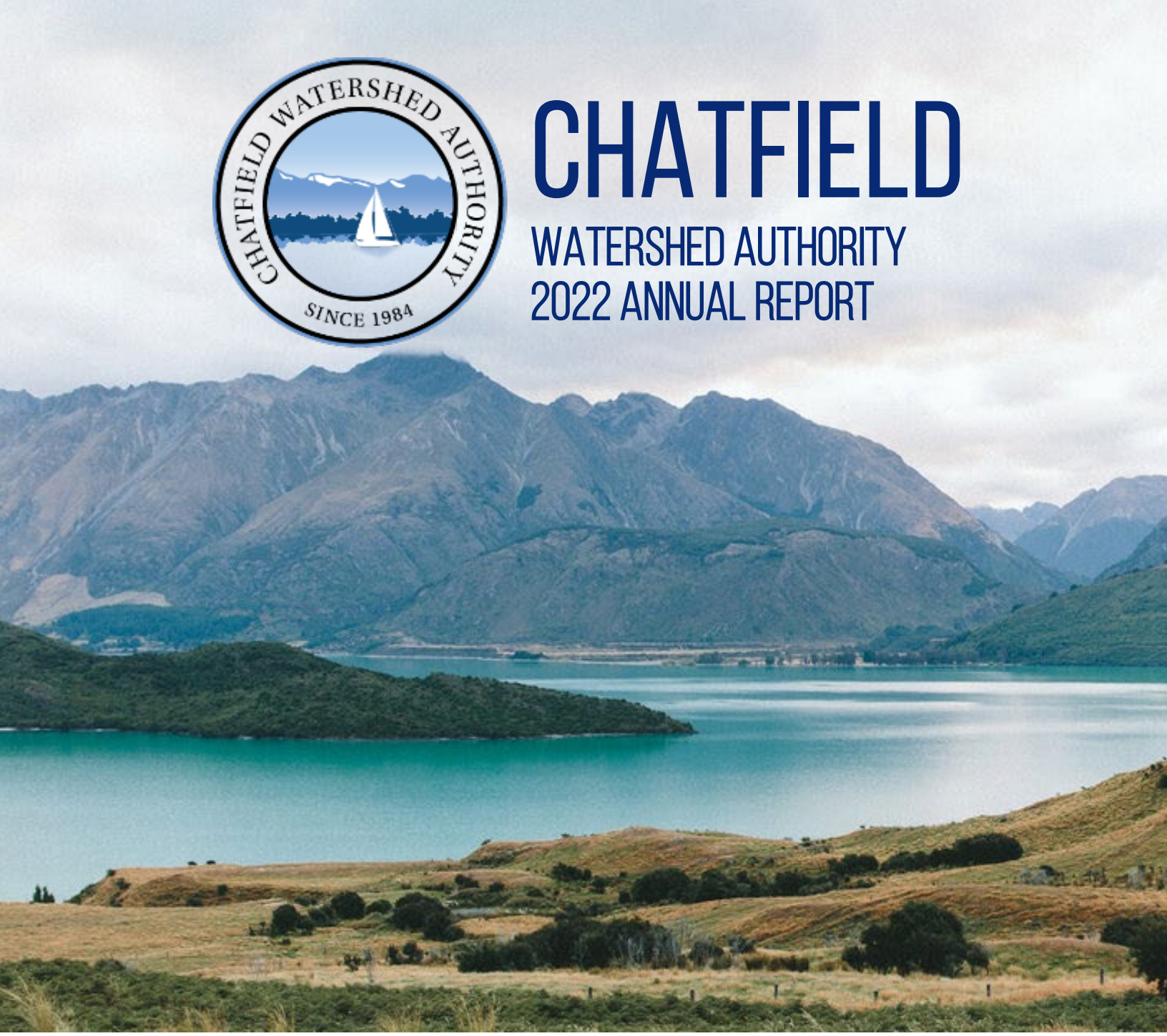
CHATFIELD

WATERSHED AUTHORITY
2022 ANNUAL REPORT



The Chatfield Watershed Authority promotes protection of water quality in the Chatfield Watershed for drinking water supplies, recreation, fisheries, and other beneficial uses.

DRAFT – APRIL 17, 2023

We Protect the Water You Enjoy

www.chatfieldwatershedauthority.org

The **2022 Annual Report** is the annual water quality summary and status report presented by the Chatfield Watershed Authority to communicate the water quality of Chatfield Reservoir and its watershed, highlighting information required by the Colorado Water Quality Control Commission in Control Regulation #73.

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Chatfield Watershed Authority

May 15, 2023

Water Quality Control Commission
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246

Dear Commissioners:

The Chatfield Watershed Authority (CWA or Authority) is pleased to submit this 2022 Annual Report to the Water Quality Control Commission (WQCC) in accordance with the reporting requirements of the Chatfield Reservoir Control Regulations, Regulation #73. 2022 has certainly been a different year, not only due to the continued impacts of Covid 19, but also due to the continued dry climate conditions occurring in the summer and fall of 2022. Chatfield Reservoir was in compliance with Regulation 38 (WQCC CCR 1002-38) TP and chlorophyll-α standards for the 2022 monitoring period.

The Authority has been busy in 2022 as is evidenced by the activities reported in this annual report. These activities included the continued use of the Chatfield watershed model to further evaluate the impact on water quality of the existing and full use of existing wastewater treatment facility's wastewater allocations and the continued efforts of our members to promote water quality education and control of water quality from construction activities through their stormwater criteria and MS4 permitting activities. The Authority continues to participate in the West Plum Creek Stream Management Plan and in the Colorado School of Mines' annual water quality field session in the Chatfield watershed. Last, the Board approved a 20% increase in the voluntary dues paid by its member entities for 2022 and beyond to address the continued rising costs of the Authority's ongoing operations while continuing to fund and promote activities and non-point source projects that improve water quality in the Chatfield watershed and Reservoir. We hope you enjoy reading our report and look forward to presenting this report at a future WQCC meeting.

Sincerely,

Lora L. Thomas
2022 Chatfield Watershed Authority Board Chair

CHATFIELD WATERSHED AUTHORITY

The Chatfield Watershed Authority (CWA or the Authority) was established in 1984 when the Governor of Colorado designated the Authority as the 208 Management Agency, in accordance with the Federal Clean Water Act. The Authority purpose is to preserve the beneficial uses in Chatfield Reservoir and Watershed through the promotion of point source, nonpoint source, and stormwater controls that reduce phosphorus and chlorophyll.

The Authority continues to implement Colorado Water Quality Control Commission (WQCC) Chatfield Reservoir Control Regulation (Code of Colorado Regulations No. 73 , 5 CCR 1002-73); and coordinating with state and federal agencies regarding water quality control measures.

The Authority is comprised of stakeholders (members) within the 400 square mile watershed and is comprised of the Plum Creek basin and portions of the South Platte River basin (from the outfall of Strontia Springs Reservoir to Chatfield Reservoir, including the Massey Draw and Deer Creek sub-basins). The members develop and implement projects to protect the watershed, reservoir health and water quality. Opportunities exist within the watershed to address the chemical, physical and biological constituents (pollutants) that impact the watershed and reservoir. Some examples of this include phosphorus removal in wastewater treatment, stabilizing degraded streambanks, mitigating runoff from agricultural lands, minimizing leachate from septic systems, controlling runoff from wildfire burn areas, and providing public education for reducing contamination from the actions of people.

The Authority members' jurisdictions and service area boundaries as well as the Chatfield watershed boundary are shown on Figure 1. The five-member Board of Directors (Board) is comprised of three elected officials representing Douglas County, Jefferson County, and the Town of Castle Rock; one wastewater district representative; and one representative for other members. The Board continues to implement the Chatfield Reservoir Control Regulation and meets regularly to address policy and fiscal issues.

2022 BOARD MEMBERS

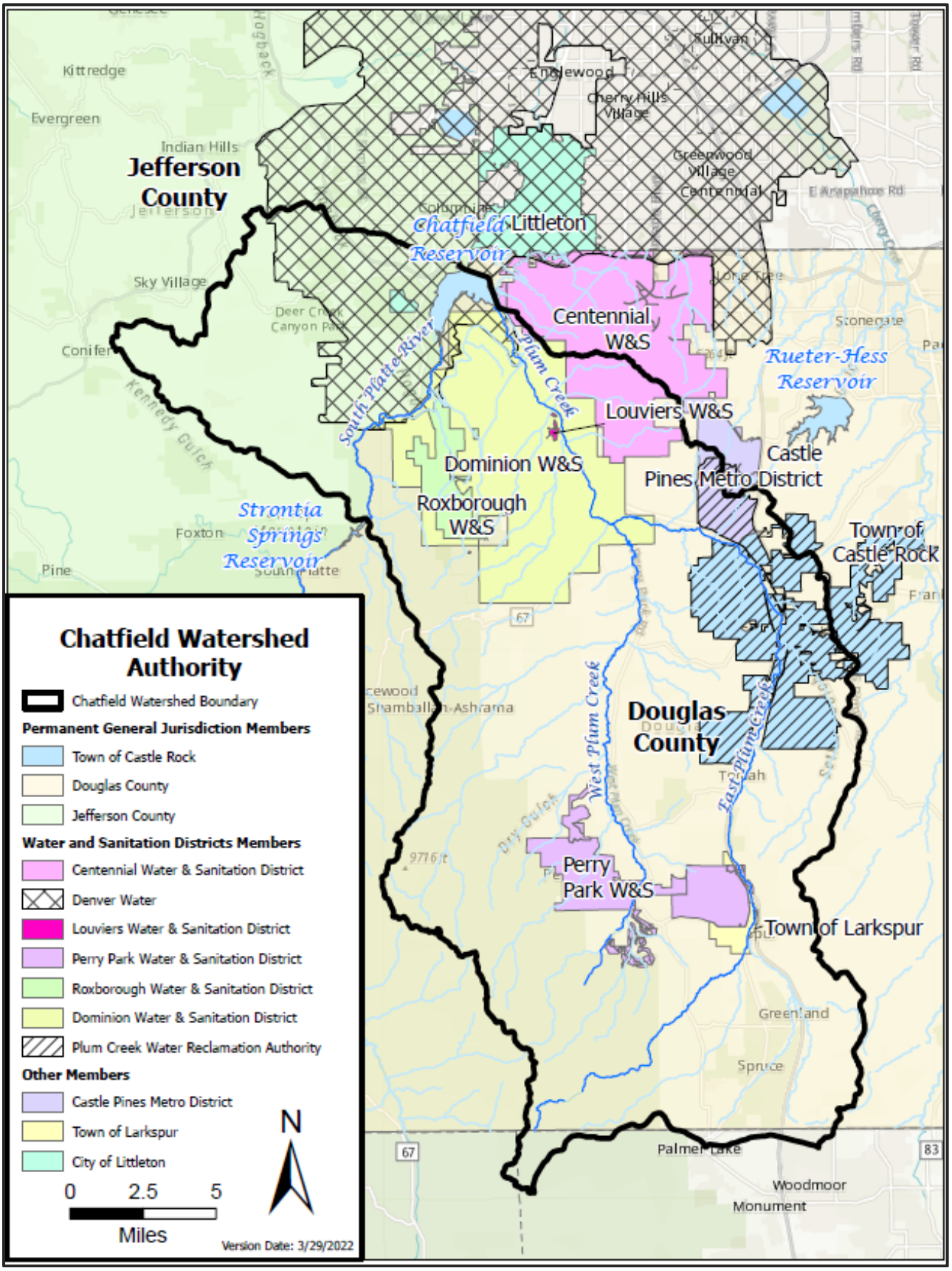
Board Chair: Lora L. Thomas, Douglas County Commissioner
Board Vice-Chair: Laura Cavey, Town of Castle Rock
Board Director: Lesley Dahlkemper, Jefferson County Commissioner
Board Director of Water and Sanitation Members: Barbara Biggs, Roxborough Water & Sanitation District Manager
Board Director of Other Members: Alison Witheridge, Denver Water

The Technical Advisory Committee (TAC) is a standing committee that meets monthly to address technical and scientific matters, serving the needs of the Board. Other standing committees are formed, as necessary, to address specific issues at the Board's request.

2022 TECHNICAL ADVISORY COMMITTEE REPRESENTATIVES

Jefferson County: Representative, Patrick O'Connell
Dominion Water & Sanitation District: Representative, Bob Neal
Castle Pines Metropolitan District: Representative, Gina Burke
Centennial Water & Sanitation District: Representative, Julie Tinetti
City of Littleton: Representative, Carolyn Roan
Denver Water: Representative, Alison Witheridge
Douglas County: Representative, Ryan Adrian
Louviers Water & Sanitation District: Representative, Matt Collitt
Roxborough Water & Sanitation District: Representative, Barbara Biggs
Plum Creek Water Reclamation Authority: Representative, Weston Martin
Perry Park Water & Sanitation District: Representative, Diana Miller
Town of Castle Rock: Representative, Dave Van Dellen
Town of Larkspur: Representative, Sean Hogan

Figure 1. Chatfield Watershed Authority Watershed Boundary and Member Entities.



RESERVOIR REGULATORY COMPLIANCE

Chlorophyll-a

In 2022 Chatfield Reservoir maintained compliance with the Code of Colorado Regulations No. 38 (5 CCR 1002-38) chlorophyll-a (chl-α) standard. The Chatfield Reservoir chl-α standard is 10 µg/L, with a one in five-year allowable exceedance frequency. The WQCC adopted a chl-α assessment threshold of 11.2 µg/L to determine compliance with the standard. The chl-α standard is the growing season (July through September) average. In 2022, the chl-α average was 4.4 µg/L, below both the standard and the assessment threshold. Given the allowable exceedance frequency for chl-α , the Chatfield Reservoir is in compliance with the chl-α standard (Figure 2). Observed 2022 chl-α concentrations in Chatfield Reservoir are depicted in Figure 3.

Figure 2.Growing Season Average Chlorophyll α Concentrations, Chatfield Reservoir, 1983-2022.

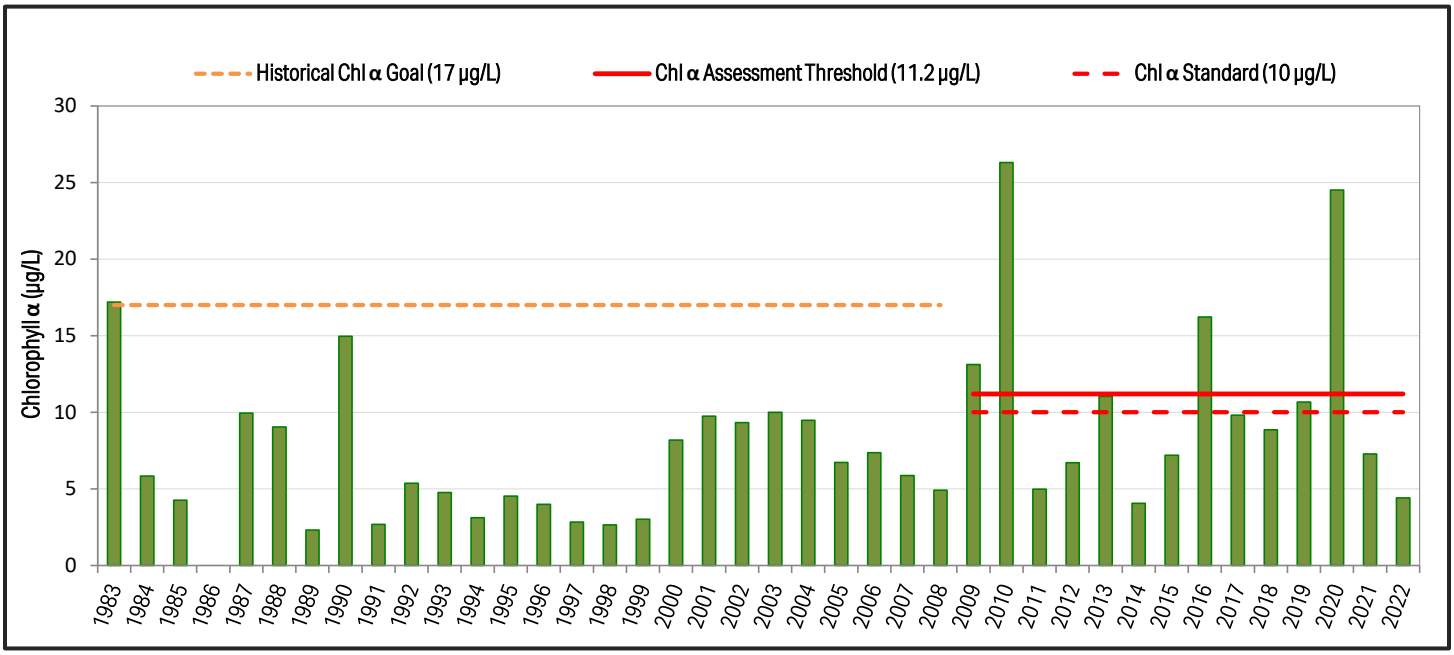
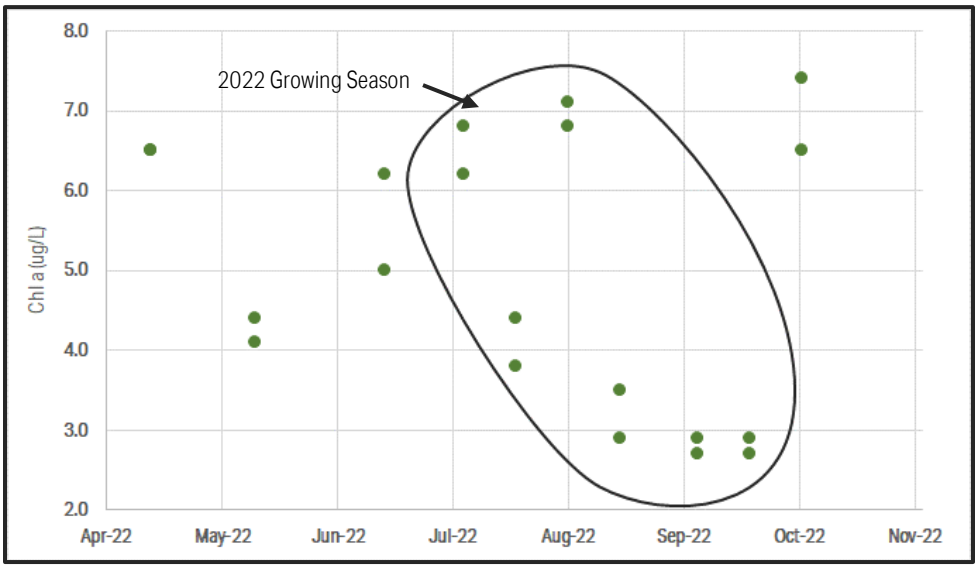
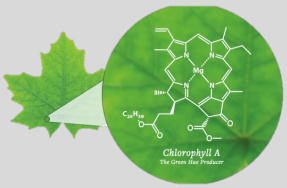


