

DENVER ENVIRONMENTAL HEALTH

2016 WATER QUALITY UPDATE

An overview of water quality in Denver's streams



DENVER
ENVIRONMENTAL HEALTH

Denvergov.org/waterquality

WHAT IS WATER QUALITY?

Water quality is the measure of the chemical, physical, biological, and radiological characteristics of water relative to the requirements of one or more biotic species and / or to any human need or purpose.



For up-to-date information on water quality, follow us at [facebook.com/DenverEnvironmentalQuality](https://www.facebook.com/DenverEnvironmentalQuality) or Twitter at twitter.com/DenEnviroHealth.

For detailed information on water quality in Denver's streams visit denvergov.org/WaterQuality, or email waterquality@denvergov.org.

WHY DOES WATER QUALITY MATTER?

Our indispensable water resources have proven themselves to be greatly resilient, but they are increasingly vulnerable and threatened. Our growing population's need for water for food, raw materials and energy is increasingly competing with nature's own demands for water to sustain already imperiled ecosystems and the services on which we depend. Day after day, we pour millions of tons of untreated sewage and industrial and agricultural wastes into the world's water systems. Clean water has become scarce and will become even scarcer with the onset of climate change.

— *Ban Ki-moon,*
UN Secretary General, 2007 - 2016

Denver's streams and lakes and the parks which surround them are the City's greatest natural amenities. They are directly linked to the quality of our lives and the health of our environment. They are also places where residents and visitors can enjoy recreational activities and opportunities for active, healthy lifestyles.

Denver's streams and lakes provide drinking water to downstream communities, enhance opportunities for recreation and act as green corridors for wildlife. High quality water in Denver's streams is necessary to support these uses. It enhances park visitor's experiences and adds to the quality of life that Denver residents enjoy. It also creates opportunities to engage youth in environmental education and supports diverse, healthy wildlife communities by sustaining ecological processes that support native fish populations, vegetation, wetlands and birdlife.

The quality of water in our streams is directly related to the value of recreational amenities, including boating and fishing opportunities. It is also related to nearby land values. The higher the quality of the water, the higher the value of Denver's recreational amenities and of nearby land. High quality water supports economic growth in our community.



Figure 1. An illustration of how water quality, environmental health, economic growth and quality of life are related. Image courtesy of Denver Department of Public Works (DPW), Policy, Planning and Sustainability Section.



HOW IS WATER QUALITY MEASURED?

Denver's Department of Environmental Health (DEH) samples most of the streams in Denver and submits samples to a laboratory to be analyzed for a suite of pollutants. Samples are collected monthly from the South Platte River and Cherry Creek and quarterly from other streams in Denver. Results from sample analysis are compared to water quality standards set by the State of Colorado (Colorado) and the US Environmental Protection Agency (EPA) to determine if water quality in Denver's streams meets standards.

WHAT'S IN THIS REPORT:

This report presents an overview of water quality in the City's streams during 2016 and describes ongoing efforts by Denver and its stakeholders to improve water quality. The report also contains information on actions citizens can take to prevent pollution from reaching Denver's streams and lakes. The report does not contain information related to drinking water quality.

WATER QUALITY IN DENVER'S STREAMS

Pollutants from many sources impact Denver's streams. The extent of those impacts is assessed by DEH's stream sampling program. DEH samples most of Denver's streams at least once a quarter. Samples are analyzed for a broad suite of pollutants, including nitrogen and phosphorous, Escherichia coli (E. coli) and metals. Analytes are selected to allow DEH to determine:

- Whether water in Denver's streams meets the State of Colorado's water quality standards;
- Whether it is safe for people to wade, boat, or fish in Denver's streams;
- Whether Denver's efforts to reduce the amount of pollution entering our streams are effective;
- Trends in water quality, and;
- Progress towards achieving the Mayor's goal of ensuring all streams and lakes in Denver are safe for fishing and swimming.

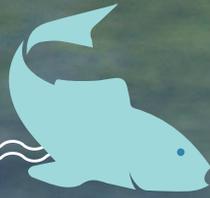
Colorado's Water Quality Control Commission determines the appropriate (or intended) uses for all streams in Colorado and develops water quality standards that are protective of those uses. Table 1 is a list of the streams in Denver and their intended uses. Every other year, water quality data from Denver's streams is evaluated by the Colorado Department of Public Health and Environment (CDPHE) to determine which streams meet standards. The streams which don't meet standards are compiled into a list called the 303(d) list. If a stream is placed on the 303(d) list, it means that additional protection or action is needed for the stream to achieve or maintain water quality standards.

