

FLOOD HAZARD NEWS

AN ANNUAL PUBLICATION OF THE DISTRICT



Protecting people, property, and the environment through preservation, mitigation, and education.

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WESTMINSTER'S AWARD-WINNING DRAINAGE & FLOOD CONTROL PROJECT

BY DAVID SKUODAS, PROJECT MANAGER, STREAM SERVICE

In 2005, the Little Dry Creek corridor between Federal and Lowell Boulevards in Westminster, Colorado was a frequent dumping ground for household and construction waste, hosted homeless encampments, and was only visited by locals if they were quickly passing through on the broken regional trail.



Fast-forward to 2017, the community now enjoys a transformed and engaging space hosting a new 2.5-acre lake, nearly 5 miles of trails and, an accessible creek edge designed to be inviting and explored. The Little Dry Creek Drainage and Flood Control Project was a significant improvement within a greater \$80 million investment in this once blighted area.

To begin the transformation, Westminster collaborated with Design Studios West (now Matrix Design Group) to develop conceptual master planning documents.

Later, in 2009, the City signed intergovernmental agreements with the Urban Drainage and Flood Control District and Adams County and embarked on the design and construction process by selecting Muller Engineering Company to lead a multi-faceted design team. In 2010, the project was encumbered with a major challenge—the announcement of RTD’s B Line Commuter Rail Project. Initial plans showed the train tracks would be located within the 100-year floodplain. Without the addition of flood storage and other improvements, the commuter and freight rail tracks would be covered by five feet of water.

During the years between 2010 and 2014 critical utilities were relocated, land was purchased, groundwater contamination remediated, and Express Inc. (CEI) was selected to engage in a construction manager/general contractor (CM/GC) method of contracting. This innovative contracting method brought the project sponsors,



the engineer, the architect, and the contractor to the design table, which resulted in providing CEI significant latitude to move this drainage and flood control project forward. CEI started phase one with a 70-page set of drawings originally bid at \$7 million. Over the following two years, the project scope strategically evolved and expanded into 400 pages of final plans and a total project cost of \$16.2 million.

UDFCD contributed planning, floodplain mapping, technical expertise, and project management for the design and construction of this project, with management of the construction contract switching over to the City in later phases because of the various sources of funding coming into the project. The District also contributed around \$3.4 million towards the project.



Future programming for the 40-acre site included a cutting-edge natural play area, restrooms, and an educational xeric garden in partnership with the Butterfly Pavilion that will break ground in spring of 2018. These transformational improvements to this once blighted area will act as catalysts for economic growth and bring people out to enjoy and engage in their open space.

This project won the Grand Award at the Colorado Association of Stormwater and Floodplain Managers Annual Conference, and was part of the greater overall Westminster Station project that won the American Public Works Association Project of the Year Award for the State of Colorado.

PROJECT SNAPSHOT

- Cost: \$16.2 million
- Timeline: 2005 to 2017
- Lowered the 100-year floodplain by five feet
- Integrated 172 acre-feet of flood storage detention
- Relocated and restored 4,100 liner feet of Little Dry Creek, 200 feet to the north
- Cleaned up 3 million pounds of trash
- Restored and created aquatic habitat and riparian corridor
- Planted over 450 trees
- Planted 26,000 square feet of shrubs and grasses
- Tunneled 800-feet of utility pipeline up to 108-inch in diameter under Federal Blvd.
- Relocated one beaver



Finished Project Looking West



Finished Project Looking East



Finished Project at Pond Outlet



Finished Project West of Lowell



Finished Project at Lowell Underpass



Pre-Project at Lowell Underpass – note the continually flooded underpass

A MESSAGE FROM THE EXECUTIVE DIRECTOR

KEN MACKENZIE



I was raised with the rule that there are three topics of conversation that are taboo in polite company: politics, religion and money. In this article I am going to break that rule because we really need to have a frank conversation about

money. Money allows UDFCD to provide the many services for which we are known, including: flood prediction and warning services; flood risk mapping studies; watershed planning studies; design and construction of award-winning infrastructure; research into new technologies and practices, or regular management and maintenance of the thousands of structures and improvements we have made over the 1,600 miles of major waterways throughout UDFCD's service area. We use money to preserve open spaces, create recreational opportunities, and keep people safe from flooding. Our people make us great, but without money we can't do much.

UDFCD's funding source is in the form of a tax mill (one mill is 1/1,000 of a dollar), levied against the assessed value of real property within the UDFCD boundaries. As an example, if you own a \$100,000 residential property in Colorado, your property's current assessed value is 7.2% or \$7,200. If your property is within the UDFCD boundary, your UDFCD mill levy in 2018 is 0.56 mills so you will pay \$4.03 in property taxes to support UDFCD in 2018. If your property is worth \$400,000 (approximately the average residential property value within the District), just multiply these numbers by four. In 2018, this small tax will bring UDFCD about \$29 million in revenue.


Please allow me to frame the rest of this discussion with some history. If history doesn't interest you, kindly skip to the last five paragraphs with my apologies.

In 1969, the Colorado General Assembly created UDFCD and authorized us to initially collect 0.1 mills, to be used for engineering and operations, and to get the District started. 1970 was the first year property taxes were collected, bringing in a revenue of about \$276,000.

In 1973, the Colorado General Assembly authorized UDFCD to collect an additional 0.4 mills, to be used for capital construction. This resulted in a 1974 property tax revenue of about \$1.8 million.

In 1979, the Colorado General Assembly authorized UDFCD to collect another additional 0.4 mills for the maintenance and preservation of floodplains and floodways within the District on a trial basis for the years 1981 through 1983. This resulted in a 1980 property tax revenue of about \$5.6 million. In 1983, UDFCD successfully lobbied the legislature to remove the three-year restriction and make the taxing authority, which was at that time up to 0.9 mills, permanent.

In 1982, the Gallagher Amendment to the Colorado Constitution was adopted by legislative referendum. This provided an immediate reduction in real property tax assessment rates and required the state legislature to adjust the assessment percentage for residential property biennially to ensure that the percentage of the statewide valuation for residential property in relation to other taxable property would generally remain the same as that in the prior year, i.e., 45% of the total with non-residential property making up the other 55%. This means that when residential property values increase at a rate higher than do commercial properties, the residential assessed valuation must go down to preserve the 45/55 split. In 2017 under Gallagher, the statewide residential assessment rate decreased from 7.96% to 7.20% to compensate



for the dramatic increase in residential property values. In 2019 it is projected to decrease again, down to 6.22%. Comparing this to the 30% assessment rate Coloradans faced pre-1982, Colorado property owners are the envy of most of the nation with regard to property taxes, all while our public infrastructure crumbles away.

In 1986, UDFCD successfully lobbied the legislature to add a final 0.1 mill taxing authority for all counties within the District except Boulder County (Broomfield was not yet a county). This new property tax would be for construction and maintenance of infrastructure on the South Platte River only. In 1987, for the first and last time in the history of our organization, UDFCD exercised our full taxing authority of 0.9 mills in Boulder County and 1.0 mill throughout the rest of the District, resulting in a 1987 property tax revenue of about \$9.1 million.

The following year in 1987, UDFCD was faced with a dilemma. County tax assessors across the District reassessed property at nearly twice the 1986 market value and correspondingly the assessed value nearly doubled, from \$9.2 billion to \$18.2 billion. The Colorado statutory “5.5% Property Tax Revenue Limit”, also known as the “Annual Levy Law” (Section 29-1-301, et seq., C.R.S.) forbids non-home rule local governments from increasing property taxes by more than 5.5% annually, excluding any local growth in the economy. In order to stay within the 5.5% limit, UDFCD had to reduce our mill levy by nearly half, dropping to 0.464 mills in Boulder County and 0.518 mills for the remainder of the District, resulting in a 1988 property tax revenue of about \$10.3 million.


UDFCD increased our mill levy in each of the following years, and by 1992 we were taxing at 0.696 mills in Boulder County and 0.780 mills for the remainder of the District, bringing in \$12 million. This was the year that the “Tax Payer’s Bill of Rights” (TABOR) Amendment to the Colorado Constitution became law, forever locking UDFCD’s

maximum mill levy at 0.696 mills for Boulder (and now Broomfield) Counties, and 0.780 mills for the remainder of the District. By this time the assessed valuation of real property within the District had dropped from the 1987 value of nearly \$19 billion to \$14.1 billion, a 23% reduction in taxable property value, resulting in a 1992 property tax revenue of about \$11.1 million.

In the “Financial Powers” articles of the enabling statute for UDFCD (Section 32-11-217, et seq., C.R.S.), it is clear that the authors of the Urban Drainage and Flood Control Act envisioned UDFCD by 2018 to be collecting up to 2.5 mills, subject to “...the favorable vote of a majority of the electors of the district...” In 2018, UDFCD will collect property taxes not at a mill levy rate of 2.5 mills, but of 0.56 mills; a 44% reduction in revenue compared to our full statutory authority and only 22% of the revenue those visionary legislators had ultimately imagined for us.

The TABOR Amendment, combined with the Gallagher Amendment and the Annual Levy Law, limit the growth of UDFCD during times of economic prosperity while also shrinking our revenues during times of economic hardship, in the same manner that a boa constrictor kills its prey by squeezing a bit tighter every time the prey exhales such that it may never again take in a full breath. This is widely known as the ratchet-down effect of TABOR, an effect that was not explained to nor understood by the voters who supported it in 1992, myself included. Douglas Bruce, the author of TABOR, knew that even the politicians who would be bound by the law didn’t understand what was in it, once telling a reporter that “their mouths would drop open” when politicians found out what impact it would have on state and local governmental agencies.

Without a favorable vote of the people of the District, the status quo for UDFCD will be to carry on the best we can with a property tax mill levy that is currently 0.56 mills and will only go lower

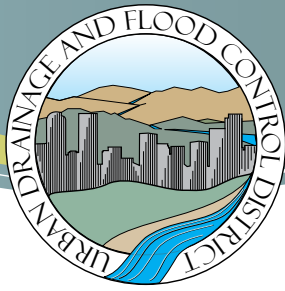


and lower over any considerable time period. It will never again be 1.0 mill as legislated in 1986, nor will it be 0.78 mills as it was when frozen in 1992. Yes, we will continue to bring in \$30 million or so per year adjusted for inflation, and we will continue to put that money to the highest and best use we can. But the estimated cost of all of the maintenance and restoration improvement projects requested by our partners at the 33 cities and towns and seven counties we serve is over \$53 million in 2018 alone, and will only grow as the region continues to develop at unprecedented rate. The \$24 million revenue shortfall this represents is roughly equal to the revenue reduction impacts the TABOR Amendment, combined with the Gallagher Amendment and the Annual Levy Law, have had on us.

Fortunately, one of the key provisions of the TABOR amendment is that it allows special districts like UDFCD to restore our legislated mill levy if the voters within the District agree to it. I have discussed this situation at length with the UDFCD Board of Directors and they fully understand the predicament. While no decision has been made at this time, it is my hope that UDFCD will someday ask the voters to allow us to restore the 1.0 mill levy the State Legislature authorized us to collect. I cannot overemphasize the fact that this would not be a tax rate increase, it would simply restore to us that which we were granted by the State Legislature in one of their most lucid moments.

If this were someday to happen, I hope you would support us and vote to restore UDFCD to the vision the authors of the Urban Drainage and Flood Control Act had for this organization. We would be asking the voters to increase the current \$4.03 per \$100,000 of residential property market value up to \$7.20. So for the example of the \$400,000 property mentioned earlier, this would increase the annual tax bill from \$16.13 to \$28.80, a \$12.67 annual increase.

The Denver Post recently reported that Coloradans drink craft beer at a rate twice the rest of the nation, consuming \$1.15 billion dollars in craft beer each year. Coloradans consume approximately 330 bottles of beer per capita each year, of which 11% is craft beer, typically costing around \$15-\$17 per 12-pack. With these facts in mind, I want to close with this thought: a region where folks spend over \$200 per capita annually on craft beer should not flinch at an additional \$13 per household per year on average for flood safety and preserving green spaces within the urban environment. If UDFCD does someday ask the voters to restore our statutory mill levy, I hope you will support the effort in any way you can—if nothing else, consider buying us a craft beer.



Board of Directors 2017

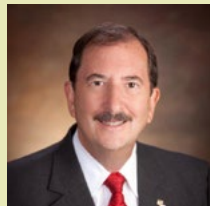
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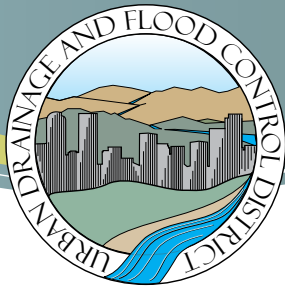


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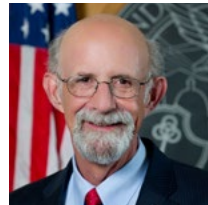
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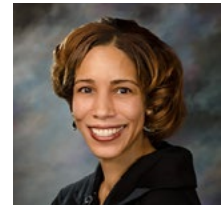
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UDFCD 2017 ORGANIZATIONAL CHANGES

LAURA KROEGER,
MANAGER, STREAM SERVICES PROGRAM

SHEA THOMAS,
MANAGER, WATERSHED SERVICES PROGRAM

DAVID BENNETTS,
MANAGER, OPERATIONS AND DEVELOPMENT PROGRAM


In order to advance our mission and vision within a rapidly changing world and the complex natural system we manage, we need to continually expand our understanding of watersheds and stream systems. We then need to be adaptive as an organization to take full advantage of the knowledge gained and apply that knowledge to improved processes for implementing projects. UDFCD has made large strides in how to work in a natural environment by embracing the value of working with diverse project teams of experts to complete mitigation projects, as well as in standardizing and improving the quality of master plans. While the advances made to date are significant, we recognize that broader system-wide process improvements are still needed in order to produce significant gains in the overall quality of mitigation projects that meet the UDFCD mission and vision.

UDFCD identified several of these system-wide improvements during a staff retreat in 2015, and through an ongoing strategic planning effort. Additionally, as more staff have become involved in other UDFCD services such as the Maintenance Eligibility Program, a greater awareness has developed resulting in ideas and opportunities to improve processes and outcomes.

The merging of the Floodplain Management and Master Planning Programs into the Watershed Services group in early 2017 provided the first step, allowing us the opportunity to look at processes and philosophies with a fresh

perspective. This significant change also allowed for the first time for Stream Services (formerly Design, Construction and Maintenance Program) and Watershed Services to work together and collaborate on addressing challenges at a system level, not just within work programs. Watershed Services, which tasks include master plans, floodplain mapping and our maintenance eligibility program (MEP), were expanded to three project managers (PMs) for each rather than the historic scenario of one PM for each service. There have been tremendous improvements in products, processes, response time and relationships with local government partners and land developers in the short period of time Watershed Services has been operating under the new structure. There are still barriers between program services and inconsistencies for our local government partners that prevent opportunities for meeting our mission and vision.

To help close these gaps UDFCD is in the process of making two more organizational changes. One change took place at the end of 2017 with the creation of the Operations and Development Program. David Bennetts took on the challenge of creating a new program to address many of the organizational needs that have not had focused time or resources in the past. These include developing and integrating special projects across service areas to achieve the District's strategic objectives, outreach and education, research and development of criteria and technical standards, and management of many of the District's system



operations. The District has assigned a Standards Development Manager, Information Services Specialist, and Senior Construction Manager to support the success of this new program.

The other organizational change that will take place starting in 2018 is moving to a Watershed Project Management Approach. The philosophy of this new approach is to have a system wide understanding of the watershed and strong general project management as the priority. UDFCD boundaries will be broken into eight watershed service areas with one Project Manager and one Construction Manager, and the District added two new senior construction managers to assist with this effort. The project management teams will be responsible for providing both watershed and stream services within the watershed service area. The benefits of this approach are:

- Requires people to think in watersheds rather than jurisdictions
- Provides continuity for all services/projects

- Understanding of system without doubling up on workload
- Potential for coordinating with other interests in watershed
- More PMs on each service allows for opportunities for innovation
- Maintains cultural structure of PM autonomy

Key Points for our local governments:

- Construction and maintenance tax dollars collected in each county will be spent only in that county
- The transition to this new approach will be a well-planned and carefully executed to ensure no loss of service to our partners
- The primary goal of this approach is improved service to our partners
- The District will identify a single point of contact for each local government

The District is excited about these changes, and believes they will better serve the public, our partners, and the watersheds we work within.

STREAM SERVICES

LAURA KROEGER,
STREAM SERVICES MANAGER

The construction managers have had an eventful year, being able to finally move some of our longer running projects into construction. One of these projects was the Hoffman Drainageway; the original UDFCD project manager for this project was Dave Lloyd. For those who new Dave, you can tell how long ago this project started (the late 1990's in this case). Another Dave, Dave Skuodas worked with Adams County and Regional Rail Partners to finally obtain the easements and finances to build this much-needed flood control improvement.

The Stream Team also enjoyed receiving recognition in the form of awards from several different professional organizations:

- South Platte River and 33rd Street Outfall – Colorado Contractors Association – H₂O Project Award
- Little Dry Creek at Federal – CASFM Grand Award, APWA Colorado Chapter Grand Award
- Lafayette/Louisville Boundary Area Drainage Project - CASFM Runner-Up, APWA Colorado Chapter Environmental Small Community Project Winner

UDFCD's alternative project delivery approach called Project Partners is rounding off its fifth year of being in effect. This process has provided an opportunity to grow our partnerships between stakeholders, consultants, and contractors to construct the best value projects for our communities. UDFCD is extremely appreciative to our partners for their continued hard work, dedication, and inspiration to solve problems and improve the quality of life within the metro area.