Figure 3. Observed Chlorophyll α Concentrations, Chatfield Reservoir, 2022.



The July-September growing season chlorophyll-α average in 2022 was 4.4 µg/L, below the assessment threshold of 11.2 µg/. In 2022, the Chatfield Reservoir was in compliance with the chlorophyll-α water quality standard.



The chl-α concentrations observed result from background, point source and nonpoint sources of nutrients and internal loading. Cyanobacteria, also known as Cyanophyta or blue-green algae, are type of phytoplankton that can product toxins that can harm people, animals, and aquatic ecosystems. Intensified Cyanophyta growth due to certain environmental conditions, including light availability, water temperatures, and nutrient loading, is referred to as a Harmful Algal Bloom (HAB). Although there is currently no standard or assessment threshold for Cyanophyta, a goal of the Authority is to limit conditions that could result in an HAB. Some species of cyanobacteria convert nitrogen gas to biologically available forms of nitrogen, serving as an additional source of nitrogen to reservoir systems. No HABs were reported in 2021.

In 2021, Cyanophyta concentrations ranged from 2,143 to 98,364 algal cells/ml which are slightly lower than the Cyanophyta levels in 2020 which ranged from 229 to 153,079 algal cells/ml. The highest concentrations of Cyanophyta occurred in September, averaging 94,340 algal cells/mL **(Figure 4**).

A 2021 water quality study by Hydros Consulting showed elevated chl-α concentrations in 2020 were partially driven by higher dinoflagellate (Pyrrhophyta) concentrations. However, in 2021, Cyanophyta were the predominant algae observed in most of the April - October sampling events, with the exception of Bacillariophyta, which were higher than the Cyanophyta in April and May (**Figure 5**).

Figure 4. 2021 Phytoplankton Monthly Summary

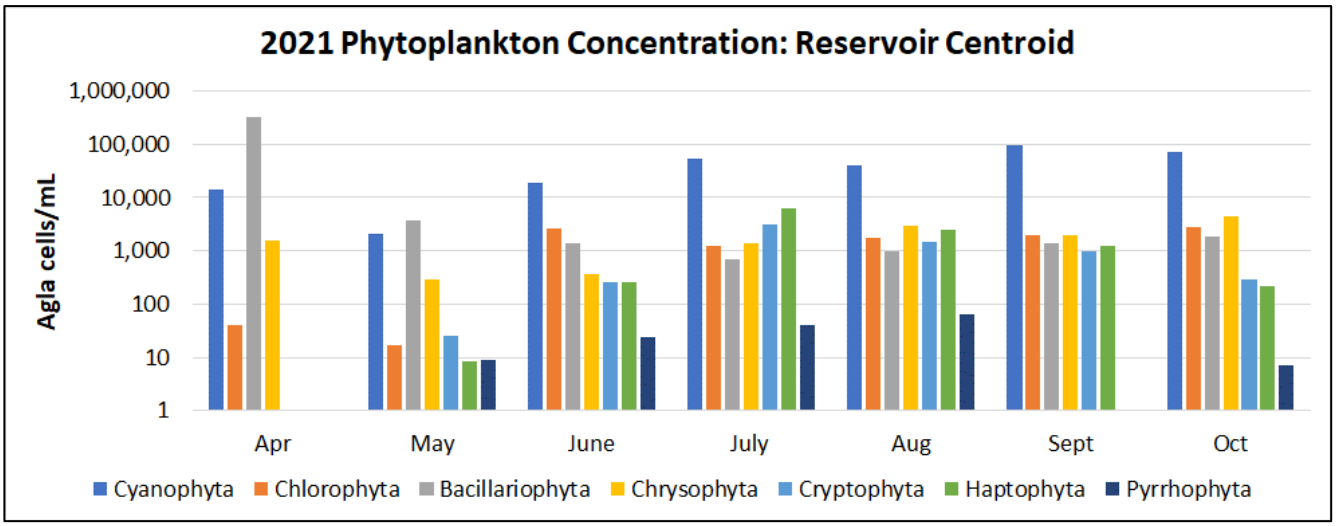
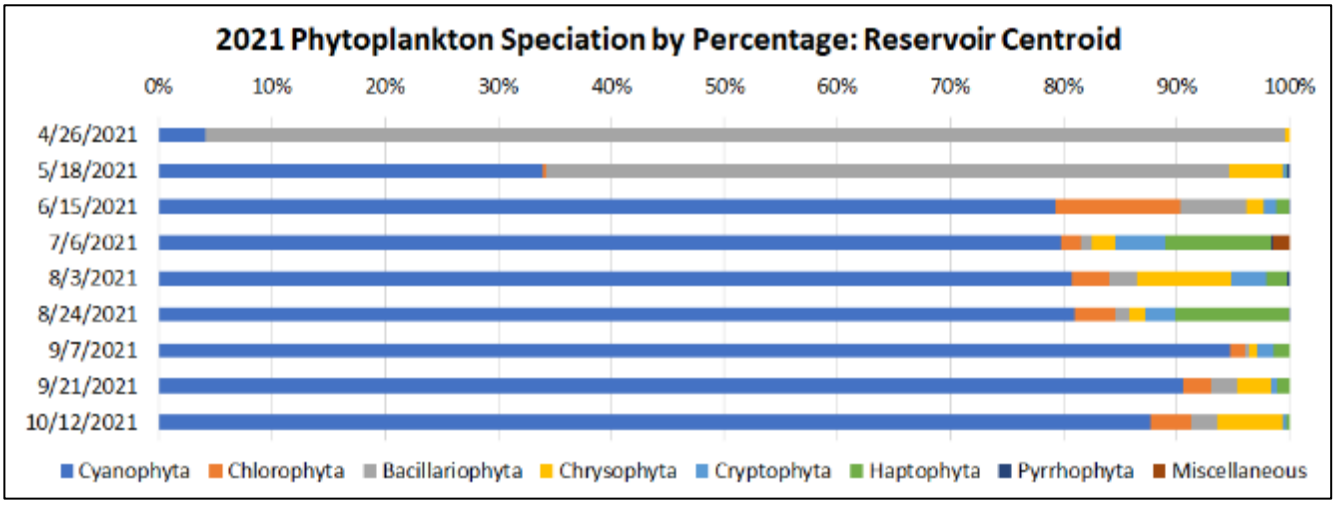


Figure 5. 2021 Phytoplankton samples taken in the reservoir during 9 sampling events from April through October 2021.



Total Phosphorus

In 2022 Chatfield Reservoir maintained compliance with the 5 CCR 1002-38 total phosphorus standard. The total phosphorus (TP) growing season (July through September) average was 17.2 µg/L, which is below the standard of 30 µg/L and below the assessment threshold of 35 µg/L. A review of TP compliance with the water quality standard from 1983 to 2022 is illustrated in **Figure 6**. The TP growing season average remained below the water quality assessment threshold of 35 µg/L, except for the 2020 concentration, since the standard changed in 2009. The monthly TP concentrations observed in 2022 in Chatfield Reservoir are shown in **Figure 7**.

Figure 6. Growing Season Average Total Phosphorus Concentrations, Chatfield Reservoir, 1983-2022.

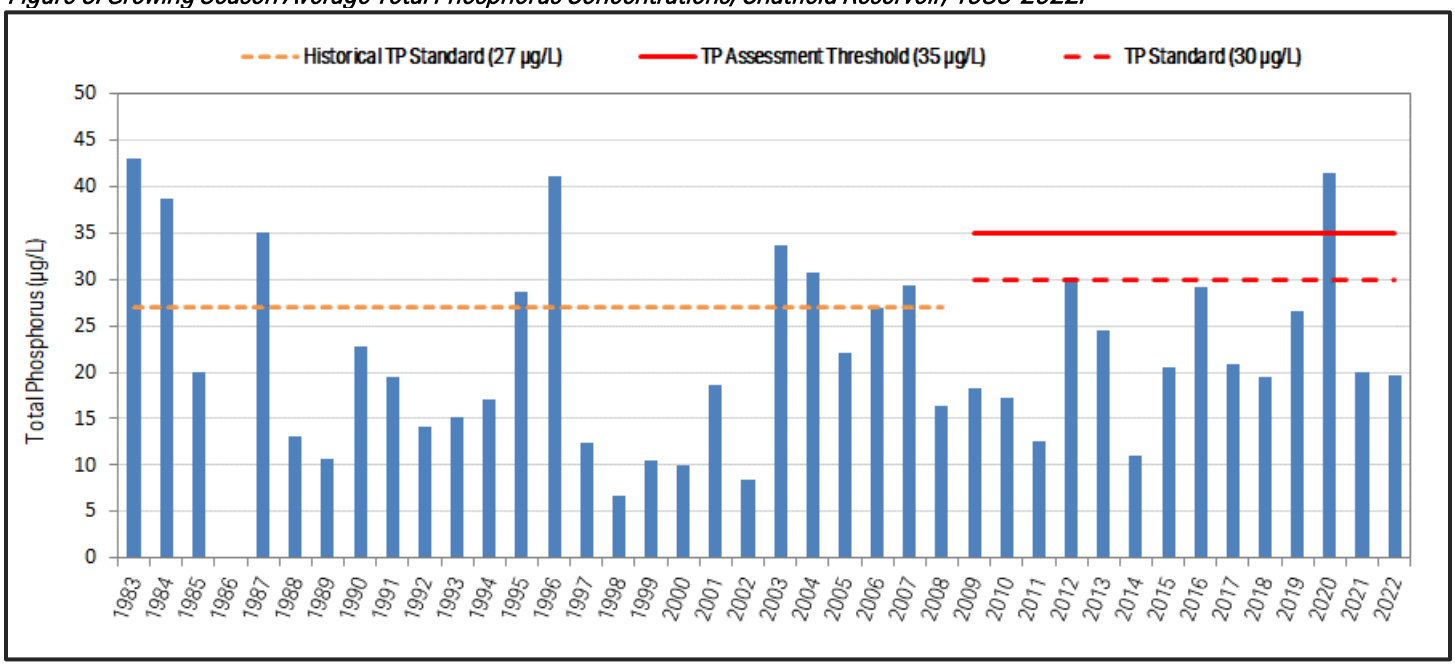
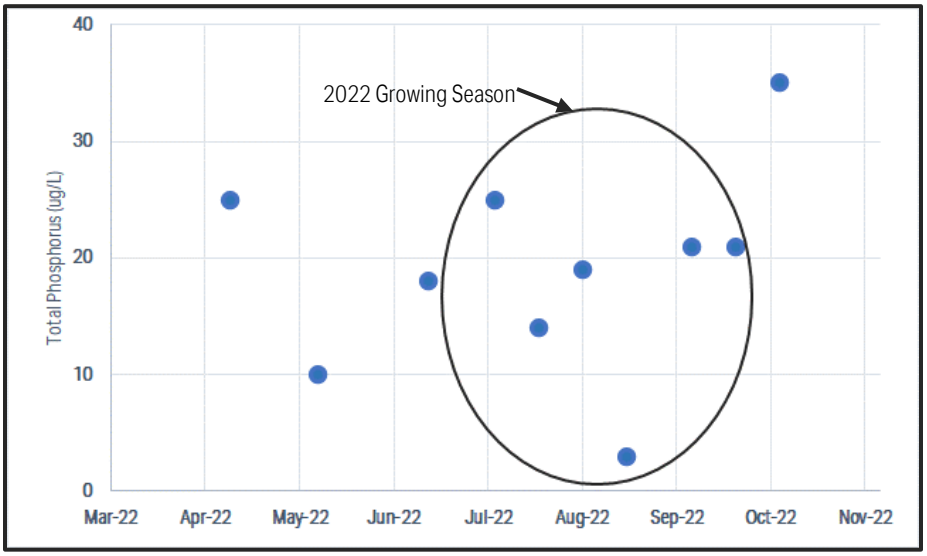
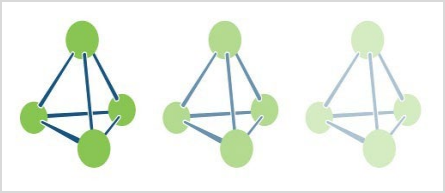


Figure 7. Monthly Total Phosphorus Concentrations, Chatfield Reservoir, 2022.



The July-September growing season TP average in 2022 was 17.2 µg/L, below the assessment threshold of 35 µg/L. In 2022, Chatfield Reservoir was in compliance with the TP water quality standard.



CHATFIELD RESERVIOR TMAL

The phosphorus Total Maximum Annual Load (TMAL) of 19,600 pounds/year at a median flow of 100,860 acre-feet/year was revised by the WQCC in 2009, based on statewide reservoir data and a probabilistic model describing the linkage between watershed TP loads and in-lake TP concentrations.

The Authority completed the development and calibration of an initial watershed model in 2016. In 2019, plans were developed for additional model runs in 2020 through 2022 to model the effects of possible improvements and other possible events in the watershed. These initial model runs started in late 2019 and continued into 2022.

The Authority continues to collect water quality data (over 20 years of monitoring) and since 2016 has collaborated with the Chatfield Reservoir Mitigation Company (CRMC) on data collection efforts pursuant to the Memorandum of Understanding between the two agencies.

The Authority continues to coordinate with the CRMC regarding Chatfield Reservoir data collection (required as part of the water quality adaptive management program). The Authority served on the Chatfield Reservoir Model Coordination Committee (RMCC), which was tasked with overseeing the development of a two-dimensional, hydrodynamic water quality model for the reservoir. Development of a model was funded by the CRMC as part of the Chatfield Storage Reallocation Project (CSRP). The independently peer-reviewed model has been calibrated for the period of 2013 through 2016. In 2018, sensitivity analysis runs were completed. The Chatfield Reservoir Water-Quality Model Documentation Report was completed by Hydros in December 2018. Future tasks will include ongoing annual model updates (with more recent data) and predictive runs to support the Chatfield Reallocation project management. Potential impacts from the Chatfield Reallocation Project, if any, will be evaluated on a yearly basis.

2022 TP Concentrations – Instream and Reservoir

Average monthly TP concentrations for 2022 at the Chatfield Reservoir Centroid, Chatfield Reservoir Outflow, Plum Creek Inflow, and South Platte Inflow are depicted in **Figure 8.** Refer to **Figure 12** for these sampling locations. Plum Creek TP concentrations were highest for all months of the year in comparison to South Platte Inflows.

