2014 - 2015
City of Fort Collins
Lower Cache la Poudre River
& Urban Creek
Water Quality Report

Students learn about possible pollutant effects on water quality as they study macroinvertebrate populations in the Cache la Poudre River.

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2014 Lower Poudre River & Urban Creek Water Quality Report

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Introduction:

This 2014 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", Resolution **95-14** "Approving the Watershed Approach to Stormwater Quality Management" and **Resolution 2000-128** "Recognizing the Need to Protect Water Quality", 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 2014 status of several MS4 and low impact development (LID) improvement programs in the City's Stormwater Program.

Executive Summary:

In 2014 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. **Municipal Separate Storm Sewer System (MS4) Permit Program Activities**: In 2003, the City obtained coverage under the Phase 2 MS4 General Permit and began implementation of the required program. This federally mandated program is administered by the Colorado Department of Public Health and Environment (CDPHE), Water Quality Control Division (WQCD). Fort Collins is currently in its second permit term, which expired in 2013 but has been administratively extended until the WQCD renews it. The goal of the program is to

minimize the amount of pollutants entering streams, creeks, lakes and rivers as a result of rain water and snowmelt from residential, commercial and industrial areas. The following six minimum control measures must be met: public education and outreach, public participation, illicit discharge detection and elimination, construction site stormwater runoff control, post-construction site stormwater management, and pollution prevention/good housekeeping for municipal operations. Details on 2014 MS4 program activities begin on page 9.

2. **Low Impact Development Program and Progress:** In effect since March 1, 2013, Ordinance 152-2013, commonly referred to as the City's Low Impact Development (LID) Policy, addresses the City's requirements and incentives for a more distributed stormwater runoff management program. It requires a minimum level of stormwater treatment and controls that rely primarily on filtration and infiltration to manage storm runoff. Additional details on current LID programs begin on page 18.

3. **Nutrient Control Regulations**: The WQCD implemented a new pollution control program in March 2013. The regulation focuses on limiting the discharge of 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 and fishing. This program is having long-term significant cost impacts on capital improvements operation and maintenance of the City's two water reclamation facilities. This program is called Nutrient Control or Regulation 85 (Reg85). Additional details about this regulatory change and where we currently stand are presented beginning on page 28.

4. **Selenium levels and the 303(d) impaired listing of the lower Poudre**: Water quality conditions in the Cache la Poudre River from Shields Street downstream to just above Boxelder Creek (Segment 11) are currently listed by the WQCD as 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. Additional monitoring has shown that the reported high levels of Selenium in Segment 11 are no longer being observed. In 2015, the WQCD is reporting that Segment 11 as well as Segment 12 from Boxelder Creek downstream to the confluence with the Platte will be removed from the list because the data is showing attainment of the stream standard. Further details regarding this issue are presented on page 38.

5. **Both Fossil Creek and Boxelder Creek are listed as "303(d)-impaired" (low priority) for high selenium levels.** Like the Poudre, exceedences of regulated selenium levels in Fossil and Boxelder Creeks were the result of 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 immediately 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 38.

6. **Both Fossil Creek and Spring Creek 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 also 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 control measures to be taken on this issue. In response, additional creek water quality monitoring and field survey efforts are underway to ensure that possible illicit discharges such as leakage from sewer pipes or septic systems are not contributing to the problem. Additional details on this issue begin on page 42.

Natural disasters, 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: data was needed to assess the impacts of the treated discharges from its two wastewater treatment plants on 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 City 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 the Environmental Protection Agency's (EPA) 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, Carestream Health (formerly KCD) and the City of Greeley. The alliance monitors over 42 miles of the Poudre at ten separate sites from Lincoln Street to its confluence with the Platte.

In the fall of 2012, the Alliance was expanded to meet the requirements of the Colorado Nutrient Control Regulations, Reg85. Leprino Foods, Inc., joined as a cooperating agency. Net effects of this consolidation include reduced costs and heightened cooperation among the affected agencies and communities that discharge to the lower Poudre.

Since 1984, the City has monitored water quality in Parkwood Lake. The lake receives storm water inputs from the area bounded by Drake and Lemay Avenues. Beginning in 2000, the program was expanded to include routine testing at three urban creeks: Boxelder Creek, Spring Creek and Fossil Creek. Two sites on each creek are monitored each calendar quarter for a variety of water quality parameters including potential *E. coli* and selenium contamination that have been issues in the past.

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 locations on the Poudre in the City begin in the mid-1970s. The Poudre, as it flows through town from Shields Street to Boxelder Creek (Segment 11), is currently sampled, monitored, and tested by several agencies, including: the City of Fort Collins, Colorado State University (CSU), the WQCD, CDPHE, Colorado Parks & Wildlife, the USGS, In-Situ, Inc., Boxelder Sanitation District, and RiverWatch.

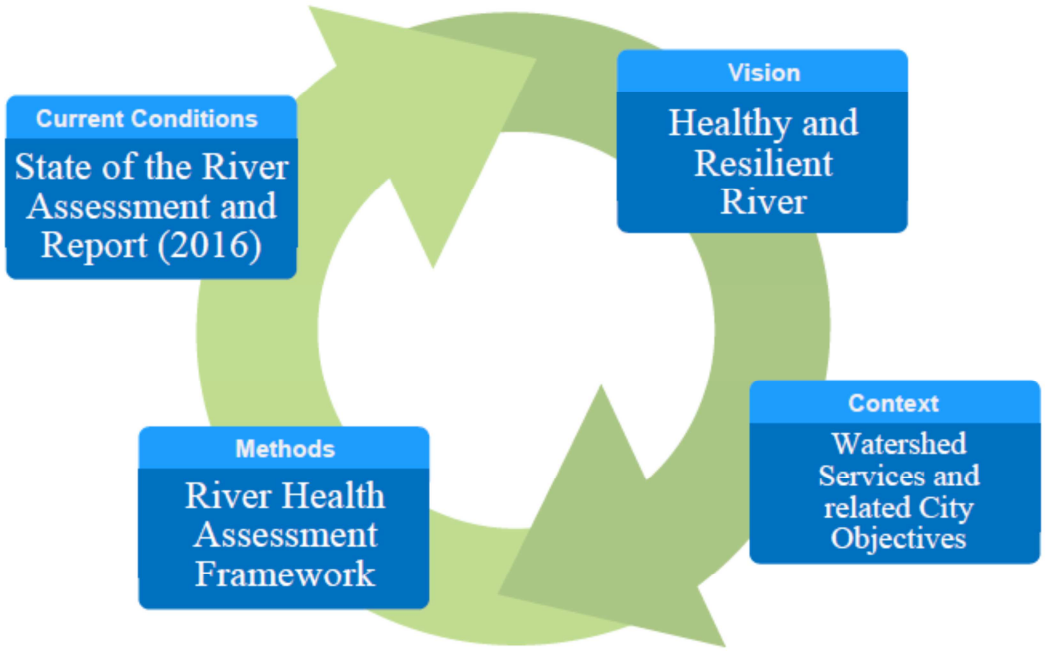
The River Health Assessment Framework

The City of Fort Collins Natural Areas Department and Utilities Service Area developed the River Health Assessment Framework (RHAF) to clearly define the City's vision for a healthy and resilient Poudre River. This vision includes aspirations for improving the Poudre River's health as well as sustaining current ecosystem function. The RHAF was developed to help guide and inform the City's efforts to support watershed services and river management efforts. The scope of the RHAF encompasses the entire Poudre River as it affects the City, from its headwaters to Windsor, but with greater emphasis on the reach extending from the City's water supply intake in the lower Poudre Canyon to I-25.

The RHAF is a functional condition assessment tool for the Poudre River and is closely modeled on the Functional Assessment of Colorado Streams (FACStream) framework (M. Beardsley, pers. Comm. Jan. 10, 2015). It provides a meaningful, objective means by which to organize, monitor and report comprehensively on specific metrics of river health. Through its application, the RHAF can assist the City in evaluating key stressors on the river and guide future dialogue about how the City can work in a targeted way to sustain a healthy, resilient Poudre River.

The RHAF evaluates ten key physical, chemical and biological indicators of river health, including water quality. The key metrics for evaluating water quality across the different river reaches include temperature, nutrients, pH and dissolved oxygen. Data collected from the City's

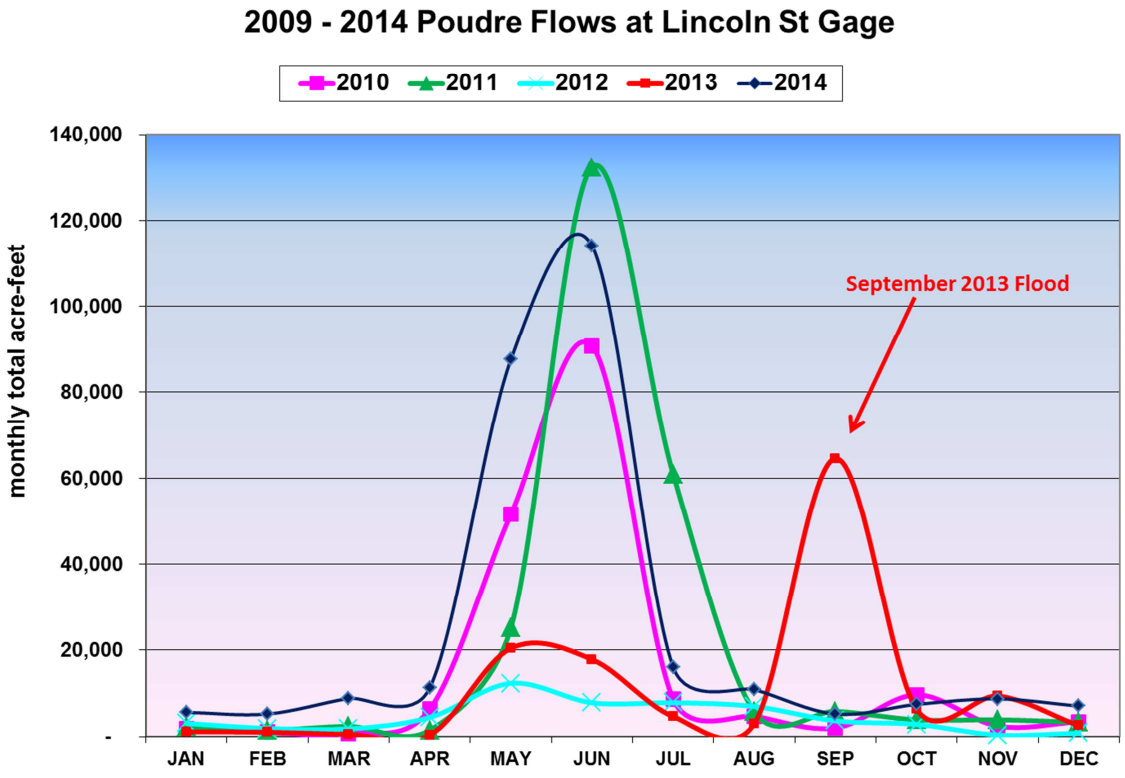
water quality monitoring programs, including the Lower Poudre Monitoring Alliance will be included in this assessment. Specifically, data provided by the Alliance will serve as the primary source of information about water quality in the lower reaches of the Poudre through Fort Collins and past I-25. Aquatic macroinvertebrate data collected through the Alliance will also be used to evaluate a second key indicator: aquatic and riparian Wildlife.



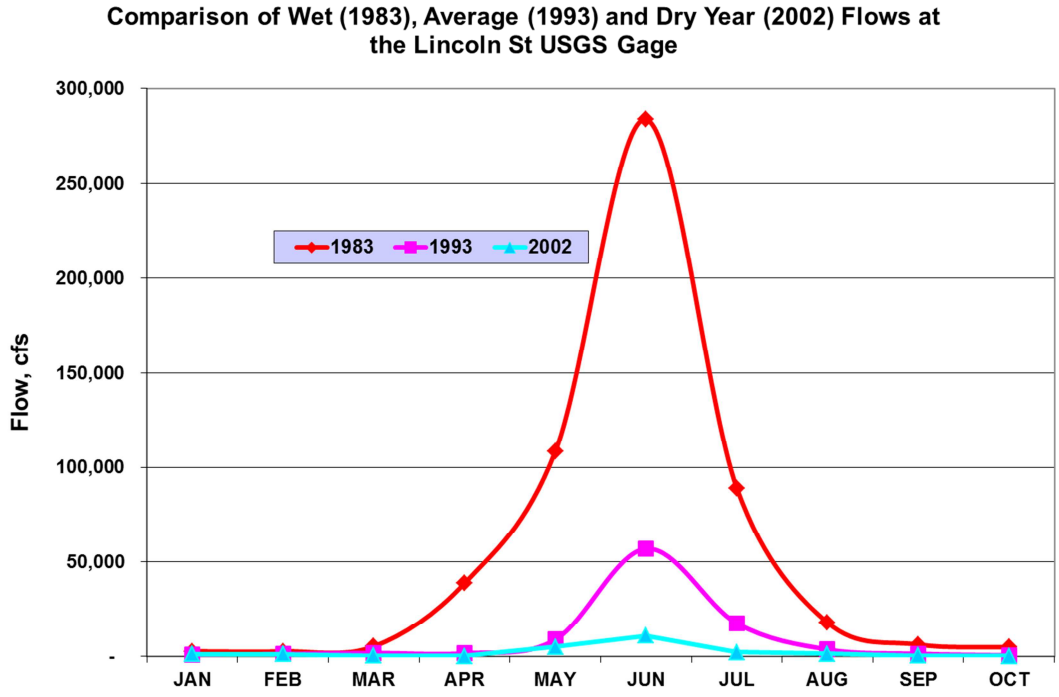
In application, the current year water quality will be evaluated against historical observations as well as against the recommended concentration ranges that were developed to support desired conditions. Each metric will be assigned a letter grade (A to F) that corresponds to a functioning status (e.g. a "B" grade indicates highly functioning). A full description of the recommended ranges and the corresponding grading system for each of the key indicators and metrics is provided in the 2015 RHAF Report and Appendices.

2013 Lower Poudre River Flows and the September Flood

In 2013 spring runoff flow rates in the Poudre were substantially below the levels observed in 2009 through 2011 but were higher than 2012. The 2013 September flood flow rates exceeded the monthly total acre-feet during spring runoff flows by almost a factor of three. It is of interest to note that the numbers and biomass of brown trout observed during the November 2012 CSU fish survey upstream of Lincoln Street exceeded levels observed in 2011. However, the fish survey completed after the 2013 flood showed reductions in both the abundance and biomass of fish recovered from the Poudre. The September flood also scoured much of the ash sediments from the riverbed. The fall 2014 fish survey reveal that this scouring had a positive effect on restoring macro-invertebrate populations and encouraged a strong recovery of fish populations in the lower Poudre.



