2010
City of Fort Collins

Lower Cache la Poudre River
&
Urban Creek

Water Quality Report

2010 Photo of Fossil Creek Reservoir in morning fog - by Jill Oropeza, Utility Watershed Specialist

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2010 Lower Poudre River & Urban Creek Water Quality Report

Table of Contents

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Introduction:

This 2010 Lower Poudre and Urban Creek Water Quality Report provides a water quality-focused summary of the scope, status and trends of the City's monitoring efforts on the Cache la Poudre River through Fort Collins and three urban creeks in our community. The presentation includes discussion of current and future regulatory changes and initiatives that affect the Poudre. In addition, key stormwater quality enforcement and improvement efforts, regulatory requirements, activities and associated compliance and non-compliance issues are also highlighted. Details on river and creek monitoring site locations, test parameters, key results and trends are presented. It must be noted, however, that aspects of this report are limited in scope: flow and water quality are just two of many key factors that influence and reflect the health of a river or creek. Other factors include man-made changes and activities as well as stream geomorphology and the abundance and diversity of its biological community. The ability of the biological community in a stream to survive and thrive is dependent, in part, on the quantity, quality and physical characteristics of the water flow as well as stream habitat. Future monitoring reporting efforts and programs will strive to identify, assess and explain the interdependencies that tie together the many factors affecting the health of the Poudre and urban creeks in our community.

Purpose of the Report:

In order to fulfill City Council's goal of protecting and enhancing the Poudre River as outlined in Council Resolution 92-14 "Framework for Environmental Action" and Resolution 95-14 "Approving the Watershed Approach to Stormwater Quality Management", City staff has prepared the following status report on water quality conditions in key urban creeks and the Cache la Poudre River through Fort Collins. This report also includes summaries on the 2010 status of several stormwater quality monitoring and improvement programs in the City.

Executive Summary:

In 2010 several significant regulatory changes occurred that reveal both positive and negative trends in current water quality conditions in the Poudre through Fort Collins as well as our urban creeks.

1. **Selenium levels in the Poudre**: Water quality conditions in the Cache la Poudre River from Shields Street downstream to just above Boxelder Creek are currently better than all WQCD-defined aquatic life stream standards except for the levels of selenium. Selenium is associated with shale and is naturally present in the soils, river- and creek-banks in our area. Over the years, higher selenium levels in the Poudre have not been observed. However, the WQCD-defined stream standard is now more restrictive and reported selenium levels exceed that new stricter standard. The selenium levels were sufficient for the WQCD to list the Poudre through the City as 303(d)-impaired for chronic exposure aquatic life standards. The

WQCD gave this listing a low 303(d) priority for corrective action. Further details regarding this issue are presented on page 12.

2. **In 2010, both Fossil Creek and Boxelder Creek were listed in early 2010 as "303(d)-impaired" (low priority) for high selenium levels.** Like the Poudre, exceedances of regulated selenium levels in Fossil and Boxelder Creeks were the result of new, stricter selenium standards and not reduced water quality in the creeks. City data show that high selenium levels in our urban creeks are observed during and after major storm events. In addition, any activities that erode creek banks or otherwise contribute to soil erosion can contribute to higher selenium levels in the water. Further details on this issue are presented on page 45.

3. **In early 2010, both Fossil Creek and Spring Creek were 303(d) listed as impaired, *high priority*, for seasonal *E. coli* contamination**: *E. coli* is an indicator of fecal contamination. Although these bacteria can be pathogens, their presence in water indicates that other water-borne disease-causing enteric bacteria (Salmonella, Shigella) may also be present. In our urban creeks, high *E. coli* levels show strong seasonal trends with the highest levels appearing during the late spring and summer months and the lowest levels during the late fall and winter. These urban creeks are listed as a "high priority" because of the corresponding high probability of human and animal contact during recreational activities in nearby parks. The State is expecting proactive corrective actions be taken on this issue. In response, additional creek water quality monitoring and field survey efforts are underway to ensure that possible illicit discharges, leakage from sewer pipes or septic systems are not contributing to the problem. Additional details on this issue are presented starting on page 54.

4. **Stormwater Monitoring Programs Underway**: The City in cooperation with Colorado State University (CSU) is conducting a wet-weather monitoring program to assess the effectiveness of existing structural stormwater Best Management Practices (BMPs) and new Low Impact Development (LID) BMPs. Data collection activities started in the winter months of 2009 and continued through 2010. Details on the stormwater quality programs begin on page 19.

5. **Nutrient Criteria**: There is one new water quality control program under development in Colorado that will also have significant cost impacts on the design, capital improvements and long-term operation of the City's two water reclamation facilities. This regulatory program is called "Nutrient Criteria". The proposed changes focus on limiting the discharge of the key the nutrients nitrogen and phosphorus into state waterways. These nutrients can promote the growth of nuisance algae that can adversely affect water quality and disrupt the food web in lakes, reservoirs, rivers, and streams. In addition, algae blooms can create aesthetic problems (visual, taste and odor) for drinking water supplies and adversely impact recreational activities like swimming. Currently, the State's "Nutrient Criteria" program is a moving target. It is limited, in part, by the lack of cost-effective treatment technologies available for removing nitrogen and phosphorus from wastewater. Though no decision has yet been reached, CDPHE may begin the program by first imposing nitrogen control limits on wastewater treatment plants over the next several years. Additional details on this issue and its potential impacts are presented on page 14.

These recent and proposed regulatory changes and corresponding impacts at the local level point to the continued need for long-term, proactive monitoring and testing programs for the Poudre and our urban creeks. Successful water quality monitoring programs will help keep our community at the forefront of environmental protection efforts and provide the data necessary for careful stewardship of our limited resources.

- **History of the City's River, Creek and Stormwater Quality Monitoring Programs:**

In the mid-1970s, the Colorado Water Quality Control Commission held its first stream classification hearings for the Cache la Poudre River. At that time, both Federal and State Clean Water Act mandates were being implemented across the state and the nation. Unfortunately, little or no water quality data were available for the Poudre as it flowed past the City's two wastewater treatment plants. At the Commission's hearings it quickly became apparent that because of this lack of data, the City was at both a tactical and strategic disadvantage: proof was needed that treated discharges from its wastewater treatment plants were not harming the river. As a result, the City initiated several long-term monitoring efforts to gather flow and water quality data to protect both the Poudre and the City's interests.

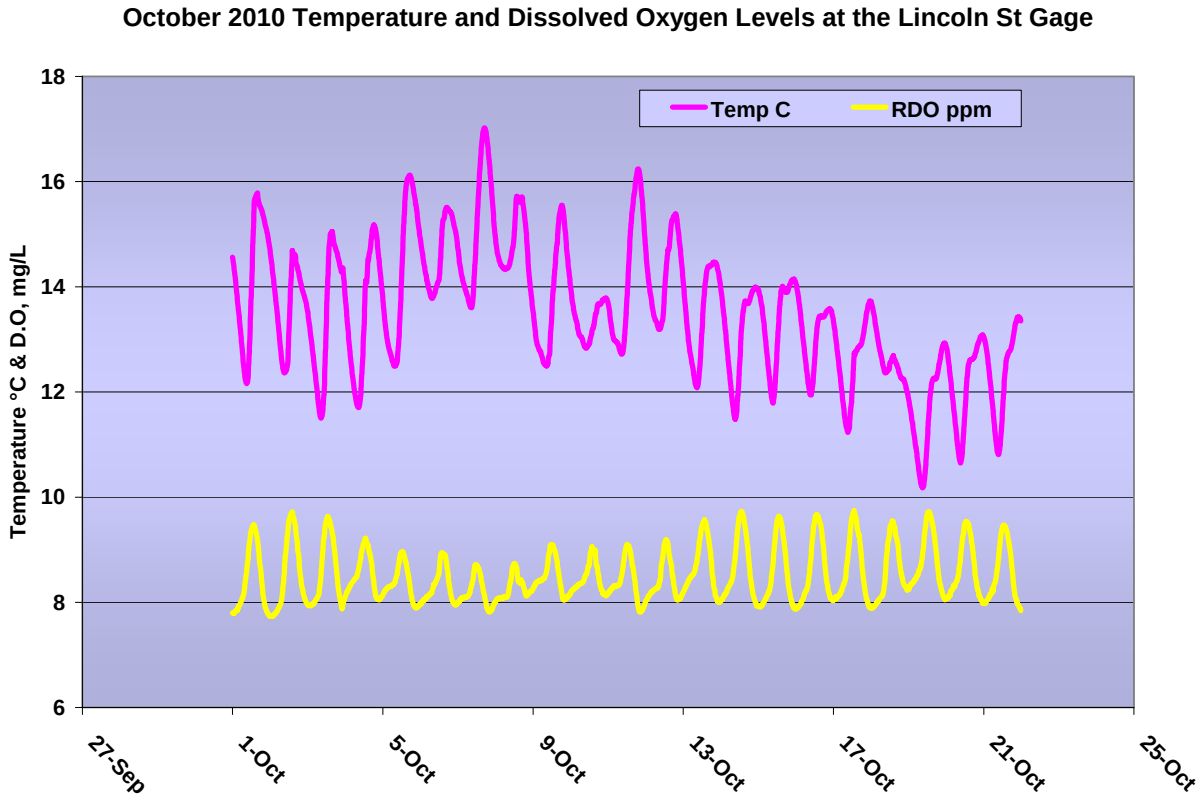
Since the late 1970s and in cooperation with the US Geological Survey (USGS), the City has been monitoring both flow and water quality in the Cache la Poudre River above and through Fort Collins. Beginning in the early 1980s, and in cooperation with Colorado State University and Kodak Colorado Division (KCD), the USGS program was expanded to include assessments of the fish and benthic macro-invertebrate communities in the Poudre. At that same time, City staff from the Pollution Control Lab began weekly water quality monitoring both up- and down-stream of the City's two wastewater treatment plants. The City-CSU-KCD cooperative program expanded in 2007 to form the Poudre Monitoring Alliance.

The Poudre Monitoring Alliance is part of EPA's award winning *Performance Track* program. It brings together under one roof the monitoring efforts of the City, Boxelder and South Fort Collins Sanitation Districts, the Town of Windsor, KCD and the City of Greeley. The alliance monitors over 42 miles of the Poudre at ten separate sights from Lincoln Street to its confluence with the Platte. In May 2007, the Utility received a letter of appreciation from Dave Akers, manager of the Clean Water Facilities program of the Colorado Water Quality Control Division commending the City's thirty year commitment to on-going water quality monitoring on the Cache la Poudre River. In the late fall of 2007, the City received a letter of recognition from then Senator Ken Salazar lauding the example of the Poudre Monitoring Alliance for on-going regional cooperation.

Since 1984, the City has monitored water quality in Parkwood Lake. Beginning in 2000, the City's water quality monitoring program was expanded to include routine testing at three urban creeks: Boxelder Creek, Spring Creek and Fossil Creek. In 2003, the stormwater quality monitoring program initiated a water quality assessment of the effectiveness of the Udall treatment site below Lincoln Street.

- **Agencies with Monitoring Activities on the Poudre & Urban Creeks in Fort Collins:**

Natural water bodies in the Fort Collins area are actively monitored at numerous locations to evaluate the impacts of human and natural activities on water quality. Water quality datasets for some sites in the City begin in the mid-1970s. The Cache la Poudre River, as it flows through town from Shields Street to Boxelder Creek (Segment 11), is currently sampled and tested by several agencies, including: the City of Fort Collins, Colorado State University (CSU), the Colorado Water Quality Control Division (WQCD), the Colorado Department of Health & Environment (CDPHE), the U.S. Geological Survey (USGS), In-Situ, Inc., Boxelder Sanitation District, and RiverWatch.



October 2010 Temperature and Dissolved Oxygen Levels in the Cache la Poudre River at the Lincoln St Gage. This data was collected in cooperation with In-Situ®, Inc. as part of an on-going program to monitor water quality in the Poudre in "real time". Note strong natural diurnal high-low cycles for these two water quality parameters. Their relationship is an inverse function: warmer water temperatures result in lower dissolved oxygen levels. This and other real-time water quality data from this site are collected and relayed to an on-line database using instrumentation provided by In-Situ®, Inc. The 15 minute interval data can be viewed and downloaded in near real time via the internet.

Water Quality Monitoring Locations, Test Parameters and Test Frequencies:

Location details for the City's water quality monitoring sample sites on the Cache la Poudre River are presented in **Appendix A**. The table includes sites routinely checked by the staff from the Utility's Pollution Control Lab plus river sites that are part of the Poudre Monitoring Alliance. **Appendix A** provides details on the 2010 monitoring locations and test frequencies for the Cache la Poudre River and six urban creek sites, respectively. In addition, maps of the Boxelder Creek, Spring Creek and Fossil Creek watersheds are presented

Currently there are four key monitoring sites on the Poudre in Fort Collins that are checked each week by staff from the Pollution Control Lab:

1. the Lincoln Street USGS Gage (06752260),
2. a site upstream of Prospect Street,
3. at the Nature Center above the Drake Water Reclamation Facility (DWRF), and
4. at the USGS Boxelder Gage (06752280) located upstream of the confluence of the Poudre with Boxelder Creek above I-25.

Moving downstream from the Boxelder Gage to the confluence of the Poudre with the South Platte, there are six additional river sites that combine to form the ten water quality test locations for the Poudre Monitoring Alliance.

To evaluate the potential impacts of the City's two wastewater treatment plants on the Cache la Poudre River, the Utilities sponsors a biosurvey program of fish and bottom-dwelling invertebrates in the river both upstream and downstream of the City's water reclamation facilities. CSU provides the field experience and technical expertise for these studies. The City, Carestream Health, Inc (formerly Kodak Colorado Division) and CSU have participated for 30 years, and Boxelder Sanitation District joined the program eight years ago. At a location on the Poudre downstream of Martinez Park, the City and Carestream share the costs of the biosurvey program.

Beginning in 2007, the biosurvey program became an integral part of the Poudre Monitoring Alliance. For the City of Fort Collins and as part of the regional Poudre Monitoring Alliance, this biosurvey program includes: 1) testing four sites eight times each year for bacteriological, physical, and chemical parameters, 2) testing three sites four times each year for benthic macro-invertebrate population abundance and diversity, and 3) testing two sites once each year for fish abundance and diversity. Overall the data show strong seasonal trends with generally the highest species diversity and population numbers in early summer months. Similarly, the data show that the Poudre below Shields Street to the confluence with the Platte is primarily flow and habitat-limited rather than water quality-limited.

Graphical depictions of the 2010 CSU fish survey results completed for the Poudre Monitoring Alliance are presented in **Appendix D**, page 61. Percent Abundance and biomass results by species are presented for four sites on the Poudre starting upstream of Lincoln Street in Old Town to the Strauss Cabin located upstream of I-25. The complete 2010 Poudre water quality, fish and macroinvertebrate survey report from CSU is available from the Utility's Environmental

Services Division. Below are a partial listing of the fall season 2010 fish survey results from Dr Bestgen and his staff at CSU:

Site P-1 Poudre River 75 m upstream of Lincoln St. Bridge, Fort Collins

Seining time (min)	22	Seine haul #	8	Sampling date	3 Nov. 2010
Electrofishing time (min)	22	seconds	1204		
Sampling duration	830-900				

Common Name	Abundance (No.)	(%)	Biomass (kg.)	(%)
johnny darter	3	6.0	0.0017	0.38
white sucker	2	4.0	0.0376	8.36
brown trout	14	28.0	0.3815	84.78
longnose sucker	5	10.0	0.0076	1.69
creek chub	1	2.0	0.0007	0.16
longnose dace	25	50.0	0.0209	4.64
6 species				
Totals	50	100.0	0.45	100.00

Site P-2 Poudre River 200 m upstream of Prospect St. Bridge, Fort Collins

Seining time (min)	22	Seine haul #	9	Sampling date	3 Nov. 2010
Electrofishing time (min)	22	seconds	1192		
Sampling duration	1000-1030				

Common Name	Abundance (No.)	(%)	Biomass (kg.)	(%)
brown trout	8	9.6	2.834	63.87
rainbow trout	3	3.6	1.45	32.68
white sucker	1	1.2	0.0025	0.06
longnose dace	58	69.9	0.1162	2.62
fathead minnow	13	15.7	0.0344	0.78
5 species				
Totals	83	100.0	4.4371	100.00

Site P-3 Poudre River Adjacent to Boxelder Sanitation District plant, at east edge of the Environmental Learning Center.

Seining time (min)	22	Seine haul #	10	Sampling date	3 Nov. 2010
Electrofishing time (min)	22	Seconds	1499		
Sampling duration	1100-1130				

Common Name	Abundance (No.)	(%)	Biomass (kg.)	(%)
Longnose dace	1	1.1	0.0038	0.10
rainbow trout	4	4.3	2.7500	74.57
green sunfish	11	12.0	0.0967	2.62
Common carp	10	10.9	0.1004	2.72
johnny darter	1	1.1	0.0012	0.03
white sucker	34	37.0	0.5204	14.11
fathead minnow	6	6.5	0.0128	0.35
largemouth bass	20	21.7	0.1874	5.08
sand shiner	5	5.4	0.0149	0.40
9 species				
Totals	92	100.0	3.6876	100.00

Site P-4 Poudre River, Near Strauss Cabin

Seining time (min)	17	Seine haul #	8	Sampling date	3 Nov. 2010
Electrofishing time (min)	25	seconds	1496		
Sampling duration	1340-1410				

Common Name	Abundance (No.)	(%)	Biomass (kg.)	(%)
common carp	9	12.2	3.1067	73.32
creek chub	1	1.4	0.018	0.42
largemouth bass	6	8.1	0.0677	1.60
fathead minnow	13	17.6	0.0312	0.03
sand shiner	7	9.5	0.0133	0.31
white sucker	38	51.4	1	23.60
6 species				
Totals	74	100.0	4.2369	99.29

Water Quality Monitoring Programs and Associated Cost:

The following table presents a listing of the City's 2010 water quality monitoring programs on the Poudre and urban creeks with their associated costs. Details on the costs for the City's stormwater quality monitoring programs are presented on page 35.