A great example of a team being creative and committed to the right solution is on Piney Creek in Arapahoe County. The challenging sand bed creek needed a systems approach to responsibly address the instability issues the property owners where experiencing. Rich Borchardt worked with the Southeast Metro Stormwater Authority (SEMSWA) and UDFCD pre-qualified consultants and contractors to design and build improvements to protect people, property and the environment along Piney Creek. SEMSWA took the lead in acquiring easements and securing funding which was a significant effort.

In 2017, UDFCD leveraged just over \$12 million that was at least matched at a 50% level to implement the Capital Improvement Plan (CIP) projects. UDFCD also completed \$9.3 million in stream management projects ranging from routine work to restoration projects. Project highlights for each county are listed on the following pages.

Adams County

DAVID SKUODAS, PROJECT MANAGER

School Tributary

This CIP project, in conjunction with the City of Thornton, involved in the installation of around 2,000 linear feet of new 84-inch storm drain to provide an outfall location for a new planned neighborhood west of Monroe Street and north of 88th Avenue. An existing 84-inch pipe had been installed from east of Colorado Boulevard and through an apartment complex, with the end of the pipe situated under the entrance to the Catalina Apartments. The District worked with Merrick and Company to design the pipe extension, and with American West Construction to install the new pipe. Numerous utilities had to be dealt with including gas lines, sewer lines, telecommunication lines, and an existing City of Thornton sludge line. Construction wrapped up in late fall 2017.



Connecting to the existing 84-inch pipe



84-inch pipe installation along 88th Ave.

Big Dry Creek at Thorncreek Golf Course

This maintenance restoration project, in conjunction with the City of Thornton, involved ecological restoration and bank stabilization of around 2,500 linear feet of Big Dry Creek through the Thorncreek Golf Course. The City of Westminster's and the City and County of Broomfield's wastewater treatment plants discharge their effluent into Big Dry Creek upstream of the golf course. This continual discharge into the creek creates an unnatural base flow that resulted in chronic stream degradation through the golf course. This project installed an ungrouted boulder drop structure and re-shaped the channel banks to stabilize the stream and to improve public safety, as there were nearly 10-foot vertical banks along the creek throughout the golf course.



Pre-Construction Looking North



Post-Construction Looking North



Post-Construction Aerial



Post Construction

Grange Hall Creek from Marion to Larson

This project, in conjunction with the City of Northglenn, involved improvements downstream of Marion Street and at the Larson Drive crossing. A pair of 60-inch pipes carry Grange Hall Creek flows under Marion Street. East of Marion Street, the 60-inch pipes connect to a junction box, which connected to a 48-inch diameter corrugate metal pipe. The 48-inch pipe rusted out and a sinkhole formed between Marion Street and the outfall. Since the 48-inch pipe was significantly undersized, there was a desire to increase the capacity as part of the repair. The City of Northglenn and the District partnered with Muller Engineering to design an open channel that would daylight 450 feet of stream that was formerly buried underground in the 48-inch pipe. Construction at Marion Street wrapped up in late 2017.

Work at Larson Drive involves increasing culvert capacity under Larson Drive. The existing culvert is a single 30-inch pipe, which was so undersized it caused flows to backup into the Washington Street culvert and underpass one block to the west. A new 14-foot by 5-foot concrete box culvert will remedy this problem. Construction at Larson Drive began in late 2017 and will conclude in the spring of 2018.



Pre-Construction Aerial of sinkhole



Post-Construction Aerial of Channel



Pre-Construction View of sinkhole



Post-Construction View of Channel

Arapahoe County

RICH BORCHARDT, PROJECT MANAGER

Piney Creek from Tower Road Liverpool to Caley Drive

The District and the Southeast Metro Stormwater Authority in cooperation with the Goodman Metro District completed construction of a capital project on Piney Creek at Tower Road Liverpool to Caley Drive, located southwest of the intersection of Tower Road and Yampa Street. Development in the Piney Creek watershed stressed out the existing stream system. As a result, Piney Creek from Tower Road to Liverpool Street experienced severe erosion, which the stream transported and deposited downstream of Tower Road. A June 2015 storm was a turning point; depositing large amounts of sediment and increasing the flood risk to the homes to the north. Large portions of the regional trail were either buried or underwater. The stream relocated itself to the trail. This project removed a large deposit of sediment and restored the stream. The trails have been re-opened, the stream is back in its banks, and the neighbors are now at a lower flood risk. A sediment capture area and improved maintenance access were included to facilitate on-going maintenance.



Before Construction – Piney Creek at Tower



After Construction – Piney Creek at Tower

Englewood Dam on Willow Creek

The District in cooperation with South Suburban Park and Recreation District completed a maintenance project on Englewood Dam on Willow Creek located southeast of the intersection of Arapahoe Road and Holly Street. The Works Program Administration originally built Englewood Dam in 1936. In 1975, the District improved the dam to a stormwater/flood control facility that lowers flood risk to downstream communities. The 2017 maintenance project included regrading and resurfacing the top of the dam, reseeding the spillway, and improving the trail system around the dam. Englewood Dam is next to the Willow Creek Open Space—an area that includes several trails and a great view of the mountains. Over time, several trail shortcuts were created and were eroding. The project removed and restored shortcuts, improved the circulation around and over the dam, and provided signage to encourage use of formal trails and discourage users from creating shortcuts.



During Construction – Englewood Dam on Willow Creek



After – Englewood Dam on Willow Creek

Boulder County

DAVID SKUODAS, PROJECT MANAGER

Wonderland Creek

Hundreds of multi-family homes currently lie within the Wonderland Creek 100-year floodplain along a one-mile reach from Winding Trail Road downstream to Foothills Parkway. The District partnered with the City of Boulder to design improvements to the creek to reduce the 100-year flood risk such that all of these multi-family homes will no longer be in the 100-year floodplain. The project includes a new bridge and underpass at the crossing of the BNSF Railroad, relocation of the Boulder and White Rock Ditch, six separate road crossing improvements, and a new trail corridor with underpasses at Kalmia Avenue and at 28th Street.

Construction began in early 2016 and was near completion by the end of 2017. Construction is planned to wrap up in the spring of 2018.

Completed construction includes:

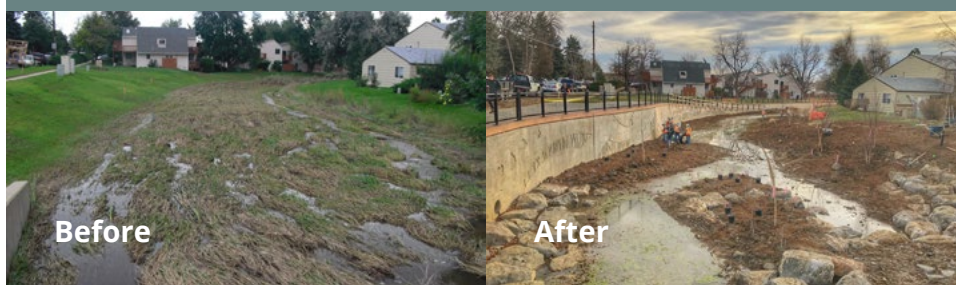
- Relocation of the Boulder and White Rock Ditch
- A new bridge and trail underpass of the BNSF Railroad
- A new 100-year culvert crossing at Spring Creek Place
- A new 100-year culvert under 34th and Iris
- 100-year channel improvements from Foothills Parkway to north of Iris Avenue
- 100-year channel improvements south of Kalmia Avenue
- A 100-year culvert crossing and pedestrian underpass at Kalmia Avenue
- 100-year channel improvements from Kalmia to 28th Street
- A 100-year culvert crossing and pedestrian underpass at 28th Street
- A 100-year culvert crossing at Winding Trail Drive

Construction continues on the channel from Winding Trail to 28th Street, with final flatwork, paving and revegetation to be completed in the first few months of 2018.

BNSF Railroad Crossing – New Bridge and Underpass



From 34th and Iris Avenue looking east



Drainageway No. 2 at 111th Street

This project, in conjunction with the City of Lafayette, involved enlarging the crossing of 111th Street and providing a pedestrian underpass. The existing culverts consisted of four significantly undersized corrugated metal pipes that caused frequent flooding of 111th Street. A regional trail east of 111th Street is planned to be extended across 111th Street and west up to Highway 287. The new trail underpass of 111th Street is a major public safety improvement, as it separates cars along 111th Street from pedestrians using the regional trail. This project started construction in the fall of 2017 and will wrap up in the spring of 2018. The western half of the box culvert was constructed by the end of 2017, with traffic being planned to switch over on to the new box culvert in early February so the eastern half of the box can be constructed. The box culvert is being constructed in halves so that two lanes of traffic can be maintained at all times, as 111th Street is a collector road with a fire station and police station located directly adjacent to the project, which both require 24-hour access.



Pre-Construction View of Culvert



Mid-Construction View of Culvert



Steel Work on Box Culvert Slab



View of Old Culverts and New

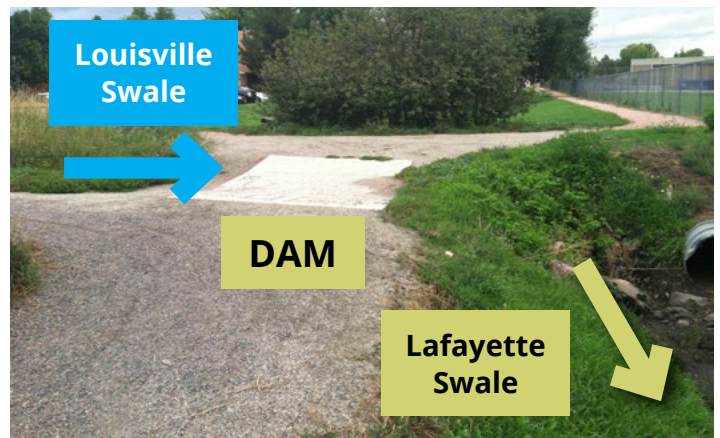
Lafayette—Louisville Boundary Area Drainage Improvements

PROJECT OVERVIEW

Louisville, Colorado has appeared on Money Magazine’s “Top 10 Best Places to Live” list several times, with a #1 appearance in 2011. An existing floodplain hindered development and redevelopment in the ever more vibrant downtown area. The City of Louisville sought to reduce the regulatory floodplain to the maximum extent practicable; protect public and private property including the City’s wastewater treatment plant (WWTP); and allow the City and developers to implement their plans.



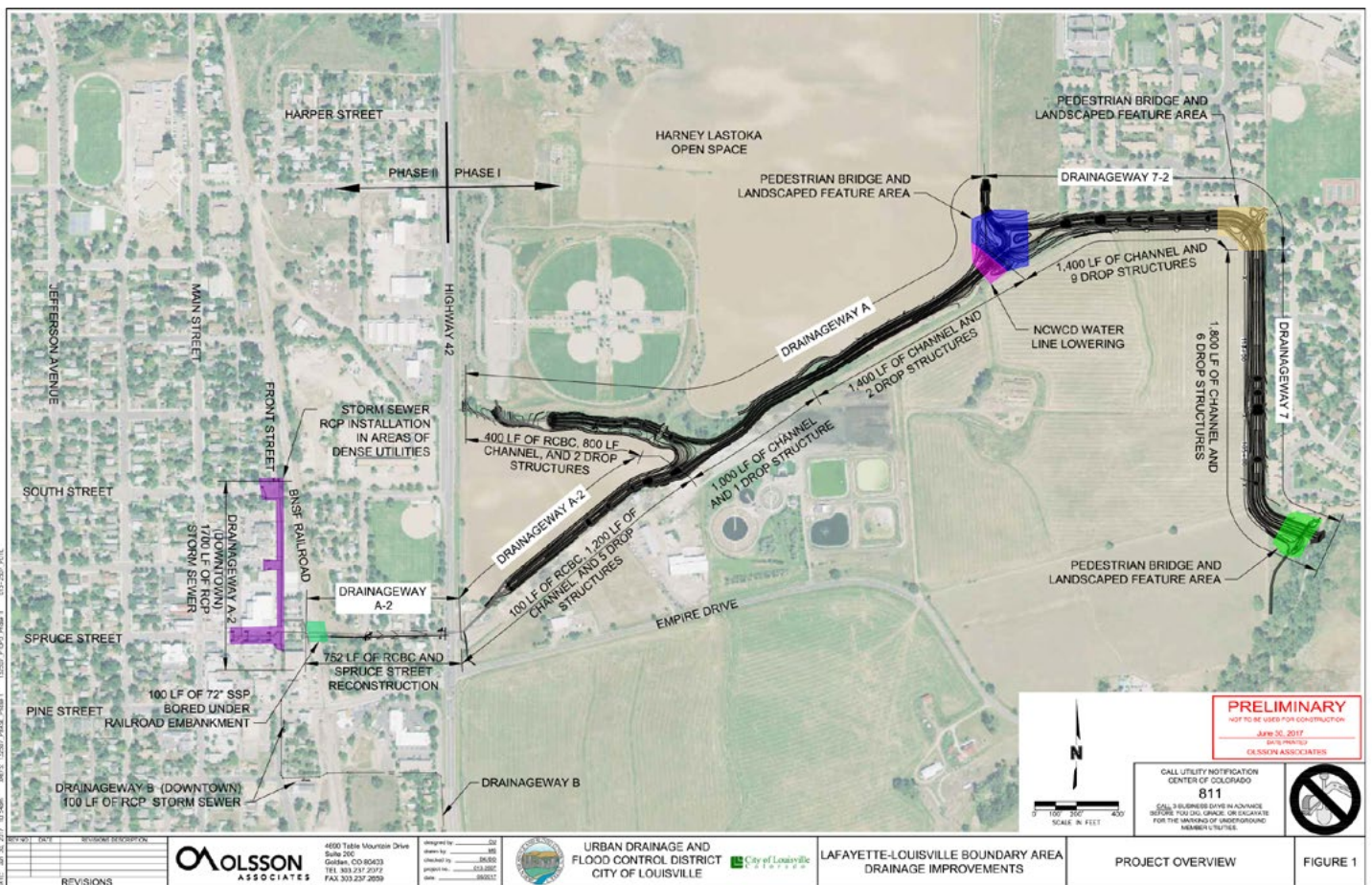
The main cause of the floodplain in downtown Louisville was an existing railroad embankment that backed-up Drainageway A-2 flows on its upstream (west) side. Drainage issues in this area have been problematic, to say the least. In the past, the cities of Louisville and Lafayette had disagreed over drainage improvements near the boundary area between the two cities, to the point that one municipality put a dam across an undersized channel to avoid “receiving” water from the other community.



To make needed improvements, land was needed from an adjacent agricultural property owner. The history was so contentious that Paul Hindman, former UDFCD Executive Director, was once chased off the property by a landowner with a shotgun. The Lafayette-Louisville Boundary Area Drainage Improvements project was comprised of many components, each of which had its own challenges. Final design took place from 2013 through 2015, with construction beginning early 2016 and concluding in the fall of 2016, with some revegetation in early 2017.

The conglomeration of so many components and issues made for a unique project that resulted in decreased flood risk and the addition of regional recreational amenities.

Main project components are shown on the map below:



Main project components included:

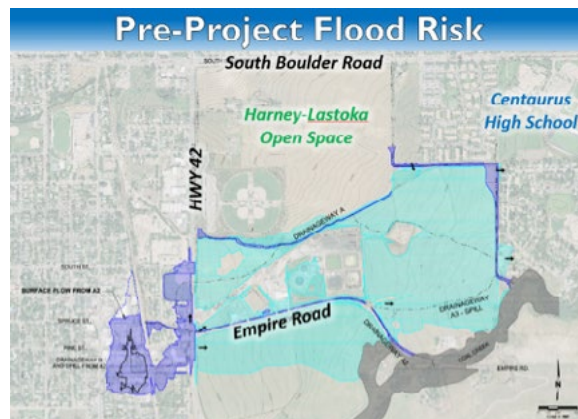
- 1.3 miles of open channel with grouted, ungrouted, and void-filled riprap grade control structures east of State Highway 42 where the channel ultimately outfalls into Coal Creek.
- Three pedestrian bridges, trail connections, and landscape design adjacent to the open channels.
- 3,200 linear feet of storm drain, manholes, inlets, and culverts designed to capture and convey the 100-year storm event, including one open cut crossing of Highway 42.
- Design and installation of a 72-inch diameter steel pipe under the railroad via tunneling methods.
- Design and construction of the lowering of a Northern Colorado Water Conservancy District 16-inch raw water line that was the primary source of water for two neighboring towns. Construction on this line had to be completed in less than one week.
- 404 permitting and floodplain permitting through several entities, along with a LOMR.

- Incorporating an offline water quality and detention pond that is part of a new commercial development into the channel design.
- Relocating Louisville’s main power feed twice, plus 40 other utility adjustments.
- Construction adjacent to the City of Louisville’s WWTP upgrade project.
- Federal funding was used for the project, adding numerous requirements for construction and construction administration.
- Timing of construction to minimize impacts to Louisville’s many downtown summer events.