Stream	Use Supported?			
	Aquatic Life	Recreation	Water Supply	Agriculture
South Platte River	✓	✓	✓	✓
South Platte Tributaries				
Bear Creek	✓	✓	✓	✓
Lakewood Gulch	✓	✓		✓
Weir, Sanderson, Harvard West, and Harvard Gulches and Westerly Creek	✓	✓		✓
Cherry Creek	✓	✓	✓	✓
Cherry Creek Tributaries				
Goldsmith Gulch	✓	✓	✓	✓

Table 1. Streams in Denver sampled by DEH with intended use as designated by the State of Colorado.



AQUATIC LIFE



Several factors affect whether a stream is suitable for aquatic life. The factors include water quality and quantity, habitat and stream substrate. Ongoing efforts to improve conditions for aquatic life include improvements to instream habitat (Denver's Department of Parks and Recreation and the Urban Drainage and Flood Control District) and fundraising for the environmental pool at Chatfield Reservoir. DEH is evaluating tools to assess the impact of those efforts on aquatic life.

DEH currently monitors water quality and compares sampling results to Colorado's instream water quality standards to assess stream suitability for aquatic life. Table 2 summarizes whether DEH's 2016 sampling results indicated that water quality in each stream was suitable for aquatic life. The table also indicates whether streams are on Colorado's 303(d) list. The discrepancy between the 2016 support for aquatic life and inclusion on the 303(d) list is the result of different data sets. The 303(d) list evaluated data collected between 2011 and 2015 while the evaluation of whether water quality was suitable for aquatic life only included data collected in 2016.

Stream	Water Quality Suitable for Aquatic Life in 2016?	On 303(d) List?	Cause for Not Supporting or Inclusion on 303(d) List
South Platte River	✓		
South Platte Tributaries			
Bear Creek	✓	✓	303(d) list for habitat degradation
Lakewood Gulch	✓		
Weir Gulch	✓	✓	303(d) list for elevated selenium levels
Sanderson Gulch	✓	✓	303(d) list for elevated selenium levels
Harvard Gulch		✓	Elevated selenium levels
Harvard Gulch West		✓	Elevated selenium levels
Westerly Creek	✓	✓	303(d) list for elevated selenium levels
Cherry Creek	✓		
Cherry Creek Tributaries			
Goldsmith Gulch		✓	Elevated selenium levels

Table 2. Streams in Denver sampled by DEH and if they met water quality standards to support aquatic life in 2016. 303(d) List information from: CDPHE, Water Quality Control Commission, 5 CCR 1002-93, Regulation #93, Colorado's Section 303(d) List of Impaired Waters and Monitoring and Evaluation List. Adopted January 11, 2016.



AQUATIC LIFE

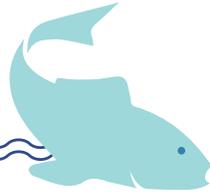


Table 2 indicates that the primary reason for water quality not being suitable for aquatic life was elevated levels of selenium. Selenium is a metal that, at trace levels, is essential to the health of humans and wildlife, but at higher levels can have negative health effects including reproductive failure or birth defects. Selenium occurs naturally in bedrock underlying parts of Denver. In areas where bedrock is in contact with streams, such as along Goldsmith Gulch, it is common for selenium levels in surface water to be elevated (Herring and Walton-Day, 2007). Development can exacerbate this problem, especially when bedrock is disturbed or when building foundations require permanent dewatering.

Evaluation of selenium levels in Denver's streams indicates that selenium levels are highest in Goldsmith Gulch and Westerly Creek. Selenium is generally not detected in Bear Creek or the South Platte, but is sometimes detected in Cherry Creek. Levels in Cherry Creek tend to be highest downstream of its confluence with Goldsmith Gulch, but decrease further downstream. Selenium has also been detected in Harvard Gulch and Harvard Gulch West at levels that exceed instream standards.

