.00015	<0.000014	<0.000014	0.18	0.19	0.00035	0.000075	3	0.0065	0.01	0.64		
12/02/19	0.0024	0.00083	0.00063	0.00022	<0.00015	<0.000014	0.00022	0.2	0.19	0.00038	0.000045	9	0.0068	0.0097	0.68	NT	

STANDLEY			
Method			
DL			
Max Sig figs			
Max decimals			
Reporting Units			
Sample Date	**Conclusion**	**Field Notes**	**Lab Notes**
10/01/19			Chloride analyzed by EEA
10/08/19			
10/08/19			
10/08/19			
10/14/19			
10/14/19			
10/14/19			
11/05/19			
11/05/19			
11/05/19			
12/02/19			
12/02/19			
12/02/19			