2010 Poudre River and Urban Creek Water Quality Program Cost Summary:

2010 Monitoring Program Description	Cost	Comment
USGS: U.S. Geologic Survey cooperative monitoring program for six flow and two water quality sites on the Cache la Poudre from the Michigan River near Cameron Pass to the gage station upstream of Boxelder Cr.	$116,580	City's share: $81,680. Federal funds cover remainder.
Poudre River: City's Pollution Control and Water Quality Lab monitoring on Cache la Poudre River at both up- and down-stream sites from water reclamation facilities with both a weekly schedule and 8 special data collections for the Poudre Monitoring Alliance including the CSU fish and benthic macroinvertebrate surveys.	$92,152	Cost value of field sampling, field measurements and lab work; includes City's portion of Poudre Monitoring Alliance Program.
Urban Creeks: City's Pollution Control and Water Quality Lab quarterly monitoring at two sites on three urban creeks plus Parkwood Lake at three locations twice each year.	$6,939	Cost value of field sampling, field measurements and lab work.
Fossil Creek Ditch: 2008 - 2010 City's Pollution Control and Water Quality Lab bi-weekly monitoring of Fossil Creek Ditch at three sites from above the Drake WRF to Kechter Drive above the inlet to Fossil Cr Res. Monitoring began in late fall of 2008 and continued through 2010.	$46,484	Cost value of field sampling, field measurements and lab work. Study needed for development of future DWRF discharge permit limits.
2009 – 2010 Evaluation of Anti-Degradation Requirements (ADR) on the City's treated wastewater limits by the CU Center for Limnology	$8,040	Study to determine the impacts of ADR with resulting stricter discharge limits for the City's two water reclamation facilities
Fossil Cr Reservoir Water Quality: 2008 – 2010 Fossil Creek Reservoir water quality study for the Drake Water Reclamation Facility (DWRF). The study was needed for development of DWRF discharge permit limits.	$56,273	Cooperative monitoring program and cost sharing between the City and South Fort Collins Sanitation District. Data analysis and reports from Western Environmental Analysts, Inc.
2010 **CSU** Fish and Macro-invertebrate Biosurveys on the Poudre through the City	$22,250	Part of the Lower Poudre Monitoring Alliance Program

In 2010, the City committed over $348,000 to collect both water quality and flow data on the lower Cache la Poudre River, key urban creeks and Fossil Creek Reservoir. This data is used to help manage operations at the City's two water reclamation facilities and to manage its extensive water rights portfolio. The data is also used to assess stormwater impacts on key urban creeks in the City as well as the river.

Is the Cache la Poudre River through Fort Collins Meeting All Stream Standards? No, Selenium levels exceed the aquatic life stream standards.

Water quality conditions for the Cache la Poudre are reviewed approximately every five years by the Water Quality Control Division (WQCD) of the Colorado Department of Public Health and Environment (CDPHE). This review is used to develop new stream classifications and standards, to identify exceedences in water quality standards and then to subsequently develop discharge permit limits for industries, communities and sanitation districts. Permitted discharge limits are designed to protect public health as well as aquatic life in the receiving stream. The WQCD completed a review of the Poudre through Fort Collins in 2010. A summary of their findings is presented in the following table:

Poudre Water Quality: Standards vs. Actual Test Results. 2010 report from the Colorado Water Quality Control Division for Segment 11 of the Cache la Poudre from Shields Street to Boxelder Creek just upstream of I-25.

Parameter	TVS†	Results‡	# of Tests	Meeting Std?
pH, std units	6.5 – 9.0	7.6 – 8.51	438	Yes
Dissolved Oxygen, mg/L	5	8.4	384	Yes
Hardness, mg/L as CaCO3	NA	284	448	Yes
E. coli # / 100ml	126	24	185	Yes
Arsenic, dissolved, µg/L	7.6	0	112	Yes
Cadmium, dissolved, µg/L	0.93	0	148	Yes
Copper, dissolved, µg/L	21.81	2.77	330	Yes
Iron, dissolved, µg/L	NA	69	286	Yes
Iron, total recoverable	1000	180	264	Yes
Lead, dissolved, µg/L	7.67	0	145	Yes
Manganese, dissolved, µg/L	2335	53.4	119	Yes
Selenium, dissolved, µg/L	**4.60**	**5.4**	**205**	**No**
Silver, dissolved, µg/L	1.93	0	208	Yes
Zinc, dissolved, µg/L	302.5	23.2	147	Yes
Uranium, dissolved, µg/L	4738	9.4	5	Yes
Ammonia-N, mg/L	TVS	0.3	381	Yes
Nitrate-N, mg/L	100	1.18	252	Yes
Sulfate, mg/L	NA	282.4	75	Yes

Derived from "Colorado Department of Public Health & Environment. Water Quality Control Commission, Regulation No. 38, WQCD Exhibit 38-11, June 2009..

† = TVS: Table Value Standard µg/L = part per billion mg/L = part per millions

‡ Results from the Water Quality Control Division, US Geological Survey, RiverWatch, Boxelder Sanitation District and the City of Fort Collins. Selenium exceedences on the Cache la Poudre were reported by RiverWatch. TVS stream standard for Selenium was reduced by the EPA to a lower level in 2001. Selenium exceedences were the result of stricter standards, more reported data and not a change resulting in deterioration of water quality.

The chronic dissolved selenium standard was exceeded in the Cache La Poudre River at the USGS gage above Boxelder Creek (BSD #Station 4), at Lee Martinez Park (Riverwatch, RW #599), at Prospect Rd. (RW #602), and above Boxelder Creek (USGS #6752280). The acute dissolved copper standard was exceeded in the Cache La Poudre River at Lee Martinez Park (RW #599).

303(d) Listing of *Impaired* Waters on the Cache la Poudre River

In accordance with Section 303 of the Clean Water Act (PL 92-500), the Colorado Water Quality Control Division (WQCD) evaluates waters every two years to determine if they are impaired from meeting their water quality criteria. Waters that are determined to be impaired are added to the State's 303(d) list and become eligible for grant funds to determine the cause of impairment. Based on data collected in part by the City, the Cache la Poudre River, below the confluence with Boxelder Creek and then east to the South Platte River was put on the State's 303(d) list for high *E. coli* levels in 2004. The presence of *E. coli* is an indicator of fecal contamination in the water. This has been a long-term issue on the lower reaches of the Cache La Poudre and is attributed primarily non-point source, stormwater runoff and irrigation return waters from agricultural operations.

Table 3 presents a summary of the 303(d) listing status for the Cache la Poudre River from the Monroe diversion through the various classification segments to its confluence with the Platte River east of Greeley.

However, both Fossil and Boxelder Creeks as well as Segments 11 and 12 of the Poudre below Shields Street are listed as 303(d) impaired for selenium values that exceed the aquatic life chronic table value stream standard of 4.6 µg/L (part per billion). The following paragraph provides details on the toxicity, nature and fate of selenium in waters and the environment:

> *"Selenium is an essential nutrient for humans and animals. There is a narrow margin between too little and too much selenium. Selenium can be harmful to humans at 5 to 10 times recommended daily dose (55 micrograms per day for adults). Selenium is more toxic to vertebrates than to invertebrates and plants. Selenium is more toxic to fish and wildlife than to humans. Selenium "bioaccumulates" in the food chain, when selenium is ingested in amounts greater than the body needs, the excess selenium is not excreted, but instead is retained within the body. As organisms are preyed upon by other animals higher on the food chain, the predator takes on the entire body burden of selenium carried by the prey. High concentrations of selenium can result in adverse impacts to birds and fish, including selenium poisoning and reproductive toxicity. Extremely high concentrations of selenium can result in adverse impacts to livestock."* (Source: Fountain Creek Watershed Group, Pikes Peak and Pueblo Areas Council of Governments)

It should be noted that the selenium-impaired listings given in the following table are a result of a lower EPA and CDPHE aquatic life stream standard and <u>not</u> changing water quality. For comparison, the safe drinking water standard for selenium is 50 µg/L (microgram per liter or part per billion, ppb) and Fort Collins drinking water contains less than 1 µg/L or less than 1 ppb.

2010 Colorado 303(d) Listing of Impaired Waters on the Cache la Poudre River:

River Segment COSPCP ID#	Segment Description	Designation	Use Classifications	Portion	Impairment	State's Priority	Easy Fix?
10	**Cache la Poudre River, Monroe Canal to Shields Street**	Anti-Degradation Review (ADR) in 2009†	Aquatic Life Cold 2 Recreation E Water Supply Agriculture	Below confluence with North Fork	**pH, Copper**	Medium	No
11	**Cache la Poudre River, Shields St to Boxelder Cr**	ADR in 2009†	Aquatic Life Warm 2 Recreation E Agriculture	All	**Selenium**	Low	No
12	**Cache la Poudre River, Boxelder Cr to S. Platte River**	ADR in 2009†	Aquatic Life Warm 2 Recreation E Agriculture	All	**Selenium / *E. coli***	Low / High	No
13a	All tributaries to the Cache la Poudre River, including all lakes reservoirs and wetlands, from the North Fork of the Cache la Poudre River to the confluence with the South Platte River; **Spring and Fossil Creeks**	--	Aquatic Life Warm 2 Recreation E Water Supply Agriculture	Spring Cr & Fossil Cr	**Selenium for Fossil Cr / Seasonal *E. coli* both Fossil and Spring Creeks**	Low / High	No
13b	**Boxelder Creek** from source to the Cache la Poudre River	--	Aquatic Life Warm 2 5/15-9/15 Recreation P 9/16-5/14 Recreation N Agriculture	All	**Selenium / Seasonal *E. coli***	Low / High	No
22	**Fossil Cr Reservoir**	Use Protected Status Renewed in 2009	Aquatic Life Warm 2 Recreation E Water Supply Agriculture	Fossil Creek Reservoir	Selenium	Low	No

Derived from: Colorado Department of Public Health and Environment; Water Quality Control Commission; 5 CCR 1002-93 April 2008; Regulation #93; Section 303(d) list water-quality-limited segments requiring TMDLs. † Moved to "Reviewable" Anti-Degradation Status by the Water Quality Control Commission on 09 June of 2009.

Proposed Colorado Nutrient Criteria for Lakes, Reservoirs, Rivers & Streams

Background:

Nutrient criteria will be adopted in the 2012 Regulation 31 Basic Standards Hearing. In preparation for that hearing, the Colorado Department of Health and Environment (CDPHE) - Water Quality Control Division (WQCD) has developed preliminary criteria for total phosphorus and total nitrogen.

The nutrient criteria will consist of both a "**Control Regulation**" for permitted dischargers and a set of "**Stream Standards**" spelled out in the Water Quality Control Division's Regulation 31:

- The **Control Regulation** will define technology-based requirements for dischargers to "control" the release of nutrients and will be based on best available technology (BAT):

Control Parameter	Annual Average Effluent Concentration	Quarterly Average Effluent Concentration
Total Phosphorus	0.7 mg/L	1.0 mg/L
Total Inorganic Nitrogen (TIN)	5.7 mg/L	9.0 mg/L

Other requirements of the proposed control regulation include:

- Municipal Separate Stormwater System (MS4) control measures:

  Public education and outreach targeting potential nutrient sources and
  Identification and control of nutrient sources from municipal operations

- Proposed Monitoring requirements for Publicly Owned Treatment Works (POTWs):

  Monthly effluent monitoring for total inorganic nitrogen (TIN) and phosphorus and
  Monthly in-stream monitoring above and below the POTW discharge

- Proposed Monitoring Requirements for MS4s:

  Both wet and dry weather monitoring at representative outfalls throughout the MS4

- **Stream Standards:** Regulation 31 will set water quality standards based on protection of designated uses and these standards will be based on best available science.

  The WQCD has developed the following preliminary stream standards for total phosphorus and total inorganic nitrogen levels for rivers and streams:

Proposed Nutrient Criteria Regulated Standards for Rivers and Streams:

	Total Phosphorus	Total Inorganic Nitrogen (TIN) †
Cold Water	0.11 mg/L	0.40 mg/L
Warm Water	0.16 mg/L	2.0 mg/L

† Total Inorganic Nitrogen is the sum of the levels of Ammonia-Nitrogen, Nitrate-Nitrogen and Nitrite-Nitrogen. From Shields Street to the Platte, the Poudre is classified as "warm water".

The WQCD has also developed the following preliminary criteria for chlorophyll-a, phosphorus and total inorganic nitrogen for lakes and reservoirs that are directly used as drinking water supplies and that can be significantly impacted by nutrient loading.

Proposed Nutrient Criteria Regulated Standards for Lakes and Reservoirs:

Designation	Chlorophyll-a	Total Phosphorus	Total Inorganic Nitrogen (TIN) †
Cold Water	8 µg/L	0.02 mg/L	0.41 mg/L
Warm Water	20 µg/L	0.08 mg/L	0.85 mg/L

These very low levels of nutrients are intended to prevent the growth of nuisance algae that can produce taste and odor problems in drinking water as well as to prevent the production of algal toxins.

Comparison of Proposed Colorado Nutrient Criteria to Various Wastewater Treatment Technologies:

Treated Effluent Test Parameter	Typical Municipal Raw Sewage, mg/L	Treated Effluent (No Nutrient Removal), mg/L	Typical Biological Nutrient Removal (BNR), mg/L	Enhanced Nutrient Removal (ENR), mg/L	Limits of Current Treatment Technology, mg/L	Draft Colorado In-Stream Nutrient Criteria, mg/L Cold Water (Warm Water)
Total Phosphorous	4 - 8	4 - 6	1 – 3	0.3 or less	0.05 - 0.07	0.11 (0.16)
Total Nitrogen	25 - 35	20 - 30	8 - 10	3 - 6	3 -4	0.40 (2.0)

Sources: **Municipal Wastewater Treatment Considerations: Dave Clark (HDR) – presentation to Colorado Nutrient Workgroup, April 13, 2010:**
http://projects.ch2m.com/cwqf/Workgroups/Content/nutrient_criteria/Meetings/04%202010%20April/Colorado%20Nutrient%20LOT%20and%20Permitting.pdf
and http://www.waterworld.com/index/display/article-display/286210/articles/waterworld/volume-23/issue-3/editorial-feature/wastewater-industry-moving-toward-enhanced-nutrient-removal-standards.html

- **Potential "Nutrient Criteria" Implementation Issues for both Drinking Water Treatment & Water Reclamation Operations in Fort Collins**:

Technology is getting close to achieving the proposed phosphorous level, but is no where near achieving that proposed for nitrogen. The associated costs increase dramatically as different

technologies are applied from advanced treatment nutrient removal to enhanced nutrient removal and finally to the limit of technology.

These treatment processes are expensive and use a lot of energy. The Denver Metro Wastewater Treatment Department completed as detailed evaluation of the potential costs associated with nutrient removal. They have reported that in order to achieve levels of 3 mg/L nitrogen and 0.1 mg/L phosphorous, it will cost Denver Metro $2.2 billion in capital costs, with an annual incremental increase of $20 million for operational and maintenance costs. This represents a 12 to 13% cost increase per year for treatment services. To achieve levels of 1.3 mg/L nitrogen and 0.05 mg/L phosphorous would cost an additional $2.8 billion in capital expenditures, with an annual incremental increase in $20 million for operational and maintenance costs (from Nutrient Criteria Meeting - April 13, 2010, Memo of Jerry Raisch and Aine L. Durkin, 21 April 2010).

- **Cost Implications to the City to Implement Nutrient Controls**:

  - Both capital improvements and operational changes will be needed to bring the DWRF into compliance with the proposed tighter limits on discharges of phosphorus and total inorganic nitrogen (TIN). TIN is the sum of the ammonia, nitrate and nitrite concentrations as nitrogen.

  - Planning and design for those improvements are already underway for the DWRF. Biological Nutrient Removal (BNR) is planned for the plant within the next 4 years at a cost of 12 million dollars. If proposed regulations require Enhanced Nutrient Removal, and additional 24 million dollars in phosphorus and nitrogen removal improvements will be required.

  - Biological Nutrient Removal was recently completed at MWRF for phosphorus and TIN removal. If regulations dictate Enhanced Nutrient Removal of phosphorus and nitrogen, an additional 8 million dollars will be required.

- **Anticipated Nutrient Criteria Implementation Timeline**:

  - If the WQCD follows the proposed schedule for nutrient criteria implementation, these criteria will be incorporated into the Mulberry and Drake Facilities discharge permits in approximately 2017/2018. It may be possible to receive a 5 year + compliance schedule to meet the proposed nutrient standards.

  - **Best Case Scenario Timeline** – Temporary modifications are adopted in the 2015 Stream Standards (Regulation 38) South Platte Basin Hearing. This would delay implementation of nutrient criteria into discharge permits past 2018 and allow for five year compliance schedules.

- **Worst Case Scenario Timeline** – The WQCD does not grant temporary modifications, adopts nutrient criteria simultaneously into the basin regulations, and does not allow lengthy compliance schedules. Compliance with nutrient criteria would be required as early as 2017.

- **Control Regulation "85" for Publicly Owned Treatment Works (POTWs)**:
  - The rulemaking hearing is scheduled for March 2012
  - It would become effective May 2012
  - It would be adopted into the City's permits 2015-2016 (based on no backlog)
  - Provision of a compliance schedule is unknown.

- **Nutrient Control Stream Standards (Regulation 31)**:
  - The rulemaking hearing is scheduled for March 2012
  - Total Phosphorus (Total P) limits are proposed
  - They would become effective May 2012
  - They would be implemented in various Colorado river basins beginning 2022
  - Total Inorganic Nitrogen (TIN) limits are proposed. These would control the sum of ammonia-nitrogen, nitrate-nitrogen and nitrite-nitrogen in treated effluent
  - TIN limits would become effective in May 31, 2017

- **Nutrient Criteria and Drinking Water Treatment**:

It is likely that a new sub-designation for drinking water reservoirs will be available for those reservoirs where water is taken out and then treated for drinking water. This is in contrast to reservoir waters that are not going into another reservoir or stream. The subset will be referred to as *direct use* reservoirs. It is likely that these reservoirs will have more stringent nutrient standards than reservoirs that are not directly used for drinking water supply.

This proposed "reservoir" sub-designation would affect Horsetooth Reservoir, one of the City's two drinking water supplies. In 2010, the average total phosphorus concentrations in the raw water intakes from Horsetooth Reservoir and the Cache la Poudre River were 0.01 and 0.03 mg/L (ppm), respectively. These levels are well below the proposed limits for a direct use drinking water supply.

Should either Glade or Halligan-Seaman Reservoirs be used as direct sources for drinking water production rather than water exchanges, nutrient criteria may become important issues in relation to both water production and non-pointsource pollution control.

The Change to "*Anti-Degradation Review Status*" for the Cache la Poudre River through Fort Collins:

For over thirty years, Segment 11 of the Poudre River from Shields Street to the confluence above Boxelder Creek, has been designated "*use-protected*". The "Use protected" classification meant that regulated discharges, such as permitted wastewater effluents, could "use-up" the assimilative capacity of the river up to the water quality standard. Like other dischargers to "use-protected" streams, discharge limits for the City's Mulberry and Drake Water Reclamation Facilities (MWRF & DWRF) were calculated on that assumption. In their 2008 review of stream classifications and standards, the Colorado Water Quality Control Division (WQCD) reported:

> ***"Evidence shows that the water quality in this* [i.e. the Poudre] *segment is better than TVS* [*sic*: table value standards] *for the key parameters, and supports the removal of the Use-Protected designation as defined in 31.8(2)(b). Of the 12 key parameters, only the dissolved selenium standard was exceeded."***

The WQCD reached this determination after careful review of the available water quality data in that segment of the Poudre. The Division made use of the extensive water quality datasets collected directly by the City's Pollution Control Laboratory and as well as the City-sponsored USGS flow and water quality monitoring program on the Poudre through Fort Collins.