Elevated levels of nitrogen and phosphorous can also affect the suitability of a stream for aquatic life. Common sources of nitrogen and phosphorus in streams include wastewater treatment plants, runoff of excess fertilizer, and cross connections between storm and sanitary sewers. Colorado has developed instream water quality standards for nitrogen and phosphorous that are

protective of aquatic life, but those standards have not yet been applied to many of the streams in Denver.

DEH's sampling data indicates that the South Platte River, Weir Gulch, Sanderson Gulch, Harvard Gulch West, and Harvard Gulch would not meet the new nitrogen standard, and that the South Platte River, Cherry Creek and Westerly Creek would not meet the new phosphorous standard. A statistical analysis of nitrogen and phosphorous data from the South Platte River indicate a gradual downward trend in levels of both pollutants over the past 15 years, especially at sites downstream of Alameda Avenue. Likewise, an analysis of nitrogen and phosphorous levels in Cherry Creek reveals decreasing levels of both over the past fifteen years, especially at sites downstream of the approximate location where Highline Canal crosses Cherry Creek at Dayton Street. Decreases in nitrogen and phosphorous levels in the South Platte River may be related to improvements in nutrient controls at the Littleton/Englewood Wastewater Treatment Plant, which is located near where Dartmouth crosses the South Platte River. Improvements in nutrient levels in Cherry Creek are probably related to the 2006 decommissioning of the Glendale Wastewater Treatment Plant.

DEH does not currently evaluate the other factors that influence stream suitability for aquatic life; however, recent improvements to parks along the South Platte River included riparian zone and habitat restoration, and efforts are underway to try and acquire water rights in Chatfield Reservoir for environmental flows. The water rights would secure water to be released to the South Platte River for the benefit of aquatic life and recreation during low flow conditions. The ability to provide the new water comes from the recently completed Chatfield Reallocation project.

RECREATION



Colorado has determined that all streams in Denver are suitable for recreation and has assigned water quality standards to protect recreational uses. This is an acknowledgement of current and potential uses — not that the streams are safe for recreation.

DIRECT CONTACT RECREATION

Allowable direct contact recreation in Denver’s streams includes wading, water play and boating. Section 24-9 of the Denver Revised Municipal Code prohibits swimming in City streams.

The primary measure for determining if a stream is safe for direct contact is the level of E. coli present. In Colorado, there are two standards for E. coli: the instream water quality standard and Colorado’s swim beach standard. DEH uses the swim beach standard as an indicator of whether Denver’s streams are safe for recreation. The swim beach standard is 235 colonies of E. coli. When the standard is exceeded, there is an elevated risk of becoming ill when recreating in a water body. When E. coli levels are less than the standard, the water body is considered safe for recreation.

SAMPLING RESULTS

DEH monitors E. coli year-round, increasing sampling frequency and adding additional sampling locations during times of high use (May through early October). The additional locations are all heavily used for wading, boating and fishing. In 2016, those sites included:

- The South Platte River and Cherry Creek at Confluence Park;
- Bear Creek near the picnic shelter in Bear Valley Park;
- Cherry Creek near Holly; and,
- Westerly Creek near the playground at Great Lawn Park.

Table 3 summarizes whether DEH’s 2016 sampling results indicated that water quality in each stream was safe for direct contact recreation. The table also indicates if streams are on Colorado’s 303(d) list.

Table 3 indicates that Denver’s streams are not always safe for wading or boating. Figure 2 shows that the risk of illness due to exposure to elevated E. coli levels is higher for those who recreate in Denver’s streams during the summer and fall.

Stream	Water Quality Suitable for Recreation in 2016?	On 303(d) List?	Cause for Not Supporting or Inclusion on 303(d) List
South Platte River			Removed from the 303(d) list while E. coli mitigation efforts underway
South Platte Tributaries			
Bear Creek		✓	Exceeds E. coli standards between May and October
Lakewood Gulch			
Weir Gulch		✓	Exceeds E. coli standards between May and October
Sanderson Gulch		✓	Exceeds E. coli standards between May and October
Harvard Gulch		✓	Exceeds E. coli standards between May and October
Harvard Gulch West		✓	Exceeds E. coli standards between May and October
Westerly Creek		✓	Exceeds E. coli standards between May and October
Cherry Creek		✓	Exceeds E. coli standards
Cherry Creek Tributaries			
Goldsmith Gulch		✓	Exceeds E. coli standards

Table 3. Streams in Denver sampled by DEH and if they met water quality standards to support recreation in 2016. 303(d) List information from: CDPHE, Water Quality Control Commission, 5 CCR 1002-93, Regulation #93, Colorado’s Section 303(d) List of Impaired Waters and Monitoring and Evaluation List. Adopted January 11, 2016.