As a result of this project, at least 37 buildings, including some multi-family units, 20 commercial properties, and the WWTP, will be out of the floodplain, and redevelopment that will spur economic growth can occur. Flood risk resulting from unmapped spills in Lafayette has been reduced and eliminated at the 100-year level. The pre and post-project floodplains are shown below:

The project involved many moving parts. Significant project challenges included:

- Overcoming past issues to work together on solving drainage problems.
- Aggressive design and construction schedules to respond to development pressure.
- Two concurrent project design phases, and two construction projects with two very different contractors with overlapping physical work spaces. Phase I generally consisted of the open channel portion of the project east of Highway 42, and Phase II consisted of work west of and within Highway 42.
- Multiple agency review processes and accommodating agricultural uses in the Harney-Lastoka Open Space jointly owned by Boulder County, Louisville and Lafayette.
- Easement acquisition from four private properties.
- 80,000 cubic yards of earthwork. Spoiling surplus dirt on adjacent agricultural land managed by Boulder County required special treatment.



The new pedestrian trails along the open channels, pedestrian bridges, and connections to regional trails are highly used regional amenities.



PROJECT TEAM

Many areas of expertise contributed to the project success. The following vendors provided significant work efforts:

- Olsson Associates' services included topographic survey, legal descriptions, engineering analysis and design, structural engineering design, floodplain modeling and permitting, bidding and construction phase services, and materials testing and special inspections during construction.
- Stream Design, LLC, provided park planning and landscape design services that greatly enhanced the project for now and the future.
- Brierley Associates provided geotechnical services, designed the boring under the railroad, and provided construction observation for the railroad bore.
- Dewberry Engineers, Inc. designed the lowering of a critical Northern Colorado Water Conservancy District 16-inch water line and provided construction phase services.
- ERO Resources Corp. completed U.S. Army Corps of Engineers permitting.
- The contractor for Phase I, which consisted primarily of the open channel work, was Concrete Express, Inc. (CEI). The Phase II contractor, Redpoint, completed most of the storm sewer work.

CONCLUSION

Development and redevelopment in the thriving City of Louisville was hindered by the existing mapped floodplain. Flood risk to properties in the downtown Louisville existed, in addition to risk along Drainageway 7 to residents in Lafayette. By constructing a 100-year storm sewer system in downtown Louisville, conveying it under an existing railroad and through new open channels to Coal Creek, flood risk to residents in Louisville and Lafayette has been reduced, areas for economic opportunities that will enhance the area have opened up, and improved recreational amenities in the Harney-Lastoka open space have been provided. The project was a conglomeration of many different elements that ultimately resulted in a project that met its objectives and provided enhanced amenities for area residents.

This project won an award from the American Public Works Association for Small Community Environmental Project of the Year.

City and County of Broomfield

BRYAN KOHLENBERG, PROJECT MANAGER

City Park Channel

UDFCD collaborated with Broomfield and Westminster to design the City Park Channel - Lower Reach improvements from upstream of Lowell Boulevard to Big Dry Creek. The proposed City Park overflow channel will convey flood flows directly to Big Dry Creek south of 120th Avenue while preserving the existing low-flows in the channel that currently flow into Nissen Reservoir Channel on the north side of 120th Avenue. As a result, the 100-year flow in Nissen will be significantly reduced and the risk of overtopping the historic Metzger Farm Pond dam downstream will be much lower. The District's Project Partners approach with Jacobs-CH2M (Engineer) and Naranjo Civil Constructors (Contractor) was instrumental in working through construction phasing, permitting, and limited budget issues. Construction will be underway in 2018, paving and revegetation to be completed in the first few months of 2018.

The next project up for Broomfield will be the design of Nissen Reservoir Channel Improvements from Tennyson Street to Lowell Boulevard.



Future City Park Channel Alignment

City and County of Denver

JASON STAWSKI, SENIOR CONSTRUCTION MANAGER

33rd Street Outfall

The 33rd Street Outfall conveys stormwater from the 33rd Street Storm Drain System (SDS) that drains part of downtown Denver into the South Platte River. The 33rd Street SDS will carry about 1,200 cfs flowing east to west from downtown Denver through Lafayette Street to Arkins Court where the pipe system discharges into the South Platte River. This project is located in the River North area of Denver. The District collaborated with Denver to complete this unique outfall in October 2017.

The goal of the project was to provide end-of-pipe energy dissipation, enhance water quality, minimize impact to the South Platte River, and to serve as a place-making element. The South Platte River is highly valued for regional open space and recreation, and as a riverfront. The outfall treatment for the end-of-pipe system could have been a typical pipe and grouted boulder drop structure that ignored these values, but instead the project team imagined creating a space that would achieve all of the project goals while serving as a place-making element. We learned that the cost of this architecturally unique outfall was similar to a grouted boulder drop structure and that adding value does not necessarily equate to higher costs.

Constructed improvements include extending the existing double 18' by 3' box culvert; an urban step-pool outfall equipped with grasscrete, vegetated steps, and tree planting wells; a new 16-foot wide, 270-foot long pedestrian bridge; and re-vegetation. Muller Engineering and Stream Design Landscape Architecture designed the outfall and Concrete Express Inc. was the General Contractor for the work.



33rd Street Outfall Before



33rd Street Outfall After

Westerly Creek Restoration from 11th Avenue to 13th Avenue

Westerly Creek is a tributary to Sand Creek that flows south to north from East Yale Avenue in Arapahoe County to its confluence with Sand Creek at Prairie Uplands Park just southwest of I-70 and Havana Street in Denver. This project, located just downstream of Kelly Road Dam in Denver, restored the stream from East 11th Avenue to East 13th Avenue. The District collaborated with the City and County of Denver to complete approximately 1,125 feet of improvements in August 2017. The goal of the project was to restore the ecology of the stream by improving the stream cross section and planform. Although the team had limited space to work with, sufficient adjustments were made to improve energy dissipation, stream morphology, quality of habitat and diversity of wetland and riparian plant species.

The project improvements include a multi-staged stream; meandering active channel with riffle pool bedforms; new pedestrian trails and a low-flow stream crossing; alleys and landscaping. Muller Engineering and Wenk designed the improvements and Tezak Heavy Equipment was the General Contractor.



Westerly Creek 11th to 13th Before



Westerly Creek 11th to 13th After

Cherry Creek

In 2017, UDFCD and Denver were able to address flood concerns from the 2015 storms in several areas, two of which were along Cherry Creek. The West 11th Avenue bridge abutment had shown signs of seepage evident by a sinkhole occurring above the levee walls adjacent to southbound Speer Boulevard. The District collaborated with Denver Public Works to address the problem. ICON Engineering designed the modifications to the abutment and creek. Concrete Express Inc., the General Contractor, dealt with heavy bike and pedestrian traffic, as well as difficult access, to accomplish construction in about a week.



Cherry Creek 11th Before



Cherry Creek 11th After

Cherry Creek – Cook Park

Cherry Creek near Cook Park had been degrading for quite some time and by 2017, it was a big safety concern to Denver Parks and Recreation because of the 15-foot vertical bank immediately adjacent to the Cherry Creek regional trail. The District worked with local authorities to stabilize Cherry Creek by laying back slopes and adding buried riprap and a pre-formed scour hole along the south bank of Cherry Creek. Muller Engineering designed the modification and Naranjo Civil Constructors was the General Contractor.



Cherry Creek Cook Park Before



Cherry Creek Cook Park After

Douglas County

JASON STAWSKI, SENIOR CONSTRUCTION MANAGER

Big Dry Creek at University

Big Dry Creek is a tributary to the South Platte River that flows south to north from Castle Pines to Littleton. This project, located at Cheese Ranch Historic Park in Highlands Ranch, stabilized the stream from mid-park near the South Cornell Circle pedestrian bridge to University Boulevard. The District partnered with Highlands Ranch Metro District to complete approximately 1,550 feet of improvements in April 2017. The goal of the project was to control channel degradation.

Constructed improvements include lifting the stream to control the channel degradation; adjusting the stream cross section; installing grade control with five sculpted concrete drop structures; and re-vegetation. ICON Engineering designed the improvements and Naranjo Civil Constructors was the General Contractor for the work.



Big Dry Creek at University Before



Big Dry Creek at University After

West Fork Big Dry Creek

West Fork Big Dry Creek is a tributary to Big Dry Creek in Douglas County that flows from south to north from University Boulevard to its confluence with Big Dry Creek just north of C-470 in David Lorenz Regional Park. This project stabilized the stream from Canongate Lane to Birmingham Court. The District partnered with Highlands Ranch Metro District to complete approximately 1,600 feet of improvements in May 2017. The goal of the project was to control stream degradation.

Constructed improvements include lifting the stream and correcting the stream cross section and planform; introducing riffle pool bedform; and re-vegetation. Muller Engineering designed the improvements and Tezak Heavy Equipment was the General Contractor for the work.



West Fork Big Dry Creek Before



West Fork Big Dry Creek After

Fairways Tributary

Fairways Tributary in Lone Tree was historically mowed to control weeds. In 2017, a different approach was implemented and the vegetation was allowed to grow native. The District provided spot weed control as needed as an option to mowing. The District worked with local community leaders, Valles Construction, and the City of Lone Tree to remove sediment and repair parts of all 13 drop structures. Vegetation management will continue in 2018 with Habitat Management Inc. leading the effort.



Fairways Tributary

Heritage Hills Detention Basin

The outlet structure at Heritage Hills Detention Basin had clogged in the middle of the year from several feet of water that had inundated much of the facility. UDFCD worked with the Heritage Hills HOA, the City of Lone Tree, Naranjo Civil Constructors, and Muller Engineering to design and install a retrofit to the outlet structure to allow the pond to drain with less frequent clogging. Naranjo also performed a major sediment removal within the micropool and the basin is now functioning as intended.



Heritage Hills Detention Basin

Jefferson County

BRYAN KOHLENBERG, PROJECT MANAGER

Massey Draw at Deer Creek Golf Course

A large flood occurred on Massey Draw at the Deer Creek Golf Club near Kipling and C-470 on June 27, 2004. Floodwaters unexpectedly split off north of Massey Draw into an area not identified as being within a regulatory floodplain at the time. This resulted in roadway overtopping and damage to homes without flood insurance coverage by what was considered a large event, but less than the 100-year flood.

The initial solution was to increase Massey Draw's main channel capacity, however, this solution would have reconfigured at least four golf course holes, disrupted play for six months, impacted wetlands significantly, intercepted a high groundwater table, and possibly required constructing the dreaded L-word—*I e v e e*. The better solution was to improve the secondary channel along the unexpected flow split path through the Meadow Ranch Subdivision. This solution required new box culvert crossings at Oak Street and Rockland Avenue, and connecting channels. Although the Rockland Avenue box culvert barely fit between the houses, this alternative was less expensive, disrupting only one tee box and preserving the existing wetlands along Massey Draw.

The District and Jefferson County funded the project. Icon Engineering completed the design, while Naranjo Civil Constructors assisted with design and provided construction that was completed in 2017. Arrowhead Landscaping was instrumental and very patient in working with property owners to replace their disturbed yards to their satisfaction. All homes flooded in 2004 should be out of the new reduced regulatory floodplain soon.



Massey Draw – Oak Street to Rockland Avenue construction completed



Rockland Avenue – New box culvert crossing with new landscaping

NEW OPERATIONS AND DEVELOPMENT SERVICES

DAVID BENNETTS, OPERATIONS AND DEVELOPMENT MANAGER

Last fall, the District announced the creation of a new program, Operations and Development, which formally began in October 2017. The idea for the program came out of the District's recent strategic plan, adopted in 2016, which suggested developing an organizational structure better suited to meet the current and future needs of the District. Stated broadly, the program was created to develop and integrate special projects across service areas to ensure we achieve our operational objectives and strategic business goals. More specifically, the role of the program is one of service and support of the organizations activities and our local government partners.

Looking at each of the two service categories in more detail, Operations Services manages, monitors, and measures the effectiveness of the day-to-day operations of the organization. This includes data development and management; work products such as the criteria manual and software; coordination of our educational and outreach activities; development of publications such as the Flood Hazard News, Annual Report, and Summary of Services; and support of the Flood Warning Services. In addition to providing support for existing services, Development Services is tasked with the creation and management of new services, many also identified in our strategic plan. These include a succession plan for the organization; leadership development planning and training; a community learning center; and development of software and technical tools.

The program's initial activities center on a large public information and education campaign to communicate to the public the work the District does, and its importance to the region. As our Executive Director Ken MacKenzie mentioned in

his column, the District is considering asking the voters to restore our mill levy rate to what the legislature originally authorized us to collect. This outreach campaign will support this effort by informing the public about our on-going projects and services; our flood-warning program and its importance to public safety; and how this work contributes to trails and open space preservation for future generations.

The program is also in the process of identifying future needs of the organization, and compiling a list of the District's planned and on-going special projects. Special projects are outside our normal day-to-day duties, but add value or increase the District's knowledge base to advance our strategic goals. The District has always supported special projects, but in the past this initiative lacked both the dedicated time and resources to make them truly successful. A couple of examples of these types of projects include development of new web tools, development of hydraulic and geomorphic scientific data, improved criteria and specifications, and improved tools to ensure public safety. The ultimate goal, once the process is running, is to share what we have learned from these special projects through our outreach and training efforts, and community-learning center - so stay tuned.

The overall objective of the Operations and Development Program is to ensure the District has the staff and training needed for the future, and that we are providing relevant services to our partners and constituents. This will ensure the District's place as a leader in the industry moving into the future. This is a great challenge that the Operations and Development program team is excited to tackle!

Operation & Development Services

HOLLY PIZA, STANDARDS DEVELOPMENT MANAGER

Urban Storm Drainage Criteria Manual



Volume Reduction practices take stormwater runoff from impervious areas and direct them to pervious areas.

The new NPDES Phase 2 MS4 permit identified five design standards for addressing post-construction water quality requirements. One of those standards is for volume reduction, a practice that UDFCD has promoted since the first release of Volume 3 of the Urban Storm Drainage Criteria Manual (USDCM) in 1992. UDFCD is currently working with SEMSWA and Douglas County to develop criteria for quantifying volume reduction associated with grass buffers and grass swales. Criteria is based on SWMM modeling by Wright Water Engineers as well as field studies led by Muller Engineering. This will be accompanied by revisions to UD-BMP, the workbook tool outlining design of various BMPs within the USDCM. The release of both is planned for early 2018.

UDFCD adopted NOAA Atlas 14 in March 2017. This resulted in changes to the rainfall and runoff chapters as well as all UDFCD software and workbook tools. When revisions are made to the USDCM, notifications are sent to all UDFCD email subscribers and revisions are described in detail on the Criteria Manual Updates page which can be found at www.UDFCD.org.

UDFCD Software

This year UDFCD released UD-Rational 2.00. This work incorporates new runoff coefficients and a time of concentration equation. This Microsoft Excel-based workbook for clarity, assists designers in calculating peak runoff and its new format is much more user-friendly.

BMP-REALCOST also received updates with regard to the most recent data from the International BMP Database — including both concentrations and volume reduction. Land value costs were also updated and E. coli was added to the list of constituents for evaluating BMP performance.

UDFCD Annual Seminar

Over 370 people attended our 2017 annual seminar. The proceedings are available at: <http://udfcd.org/presentations>.

On April 3, 2018 we will have our next annual seminar. This one-day program will be at the Omni Interlocken in Broomfield. Register soon and join us to find out what's going on regionally and nationally in drainage, stormwater quality, and floodplain management. Registration information is currently on our website.

UDFCD BMP Monitoring Program

UDFCD has been monitoring stormwater BMPs since the late 1990s. This year we continued monitoring influent and effluent water quality for two stormwater research sites, the green roof at Denver Botanic Gardens and a rain garden located in the right-of-way of Lakewood. We also started monitoring two additional sites — a new rain garden at Broken Tee golf course and two different sections of permeable interlocking concrete pavement (PICP) at the Industry site in the River North neighborhood in Denver.

We also finished work at the Denver Green School where we were monitoring a rainwater harvesting system with real-time stormwater controls. Results from our work are posted on our website.

Special Projects

A Physical Model to Evaluate and Optimize Safety Grate Design

Prompted by a lack of national research on safety grate design, UDFCD has partnered with Colorado State University to use a physical model to evaluate various safety grate configurations. The goal of this study will be to optimize safety grate design. Past work in this area has consisted of quantitative analysis taking into consideration what engineers believe is a safe velocity through the grate in the event that a person becomes trapped up against the grate. This physical model will put rained rescue divers in the flume to evaluate on a more qualitative basis, what design velocity is most appropriate. The Larimer County Dive Rescue Team provided early testing using a safety mannequin.