Subsequently in June 2009, the Colorado Water Quality Control Commission (WQCC) approved the change to "anti-degradation review (ADR)" status for Segments 10, 11, and 12 of the Poudre. The basic purpose of ADR status is to maintain and protect existing water quality. These three classification segments extend from the Monroe Canal diversion upstream of Gateway Park to the confluence of the Poudre with the Platte east of Greeley. A more thorough discussion of ADR is available in the 2009 Lower Poudre and Urban Creek Water Quality Report. Overall, it will mean stricter discharge limits in the future for both of the City's water reclamation facilities

2010 Colorado Water Quality Control Division Stream Classification Segments of the Lower Cache la Poudre River. Segments 10, 11, 12, 13b and 14 are all now classified with anti-degradation review (ADR) status:

Poudre River Classification Segment ID#	Segment Description
10	Cache la Poudre River, Monroe Canal to Shields Street
11	Cache la Poudre River, Shields St to Boxelder Cr
12	Cache la Poudre River, Boxelder Creek to S. Platte River
13a	All tributaries to the Cache la Poudre River, including all lakes reservoirs and wetlands, from the North Fork of the Cache la Poudre River to the confluence with the South Platte River (Spring Creek, Fossil Creek, Parkwood Lake)
13b	Boxelder Creek from source to the Cache la Poudre River
14	Horsetooth Reservoir
22	Fossil Creek Reservoir (Use-Protected Classification)

Stormwater Quality Study Programs Underway in 2010 and 2011:

In cooperation with Colorado State University (CSU), the City continued work on the wet-weather monitoring program to assess the effectiveness of existing structural stormwater Best Management Practices (BMPs) and new Low Impact Development (LID) BMPs. The program has been in operation now for two years and will be extended through an extension of the CSU contract beyond its original September 2011 end date to September 2012. The extension will be funded from the existing contract funds as the as the originally allocated amount was sufficient to cover the additional costs through 2012.

Existing City owned and operated BMPs currently being monitored include the wetlands located at the Howes Outfall near Martinez Park, the large regional water quality pond located at the Udall Natural Area and the sand infiltration basin located at 215 N. Mason Street.

The City's LID pilot projects, which incorporate more innovative BMPs, include the permeable pavers at the Mitchell Block (Bohemian Foundation Building) and the porous concrete pavement located at CTL Thompson (351 Linden St.) The locations of the stormwater sampling sites are shown on the attached map. [see attached map]

Tree filter at Mitchell Block

BMP monitoring began in fall of 2009. Approximately 20 precipitation events have been monitored through May 2011, though not all sites were monitored for both water quality and quantity for all of those events for various reasons. Our sampling protocol is designed to monitor water quality during events with total precipitation between approximately 0.25-1 inches, so events smaller and larger than those are generally not monitored for water quality. On average, approximately 8-10 such events occur in Fort Collins per year.

Mitchell Block Inlet Sampling Station.

Preliminary results of BMP/LID effectiveness for removing select pollutants are presented in the tables below. These results are from 2009-2010 water quality monitoring data and are reported in terms of annual pollutant loading (lbs/year). With few exceptions, the BMPs/LIDs for which results were computed show significant reductions in Total Suspended Solids (TSS), Total Nitrogen (TN), Total Phosphorus (TP), Total Zinc (TZn) and Total Copper (TCu). The permeable pavement sites at Mitchell Block also show significant reduction in *E. coli*, however both the Udall ponds and Howe's St wetland show negative reductions in *E. coli*. Generally, this is expected in such BMPs as standing water not only attracts wildlife (a significant source of *E. coli*) but also provides a warm environment (especially during the summer) that promotes *E. coli* growth. This is a well known "Catch 22" in terms of stormwater BMP treatment.

Udall Natural Area Stormwater Control Pond Outlet.

Preliminary BMP Treatment Effectiveness Results:

Howes Outfall Total Annual Loading				
Pollutant	In	Out	Difference	% Reduction
TSS (lbs)	270000	58000	212000	79%
TN (lbs)	4700	5700	-1000	-21%
TP (lbs)	1400	770	630	45%
TCu (lbs)	17	12	4.4	27%
TZn (lbs)	100	84	16	16%
E. coli (#)	1.5E+11	5.8E+11	-4.3E+11	-289%

Udall Outfall Total Annual Loading				
Pollutant	In	Out	Difference	% Reduction
TSS (lbs)	260000	87000	173000	67%
TN (lbs)	4100	3000	1100	27%
TP (lbs)	1700	520	1180	69%
TCu (lbs)	37	11	26	71%
TZn (lbs)	210	56	154	74%
E. coli (#)	2.6E+11	3.1E+11	-5.0E+10	-19%

Mountain Ave Total Annual Loading				
Pollutant	In	Out	Difference	% Reduction
TSS (lbs)	140	9.10	131	94%
TN (lbs)	3.4	1.30	2.1	62%
TP (lbs)	0.94	0.21	0.7	78%
TCu (lbs)	0.02	0.01	0.0	36%
TZn (lbs)	0.11	0.01	0.1	90%
E. coli (#)	1.4E+08	3.1E+06	1.4E+08	98%

Walnut Ave Total Annual Loading				
Pollutant	In	Out	Difference	% Reduction
TSS (lbs)	100	5.20	95	95%
TN (lbs)	2.4	0.75	1.7	69%
TP (lbs)	0.66	0.18	0.5	72%
TCu (lbs)	0.01	0.00	0.0	69%
TZn (lbs)	0.08	0.01	0.1	93%
E. coli (#)	1.0E+08	8.8E+05	9.9E+07	99%

CSU currently has two graduate students working full time on the stormwater monitoring and analysis of the results. The first study, expected to be released in the next few months, will evaluate the effectiveness of the BMPs at the Udall and Howes sites, provide a comparison of the

effectiveness of those BMPs to similar BMPs throughout the US and provide recommendations for structural changes to those BMPs (if necessary) to improve their effectiveness. The second study, expected to be completed in summer 2012, will provide an in depth analysis of the effectiveness of permeable pavements in regard to stormwater management. The existing CSU contract has enough funds to continue BMP monitoring through the summer of 2011 and subsequent analysis by CSU graduate students through spring of 2012.

Howes Street Outfall Sampling Equipment at Lee Martinez Park

Monitoring vault at CTL Thompson site

Other activities completed under the existing CSU/Fort Collins Stormwater Utilities contract include:

- A stream health assessment study and rehabilitation prioritization study completed in summer 2010 (Roznowski's thesis and report).

- An evaluation of existing BMPs, focusing on identification of those performing inadequately and/or in poor aesthetic condition. A memorandum was submitted in fall 2010 documenting various recommended improvements identified for solving those problems.

- The City will be installing in summer of 2011 a newly designed bio-retention facility at 700 Wood Street. This facility was designed with new treatment technologies that will be tested at the City of Fort Collins Utilities employee parking lot site. These technologies are being developed in cooperation with the City of Loveland and the Urban Drainage and Flood Control District. Through this multi-agency effort it is hoped that new construction and treatment standards can be learned and later adopted but all other municipalities throughout the Front Range area and Colorado.

- A monitoring program for the new bio-retention pilot project to be constructed at the Fort Collins Utilities site was developed by CSU in order to better understand the effectiveness of this type of LID in terms of stormwater quality and quantity. CSU will be responsible for the monitoring efforts of this site through its existing contract.

OLD TOWN STORMWATER QUALITY SAMPLING LOCATIONS

City of Fort Collins GIS

N W E S

0 500 1,000 2,000 Feet

Printed: 10/9/2009

Fort Collins Winter Stormwater Runoff Study:

At the request of City Council, the Utility started a 2010-2011 winter monitoring study to assess the impact of deicing agents on City streams and lakes. This effort was a cooperative project between the Utilities' Stormwater Department and Regulatory and Government Affairs Division, the Streets Department and CSU.

The City currently uses several types of chemical deicing materials which make their way to local water bodies. The designated use of these streams and rivers is for drinking water, aquatic life protection and recreation. This project is a monitoring study to assess the impact of these deicing chemicals on surface water quality in Fort Collins. It will attempt to determine the impact of the applied chemicals and provide recommendations to reduce the impact on water quality and aquatic life. In order to determine how chloride is affecting the City's water bodies, an inventory of possible contaminant inputs and outputs were taken from January to March of 2011 in the Spring Creek watershed.

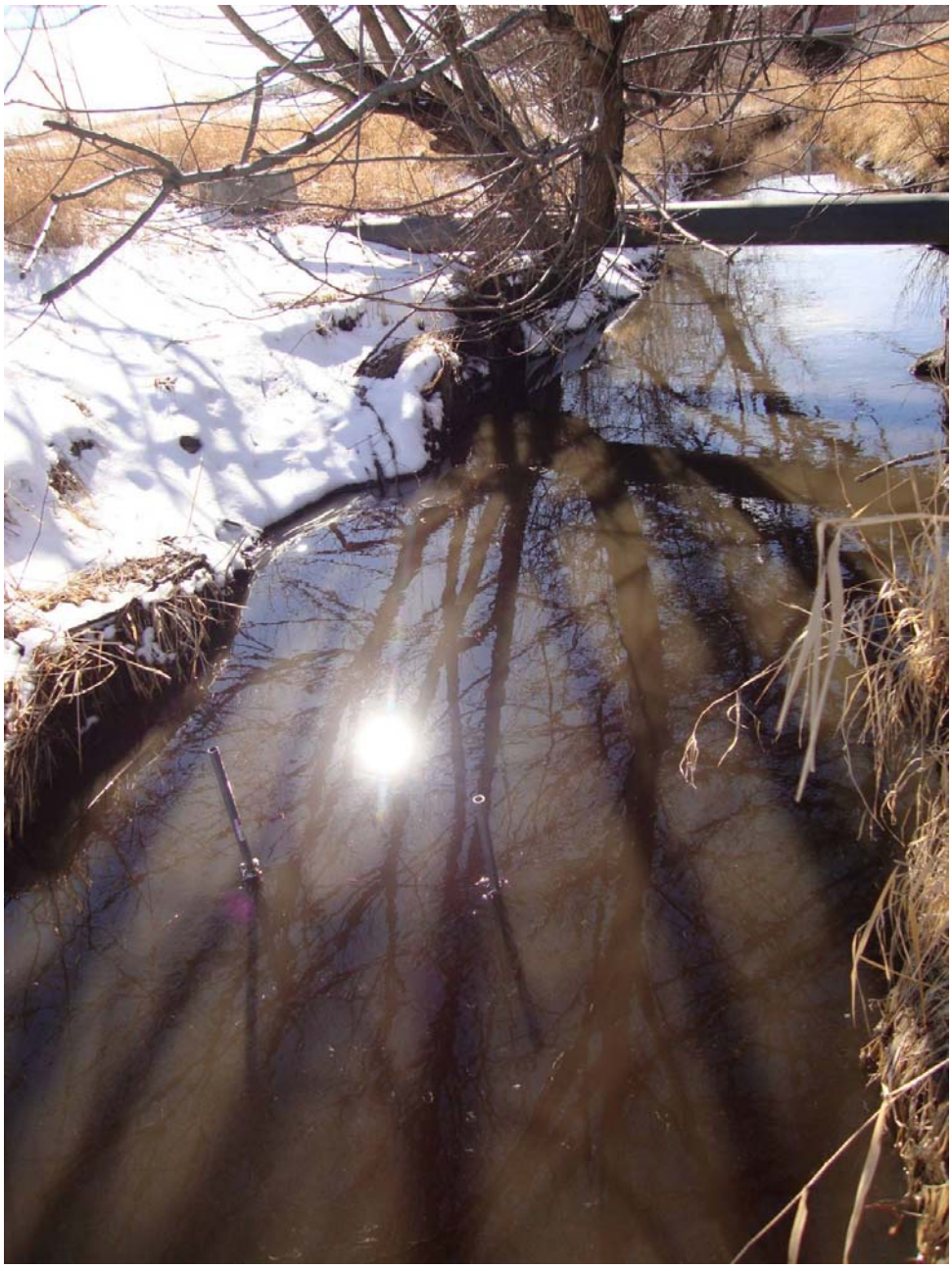
In order to create an economically feasible study, one basin out of the City's twelve drainage basins was monitored. The factors used to determine the optimal basin included a high unit load application rate, drainage to a natural channel, accessibility and visibility. A high unit load application rate was desired to see the effects of the "worst case" in the City. Natural channel drainage was preferred to irrigation canal drainage for ease of pollutant tracking through the system. Also, accessibility and visibility were important for ease of data collection and public awareness. Spring Creek was also identified as the best water body to monitor, due to its central location within the City of Fort Collins. It is hoped that data collected from this watershed would be representative of other locations within the City. Application data for deicing agents were collected from the City Streets Department. Specific conductivity levels in the Creek were monitored as a surrogate for deicing agent chloride concentrations. Results were then compared to recommended State and Federal aquatic life standards for chloride. Based on the results, recommendations were provided to the Streets Department to reduce the City's potential impact on the local streams.

Four YSI 6600 Series Sondes collected data on specific conductivity, temperature, dissolved oxygen, pH, depth and chlorophyll. The data were recorded in 15-minute intervals at four monitoring locations:

- Drake Road and Spring Creek,
- Center Avenue and Spring Creek,
- College Avenue and Spring Creek and
- Timberline Road and Spring Creek. [see map below]

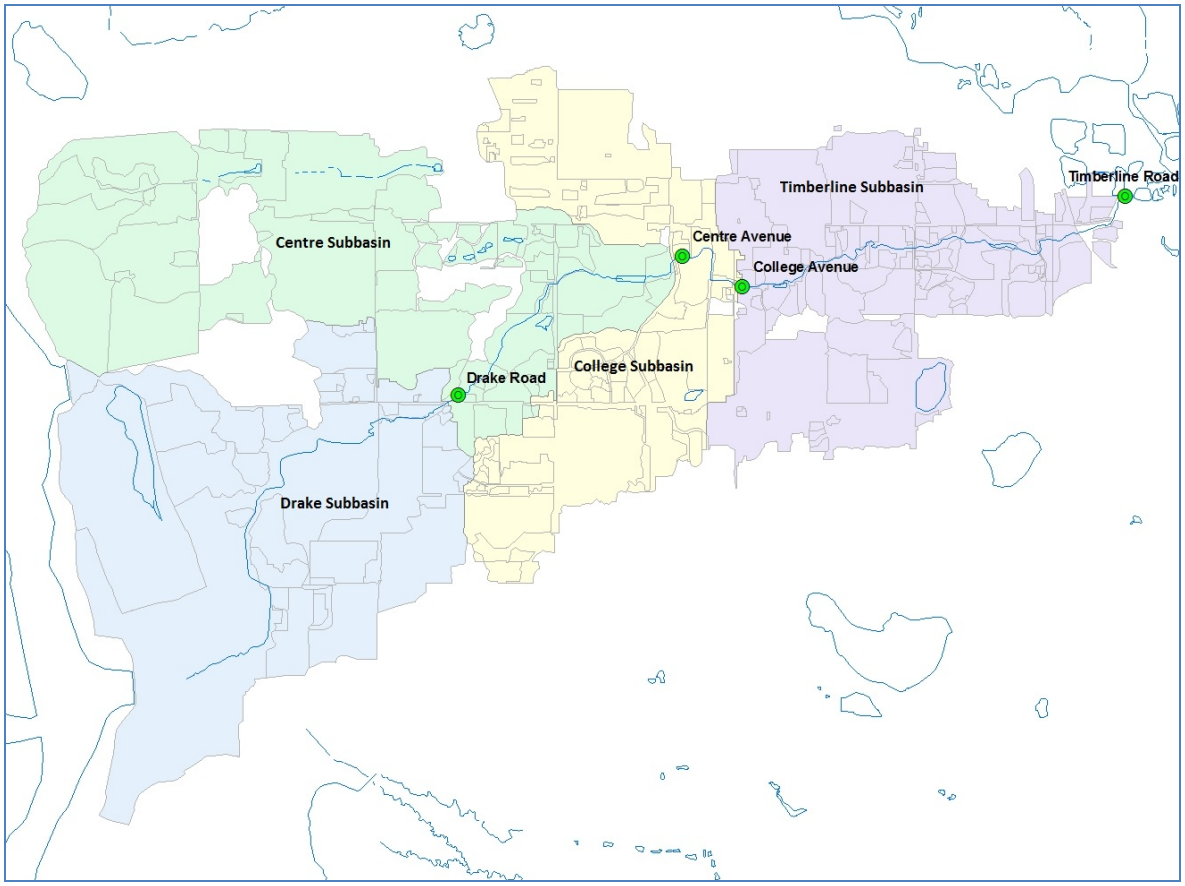
Spring Creek monitoring sonde at Drake Road looking downstream on February 26, 2011

Spring Creek monitoring sonde at Drake Road looking upstream on February 26, 2011



Spring Creek monitoring sonde at Centre Avenue looking upstream on February 26, 2011

Spring Creek sonde installation at College Avenue looking downstream on January 10, 2011



Spring Creek Stormwater Sub-Basins monitored in 2010.

Analyses and Findings:

The analyses conducted for the study involved converting specific conductivity measurements into corresponding chloride values. Tables 1 and 2 show the chloride values determined from the lab procedures for February 11th and February 26th, respectively.