2010 – 2014 Comparative monthly flows at the Lincoln St Gage



Comparison of Wet, Dry and Average Year Flows at the Lincoln St Gage

Lower Poudre Water Quality Programs & Municipal Separate Stormwater Sewer System (MS4) Monitoring Programs and Costs:

2014 Monitoring Program Description	Cost	Comment
USGS: October 2012 – September 2013 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.	$133,270	City's share: $101,450. Federal funds cover the remaining portion of the cooperative program.
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 macro invertebrate surveys.	$92,152	Cost value of field sampling, field measurements and lab work; includes City's portion of Lower 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.	$7,000	Cost value of field sampling, field measurements and lab work.
2014 **CSU** Fish and Macro-invertebrate Biosurveys on the Poudre through the City as part of the Lower Poudre Monitoring Alliance Program	$26,000	Fort Collins share of this portion of Lower Poudre Monitoring Alliance Program
2014 Nutrient Control Regulation – Reg85 Cooperating Agencies	$17,750	Fort Collins portion was $2,700
Municipal Separate Storm Sewer System (MS4) Permit Compliance Program	$324,452	Managed by the Division of Government and Regulatory Affairs

In 2014, the City committed over $600,000 to collect flow and water quality data on the lower Cache la Poudre River as well as water quality data on key urban creeks, Parkwood Lake, stormwater and for MS4 permit compliance. USGS flow and water quality data are 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 regulatory compliance and stormwater impacts on key urban creeks in the City as well as the river.

2014 Municipal Separate Storm Sewer System (MS4) Program 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 decrease 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 employees take pride in implementation of these pollution prevention measures and the resulting urban watershed quality. Listed below are the minimum control measures, a summary of the requirements and 2014 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.*

   Highlights of the 2014 stormwater education program:

   - The City's WaterSHED (Stormwater Habitat Education Development) program educated 3,889 students and 1,316 adults, for a total of 5,417 student and 861 adult contact hours.

Students learn about stream ecology through the WaterSHED program

   - Community outreach events that included watershed and stormwater education included Poudre Watershed Bus Tours, Poudre RiverFest, NoCo Nature Festival, and a Kiwanis Club presentation

- Twenty adults were trained though the Master Naturalist program, which included a four-hour segment on water quality monitoring
- Interpretive signage is displayed at select outdoor classrooms in Fort Collins, as well as the Low Impact Development pilot projects
- Storm drain markers were installed on 433 storm drain inlets
- The Children's Water Festival had 1659 student participants
- Responded to 57 requests for a special events permit with information about stormwater pollution prevention
- The 2014 Stormwater Business Outreach program empowered 57 local pet businesses to act as ambassadors to their employees and the community using educational postcards and posters about the effects of pet waste on local water quality. To complement the business program, targeted outreach for residents included:
- 250 metal signs installed at pet waste stations in all City parks
    - Ben & Jerry's ice cream coupons were presented to people seen picking up pet waste
    - Posters were installed posters in park shops and kiosks

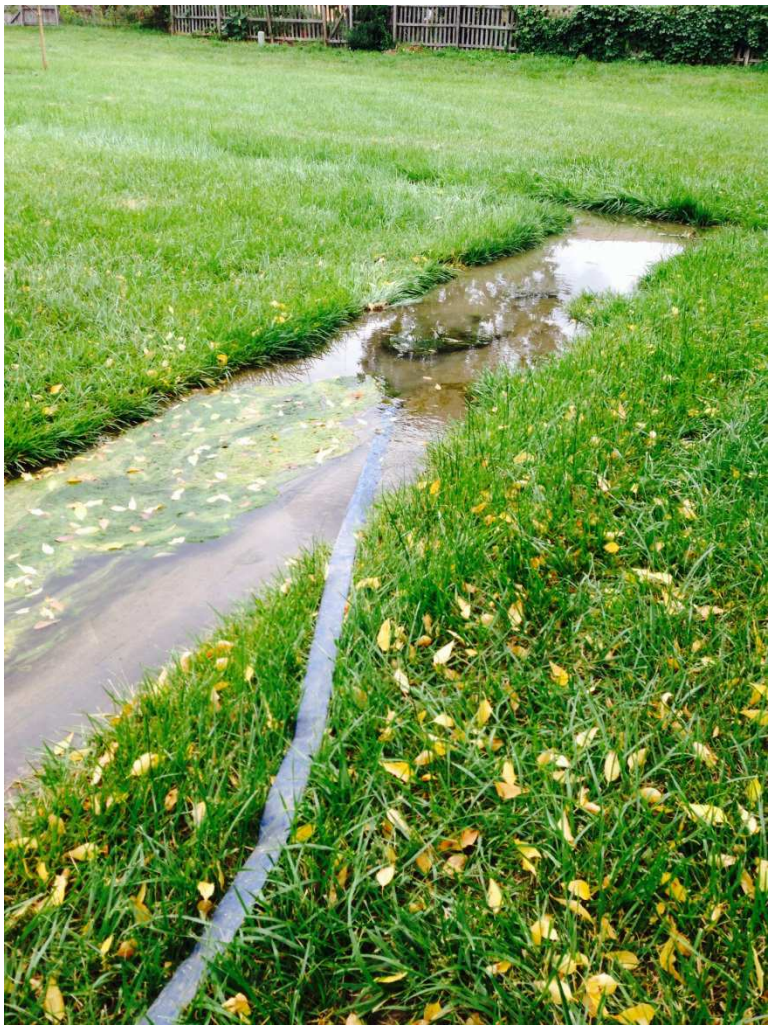
2. **Public Participation and Involvement -** *The permittee must provide a mechanism and process to allow the public to review and provide input on the CDPS Stormwater Management Program.*

- An annual update of the permit Stormwater Management Program is presented to the Natural Resources Advisory Board and the Water Board. The 2014 MS4 Permit update included a summary of the 2013 MS4 Permit annual report, 2013 highlights of the minimum control measures, and a regulatory update on the MS4 Permit renewal process and proposed changes.
- The City's MS4 Permit Stormwater Management Program description and 2008-2014 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 (IDDE)** - *The permittee must develop, implement and enforce a program to detect and eliminate illicit discharges into the permittee's MS4.* During 2014, staff

A resident continued to park a leaking vehicle over this storm drain, even after educational attempts and a warning. This incident resulted in a municipal citation issued to the responsible party.

- responded to 53 spill complaint calls, including site visits, incident investigations, on-site and phone education, delivery of educational door hangers and follow-up letters
- issued seven written and two verbal notices of violation and provided education for 24 incidents
- issued one charge to recover pollutant cleanup costs and one municipal summons, resulting in a 2015 sentence
- participated in ongoing collaboration with the Poudre Fire Authority (PFA) Hazmat Team
- coordinated and participated in a Mock Spill Response Exercise Drill with PFA
- coordinated and participated in the multi-agency Spill Boom Training including the Environmental Protection Agency, PFA, and Larimer County



Discharge of groundwater related to construction activities is regulated via a Colorado Discharge Permit System permit. This illegal discharge was stopped and the responsible party was not allowed to continue without the proper permit.

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.*

Properly installed inlet protection prevents construction site sediment and related pollutants from entering the storm sewer system inlet.

- Staff conducted 2304 full level and 408 reconnaissance inspections on 101 construction sites for sediment and erosion control.
- Inspections included 860 individual building sites and an annual average of 91 development sites.
- Enforcement measures for noncompliance with erosion control requirements included:
    - 821 verbal notices
    - two written notices
    - 23 building permits and certificates of occupancy held
- 862 building permits held on individual lots to ensure BMPs installation
- Signed off on 727 Soil Amendment Certifications
- Responded to over 500 phone calls addressing customer questions regarding soil erosion control, stormwater pond inspections and permit compliance
- Attended 21 development construction permit meetings
- Assisted City staff with the development of erosion control plans for ten City projects including the Drake Water Reclamation Facility (DWRF), Water Treatment Facility and the Forney Property Dirt Sifting Operations
- Advised City departments and contractors on construction stormwater permit and stormwater management plan requirements for various projects
- Coordinated and presented at CDPHE Construction Dewatering Training for project managers

A windshield inspection reveals improper practices on this construction site, resulting in discharge of sediment to the street and gutter.

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.*

    - Staff performed inspections on 126 private water quality ponds and 184 private stormwater detention ponds
    - A total of 550 inspections were performed, including follow up inspections to ensure compliance with maintenance requirements
    - Enforcement measures included 116 written and 32 verbal notices of violation for maintenance issues
    - Staff added 21 new stormwater basins to the stormwater system (SWIMS) database
    - Staff responded to an MS4 permit post-construction program deficiency with CDPHE reporting and program improvements
    - Staff partnered with CDOT on Regional Water Quality BMPs and Stormwater Master Plans

In addition to flood prevention, water quality basins are designed to detain stormwater long enough to remove sediment and associated pollutants from stormwater.

An improperly maintained water quality outlet structure can plug, causing an excess buildup of sediment and debris, and allowing excess vegetative growth in the concrete drainage pan.

Proper maintenance of this basin entails regular cleaning of the outlet structure and removal of debris and vegetative growth from the concrete pan.

6. Pollution Prevention/Good Housekeeping (P2/GH) 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.*

    - Staff conducted Stormwater Pollution Prevention/Good Housekeeping/Hazardous Waste Training for 348 City employees
    - Staff provided outreach on treatment and discharge of super-chlorinated water from water line installation
    - Staff conducted Snow and Ice Training for Streets
    - Staff conducted stormwater pollution prevention and waste management audits at Drake Water Reclamation Facility, Water Treatment Facility, and Streets Facility as a component of the Environmental Management System

Facilities are evaluated for proper management of wastes and materials, which helps prevent discharge of pollutants to the storm sewer system.

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Many activities, such as participation in stakeholder groups and outreach, supplement and support MS4 Permit requirements. Staff participated in the following:

- Reconvened the City Stormwater Quality Team
- Gave two presentations and panel discussion at Montana Stormwater Conference
- Represented the Colorado Stormwater Council in the National Stormwater Summit
- Moderated WEFTEC MS4 Stormwater Program Topics Session and Panel Discussion
- Provided outreach on Construction Dewatering activities/permits
- Continued Treated Water Management Plan discussions with Water Field Operations
- Provided outreach on MS4 compliance and municipal code to Police Services
- Coordinated with staff and legal counsel to compile comments on the draft MS4 Permit
- Participated in the CSU Colorado Stormwater Center steering committee
- Advised on the development of the Resource Recovery Farm Sand & Gravel Permit Stormwater Management Plan
- Collaborated with Front Range Community College and City Attorney's Office regarding an MOU for coordination of permit requirements
- Advised on potential permitting and permit transfer issues for the Woodward project
- Attended meeting with IT to facilitate tracking of storm drain markers

Stormwater Quality Control Low Impact Development (LID) Program

City Council requested a review of the Stormwater Program in October 2008. Council directed that additional emphasis be placed on improving stormwater quality and protecting the City's urban watersheds while preserving natural and beneficial functions of floodplains. The resulting Stormwater Utility Repurposing program review consisted of 14 major components:

- Stormwater Purpose Statement
- BMP Policy Update
- Urban Stream Health
- Floodplain Regulations
- City-Owned BMP Review
- LID Demo Projects
- Stormwater Criteria Update
- Stormwater Rates
- LID Policy Review
- Level of Protection Policy
- Stormwater Quality Sampling
- Detention Pond Landscaping
- Homeowner Association (HOA) Assistance Program
- Stormwater Quality Geographic Information System (GIS) Coverage

In effect since March 1st, 2013, Ordinance 152-2013, commonly referred to as the City's LID Policy, addresses City requirements and incentives for a more distributed stormwater runoff management program. It includes a minimum level of stormwater treatment and controls that rely primarily on filtration and infiltration to manage storm runoff. The overall goal of this effort is to improve the quality of life, to support economic health and to enhance and protect the City's natural resources.

Key components of the LID program include:

- An overall site planning approach that promotes conservation design at both the watershed and site levels.
- A site design philosophy that emphasizes multiple controls distributed throughout a development, as opposed to a central treatment facility.
- The use of swales and open vegetated conveyances, as opposed to curb and gutter systems.
- A focus on stormwater volume reduction rather than peak flow reduction.

The City has been engaged in construction of LID of both public and private demonstration projects since 2009. These projects were intended to provide guidelines for specific measures that should be recommended for different types of land uses. The existing projects are currently being monitored for structural integrity, cost of maintenance as well as for stormwater quantity reduction and water quality improvement. Ongoing monitoring will guide refinement of future LID policies.

New development projects must have at least 50% of their site area treated through LID-type (infiltration based) technology and at least 50% of any added pavement needs to be pervious. This reduces the volume of runoff from paved areas and improves water quality. The ordinance also allows for an equal or better standard. The intent of this equal or better standard was to enable staff to make informed judgments in cases where one standard cannot be met. However, it ensures that the entirety of the site design meets the scope, spirit and the intent of the ordinance.

Since March 2013, a total of 22 development projects have been approved that comply with the ordinance. These projects used a combination of techniques to reach the minimum 50% LID requirement. In general this requirement has been easily met through a combination of measures including bio-retention (more commonly known as rain gardens) and pervious pavement.

Bioretention has been used in 21 of these projects and pervious pavement used in 12. A combination of both measures was used at nine of these sites. The equal or better standard was applied in four cases. 100 % LID-type technology was provided through bioretention, while the 25% permeable pavement requirement was not met due to site physical conditions including excessively steep slopes or presence of expansive clay. Some projects noted above did not have to meet the pervious pavement requirement since none was added.

Next Steps in the LID Program:

The City staff intends to closely monitor LID performance in meeting the goals of the ordinance. This will include investigation of implementation barriers and challenges such as unfamiliarity with construction techniques, lack of coordination between different sub-contractors and lack of training for construction inspectors.

To that end, the City has contracted with CSU to complete a survey of all existing LID facilities in the City. Four tasks have been identified: 1) monitoring of the performance of recently constructed LID facilities, 2) evaluation of compliance of new developments with industry recognized construction techniques, 3) evaluation of LID performance with respect to clogging and maintenance, and 4) evaluation of construction inspection procedures that will minimize future performance and maintenance issues.