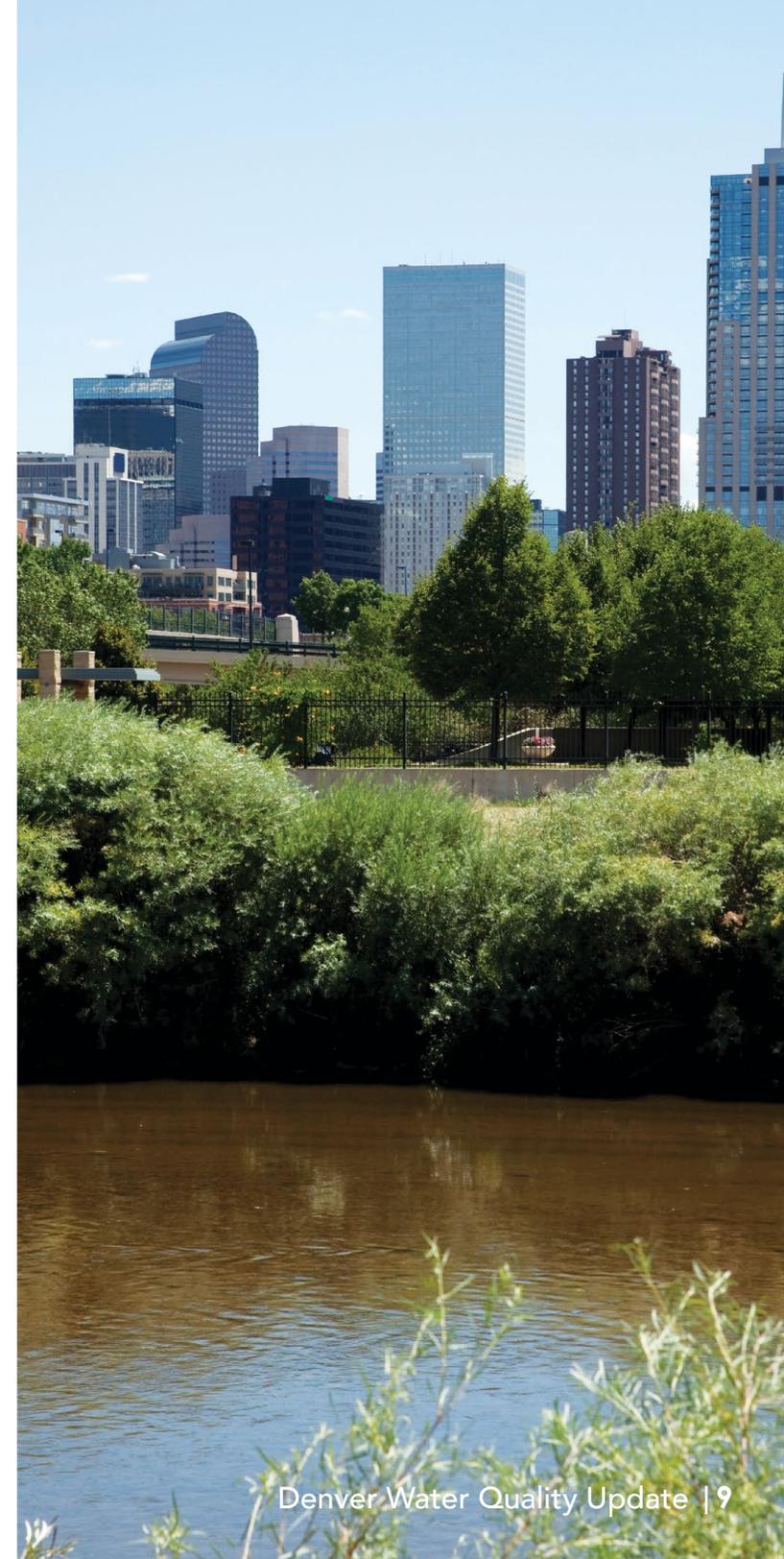
RECREATION



DEH provides information about water quality conditions to Denver's Park Rangers and posts the most recent sampling results on a map on the Water Quality Program's web page and Facebook page. The map provides up to date information on E. coli levels and temperature and indicates if water quality conditions are good or bad. The map is updated weekly during the recreation season and at least twice a month during cooler weather.