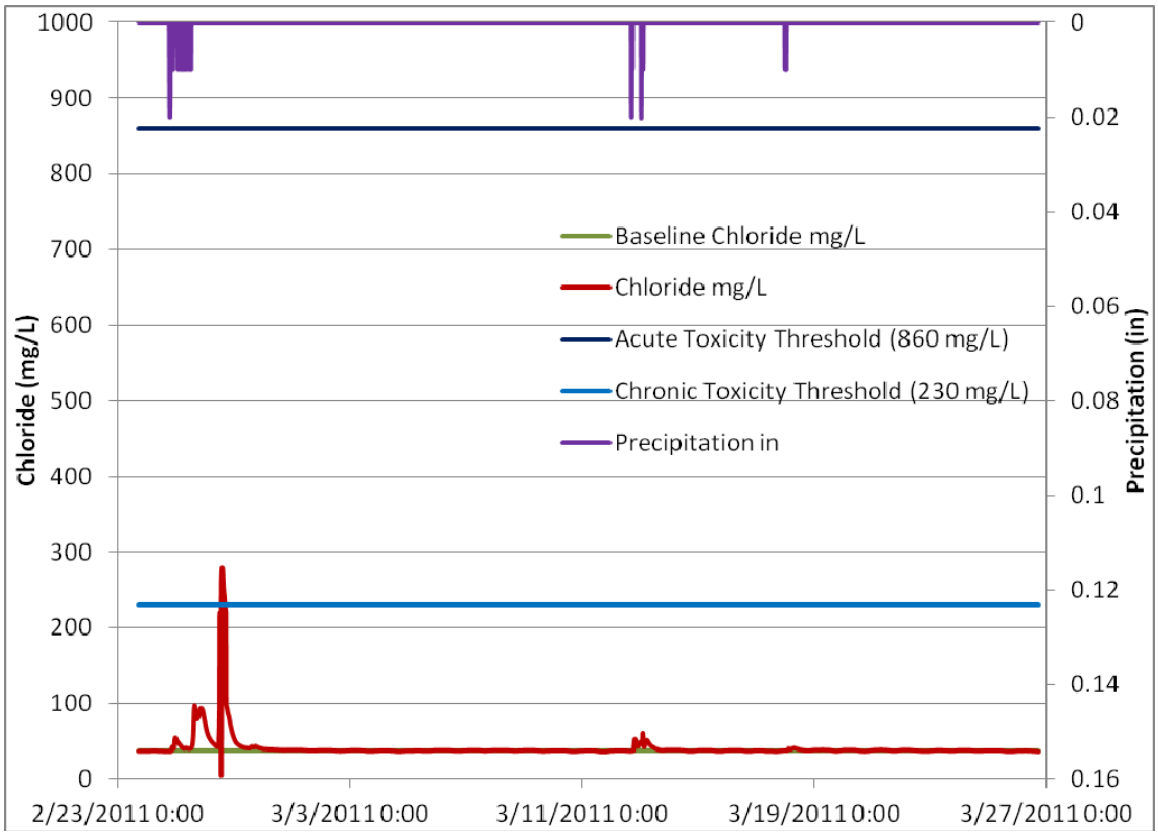
Table 1. Chloride concentrations at each monitoring location on February 11, 2011

Location	1st trial (mg/L)	2nd trial (mg/L)	3rd trial (mg/L)	Average Chloride (mg/L)
Drake	33.26	32.63	28.24	31.38
Centre	72.16	65.89	65.26	67.77
College	50.83	46.44	58.36	51.87
Timberline	20.71	18.83	21.34	20.29

Table 2. Chloride concentrations at each monitoring location on February 26, 2011

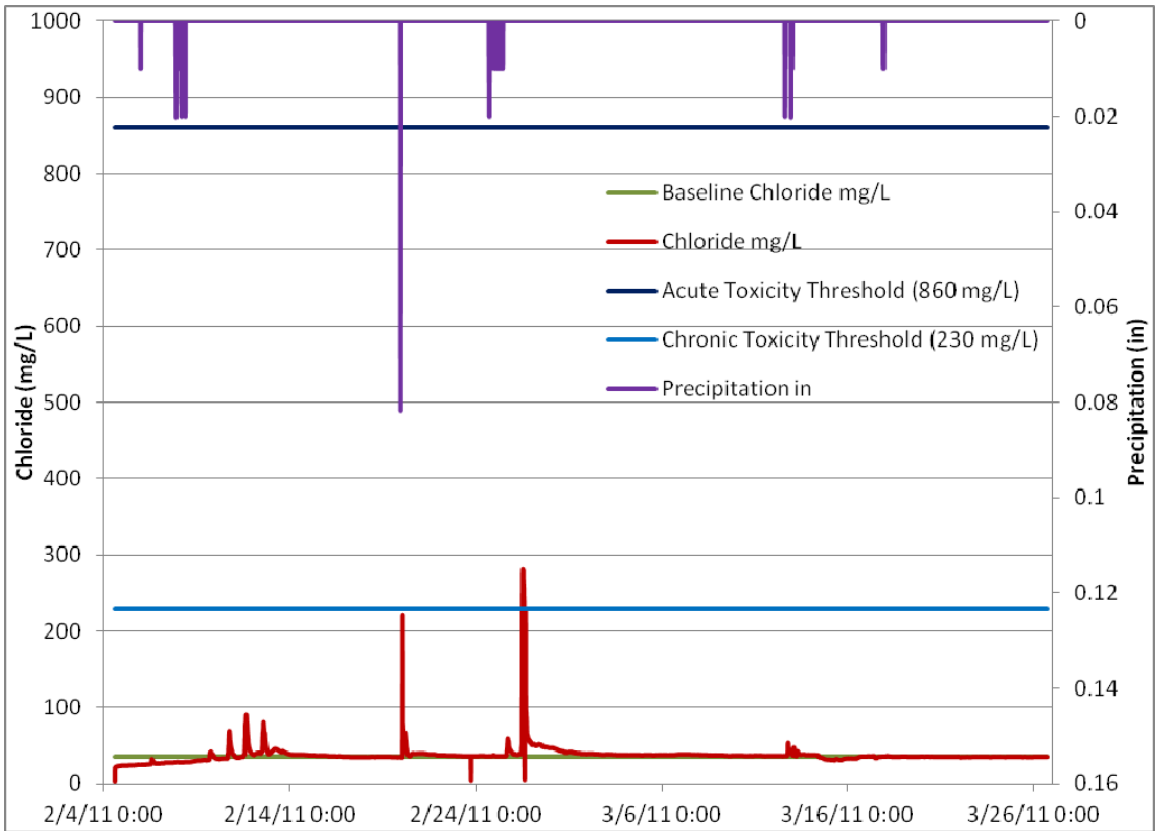
Location	1st trial (mg/L)	2nd trial (mg/L)	3rd trial (mg/L)	Average Chloride (mg/L)
Drake	246.61	264.81	229.04	246.82
Centre	83.46	122.36	58.99	88.27
College	235.32	234.69	222.14	230.71
Timberline	57.73	56.48	50.20	54.80

The following diagrams show the monitored chloride levels at the four monitoring locations and a comparison of these results to acute and chronic toxicity levels.



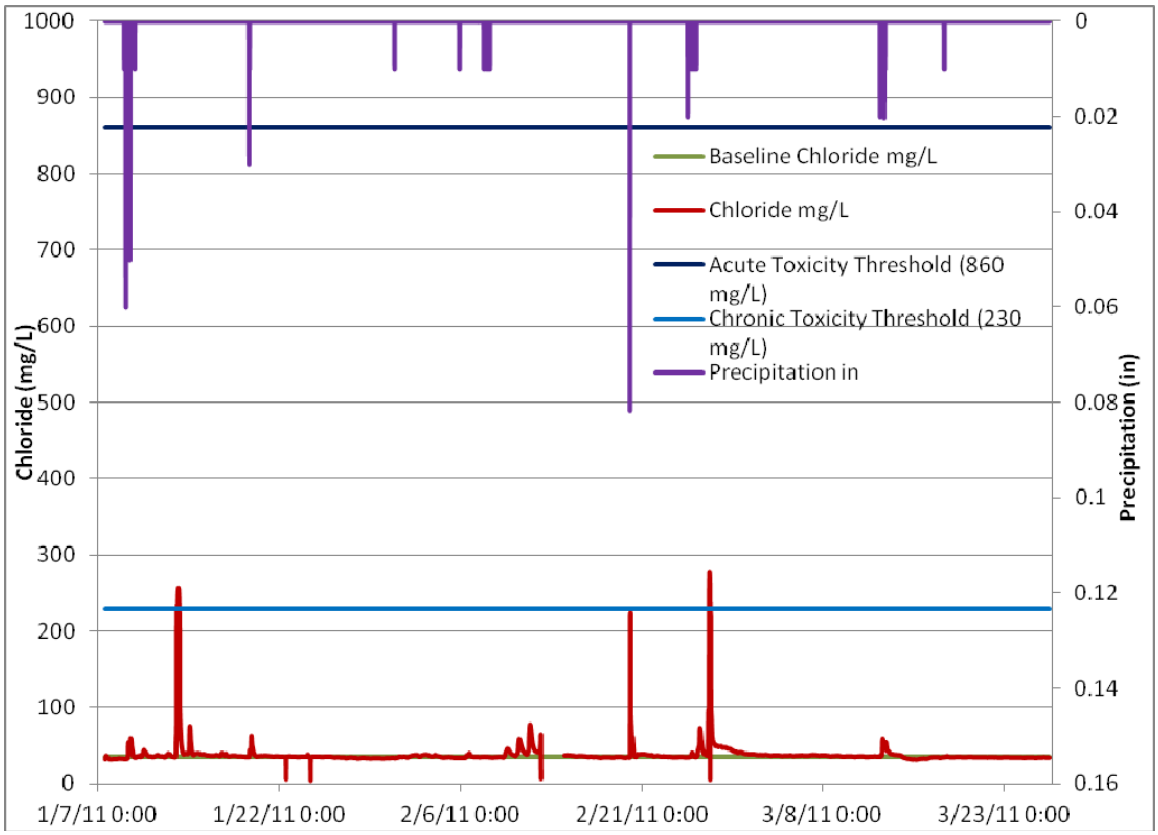
Chloride Concentrations at Drake Road station.

The monitoring site on Spring Creek at Drake Road captured snowmelt runoff from one snow storm on February 26th. The chronic toxicity threshold was exceeded for three hours between 2pm and 5pm with a maximum chloride concentration of 279mg/L at 2:30pm. Although the chloride level exceeded the chronic standard, the time frame was too short to exceed the EPA recommended criteria.



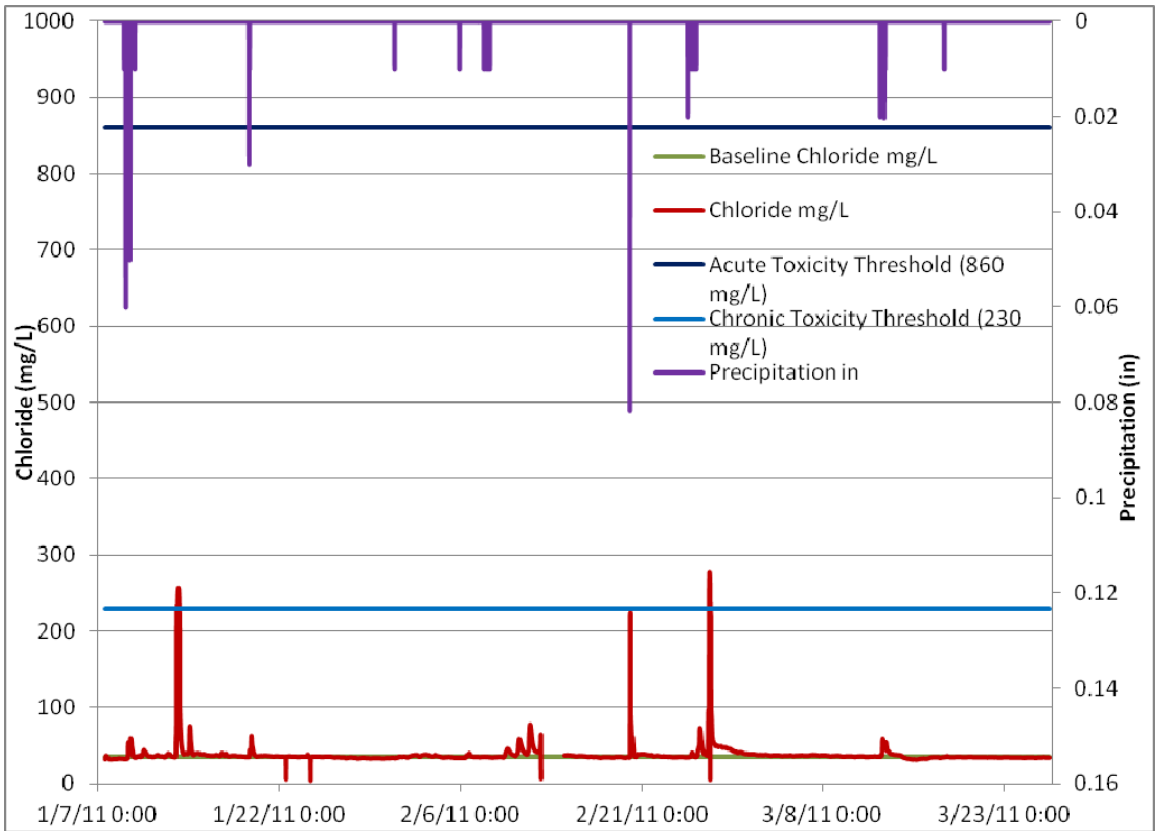
Chloride Concentration in Spring Creek at Centre Avenue

Spring Creek at Centre Avenue had several snow events and subsequent snowmelt with chloride peaks. The chronic toxicity threshold was exceeded for two hours on February 26th between 12:15pm and 2:15pm. The maximum chloride concentration was 280mg/L at 12:30pm. As with the sonde at Drake, the four-day time period required to exceed the EPA criteria was not surpassed. Also, the same small peak in chloride concentration occurred on March 12th suggesting that chloride remains on the roads after snow melts from previous events.



Chloride Concentration for Spring Creek at College Avenue

College Avenue site for Spring Creek exceeded the chronic toxicity threshold on two occasions. The first exceedance occurred on January 13th for 15 minutes at 2pm and for three hours from 3:45pm to 6:45pm. The maximum chloride concentration was 257mg/L at 5pm. The second exceedance occurred for two hours and 45 minutes on February 26th between 1:45pm and 4:30pm. The maximum chloride concentration of the 26th was 277mg/L at 2:30pm. Although the chronic threshold concentration was exceeded, the four-day time period required to exceed the EPA-defined criteria was not surpassed.



Chloride Concentration in Spring Creek at Timberline Road

The runoff concentrations for Spring Creek at Timberline were consistently lower than the concentrations at College Avenue. This is likely due to dilution and/or detention between the sites.

Results and Conclusions:

This study assessed the impact of deicing materials on surface water quality in Fort Collins. Overall, the threshold analysis showed that there was some impact on aquatic life, but not enough to exceed the chronic or acute toxicity criteria. Although the aquatic life criteria were not exceeded, the drinking water threshold of 250mg/L was exceeded several times during snowmelt runoff events which may impact downstream drinking water plants. Since Spring Creek is not used as a drinking water source, this impact should have no operational impact on the City of Fort Collins. Also, residual chloride was detected from washoff after a snowfall event that wasn't treated with deicing chemicals. This indicates that there is some excess chloride applied, so there is an opportunity to reduce the amount used. In order to reduce the impact of the deicing chemicals, the materials should be applied in order of lowest to highest chloride concentration. The City is currently assessing the potential extension of this study for another year in order to have a more significant data set to assess the validity of these preliminary conclusions.

Sheldon Lake Stormwater Quality Study:

Sheldon Lake has been severely impacted with algae growth and blooms in the past. The City had previously attempted to improve water quality in the lake by dredging and removing nutrient materials from the lake during the Sheldon Lake stormwater improvements completed in 2004. As a result of those improvements the levels of turbidity in the lake were greatly improved and algae growth was noticeably reduced. An aeration system was also installed in the lake in order to control and minimize algae growth. Subsequent to those improvements, water quality in the lake has deteriorated somewhat in comparison to the better quality that was experienced in the 2005-2006 years.

In order to assess whether the water quality is primarily being impacted by stormwater runoff into the lake or by the irrigation flows used to filling the lake, the City initiated a cooperative study by Stormwater and Parks departments in cooperation with CSU. The study will be completed in summer of 2011. Its goals include:

- determination of the sources of the water quality impacts,
- recommended mitigation measures, and
- determination of an optimal level of aeration to maintain the best possible level of water quality in the lake.

2010-2011 Stormwater Quality Monitoring Program Costs:

Monitoring Program Description	Cost	Comment
City-CSU event-based Best Management Practices (BMP) Stormwater Quality Monitoring Program	$ 46,000	$20,000 approximately in direct water quality testing costs from the City's Pollution Control Lab with the balance for salaries and program expenses. Project funded through the City-CSU stormwater contract.
Stream Health Assessment and Benthic Survey. Benthic macro-invertebrate survey of streams at nine locations within the City. Study completed in 2010.	$12,500	2010 salary costs of $ 8,000 and benthic survey costs of $ 4,500 Project funded through the City-CSU stormwater contract
Winter Runoff Monitoring Study	$ 15,000	$ 5,000 in monitoring equipment and lab analysis costs and $ 10,000 in salary costs Equipment costs funded by Utilities Regulatory and Government Affairs rest funded by City-CSU contract
Sheldon Lake Study	$ 4,000	Lab analysis and salary costs through May of 2011 Funded by City-CSU contract

2010 Municipal Separate Stormwater Sewer System (MS4) Water Quality Study Programs:

Previous Stormwater Quality Study Programs Completed:

- Assessments of all flowing stream corridors were completed in 1999 by Dr. Bob Zuellig for development of the Master Plans.

- Udall study completed in 2004.

MS4 Report Background & Highlights:

The City of Fort Collins is required by the Colorado Water Quality Control Division (WQCD) to have a Municipal Separate Storm Sewer System (MS4) permit in order to discharge stormwater from its MS4 into State waters. The City must implement a Colorado Discharge Permit System (CDPS) Stormwater Management Program in accordance with the MS4 permit. The City's Stormwater Management Program is a comprehensive program comprised of six minimum control measures designed to reduce the discharge of pollutants from its MS4. Each measure requires several detailed elements that must be implemented annually or on an ongoing basis.

In addition to maintaining permit compliance, the elements facilitate protection of water quality and habitat of the Cache la Poudre River and our urban streams. City staff take pride in implementation of these pollution prevention measures and the resulting urban watershed quality. Many of the elements identified below were originally developed as a part of the "*Watershed Approach to Stormwater Quality*". Listed below are the minimum control measures, abbreviated requirements, and 2010 accomplishments.