In addition, the City is creating a database that will allow it to track the location, type and performance of all existing LID installations. It will be tied to the City's GIS mapping program. It is expected that this database will facilitate performance evaluation of LID structures and guide the establishment of inspection frequencies.

A report will be developed in 2014 that highlights lessons learned from this survey regarding construction inspection, recommended maintenance regimes and standard operating procedures for inspection and maintenance. In early 2015 the Stormwater Department will provide a report to City Council updating results of the LID installations survey and recommending potential updates to the LID ordinance based on the survey findings.

Potential Updates to the LID Ordinance: At the end of this evaluation period the Utility may be recommending updates to the LID ordinance. Potential updates include:

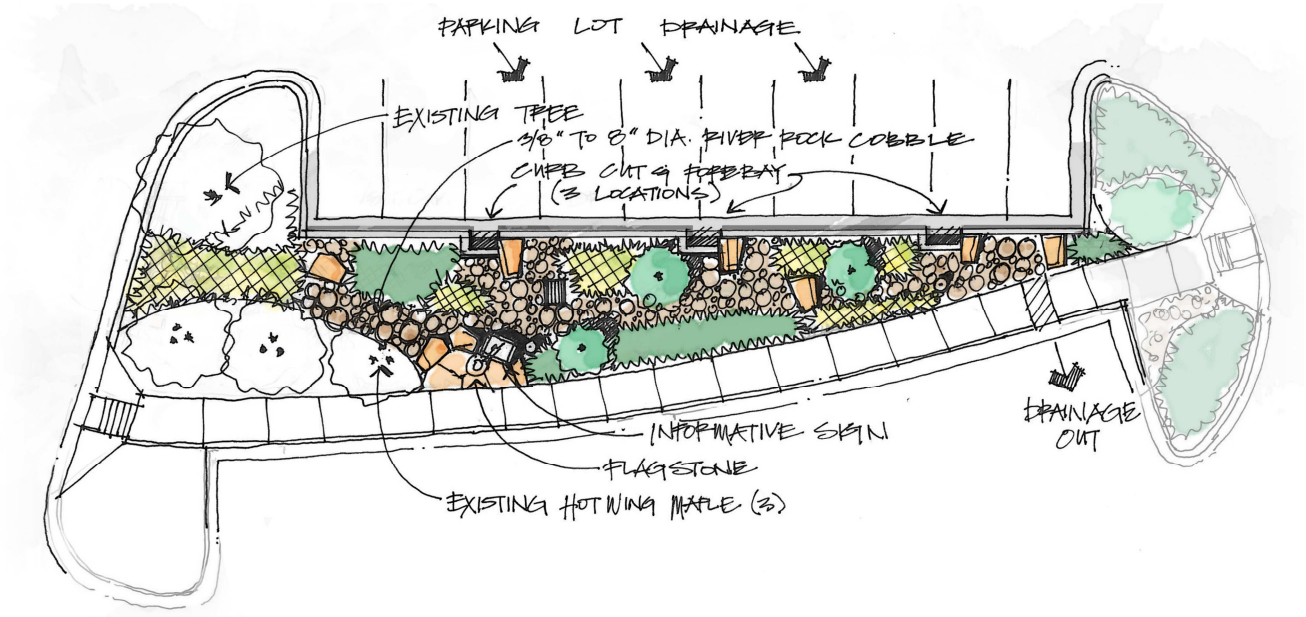
- Adding more flexibility and variety in the types of LID facilities that are accepted, enabling more innovative and cost effective designs.
- Providing additional incentives for the installation of LID-type facilities.
- Allowing LID-type facilities to be constructed on a block scale. This would allow multiple adjacent small developments the use of a shared facility, reducing construction costs and the amount of land consumed.

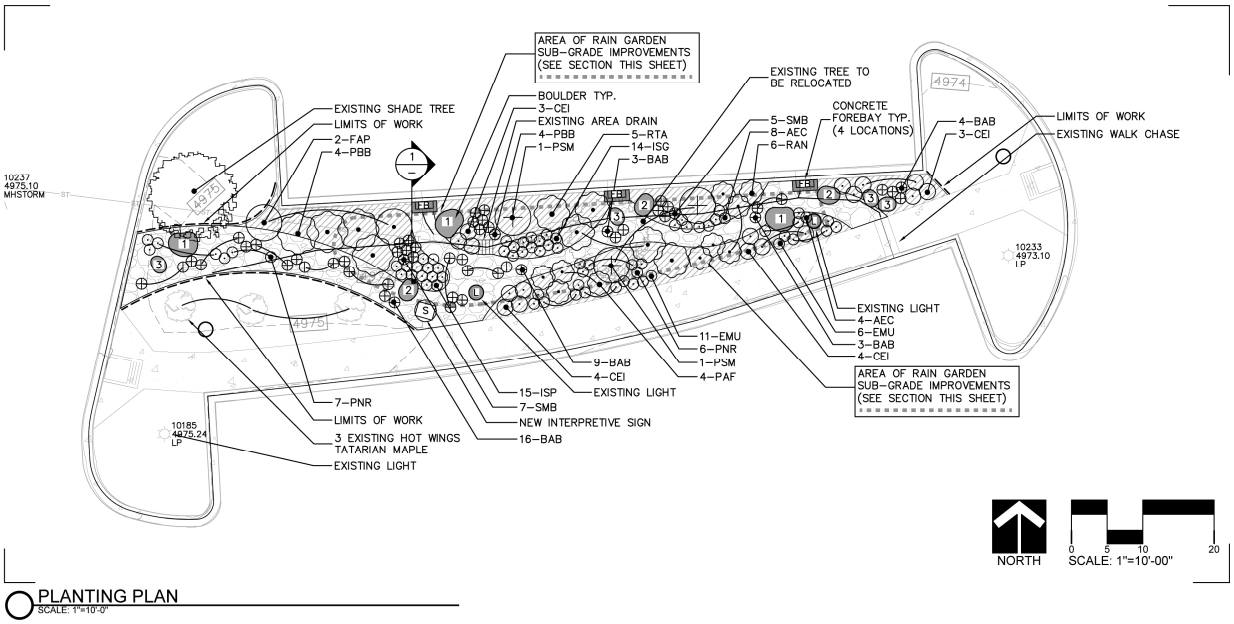
- Establishing a payment in lieu of construction fund that would allow the City to use the funds to construct LID facilities in retrofitted areas within regional City-owned facilities. This would help reduce the maintenance issues associated with privately owned and maintained sites.

Fort Collins Museum of Discovery Rain Garden

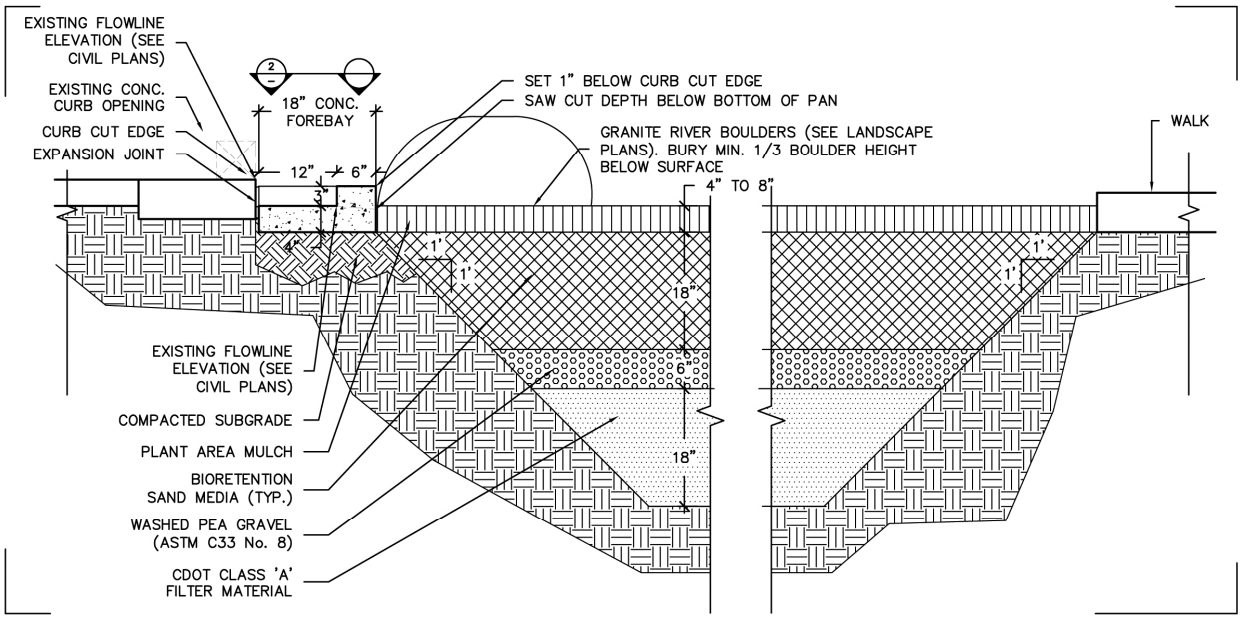
In 2014 Stormwater Department staff found that the existing Museum of Discovery parking lot landscaped island drainage system did not function as intended. The drainage swale, as designed, did not properly evacuate water and presented an aesthetic problem in a City of Fort Collins highly visible signature site. In cooperation with the City's facilities department and with the design help of Ripley Associates and Northern Engineering, a design plan was developed to restore the area and to create a rain garden filled with native landscapes.

Concept Plan:





PLANTING PLAN
SCALE: 1"=10'-0"

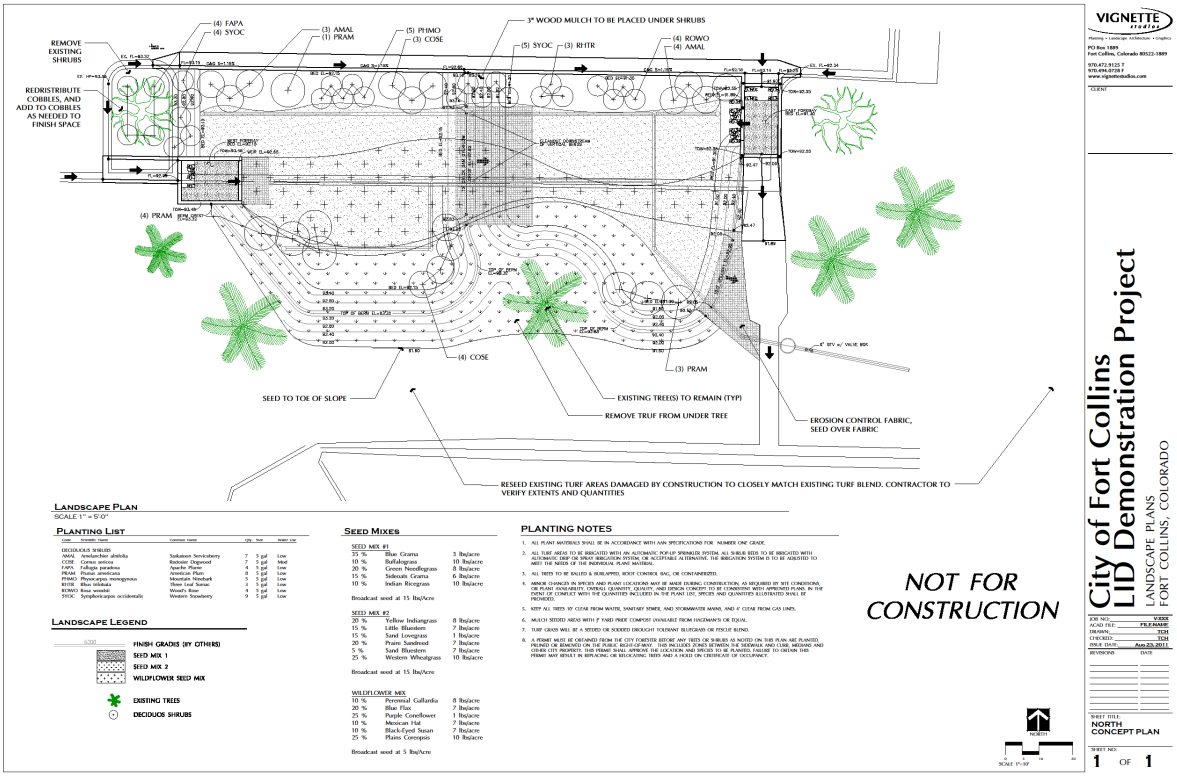


RAIN GARDEN SECTION
SCALE: 3/4"=1'-0"

Construction of the Museum of Discovery Rain Garden Project is slated to begin in late summer of 2015 with landscape installation in the fall. The project will include educational signage to inform the public on the benefits of rain gardens.

Utility Service Center Stormwater Bioretention Cell (BRC) Monitoring Program:

The City of Fort Collins initiated a demonstration project to construct a retrofit bioretention basin at the City's Utility Service Center parking lot. The goal of the Fort Collins project was multi-faceted and involves a significant monitoring effort. The drainage basins contributing to these bioretention areas are highly impervious, fully developed, lack room for idealized construction conditions or standard designs, and contain a significant amount of public right-of-way or paved areas typical of urbanized environments. The City of Fort Collins has partnered with Colorado State University to collect and analyze data from a variety of LID-type BMPs, including this project.



View of the Utility Bioretention Pond looking southeast from 700 Wood St.

In 2014 the City continued to monitor the performance of the bioretention cell (otherwise referred to as a "Rain Garden") located at the Utilities Service Center parking lot at 700 Wood Street. Following is a summary of the results of the investigation completed by Colorado State University researchers at this site.

Study Objectives:

The overall objective of this study was to determine the performance of the BRC at removing pollutants from stormwater runoff and reducing the overall volume of stormwater runoff discharged to receiving waters. With respect to stormwater pollutant reduction, the objectives were to estimate the average annual pollutant load reduction for total suspended solids (TSS), total nitrogen (TN) and total phosphorus (TP). TN and TP are nutrients that can cause eutrophication of receiving waters and are potentially subject to the Reg85 promulgated by CDPHE. The analyte TSS is not a pollutant per se, but has long been used as a surrogate measure of BMP performance because of other pollutants (e.g., heavy metals) tendency to attach to particulates in urban stormwater. It is often assumed that the removal of TSS has a direct correlation with the removal of other pollutants.