Figure 2. Percent of samples collected from Confluence Park in which E. coli levels exceeded Colorado's swim beach standard, May through the end of October of 2016.



RECREATION



FISHING

Currently, DEH does not assess whether fish from the South Platte River or other streams in Denver are safe for consumption. As a result, DEH recommends against eating fish from Denver streams.

PROGRESS TOWARDS MAYOR'S FISHABLE / SWIMMABLE GOALS

In 2013, Mayor Michael B. Hancock announced Denver's 2020 Sustainability Goals. The goal for water quality is to ensure Denver's streams will be safe for swimming and fishing. DEH uses the data it collects to measure progress towards reaching this goal.

SWIMMABLE WATERS

The primary measure for determining if a water body is suitable for swimming is whether E. coli levels meet health based standards for recreation. Table 3 indicates that most of the streams in Denver do not meet those standards and Figure 2 shows that during the 2016 recreation season, both Cherry Creek and the South Platte River were frequently not safe for recreation.

Evaluation of data from DEH's sampling efforts indicates that progress towards meeting the 2020 Sustainability Goal of making all streams in Denver safe for swimming has been negligible. Statistical analysis of E. coli data from the South Platte River suggests a gradual worsening of conditions through time, especially at the three sampling locations downstream of Lakewood Gulch. A similar analysis of E. coli data from Bear Creek and Cherry Creek reveals that there is too much variation in the data to draw any conclusions about changes in E. coli levels. The lack of progress, even though several new water quality facilities have been installed and thousands of feet of riparian habitat along the South Platte River have been improved, serves as a reminder of how difficult it is to address E. coli in City streams.

Areas surrounding sampling locations in the South Platte River downstream of Lakewood Gulch include the LoHi, Union Station and RINO neighborhoods. These areas are all rapidly redeveloping and densifying. Redevelopment and densification increases the amount of impermeable surfaces and, as a result, the amount of runoff coming from those neighborhoods. Increases in E. coli levels in receiving waters in urban areas have been linked to increased amounts of impermeable surfaces. The apparent relationship between rapid densification of neighborhoods near the South Platte River and increasing E. coli levels underlines the need for more water quality facilities in those areas.



RECREATION



FISHABLE WATERS

The most important measure of whether a water body is suitable for fishing are water quantity, water quality, fish habitat and fishing access. Gradual improvements are being made in most of those areas. It is safe to fish in Denver's streams and lakes; however, DEH discourages consumption of fish caught in the City's waterways.

In 2016, most of the progress towards the 2020 Sustainability Goal for fishable waters was the completion of construction at Pasquinel's Landing and at Grant-Frontier Park. Construction on the first phase of Confluence Park also resumed. The projects include features which will improve water quality, add habitat for fish and wildlife, provide recreational access points and restore riparian zone habitat.

Denver also continued its collaboration with the US Army Corps of Engineers on a study of the feasibility of making improvements to Denver streams. Improvements could include ecosystem and riparian habitat restoration, channel stabilization and flood containment. In 2016, the project team completed the first round of public outreach and began drafting the feasibility study for identified project areas (the South Platte River between 6th Avenue and 58th Avenue, Weir Gulch and Harvard Gulch). The feasibility study will be released in 2018. A second study with the Army Corps of Engineers, which is looking for opportunities to make improvements to the South Platte between Grant Frontier Park and Johnson Habitat Park, kicked off in 2016.

DEH also used its water quality sampling results to determine whether water quality will support aquatic life. Table 2 indicates that when compared to Colorado's

water quality standards, 2016 water quality in most streams in Denver was of high enough quality to support a healthy and diverse population of aquatic life. Elevated selenium levels in Harvard Gulch, Harvard Gulch West and Goldsmith Gulch in 2016 were of concern to aquatic life; however, those streams are small and unlikely to support fish populations that would be attractive to people interested in fishing. Elevated levels of nitrogen and phosphorous in some of Denver's streams may also affect the ability of those streams to support aquatic life. As discussed earlier, nitrogen and phosphorous levels have been gradually decreasing in both Cherry Creek and the South Platte River over the past 15 years.