1. **Public Education and Outreach** - *The permittee must implement a public education program in an effort to promote behavior change by the public to reduce water quality impacts associated with pollutants in stormwater runoff and illicit discharges*

Susan Strong, Utility Environmental Regulatory Specialist, teaching at the 2010 "Water Festival"

Highlights of the 2010 Stormwater Education Program:

- The City's WaterSHED (Stormwater Habitat Education Development) program educated 4,384 students and 630 adults, for a total of 7,515 student and 956 adult contact hours.
- Teacher training was conducted for 13 adults equaling 208 contact hours.
- Staff educated 300 students and 300 adults on the land-water connection at the Birding Fair.
- Ten City employees participated in a stream study.
- Larimer County Youth Corps participated in stream education and stenciling.
- Staff created watershed collaboration between city schools, mountain schools and forest land owners resulting in a Rocky Mountain High School, Stove Prairie Elementary school and local land owner study of Mountain Pine Bark Beetle and the possible impact on our water supply.
- Storm Drain Stenciling program participants stenciled 450 storm drains.
- Seventeen adults were trained though the Master Naturalist program.
- The Children's Water Festival had 1700 student participants.
- The Stormwater Business Outreach Program distributed stormwater education materials to 52 food and beverage vendors for outdoor events. Materials included flyers listing stormwater best management practices for outdoor events and guidance on proper collection and disposal of power washing wastewater. A process was put into place via the Special Events Permit to alert staff to supply this information to organizers of applicable outdoor events, and the flyers are available on the City's web site at:

http://www.fcgov.com/utilities/what-we-do/stormwater

- Interpretive signage is displayed at select outdoor classrooms in Fort Collins, including the watershed display at the Spring Creek Bicycle Trail.

2. **Public Participation and Involvement** - *The permittee must provide a mechanism and process to allow the public to review and provide input on the CDPS Stormwater Management Program.*

- An annual update of the permit Stormwater Management Program is presented to the Natural Resources Advisory Board and the Water Board. The 2010 MS4 Permit update included a summary of the 2009 MS4 Permit annual report, minimum control measure internal assessment and tracking, and program challenges and successes.
- The City's MS4 Permit Stormwater Management Program description and 2008-2010 annual reports are posted on the City's website at: http://www.fcgov.com/utilities/what-we-do/stormwater/stormwater-quality/management-program

3. **Illicit Discharge Detection and Elimination** - *The permittee must develop, implement and enforce a program to detect and eliminate illicit discharges into the permittee's MS4.*

- Staff responded to 63 spill complaint calls in 2010. Responses included site visits, incident investigations, on-site and phone education, delivery of educational door hangers and follow-up letters. Staff reported 20 verbal and 20 written notices of violation, and one criminal conviction.
- Staff met with Poudre Fire Authority to discuss the Spill Response BFO offer.
- Amendments to Chapter 26 of the City Code Relating to Right of Entry and Nuisance Abatement and Article VII of Chapter 26 relating to stormwater quality and enforcement were adopted.

Stopping an antifreeze spill.

4. **Construction Site Runoff Control** – *The permittee must develop and implement a program to assure adequate design, implementation, and maintenance of BMPs at construction sites within the MS4 to reduce pollutant discharges and protect water quality.*

In 2010, stormwater quality staff

- performed 1,059 inspections on 92 construction sites for sediment and erosion control in 2010. Enforcement measures for inadequate sediment and erosion control included: 30 verbal warnings, one written notice of violation, one stop-work order, 34 building permits held, and holds issued on 108 initial building permits until installation of erosion control measures was complete.
- administered the City erosion control re-vegetation contract and assisted City engineering staff with the development of erosion control and wetlands plans for 15 City projects.
- responded to construction site screening inspection reports by the Colorado Water Quality Control Division.
- arranged a second party audit of the Construction Site Runoff Control Program.

2010 Construction Site BMP Academy

- organized Stormwater Management training for City project engineers and staff.
- conducted on-site erosion control training with private developers and their contractors.
- advised City departments and contractors on Construction Stormwater Permit and Stormwater Management Plan requirements for fifteen City projects
- attended four development construction permitting meetings to review plans for new building projects within the City.

5. **Post-Construction Stormwater Management in New Development/ Redevelopment** - *The permittee must develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment projects that disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, that discharge into the MS4. The program must ensure that controls are in place that would prevent or minimize water quality impacts.*

   In 2010, Stormwater Quality Staff:

- inspected 104 permanent water quality control features, or best management practices. Enforcement actions included 39 written notices of violation.
- developed an inventory of over 2,730 photos of stormwater basins and best management practices.
- Added 93 stormwater basins to the stormwater system (SWIMS) database. Mapped 538 basins on ArcGIS (ESRI), along with GPS coordinates.

- participated in the Stormwater Quality Team to review Best Management Practices in Fort Collins.

2010 Post-Construction Inspection. Note padlocks on grate.

6. **Pollution Prevention/Good Housekeeping for Municipal Operations** - *The permittee must develop and implement an operation and maintenance program that includes an employee training component and has the ultimate goal of preventing or reducing pollutants in runoff from municipal operations.*

In 2010, stormwater quality staff:

- conducted Stormwater Pollution Prevention / Good Housekeeping / Hazardous Waste Training for 252 City employees.
- conducted stormwater inspections at eight City facilities.
- observed water main break repairs and advised on best management practices to protect water quality and attended several meetings to discuss standard operating procedures for water main breaks and the Treated Water Management Plan.
- advised Operations Services, Utilities, Parks, Light and Power, and Parks Planning on stormwater issues related to municipal operations.

The following activities supplemented the programs that support MS4 Permit requirements. During 2010, staff:

- presented at the EPA Region 6 MS4 Operators Conference in Santa Fe, NM.
- commented on the Urban Drainage and Flood Control District (UDFCD) draft Urban Storm Drainage Criteria Manual Volume 3, and coordinated submittal of Stormwater Engineering's comments.
- advised on stormwater issues for the development of the green building code.
- completed delegation of authority memos to allow Regulatory and Government Affairs staff to enforce recently adopted stormwater code changes.
- assisted the Colorado Stormwater Council (CSC) Permit Compliance Committee in development of the *Industrial Permit and Low Risk Discharge Guidance* quick guide for MS4s and CSC member survey.
- obtained Certified Stormwater Manager designation by the American Public Works Association.

Leaking electrical transformer spill containment.

2010 Fort Collins Urban Creek Water Quality Monitoring Program:

The Colorado Department of Health and Environment (CDPHE) has established public use classifications and water quality standards for Spring Creek and Fossil Creek designed to protect aquatic life and support public uses, recreation and agriculture. Available water quality data from November 2000 through August 2007 show that Fossil Creek and Spring Creek consistently meet water quality standards for pH, dissolved oxygen, and nitrite designed to support aquatic life.

The water quality standard for the indicator bacteria, *E. coli*, is designed to protect recreational use. Spring Creek and Fossil Creek are both designated as "Recreation Class 1a" waterbodies. This classification indicates waters where primary contact occurs including swimming and frequent water play by children. Water quality data for *E .coli* show strong seasonal trends with individual values above the water quality standard primarily during summer months. Sources of *E. coli* contamination include human and animal waste. Controlling or minimizing contamination from improper connections to the City's river and creeks is the focus of the Utility's Illicit Discharge Program, a component of the City's stormwater quality program.

In 2006, Fossil Creek was included on CDPHE's list of impaired waterbodies for non-attainment of the selenium water quality standard. Available monitoring data shows selenium values consistently above the water quality standard. High concentrations of selenium are found in local shale deposits.

The EPA has published more stringent Selenium standard of 4.6 ppb in a revision of water quality criteria. Consequently in 2006, Colorado adopted this as a water quality standard and is now placing numerous river and stream segments on the 303(d) list for Selenium. The following local stream segments were put on the 303(d) list in 2006 due to exceeding the new selenium standard:

- the Poudre River from Boxelder Creek to where it meets the South Platte River,
- all of Fossil Creek, and
- Boxelder Creek, from its origin in northern Colorado to where it meets the Poudre River.

Selenium is naturally occurring in the underlying shale. The listings given above were a result of a new lower standard and not changing water quality. Selenium can be mobilized by precipitation runoff and infiltration to surface water and groundwater, resulting in elevated stream concentrations.

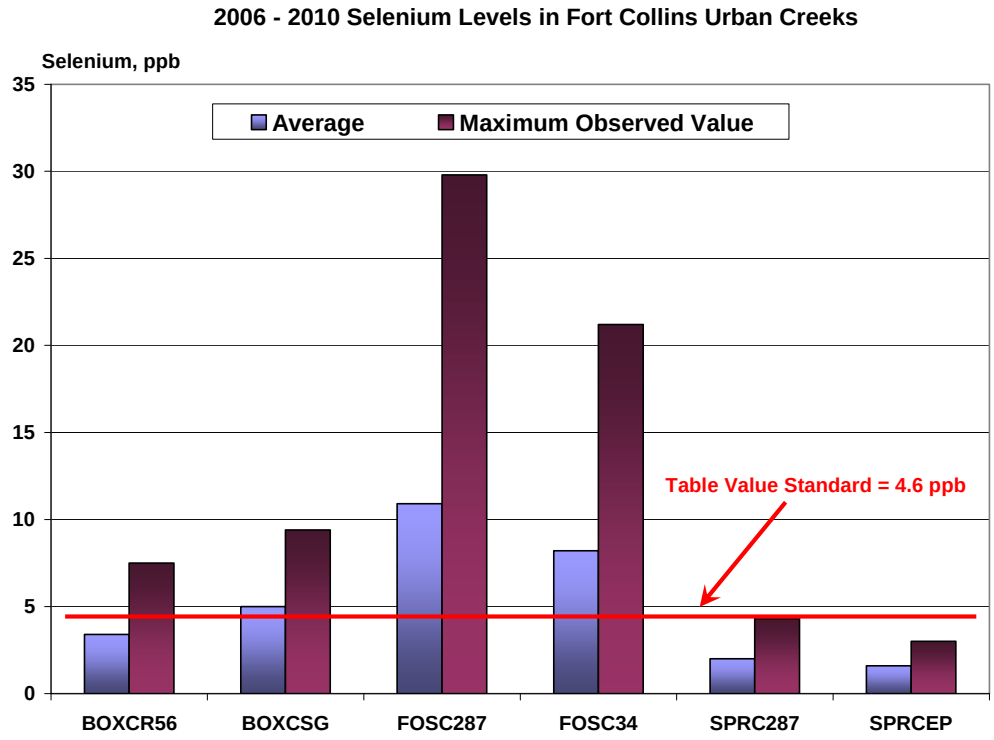
As directed in City Council Resolution 2000-128, "Recognizing the Need to Protect Water Quality", the City monitors Boxelder Creek, Spring Creek, and Fossil Creek at two sites every calendar quarter for inorganic chemicals, dissolved oxygen and bacteria. Parkwood Lake is sampled twice per year for bacteriological, physical, and chemical parameters.

2010 Monitoring Sites and Test Parameter Matrix for Urban Creek Sites through Fort Collins.

City of Fort Collins / Utilities Pollution Control Lab	Surface Water Quality Test Matrix						
	CREEK MONITORING SITES						PARKWOOD LAKE
Test Parameters	**FOSC287**	**FOSC34**	**SPRC287**	**SPRCEP**	**BXC56**	**BSCXG**	**PKL**
Alkalinity, mg/L as CaCO3							
Ammonia-N, mg/L	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	2/year
Arsenic, µg/L							
Biochemical Oxygen Demand, mg/L							2/year
Cadmium, µg/L							
Chromium, µg/L							
Conductivity, µmhos/cm	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	
Copper, µg/L							2/year
Dissolved Organic Carbon, mg/L							
Dissolved Oxygen, mg/L	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	
E. coli / 100ml	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	
Flow, cfs							
Hardness, mg/L as CaCO3	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	2/year
Iron, µg/L							
Lead µg/L							2/year
Manganese, µg/L							
Mercury, µg/L							
Nickel, µg/L							
Nitrate-N, mg/L	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	2/year
Nitrite-N, mg/L	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	2/year
pH	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	2/year
Selenium, µg/L	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	
Silver, µg/L							2/year
Sulfate							
Temperature, °C	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	2/year
TKN-N, mg/L							
Total Organic Carbon, mg/L							
Total Phosphorus, mg/L	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	1/Qtr	2/year
Zinc, µg/L							2/year

Site Code	Description
FOSC34	Fossil Creek at County Rd 34
FOSC287	Fossil Creek at College Avenue
SPRC_EP	Spring Creek at Edora Park
SPRC287	Spring Creek at College Avenue
BXCG	Boxelder Creek Gage
BXC56	Boxelder Creek at County Road 56
PKL	Parkwood Lake

2006 – 2010 Maximum, Average and Aquatic Life Table Value Standard for Selenium Levels in Fort Collins Urban Creeks.



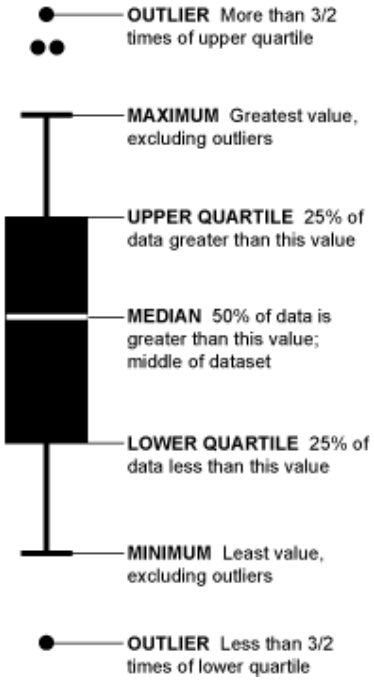
Legend:

BOXC56 = Boxelder Creek at County Road 56
BOCSG = Boxelder Creek at Staff Gage located south of Prospect St.
FOSC287 = Fossil Creek at Hwy 287
FOSC34 = Fossil Creek at County Road 34
SPRC287 = Spring Creek at Hwy 287
SPRCEP = Spring Creek at Edora Park

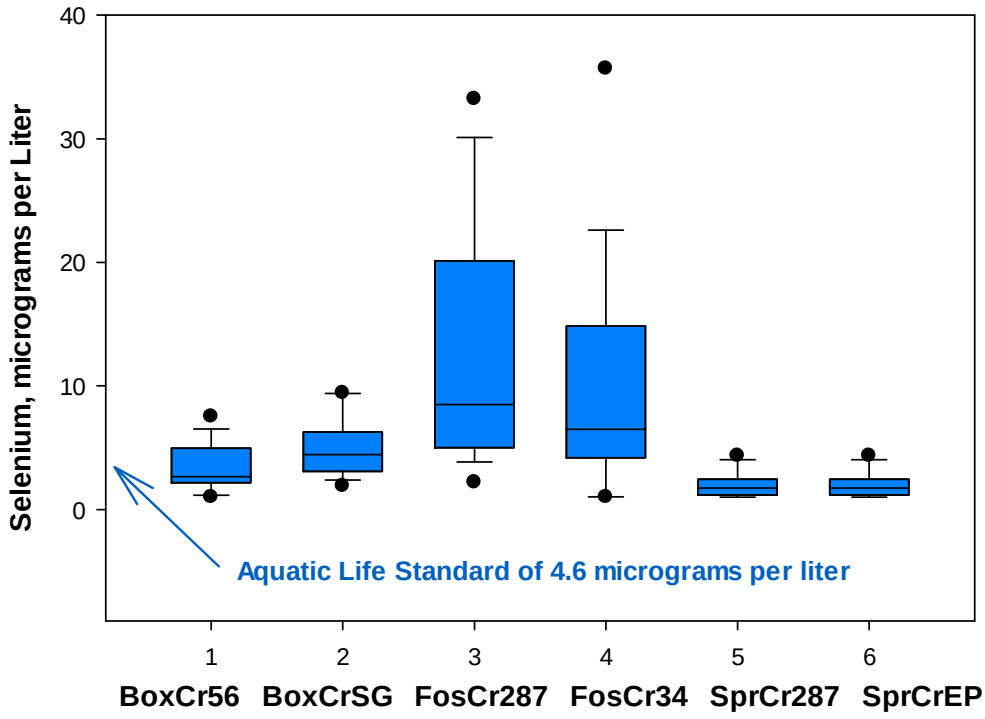
The Colorado Department of Health, Water Quality Control Division has listed both Boxelder Creek and Fossil Creek as 303(d)-impaired for the naturally elevated selenium levels in those waters. The Table Value Standard (TVS) for selenium levels in these creeks is 4.6 micrograms per liter (parts per billion). Selenium is associated with the shale common to soils in our geographic region. The City's Pollution Control Lab monitors the selenium levels in each of these three urban creeks at two locations every calendar quarter.

How to Read a Boxplot or a Box & Whisker Plot?

1. First note the location of the median (white line) in the box. If the median is in the middle the box, the data is not skewed to a predominance of high or low values. The overall height of the box indicates the overall range or distribution of the data. A tall box indicates a wide range in values.
2. The top and bottom of the box define the upper and lower quartiles at 25% and 75%.
3. The maximum and minimum values (excluding outliers) are represented by the horizontal lines at the end of the whiskers.
4. Outlier data points are represented by dots.



2006 - 2010 Levels of Selenium in Fort Collins Urban Creeks
Boxelder Creek, Fossil Creek and Spring Creek

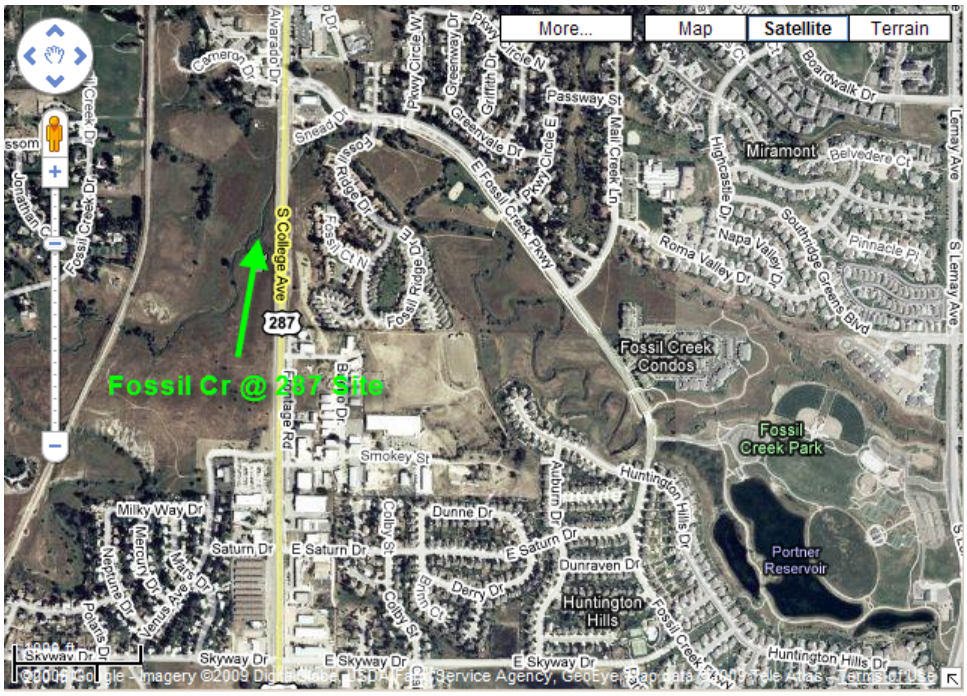


The plots show substantially higher and a broader range of selenium concentrations in Fossil Creek than in either Boxelder or Spring Creeks.