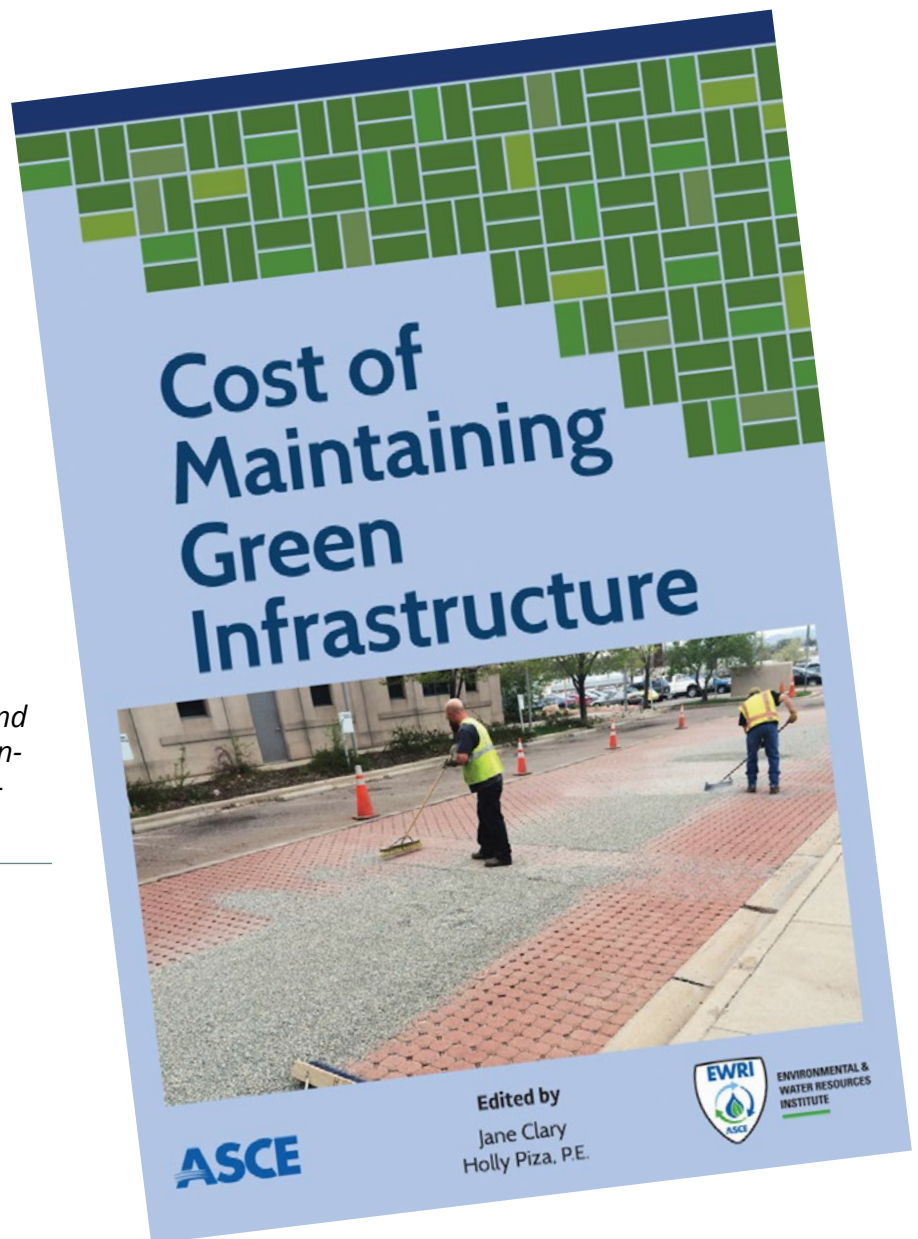
Members of the Larimer County Dive Rescue Team use a safety mannequin for initial testing at the CSU safety grate physical model.

Cost of Maintaining Green Infrastructure

Co-edited by Holly Piza (UDFCD) and Jane Clary (Wright Water Engineers), *Cost of Maintaining Green Infrastructure* was published by ASCE in November and featured at the 2017 Environmental & Water Resources Institute (EWRI) Operations and Maintenance Conference. The book reports findings from a survey and literature review to capture and quantify the expenses associated with operating and maintaining sustainable stormwater management technologies. Green infrastructure (GI) practices use processes found in the natural environment to manage stormwater with the end goal of reducing stormwater runoff volumes and corresponding pollutant loading from urban surfaces. Because GI installations require ongoing maintenance to remain effective, the authors set out to compile data to support whole-life cost estimates for a suite of small-scale, distributed GI technologies with particular emphasis on maintenance costs.

UDFCD provided complementary copies of this book to its local government representatives.

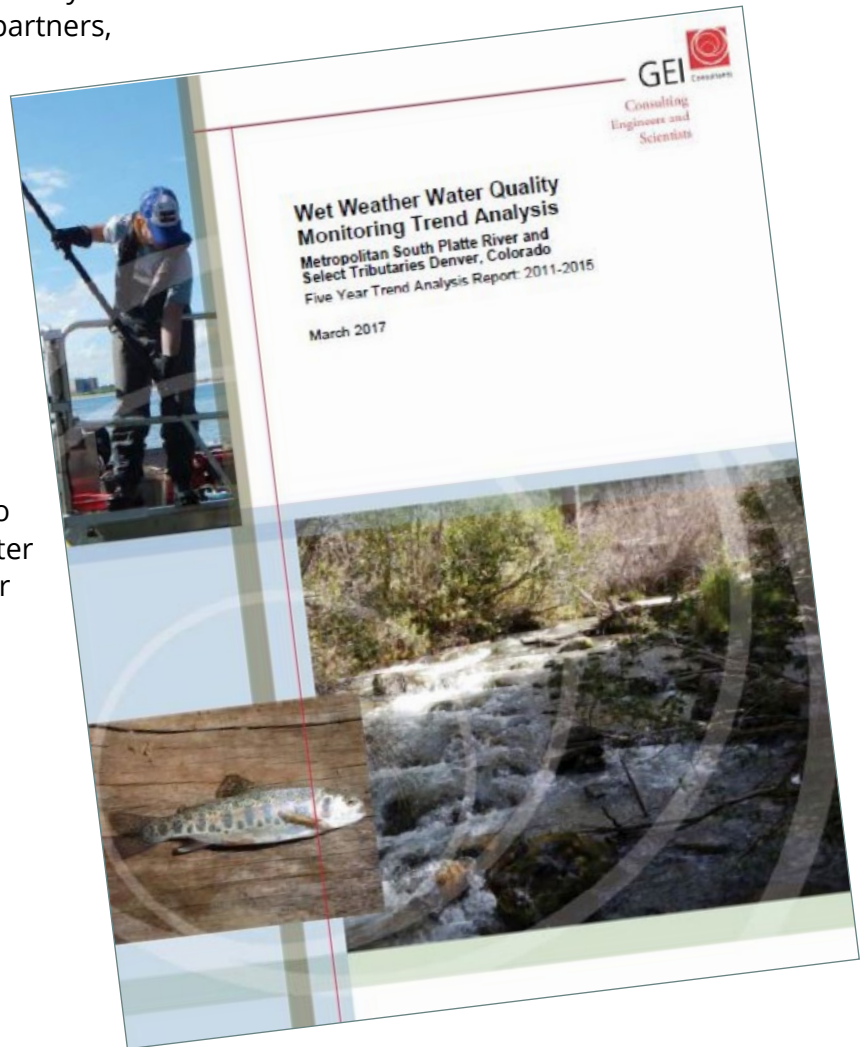
Cost of Maintaining Green Infrastructure explores G.I. programs structure, types and frequency of maintenance practices, maintenance program costs, data tracking approach, and budgeting.



Colorado MS4 Permit Assistance

As a Phase I MS4 permit requirement; Denver, Aurora and Lakewood must each monitor in-stream water quality during runoff-producing events. UDFCD has assisted these communities in complying with the requirement since 1998 by co-funding and managing their data collection, analysis and reporting activities. Together with our partners, UDFCD has collected 20 consecutive years of wet-weather in-stream data at five locations within UDFCD's boundary. On April 1, 2017 we delivered the third Wet Weather Water Quality Monitoring Trends Analysis report to the State.

UDFCD also continues to host and actively participate in the general assembly and legislative committee meetings for the Colorado Stormwater Council, an MS4 permittee-only group comprising 98% of all permit holders in Colorado. The District also hosts a quarterly MS4 meeting with the Water Quality Control Division of CDPHE and other interested parties.



UDFCD delivered the five-year trend analysis report to the State in April 2017. The report synthesizes almost two decades of water quality data from in-stream wet-weather monitoring.

New Web Maps

JULIA BAILEY, INFORMATION SERVICES SPECIALIST

The interactive mapping application known as the EDM was retired mid-2017. Since then, the [mapping page](#) on the UDFCD website has been expanded to include several new web maps. Rather than supporting a single web map that attempts to be an all-in-one application, now, you have access to multiple maps highlighting different subjects and information, and all maps are accessible via mobile devices.

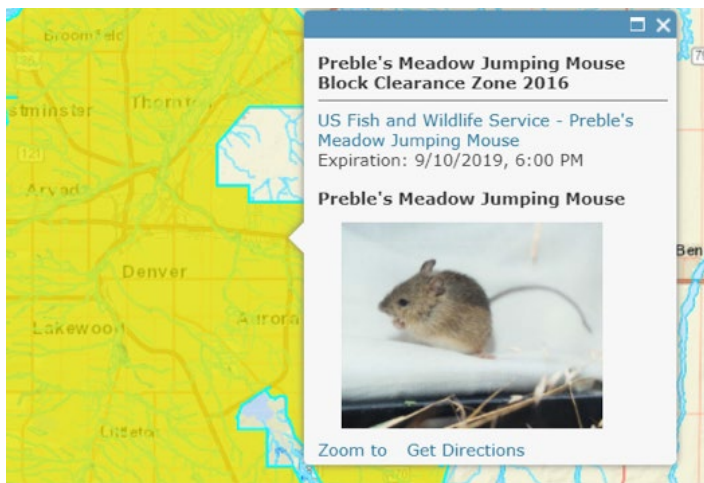
Document Search by Stream

The first map is meant for retrieval of documents such as master plans, flood hazard area delineation reports, as-built drawings, and design reports. Using the doc search widget, you are able to draw a box intersecting a stream and a list of related records is generated. Use the stream search widget if you need to locate the stream within the map.

Data Viewer Map

The purpose of the next map is data viewing and exploration. This map contains a variety of layers and provides a good overview of available data. You can turn layers on or off, adjust layer transparency, and many layers provide information in the form of a popup as shown below.

The data viewer map contains additional features such as the ability to add annotations within the map and create pdf exports. You can also use a measure tool to collect area, length, and positions in a variety of units.

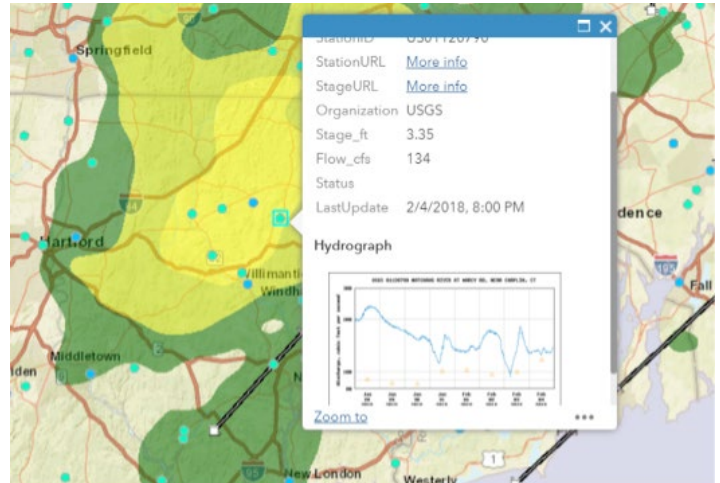


Popup information for endangered species block clearance.

Data available through the layer control widget
District Boundary
Dam safety (DWR)
Streams
Basins
Counties (DRCOG)
Municipalities (DRCOG)
100-yr Floodplains
Routine maintenance
Development review cases
Construction projects
Master planned proposed improvements
Endangered species block clearance zones

Real-Time Storm and Flood Data

Next up is the Real-Time Storm and Flood Data map. Here you can see active alerts from the National Weather Service, current radar, 1-hour storm tracks, and lightning strike data. You can also see rainfall and streamflow measurements in real-time by the District's ALERT System as well as from sources such as USGS and NWS shown below. The most interesting to explore this map is during a storm event.



Radar, 1-hr storm tracks, and streamflow information available through the Real-time Storm and Flood Data map.

2013 Flood Peak Estimates

Next, you'll find the 2013 Flood Peak Estimates map. Check out this map if you are interested in a look back at estimated peak flows and approximate flood extents from the major flood event in September 2013.



Peak flow estimates and approximate flood extents from the 2013 Flood Peak Estimates map.

Watershed Service Areas

The last map that you will find on the mapping page is a service area map. The purpose of this map is to show where District project managers are assigned geographically.

Feedback

We look forward to your feedback on the new maps. We would also be very interested to hear about additional maps that would be useful to you. Please send your comments and suggestions to jbailey@udfcd.org and look for more maps coming in 2018.

The Flood Control District's flood warning services area (FW/IS) is preparing to make a noticeable move into the public arena in 2018 using social media and other vehicles. One good way to keep track of our progress will be to follow us on [Twitter](#), [Facebook](#), [LinkedIn](#), [Instagram](#), and [YouTube](#). There is no breaking news on this activity yet, but keep watching. So much for the news teaser, now for the 2017 highlights...

New developments this past year include a staff change, hardened ALERT System communications, flood forecasting enhancements, and WebMap improvements. Webpages are also frequently updated and early notification processes keep evolving as Internet technologies are ever changing.

FW/IS must bid a virtual goodbye and best wishes to our project engineer, Julia Bailey, who is currently in her 8th year of District service. Fortunately, for us this farewell is only virtual because Julia's service is being broadened under UDFCD's newest program area, Operations & Development, led by Dave Bennetts. There she will continue to manage the [OnBase™](#) project, direct GIS activities, improve WebMap capabilities, and make E-documents easy to find. She also will carry on being a key resource to FW/IS by assisting with critical Internet and satellite data communications. Be sure to read Julia's Flood Hazard News article to discover her latest contributions. Congratulations Julia!

Derrick Schauer is entering his 11th year of full-time employment as the Flood Control District's network administrator. IT systems security and day-to-day operations are very high priorities for Derrick as well as website administration. Derrick will also be upgrading some critical server equipment in 2018 that will give us even better IT services well into the future.

2017 Flood Season Recap

With the number of flood threat days being somewhat above average, the flooding that did occur in 2017 failed to attract much attention. That is certainly good news for the region as recovery efforts continue from the devastating floods of 2013 and 2015.

This past year the ALERT System generated rainfall rate alarms on only 15 calendar days. This compares to 21 days the previous year and 31 two years prior. And 'no', we did not change the alarm thresholds.

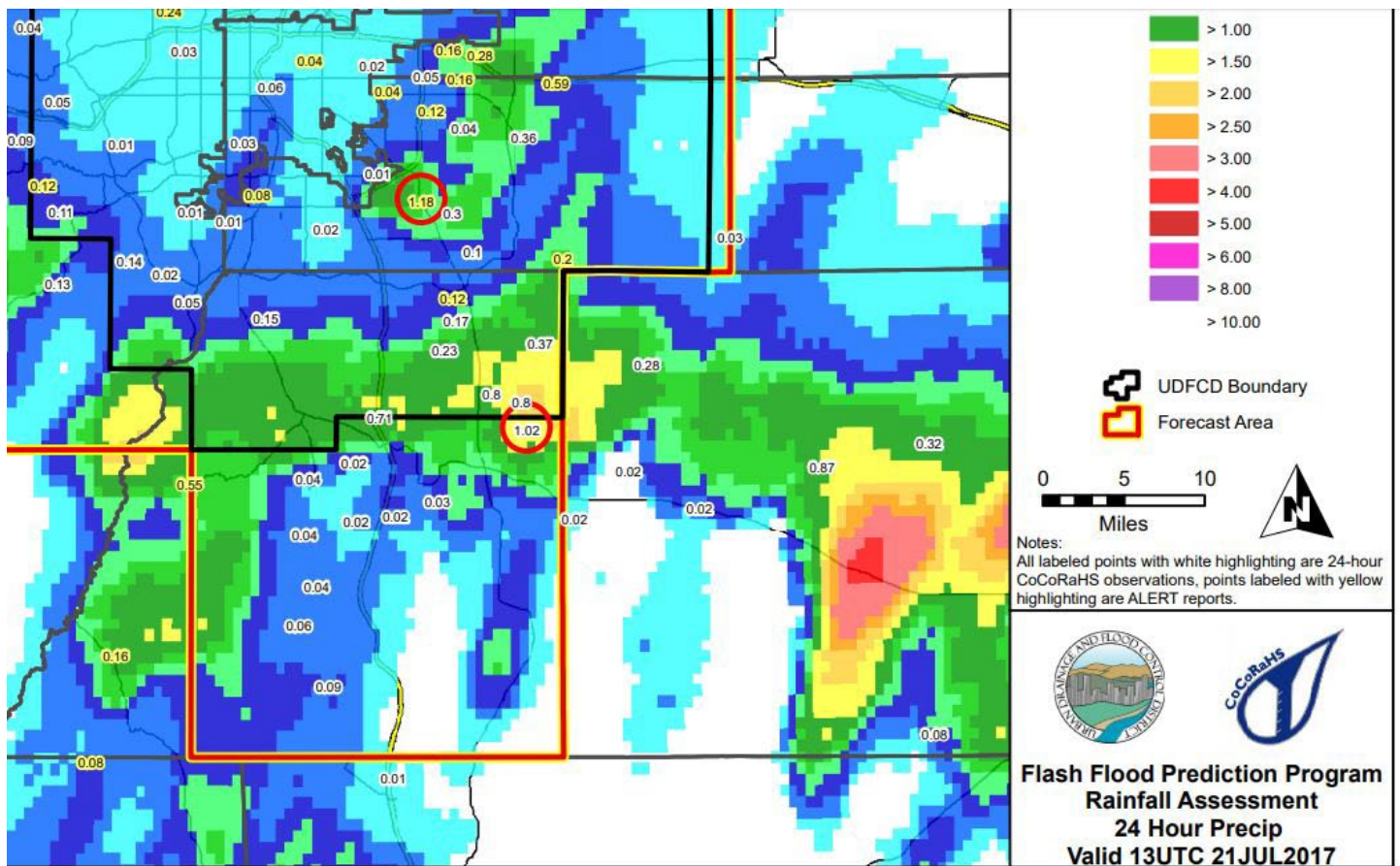
Intense rainfall exceeding 3 inch/hour rates occurred on May 8 & 17; June 7, July 8, 19, 20, 23, 26 & 28; and August 2, 3, 5, 12, 14 & 15. All of these measurements occurred within 10 minute time-periods and they all correspond to return periods of 5-years or greater according to [NOAA's precipitation frequency atlas](#). It may be surprising to note that this is not unusual activity for this region. In addition, these records support ongoing conversations that so called "rare events" are not rare as many news stories tend to suggest. Had a single rain gauge recorded all of these measurements, we would really have something remarkable to talk about.