Calculated TP load

The calculated annual TP load is the sum of the average monthly loads. The 2022 annual TP load to the reservoir totaled 6,548 pounds at an inflow of 66,038 acre-feet. This is compared to the TMAL of 19,600 pounds at an inflow of 100,860 acre-feet. **Figure 9** shows the calculated annual TP loads to Chatfield Reservoir from 1986 to 2022. **Figure 10** shows the Chatfield Reservoir calculated annual inflows from 1986 to 2022. A comparison of the 2022 inflows and TP load contributions per source is presented in **Figure 11**.

The relative TP loading from sources is lower than typical compared to historic TP inputs. In 2022, TP loading from Plum Creek was 2,749 pounds, or 42% of total input, compared to 3,139 pounds from the South Platte River, or 48% of total input. Direct precipitation on Chatfield Reservoir, alluvial inflows, and other direct flow sources contributed approximately 660 pounds, or 10% of total input.

Because of the unusually dry conditions in July 2023 (average monthly flow of 0.07 cfs) and September 2023 (average monthly flow of 0.57cfs) in Plum Creek, no phosphorus samplers were collected for the Plum Creek Inflow to Chatfield Reservoir. Historically, the 2019-2021 average phosphorus concentration in Plum Creek was 99.1 ug/L in July and 91.67 ug/L in September. The estimated TP loading in July and September 2022, calculated using 2019-2021 average concentrations, results in an estimated 9.71 pounds of phosphorus loading during these two months.

In addition, one sample collected in Plum Creek in August 2022 resulted in a TP concentration of 1,338 ug/L, which is 600% greater than the 2022 annual average concentration of 193.6 ug/L. The additional data collected during 2022 does not support this concentration being representative of the conditions in Plum Creek. The data is included in the analysis below.

Figure 8. Average Monthly TP Concentrations in Chatfield Watershed and Chatfield Reservoir.

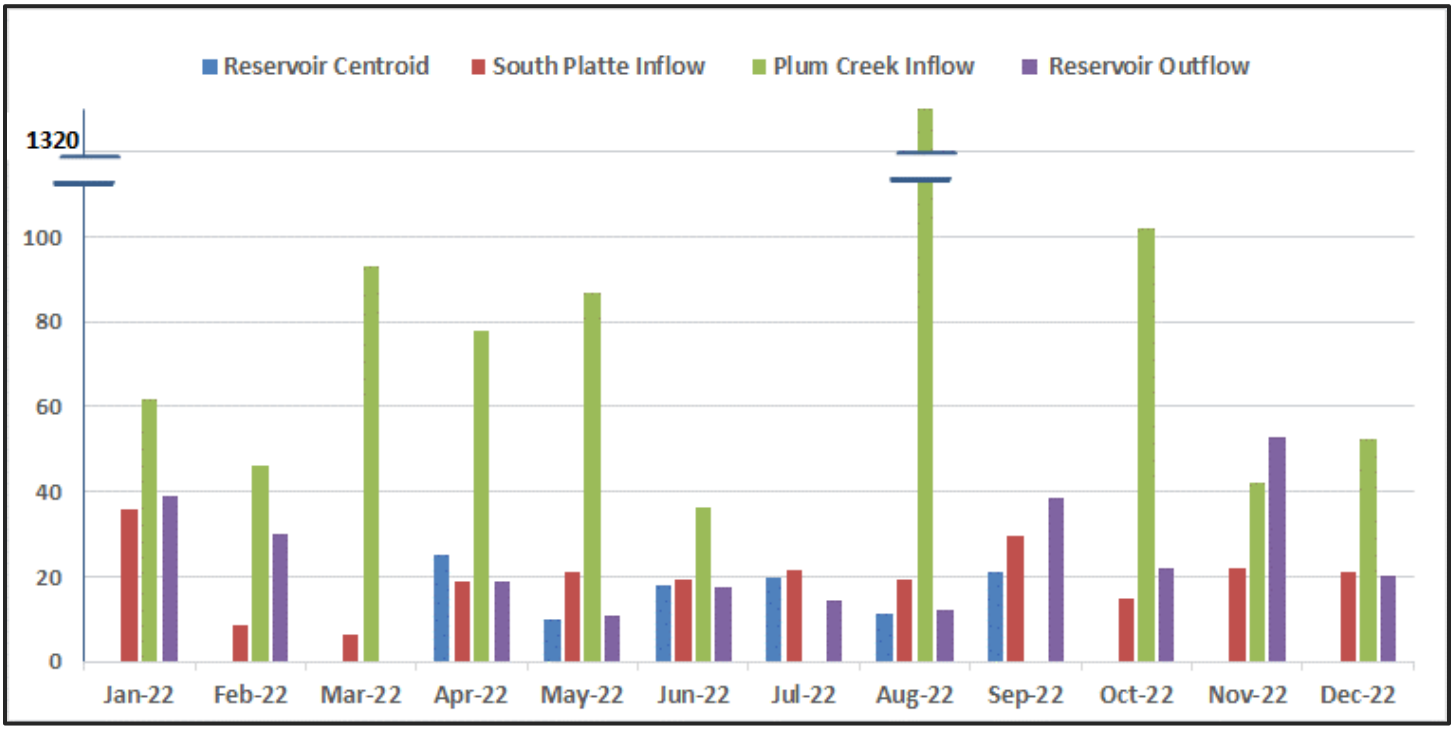


Figure 9. Calculated Annual TP Loads to Chatfield Reservoir from 1986 to 2022

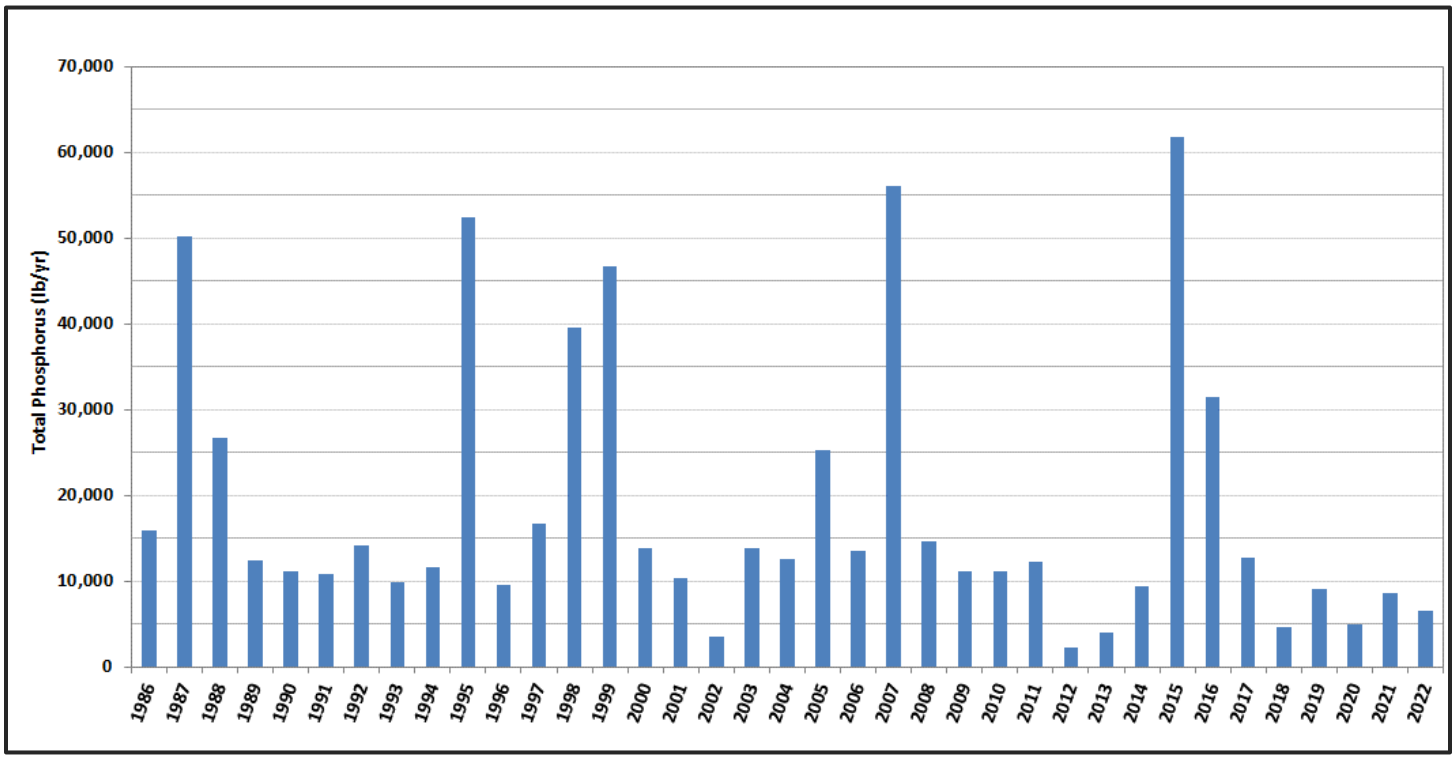


Figure 100. Chatfield Reservoir Calculated Annual Inflow (1986 – 2022)

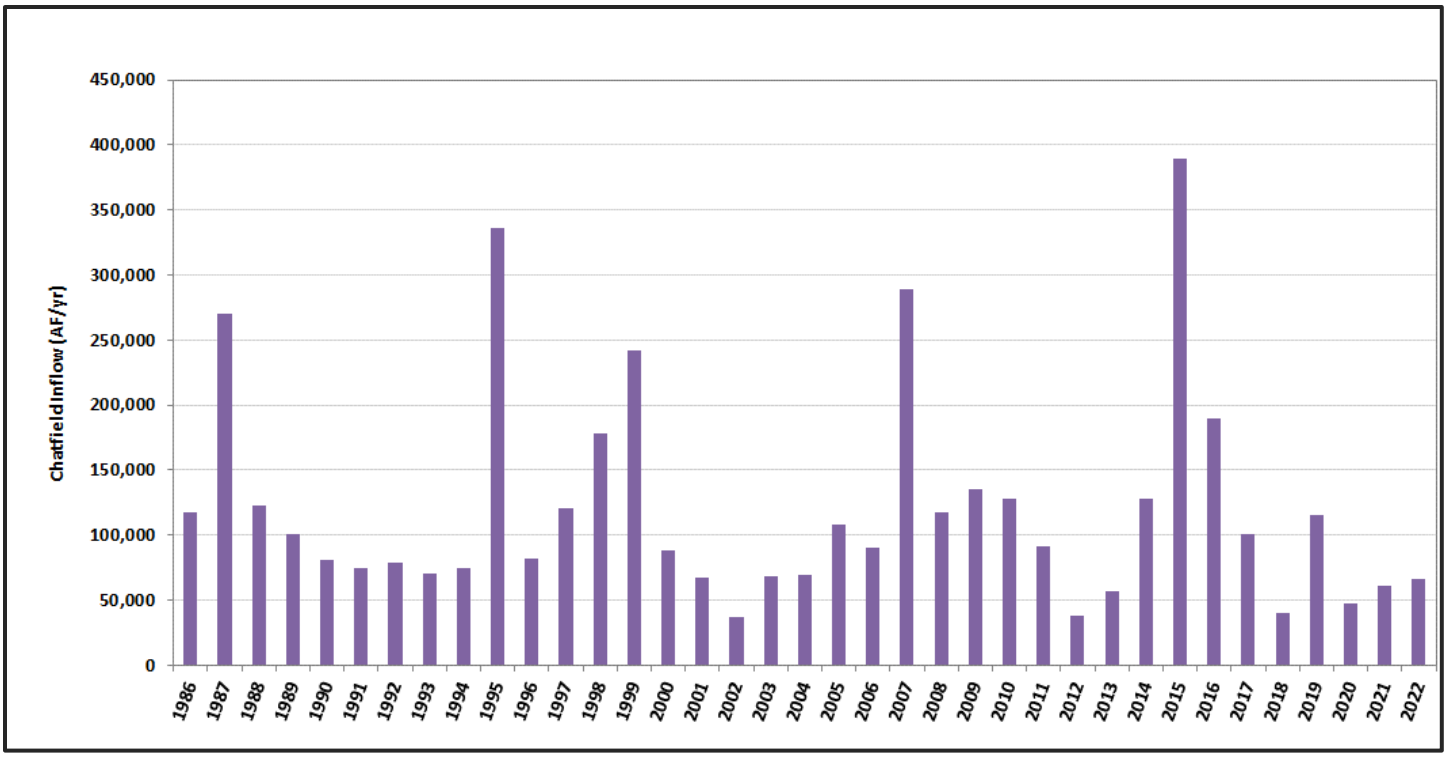
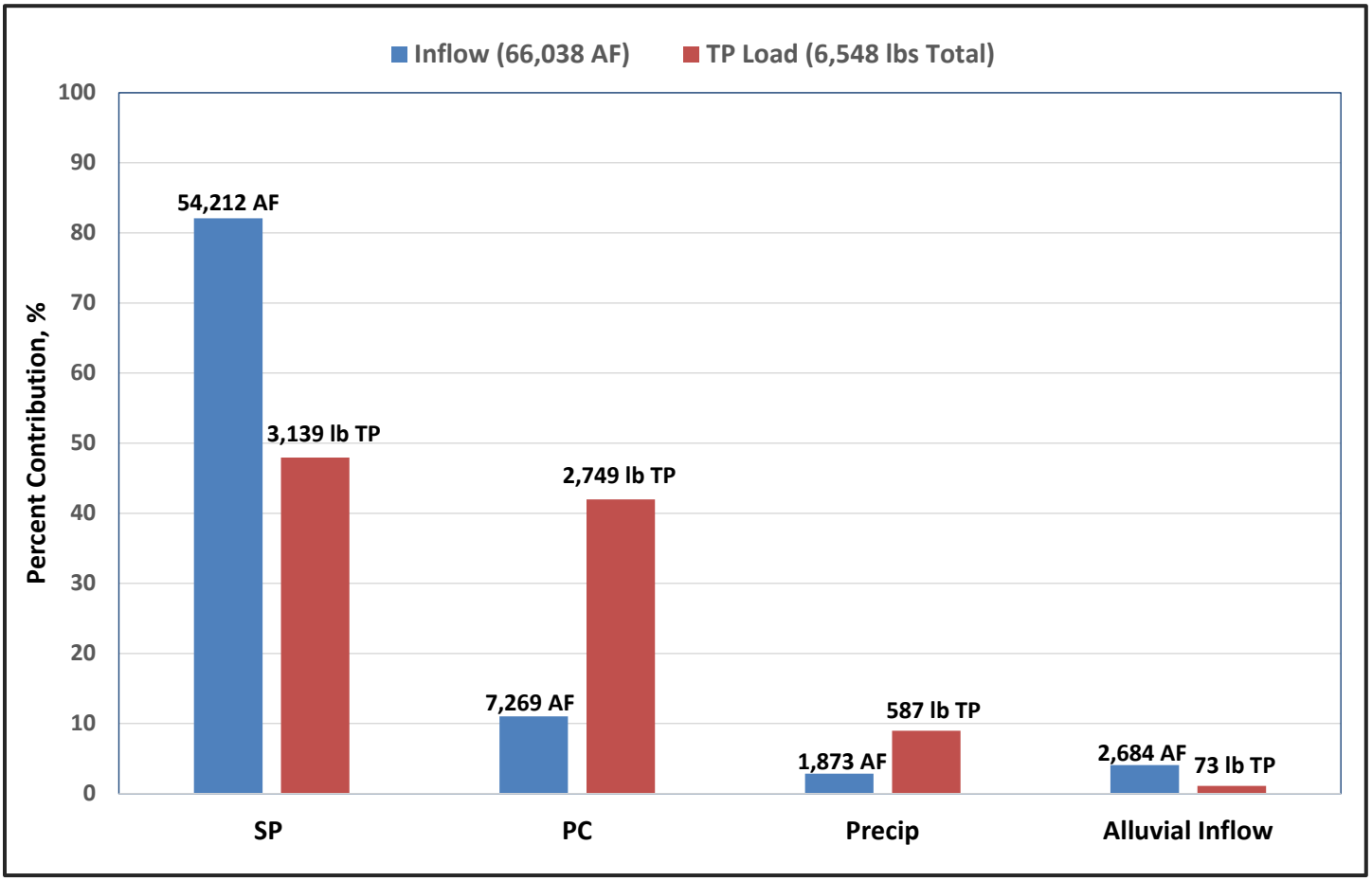


Figure 111. 2022 Chatfield Reservoir Inflows and TP Loads by Source.