OTHER USES



DO DENVER'S STREAMS SUPPORT OTHER USES?

Many of Denver's streams are also designated for use as a water supply and for agriculture. Table 4 summarizes whether DEH's 2016 sampling results indicated that water quality in each stream was safe for water supply or agriculture. The table also indicates if streams are on Colorado's 303(d) list.



Stream	Water Quality Suitable for Water Supply / Agriculture in 2016?	On 303(d) List?	Cause for Not Supporting or Inclusion on 303(d) List
South Platte River		✓	Exceeds arsenic standard for drinking water plus fish ingestion
South Platte Tributaries			
Bear Creek		✓	Exceeds arsenic standard for drinking water plus fish ingestion
Lakewood Gulch	✓		
Weir Gulch	✓		303(d) list for elevated selenium levels
Sanderson Gulch	✓		303(d) list for elevated selenium levels
Harvard Gulch	✓		Elevated selenium levels
Harvard Gulch West	✓		Elevated selenium levels
Westerly Creek	✓		303(d) list for elevated selenium levels
Cherry Creek	✓		
Cherry Creek Tributaries			
Goldsmith Gulch	✓		Elevated selenium levels

Table 3. Streams in Denver sampled by DEH and if they met water quality standards to support use as a water supply or for agriculture in 2016. 303(d) List information from: CDPHE, Water Quality Control Commission, 5 CCR 1002-93, Regulation #93, Colorado's Section 303(d) List of Impaired Waters and Monitoring and Evaluation List. Adopted January 11, 2016.

IMPROVING WATER QUALITY IN OUR STREAMS



DEH, DPW and Denver Parks and Recreation are committed to understanding and improving water quality in the City's streams and lakes. Here are a few examples of the things Denver is doing to achieve that:

CITY PROJECTS

In 2016, DPW developed a Green Infrastructure Implementation Strategy which builds on Denver's Water Quality Scorecard to identify opportunities and set priorities to reduce the impact of stormwater runoff on streams, lakes and drainageways. The document includes detailed consideration of potential projects that could be implemented over six-year and twelve-year planning horizons, and includes a discussion of promising water quality treatment opportunities for each project, potential partners and costs. An example of one of the projects is shown in Figure 3. The implementation strategy will be published in 2017.





IMPROVING WATER QUALITY IN OUR STREAMS

In 2016, Denver held a series of public meetings to discuss the Platte to Park Hill project and design on the project began. The Platte to Park Hill project consists of four stormwater management projects in Denver's Park Hill, Elyria-Swansea, Cole, Clayton, Skyland, Whittier, Five Points and Northwest Park Hill neighborhoods. The goal of the project is to protect people and property from flooding while improving water quality and enhancing public spaces. Planned improvements are:

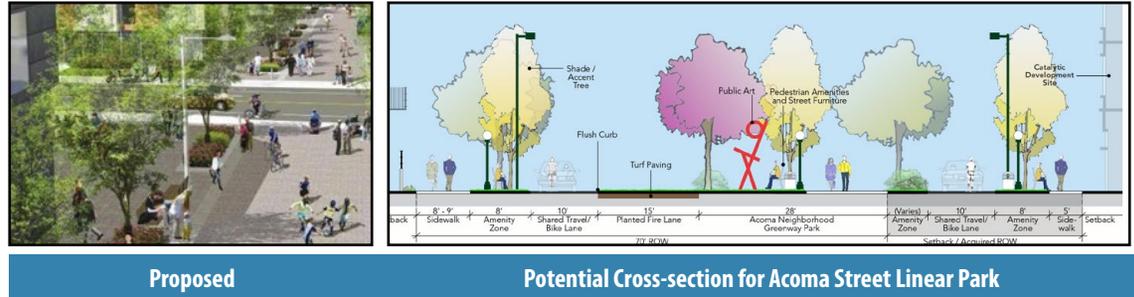
- Redesign of Globeville Landing Park combined with a new storm water open channel connecting to the South Platte River (Figure 4). The open channel design will help clean storm water naturally, restore natural ecosystems and create a wildlife corridor;
- Integrating storm water detention into the City Park Golf Course to temporarily hold and slow floodwaters, to improve water quality by allowing storm water to infiltrate, and to improve natural ecosystems, plant diversity and wildlife habitat;
- Creation of an open channel and greenway along 39th Avenue. Plantings and vegetation surrounding the open channel will provide natural filtration to improve water quality, and;
- Construction of a detention pond in Park Hill.