Serious flooding normally requires more than just intense rainfall; the storm totals must also be high. For the Denver/Boulder metro area, this generally requires rain amounts to exceed at least an inch, and in most cases it takes over two inches before the flooding threat is elevated. In 2017, the 2-inch one-hour threshold was only exceeded one time at one ALERT gage on July 26 near Franktown in Douglas County. That same station recorded a storm total amount of 3.78" over a 7-hour period ending around 1AM on the 27th. Two other nearby

ALERT stations recorded between 2 and 3-inch storm totals. Only one other station measured over two inches of rain in a 6-hour period during the 2017 flood season. That station was also in Douglas County and the storm date was the following day, July 28. Douglas County definitely won the preferred storm track award for 2017.

Something else to keep in mind is the fact that large rainstorms in the region sometimes miss being measured by the relatively dense network

of rain gauges that exists. July 20 was one of these days when radar detected what appeared to be a very large intense storm in Elbert County southeast of the District. According to radar precipitation estimates, this storm may have produced upwards of 4 inches of rain. Similar examples can be found for other days by reviewing the UDFCD [storm summary maps](#) produced for every day with flood potential.

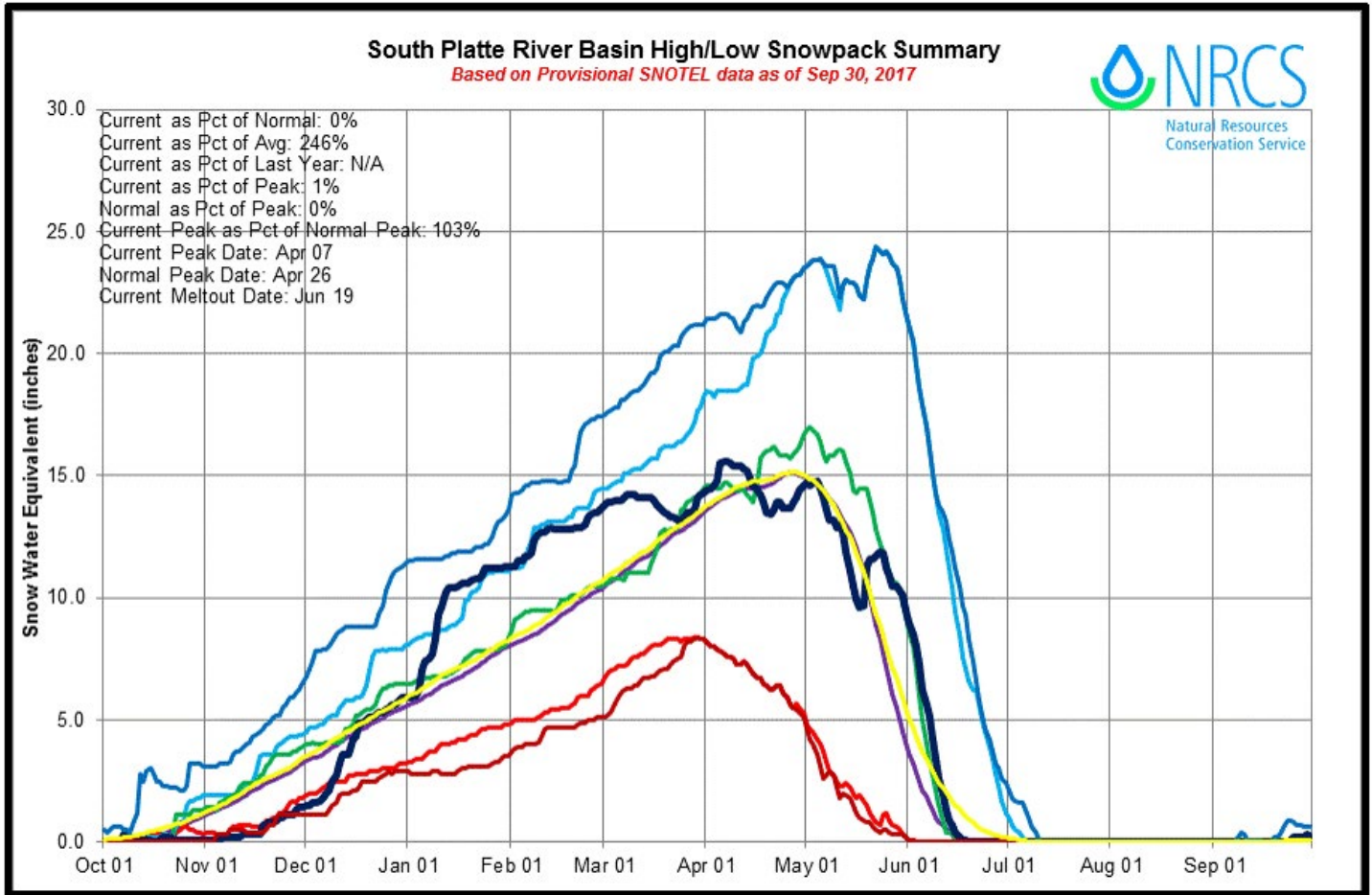


Rainfall measurements and radar precipitation estimates for July 20, 2017 storm

The following table pinpoints the specific alarm dates and shows the two days that NWS flash flood watches or warnings were issued in 2017

39 periods over 41 days with flood potential in 2017		
May	8, 9, 17-18, 26, 29	6
June	1, 2, 5, 6, 7, 11-12	7
July	8, 12, 13, 14, 15, 20, 21, 23, 25, 26, 27, 28, 29, 30	14
August	3, 5, 6, 7, 10, 12, 13, 14, 15, 16, 22, 30	12
Sept	11, 17	2

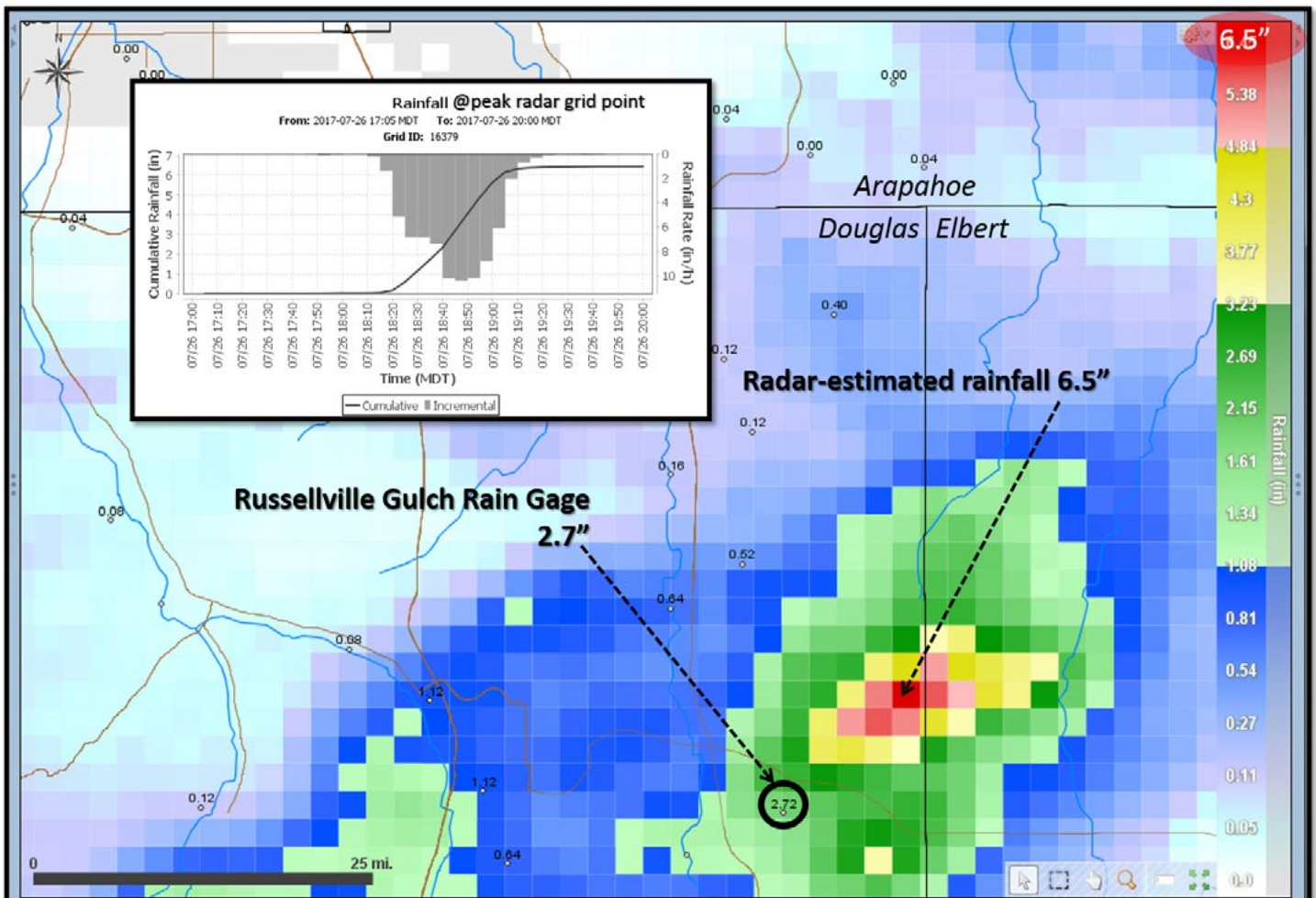
- **Red dates** are when automated rain gauges exceeded alarm thresholds.
- **Blue dates** indicate heavy rainfall only affected areas outside UDFCD's main area of concern such as the Hayman Burn Area in SW Douglas County and watersheds in northern Boulder County.
- **Green dates** are when a NWS flash flood watch was the highest threat level reached.
- **Orange** designates a flash flood warning.



The 2017 snowpack for the South Platte River basin (dark blue line above) tracked well above average (yellow line) from January to mid-March. Melting then brought the snowpack to near normal until a storm in mid-May caused a jump to above normal into June. Consequently, the water supply reports were good and the snowmelt runoff did not cause any serious flooding problems for our region, which was aided by a dry June.

Rainfall Surpasses 100-Year Threshold

In 2017, only one day (July 26) had recorded rainfall intensities that exceeded the 100-year threshold (1% AEP-annual exceedance probability) according to NOAA Atlas 14. The Russellville Gulch ALERT rain gage in Douglas County recorded a storm rainfall total of 3.78" between 5:30PM and 1AM. Rainfall maximums for 10 to 60-minute time periods had estimated return periods exceeding the 100-year threshold. The 30-minute maximum was between a 200 and 500-year event. It is interesting to note that according to a gage-adjusted radar estimate, the Russellville Gulch gage apparently did not measure the heaviest rainfall produced by this storm. Due to the relatively small footprint of the storm and its location, the impacts from the runoff attracted little attention.



Other Noteworthy Events of 2017

Before reminiscing about last year, let's revisit an earlier event that occurred on Cherry Creek through downtown Denver in 2015. That year's issue of Flood Hazard News reported a peak discharge of approximately 2,000 cfs. Subsequent reviews suggested that the actual Cherry Creek peak was considerably higher. The USGS agreed and in March of 2017, they updated their stage/discharge rating for the Cherry Creek at Denver stream gage and revised their official peak flow estimate to 3,350 cfs for the 6/24/15 event. This correction reminds us to continue questioning peak flow measurements when evidence warrants further scrutiny. In addition, we should always keep in mind that streamflow records remain provisional and subject to revision until declared official, and even then, know that the best estimates may still be flawed.



Cherry Creek flooding near Speer Blvd. and Stout St. on June 24, 2015

In 2017 the ALERT System recorded 18 days with rainfall amounts exceeding one-inch. The following events were the more prominent:



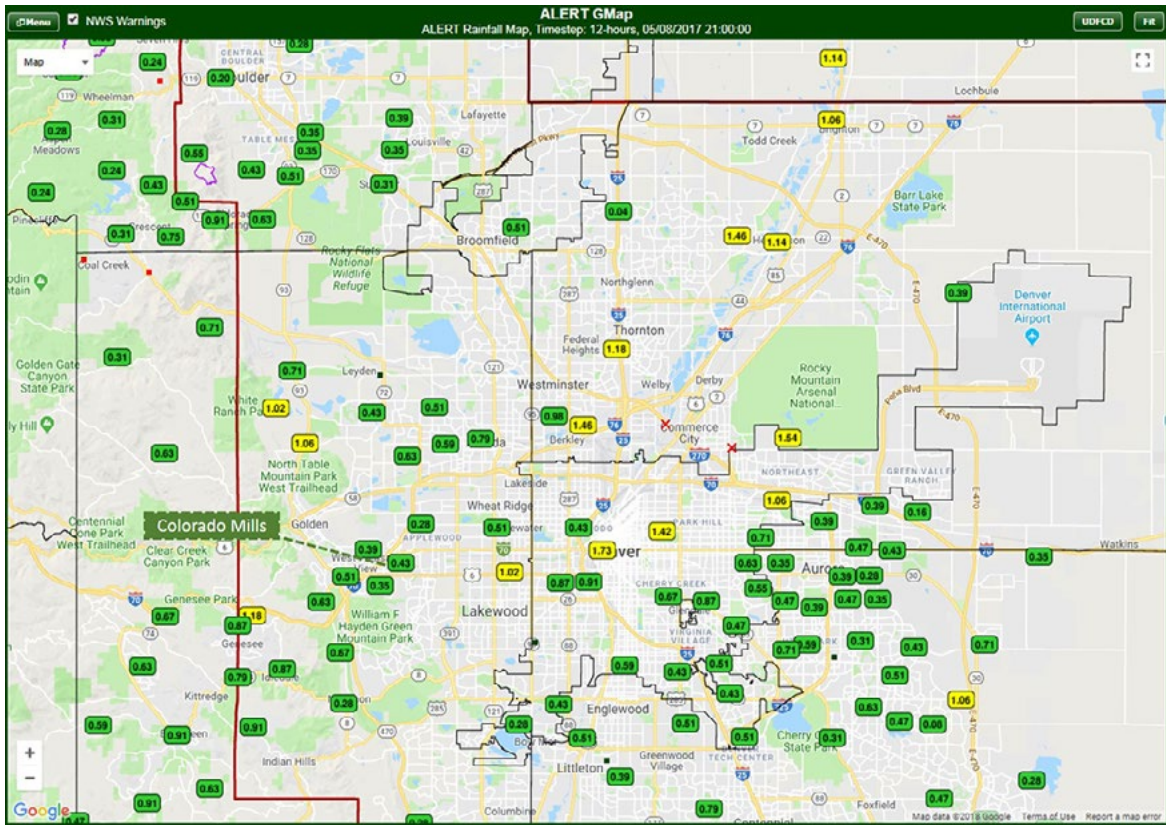
*Hailstone from Olde Town Arvada, May 8, 2017
Photo credit: Nick Stewart, resident*

Monday, May 8 will be long remembered by many people who live, work, shop and play in Jefferson County as the day that brought business to a screeching stop for six months at the upscale indoor Colorado Mills shopping mall. This late afternoon hailstorm is ranked among the nation's [16 billion-dollar](#) weather and climate disasters of 2017 and is [Colorado's most costly](#) to date.

This day was also the first flood threat day of the 2017 flood season with [Messages](#) being issued at 12:38 PM for all UDFCD counties calling for strong/severe thunderstorms capable of producing up to 1.1 inches of rain in 30-minutes or less. The forecast also noted the potential for large hail exceeding 1-inch in diameter, straight-line gusty winds, frequent lightning, and possibly an isolated tornado. Although UDFCD's meteorological services are tasked to focus on heavy rainfall, the forecasters are free to provide additional weather information while encouraging local officials to monitor the National Weather Service for severe weather statements and warnings.

A [forecast product](#) issued earlier in the day suggested a worst-case rain scenario could deliver up to 2.4" in 45-75 minutes. This day illustrates well how the Flood Control District's long-running Flash Flood Prediction Program is intended to work.

This day in Colorado history is also well known for the 1969 flood that resulted from a long duration rainstorm (May 4-8) and provided the final spark for the Colorado legislature to establish the Urban Drainage and Flood Control District.



The intense rainfall on May 8 occurred between 3:10 PM and 7:20 PM. Rainfall alarms occurred at ten stations in Denver, Adams, Arapahoe (Aurora) and Jefferson counties. The map shows a rainfall amount of 0.43" at Colorado Mills, which is in the Lena Gulch watershed in Lakewood. Given the hail at this location, this ALERT rain gage very likely under-reported what actually occurred. Tipping bucket gauges are not designed to measure frozen precipitation.