WATERSHED AND RESERVOIR MONITORING PROGRAM

Since 1984, the Authority and its members have monitored water quality in the reservoir and upstream in the watershed and has undertaken measures to protect water quality in the Watershed through voluntary funding contributions and grants. The Authority, in coordination with its membership agencies, implements point source, nonpoint source and stormwater controls pursuant to the Chatfield Reservoir Control Regulation to protect water quality and beneficial uses of the reservoir.

Chatfield Reservoir

The Authority collects water quality data to determine reservoir chlorophyll levels, temperature, dissolved oxygen concentration, phosphorous concentrations, nitrogen concentrations and inflow quantities. The members develop and implement nonpoint source and stormwater projects which benefit the watershed and reservoir. The Chatfield Watershed Plan identified opportunities within the watershed to address the chemical, physical and biological constituents (pollutants) that impact the watershed. Some examples include phosphorus reductions from stabilizing degraded streambanks, mitigating runoff from agricultural lands, minimizing leachate from septic systems, controlling runoff from wildfire burn areas, and providing public education for reducing contamination from the actions of people.

The monitoring program characterizes water quality and determines regulatory compliance in the reservoir. Surface water samples are collected in the following locations:

- South Platte Inflow
- Plum Creek Inflow
- South Platte Arm (in Chatfield Reservoir)
- Plum Creek Arm (in Chatfield Reservoir)
- Reservoir Centroid (Chatfield Reservoir)
- Reservoir Outfall

The constituents are monitored monthly when ice has melted off the reservoir. During the growing season (July through September), reservoir sampling is conducted twice per month. To better understand reservoir dynamics, the Authority collects water column measurements, including the epilimnion and hypolimnion layers, at various depth intervals. The constituents monitored are shown in the Sampling and Analysis Plan presented in **Table 1** below. All water quality data are available on the Authority's website: www.chatfieldwatershedauthority.org

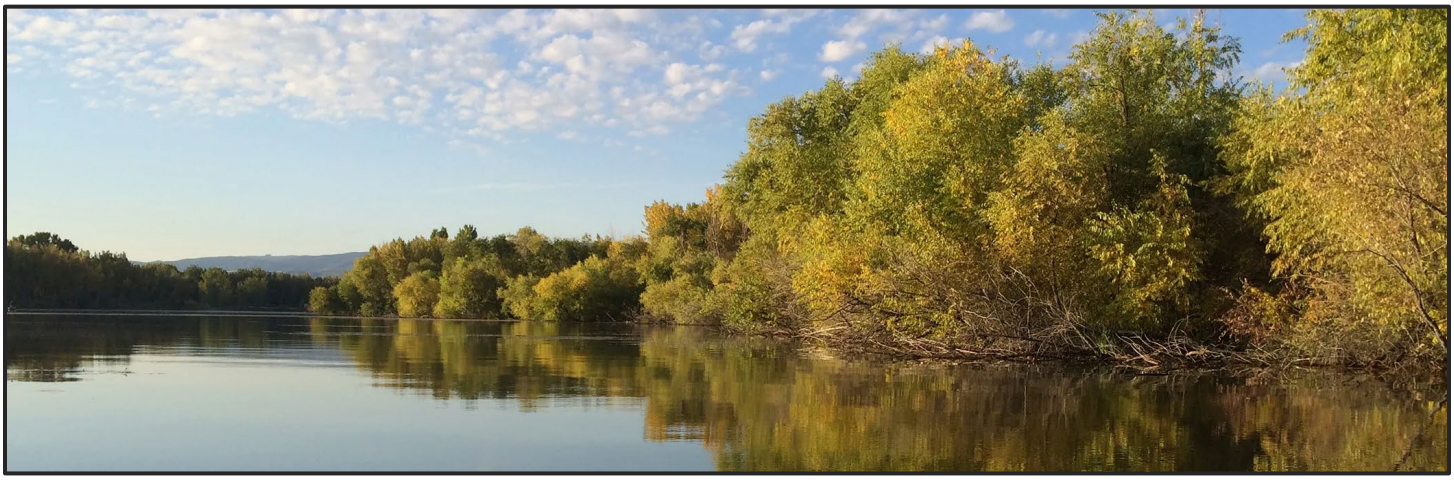


Figure 12. 2022 Chatfield Watershed Authority Sampling Locations and Constituents.

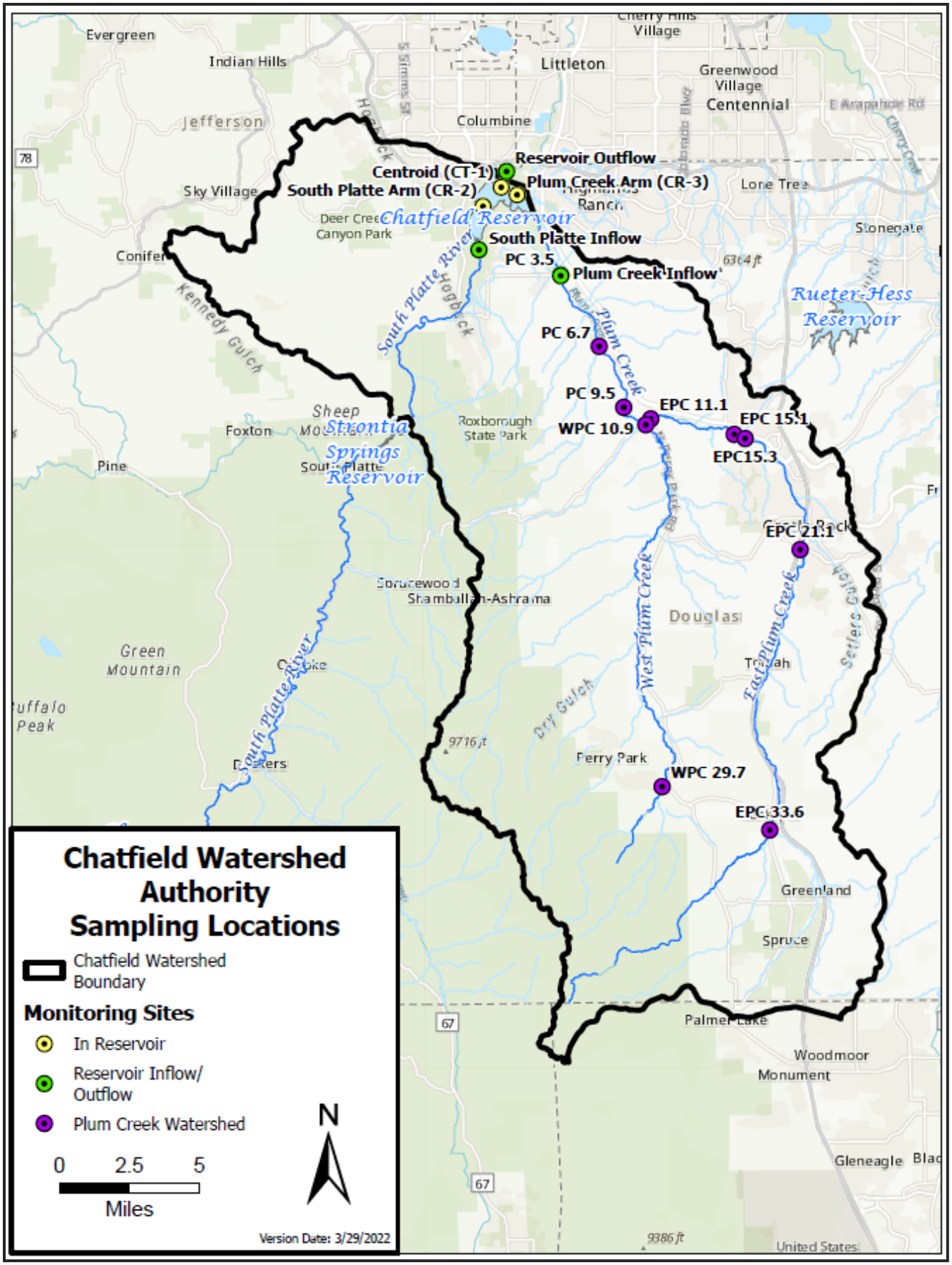


Table 1. Sampling and Analysis Plan

CONSTITUENT	PLUM CREEK WATERSHED[1]	CHATFIELD RESERVOIR[2]	RESERVOIR INFLOW/OUTFLOW[2]
Field Parameters			
pH	✓	✓	✓
Specific Conductance	✓	✓	✓
Temperature	✓	✓	✓
Streamflow	✓	✓	
Dissolved Oxygen	✓	✓	✓
Oxidation-Reduction Potential		✓	
Secchi Depth		✓	
Nutrients			
Total Phosphorous	✓	✓	✓
Ortho-Phosphorous	✓	✓	✓
Dissolved Phosphorous		✓	✓
Nitrate-nitrite	✓	✓	✓
Ammonia		✓	✓
Total Kjeldahl Nitrogen		✓	✓
Biological Constituents			
E. coli	✓	✓	✓
Chlorophyll *a*		✓	
Phytoplankton		✓	
Zooplankton		✓	
Metals			
Arsenic		✓	
Cadmium		✓	
Chromium		✓	
Copper		✓	
Iron		✓	
Lead		✓	
Manganese		✓	
Mercury		✓	
Nickel		✓	
Selenium		✓	
Silver		✓	
Zinc		✓	
Other Constituents			
Total Suspended Solids	✓	✓	✓
Total Dissolved Solids		✓	✓
Total Organic Carbon		✓	✓
Dissolved Organic Carbon		✓	✓
Carbonaceous Biochemical Oxygen Demand		✓	✓
Alkalinity	✓	✓	✓
Sulfate		✓	
Silica		✓	✓

[1] Plum Creek Watershed Monitoring Network Sampling and Analysis Plan (Tetra Tech, 2013)

[2] Chatfield Reservoir Reallocation Project and Chatfield Watershed Authority Coordinated Sampling and Analysis Plan (SAP) (Chatfield Reservoir Mitigation Company and Chatfield Watershed Authority, 2019)

Plum Creek Watershed Monitoring System

In the Plum Creek basin, watershed monitoring continued in 2022 through voluntary sampling efforts by the Plum Creek Water Reclamation Authority (PCWRA); monitoring locations are shown in **Figure 12.** The objective of the Plum Creek monitoring program is to better characterize water quality in Plum Creek and identify potential nonpoint source pollutant sources, a variety of which have already been identified in the watershed, including:

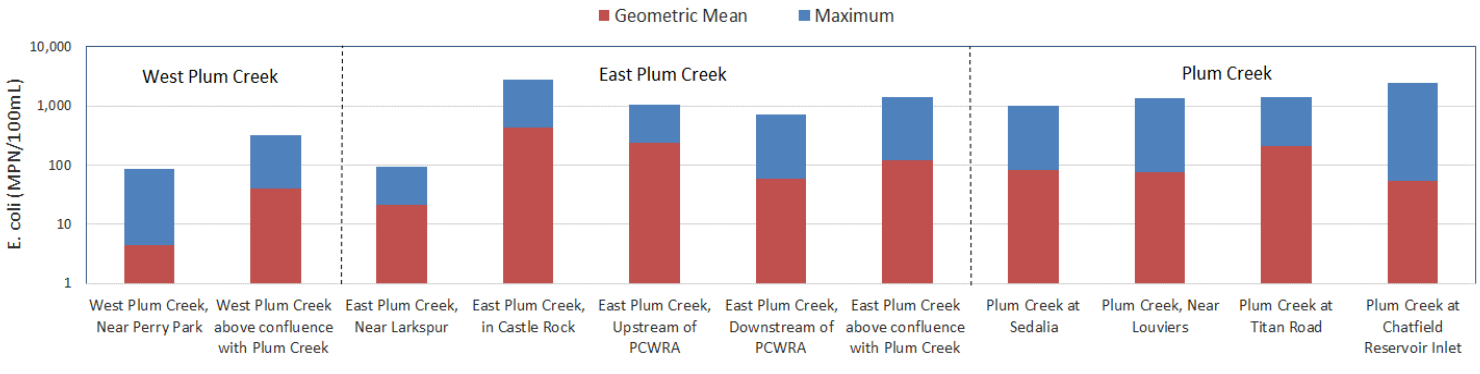
- Stormwater runoff from historic urbanized and rural areas
- Leachate from unmaintained septic systems, agricultural activities, including runoff from overgrazed agricultural lands
- Runoff from wildfire burn areas
- Runoff from impervious areas
- Erosion from degraded streambanks (Chatfield Watershed Plan, May 2015)

Further data collection is needed, contingent on available resources, to identify and quantify phosphorus sources in the Plum Creek basin. The 2022 Plum Creek water quality observations included the following:

Stream Bank Erosion. Historically, there was significant streambank erosion on Plum Creek and its tributaries. This eroding area contributed significant sediment, and likely TP. As part of the mitigation for the CRMC reallocation project, stabilization of a portion of Plum Creek in the State Park has been completed. Additional stabilization on Plum Creek and tributaries continue to be evaluated and stabilized by watershed stakeholders.

E. coli. Significant variability was evident at all monitoring sites for *E. coli* in 2022 (**Figure 13**). The water quality standard for *E. coli* is 126 organisms/100 mL. The geometric mean for *E. Coli* was above the water quality standard at the following sampling locations: East Plum Creek, in Castle Rock (426 organisms/100 mL); East Plum Creek, Upstream of PCWRA (236 organisms/100 mL); and Plum Creek at Titan Road (209 organisms/100 mL).

Figure 13. E. coli in Plum Creek Drainage Area, 2022



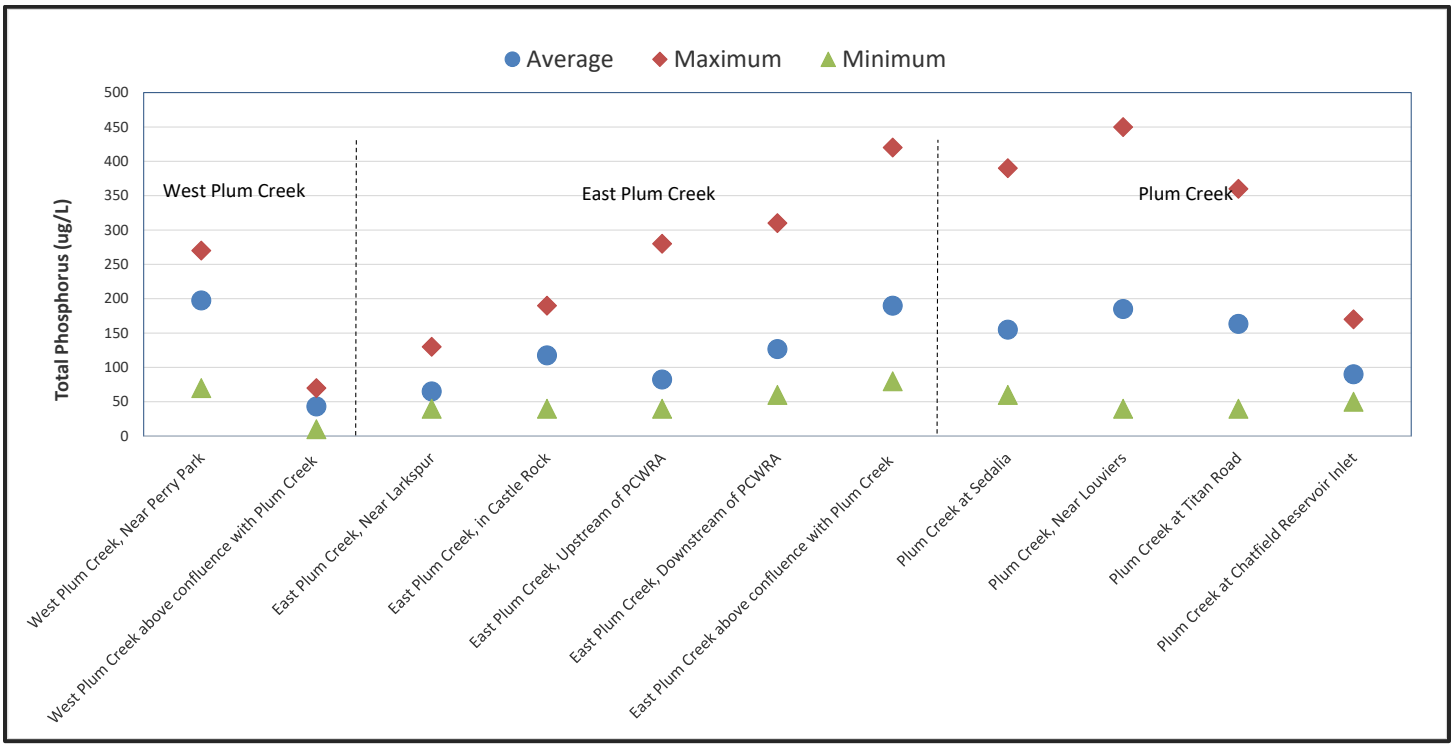
East Plum Creek, in Castle Rock: One sample collected in October2022 resulted in an *E. Coli* measurement of 2,420 organisms/100 mL. This sample is significantly higher than any sample collected in the past 3 years. If this sample is not included in the analysis, the geometric mean for this location in 2022 would be 179 organisms/100 mL, which is below the water quality standard.