With respect to reducing stormwater runoff volume, the objectives of this study were to estimate the average annual runoff volume reduction provided by the BRC and estimate the contribution of infiltration and evapotranspiration (ET) processes that provide runoff volume reduction. Many of the problems associated with urban stormwater can be alleviated by reducing stormwater runoff volume through infiltration into the groundwater and/or ET, and better understanding the contribution infiltration and ET can help to predict BMP performance at locations with different geologic and climatological conditions.

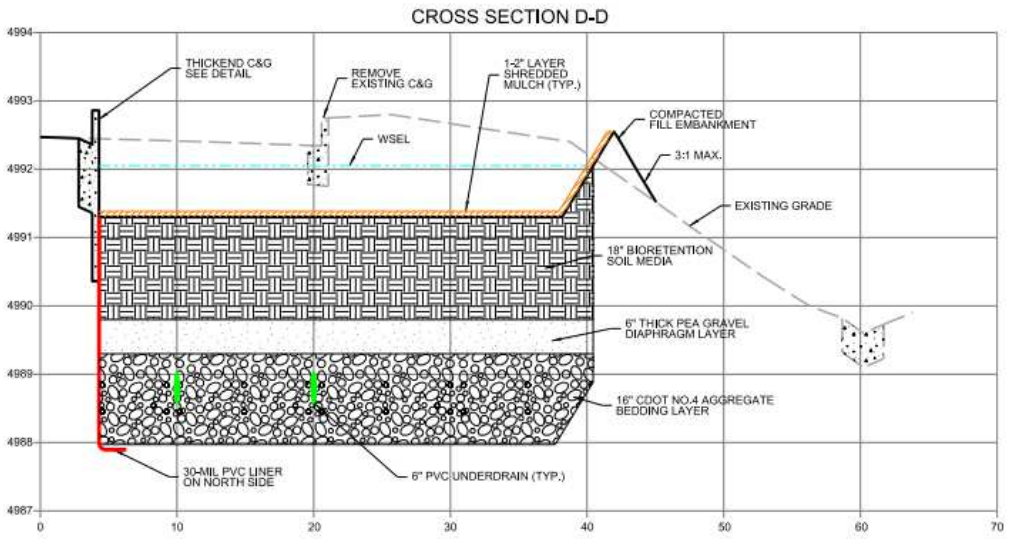
Site Description:
The BRC is located at 700 Wood Street, Fort Collins, Colorado and receives runoff from a 99,000 ft^2 parking lot. The BRC has a surface area of approximately 1,900 ft^2 and a water quality capture volume (WQCV) of approximately 1,400 ft^3, which is about 33% smaller than the WQCV required by the Utility's current design criteria.

The basin is divided into two cells, defined as East and West in this report. During a runoff event, the East and West cells receive approximately 85% and 15% of the total parking lot runoff, respectively. Runoff from each cell first enters a forebay comprised of pea gravel where trash and large particulates are removed. After flowing through the forebay, runoff enters the ponding area where runoff infiltrates through the filter media and into the gravel storage reservoir below. Runoff that accumulates in the gravel storage reservoir can either infiltrate the groundwater or discharge through the underdrain which is connected to the stormwater drainage system.

As shown in Figure 1, the BRC includes approximately 18 inches (in.) of filter media, 6 in. of pea gravel and 16 in. of CDOT #4 aggregate. The pea gravel and CDOT #4 aggregate comprise the gravel storage reservoir previously mentioned. From the gravel storage reservoir, water either infiltrates into the native soil below or is discharged through an underdrain system. The underdrain is 6 inch perforated PVC pipe and acts to discharge water from the gravel storage reservoir once water reaches a certain depth within the gravel storage reservoir. (Note: The underdrain depth was different in 2013 and 2014; this is discussed in more detail below). One underdrain serves both the east and west cells and water passing through the underdrain is discharged into the storm sewer nearby.

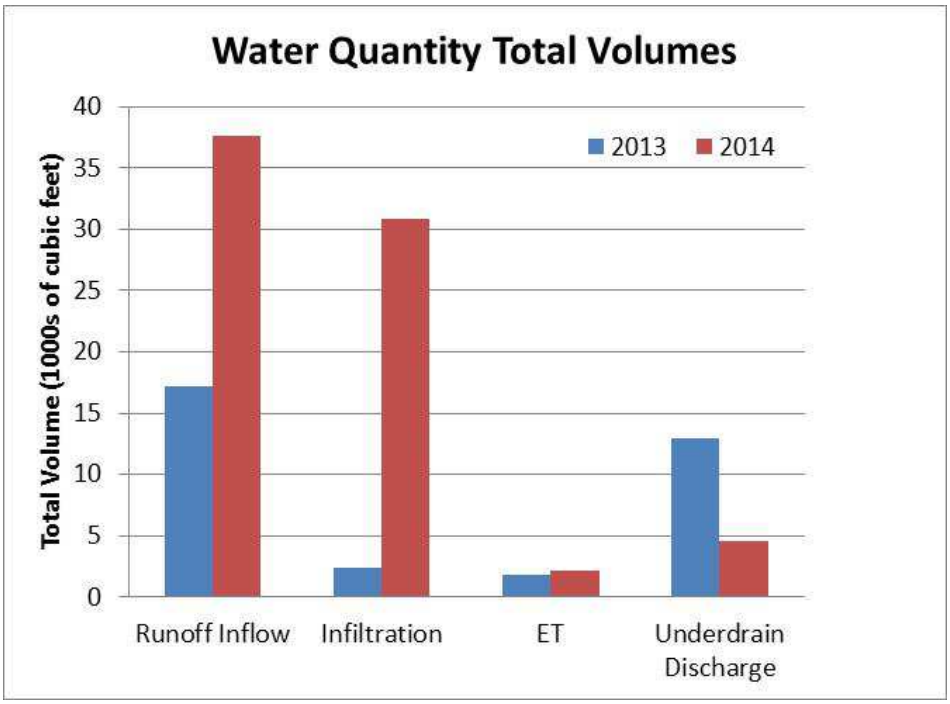
Underdrain Design and 2014 Modifications:
The BRC was originally designed with the underdrain being approximately 6 inches above the bottom of the gravel storage reservoir. This meant that water discharged through the underdrain and into the storm sewer once the depth of water exceeded 6 inches in the gravel storage reservoir. The 2013 monitoring results presented in this report were collected with this underdrain design.

In the spring of 2014 a vertical riser was installed on the underdrain system by CSU. The riser (Figure 2) essentially raised the depth of the underdrain to approximately 12 inches above the bottom of the gravel storage reservoir. The intention of raising the underdrain was to allow more water to infiltrate into groundwater table below; instead of being discharged through the underdrain and into the storm sewer. The 2014 monitoring results presented in this report were collected with this modified underdrain design.



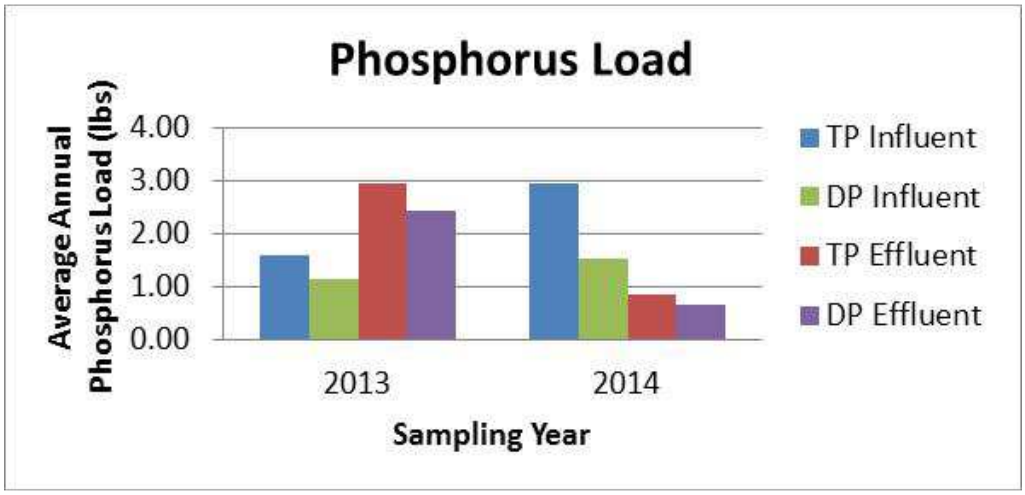
Cross-section of bioretention cell

Photograph of underdrain riser configuration installed in 2014 to encourage stormwater infiltration into the ground



Bar-chart showing total volumes of water entering and leaving the BRC system during the 2013 and 2014 monitoring seasons. Note the drop in underdrain discharge to the stormwater collection system.

The summer of 2014 was unusually wet resulting in over twice as much runoff as compared to the summer of 2013. However, the total volume of water discharged through the underdrain and into the storm sewer in 2014 was less than half of that measured in 2013. The amount of runoff that was infiltrated back into the groundwater during 2014 was greater than the total amount of runoff that occurred in 2013. There was very little difference in the total volume of water evapotranspirated. This is because the filter media has a limited capacity to capture and store water during runoff events.



Average annual total (TP) and dissolved (DP) phosphorus loads entering the BRC (influent) and discharging back to the storm sewer system (effluent).

Summary, Conclusions and Recommendations for the Bioretention Cell (BRC)

The primary objective of this study was to evaluate the performance of the BRC at the City utility parking lot in terms of stormwater pollutant and runoff reduction. The BRC was monitored during the summers of 2013 and 2014 by CSU and data were analyzed to achieve this objective. Prior to the 2014 monitoring season, the BRC underdrain system was modified to determine if a different underdrain design could increase the overall performance of the BRC. Overall, the BRC is working very well to reduce the amount of stormwater pollutants and runoff discharged from the City utility parking lot to local waterways. In 2013, the BRC prevented about 600 pounds (lbs) of TSS and 10 lbs of TN from being discharged directly to the storm sewer system; however the BRC actually increased the discharge of TP by about 1.5 lbs. Of all the runoff generated from the parking lot in 2013, approximately 25% was prevented from entering the storm sewer system by infiltration and ET provided by the BRC.

Performance of the BRC significantly increased in 2014 due to the modified underdrain design. TN removal increased from about 10 lbs/year to about 20 lbs/year and TP removal increased by a net total of approximately 3.5 lbs/year. (Note: In 2013, the BRC exported about 1.5 lbs of TP and in 2014 it reduced about 2 lbs of TP). The increase in pollutant load reductions in 2014 was primarily due to the modified underdrain design which increased the amount of runoff that infiltrated back into the groundwater instead of being discharged through the underdrain into the storm sewer. *Due to this demonstrated increase in performance, is highly recommended that the City consider modifying its bioretention design criteria to include this modified underdrain design.*

One issue that the result of this monitoring project also revealed was that the materials used in the bioretention filter media mix (i.e., compost and topsoil) may act as a source of TP and result in a net increase in TP discharges from bioretention cells. If the filter media mix is in fact the source of TP, it may be that the excess TP will slowly leach out and eventually be depleted. If this is the case, this problem may only be temporary. Since nutrient removal is a critical issue for compliance with the Reg85, it is recommended that the City continue to study this problem and potentially seek alternative bioretention filter media mixes that will not leach TP.

2014 Stormwater Quality Monitoring Program Costs:

Program Description	Cost	Comments
Event-based Best Management Practices (BMP) Stormwater Quality Monitoring Program	$ 3,000	Equipment, Replacement and Repair
Discovery Center Rain Garden Design Costs	$ 2,900	Construction costs to be funded by the City's Operations Services Department
USC Bioretention Cell/ Rain Garden Monitoring	$ 30,000	Includes Data Collection, Analysis and Lab Costs
Pavement Maintenance Research activities and Analyses	$ 15,000	Data collection, data analysis, and site evaluation. Funded through a Stormwater Utility-CSU research contract
Total	$ 50,900	

Colorado Nutrient Criteria for Lakes, Reservoirs, Rivers & Streams

Background: Nutrient criteria were adopted in the March 2012 Regulation 31 Basic Standards Hearing. In preparation for that hearing, the WQCD developed preliminary criteria for TP and TN.

The nutrient criteria will consist of both treated effluent quality limits via Control Regulation 85 for permitted dischargers and Stream Standards defined in the WQCD's Regulation 31:

The Control Regulation (Reg85) will define technology-based requirements for dischargers to control the release of nutrients and will be based on the best available technology:

Treated Effluent Control Parameter	Annual Median Effluent Concentration	95 Percentile Effluent Concentration
TP	1.0 mg/L	2.5 mg/L
Total *Inorganic* Nitrogen (TIN)	15 mg/L	20 mg/L

TIN: The sum of Ammonia-Nitrogen, Nitrate-Nitrogen and Nitrite-Nitrogen in milligrams per liter.
MS4 to implement control measures including:

- Public education and outreach targeting potential nutrient sources and

- Identification and control of nutrient sources from municipal operations
- Both wet and dry weather monitoring at representative stormwater outfalls throughout the MS4 (urban growth) area.
- Monitoring requirements for Publicly Owned Treatment Works (POTWs):
    - Monthly effluent monitoring for TIN, TP and total daily flow
    - Monthly in-stream monitoring above and below the POTW discharge for TN and TP as well as total daily stream flow from an established gaging station

Results of the first year of monitoring were reported to the WQCD in March of 2014.

Cost Implications for the City to Implement Required Wastewater Treatment Nutrient Controls:

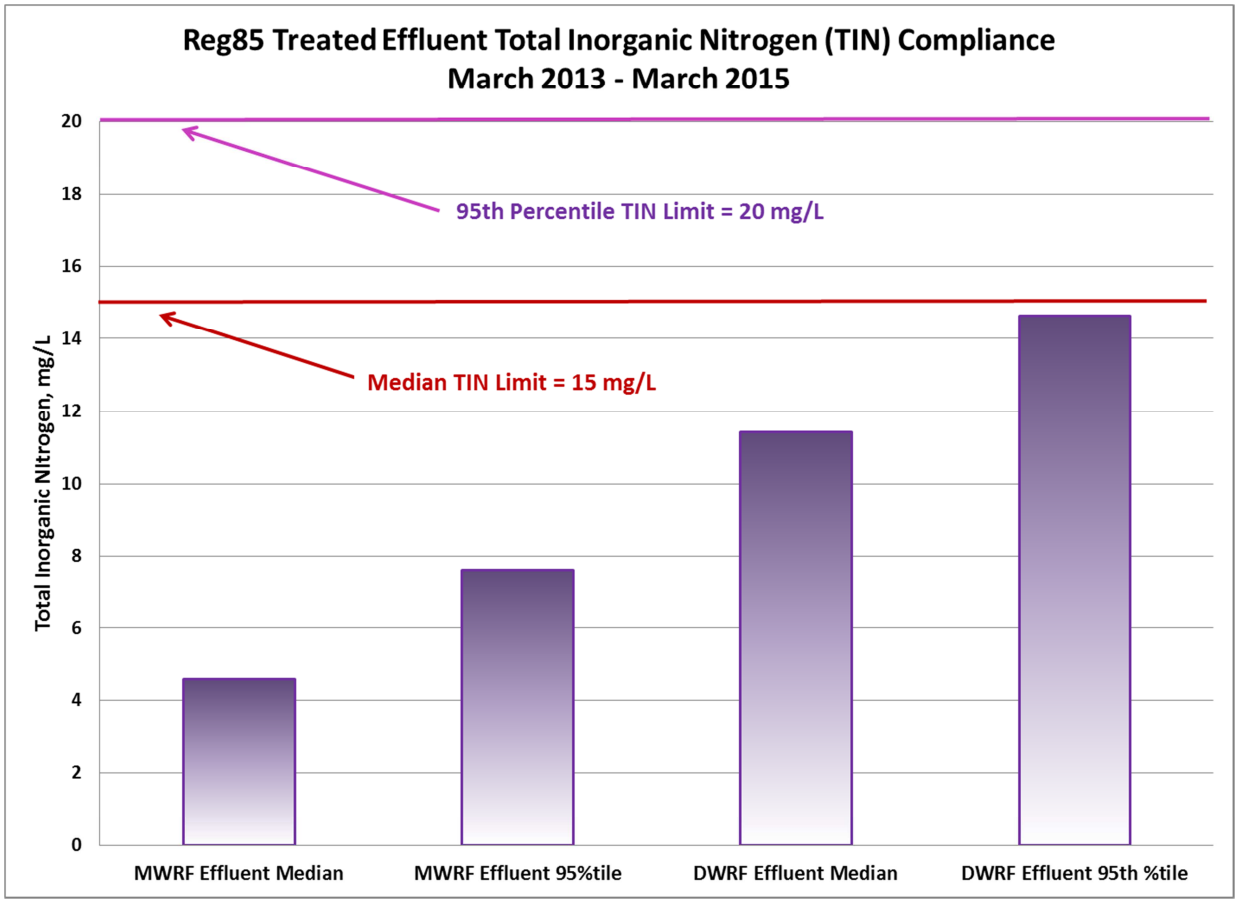
- Biological Nutrient Removal (BNR) upgrades were completed at the Mulberry Water Reclamation Facility (MWRF) in the summer of 2011. If future Colorado regulations require Enhanced Nutrient Removal (ENR) of phosphorus and nitrogen to achieve tougher limits, an additional eight million dollars in capital improvements will be needed at the MWRF.
- Both capital improvements and operational changes are underway that will bring the DWRF into compliance with the proposed tighter BNR limits on discharges of TP and TIN.

Fort Collins Water Reclamation Facility BNR Construction Timeline and Costs: The MWRF re-started with BNR operations on July 5th, 2011. Treatment processes are being fine-tuned to achieve effluent levels of nutrients below the newly Reg85 established control limits. Design and construction improvements to the DWRF for BNR are underway as described in the following table:

Reclamation Facility	Current Status	Cost
MWRF	Upgrades Complete	$25.2 Million
DWRF: North Treatment Trains	Construction completed in October 2012	$7.5 Million
DWRF: South Treatment Train	Design: 2014 Construction: 2015	$5.9 Million

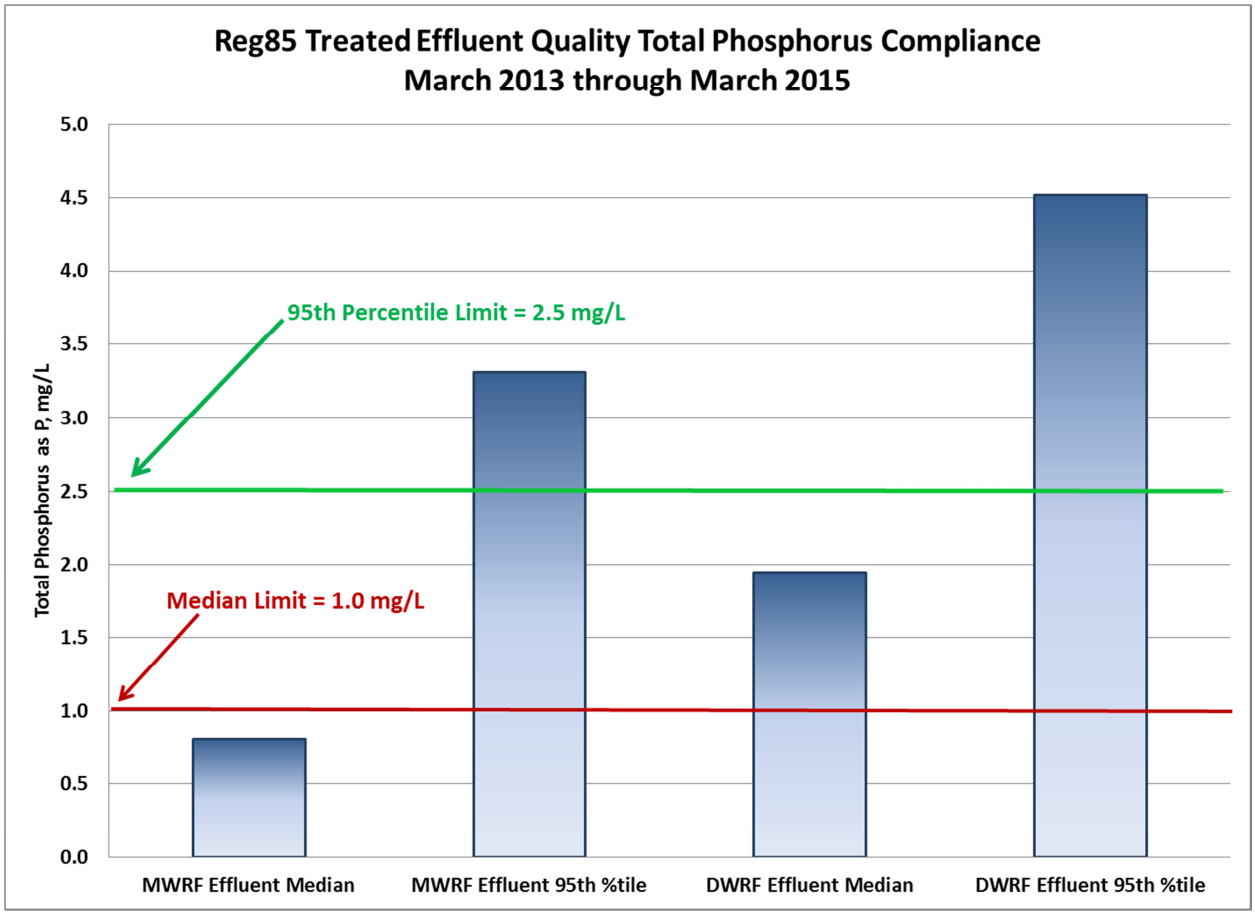
***Note**: Should ENR be required in the future, an additional $50 to $60 million dollars in capital improvements will be required at the DWRF.*

Are we meeting the Reg85 Nutrient Control requirements? Yes, for TIN removal but 'No' for TP Removal. Why not? Effective phosphorus removal requires a simple carbon source like ethanol or methanol, or simple fatty acids like acetate. We are investigating the use of beer waste from a local brewer to meet that need. Also, the related Drake process improvements for full BNR are not quite complete but should begin operations in the fall of 2015.



Official Reg85 monitoring for the removal of TIN began in March of 2013. The graph above depicts the results of two years of testing. TIN is defined as the sum of the individual levels of Ammonia-Nitrogen, Nitrite-Nitrogen and Nitrate-Nitrogen in the treated effluent. Monitoring is required monthly but if more samples are tested, those results must be included in the calculations. For the first two years of testing, both the MWRF and DWRF were in full compliance with the new Reg85 limits for removing TIN.

Compliance monitoring for Reg85 began in March of 2013. Data collected through March 2015 depicted in the graph shown on the following page show that the MWRF treated effluent is in compliance with the Annual Median Limit for TP removal but <u>not</u> the 95th percentile limit. However, capital improvements for BNR-level treatment are *not* complete and hence the DWRF effluent is not yet in compliance with the limit. Capital improvements are nearing completion and the DWRF expects to become operational in full BNR-mode in the fall of 2015.



Nutrient Control River and Stream Standards (Regulation 31): This regulation will set water quality standards based on the need to protect designated uses (water supply, agriculture, etc.). The WQCD has developed the following stream standards for TP and TIN levels for rivers and streams:

Proposed Nutrient Criteria Regulated Standards for Rivers and Streams (*From Shields Street to the Platte, the Poudre is classified as "warm water"*)

Designation	TP†	TN ‡	Chlorophyll-a[a]
Cold Water	0.11 mg/L	1.25 mg/L	150 mg/m^2
Warm Water	0.17 mg/L	2.01 mg/L	150 mg/m^2

† Running annual median of TP (µg/L) with an allowable exceedence frequency of 1-in-5 years.

‡ Running Annual median TN. TN is the sum of the levels of Total Kjeldahl Nitrogen, Nitrate-Nitrogen and Nitrite-Nitrogen.

[a] Summer (July 1 – September 30) maximum attached algae, not to exceed.

Nutrient Control Regulations and the Lower Poudre Monitoring Alliance:

In the fall of 2012, the Lower Poudre Monitoring Alliance extended their cooperative efforts to meet the requirements of Reg85. This alliance includes the Cities of Fort Collins and Greeley, the Town of Windsor, Carestream Health, the Boxelder Sanitation District and Leprino Foods, Inc. As required by regulation, all of these entities now collect river water samples once each month both up and downstream of their respective discharge points. River samples along with treated effluent samples are delivered to and tested at the City's Pollution Control Lab. Lab results are reported once each year to the participants, CDPHE and uploaded to EPA's national Water Quality Exchange internet database. The data will be used to assess compliance with the requirements of Reg85 and the program will continue indefinitely.

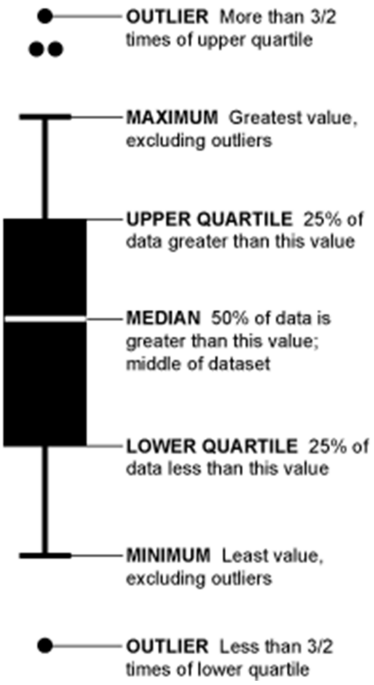
Aerial map showing locations of key gaging stations, effluent discharger points and water quality monitoring sites on the lower Poudre that are part of the cooperative *Lower Poudre Monitoring Alliance*. A detailed sampling and analysis plan was submitted to the WQCD in February 2013 and is available for review. Full implementation of the cooperative monitoring program began in March 2013. USGS and Colorado Department of Water Resources (DWR) gaging stations used for Reg85 compliance are located on the Poudre at:

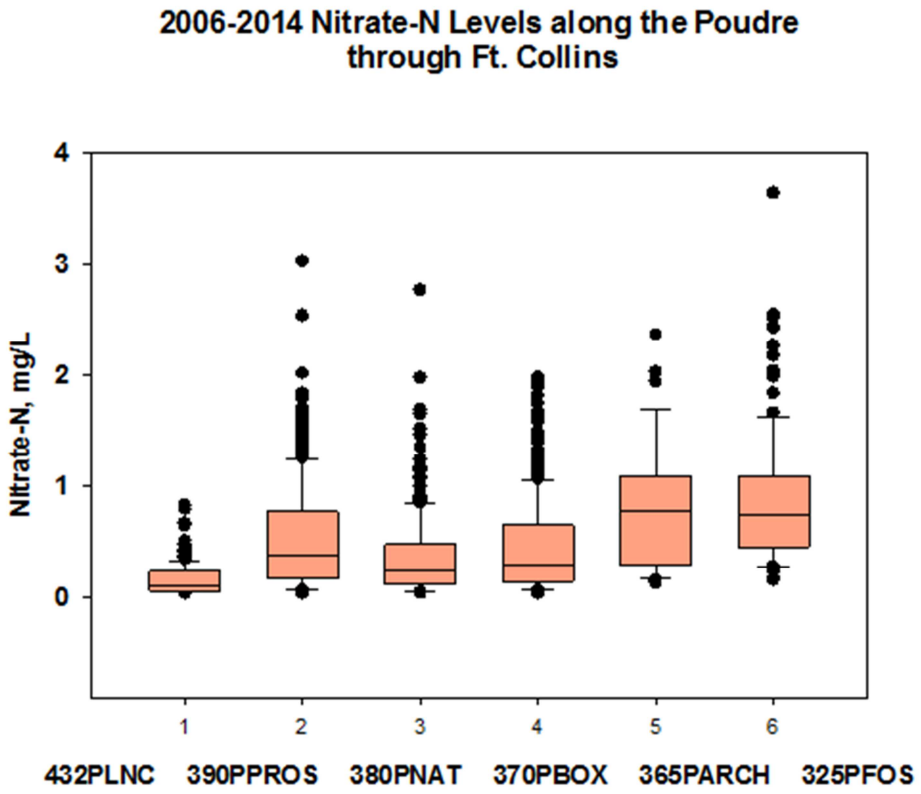
- Lincoln Street (432 PLNC) in Fort Collins,
- above the confluence with Boxelder Creek (370 PBOX),
- below Fossil Creek Reservoir at the New Cache Ditch (DWR CLARIVCO gage),
- the Staff Gage (225 SGage) above the Town of Windsor and Carestream Health outfalls,
- the DWR CLAWASCO gage above Greeley's and Leprino Foods discharge points and
- the DWR CLAGRECO gage below the City of Greeley near Fern Avenue.

Note: the numeric descriptive before the site abbreviation, **432** PLNC for example, is code for the approximate river mile location (43.2 miles) upstream of the confluence of the Poudre with the Platte River

How to Read a Boxplot or a Box & Whisker Plot

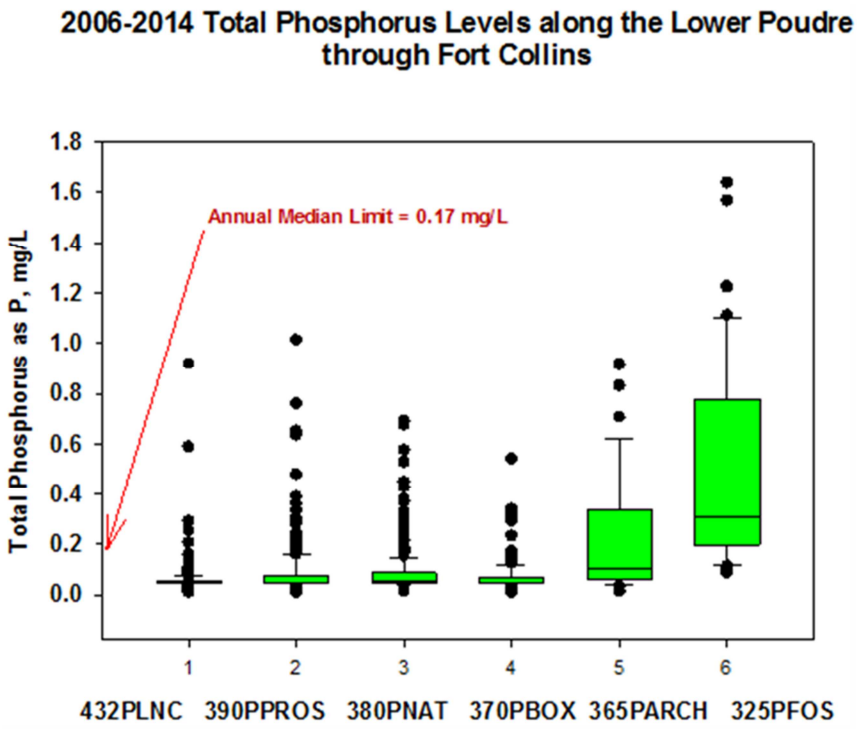
1. First note the location of the median (white line) in the box. If the median is in the middle the box, the data is not skewed to a predominance of high or low values. The overall height of the box indicates the overall range or distribution of the data. A tall box indicates a wide range in values.
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.





Nitrate-Nitrogen (NO_3-N) levels in the lower Poudre are a key indicator of potential compliance issues with Reg85. The City monitors four sites on the Poudre for nitrate levels. Proceeding from Lincoln Street (PLNC), to the Nature Center (PNAT), then to the USGS Gage above Boxelder Cr (PBOX), and then at the Archery Range, the *running annual median* Nitrate-N levels do not exceed the stream standard of 2.01 mg/L.

TP levels are another key indicator of the nutrient status of the Poudre and compliance with Reg31. High levels of phosphorus can promote algal growth, lower dissolved oxygen levels in the water, create nuisance odor and adversely affect the aesthetics of an out-of-doors experience. Under extreme conditions, algae can produce toxins that can affect both the aquatic community and animals including humans, pets and livestock.



Poudre Site Legend: 1-PLnc (Lincoln St), 2-PPros (Prospect), 3-PNat (Nature Center), 4-PBox (above Boxelder Creek), 5-PArch (Archery Range), 6-PFos (below Fossil Creek Reservoir).

With near weekly monitoring completed since June of 2012 and even with the spikes in levels nutrients observed in High Park Fire stormwater samples, the Cache la Poudre River through Fort Collins upstream of Boxelder Creek is in compliance with the Reg85. However, median TP levels at the Archery Range below the confluence with Boxelder Creek exceeded the annual median limit of 0.17 mg/L. In the spring of 2014, the Boxelder Sanitation District completed a ten million dollar upgrade to its treatment plant to perform full BNR, which will help bring next year's data at PArch into compliance with the new TIN and TP limits.

Results since March 2013 indicate that the Poudre at the Archery Range as well as sites downstream are not in compliance with the Reg31 limits. These high levels of phosphorus are due, in part, to return waters from irrigated fields and stormwater runoff from confined animal feeding operations. Other sources of nutrients include municipal stormwater as well as industrial and community wastewater treatment plant effluents.

Urban Creek Water Quality Monitoring Program Highlights:

The 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" water bodies. 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.

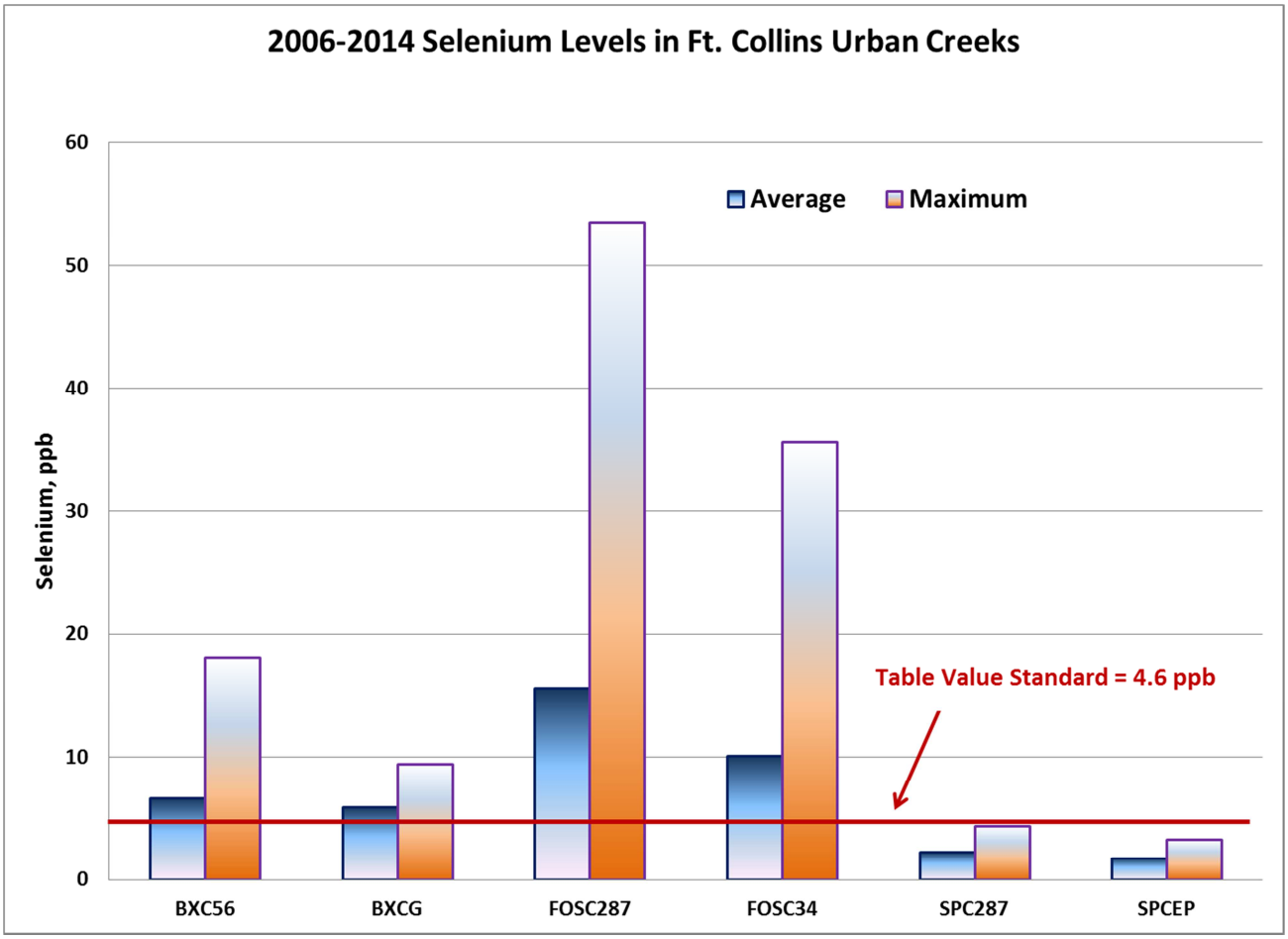
The EPA has published more stringent selenium standard of 4.6 ppb in a revision of water quality criteria. Consequently in 2006, Colorado adopted this as a water quality standard and is now placing numerous river and stream segments on the 303(d) list for selenium. The following local stream segments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

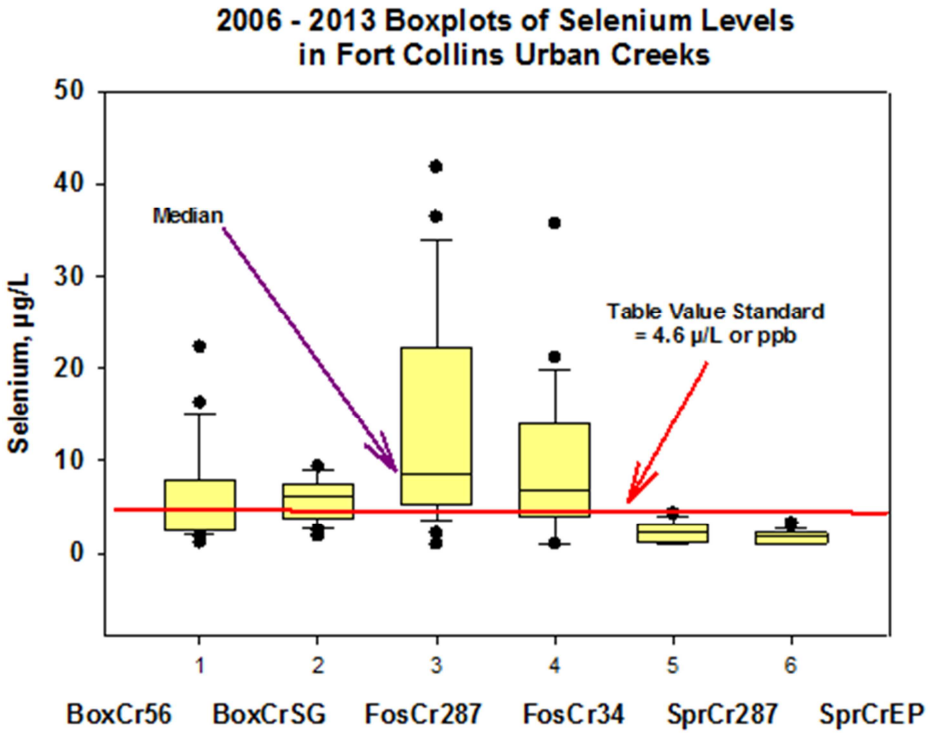
2006 – 2014 Maximum, Average and Aquatic Life Table Value Standard for Selenium Levels in Fort Collins Urban Creeks.



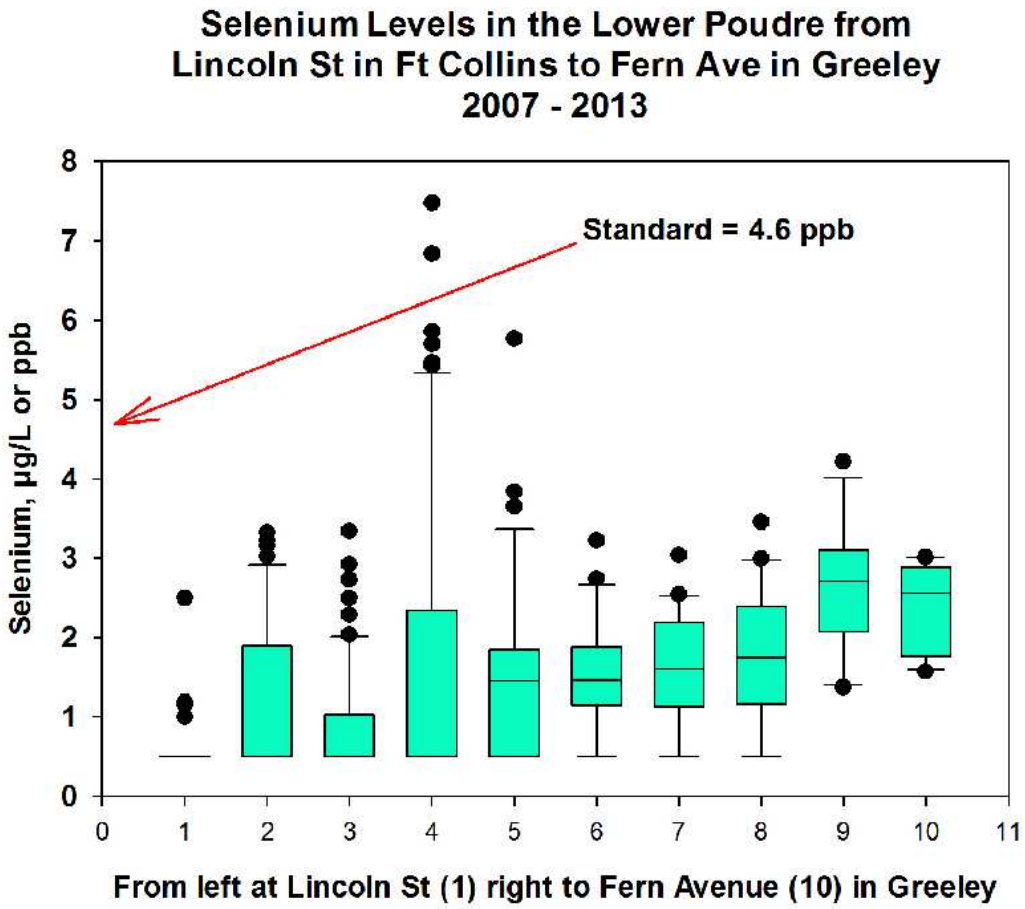
Legend:

BoxCr56 = Boxelder Creek at County Road 56
BoxCrSG = Boxelder Creek at Staff Gage located south of Prospect St.
FosCr287 = Fossil Creek at Hwy 287
FosCr34 = Fossil Creek at County Road 34
SprCr287 = Spring Creek at Hwy 287
SprCrEP = Spring Creek at Edora Park

The WQCD has listed both Boxelder Creek and Fossil Creek as 303(d)-impaired for the naturally elevated levels of selenium. The Table Value Standard (TVS) for selenium in these creeks is set at 4.6 micrograms per liter (parts per billion, ppb). Selenium is associated with the shale common to soils in our geographic region. The City's Pollution Control Lab monitors the selenium levels in waters from each of these three urban creeks at two locations every calendar quarter. Additional testing is done at these sites each calendar quarter for the presence of nutrients, temperature, pH, dissolved oxygen, *E. coli*, etc.



These boxplots show substantially higher and a broader range of selenium concentrations in waters from Fossil Creek than in either Boxelder or Spring Creeks. Selenium levels in both Boxelder Creek and Fossil Creek exceed the table value standard for aquatic life. Hence, they have been listed as 303(d)-impaired for selenium. Selenium levels in Spring Creek are below the Table Value Standard and are in compliance. Storm events, construction and other physical-mechanical events can mobilize selenium from creek-beds.



Legend:

1. Poudre at Lincoln Street above discharge point for the MWRF
2. Poudre at Nature Center at Poudre diversion to Fossil Creek Reservoir Inlet Ditch
3. Poudre at Boxelder Gage, USGS 6752280
4. Poudre at Archery Range downstream of Boxelder Sanitation District discharge
5. Poudre at CR 32E below discharge from Fossil Creek Reservoir;
6. Poudre at Staff Gage above the Windsor and Carestream Health discharge points
7. Poudre below Windsor Discharge point and above Carestream Health's discharge point
8. Poudre below Carestream Health's discharge point to the river
9. Poudre above Greeley's and Leprino Foods discharge points to the Poudre
10. Poudre at Fern Avenue approximately 2 miles above confluence with the Platte

Very low selenium levels have been observed in the Poudre at the Lincoln Street Gage. Moving downstream, selenium levels gradually increase to Site 4 below the confluence of Boxelder Creek where the height of the boxplot and outliers indicates highly variable data. Then selenium levels continue to increase moving downstream past the discharge points for Windsor, Carestream Health, Greeley and Leprino Foods. Much of that selenium increase may be attributed to irrigation return waters and non-point-source discharges to the Poudre.

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 return for 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, there may be issues complying with the strict "nutrient criteria" standard for TP in the future. Phosphorus is a common constituent of lawn and garden fertilizers as well as a contaminant in animal and bird feces.

2006 - 2014 Parkwood Lake Water Quality Summary

Parameter	Average	Max	Min	Std	Meets Standard?
Ammonia-N (Nitrogen), mg/L (n=23)	<0.1	0.3	<0.1	TVS †	**Yes**
Biochemical Oxygen Demand-5 Day, mg/L	5.81	13	<2	none	**Yes**
Conductivity, µmhos/cm (n=12)	380	712	234	none	**Yes**
Dissolved Oxygen, mg/L (n=39)	8.8	13	**4.4**	5	**Yes**
E. coli per 100 ml (n=39)	16.1 (geomean)	**9,800**	<1	126 ‡	**Yes**
Hardness, mg/L as CaCO3 (n=13)	149	263	111	none	**Yes**
Lead, µg/L (n=5)	<5.0	<5.0	<5.0	10.55	**Yes**
Nitrate-N, mg/L (n=14)	<0.05	0.09	<0.05	10	**Yes**
Nitrite-N, mg/L (n=13)	<0.05	<0.05	<0.05	0.5	**Yes**
pH (n=27)	8.4	8.7	**5.9**	6.5 - 9.0	**Yes**
Silver, µg/L (n=6)	<0.2	<0.2	<0.2	3.27	**Yes**
Temperature, °C (n=39)	16.9	24.6	8.4	*I.D.*	**Yes**
Total Phosphorus, mg/L (n=14)	0.10	**0.21**	<0.05	**0.083** [a]	**Yes**
Zinc, µg/L (n=6)	<5.0	<5.0	<5.0	393.2	**Yes**

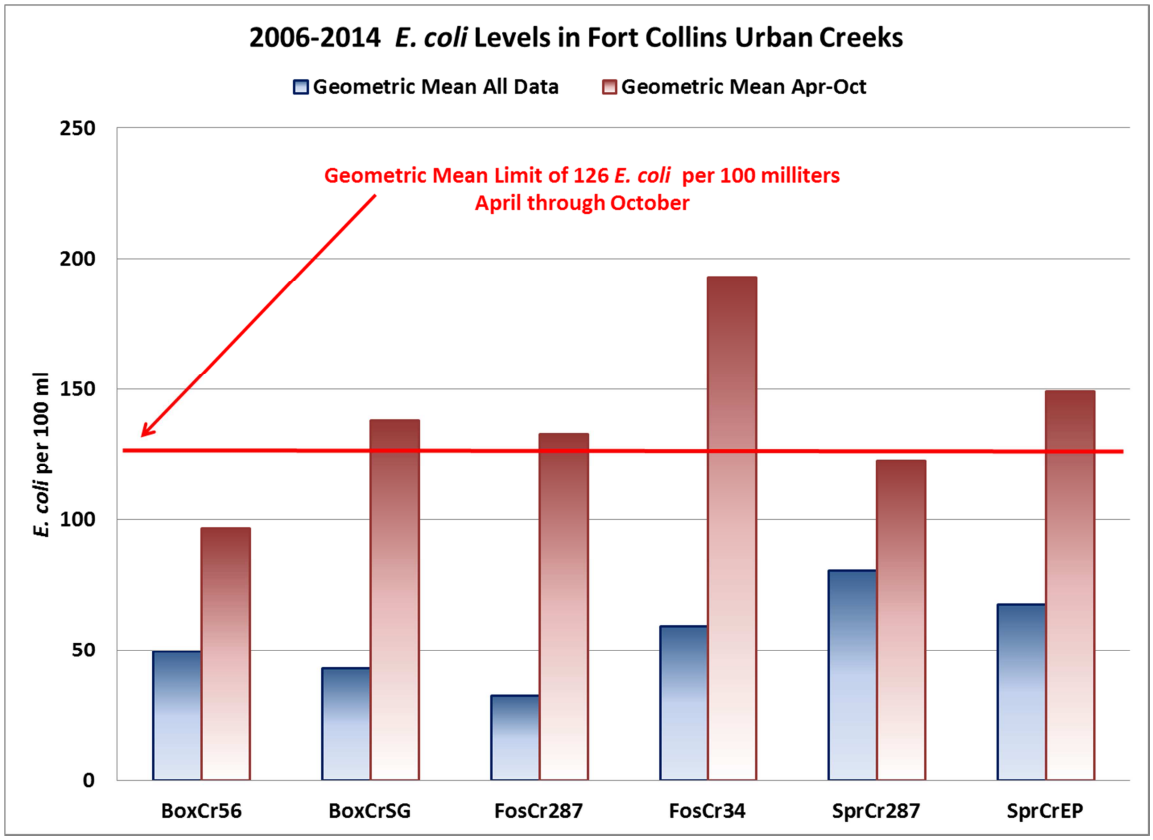
Legend:
† TVS: Table Value Standard based on pH and temperature calculation
‡ Standard is based on geometric mean calculation of available stream or lake data
I.D. = Insufficient Diurnal Data.
a: Possible compliance problem with very strict future "Nutrient Criteria" Standards for Total Phosphorus in Lakes and Reservoirs. *Exceedence of the new standard is only allowed once every five years.* High phosphorus levels may contribute to the growth of nuisance algae on the lake.

The maximum *E. coli* value of 9,800 per 100ml occurred with a single grab sample collected on October 29th, 2013. However, the Table Value Standard of 126 *E. coli* per 100ml is calculated as a geometric mean. Geometric mean calculations using log10 exert a leveling effect on the result by reducing the extremes. The geometric mean value for the lake is well below the standard at a level of 16.1 *E. coli* per 100ml. The pH at that location was also low at a value of 5.9. The other two sites had pH values of 6.5 and 7 that day. The minimum observed dissolved oxygen level of 4.4 mg/L was at one of three locations on the lake tested on June 5th, 2012. The other two sites tested that day gave normal results of approximately 7.5 mg/L dissolved oxygen.

E. coli contamination in Boxelder Creek, 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 – 2014 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 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.



Plot of 2006 – 2014 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 urban creeks are listed as 303(d) – seasonally impaired for high *E. coli* levels during the spring and summer months. Two sites each at Fossil Creek, Spring Creek, and Boxelder Creek are sampled quarterly.

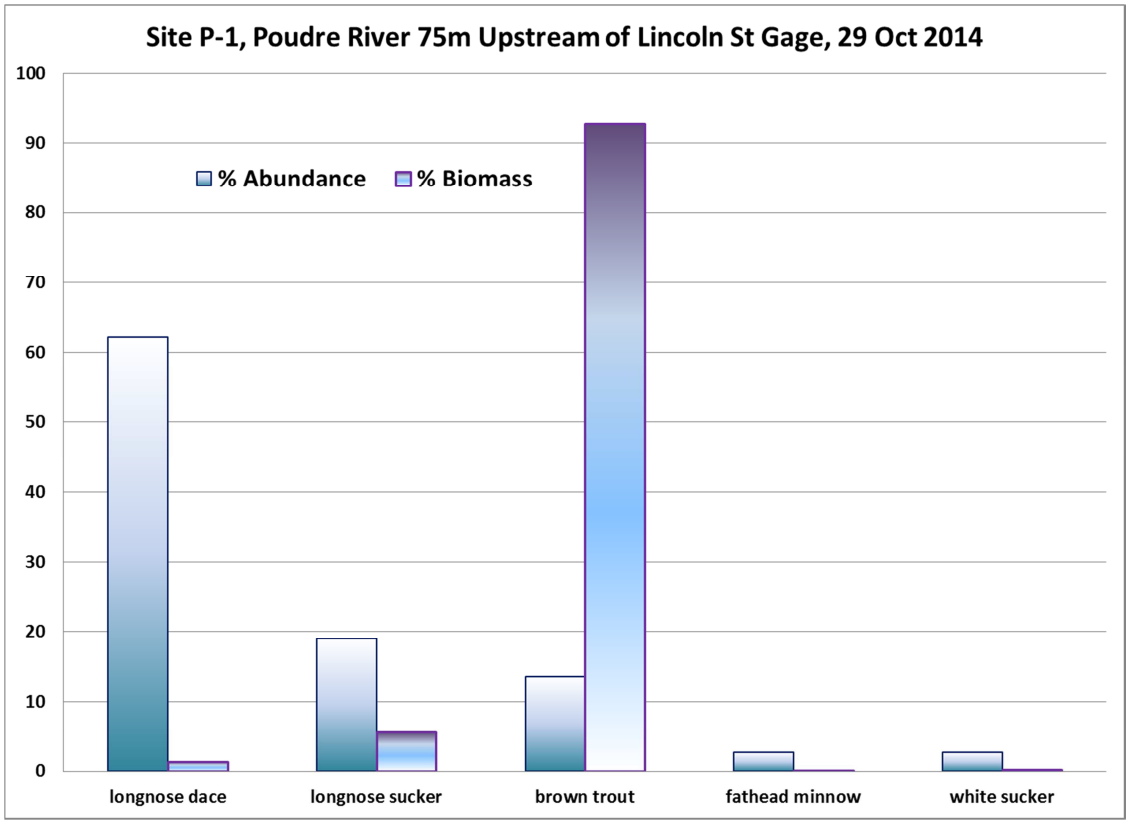
Appendix A. Fish and Macro-invertebrate Surveys with CSU on the Poudre:

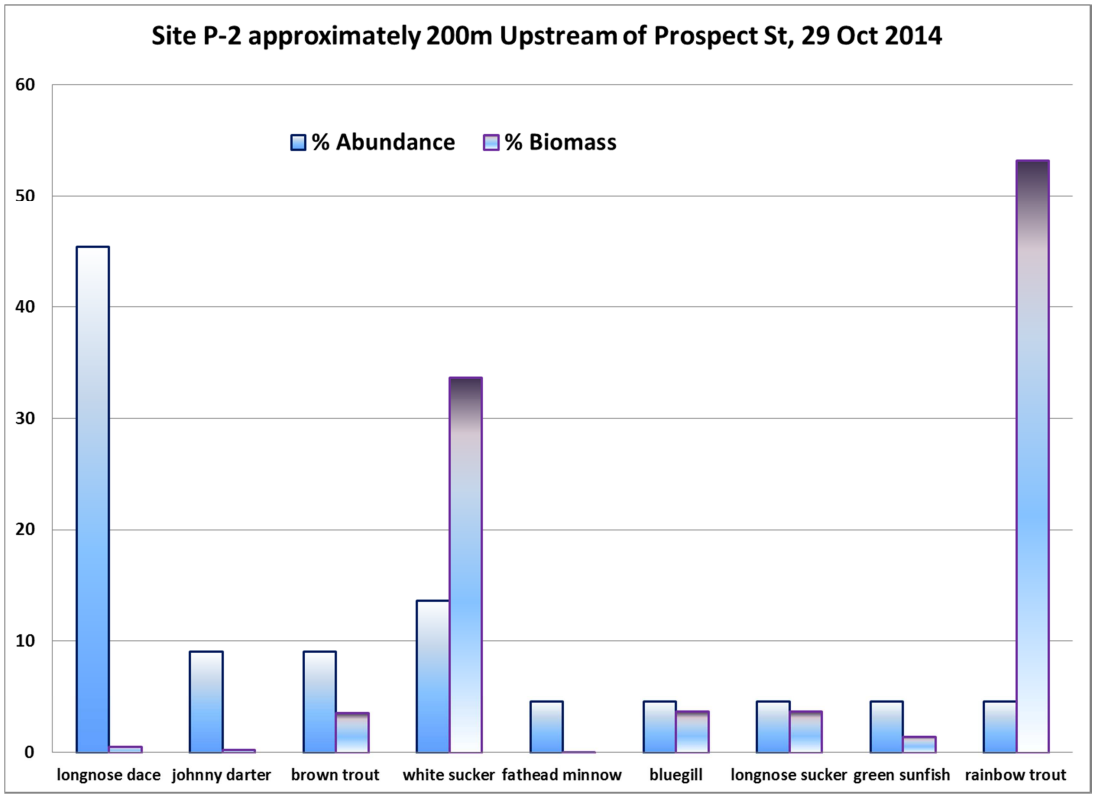
To evaluate the potential impacts of the City's two wastewater treatment plants on the Cache la Poudre River, the Utilities sponsors a biosurvey program of fish and bottom-dwelling macro-invertebrates in the river both upstream and downstream of the City's water reclamation facilities. CSU provides the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

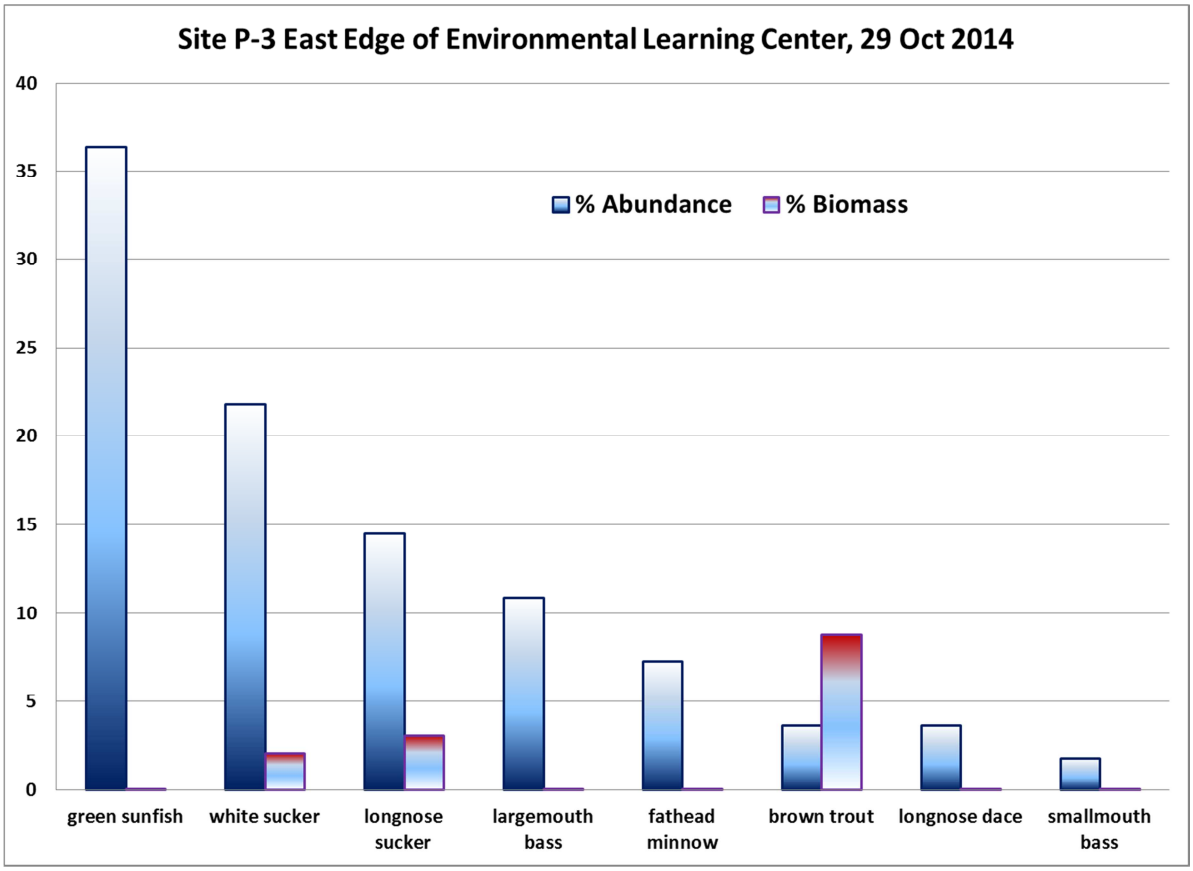
The biosurvey program expanded in 2007 and became an integral part of the Poudre Monitoring Alliance. For the City of Fort Collins and as part of the regional Poudre Monitoring Alliance, this biosurvey program includes: 1) testing four sites eight times each year for bacteriological, physical, and chemical 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 River below Shields Street to the confluence with the Platte River is primarily flow and habitat-limited rather than water quality-limited.

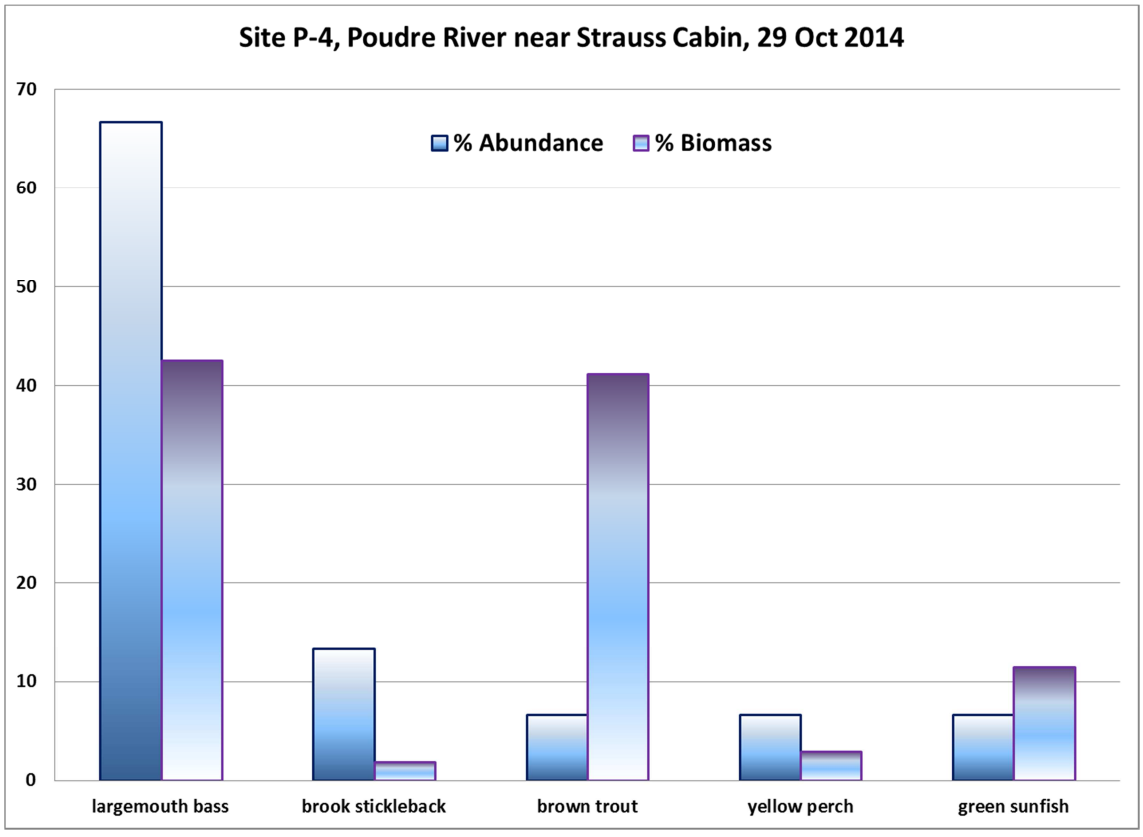
2014 Fall Season Fish Survey Results on the Cache la Poudre from Dr. Kevin Bestgen, CSU

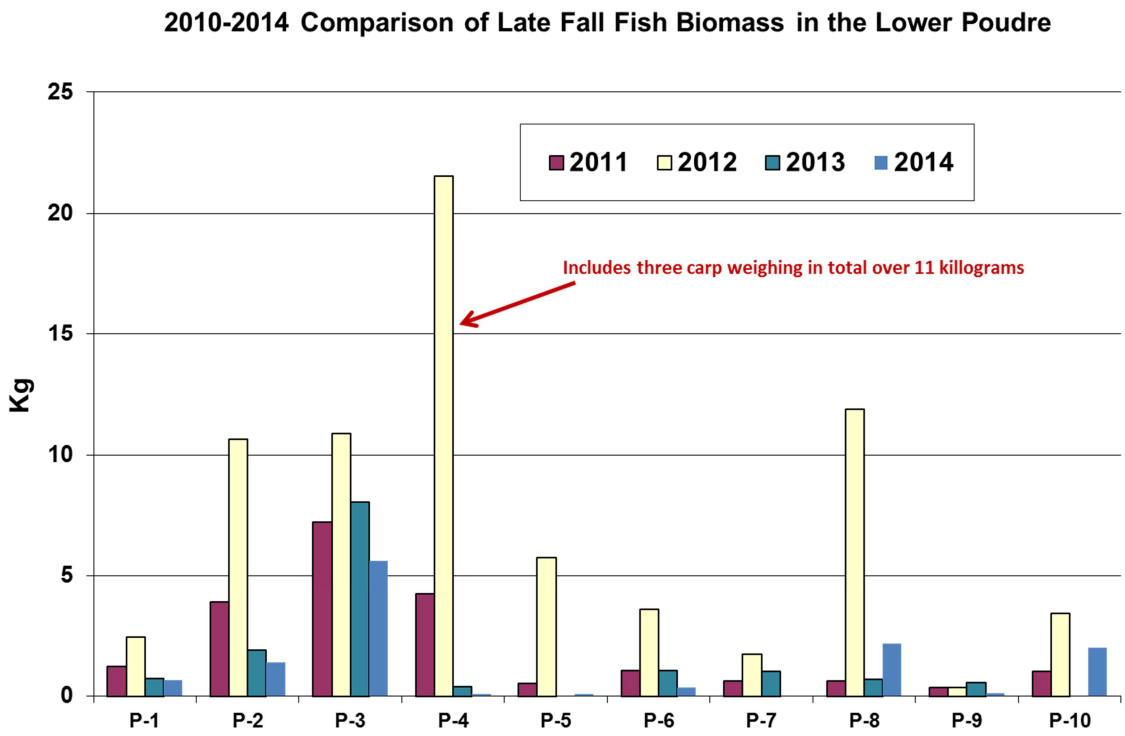
Percent abundance and biomass results by species are presented for four sites on the Poudre starting upstream of Lincoln Street in Old Town to the Strauss Cabin located upstream of I-25. The complete 2013 Poudre water quality, fish and macroinvertebrate survey report from CSU is available from the Utility's Environmental Services Division.


Site P-1, Poudre River 75m Upstream of Lincoln St Gage, 29 Oct 2014
100
90
80
70
60
50
40
30
20
10
0
% Abundance
% Biomass
longnose dace
longnose sucker
brown trout
fathead minnow
white sucker


Site P-2 approximately 200m Upstream of Prospect St, 29 Oct 2014
60
50
40
30
20
10
0
% Abundance
% Biomass
longnose dace
johnny darter
brown trout
white sucker
fathead minnow
bluegill
longnose sucker
green sunfish
rainbow trout

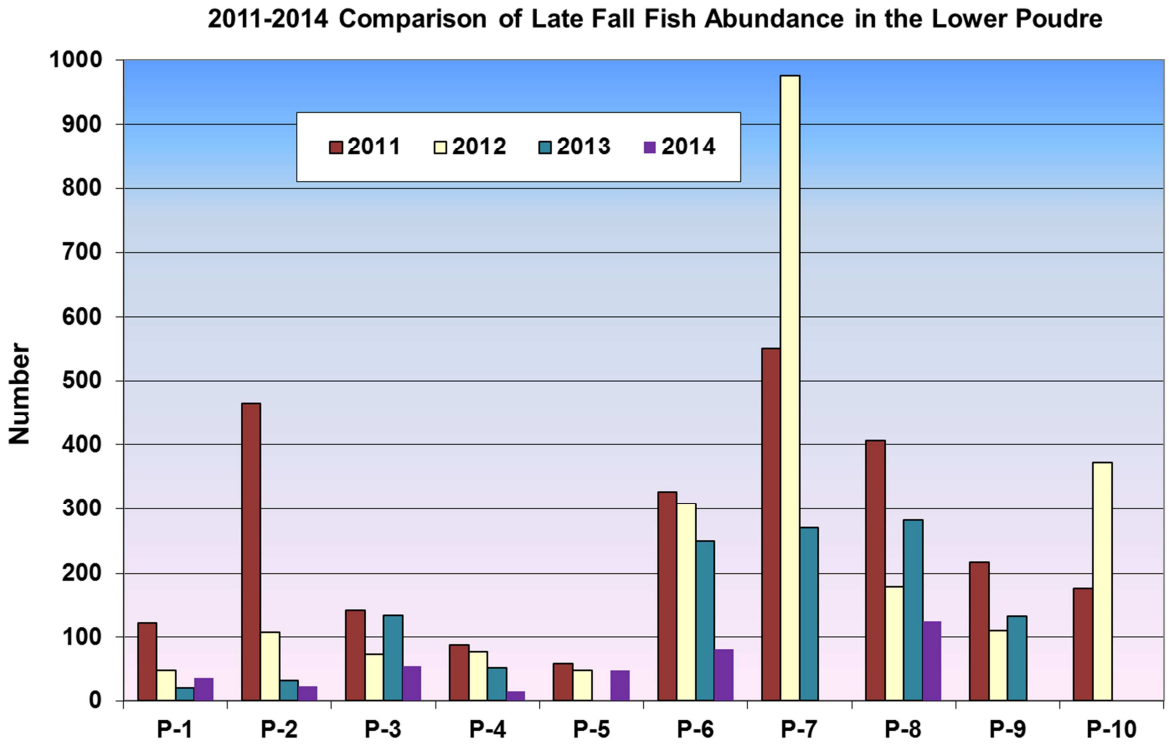

Site P-3 East Edge of Environmental Learning Center, 29 Oct 2014
40
35
30
25
20
15
10
5
0
% Abundance
% Biomass
green sunfish
white sucker
longnose sucker
largemouth bass
fathead minnow
brown trout
longnose dace
smallmouth bass


Site P-4, Poudre River near Strauss Cabin, 29 Oct 2014
70
60
50
40
30
20
10
0
% Abundance
% Biomass
largemouth bass
brook stickleback
brown trout
yellow perch
green sunfish



Site Legend:

P-1: Approximately 75 m upstream of the Lincoln Street Bridge in Fort Collins
P-2: Approximately 200 m upstream of the Prospect Street Bridge in Fort Collins
P-3: Poudre River adjacent Boxelder treatment plant, east edge Environmental Learning Center
P-4: Poudre River near the Strauss Cabin upstream of I-25
P-5: Poudre River, 1/4 mile upstream of CR 32E below Fossil Creek Reservoir discharge
P-6: Poudre River, Staff gage site just above Windsor sewage effluent
P-7: Poudre River at Sharks tooth, old bridge crossing below Carestream Health discharge
P-8: Poudre River, about 1/3 mile upstream of 59th Avenue above Greeley
P-9: Poudre River, just upstream of Hwy 85 upstream of the Greeley WWTP discharge
P-10: Poudre River, above confluence of South Platte River



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