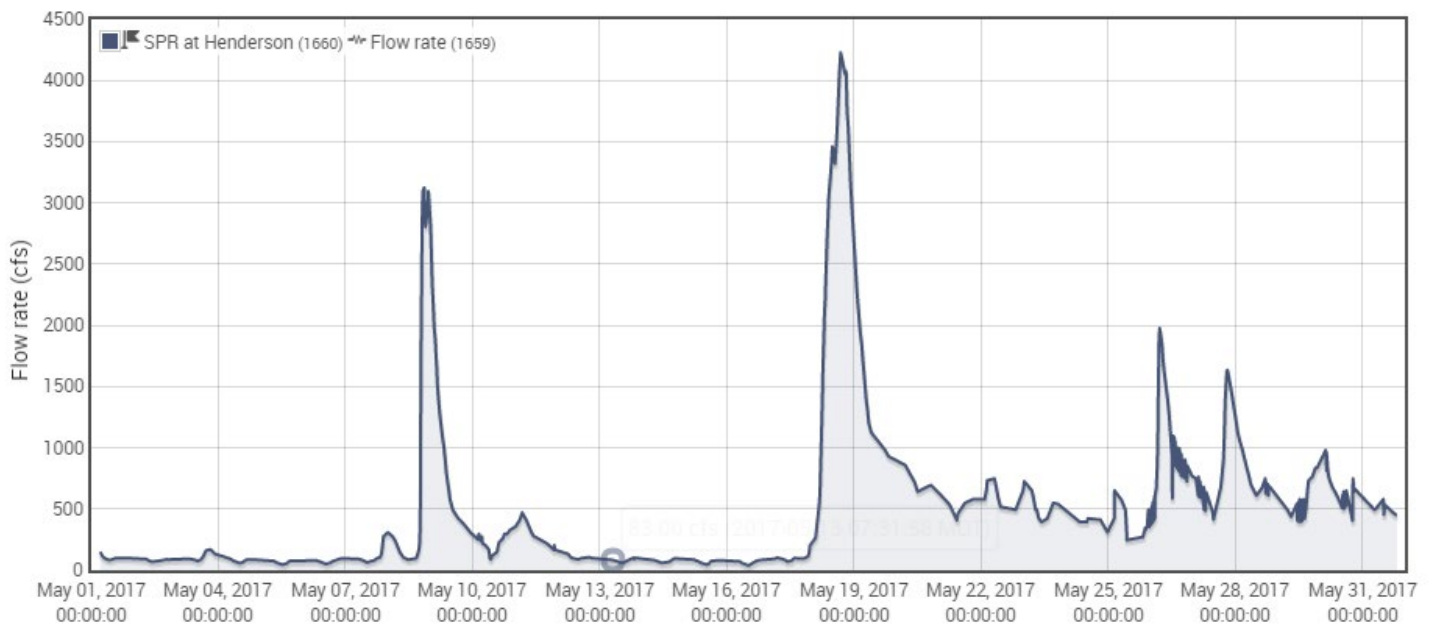
due to extreme rooftop damage from the hail, the water damage inside the Colorado Mills mall was significant. A few water level gauges did measure their [annual peaks](#) from this event in Golden, Arvada, Lakewood, Wheat Ridge, Denver, Aurora and Centennial. Cherry Creek trail flooding in downtown Denver may have been one of the more interesting high water areas in the metro area that day.

Regarding the stormwater runoff from the May 8 event, no serious stream flooding was reported but



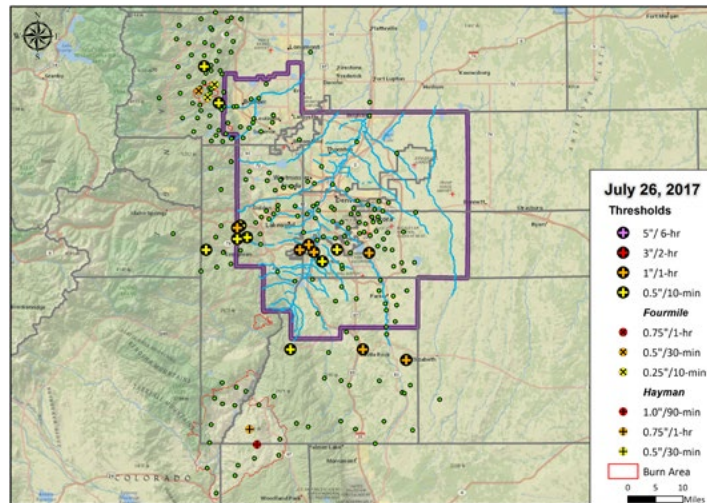
*Cherry Creek trail inundation near Champa Street in downtown Denver at 3:40PM on May 8, 2017
Photo credit: Jason Stawski, UDFCD*

The May 17-18 rain/snow storm produced the largest region-wide precipitation event of the year with liquid water accumulations exceeding 3-inches throughout much of southeast Boulder County. No intense rainfall was reported during this period. However, water level gauges recorded annual peaks from this winter-like storm at a number of stations in Adams County, Arvada, Lakewood, Broomfield, Thornton, Sheridan, Denver and Aurora.



June was unusually quiet with just a single valid rain alarm being recorded for the entire month. That day was Wednesday, June 7, and the location was the Murphy Creek Golf Course in Aurora where an isolated storm produced about an inch of rain with no notable stream flooding. Six flood threat periods were documented for June spanning seven calendar days. In the six days preceding June 7, a number of strong storms did produce heavy rainfall and some severe weather, but those events missed the ALERT rain gauges. For information about these events, see the [storm summary table](#) that contains short descriptions for all flood threat days. The annual streamflow peaks that occurred in June resulted primarily from mountain snowmelt runoff.

The last week in July is notorious for large flash floods and heavy downpours. This time of year is generally considered the peak of Colorado's Summer Monsoon. The most memorable event that week occurred during Colorado's centennial celebration in 1976, when the Big Thompson Canyon between Estes Park and Loveland received more than a foot of rain in a very short time period, sending a wall of water down the canyon claiming 143 precious lives.



ALERT System Rainfall Rate Alarms

The 2017 flood season added to this statistic with the one-week period from July 23 to July 30 having six of seven days having flood threat with Wednesday, July 26 being the only flash flood warning day of the year for the Flood Control District. Details about the most intense rainstorm activity are described above for an area in Douglas County near Franktown. Elsewhere, rainfall amounts exceeded 1-inch in less than 1-hour time periods at 7 ALERT stations, and 3 inch/hour rain rates were exceeded at 10 locations between 4:57 PM and 10:43 PM. Annual peaks for the following streams occurred on this day, however, no serious impacts were reported by the [evening news coverage](#), which focused on street flooding problems in the metro area. The next day coverage by the [Denver Post](#) provides a good synopsis of the flooding that did get noticed. It is fascinating to note that nobody appears to have been affected by the ~500-year rainstorm that occurred near Franktown.

- Plum Creek in Douglas County
- Slaughterhouse Gulch in Littleton
- Willow Creek and Little Dry Creek in Centennial
- Marston Lake North in Denver
- Cherry Creek in Parker
- Happy Canyon Creek in Douglas County
- Piney Creek in Aurora
- Goldsmith Gulch in Denver
- South Platte River in Denver
- Lena Gulch in Golden
- Van Bibber Creek in Arvada
- Ralston Creek in Arvada

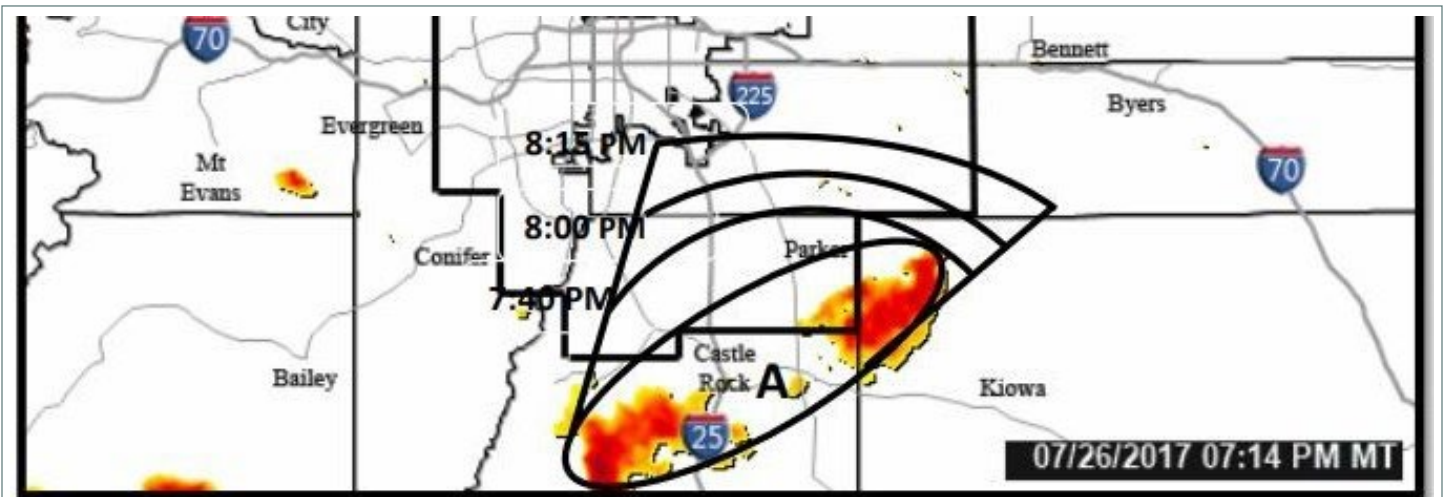
The remainder of the 2017 flood season (August & September) was relatively benign with only a few days presenting some concerns for low impact flooding. One storm on Tuesday, August 15 in the Castle Rock area may have dumped in excess of 2.5 inches in a short period according to radar, but that storm too was of little consequence to areas within the Flood Control District.

Meteorological Support

UDFCD's flash flood prediction and notification services, a.k.a. F2P2 – short for Flash Flood Prediction Program, operates from April 15 through September 30 in close partnership with NOAA's National Weather Service, focusing primarily on intense rainstorms that threaten the Flood Control District. This long-running program was conceived shortly after the July 31, 1976 Big Thompson Canyon flash flood. It has been serving UDFCD local governments since 1979.

Skyview Weather provided the meteorological support once again with daily outlooks, quantitative rainfall forecasts, storm track predictions, and location-specific flood threat notifications when warranted. Skyview President Tim Tonge has been with the program for the past 12 years. Skyview's project manager Brad Simmons is an 11-year F2P2 veteran. Other support staff consisted of 5-year veteran Alan Smith along with Justin Brooks and Nick Barlow, both returning for their second consecutive flood season.

An [annual report](#) and a complete [F2P2 product](#) archive is available.



Storm A: A cluster of storms located south of Parker has turned into a line of slow moving, nearly stationary storms and is moving to the E/NE at around 3-8mph. Heavy rainfall of 0.50-1.30" in 10-30 minutes will be possible under this cell, along with small hail.

Clip from Skyview Storm Track Prediction

CoCoRaHS Update

UDFCD has been a proud sponsor of the Community Collaborative Rain, Hail & Snow Network (CoCoRaHS) since 2001. This large network of over 20,000 volunteer observers covers all 50 states, Canada, Puerto Rico, the U.S. Virgin Islands and the Bahamas. Funding of CoCoRaHS relies on sponsorships and individual contributions. Consequently, this unique non-profit organization continues to seek new financial partners. Visit the [CoCoRaHS website](#) to donate or become a volunteer observer.

ALERT System News

The ALERT system operated by UDFCD covers an extensive regional area with over 230 gaging stations that monitor rainfall, water levels and weather conditions in real-time. Stations on Big Dry Creek and Brantner Gulch in Thornton came on line in 2017 as reported in last year's issue of Flood Hazard News. No other stations were added in 2017, but by the 2018 flood season, we anticipate that one new rain gage and a stream gage will be operating in the Coal Creek Canyon watershed located near the Boulder/Jefferson county line. A new rain gauge near Jamestown in Boulder County is also expected soon.

OneRain and Water & Earth Technologies (WET) again provided routine preventative maintenance and unscheduled repair services for 2017, enabling successfully data collection of over 14-million ALERT reports. The [Resources box](#) at end of this article contains links to annual reports and other pertinent documents.

A [MS-Excel™ workbook](#) summarizes annual water level/flow peaks and historic maximums for the period of record. The spreadsheet documents the date, time, gage height/stage and corresponding flow rate. Appropriate notes are also included as cell-specific comments where data is missing, questionable, or supplemented by other

10 Minute Peak Intensities						15 Minute Peak Intensities					30 Minute Peak Intensities						
Station	Date	Tips	Inches	in/hr	Frequency	Station	Date	Tips	Inches	in/hr	Frequency	Station	Date	Tips	Inches	in/hr	Frequency
2900	7/26/17 18:20:55	30	1.181	7.087	<200yr	2900	7/26/17 18:28:49	40	1.575	6.299	<200yr	2900	7/26/17 18:30:21	60	2.362	4.724	<500yr
2320	7/26/17 21:29:18	22	0.866	5.197	<50yr	2320	7/26/17 21:32:55	24	0.945	3.780	<50yr	1520	7/26/17 22:25:09	39	1.535	3.071	<100yr
2250	7/26/17 17:00:22	17	0.669	4.016	<25yr	1520	7/26/17 22:12:38	23	0.906	3.622	<50yr	1640	7/26/17 22:22:29	34	1.339	2.677	<50yr
1520	7/26/17 22:07:51	16	0.630	3.780	<10yr	2250	7/26/17 17:00:52	22	0.866	3.465	<25yr	2940	7/28/17 15:53:14	33	1.299	2.598	<25yr
1710	7/20/17 16:19:00	16	0.630	3.780	<10yr	2310	7/26/17 21:32:51	22	0.866	3.465	<25yr	1710	7/20/17 16:34:09	29	1.142	2.283	<25yr
2310	7/26/17 21:32:51	16	0.630	3.780	<25yr	1640	7/26/17 22:18:55	21	0.827	3.307	<25yr	2320	7/26/17 21:42:33	28	1.102	2.205	<25yr
2940	7/28/17 15:46:50	16	0.630	3.780	<25yr	2940	7/28/17 15:52:14	21	0.827	3.307	<25yr	5740	7/19/17 16:59:14	27	1.063	2.126	<25yr
5740	7/19/17 16:42:45	16	0.630	3.780	<10yr	1710	7/20/17 16:22:12	20	0.787	3.150	<10yr	1710	7/26/17 20:56:52	26	1.024	2.047	<10yr
1620	7/26/17 20:34:27	15	0.591	3.543	<10yr	5740	7/19/17 16:44:08	19	0.748	2.992	<10yr	2920	7/23/17 12:48:33	26	1.024	2.047	<10yr
1640	7/26/17 22:18:55	15	0.591	3.543	<25yr	2920	7/23/17 12:40:01	18	0.709	2.835	<25yr	2310	7/26/17 21:34:55	24	0.945	1.890	<10yr
2350	7/26/17 21:28:06	14	0.561	3.307	<10yr	1620	7/26/17 20:38:23	17	0.669	2.677	<10yr	2250	7/26/17 17:02:06	23	0.906	1.811	<10yr
600	7/8/17 15:44:08	13	0.512	3.071	<5yr	2240	7/26/17 21:27:51	17	0.669	2.677	<10yr	100410	7/30/17 17:03:33	23	0.906	1.811	<10yr
620	7/26/17 22:21:32	13	0.512	3.071	<10yr	2350	7/26/17 21:32:59	17	0.669	2.677	<10yr	1530	7/26/17 22:24:44	22	0.866	1.732	<10yr
2240	7/26/17 21:22:32	13	0.512	3.071	<10yr	3040	7/15/17 14:15:57	16	0.630	2.520	<10yr	2350	7/26/17 21:38:50	21	0.827	1.654	<10yr
2920	7/23/17 12:37:51	13	0.512	3.071	<5yr	5720	7/26/17 19:18:59	16	0.630	2.520	<5yr	2750	7/26/17 22:20:28	21	0.827	1.654	<5yr
5720	7/26/17 19:17:57	13	0.512	3.071	<5yr	100410	7/30/17 16:59:58	16	0.630	2.520	<5yr	5720	7/26/17 19:32:34	21	0.827	1.654	<5yr
2800	7/26/17 19:34:27	12	0.472	2.835	<5yr	600	7/8/17 15:48:13	15	0.591	2.362	<5yr	620	7/26/17 20:57:04	20	0.787	1.575	<5yr

Similarly, monthly rainfall data is analyzed and tabulated for various peak rainfall periods ranging from 5-minutes to 24-hours. Highlighted cells indicate that a pre-defined alarm threshold was exceeded for the respective time period. The table now includes a column that shows NOAA-14 frequencies for each measurement.

UDFCD supports two websites for accessing ALERT data. OneRain maintains the public website linked from UDFCD's [flood safety webpage](#). This page also contains links to the F2P2 and Twitter websites. The ['alert5'](#) website is a good starting point for our flood warning partner agencies.