Construction of the Globeville Landing Outfall will begin in 2017.

1 Speer Boulevard Proposed: Rain Gardens in Median



2 Acoma Street Proposed: Urban Neighborhood Greenway (Golden Triangle Neighborhood Plan)



3 Frog Hollow Proposed: Extended Detention Basin



Figure 3. Example from Denver's Green Infrastructure Implementation Strategy of opportunities and approaches to incorporating water quality features into existing landscapes in Denver. Image courtesy of DPW Policy, Planning and Sustainability Section.



COMMUNITY PARTNERSHIPS

In 2016, DEH continued its work with several community groups, non-profits, and local universities on projects to improve water quality in Denver's streams and lakes. Here are some of our partners and the projects we have been working on:

- DEH continues to work with Groundwork Denver, the Cities of Lakewood and Sheridan, and DPW on efforts to understand and address E. coli in Bear Creek downstream of Bear Creek Reservoir. In 2016, work on a draft implementation plan began, sampling efforts continued, and infrastructure maintenance activities, including storm sewer cleaning, started. A source of low-interest loans to help homeowners disconnect from septic systems was also identified. Sampling efforts, including microbial source tracking, are being used to identify potential sources of E. coli and to pinpoint areas where infrastructure investigation and maintenance may be needed. These areas will be evaluated using geographic information systems (GIS) in 2017 to determine areas where the potential for cross connections between storm and sanitary sewers exists.
- DEH also continued working with The Greenway Foundation on efforts to prevent trash from entering Denver's streams and lakes. A winning design for the 2015-2016 the Clean River Design Challenge at Metro State University was selected (Figure 5) and planning for the next challenge began. The 2017-2018 Clean River Design Challenge will address the same problem; however, the competition will include participants from Colorado State University, Colorado School of Mines and Metro State University.



Figure 5. The Nautilus, the winning design from the 2015-2016 Clean River Challenge Design at Metro State University. The design uses a basket placed along the shore to create an eddy and capture trash for removal. The Greenway Foundation is evaluating the feasibility of installing a Nautilus on the South Platte River. Source: The Greenway Foundation.

HELP KEEP DENVER'S RIVERS AND STREAMS CLEAN

Apply fertilizer and pesticides in accordance with manufacturer's recommendations



Never apply before a storm

Pick up after your pet

Place all waste in a trash receptacle not on the ground or in the gutter



Make sure your vehicle is properly maintained to minimize leaks and drips

Only wash at a car wash

Dispose of unwanted medicine, prescriptions and household and hazardous chemicals (such as paint, pesticides or vehicle oil) properly



For information, visit [Denver's Household Hazardous Waste Collection Program](#) or call to schedule a pick up at 1-800-HHW-PKUP (800-449-7587)

To find the next medication take back event or medication disposal locations near you, visit [Colorado AWARxE](#)

VOLUNTEER

ADOPT A TRAIL OR PARK NEAR A STREAM/LAKE:
Visit [Denver Parks and Recreation volunteer site](#)

RIVER CLEAN UP EVENTS:

Learn more from [The Greenway Foundation](#) and [Groundwork Denver](#)



TAKE A PLEDGE

Protect Denver's lakes, streams and rivers

Think about which of these actions you can do and take a pledge to do them

UNUSUAL CONDITIONS INCLUDE:

- A change in the color of the water
- Suds without recent precipitation
- Any unusual looking discharge from a storm outlet
- Illegal dumping activity
- An unusual or foul odor
- Unusual discharges from construction sites or industrial sites
- Large number of dead or dying fish or crayfish

REPORT UNUSUAL CONDITIONS

311 NAVIGATING
CITY SERVICES

LOOKING FOR MORE INFORMATION ABOUT WATER QUALITY IN DENVER?

Email us at waterquality@denvergov.org or visit us at denvergov.org/waterquality.

You can also get up to date information on water quality by following us on Facebook or Twitter:



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