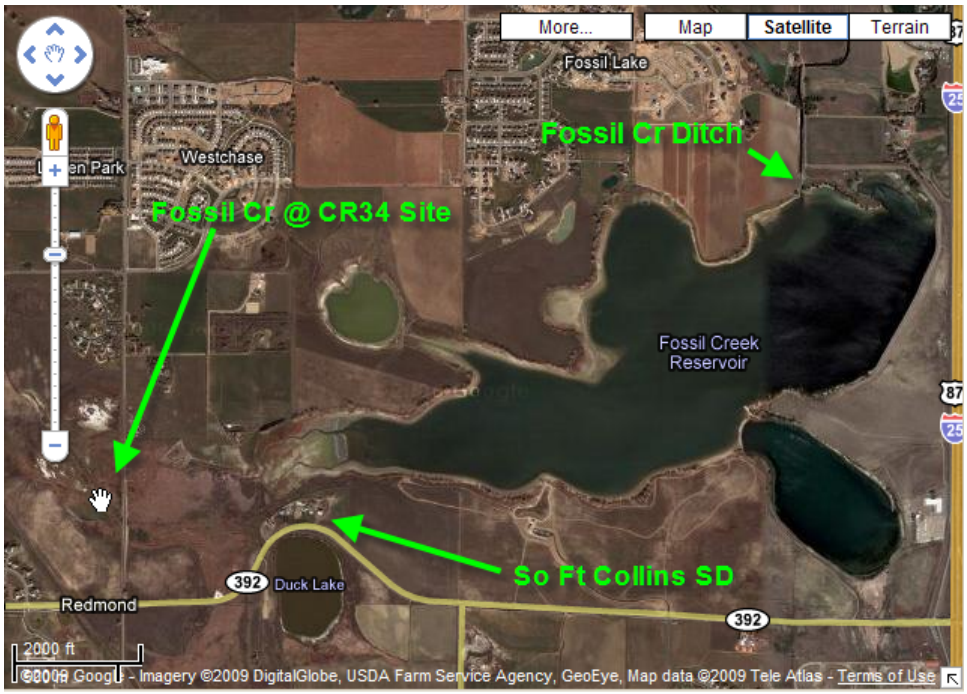
Photographs and Aerial Maps of Fort Collins Urban Creek Monitoring Sites:

- **Fossil Creek looking downstream toward Hwy 287:**

Aerial Map of Fossil Creek sample site adjacent to South College Avenue:



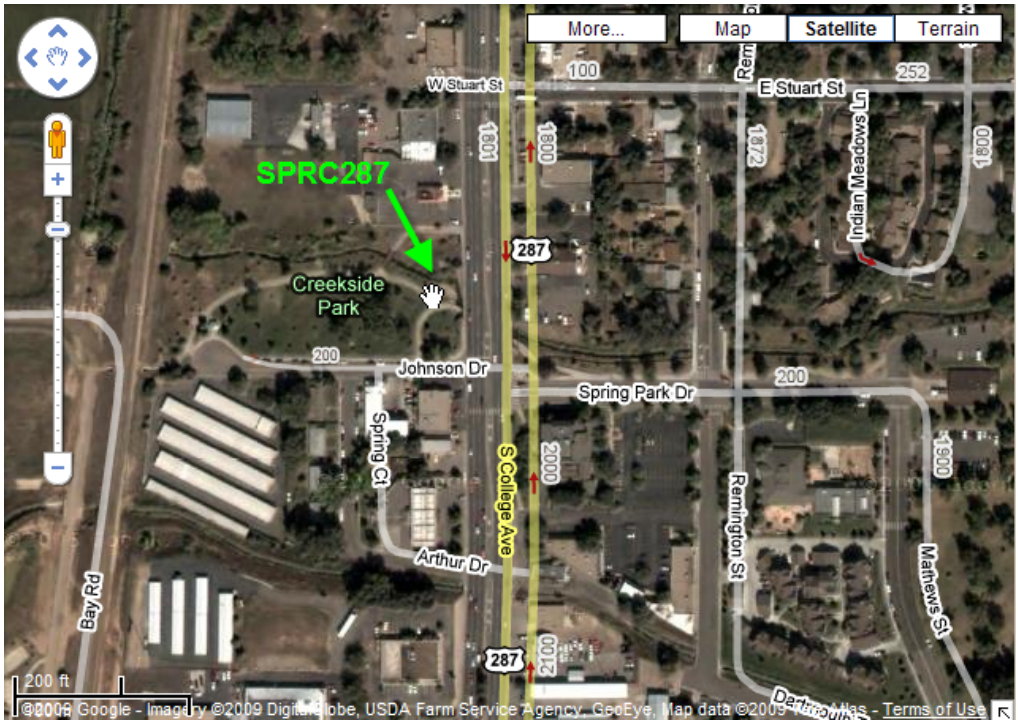
- **Aerial map of Fossil Creek @ County Road 34:**



- **Fossil Creek looking upstream from County Road 34:**

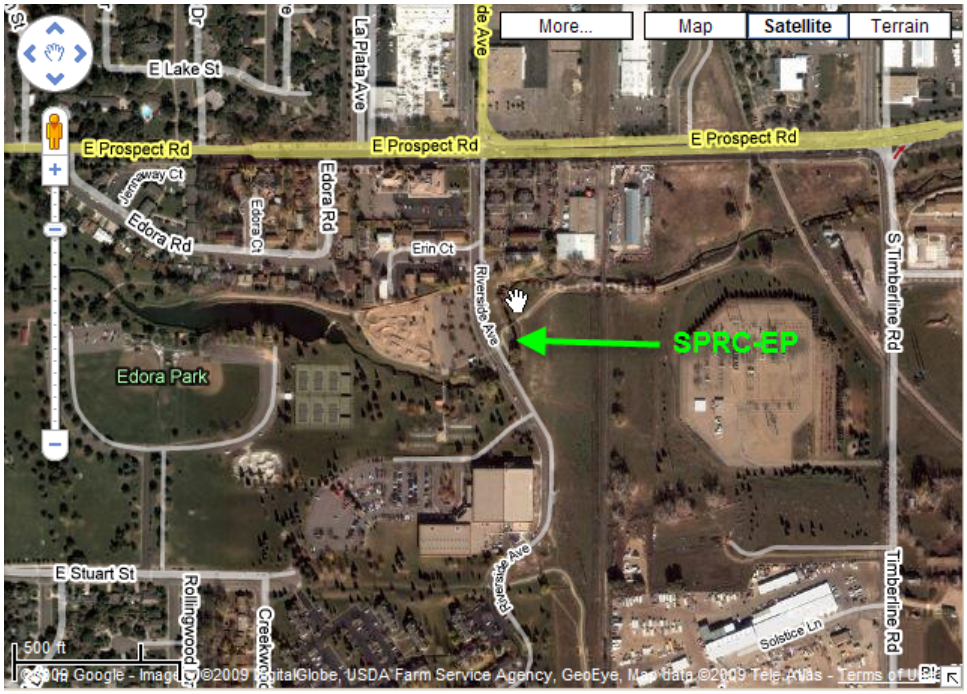
- **Spring Creek sample site near College Avenue:**

- **Aerial Map of Spring Creek sample site upstream of College Avenue:**



- **Spring Creek at Edora Park looking downstream:**

- **Aerial photograph of Spring Creek at Edora Park sample site:**

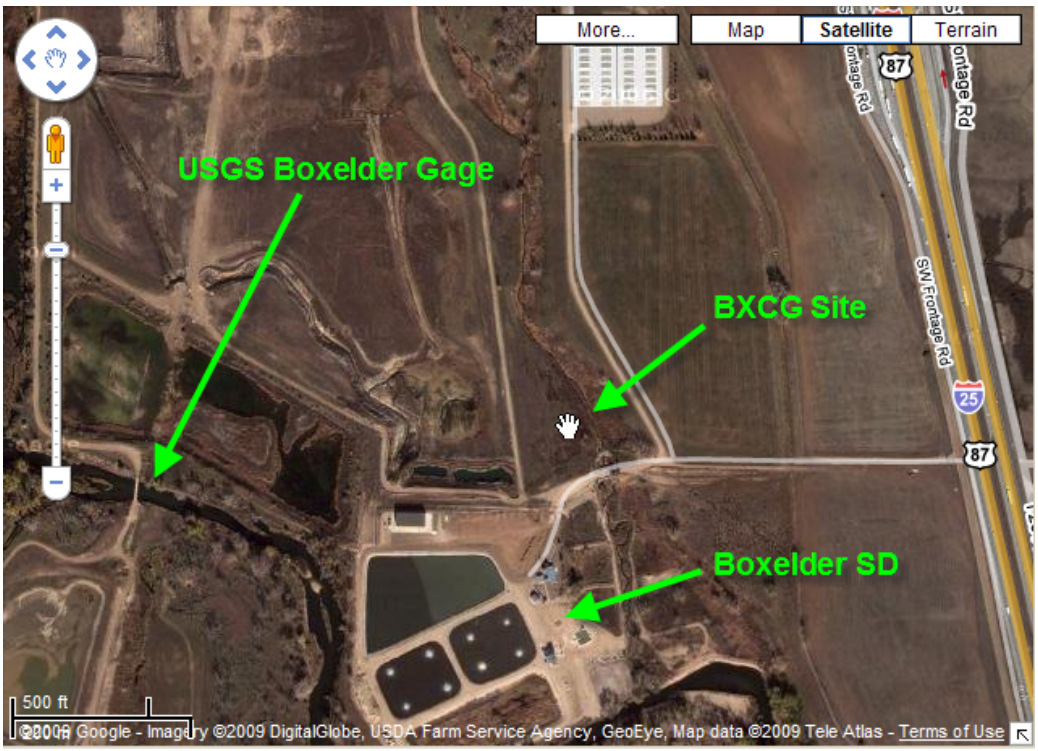


- **Boxelder Creek looking upstream from CR56**

- **Aerial photograph of the Boxelder Creek Sampling Site just upstream of CR56:**

- **Boxelder Creek looking downstream toward the confluence with the Cache la Poudre:**

- **Aerial Map of Boxelder Gage sample site a Resource Recovery Farm gage site:**



- **Parkwood Lake Water Quality:**

Since 1983, the City has shared in an agreement with the Parkwood Property Owner's Association (POA) for water quality monitoring on Parkwood Lake. The lake receives water from Arthur Ditch and stormwater from City streets. In giving permission for the City to use the lake as a receiving waterbody for stormwater, the City committed to an ongoing water quality monitoring program.

Twice each year, field measurements are taken and water samples are collected for testing at three defined locations near the shoreline of the lake. A summary of the data since 2006 is presented in the table below. Water quality is currently meeting applicable standards. However, should the Colorado Water Quality Control Division (WQCD) adopt strict "nutrient criteria" standards there may be issues with total phosphorus levels in the lake. Phosphorus is a common constituent of lawn and garden fertilizers as well as animal and bird feces.

2006 - 2010 Parkwood Lake Water Quality Summary

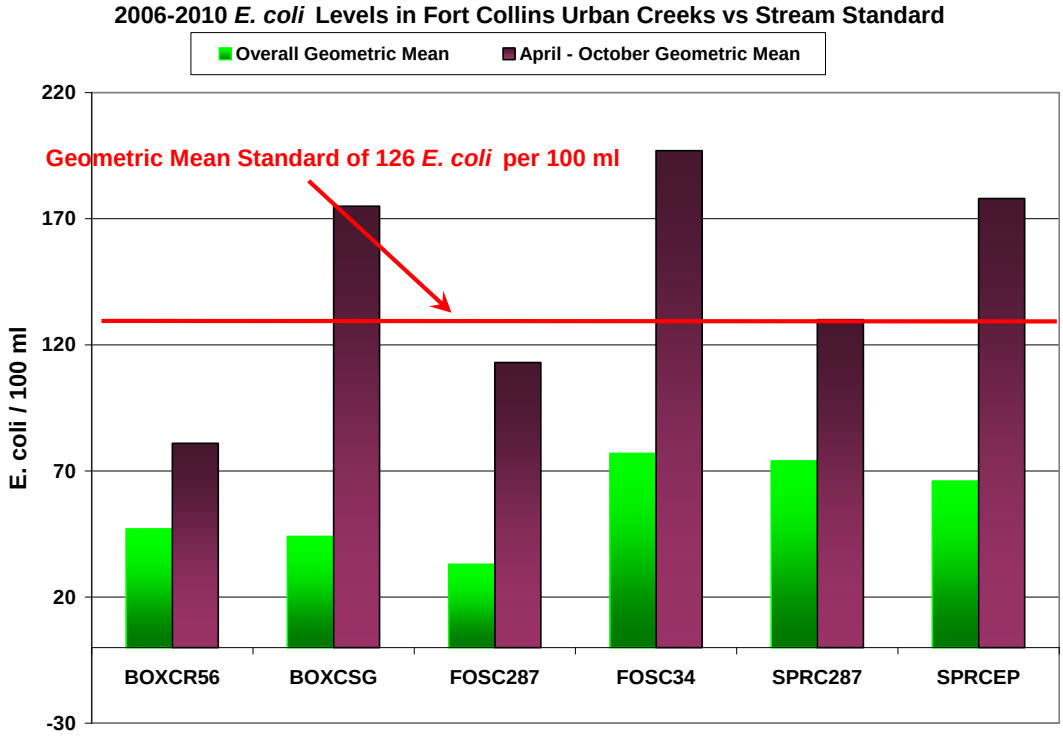
Parameter	Average	Maximum	Minimum	Standard	Good?
Ammonia-N (Nitrogen), mg/L	<0.1	0.1	<0.1	TVS †	**Yes**
Biochemical Oxygen Demand-5 Day, mg/L	4.4	8	<2	none	**Yes**
Conductivity, µmhos/cm	389	712	234	none	**Yes**
Dissolved Oxygen, mg/L	9	13	6	5	**Yes**
E. coli per 100 ml	15 (geomean)	143	<1	126 ‡	**Yes**
Hardness, mg/L as CaCO3	157	263	111	none	**Yes**
Lead, µg/L	<5.0	<5.0	<5.0	10.55	**Yes**
Nitrate-N, mg/L	<0.05	0.09	<0.05	10	**Yes**
Nitrite-N, mg/L	<0.05	<0.05	<0.05	0.5	**Yes**
pH	8.4	8.7	7.9	6.5 - 9.0	**Yes**
Silver, µg/L	<0.2	<0.2	<0.2	3.27	**Yes**
Temperature, °C	16	21	10	*I.D.*	**Yes**
Total Phosphate, mg/L	0.09	0.116	<0.1	0.082 [a]	**Yes[a]**
Zinc, µg/L	<5.0	<5.0	<5.0	393.2	**Yes**

Legend:
† TVS: Table Value Standard based on pH and temperature calculation
‡ Standard is based on geometric mean calculation of available stream or lake data
I.D. = Insufficient Data
a: Possible problem with very strict future "Nutrient Criteria" Standard for Lakes and Reservoirs. See page 14.

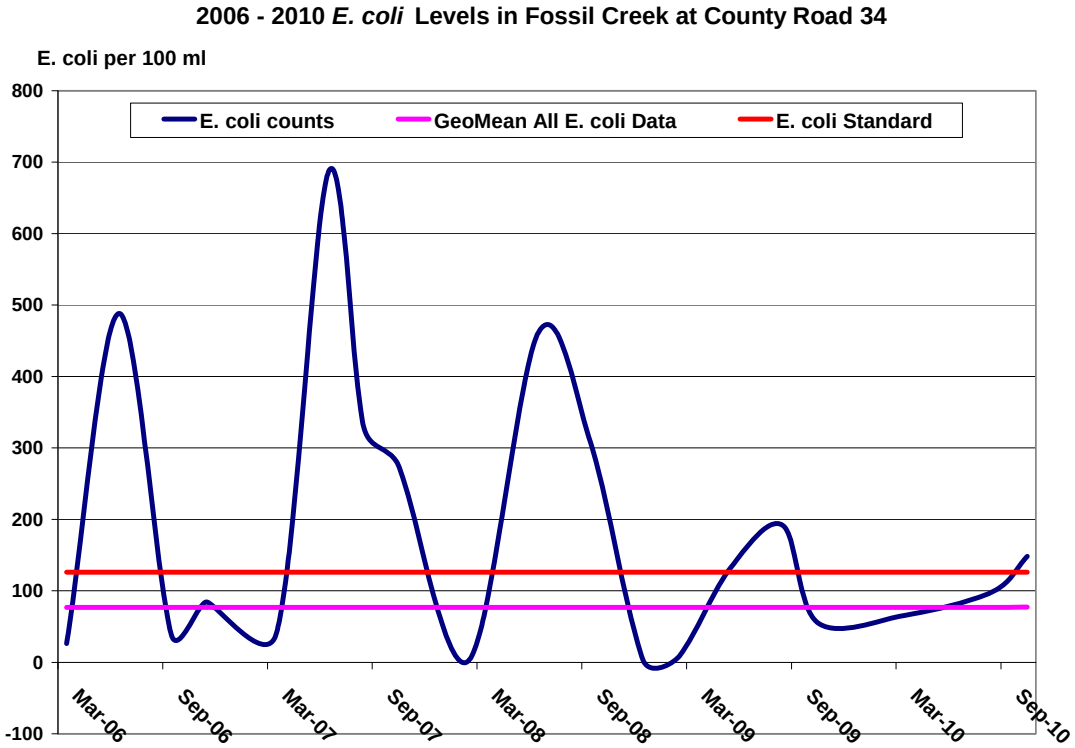
E. coli contamination in Fossil Creek and Spring Creek:

Using several years of City and USGS data and focusing on the months of April through October, the Colorado WQCD has determined that both Fossil Creek and Spring Creek are now 303(d)-listed as "impaired" for *E. coli* contamination. Both creeks were also given a "high priority" designation for developing corrective actions. Potential sources of *E. coli* contamination include failing septic systems, leaking sewer lines, domestic animals (pets, cattle, horses, etc.) and wildlife. Additional monitoring to identify potential point sources of contamination within the creeks will need to be completed.

The diagram presented below depicts the overall and seasonal geometric mean values of *E. coli* levels found in key Fort Collins urban creeks for the 2006 – 2009 timeframe compared to the stream standard of 126 *E. coli* per 100 ml. *E. coli* levels were monitored once each calendar quarter for this time period and the overall and seasonal (April through October) geometric means were calculated per Colorado Water Quality Control Division (WQCD) procedures. The overall geometric mean values (n=20) for each site were all below the 126 *E. coli* / 100 ml limit set by the WQCD. However, data for the April through October showed the creeks to be in violation of the water quality standard.