Westminster Public Safety Center



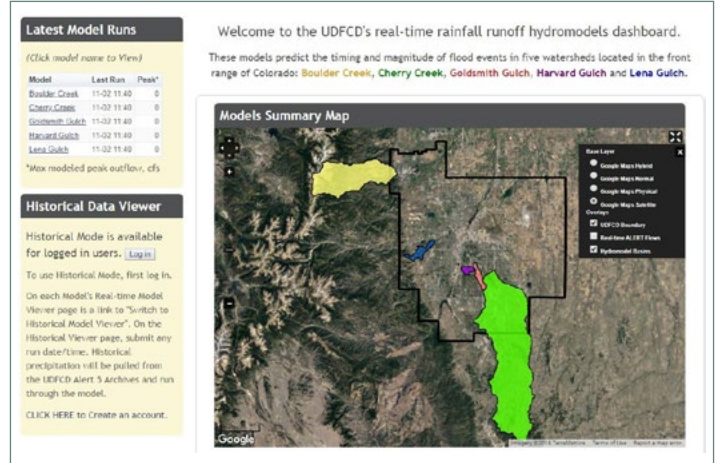
Last year the City of Westminster allowed UDFCD to install a new ALERT antenna and data receiver at their Public Safety Center. This building is home to the Westminster Police Department and Emergency Communications, and is adjacent to Westminster City Hall. The location is a strategic high point between Denver and Boulder that is capable of receiving radio transmissions from all ALERT data repeaters. After real-time data reports are received by this facility, they are sent via IP connections to multiple data collections platforms. Consequently, this unique site now serves as a critical backup data relay station for UDFCD's ALERT System operations.

The Flood Control District is grateful for its long-standing partnership with the City of Westminster and would like to extend a huge THANK YOU to the following Westminster staff: Emergency Management Coordinator Greg Moser, Emergency Communications and Technical Services Administrator Russ Bowers, Nelson Martinez with the Public Safety Communications Center, IT Network Engineer Jeff Butler, and Telecommunications Administrator Dan Hord. Thanks also to Glenn Hetchler and Scott Bores with OneRain; and Markus Ritch and his staff at WET for their roles in guiding this project to a successful completion.

ALERT antenna at the Westminster Public Safety Center

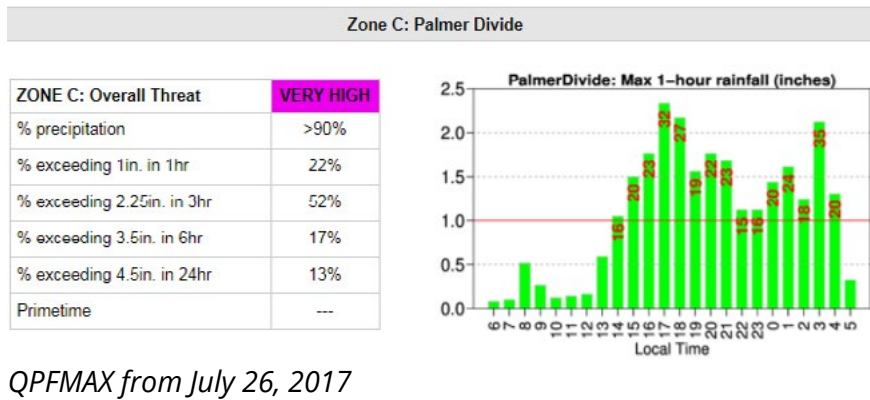
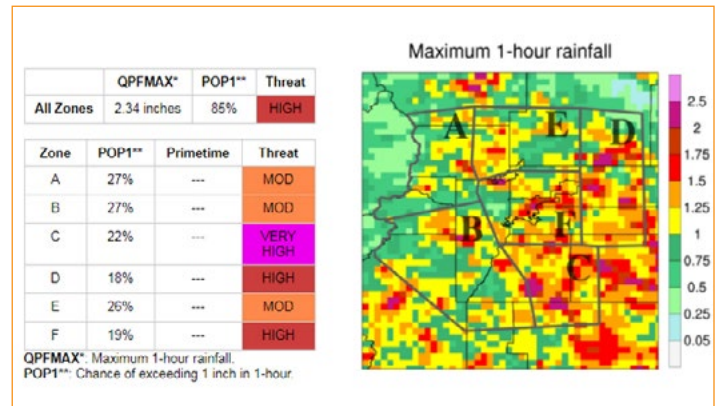
Real-Time Hydromodels

The 2017 flood season provided few opportunities to evaluate [RT-Hydromodels](#) performance, but improvements continue to be made nevertheless. Leonard Rice Engineers made viewing past events much easier. Future plans also include training for technical partners. Webinars and in-person trainings are being considered for 2018.



QPF-MAX Improvements

Dewberry continued to improve a new web-based precipitation forecast tool that was first introduced in 2015. UDFCD's [Heavy Rainfall Guidance Tool](#)—a.k.a. QPFMAX—uses an ensemble of high-resolution rainfall prediction models that is updated four times daily. An [operational report](#) is available that documents its 2017 performance and makes recommendations for future revisions. The forecast worked out exceptionally well for the July 26 event.



RESOURCES

Visit the [F2P2 website](#) for a complete archive of daily forecasts, flood threat notifications, storm track predictions, storm summary maps, and other products.

Download a workbook that contains the [annual peaks and record high water levels](#) measured by the ALERT System.

Read annual reports concerning [ALERT System maintenance](#) and [flood forecasting operations](#).

Master Planning

We completed two planning studies in 2017 and have 18 additional studies underway. We plan to initiate the following seven new planning studies in 2018:

- Brantner Gulch & Tributaries Major Drainageway Planning (MDP)
- Cherry Creek Tributaries (upstream of Cherry Creek Reservoir) MDP
- Cohens Drainage MDP

- City of Boulder Flood Mitigation Prioritization Study
- Irondale Gulch Tributaries (u/s of Rocky Mountain Arsenal) Outfall Systems Planning (OSP)
- Nevada Ditch Demobilization Plan
- Willow Creek Tributaries (u/s of Englewood Dam) MDP

To date, UDFCD has completed a total of 113 MDP studies and 96 OSP studies, which includes many updates to studies completed in the past.



STATUS OF PLANNING STUDIES				
Project	Project Manager	Sponsors	Consultant	Status
54th & Pecos OSP	Brooke Seymour	Adams Co	CH2M	70% Complete
Basin 4100 & DFA 0056 OSP	Brooke Seymour	Thornton, Northglenn, Adams Co	Olsson	25% Complete
Dry Gulch OSP	Shea Thomas	Lakewood, Denver	ICON	100% Complete
First Creek Tributaries (u/s of I70) MDP	Teresa Patterson	SEMSWA, Aurora	Merrick	0% Complete
Boulder 5-Creek Mitigation Plan	Brooke Seymour	Boulder	ICON	60% Complete
Goldsmith Gulch MDP	Morgan Lynch	Denver, Greenwood Village, SEMSWA	Matrix	0% Complete
Granby Creek & Sable Creek MDP	Morgan Lynch	Aurora	Calibre	0% Complete
Grange Hall Creek MDP	Brooke Seymour	Thornton, Northglenn, Adams Co	RESPEC	95% Complete
High Line Canal Master Plan	Shea Thomas	Cherry Hills Village, Douglas Co, Denver, SEMSWA, Aurora, Littleton, Greenwood Village, Denver Water	RESPEC	60% Complete
Little Dry Creek MDP	Brooke Seymour	Arvada, Westminster, Adams Co	Olsson	25% Complete
McKay Lake Watershed (u/s of McKay Lake) OSP	Brooke Seymour	Broomfield	Muller	5% Complete
Montclair Basin OSP	Shea Thomas	Denver	Enginuity	60% Complete
Quincy, Shop, Meadowood Creeks OSP	Morgan Lynch	Aurora	Michael Baker	100% Complete
Sand Creek (d/s of Colfax) MDP	Morgan Lynch	Aurora, Denver, Commerce City	ICON	15% Complete
Second Creek MDP	Teresa Patterson	Aurora, DIA, Adams Co, Commerce City, Brighton	RESPEC	35% Complete
SJCD (N) & DFA 6100 MDP	Brooke Seymour	Jefferson Co	Enginuity	30% Complete
Sloan's Lake Drainageway & Tributaries MDP	Shea Thomas	Denver, Edgewater, Lakewood, Wheat Ridge	Matrix	95% Complete
Third Creek MDP	Shea Thomas	Brighton, Commerce City, Adams Co, Aurora	Matrix	70% Complete
Weaver Creek MDP	Brooke Seymour	Jefferson Co, Lakewood	Olsson	95% Complete
Weir Gulch MDP	Shea Thomas	Denver	Michael Baker	75% Complete

Floodplain Mapping

One of the benefits of the reorganization and the reallocation of workload for the Watershed Services staff is an increase in breadth of expertise among project managers. Historically, we've had only one person responsible for reviewing all FHADs within the District and with the amount of projects underway we realized there was more work than staff availability to review the work in a timely manner. While we are still dealing with the backlog created prior to the reorganization, the new project managers have been trained and we now have four people handling the reviews of these large, technical efforts.

We completed two flood hazard area delineation studies in 2017 with 18 additional studies under way. We plan to initiate the following five new FHADs in 2018:

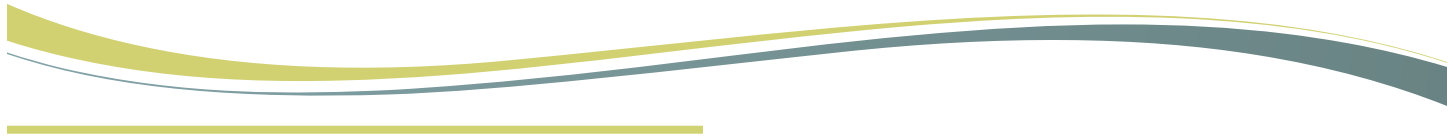
- Brantner Gulch & Tributaries FHAD
- Cherry Creek Tributaries (u/s of Cherry Creek Reservoir) FHAD
- Cohens Drainage FHAD
- DFA 0054 FHAD
- Willow Creek Tributaries (u/s of Englewood Dam) FHAD

To date, UDFCD has completed a total of 103 flood hazard area delineation studies, which includes many updates to studies completed in the past.



STATUS OF FLOOD MAPPING STUDIES

Project	Project Manager	Sponsors	Consultant	Status
Big Dry Creek (ArapCo) FHAD	Shea Thomas	SEMSWA, Greenwood Village, Englewood	RESPEC	90% Complete
Clear Creek FHAD	Brooke Seymour	Adams Co, Denver, Arvada, Wheat Ridge, Jefferson Co, Golden	ICON	70% Complete
Goldsmith Gulch FHAD	Morgan Lynch	Denver, Greenwood Village, SEMSWA	Matrix	0% Complete
Grange Hall Creek FHAD	Brooke Seymour	Thornton, Northglenn, Adams Co	RESPEC	95% Complete
Harvard Gulch FHAD	Terri Fead	Denver, Englewood	Matrix	100% Complete
Little Dry Creek FHAD	Brooke Seymour	Arvada, Westminster, Adams Co	Olsson	10% Complete
McIntyre Gulch & Tributaries FHAD	Brooke Seymour	Lakewood	Enginuity	30% Complete
Niver Creek FHAD	Brooke Seymour	Thornton, Federal Heights, Adams Co	CH2M	70% Complete
Plum Creek FHAD	Morgan Lynch	Douglas Co	Enginuity	75% Complete
Sand Creek (d/s of Colfax) FHAD	Morgan Lynch	Aurora, Denver, Commerce City	ICON	0% Complete
Second Creek (d/s of DIA) FHAD	Teresa Patterson	Aurora, DIA, Adams Co, Commerce City, Brighton	RESPEC	0% Complete
SJCD (N) & DFA 6100 FHAD	Brooke Seymour	Jefferson Co	Enginuity	0% Complete
Sloan's Lake Drainageway & Tributaries FHAD	Brooke Seymour	Denver, Edgewater, Lakewood, Wheat Ridge	Matrix	70% Complete
South Platte River FHAD	Brooke Seymour	12 communities	Olsson	30% Complete
Sulphur Gulch FHAD	Morgan Lynch	Parker	Merrick	60% Complete
Third Creek FHAD	Terri Fead	Brighton, Commerce City, Adams Co, Aurora	Matrix	80% Complete
Weaver Creek FHAD	Brooke Seymour	Jefferson Co, Lakewood	Olsson	60% Complete
Weir Gulch FHAD	Brooke Seymour	Denver	Michael Baker	50% Complete
FHAD	Terri Fead	Aurora, Denver	CH2M	100% Complete
Westerly Creek (d/s of Dam) FHAD	Morgan Lynch	Aurora, Denver	Matrix	10% Complete



Last year was a busy year for Physical Map Revisions. In 2017 Terri Fead managed the coordination with FEMA and all FHAD-impacted local governments for a record number of 33 creeks that were subsequently incorporated into the FEMA Flood Insurance Rate Maps (FIRMs). The 8-Floodplain Study modified 57 FIRM panels and includes approximately 84 miles of floodplain delineated along the following streams:

- Happy Canyon Creek
- Badger Gulch
- Green Acres Tributary
- Sand Creek (Colfax to Yale)
- Coal Creek (downstream of Yale)
- Murphy Creek (d/s of Alameda)
- Senac Creek (d/s of Aurora Reservoir)
- Toll Gate Creek
- East Toll Gate Creek (d/s of Hampden)
- West Toll Gate Creek
- Unnamed Creek
- Cherry Creek (d/s of Cherry Creek Dam)
- Littles Creek
- Marston Lake North Drainageway

The Dutch Creek, Coon Creek and Coal Creek study modified 12 FIRM panels and includes approximately 13 miles of floodplain delineated along the following streams:

- Dutch Creek (in Arapahoe County)
- Coon Creek (in Arapahoe County and Denver)
- Three Lakes Tributary (in Arapahoe County)
- Coal Creek (upstream of Yale Avenue in Arapahoe County)

The Southeast and East Denver Metro Area study modified 39 FIRM panels and includes approximately 60 miles of floodplain delineated along the following streams:

- Cottonwood Creek (upstream of Peoria)
- Havana Tributary
- Inverness Tributary
- Peoria Tributary
- East Toll Gate Creek (u/s of Hampden Avenue)
- First Creek (u/s of 38th Avenue and Picadilly)
- First Creek Tributary (u/s of Picadilly)

- Piney Creek
- Antelope Creek
- Second Creek (u/s of DIA)
- Willow Creek (u/s of Englewood Dam)

The Box Elder Coyote Run study modified 43 FIRM panels and includes approximately 56 miles of floodplain delineated along the following streams within the UDFCD boundary:

- Box Elder Creek (downstream of Jewell Avenue)
- Coyote Run

The Coal Creek and Rock Creek Study modified 19 FIRM panels and includes approximately 33 miles of floodplain delineated along the following streams within the UDFCD boundary:

- Coal Creek (downstream of Highway 128 to d/s of Bonnell Avenue)
- Rock Creek (d/s of Highway 128)

Terri Fead has also been managing the FEMA grant that, in part, permits UDFCD to review all LOMCs submitted to FEMA within UDFCD. In 2017, our renewed grant was the largest ever due to the increased number of cases. In order to handle the growing number of cases, we decided to put another firm under contract to help with technical reviews. ICON Engineering and Michael Baker now share in the review of all cases submitted in the FY17 grant cycle.

Maintenance Eligibility Program

A lot of effort was spent by Watershed Services staff working on changes to the Maintenance Eligibility Program and conveying the message of change to the development community. The MEP Guidelines were updated in August and will likely undergo another revision in 2018. The concept of Low Maintenance Streams was shared with local government staff, developers, consultant engineers, elected officials, and others in the industry in a variety of formats and venues throughout the year. Low Maintenance Stream

design consists of a geometric planform that takes into consideration the potential for natural geomorphic processes that occur over time and with changing hydrology, a cross-section that ensures a connected and frequently inundated floodplain, and a profile that allows management of energy to minimize the need for large structures and imported, expensive materials. For the last decade or so, we have encouraged floodplain preservation through our master plans and the MEP, but we have come to realize that preserving the mapped floodplain alone often does not provide the space needed to adequately maintain a stream that changes as conditions in the watershed change, nor does it ensure that restoration is provided at the time of development.

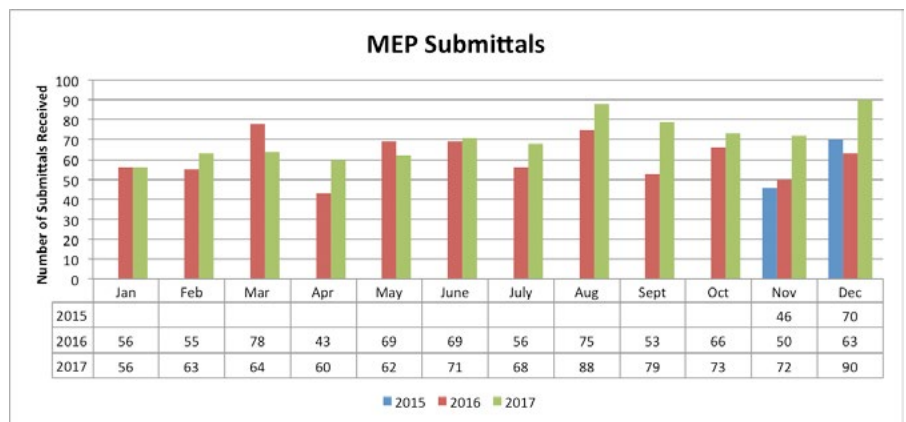
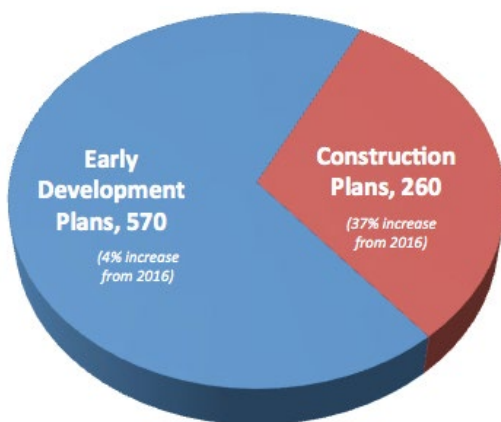
For larger development review projects that are adjacent to significant stretches of stream, Project Managers have been working with the development team to transition the mental model of stream design. Rather than armoring in place or staying out of the mapped floodplain and leaving the stream as is, the goal is to identify the needs of the stream at the time of development


in anticipation of the change in hydrology due to that development. In many cases, technical services from a geomorphologist or geomorphic engineer have been provided by UDFCD to help the development team assess the existing stream condition and create a concept plan for improvements.