East Plum Creek, Upstream of PCWRA: One sample collected in June 2022 resulted in an *E. Coli* measurement of 816 organisms/100 mL. This sample is significantly higher than any sample collected in the past 3 years. If this sample is not included in the analysis, the geometric mean for this location in 2022 would be 127 organisms/100 mL, which is below the water quality standard.

Plum Creek at Titan Road: One sample collected in June 2022 resulted in an *E. Coli* measurement of 1,203 organisms/100 mL. This sample is significantly higher than any sample collected in the past 3 years. If this sample is not included in the analysis, the geometric mean for this location in 2022 would be 87 organisms/100 mL, which is below the water quality standard.

Total Phosphorus. TP concentration generally increases from upstream to downstream for both East Plum Creek and Plum Creek (**Figure 14).** Average TP in West Plum Creek decreased between Perry Park and the confluence with East Plum Creek. TP concentrations have historically been observed to be relatively high at East Plum Creek, downstream of PCWRA as well as East Plum Creek above the confluence with Plum Creek (Site EPC-11.1), compared to other sites in Plum Creek watershed. In 2022 the average TP at East Plum Creek, downstream of PCWRA was 127 ug/L, compared to the 2021 average of 154 ug/L and the 2020 average of 183 µg/L. In 2022 the average TP at Site EPC-11.1 (East Plum Creek above the confluence with Plum Creek) was 420 ug/L, while the 2021 average TP at Site EPC-11.1 was 147.5 µg/L, compared to the 2020 average of 130 mg/L, the 2019 average of 193 µg/L and the 2018 average of 185 µg/L.

Figure 14. TP in Plum Creek Drainage Area, 2022.



Total Suspended Solids. The average Total Suspended Solids (TSS) concentration is an indicator of sediment and high precipitation events. The highest average TSS concentration observed in 2022 was at Plum Creek near Louviers at 116 mg/L TSS. In 2021, the highest TSS concentration was at the Plum Creek at Chatfield Reservoir Inlet site at 76.1 mg/L TSS. In 2020, the highest TSS concentration was at Site PC-3.5 (Plum Creek at Titan Road) at 24.5 mg/L. In 2019, the highest TSS concentration was at Site EPC-11.1 (East Plum Creek above the confluence with Plum Creek) at 64.7 mg/L. (**Figure 15)**

The average TSS at Plum Creek at Chatfield Reservoir Inlet was 10.2 mg/L in 2022. The TSS at the same location was 76.1 mg/L in 2021 compared to 14.7 mg/L in 2020. The average TSS at West Plum Creek above the confluence with Plum Creek was 4.3 mg/L in 2022, compared to 13 mg/L in 2021 and 5.3 mg/L in 2020.

All the other sites increased in average TSS concentrations in 2022 compared to 2021, potentially indicating more erosion and sediment loading to Plum Creek for 2022 as a result of precipitation events. The average TSS concentration at all sampling site for 2022, 2021 and 2020 is presented in **Figure 16**.

Figure 15. Total Suspended Solids in Plum Creek Drainage Area, 2021.

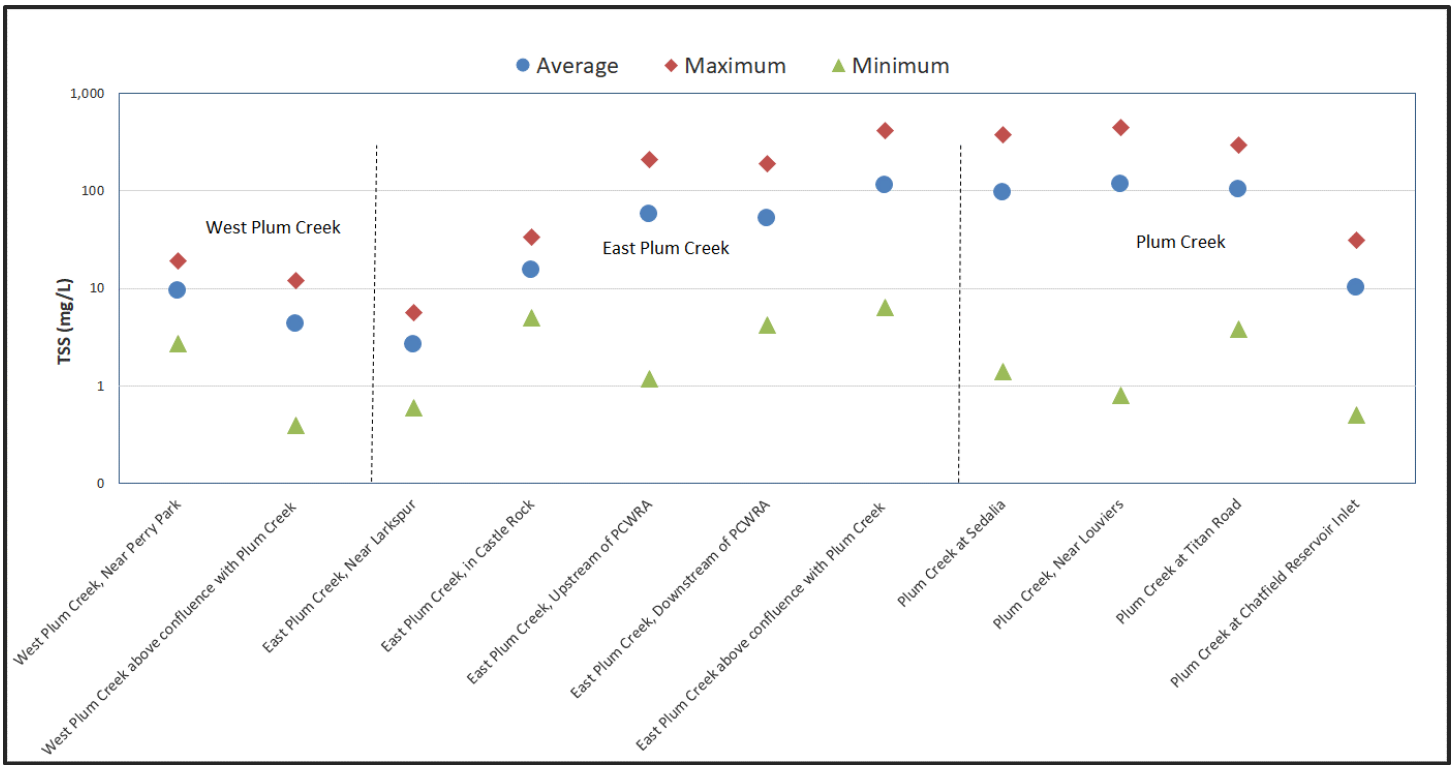
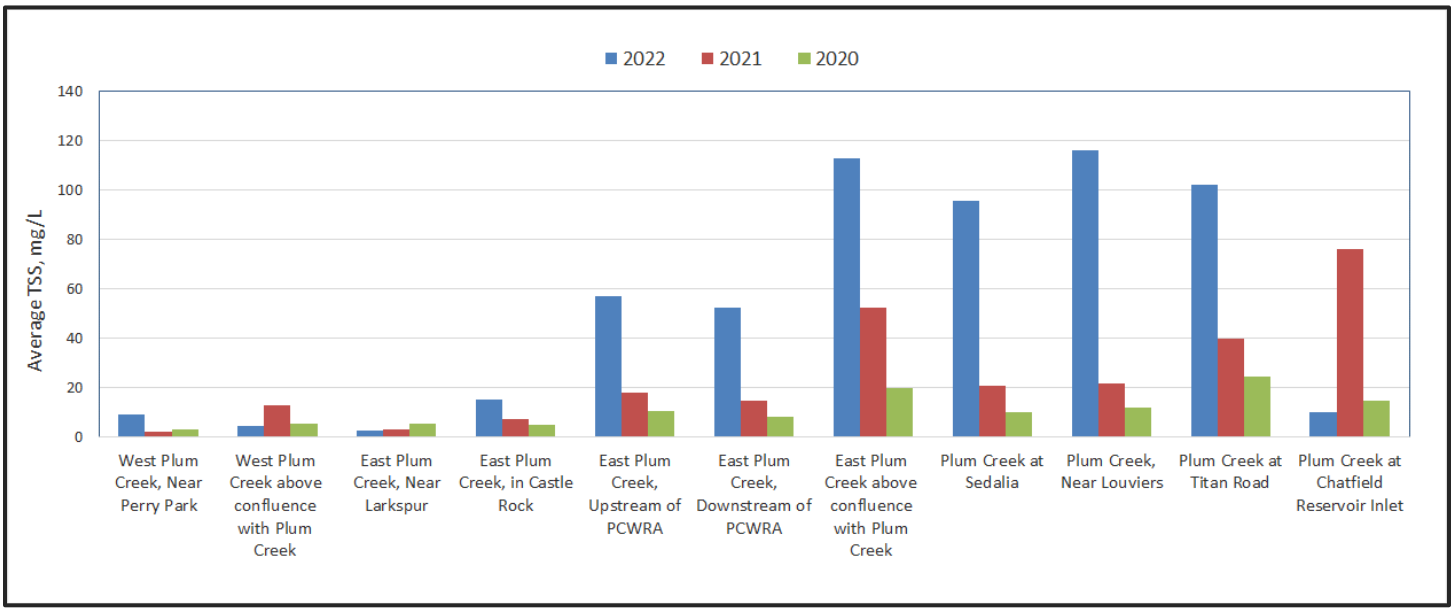


Figure 166. Average Total Suspended Solids Concentrations in Plum Creek Drainage Area, 2022, 2021, 2020.



WASTEWATER TREATMENT PLANTS

To demonstrate compliance with each respective Colorado Department of Public Health and the Environment (CDPHE) Wastewater Treatment Plants (WWTP) discharge permit, and the Chatfield Reservoir Control Regulation 73, the WWTP perform monitoring and reporting of the WWTP effluent discharge. In 2022, the total reported TP discharges from WWTPs were approximately 2,404.5 pounds out of the allowable wasteload allocation of 7,605.6 pounds. Refer to **7** for WWTP locations. During 2022, all but one WWTP maintained compliance with the permitted TP concentration limit. The WWTPs in the Chatfield watershed and their respective TP wasteload allocations are summarized in **Table 2.** The 2022 Monthly TP Concentration from WWTPs are summarized in **Table 3.**

Table 2. Phosphorus Wasteload from WWTPs in the Chatfield Watershed (Pounds).

Permittee	CDPHE Permit Number	TP Wasteload Allocation (Pounds)	TP Loading (Pounds)		
			2020	2021	2022
Plum Creek Water Reclamation Authority	CO0038547	4,256	2,142	2,044	2,135
Perry Park Water and Sanitation District	CO0022551	365	148.1	173.8	113.1
Perry Park Water and Sanitation District	CO0043044	73	52.7	59.4	64.4
Lockheed Martin Space Systems Company	CO0001511	1005	25.9	22.1	52.13
Town of Larkspur	COX632092	231	76.26	10.6	39.4
Highlands Ranch Law Enforcement Academy[1,2]	20060427	30	ND[3]	ND[1]	ND[1]
Centennial Water and Sanitation District	CO0037966	20	ND[4]	ND[4]	ND[4]
Ponderosa Retreat and Conference Center	COX047511	75	ND[5,6]	ND[4,5]	ND[4,5]
Louviers Water and Sanitation District	COX632098	122	ND[4]	ND[6]	ND[6,7]
Dominion Water and Sanitation District	CO0041645	1,218	ND[4]	ND[4]	ND[4]
Sacred Heart Retreat	COX041874	15	0.38	ND[7]	ND[8]
Jackson Creek Ranch	N/A	50	ND	ND	ND
Reserve Emergency Pool	N/A	73	ND	ND	ND
Sun Jelly RV Park	COX631080	72.6	-	105.2**	30.66
TP WASTELOADS		7,605.6	2445.34	2,415.1	2,434.69

*TP loading from WWTPs is from the WWTP point of discharge; the TP load discharged from WWTPs does not equate to the TP load delivered to Reservoir due to assimilation of TP and geochemical fate and transport processes in the watershed.

**Values indicate exceedance of the TP wasteload allocation.

*** No Data (ND)

**** Not Applicable (N/A)

1. Permits for the Highlands Ranch Law Enforcement Academy Individual Sewage Disposal Systems were issued by Tri-County Health Department. Sampling is not required by the Tri-County Health Department Individual Sewage Disposal Systems discharge permit.
2. Centennial Water and Sanitation District serves as a co-management agency for the water system and has provided the Highlands Ranch Law Enforcement Academy with a wasteload allocation of 30-pounds from its 50-pound wasteload allocation.
3. Wastewater reuse is authorized under 5 CCR 1002-84 – Reclaimed water, with no discharge.
4. No reported wastewater discharge in the Chatfield watershed.
5. Ponderosa Retreat Center water quality credits are based on a trade project completed pursuant to the Authority Trading Program. Effluent phosphorus concentration was not sampled in 2022.
6. Source: Environmental Protection Agency Integrated Compliance Information System database.
7. No phosphorus samples were collected in 2022 as the compliance point lysimeters were dry during each monthly sampling event.
8. Facility is storing and transporting all wastewater to McDonald Farms for treatment, resulting in no discharge in 2022.

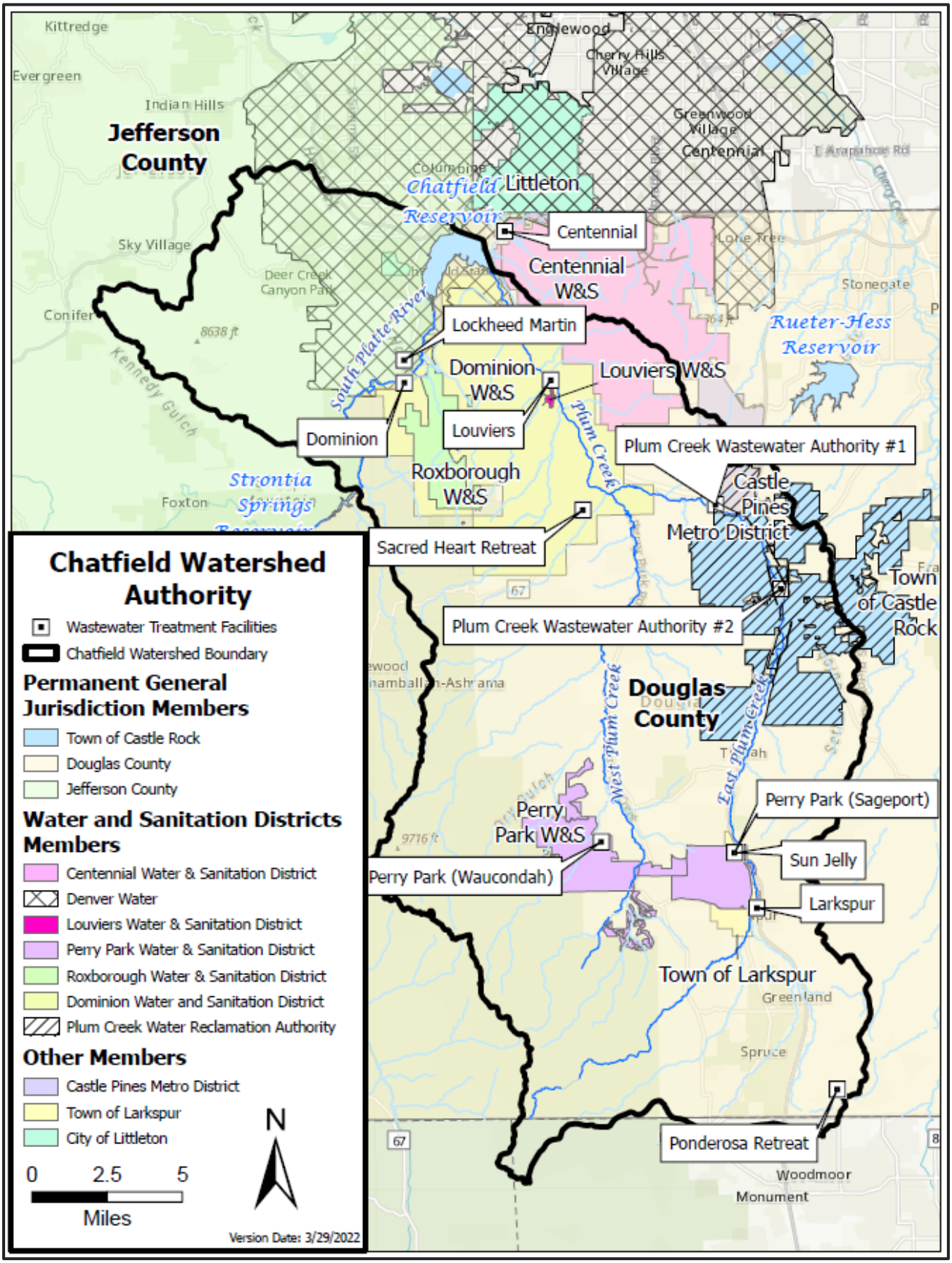
Table 3. 2022 Daily Average Phosphorus Concentrations by Month from WWTPs (mg/l)

Permittee	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Plum Creek Water Reclamation Authority	0.12	0.12	0.15	0.20	0.14	0.22	0.20	0.15	0.08	0.08	0.07	0.12
Perry Park Water and Sanitation District (CO0022551)	0.20	0.01	0.22	0.10	0.29	0.64	0.23	0.34	0.23	0.14	0.12	0.43
Perry Park Water and Sanitation District (CO0043044)	0.55	0.26	0.15	0.41	0.30	0.25	0.65	0.41	0.30	0.38	0.18	0.22
Lockheed Martin Space Systems Company	< .05	0.12	< .05	0.06	0.09	0.05	0.08	0.17	0.25	0.18	0.16	0.14
Town of Larkspur	ND[1]	0.32	0.44	0.75	ND[1]	0.51	0.40	0.37	0.28	0.25	0.34	0.34
Highlands Ranch Law Enforcement Academy	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Centennial Water and Sanitation District	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]
Ponderosa Retreat and Conference Center	ND[3,4]	ND[3,4]	ND[3,4]	ND[3,4]	ND[3,4]	ND[3,4]	ND[3,4]	ND[3,4]	ND[3,4]	ND[3,4]	ND[3,4]	ND[3,4]
Louviers Water and Sanitation District	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]	ND[1]
Dominion Water and Sanitation District	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]
Sacred Heart Retreat	ND[5]	ND[5]	ND[5]	ND[5]	ND[5]	ND[5]	ND[5]	ND[5]	ND[5]	ND[5]	ND[5]	ND[5]
Jackson Creek Ranch	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]
Reserve Emergency Pool	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]
Sun Jelly RV Park	2.33*	0.93	ND[3]	6.59*	0.00	0.52	0.00	0.07	0.00	0.00	ND[3]	ND[3]

* Non-compliance with TP concentration limits.

1. No phosphorus samples were collected in 2022 as the compliance point lysimeters were dry during each monthly sampling event.
2. Sampling is not required by the issued Tri-County Health Department discharge permit.
3. No reported wastewater discharge to the Chatfield watershed.
4. Effluent phosphorus concentration was not sampled in 2022.
5. Facility is storing and transporting all wastewater to McDonald Farms for treatment, resulting in no discharge in 2022.

Figure 177. Wastewater Treatment Plants Located within the Chatfield Watershed.



SITE LOCATION APPLICATIONS

As the 208 Management Agency, the Authority reviews site location applications and associated engineering reports for new or proposed facilities to effectively manage waste treatment works and related facilities serving Chatfield Basin.

The Authority reviews, comments, and makes recommendations to the Water Quality Control Division for site location applications for domestic wastewater treatment works, including wastewater treatment plants, individual sewage disposal systems, lift (pumping) stations, and certain interceptor sewers with a capacity of 2,000 gallons per day or greater, as well as certain facilities that produce reclaimed domestic wastewater. As required by Colorado's Site Location and Design Approval Regulations for Domestic Wastewater Treatment Works (Regulation 22), most site location applications are submitted to the Authority by the Applicant prior to submittal to the Water Quality Control Division.

Under the Chatfield Reservoir Control Regulation, the Authority is to implement the TMAL for TP loading to the reservoir. The Authority reviews site location applications for compliance with the Chatfield Reservoir Control Regulation and the Emergency Response Plan. The review primarily assesses the following criteria:

- CDPHE WQCC Control Regulation No. 73. 73.3.2(b): "No municipal, domestic, or industrial wastewater discharge in the Chatfield Watershed shall exceed 1.0 mg/L TP as a 30-day average concentration, except as provided under section 73.3(2)(f)."
- CDPHE WQCC Control Regulation No. 73, 73.3.2(c): "The allowed annual waste load of point source phosphorus in the Chatfield watershed is limited to 7,533 lb/year, allocated among the dischargers."
- The likelihood of sanitary sewer overflows and contaminants reaching Chatfield Reservoir, Plum Creek, or the South Platte River and, in the event of an emergency, the ability of emergency response plans to contain the sanitary sewer overflows and contaminants, per the Cherry Creek Reservoir Watershed Site Application Review Process Emergency Response Plan Criteria (Emergency Response Plan Criteria) which have also been adopted by the Chatfield Watershed Authority.

Perry Park Water and Sanitation District – Waucondah Wastewater Treatment Facility Site Application Review

In 2022, the Authority reviewed the Perry Park Water and Sanitation District (PPWSD) Phase 2 Improvements to the Aerobic Digestion Facility at the Waucondah Wastewater Treatment Facility (WWTF) Site Application (Application) for compliance with the Chatfield Reservoir Control Regulation.

The site approval amendment application relates to physical changes to the unit processes in the solid stream treatment that could change the characteristics of the recycle stream or the biosolids. The changes are proposed to enable the facility to better treat and handle waste sludge and meet current CDPHE Policy WPC-DR-1 criteria. The existing aerobic digester facilities are over 40 years old and have reached the end of their useful life. The proposed changes are also intended to reduce odors and noise at the facility, as well as decrease ongoing operation and maintenance costs by replacing aging equipment.

The findings on the Application are as follows:

1. Phosphorus Wasteload Allocation:

   A phosphorus wasteload allocation was not considered because the proposed aerobic digestion system improvements will not result in a change to the current phosphorus allocation for PPWSD. No change in phosphorus wasteload allocation is requested or expected with the proposed aerobic digestion system improvements.

2. Phosphorus Concentration Limit:

   The PPWSD Waucondah WWTF is currently permitted by the CDPHE to operate the WWTP under the Colorado Discharge Permit

System (CDPS), Permit CO-0022551. This permit was reissued in 2012 and has been administratively extended since the expiration on June 30, 2017. The effluent limitation for phosphorus as a 30-day average is 1 mg/L. From January 2007 through January 2012, the reported average effluent phosphorus concentration was 0.26 mg/L, with a minimum of 0.02 mg/L and a maximum of 0.83 mg/L.

3. Emergency Response Criteria:

   a. The Application includes the replacement of the existing emergency back-up power generator.

   b. The Application identifies potential spill causes and includes the necessary systems to minimize the risk of such overflows.

   c. The Application addresses the operation and maintenance practices or engineering features to address and prevent sanitary sewer overflows.

4. Consolidation of Treatment Works:

   The consolidation of treatment works was not considered because this site application is for improvements at an existing WWTF.

The proposed site application meets the Authority's Review Criteria for Site Location and Design Approvals. The Authority recommended approval of the site application to the Division.

Pine Canyon Site Application and Phosphorus Trade Application

In 2022, the Authority continued review of the following project for compliance with the Chatfield Reservoir Control Regulation:

Pine Canyon (JRW)

Project Summary: Site application for a wastewater treatment facility (0.405 mgd design capacity), and a phosphorus non-point source to point source trade application (1528 lbs./yr cattle operations elimination to 763 lbs./yr WWTF discharging to East Plum Creek). Pine Canyon proposed to remove on-site cattle operations on the JRW property as the source of the nonpoint source trade.

2020

- The Authority's technical consultant reviewed the submitted applications and found that Pine Canyon's initial analyses which calculated the phosphorus removal effect of cattle removal did not account for the diminished effect of the change on the amount of phosphorus actually reaching the waters of East Plum Creek. On December 29, 2020, Pine Canyon revised their request to address this issue, and proposed a revised nonpoint source phosphorus credit of 380.5 lbs./yr. based upon a calculated 761 lbs./yr. of phosphorus reaching East Plum Creek from the JRW property.
- On October 27, 2020, the Division issued a Request for Information (RFI) on the submitted Site Application for the WWTF. The RFI included, among other requests, a request of the Applicant to 1) submit an application to the Division for the phosphorus allocation approval following the final recommendation of the phosphorus allocation by the Authority, and 2) to address the phosphorus allocation with respect to the MS4 requirements in the phosphorus allocation application. The Applicant provided responses to the Division's RFI on December 10, 2020.

2021

- On January 26, 2021, the Division issued a letter to the Applicant stating that "because the Applicant's property is subject to Douglas County MS4 permit, the discharge is a point source, not a nonpoint source. Furthermore, discussions with our MS4 workgroup have clarified that trading under an MS4 permit also is not a feasible option at this time".
- On January 28, 2021, a separate letter from the engineering division within the Water Quality Control Division to the applicant determined: "Further consideration of the site application by the Division staff is "premature" because applicant

has not resolved the issue of a phosphorus allocation for the proposed facility".

- On February 18, 2021, the CWA sent a letter to the Water Quality Control Division notifying the Division that it had denied the applicants phosphorus trade at its February 2, 2021, meeting; the letter went on to say that the CWA review of the applicants site application had been put "on hold".
- On May 5, 2021, the CWA denied Pine Canyon's Site Application.
- On December 2, 2021, the Division sent a letter to the applicant "to provide more detailed information on the underlying rationale behind our initial determination that the trade is not feasible".

2022

- On April 6, 2022, the applicant submitted an amended site application to CWA for a proposed 0.405 MGD Pine Canyon Water Reclamation Facility (PCWRF).
- The Authority's Technical Consultant reviewed the site application and provided review comments to the Authority's TAC in a Memorandum on June 7, 2022. The memorandum identified deficiencies in the site application and concerns with the practical application and implementation of the proposed Land Application Management Plan (LAMP).
- On June 7, 2022, the Authority's TAC took action to recommend to the Division that the Pine Canyon Site Application be denied for the reasons presented in the forementioned memorandum.
- On December 1, 2022, notice was provided in the December 2022 Water Quality Bulletin that the site location application for the Pine Canyon Water and Sanitation District's PCWRF was found by the Division to be in conformance with the Water Quality Control Commission's Site Location and Design Regulations for Domestic Wastewater Treatment Works, 5 CCR 1002-22 (Regulation 22) and was approved (Regulation 22 Site Location Approval No. ES.20.SA.05399). The conditions of approval were provided in the letter dated November 16, 2022, from the Division to Jim Walker regarding the subject application.
- On December 6, 2022, the TAC decided not to appeal the issuance of the site application approval but instead decided to formally remind the Division of the Authority's opposition with the Division's finding that the proposed PCWRF would be able to operate using a LAMP without the requirement of a wasteload allocation under the requirements of Regulation #73.

WATERSHED MODELING

The Authority contracted with Lynker to use the watershed model to further explore model assumptions and inputs on the model results. The purposes of the modeling efforts started in 2022 were to:

- Simulate the watershed response to removal of modeled point source discharges
- Simulate the watershed response to wastewater facilities operating in the future at their full wasteload allocations

The model was calibrated using water quality records from 2000 to 2015. The model currently simulates five point source discharges in the watershed: PCWRA, Lockheed Martin, Sageport WWTF, Waucondah WWTF, and the Roxborough WWTF. In most instances the point sources are simulated in the model from 2000 to 2015 using average monthly data. The Louviers and Town of Larkspur WWTFs were not included in the model because they had not recently discharged to the watershed when the model was built (Leonard Rice Engineers and Lynker Technologies, 2016).

In the analysis, impact of changes to the point source discharges in the watershed were evaluated by simulating the point source discharges a) off and b) increased to the full wasteload allocation. In the first analysis, to evaluate the impact of these point sources on total phosphorus loading in the Chatfield Reservoir watershed, the model was run with these five point source discharges turned off and compared the results to the watershed model representing historical conditions (point sources following historical operations). In the second analysis, the model was run with the point source dischargers set to their full wasteload allocation and the results compared with the watershed model representing historical conditions.

A summary of the annual total phosphorus source loads included in the model is provided in **Table 4.**

Figure 188. Point Sources and Water Quality Sites.

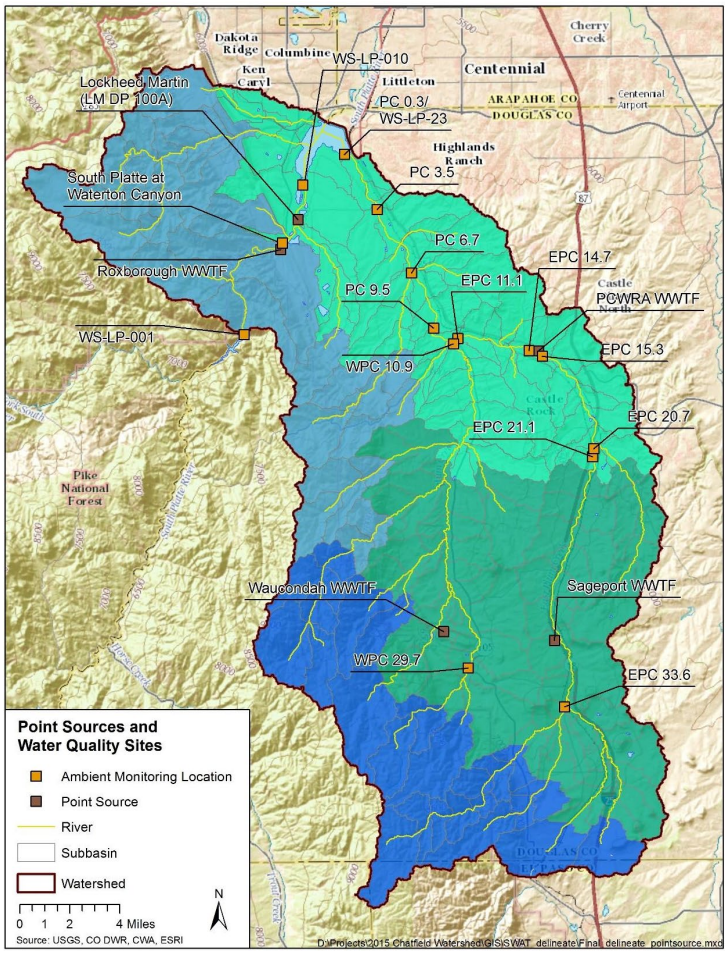


Table 4. Annual Total Phosphorus Point Source Load

Year	PCWRA (lbs)	Lockheed Martin (lbs)	Sageport WWTF (lbs)	Waucondah WWTF (lbs)	Roxborough WWTF (lbs)
2000	1,250	310	0	0	480
2001	1,630	140	0	0	450
2002	2,650	190	0	0	550
2003	3,310	180	0	0	770
2004	3,910	200	0	0	830
2005	2,650	230	62	103	1,180
2006	2,300	170	66	107	760
2007	2,180	280	51	144	970
2008	2,660	80	53	209	0
2009	2,880	20	47	101	0
2010	1,850	20	40	93	0
2011	2,210	10	34	81	0
2012	2,510	10	25	69	0
2013	1,860	20	25	85	0
2014	1,900	20	29	91	0
Average (when discharging)	**2,380**	**120**	**43**	**105**	**750**

Analysis 1: Watershed Simulated without Point Source Discharges

The Chatfield watershed model was used to run scenarios with the point sources operating normally (the historical model) and with the point sources turned off. When the point sources are turned off, all five point sources (PCWRA, Lockheed Martin, Sageport WWTF, Waucondah, and Roxborough WWTF) no longer discharge flow, total phosphorus, and other water quality constituents into the watershed.

The model was run for the full period of record (January 1995 to September 2015) and analyzed the results from January 2000 to December 2014, representing the calibrated model record. The simulated annual total phosphorus loads for the South Platte (model reach 16) and Plum Creek (model reach 15) are shown in **Table 5**. On average, the total phosphorus contribution from the South Platte River decreased by 360 pounds per year and the total phosphorus contribution from Plum Creek decreased by 1,740 pounds per year when the model simulates the watershed without point source discharges.

Table 5. Simulated Annual Total Phosphorus Load

Year	South Platte River Total Phosphorus Load (lbs)			Plum Creek Total Phosphorus Load (lbs)		
	Historical Model	Point Sources Off	Difference	Historical Model	Point Sources Off	Difference
2000	5,610	5,030	590	4,110	3,370	750
2001	3,010	2,700	310	4,100	3,080	1,020
2002	3,550	3,090	450	3,090	1,390	1,700
2003	7,440	6,800	640	10,630	8,270	2,350
2004	7,050	6,330	720	6,870	3,990	2,880
2005	8,730	7,760	960	6,720	4,630	2,080
2006	4,310	3,710	600	5,610	3,920	1,690
2007	17,090	16,130	960	19,190	17,340	1,850
2008	4,020	3,940	70	5,110	3,070	2,040
2009	5,320	5,300	20	7,750	5,590	2,170
2010	4,860	4,850	20	15,260	13,840	1,420
2011	1,590	1,580	10	4,960	3,400	1,560
2012	680	680	10	4,420	2,690	1,730
2013	2,060	2,040	10	4,010	2,750	1,260
2014	5,950	5,920	20	5,070	3,710	1,370
Average	**5,420**	**5,060**	**360**	**7,130**	**5,400**	**1,720**

Analysis 2: Full Wasteload Allocation Simulation

The Chatfield watershed model ran scenarios with four of the five-point sources discharging their full wasteload allocation to represent future potential buildout conditions in the Chatfield Reservoir watershed. In this scenario the Roxborough point source does not discharge into the watershed due to a change in ownership of the wasteload. **Table 6** presents the total phosphorus load from the last 10 years of historical record in the model (2005-2014). This loading was used in the development of parameters for the wasteload allocation scenario. The total phosphorus load in the 10-year historical record is similar to the total phosphorus load for the most recent historical data (2021), representing a reasonable approximation of current conditions.

The TP load simulated by the model in the wasteload allocation scenario is 5,699 pounds (lbs)/year, which represents 75% of the TP wasteload allocation for all point sources in the watershed (7,605 lbs/year).

Table 6. TP Annual Historical and Wasteload Allocation.

Permittee	CDPHE Permit	Total Phosphorus Load, lbs/yr)		Total Phosphorus Wasteload Allocation (lbs/yr)
		Historical (2005-2014)	2021	
Plum Creek Water Reclamation Authority (PCWRA)	CO0038547	2,035	2,044	4,256
Lockheed Martin Space Systems Company	CO0001511	57	22.1	1,005
Perry Park Water and Sanitation District (Sageport)	CO0043044	41	59.4	73
Perry Park Water and Sanitation District (Waucondah)	CO0022551	107	173.8	365
Total		**2,241**	**2,299**	**5,699**

Note: Roxborough stopped discharging to the watershed in 2007, and their wasteload allocation is owned by the Dominion Water and Sanitation District, which was not modeled for this analysis.

The wasteload allocation modeling scenario simulates an increase of approximately 3,458 pounds of TP per year compared to the 10-year historical average (2005-2014), of which about 950 pounds are distributed to the South Platte River and 2,500 pounds are distributed to Plum Creek. The Total Phosphorus wasteload allocation by River Basin is provided in **Table 7**.

Table 7. TP Wasteload Allocation by River Basin (pounds).

Watershed	Wasteload Allocation	Historical (2005-2014)	Difference
South Platte	1,005	57	948
Plum Creek	4,694	2,183	2,511
Total	**5,699**	**2,241**	**3,458**

The TP load is the product of concentration and flow volume. Therefore, when simulating the wasteload allocation, increases to both TP concentrations and flow were evaluated. For this analysis, it was assumed that future TP concentrations would remain similar to historical TP concentrations, as dischargers are trying to meet concentration limits, so the increase in TP load is simulated by an increase in the total effluent (total flow) of the facility.

The historical TP concentrations and flow for each facility from the last 10 years of the historical record available in the model (2005-2014) are shown below int Table 8 along with the modified TP concentrations and flow for the full wasteload allocation scenario. The average historical total phosphorus concentrations (2005-2014) were used as the basis of the total phosphorus concentrations in the wasteload allocation scenario. For each facility, historical and wasteload concentrations are similar while flows have increased, contributing to the increase in TP load. The TP concentrations and flows from **Table 8** were used to calculate a monthly TP load for each point source (**Table 9**), which sum to the TP annual wasteload allocation shown above (5,699 pounds).

Table 8. Simulated TP Annual Wasteload Allocation.

Point Source	Historical Data (2005-2014)		Wasteload Allocation Scenario	
	TP Concentration (mg/L)	Flow (ft^3/s)	TP Concentration (mg/L)	Allocation Flow (ft^3/s)
Plum Creek Water Reclamation Authority (PCWRA)	0.22	4.70	0.22	9.87
Lockheed Martin Space Systems Company	0.16	0.19	0.16	3.22
Perry Park Water and Sanitation District (Sageport)	0.24	0.23	0.26	0.71
Perry Park Water and Sanitation District (Waucondah)	0.30	0.07	0.31	0.12

Table 9. TP Monthly Wasteload Allocation (lbs).

Month	PCWRA	Lockheed	Sageport	Waucondah	Roxborough	Total
January	361	85.4	6.1	30.4	0	483
February	326	77.1	6.1	30.4	0	440
March	361	85.4	6.1	30.4	0	483
April	350	82.6	6.1	30.4	0	469
May	361	85.4	6.1	30.4	0	483
June	350	82.6	6.1	30.4	0	469
July	361	85.4	6.1	30.4	0	483
August	361	85.4	6.1	30.4	0	483
September	350	82.6	6.1	30.4	0	469
October	361	85.4	6.1	30.4	0	483
November	350	82.6	6.1	30.4	0	469
December	361	85.4	6.1	30.4	0	483
Total	**4,256**	**1,005**	**73**	**365**	**0**	**5,699**

The model ran for the full period of record (January 1995 to September 2015) and analyzed the results from January 2000 to December 2014, representing the calibrated model record. In this analysis, the results of the wasteload allocation scenario, which represents steady-state conditions where the total phosphorus point source load is always 5,699 pounds per year, were compared to the historical model in which the total phosphorus point source load varies from year to year based on the historical data. The results from the model simulation are shown at key locations in the watershed, South Platte River at Chatfield Reservoir and Plum Creek at Chatfield Reservoir for TP and total flow. Supplementary model results are provided for the point source locations including PCWRA (reach 52), Lockheed Martin (reach 16), Sageport (reach 116), and Waucondah (reach 113).

The model simulation shows there is an average annual increase in TP of approximately 620 pounds in the South Platte River and an average annual increase in TP of approximately 1,830 pounds in Plum Creek (**Table 10**). For the South Platte River, we note that the average annual increase is really 960 pounds (using years 2008-2014), because the Roxborough point source discharges from 2000 to 2007 in the historical model but does not discharge at all in the wasteload allocation simulation, which causes an anomalously low difference from 2000 to 2007. This increase is comparable to the increase for the South Platte shown, indicating that all of the simulated increase in TP load reaches Chatfield Reservoir. In Plum Creek, the simulation shows that on average approximately 73% of the increase in the wasteload allocation is discharged to Chatfield Reservoir, indicating there is some loss from the point source dischargers to Plum Creek before reaching the reservoir.

In **Table 11**, the simulated flows for the South Platte at Chatfield Reservoir and Plum Creek at Chatfield Reservoir are provided to show the increase in flow between the wasteload allocation scenario and the historical model results. The simulated TP loads for each reach where a point source discharges into the watershed is shown in **Table 12.** The results confirm that the largest increases in TP load occur in the reaches where the PCWRA and Lockheed Martin discharge into the watershed.

Table 10. TP Annual Wasteload Allocation at Chatfield Reservoir

	Wasteload Allocation (lbs)		Modeled Historical (lbs)		Difference (lbs) (wasteload – historical)	
Year	South Platte at Chatfield Reservoir (Reach 16)	Plum Creek at Chatfield Reservoir (Reach 15)	South Platte at Chatfield Reservoir (Reach 16)	Plum Creek at Chatfield Reservoir (Reach 15)	South Platte at Chatfield Reservoir (Reach 16)	Plum Creek at Chatfield Reservoir (Reach 15)
2000	6,020	6,940	5,610	4,110	410	2,820
2001	3,680	6,600	3,010	4,100	670	2,500
2002	4,080	4,810	3,550	3,090	530	1,720
2003	7,790	11,810	7,440	10,630	350	1,190
2004	7,310	7,570	7,050	6,870	270	700
2005	8,750	8,240	8,730	6,720	20	1,530
2006	4,690	7,470	4,310	5,610	380	1,870
2007	17,120	21,140	17,090	19,190	30	1,950
2008	4,930	6,590	4,020	5,110	920	1,480
2009	6,280	9,180	5,320	7,750	960	1,430
2010	5,840	17,490	4,860	15,260	970	2,220
2011	2,550	6,890	1,590	4,960	960	1,940
2012	1,630	6,130	680	4,420	950	1,720
2013	3,030	6,190	2,060	4,010	970	2,180
2014	6,920	7,260	5,950	5,070	970	2,190
Average	**6,040**	**8,950**	**5,420**	**7,130**	**620**	**1,830**

Table 11. Total Flow Annual Wasteload Allocation.

Year	Wasteload Allocation (acre-foot (af))		Modeled Historical (af)		Difference (af) (wasteload – historical)	
	South Platte at Chatfield Reservoir (Reach 16)	Plum Creek at Chatfield Reservoir (Reach 15)	South Platte at Chatfield Reservoir (Reach 16)	Plum Creek at Chatfield Reservoir (Reach 15)	South Platte at Chatfield Reservoir (Reach 16)	Plum Creek at Chatfield Reservoir (Reach 15)
2000	71,200	23,160	69,510	17,670	1,690	5,490
2001	52,910	19,390	51,260	14,210	1,650	5,180
2002	34,710	10,650	32,980	5,600	1,730	5,040
2003	53,520	30,330	51,960	25,610	1,560	4,730
2004	48,760	22,700	47,230	18,180	1,530	4,520
2005	76,180	29,400	74,780	25,190	1,400	4,220
2006	86,600	20,080	85,190	16,050	1,400	4,020
2007	258,780	65,650	257,230	62,000	1,550	3,650
2008	114,900	21,180	112,660	17,360	2,240	3,810
2009	113,850	30,010	111,610	26,560	2,240	3,450
2010	105,560	47,680	103,310	43,960	2,250	3,720
2011	61,860	17,050	59,600	13,400	2,260	3,650
2012	25,620	16,820	23,340	13,020	2,280	3,800
2013	55,900	17,010	53,630	13,720	2,270	3,300
2014	140,000	19,580	137,730	16,590	2,270	2,990
Average	**86,690**	**26,050**	**84,800**	**21,940**	**1,890**	**4,100**

Table 52. TP Annual Wasteload Allocation at Point Source Locations

Year	Modeled Wasteload Allocation (lbs)				Modeled Historical (lbs)				Difference (wasteload – historical)			
	PCWRA	Lockheed Martin	Sageport	Waucondah	PCWRA	Lockheed Martin	Sageport	Waucondah	PCWRA	Lockheed Martin	Sageport	Waucondah
2000	6,330	6,020	610	470	3,270	5,610	540	120	3,070	410	70	360
2001	6,160	3,680	600	460	3,490	3,010	530	100	2,680	670	70	360
2002	5,240	4,080	290	410	3,560	3,550	220	50	1,670	530	70	360
2003	8,310	7,790	2,210	800	7,290	7,440	2,140	430	1,020	350	70	360
2004	6,750	7,310	640	480	6,330	7,050	570	120	410	270	70	360
2005	6,860	8,750	1,090	580	5,230	8,730	1,080	320	1,630	20	10	250
2006	6,630	4,690	1,080	560	4,680	4,310	1,070	310	1,960	380	10	250
2007	12,010	17,120	4,200	1,210	9,910	17,090	4,180	1,000	2,090	30	20	210
2008	6,140	4,930	550	470	4,520	4,020	530	310	1,620	920	20	150
2009	7,130	6,280	960	520	5,730	5,320	940	260	1,400	960	30	260
2010	10,050	5,840	3,420	1,090	7,630	4,860	3,390	820	2,420	970	30	260
2011	6,470	2,550	490	450	4,410	1,590	450	170	2,070	960	40	280
2012	5,970	1,630	430	440	4,180	680	380	150	1,790	950	50	290
2013	5,970	3,030	480	450	3,550	2,060	430	170	2,430	970	50	280
2014	6,600	6,920	520	460	4,220	5,950	480	190	2,380	970	40	270
Average	**7,110**	**6,040**	**1,170**	**590**	**5,200**	**5,420**	**1,130**	**300**	**1,910**	**620**	**40**	**290**

PCWRA is located in model reach 52, Lockheed Martin is in reach 16, Sageport is in reach 116, and Waucondah is in reach 113.

REGULATED STORMWATER SOURCES

Colorado's stormwater permit program requires control of stormwater runoff in all Phase I and Phase II Municipal Separate Storm Sewer Systems (MS4) entities. These requirements are separate and distinct from the Chatfield Control Regulations and complement the TMAL's purpose. Through the efforts of the MS4s, rate payers have spent significant funds to address water quality through implementing projects to mitigate impacts from urban stormwater runoff. Authority members with Phase I and II MS4 permits in the Chatfield Basin include:

- Statewide General Permit (COR090000)
  - Jefferson County
  - City of Littleton
- Cherry Creek Reservoir General Permit (COR080000)
  - Douglas County
  - City of Castle Pines
  - Town of Castle Rock
- Individual / Other Permit
  - Castle Pines Metropolitan District
  - Colorado Department of Transportation
- Non-Standard General Permit (COR070000)
  - Douglas County School District
  - E-470 Toll Road
  - Regional Transportation District
  - Castle Pines Metro District
  - Castle Pines North Metro District
  - Highlands Ranch Metro District
  - Highlands Heritage Metro District
  - Meridian Metro District
  - Southeast Metro Stormwater Authority
  - Stonegate Village Metro District
  - Stonegate Village North Metro District

General MS4 permits require the permittee to develop programs that meet six minimum control measures:

- Public education and outreach on stormwater impacts
- Public participation and involvement
- Detection and elimination of illicit connections and discharges
- Construction site stormwater runoff control
- Post-construction stormwater management in development and redevelopment
- Pollution prevention/good housekeeping for municipal operations

MS4 permits require implementation of best management practices (BMPs) to reduce pollutants discharged to the "maximum extent practicable." A summary of 2022 MS4 permit inspection and enforcement metrics are provided in **Table 13.**

Table 6. Summary of 2022 MS4 Permit Activities

Land Use Agency	Permit Number	Permit Inspection Actions			Permit Enforcement Actions		
		Illicit Discharges	Construction	Post-Construction	Illicit Discharges	Construction	Post-Construction
Douglas County	COR080003	2	5888	90	0	200	0
Jefferson County	COR090024	29	498	12	29	20	0
Town of Castle Rock	COR080012	32	3035	298	22	1515	0
City of Littleton	COR090055	5	159	6	1	1	0

Notes:

- Castle Pines Metropolitan District inspection and enforcement action data are incorporated in Douglas County reporting; City of Castle Pines MS4 boundary is predominately in the Cherry Creek Basin; only a very small portion is located in the Chatfield Watershed.
- Town of Castle Rock inspection and enforcement action data includes data from the Cherry Creek Basin and the Chatfield Watershed. The Town of Castle Rock MS4 boundary is predominately in the Chatfield Basin; about two-thirds of the Town is located in the Chatfield Watershed.
- The data for the City of Littleton includes all MS4 activities within the city limits. However, the city limits of Littleton only overlap with the Chatfield watershed boundary for a small portion (i.e., the Trailmark development)
- Data for Jefferson County includes all MS4 activities within the County limits.
- Douglas County data included only MS4 activities within the watershed.

EDUCATION AND OUTREACH

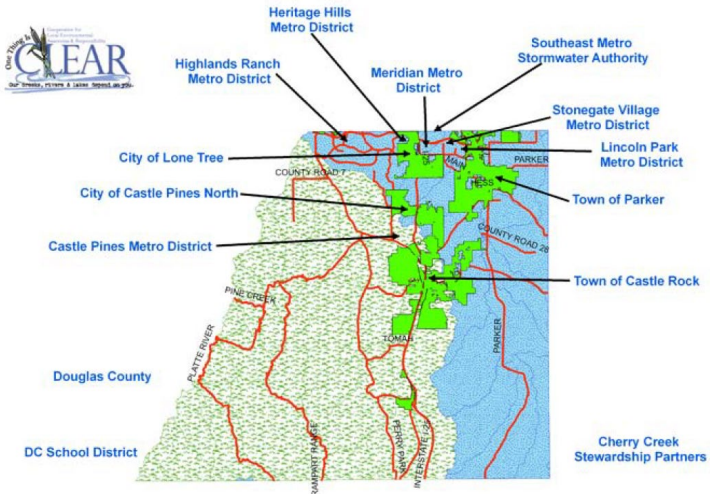
Many Authority members were able to resume some in person events and connect with the public to educate and inform on the benefits of their stormwater programs. Authority members also continued outreach efforts via on-line programs, billing inserts, and advertisements in 2022. Programs used by Authority members are as follows:

Douglas County

Douglas County's Stormwater Management Program provides public education, tracking of stormwater system impact activities, stormwater system project reviews, and coordination between federal, state, and local government for compliance with federally mandated programs.

Through the Cooperative for Local Environmental Awareness and Responsibility (CLEAR), the county has created the "One thing is Clear: our creeks, rivers and lakes depend on you" public awareness program. The interactive website provides information for Douglas County residents on how they can work to keep pollution out of their water ways. CLEAR Members (shown below) collaborated with Members of Stormwater Permittees for Local Awareness of Stream Health (SPLASH) on Nutrient Outreach and training seminars.

Douglas County's 2022 program activities:



- Maintained a portable "Road Show" for members to use as an Education and Outreach tool with the public. "In-person" events continue to be limited due to the COVID-19 pandemic.
- Updated & maintained the CLEAR website at http://onethingisclear.org/.
- A total of 12 two-third page residential and commercial awareness advertisements ran monthly in 10 Colorado Community Media newspapers covering certain portions of Douglas, Arapahoe, Jefferson and Elbert Counties. Ads ran in the Castle Rock News Press, Castle Pines News Press, Douglas County News Press, Highlands Ranch Herald, Lone Tree Voice, Elbert County News, Parker Chronicle, Centennial Citizen, Englewood Herald, Littleton Independent and South Platte Independent.
- Held six (6) membership meetings (February 22nd, April 26th, June 28th, August 23rd, October 25th and December 27th) to discuss the stormwater topics of the day and maintain an organized discussion on the interpretation and application of federal and state stormwater regulations. All meetings are open to the public with the opportunity to comment. Meetings were virtual due to COVID-19.
- Douglas County contracted with Waste Management for a curbside program in 2022 which serves all DC residents even in incorporated areas. The Program started in July and had a total of 355 residential pickups and 39 drop-offs for a total of 21,127 lbs. collected.
- Members supported and attended both general and committee meetings of the Colorado Stormwater Council (CSC).
- Members supported the Cherry Creek Stewardship Partners.
- Members actively participated and commented in CDPHE Stakeholder Meetings for the new Non-Standard MS4 Permit. Members prepared information and participated in December's Non-Standard MS4 Permit Workshop sponsored by SPLASH.

- CLEAR Members continue to collaborate with Members of SPLASH on New Non-Standard MS4 Permit, Nutrient Outreach, training seminars, newspaper ads, etc.

Additional information on various topics related to Stormwater and Pollution Control can be found on Douglas County's website.

Town of Castle Rock

Spring Up the Creek has become a tradition for Castle Rock and draws residents every year to preserve our waterways by removing trash that collects along the stream banks. The event occurred on Saturday, May 7, 2022.

178 community volunteers participated, like the 2019 participation rate. Approximately 89 bags of trash were collected, as well as several large items, consisting mainly of building materials. 18 staff trail leaders from across several departments participated, as well as several family members.

To maintain social distancing, the event was not headquartered at Festival Park, but instead volunteers assembled at specific trailheads. The number of routes was increased from the previous event's 7 to 10 trails throughout Town.

The Town of Castle Rock hosted this event in partnership with Douglas County, Castle Pines Metro District, Chatfield Watershed Authority, and Plum Creek Water Reclamation Authority. Event sponsors included Burns & McDonnell, Dana Kepner, Enginuity, Jacobs, JRS Engineering, Muller, Starwood, and W. W. Wheeler & Associates, Inc. Contributions totaled $3,550, which covered the total cost of the event.

The Town of Castle Rock also invited elementary school students to participate in a tour of the Plum Creek Water Purification Facility. The tour included a water quality presentation.

In October 2022, the Town of Castle Rock adopted a landscape ordinance that limits grass lawns for new residential and commercial properties. The ordinance prohibits grass front lawns, and limits backyards to 500 square feet of irrigated grass lawn. In addition to reducing peak water demand, this ordinance will also reduce the potential for additional fertilizer to enter the drainage system and thereby Plum Creek and Chatfield Reservoir.

Jefferson County

Jefferson County is active in the Bear Creek Watershed Association in addition to the Chatfield Watershed Authority. Both watershed groups have WQCC Control Regulations associated with nutrients and have extensive monitoring and outreach activities. Both groups evaluate the data, identify nutrient sources, hold public meetings and provide outreach to the community.

Jefferson County provides brochures and information on the website related to household hazardous waste collection, sediment and pet waste. Jefferson County hosted a public cleanup of the Clear Creek corridor on National Public Lands Day. There were 690 volunteers that removed 26,250 pounds of trash/debris along 22 miles of the corridor. In addition, Jefferson County provides illicit discharge handouts to contractors and property owners that are obtaining information or a permit related to land disturbance.

Jefferson County provides dog waste bag dispensers and educational materials at approximately 60 locations throughout the Jefferson County Open Space system. Jefferson County is a partner in the collaborative "Lets Doo It!" campaign to promote proper disposal of dog waste. In addition, there are five human waste collection bag (wag bags) dispensers associated with popular rock climbing areas in Clear Creek Canyon.

Jefferson County maintains a small-site erosion control manual that explains the basic principles of erosion and sediment control and illustrates techniques to control sediment from small development sites, and has an inspection program for illicit discharges, construction activities, and post-construction inspections.

Jefferson County regularly reports to the Authority on stormwater management practices and programs. More information about Jefferson County's municipal stormwater program is contained in their CDPS Stormwater Permit Annual Report. More information about Jefferson County's municipal stormwater program is contained in their CDPS Stormwater Permit Annual Report.

City of Littleton

The City of Littleton participated in Stormwater Permittees for Local Awareness of Stream Health (SPLASH), which supports and conducts a wide range of educational activities. In 2022, SPLASH, with Littleton staff, manned a stormwater booth at three Meet, Great, and Eat events on June 15th; July 13th, August 24th; and at the Western Welcome Week on August 20th. SPLASH also put on their first Rain Barrel Workshop.

Staff conducted stream cleanups and water quality educational outreach via the City of Littleton newspaper, at community events, and through social media sites. The City of Littleton holds an annual Hazardous Household Waste collection event with the City of Englewood.

The City of Littleton joined efforts of regional groups with radio advertisements and waterway cleanups. In addition, the City of Littleton publishes articles on water quality awareness in the Littleton Report and social media.

PROGRESS TO PROMOTE WATER QUALITY PROTECTION

While funding sources remain very limited, the Authority's collaborative role seeks out partnerships to support our water quality goals now and in the future. Donations and in-kind services from Authority members to support progress to promote water quality protection included:

- Continued implementation of the amended Intergovernmental Agreement (IGA) and bylaws.
- Continued water quality monitoring program in both the reservoir and the watershed.
- Continued implementation of the Chatfield Watershed Plan.
- Continued collaboration with Chatfield Reservoir Mitigation Company (CRMC) regarding data collection to support CRMC reservoir modeling efforts.
- Continued Watershed modeling efforts.
- Collaboration with local and state agencies in grant funding effort.
- Continued Public Outreach Committee activities.

In addition, our members have been expending significant funds for drainageway and storm sewer projects to reduce erosion and flooding and improve water quality. The following are example projects completed by Authority Members.

Douglas County

Rural Culvert Repair Projects

Projects include lining over 20 roadway culverts throughout rural Douglas County, some of which are located in the Chatfield Watershed. These culverts range from 15-inch to 120-inch in size. The linings vary from slip lining to cured in place pipe, and the capacity is observed at each crossing to keep historic flow conditions.

East Plum Creek Restoration Partnership

The Douglas County Conservation District received a $19,935.00 grant from the Colorado Healthy Rivers Fund for the East Plum Creek Restoration Partnership (EPCRP) located at the Colorado Agricultural Leadership Foundation's (CALF) Historic Lowell Ranch in southern Castle Rock, Douglas County. CALF owns the 168-acre property, and the entire stream restoration project is approximately a 1-mile-long riparian corridor containing East Plum Creek. The property has a conservation easement held by Douglas Land Conservancy in perpetuity. This project is an important link to reduce fragmentation and connect a variety of protected habitats both upstream and downstream of the project. The District in collaboration with project sponsors will work with contractors to continue the successful restoration practices implemented, which include more economical and less disruptive bank-focused lay back and stabilization methods to address bank wasting and the incised channel at the East Plum Creek Restoration Partnership. Once completed a breeding habitat will be created for waterfowl and improved habitat for a variety of Priority Wildlife Species, including beaver with the implementation of diverse plantings, woody debris and drop structures. The habitat improvement for native aquatic invertebrates, fish and amphibians will be specifically targeted as well. This project is an important link to reduce fragmentation and connect a variety of protected habitats both upstream and downstream of the project within this important wildlife corridor.

Town of Castle Rock

Plum Creek Streambank Stabilization

In collaboration with the Authority, Castle Rock Water is managing several current and proposed drainageway improvements along East and West Plum Creek. These projects enhance and, in some cases, reconstruct the natural floodplains in the Town of Castle Rock. This infrastructure serves to reduce public risk from stream channel erosion and flooding. These projects also have a water quality component that ensures our renewable drinking water supplies are preserved and protected.

Craig & Gould North Infrastructure Improvement Project

Managed by David Van Dellen, P.E., Laura Kindt, P.E. and Shantanu Tiwari, the Craig and Gould North Infrastructure Improvement Project is the second phase of improvements in the oldest residential neighborhood in Historic Downtown Castle Rock. Located just south of the Rock, this project is bound by Perry Street to the west, Sunset Drive to the east and Fifth Street to the south and comprises approximately eighty residential properties and one church. The subdivision of Craig and Gould was originally platted in 1874 and the first house within the north area was built in 1897. This neighborhood was first paved in the 1980's with inverted crown streets for drainage and gravel shoulders for parking. Since that time, the Town has responded to several complaints from residents whose houses sit lower than the street and experience flooding during heavy rain events. The Town has addressed this over the years by adding curbing and inlets where necessary to reduce the occurrence of flooding. These solutions were temporary and the neighborhood ultimately needed an overhaul to bring it up to current standards for drainage and safety.

The objectives of the Craig and Gould North Infrastructure Improvement Project were to add storm sewer within the public right-of-way to capture stormwater runoff, replace aging water and sewer infrastructure and upgrade the streets to current residential standards for safety. This includes two travel lanes on all residential streets, parking lanes, curb, gutter and sidewalks throughout the majority of the project. Existing alleyways that remained dirt up to this point were paved with concrete. In order to convey stormwater runoff, an outfall system was needed crossing the railroad. This outfall includes an underground **water quality chamber** to remove pollutants prior to discharging to East Plum Creek.

Construction began in November 2021 and will be completed no later than August 2023. JBS Pipeline, LLC was contracted by the Town to construct the project. Funding is provided by Castle Rock Water and Public Works, with a construction budget of $7.6 million. All properties within the project limits received new service line connections for water and sewer up to the property line. All water services were checked and determined not to have lead piping. Should this have been identified, lead piping services would have been replaced up to the house.

The current cost of the project is $7,217,052, which is within the budget. The project was extended by three weeks due to some necessary changes to the project scope. It is scheduled for completion by August 2023.

Omni Tributary - Prairie Hawk Dr. to Red Hawk Dr.

Lead by Erik Dam, P.E., this project consisted of Stormwater Master Plan improvements for the Omni Tributary drainageway between Prairie Hawk Dr. and Red Hawk Dr. to repair damage to the channel as a result of development runoff, reduce flood risk to adjacent residential properties, decrease sediment transport downstream, and prevent further loss of existing vegetation and trees to the maximum extent possible. Additional channel stabilization measures are also included along the nearby Unnamed Tributary adjacent to Red Hawk Ridge Golf Course Hole No. 6.

Drainageway improvements on Omni Tributary consisted of importing and placing approximately 2,000 CY of fill material and 2,470 CY of topsoil, construction of five grouted boulder drop structures, and installation of riprap at various locations for culvert outlet protection and

bank stabilization. Additionally, seven deciduous and fifteen evergreen trees will be planted at the end of the project to offset some of those lost during construction.

On Unnamed Tributary the scope of work is similar, with construction of one grouted boulder drop structure, riprap installed for bank stabilization and a steel sheet pile cutoff wall added to control the channel slope. Additionally, an existing triple 30" corrugated metal pipe crossing of a neighborhood paved trail was replaced with reinforced concrete pipe and new metal handrails for safety, and an existing raw water line crossing the channel was protected by raising the invert to provide more cover.

The contractor was 53 Corporation, LLC. The cost was $1,345,275, and the project was completed under budget. The project was completed in October 2022 (on time).



FUNDING OF NON-POINT SOURCE PROJECTS

West Plum Creek Stream Management Plan (Total Cost $265,786 with $31,000 in-kind match funding, of which $5,000 cash and $5,000 in-kind services contributed by CWA).

This ongoing project aims to fully document existing conditions and identify risks to fish populations along West Plum Creek, the last relatively unaltered transition zone stream in the South Platte Basin and perhaps the best example of a nearly intact fish assemblage along Colorado's Front Range. Colorado Parks and Wildlife, alongside partners including River Network, US Fish and Wildlife Services, Douglas County's Division of Open Space and Natural Resources, Chatfield Watershed Authority, and others will participate in the creation of a Stream Management Plan to assess native fish habitat, improve water quality, and better understand hydrology and opportunities in water management with the water users. Of primary importance is documenting fish passage barriers and understanding the hydrologic regime of the watershed, and how to maintain its integrity into the future.

Phase I is focused on stream condition assessment and characterization, development of objectives to reduce risk to native fish populations, identification of priority projects for fish passage, and landowner engagement. A subsequent phase will identify and prioritize opportunities in water management, water quality, and river/riparian restoration alongside water users.

Colorado School of Mines 2022 Field Session (Up to $5,000 of in-kind services contributed by CWA)

The Authority participates in the Colorado School of Mines (CSM) annual field session in the Chatfield Watershed. In the field session, CSM students act as consultants to the Authority to perform field investigations, perform in-stream water quality tests, collect samples for laboratory analysis, review water quality test results, summarize field observations and test results, and report their findings to the Authority with in-person presentations and a two-page water quality summary document. In 2022, six groups of an average of five students per group visited over 30 locations in the Chatfield watershed to conduct their field investigations. The Authority uses their findings and data to further the Authority's understanding of water quality in the Chatfield watershed, including obtaining data in several locations not subject to the Authority's water quality monitoring program. This program provides great value to the Authority as it is estimated that these students provide over 2400 manhours of work for the Authority not including the hours spent by CSM professors and teaching assistants who plan and lead the annual field session.

CHATFIELD WATERSHED AUTHORITY MEMBERS

www.chatfieldwatershedauthority.org

Members consist of water and sanitation districts, water providers, municipalities, metropolitan districts and other area stakeholders within the Chatfield Watershed. The membership representation consists of organization staff and elected officials. Membership dues assist with collaborative projects and water quality testing.

Chatfield Watershed Authority Members

City of Littleton
City and County of Denver (acting through its Board of Water Commissioners)
Douglas County
Jefferson County
Roxborough Water & Sanitation District
Town of Castle Rock
Perry Park Water & Sanitation District
Centennial Water & Sanitation District
Town of Larkspur
Castle Pines Metropolitan District
Dominion Water & Sanitation District
Louviers Water & Sanitation District
Plum Creek Water Reclamation Authority

Ex-Officio Participants

Colorado Agricultural Leadership Foundation (CALF)
Colorado Parks and Wildlife Commission (Chatfield State Park)
Colorado Department of Transportation
Colorado Water Conservation Board
Ken Caryl Ranch Master Association
The Law Enforcement Foundation
Ponderosa Retreat
Sacred Heart Retreat
Tri-County Health Department (dissolved on December 31, 2022)
U.S. Army Corps of Engineers
Chatfield Reservoir Mitigation Company
Water Quality Control Division of the Colorado Department of Public Health and Environment

Watershed Manager

Colorado Watershed Assembly

Financials

TWS Financial, Inc.

Technical Consultant

RESPEC Company, LLC