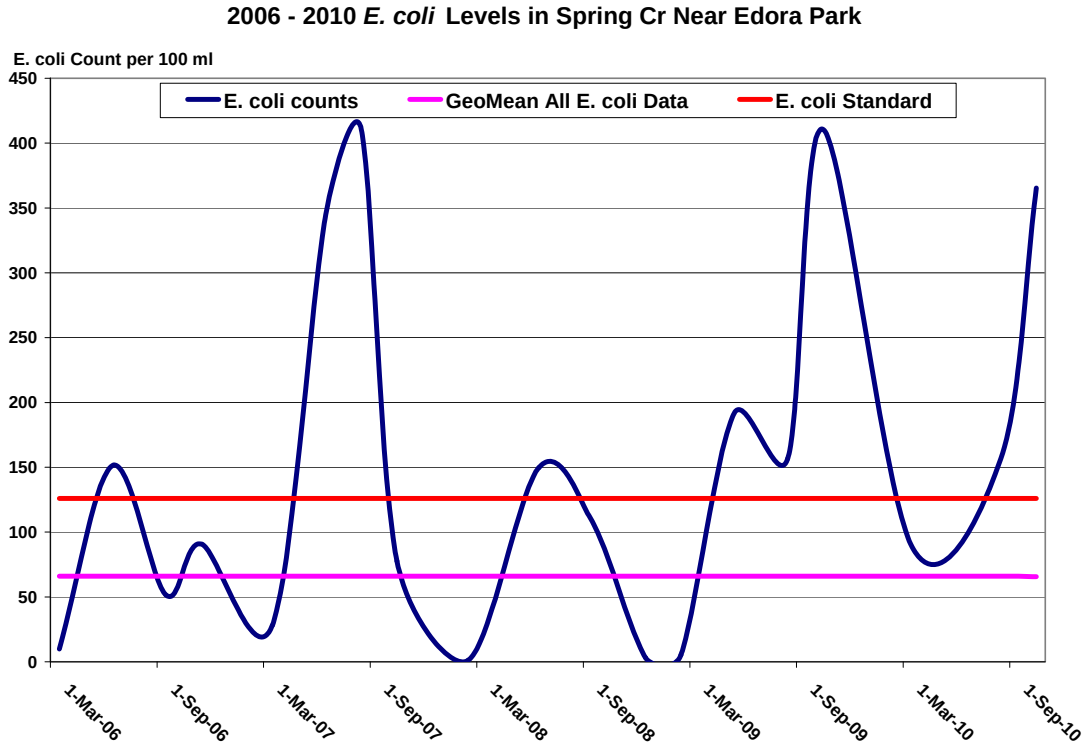


2006 – 2010 Overall and April through October *E. coli* levels in Fort Collins key urban creeks versus the stream standard of 126 *E. coli* per 100 milliliters (ml). All three sites are listed as 303(d) – seasonally impaired for high *E. coli* levels during the spring and summer months.



2006 – 2010 Overall and seasonal *E. coli* levels in Fossil Creek at County Road 34 versus the stream standard of 126 *E. coli* per 100 milliliters (ml) and the overall geometric mean of the data. Note the strong seasonal trends with the highest *E. coli* levels observed in the spring and summer months. Fossil Creek is listed as 303(d)-impaired for seasonal high levels of *E. coli* contamination.

The water quality standard for the indicator bacteria, E. coli, is designed to protect recreational use. Spring Creek and Fossil Creek are both designated as "Recreation Class 1a" waterbodies. This classification indicates waters where primary contact occurs including swimming and frequent water play by children. Water quality data for E .coli show strong seasonal trends with individual values above the water quality standard primarily during summer months. Controlling or minimizing contamination from improper connections to the City's river and creeks is the focus of the Utility's Illicit Discharge Program, a component of the City's stormwater quality program.



2006 – 2010 Overall and seasonal *E. coli* levels in Spring Creek at Edora Park versus the stream standard (straight red line) of 126 *E. coli* per 100 milliliters (ml) and the overall geometric mean of the data. Note the strong seasonal trends with the highest *E. coli* levels observed in the spring and summer months. Spring Creek is listed as 303(d)-impaired for seasonal high levels of *E. coli* contamination.

How the EPA Developed the Fresh Water E. coli Contamination Standard:

E. coli levels in rivers and streams indicate the extent of human and animal fecal contamination in the water. E. coli is much easier to grow in the lab than pathogens like Salmonella, Typhoid, or Cholera bacteria, hence, its choice as an indicator. In 1984, the EPA completed an extensive literature review and epidemiological study of the rates of gastro-intestinal illness among freshwater recreational swimmers. The study revealed that if *E. coli* levels were below 126 per 100 milliliters (~ 4 ounces) extrapolated to an illness rate was 8 individuals per 1000 swimmers. This level of contamination was established as the upper limit of an "acceptable" exposure-illness frequency. A higher incident rate was unacceptable and so the standard was set at 126 *E. coli* per 100ml.

APPENDIX A

2010 City of Fort Collins Water Quality Monitoring Site Location Details:

Sample Site Name	Site Description	River Mile
City of Fort Collins Cache la Poudre River Monitoring Sites:		
Poudre @ Shields St	USGS Sample Site 06752258	45.00
PMRT	Poudre River at Martinez Park	44.50
Lincoln Street Gage	USGS Gage 06752260	43.44
432PLNC	Poudre River @ Lincoln Ave.	43.20
1EFF	001A - Mulberry effluent weir	-
1EFF	001A - Mulberry (MWRF) outfall to Poudre	42.49
PBRY	Poudre River @ Mulberry Street	41.60
390PPROS at Prospect St	USGS Sample Site 06752270	40.30
387PNAT	Poudre River @ Nature Center	38.70
2EFF	002B - Fossil Creek weir @ Drake	-
2EFF	002B - Fossil Creek outfall @ Drake	-
2EFF	002D - Poudre outfall @ Drake (DWRF)	38.39
2EFF	005B - PRPA @ Drake	-
370PBOX	Poudre River above Boxelder Creek	37.59
Boxelder Gage	USGS Gage 06752280 above Boxelder Cr	37.59
City of Fort Collins Urban Creek Monitoring Sites:		
FOSC287	Fossil Creek Ditch at Hwy 287	
FOSC34	Fossil Creek Ditch at CR34	
SPRC287	Spring Creek at Hwy 287	
SPRC-EP	Spring Creek at Edora Park	
BXC56	Boxelder Creek at CR56	
BXCG	Boxelder Creek Gage	
Lower Poudre Monitoring Alliance Sample Sites:		
432PLNC	Poudre at Lincoln St Gage above Mulberry WRF	43.2
390PPROS	Poudre at Prospect St Bridge below Mulberry WRF	39
370PBOX	Poudre at USGS Gage above Boxelder Cr	37
350LCR5	Poudre at Larimer County Rd 5	35
325PFOS	Poudre downstream of Fossil Cr Reservoir outlet	32.5
225SGAGE	Poudre at Staff Gage above Kodak Colorado Division	22.5
200STTH	Poudre at Shark's Tooth	20
145FSPUR	Poudre at Farmer's Spur below KCD	14.5
055WPCF	Poudre at Greeley WPCF gage	5.5
022FERN	Poudre at Fern Avenue below Greeley	2.2
City of Fort Collins Parkwood Lake Stormwater Impact Monitoring Sites:		
PKLa	Parkwood Lake Site A	Northeast Corner
PKLb	Parkwood Lake Site B	Southwest Corner
PKLc	Parkwood Lake Site C	Southeast Corner

APPENDIX B

2010 Monitoring Sites and Test Parameter Matrix for Cache la Poudre River Sites through Ft. Collins.

City of Fort Collins / Utilities Pollution Control Lab	Surface Water Quality Test Matrix			
	POUDRE RIVER MONITORING SITES			
Test Parameters	**432PLNC**	**390PPROS**	**380PNAT**	**370PBOX**
Alkalinity, mg/L as CaCO3	8/year	8/year	8/year	8/year
Ammonia-N, mg/L	1/week	1/week	1/week	1/week
Arsenic, µg/L	8/year	8/year	8/year	8/year
Biochemical Oxygen Demand, mg/L				
Cadmium, µg/L	8/year	8/year	8/year	8/year
Chromium, µg/L	8/year	8/year	8/year	8/yar
Conductivity, µmhos/cm	1/week	1/week	1/week	1/week
Copper, µg/L	8/year	8/year	8/year	8/year
Dissolved Organic Carbon, mg/L	8/year	8/year	8/year	8/year
Dissolved Oxygen, mg/L	1/week	1/week	1/week	1/week
E. coli / 100ml	1/week	1/week	1/week	1/week
Flow, cfs	1/week	8/year	8/year	1/week
Hardness, mg/L as CaCO3	1/week	1/week	1/week	1/week
Iron, µg/L	8/year	8/year	8/year	8/year
Lead µg/L	8/year	8/year	8/year	8/year
Manganese, µg/L	8/year	8/year	8/year	8/year
Mercury, µg/L	8/year	8/year	8/year	8/year
Nickel, µg/L	8/year	8/year	8/year	8/year
Nitrate-N, mg/L	1/week	1/week	1/week	1/week
Nitrite-N, mg/L	1/week	1/week	1/week	1/week
pH	1/week	1/week	1/week	1/week
Selenium, µg/L	8/year	8/year	8/year	8/year
Silver, µg/L	8/year	8/year	8/year	8/year
Sulfate	8/year	8/year	8/year	8/year
Temperature, °C	1/week	1/week	1/week	1/week
TKN-N, mg/L	8/year	8/year	8/year	8/year
Total Organic Carbon, mg/L	1/week	1/week	1/week	1/week
Total Phosphorus, mg/L	1/week	1/week	1/week	1/week
Zinc, µg/L	8/year	8/year	8/year	8/year

Legend:

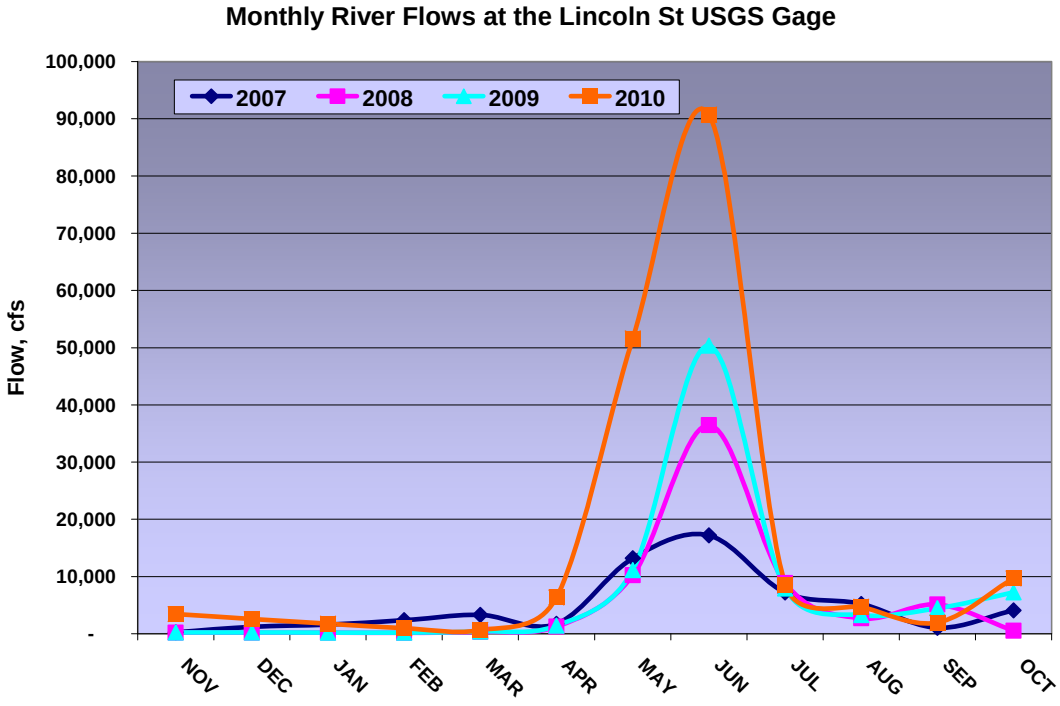
Site Code	Description
432PLNC	Poudre River @ Lincoln Ave.
390PPROS	Poudre River at Prospect Street
380PNAT	Poudre River @ Nature Center
370PBOX	Poudre River above Boxelder Creek

APPENDIX C

Cooperative United States Geological Survey (USGS) Flow and Water Quality Monitoring on the Cache la Poudre in Segment 11 through Fort Collins:

The City has participated in the USGS cooperative flow and water quality monitoring program on the Cache la Poudre River for over thirty years. This program plays mission critical roles in both managing the City's $700 million dollar water resources portfolio and providing independent documentation of ambient water quality conditions in the Poudre. Having accurate flow and water quality data is also essential for the Water Quality Control Division (WQCD) to develop accurate stream standards and discharge permit limits for the City's two water reclamation facilities.

The City pays the USGS a majority of the costs to record stream flow and water quality at several gage stations on the Poudre. At the USGS water quality sites, samples are collected and tested each month for a lengthy list of water quality parameters. Both the Lincoln Street and the river site above Boxelder Creek are equipped with continuous recording water flow gages. Real-time flow data for these two sites are posted at the USGS web site and available to the public. The entire historical record of flow and water quality data for the City-sponsored sites on the Cache la Poudre is available at the USGS web site.



The combined USGS-City cost total for the 2009 USGS flow and water quality monitoring on the Poudre was $116,580. The City's share of that amount was $81,680 with the remaining amount obtained from Federal matching funds. Details

for the 2009 USGS flow and water quality sites on the Cache la Poudre River are presented in the following table:

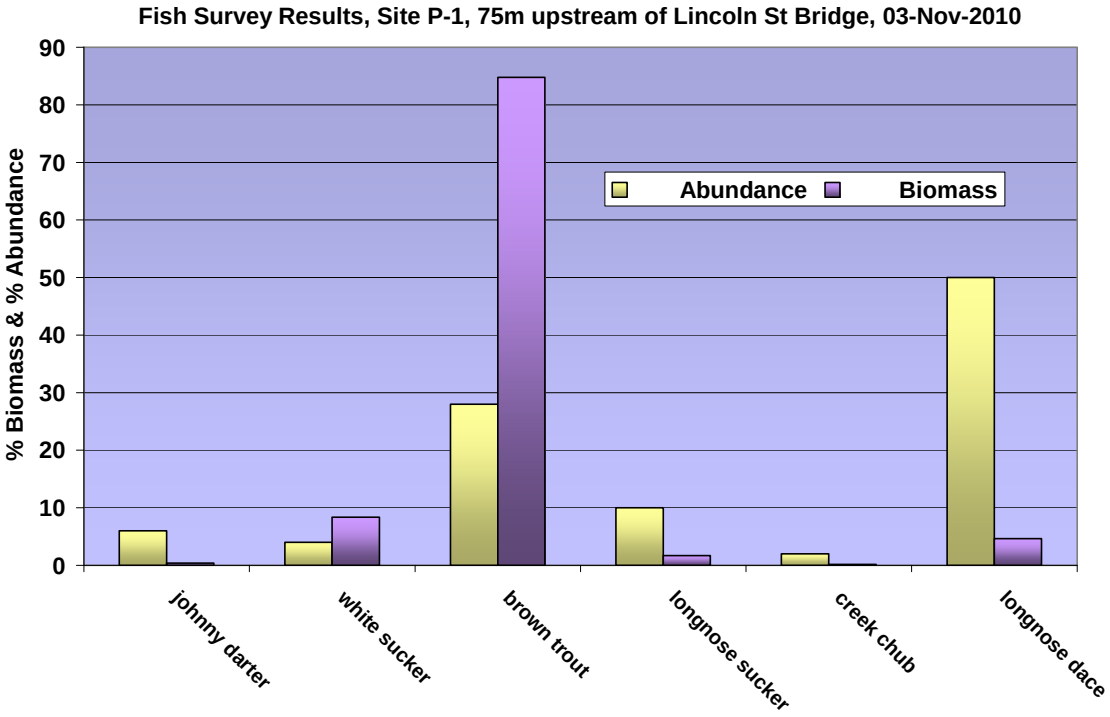
City of Fort Collins & USGS Water Flow & Quality Cooperative Monitoring Sites, Period of Record and Cost-Sharing Importance to the USGS:

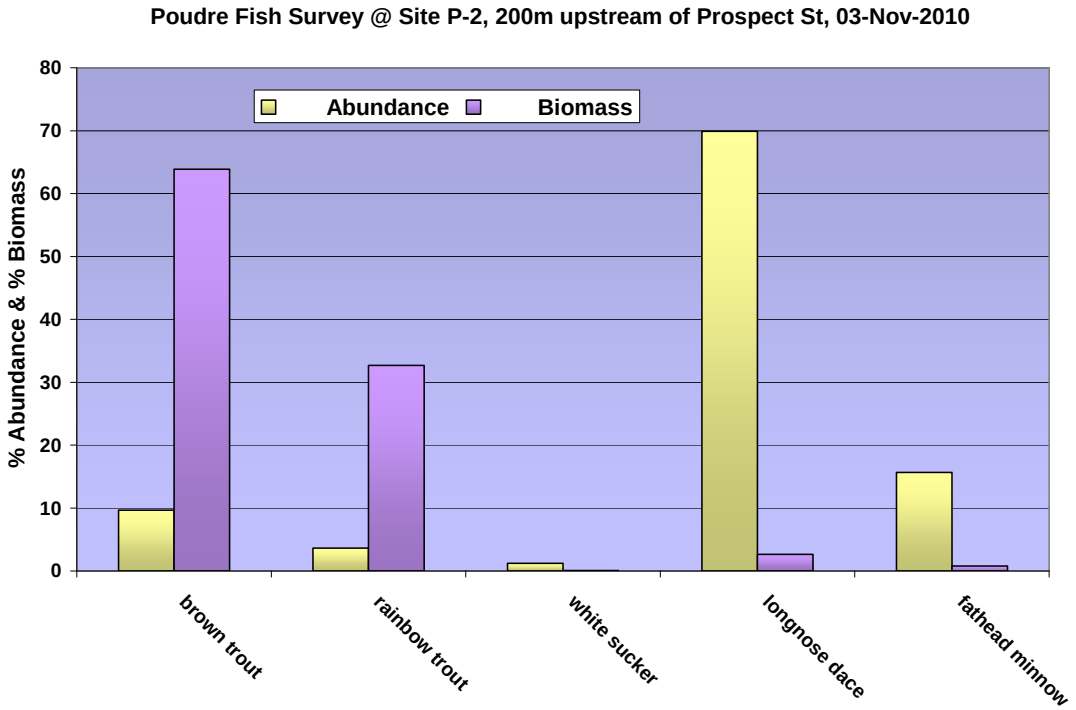
Site Number	Location	Period of Record	Flow and/or Water Quality	Importance to USGS †
6614800	Michigan River near Cameron Pass	1973 - Present	Flow	High
6746095	Joe Wright Cr above Reservoir	1978 – Present	Flow	Low
6746100	Joe Wright Cr blw Reservoir	1978 – Present	Flow	Low
06751150	North Fork Cache la Poudre blw Halligan Res.	1998 – Present	Flow	Low
06752258	Cache la Poudre at Shields St	1975 – 2005	Quality & Instantaneous Flow	Low
06752260	Cache la Poudre at Lincoln St	1975 – Present	Flow & Quality	High
06572270	Cache la Poudre at Prospect St	1975 – 2005	Quality & Instantaneous Flow	Low
06752280	Cache la Poudre above Boxelder Cr	1979 – Present	Flow & Quality	Medium
06737500	Horsetooth Res in conjunction with NCWCD & USBR	1969 - 2008	Quality	Low