The reorganization to Watershed Services provided an opportunity to increase the number of staff involved in reviewing MEP submittals. In addition to Teresa Patterson, Morgan Lynch and Brooke Seymour began reviewing development referrals sent from communities within their regions. Due to this change, there was a recognized reduction in response time for submittals in general, despite the fact that the number of submittals increased throughout the year.

This year saw a continued increase in number of referrals received, and that is after working with some of the communities to minimize the referrals sent to us that do not include MEP-eligible items. A record number of submittals were received in 2017, averaging 70 per month.

MEP Submittal Reviews Completed in 2017





Mike Sarmiento, the Senior Construction Manager responsible for MEP inspections, provided these tips entitled: Successfully Negotiating the MEP Construction Management Process. This message will continue to be conveyed to local government project managers to facilitate the inspection process and enable a smoother path to Final Acceptance:

1. Contact your UDFCD construction manager (CM) well in advance of beginning construction to schedule a preconstruction meeting. The CM will detail project components that require UDFCD observation and approval. Be sure to provide contact information (Company Name and Superintendent including email and cell phone). It is important to have the local government inspector attend this meeting to discuss expectations and the chain of contact for providing directions to the contractor.
2. The local government serves as the primary construction inspector. The UDFCD CM provides compliance observations to ensure that developer/contractor construct the stream improvements according to the approved plans and UDFCD specifications. The UDFCD CM is available to provide technical guidance regarding construction specifications, water control, materials acceptability, and acceptable construction techniques.
3. Material testings are at the discretion of the local government, however, the UDFCD CM may request testing in order to ensure that construction materials and methods meet UDFCD criteria.
4. The UDFCD CM does not perform stormwater management or USACE 404 compliance inspections; these are the responsibility of the local government.
5. Because the UDFCD CM has limited time availability, it is critically important that you provide advance notice for all critical components such as subgrade compaction, boulder/riprap placement, headwalls, wing walls, crest walls, and drop structure check structure trenches, perimeter cutoffs, toe-walls, etc. Adequate notice is at a minimum of two business days in advance.
6. Before the site is reseeded or erosion control blanket installed, we recommend that you conduct a preliminary construction acceptance walk-through of the project site with the local government and UDFCD to develop a punch list. You must notify UDFCD CM once the punch list items are resolved. Once that is complete, the site may be reseeded and final stabilization measures installed. The developer, local government, and UDFCD must conduct a formal onsite inspection of the completed stream improvements. Once that is complete, UDFCD will issue an acceptance letter to the local government.
7. Once the site has successfully revegetated with native grasses, the local government will contact UDFCD for a final acceptance inspection. The site review will be to evaluate overall revegetation success, site stability, and overall functionality of the design. If all are satisfactory, then UDFCD will issue a Final Acceptance letter to the local government.

Introducing New Staff and New Roles

The District's reorganization resulted in a several new positions. Some of these positions were filled by excellent new talent while others created well-deserved opportunities for existing staff to expand their skill set.

New Staff



Morgan Lynch joined the District on March 20, 2017 as a new Project Manager. She started her career as an intern here at UDFCD working under supervision of Jeff Fisher while attending CSU. She has 13 years of experience working as a consultant for

ICON Engineering and CH2M, along with a brief stint with a firm in Texas before moving back to Colorado. Morgan has been managing multiple master plans and flood hazard area delineations (FHADs) and has been fielding Maintenance Eligibility Program (MEP) review of developments east of the South Platte River and south of Sand Creek.

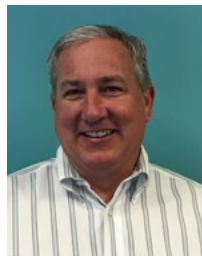


Brooke Seymour is another new Project Manager who started one week after Morgan on March 27, 2017. She came to us with 11 years of experience, primarily with McLaughlin Water Engineers (now part of Merrick & Company). Brooke is also a graduate from

CSU. She has been managing master plans and FHADs along with reviewing all MEP submittals west of the South Platte River.



Jim Watt joined the District on January 2, 2018 as a Project Manager. He has 13 years of experience with Muller Engineering Company, including design of several award-winning projects. Jim will be managing all services provided within the Boulder watersheds area.



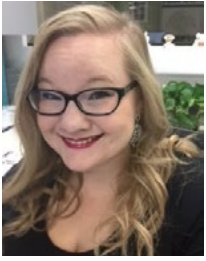
Scott Dirschl joined the District on January 8th, 2018 as Sr. Construction Manager in the Sand Creek watershed area. Scott worked for many years with Winslow Construction and most recently with Concrete Express, Inc. as a Superintendent. He has

worked on UDFCD projects for the District in his 24 years of experience including the Lafayette-Louisville Boundary Area Drainage Project and the Silverado Detention Basin.



Raymond Pribble is the District's most recent hire starting on January 29, 2018. Raymond has 25 years of experience in construction management working for firms such as McLaughlin Water Engineers, ASCG, and Matrix Design Group.

He has a BS in General Studies of Engineering Science from New Mexico Institute of Mining & Technology. Projects that Raymond has worked include Confluence Park kayak course, Town of Superior drainage improvements, and Fountain Creek Improvements.



Kelsey Mehan joined the District on November 06, 2018 as our new Receptionist. In the short amount of time she's been with the District, she's quickly become an invaluable asset to not only the administrative team but the entire office. Kelsey brings a great

energy and presence to the front office greeting and assisting visitors and callers. She's also taken on several board-meeting and office-wide responsibilities.

New Roles for Existing Staff

Teresa Patterson has been with the District almost four years and during that time has been the sole Project Manager responsible for the MEP. This year her responsibilities expanded to managing master plans and FHADs as well as continuing with development reviews in the portion of the District east of the South Platte River and north of Sand Creek.

Mike Sarmento has been with District over 30 years and has spent the last three years as the sole Senior Construction Manager for the MEP. Combined with this knowledge and experience of managing stream maintenance projects for years, Mike is able to work with developers' contractors to guide their in-stream work.

Terri Fead has 9 years under her belt as a full-time employee with the District. Her role changed this year when David Mallory retired in April. Terri's new title is Floodplain Manager, and she is responsible for managing our FEMA grant, overseeing the LOMC review process, driving the Physical Map Revisions with FEMA, and responding to a myriad of floodplain-related questions that come in on a daily basis.

Holly Piza has been at the District for nine years, and new role with Operations and Development will be as Standards Development Manager. She will oversee a number of engineering services related to the research and development of criteria and technical standards to advance stormwater quality practices in an effort to better support our local government partners.

Julia Baily has been with the District eight years, and her new role with Operations and Development will be as our Information Services Specialist. Her duties will involve developing and managing the District's GIS activities; our Enterprise Content Management software; and supporting our flood warning activities.

Jason Stawski is a Senior Construction Manager that has been with the District for about three years, and will continue in that role for the Operations and Development Program. His duties will include supporting the District's stormwater efforts including monitoring sites, data analysis, software, and outreach efforts. Two student interns also support the new program, and work closely with Holly and Jason.

2017 PROFESSIONAL ACTIVITIES OF UDFCD STAFF

Ken MacKenzie, Executive Director

- Board Member, National Association of Flood and Stormwater Management Agencies (NAFSMA)
- Board Member, Urban Watersheds Research Institute (UWRI)

Julia Bailey, Information Services Specialist, Operations and Development

- Presented Death of the EDM, Urban Drainage and Flood Control District (UDFCD) Annual Conference, Broomfield, CO
- Presented Psychological Safety, American Public Works Association (APWA) Public Works Institute

David Bennetts, Manager, Operations and Development

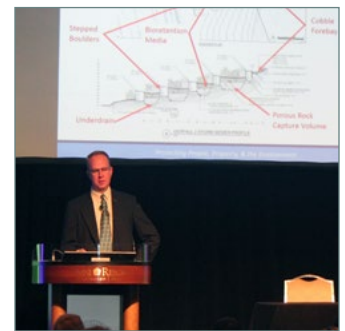
- Presented Organizational Excellence, Rocky Mountain Public Works Institute
- Board Member, CU Denver Construction Engineering and Engineering Management Advisory Board
- Board Member, APWA – Colorado Chapter
- Council Member, CU Denver Engineering Leadership Council

Rich Borchardt, Project Manager, Stream Services

- Presented Cherry Creek at Eco Park, Colorado Association of Stormwater and Floodplain Management (CASFM) Water Quality Field Trip
- Presented Partnership Builds Better Stream and Creates Value for Communities, Southeast Metro Stormwater Authority (SEMSWA) Bike Tour
- Member, Technical Advisory Committee, Cherry Creek Basin Water Quality Authority

Barbara Chongtoua, Project Manager, Stream Services

- Presented Partnering with Land Development, Urban Land Institute, Denver, CO
- Presented Resilient Stormwater Systems, American Planning Association Emerging Planning Professionals Event, Denver, CO
- Presented Stream Academy, UDFCD Annual Conference, Broomfield, CO
- Presented Watershed Approach for Stormwater, UDFCD Annual Conference, Broomfield, CO
- Chair, American Society of Civil Engineers Environmental and Water Resources Institute (ASCE EWRI) Watershed Approach for Stormwater Committee
- Vice-Chair, ASCE EWRI Sustainable Stormwater Infrastructure Committee
- Member, ASCE EWRI River Restoration Committee
- Member, ASCE EWRI Water, Wastewater, and Stormwater Council
- Reviewed and moderated sessions, 2017 ASCE EWRI Congress, Sacramento, CA
- Facilitated, 2017 ASCE EWRI Leadership and Council Meetings, Seattle, WA
- Facilitated, 2017 ASCE EWRI Leadership and Council Meetings, Memphis, TN
- Facilitated, 2017-2018 CASFM and Colorado Riparian Association (CRA) UDFCD Stream Academy, Denver, CO



Terri L. Fead, P.E., CFM, Floodplain Manager, Watershed Services

- Presented Map Changes: A Local Perspective, Federal Emergency Management Agency (FEMA) Region VIII Mapping Changes and Outreach Workshop

Bryan Kohlenberg, Project Manager, Stream Services

- Presented Alternative Construction Methods for Bank Stabilization – Sand Bags!!, UDFCD Annual Conference, Broomfield, CO
- Scoring Coordinator, MATHCOUNTS Competitions – Colorado Chapter and State

Laura A. Kroeger, Manager, Stream Services

- Published “Surfing in Colorado...Really” article, APWA Reporter, April 2017
- Presented Creating a Learning Community, UDFCD Annual Conference, Broomfield, CO
- Presented Performance Measures to Drive Change, Colorado APWA Annual Conference, Arvada, CO
- Presented Creating Effective Teams, Leading Change and Learning Organizations, Rocky Mountain Public Works Institute
- Presented Our Water Our Future, Urban Land Institute, Denver, CO
- Panel Member, Urban Land Institute, Denver, CO
- Chair, Rocky Mountain APWA Public Works Institute
- At-Large Representative, Metro Roundtable
- Board Member, APWA – Colorado Chapter
- Member, APWA National Leadership and Management Committee
- Member, APWA National Public Work Institute Evaluation Committee
- Member, APWA National Credentialing Focus Group
- Alternate Chapter Delegate, APWA



Morgan Lynch, Project Manager, Watershed Services

- Presented Cherry Creek Tributaries Major Drainageway Plan 2018: Data consideration for the master planning update and role of Cherry Creek Basin Stakeholders in the process, Cherry Creek Annual Conference
- Co-Chair, UDFCD/CASFM/CRA Stream Academy
- Vice Chair, CASFM
- Committee member, CASFM Scholarship Committee

Steve Materkowski, EI, CPESC, Senior Construction Manager, Stream Services

- Presented Public Works Role in Emergency Management, APWA Public Works Institute
- Presented Homeless Impacts on the South Platte River, South Platte Coalition for Urban River Evaluation (SPCURE) Conference
- District Representative, SPCURE
- CO APWA Representative, State All Hazards Advisory Committee
- Committee member, APWA 2017 Public Works Expo
- Member, APWA National Emergency Management Committee
- Liaison, APWA Colorado Emergency Management Association Annual Conference

Teresa L. Patterson, Project Manager, Watershed Services

- Presented The Intent of a Master Plan, UDFCD Annual Conference, Broomfield, CO
- Member, CASFM Community Rating System Committee
- Member, CASFM Colorado Flood Technical Assistance Partnership Committee



Holly Piza, Standards Development Manager, Operations and Development

- Co-Editor, Cost of Maintaining Green Infrastructure publication, ASCE
- Keynote speaker, Sustainable Stormwater Symposium, ASCE – Environmental Water Resources Group (EWRG) – Oregon Section
- Presented Quantifying Volume Reduction for a New Permit, UDFCD Annual Conference, Broomfield, CO
- Co-presented Cost of Maintaining Green Infrastructure, EWRI Operations and Management Conference
- Co-Instructed BMP Maintenance and Inspection, CSU Stormwater Center
- Chair, ASCE EWRI committee, Sustaining Long-term Commitments to Municipal Stormwater System Infrastructure
- Member (Scientific Advisory Board), Colorado School of Mines I-DST Tool, A Life-Cycle Cost Assessment and Optimization of Green, Gray, and Hybrid Stormwater Infrastructure
- Member, Conference Committee, EWRI Operations and Management Conference

Mike Sarmento, Senior Construction Manager, Watershed Services

- Presented Adventures in Construction Management, 2017 UDFCD Annual Conference, Broomfield, CO
- Presented Adventures in Construction Management, CASFM Lunch and Learn Series
- Presented Adventures in Construction Management, International Erosion Control Association (IECA) – Rocky Mountain Chapter

Dave Skuodas, Project Manager, Stream Services

- Presented The Remarkable Impact of Being an Effective Client, City of Colorado Springs Lunch and Learn
- Presented The Remarkable Impact of Being an Effective Client, Adams County Lunch and Learn
- Presented The Remarkable Impact of Being an Effective Client, City and County of Broomfield Lunch and Learn
- Presented Connecting the Mapped Risk to the Actual Risk to What's at Risk, Association of State Floodplain Managers (ASFPM) National Conference
- Presented Connecting the Mapped Risk to the Actual Risk to What's at Risk, EWRI Operations and Maintenance of Stormwater Control Measures Conference
- Presented A Systems Thinking Approach to Protecting People, Property, and the Environment, UDFCD Annual Seminar, Broomfield, CO
- Instructor, Presentation Skills, Project Management, Consultant Management, Contractor Management, and Systems Thinking, APWA Public Works Institute
- Instructor, Denver Metro Water Festival
- Guest Lecturer, CU Denver Construction Management Graduate Class
- Guest Lecturer, Colorado School of Mines Civil Infrastructure Engineering Class
- Moderated, Education and Communication, South Platte River Forum
- Committee Member, South Platte River Forum

Jason Stawski, Senior Construction Manager, Stream Services

- Chair, Special Interests and Hot Topics Subcommittee, APWA Emergency Management Committee
- Joined, CASFM Scholarship Committee

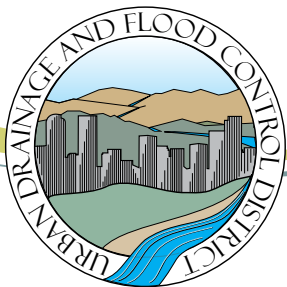
Kevin Stewart, Manager, Flood Warning & Information

- Technical Advisor, No Adverse Impact How-To Guide for Emergency Management publication, ASFPM
- Presented Innovative Uses of UDFCD's Flood Warning Services, UDFCD Annual Conference, Broomfield, CO
- Presented Climate Change Impacts, Colorado Water Congress
- Presented Understanding Extremes and Climate Change Impacts on Hydrologic Forecast and Warning, National Hydrologic Warning Council (NHWC) Biennial Conference and Exposition, Squaw Creek, CA
- Guest Instructor, Weather and Climate, Metropolitan State University of Denver, Meteorology Program
- Panelist, NHWC Biennial Conference and Exposition, Squaw Creek, CA
- Panelist, Colorado Water Congress
- Board Member, NHWC



Shea Thomas, Manager, Watershed Services

- Presented What to Expect from Watershed Services, UDFCD Annual Conference, Broomfield, CO
- Presented UDFCD Maintenance Eligibility Program, EPA Region 8 Wetlands Conference, Boulder, CO
- Presented Using Performance Measures to Guide Change, APWA Colorado Conference, Arvada, CO
- Presented Opening Remarks, CASFM Conference, Breckenridge, CO
- Moderated Conference Proceedings, CASFM Conference, Breckenridge, CO
- Chair, CASFM
- Co-Chair, Floodplain Management Committee, NAFSMA



Urban Drainage and Flood Control District

2480 West 26th Ave., Suite 156-B

Denver, CO 80211

303-455-6277

www.udfcd.org