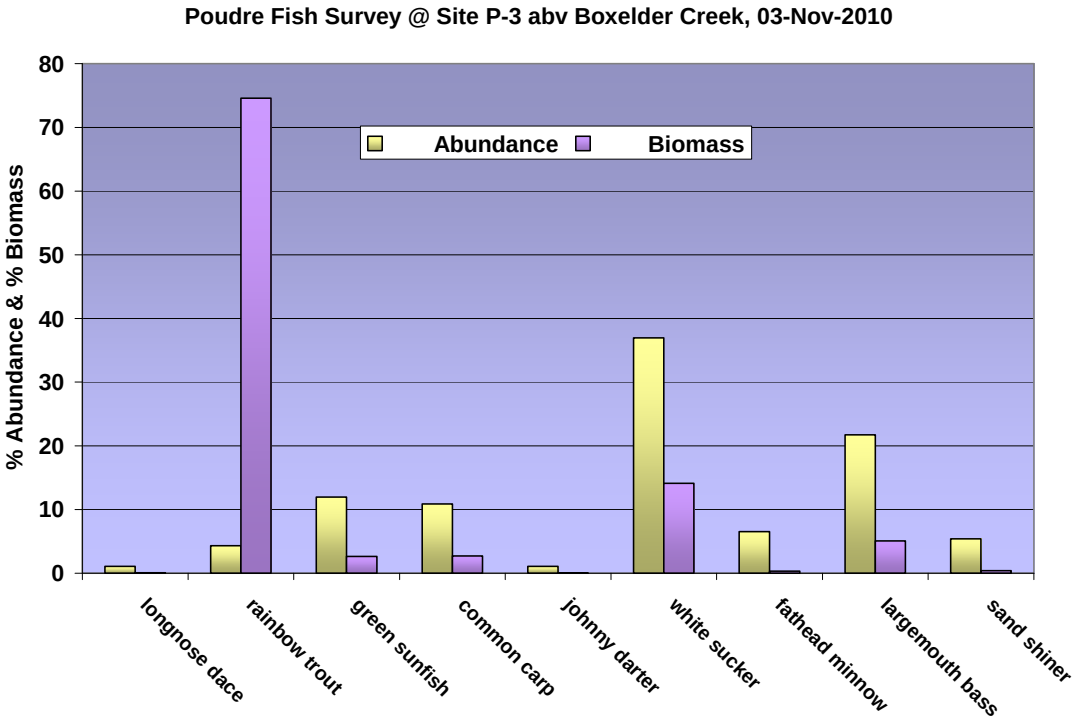
† Ranking priorities influence the cost-sharing percentages. A higher USGS importance ranking increases proportion of available Federal matching funds for flow and water quality monitoring.

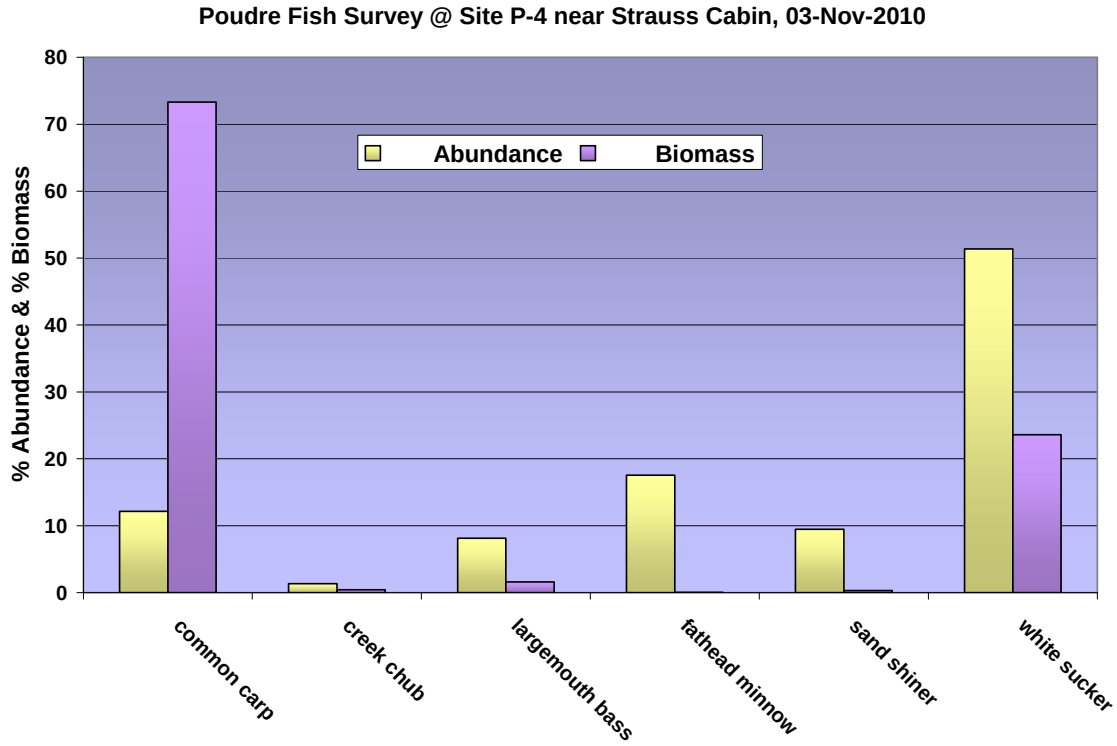
Appendix D

2010 Fish Survey Results on the Cache la Poudre from Dr Kevin Bestgen, CSU:

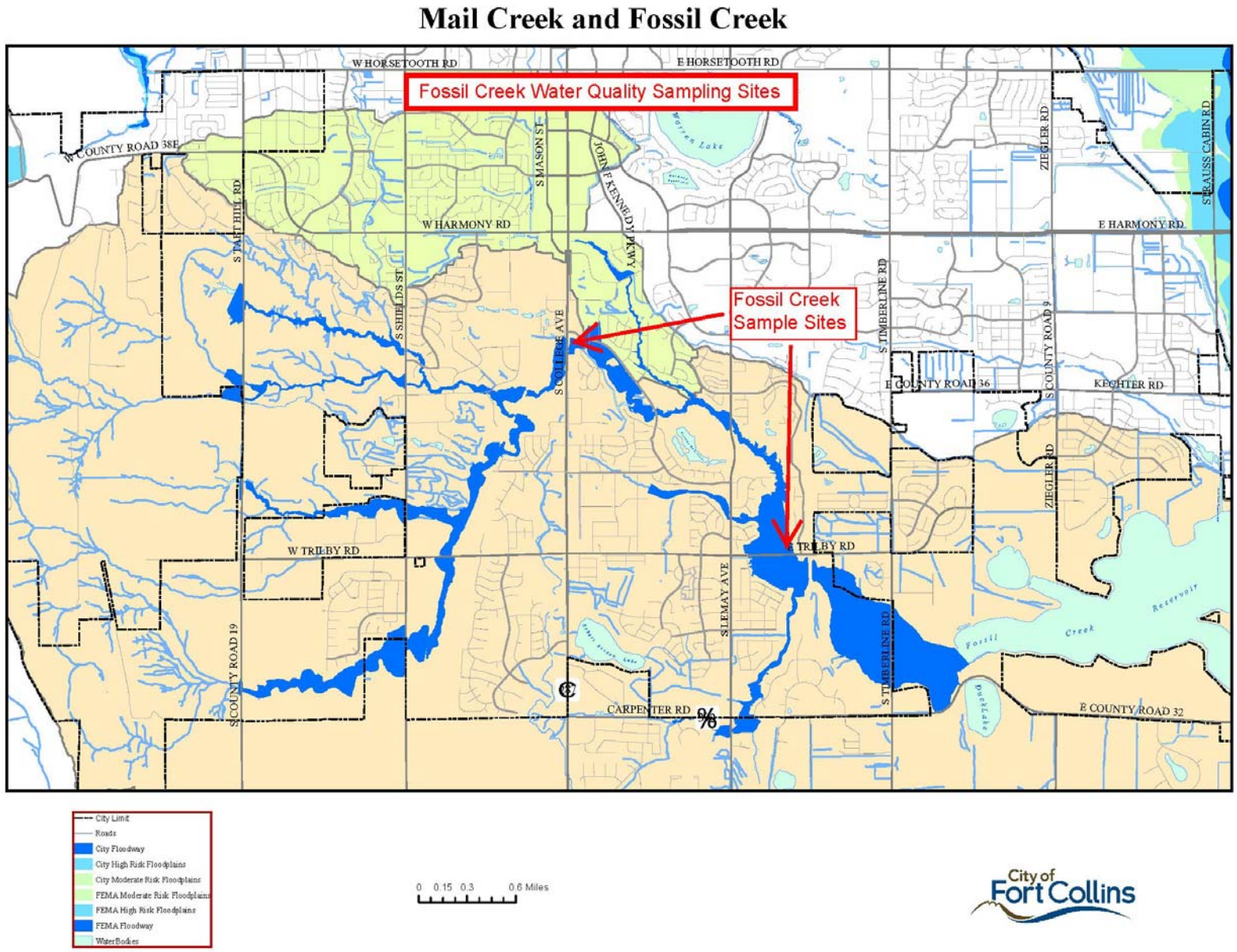




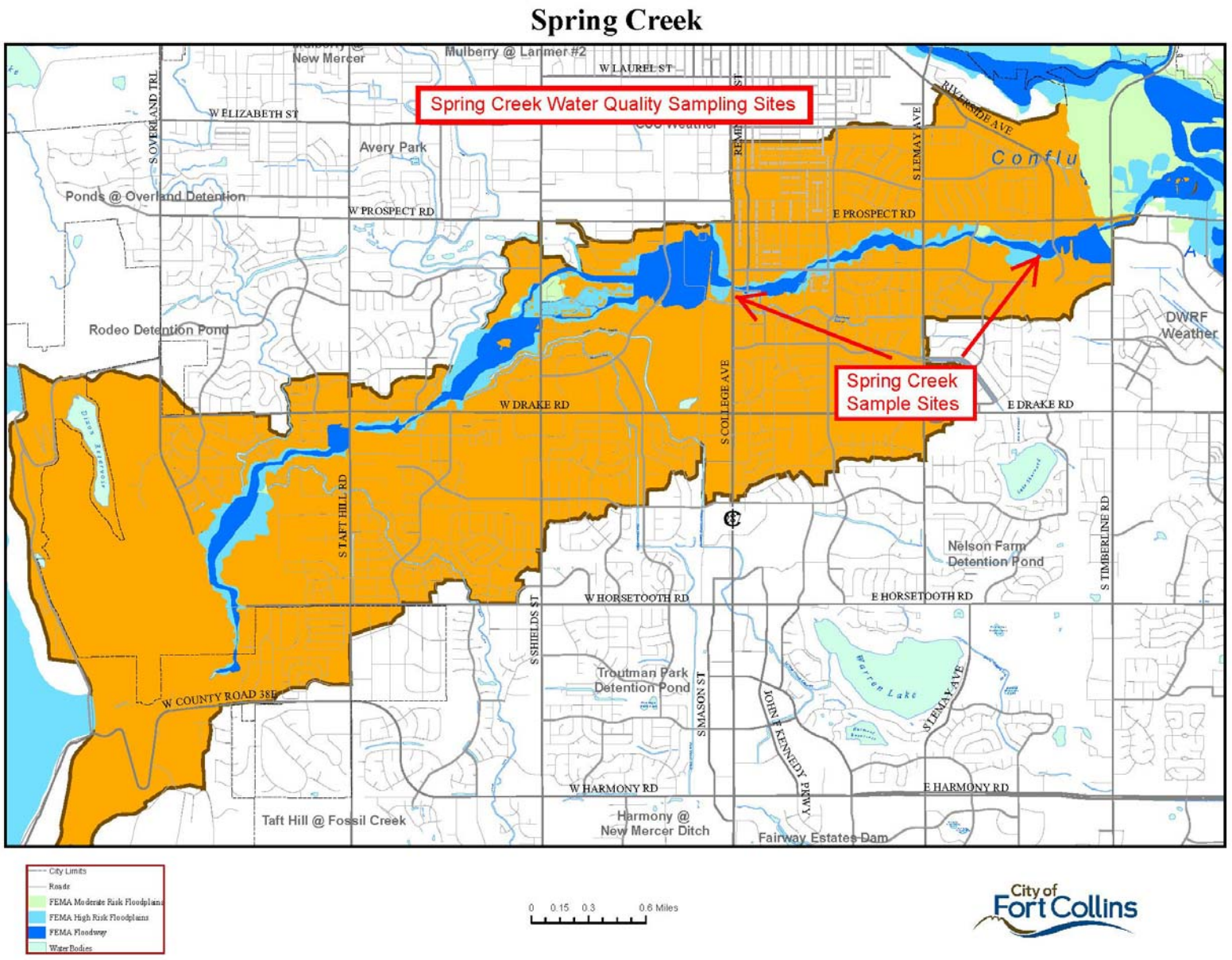

Poudre Fish Survey @ Site P-3 abv Boxelder Creek, 03-Nov-2010
% Abundance & % Biomass
80
70
60
50
40
30
20
10
0
Abundance
Biomass
longnose dace
rainbow trout
green sunfish
common carp
johnny darter
white sucker
fathead minnow
largemouth bass
sand shiner


Poudre Fish Survey @ Site P-4 near Strauss Cabin, 03-Nov-2010
% Abundance & % Biomass
80
70
60
50
40
30
20
10
0
Abundance
Biomass
common carp
creek chub
largemouth bass
fathead minnow
sand shiner
white sucker

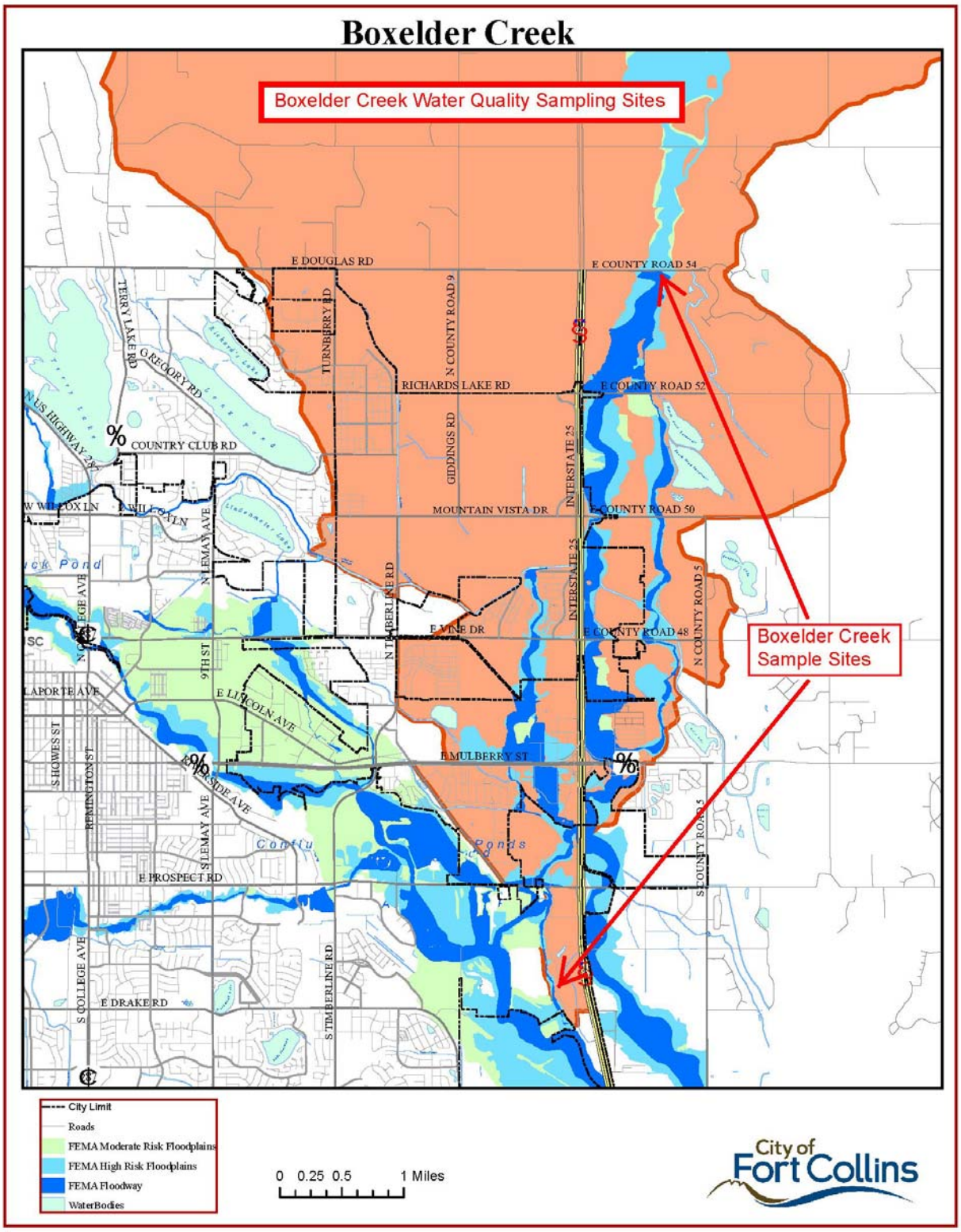
APPENDIX E. Map of Fossil Creek Floodplain and Water Quality Sampling Site Locations:



APPENDIX F. Map of Spring Creek Floodplain and Water Quality Sampling Sites:



APPENDIX G. Map of Boxelder Creek Floodplain and Water Quality Sampling Sites:



APPENDIX H. Map of Poudre River Floodplain and Water Quality Sampling Sites: