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South Platte River and Lower Lakewood Gulch Improvement Project

By

Bryan W. Kohlenberg, Senior Project Engineer

Introduction

In the late afternoon of June 16, 1965, more than 14 inches of rain fell near Larkspur, Colorado, on a tributary to the South Platte River upstream of present day Chatfield Reservoir. Later that night, flood waters deposited mud and debris that devastated roughly ten square miles of houses, mobile home parks, shopping centers, factories and hotels. Total damage was estimated at well over \$500 million in the basin. Some accounts reported up to twenty-eight people lost their lives during the flood. In Denver, flood waters overtopped river banks, split away from the channel and flowed through much of the Central Platte Valley and caused approximately \$350 million damage (1965 dollars).

Since that emergency, the Army Corps of Engineers (Corps) built Chatfield Dam in 1973 to help reduce the risk of flooding in the Denver Metro area. Unfortunately, due to the many tributaries that join the South Platte downstream of Chatfield, the newly determined 100-year discharge still exceeded the river channel capacity at several locations in the City & County of Denver (Denver). As a result, Denver and the Urban Drainage & Flood Control District (UDFCD), formed in 1969 as a direct result of the 1965 flood, have proactively worked together to reduce the threat of flooding along the South Platte River in Denver since the early 1980's.

Only forty seven years after the '65 flood (short in geologic time), the third and final phase of a much larger Upper Central Platte Valley channel improvement project from Speer Boulevard upstream to 8th Avenue, initially envisioned in the 1985 *South Platte River Major Drainageway Plan*, is now complete. This phase, cleverly titled "South Platte River and Lower Lakewood Gulch Improvement Project" is located just south of Colfax Avenue, upstream to 8th Avenue. The major goal of this project was to reduce the extensive overbank 100-year floodplain just east of the river. This large floodplain was a result of lack of channel capacity caused by limited right-of-way, shallow depth utility crossings, and a large inflatable dam used to divert cooling water to Xcel Energy's Zuni Power Plant.



The confluence of the South Platte River and Lakewood Gulch.

Lakewood Gulch flows into the South Platte just upstream of Colfax Avenue. The lower gulch reach below Decatur Street was severely undersized for the 100-year flood; with several Denver owned buildings located within the 100-year floodplain. During the design of the South Platte improvements it became apparent that the new RTD FasTracks West Corridor light rail line, following the Lakewood Gulch corridor, would need to cross the South Platte just upstream of Lakewood Gulch. Since RTD required that their tracks be located outside or above 100-year floodplains, both the gulch and South Platte improvements were expedited to meet the light rail completion schedule.

Both the gulch and South Platte reaches shared common goals, constructability issues, staging areas, light rail crossings, funding partners, construction schedules, etc., therefore, it was decided to combine both projects into one construction package. Having a single general contractor made sense due to the amount of coordination and construction phasing needed to construct both reaches simultaneously.

Design and Construction

The original South Platte portion of the project was initially to be designed and built under a cost share agreement with the Corps. Preliminary engineering was almost complete when additional Corps' funding authorizations were never appropriated by Congress. Due to the local importance of the project and the tight west corridor light rail schedule, the UDFCD and Denver committed to see the project through without federal financial support. The UDFCD and Denver contributed each year to a special project funding account to ultimately cover the entire design, right-of-way, and construction costs. In 2006, the consulting firm Matrix Design Group, Inc. was hired to design the South Platte River improvements and soon thereafter selected again to design the Lower Lakewood Gulch improvements.

The design of channel improvements to the South Platte

reach, over 3,800 linear feet, included channel widening and lowering, recreation-compatible drop structures, natural-looking sculpted concrete jetties, surface water diversion, utility protection and relocation, retaining walls, regional trail improvements, re-vegetation and wildlife habitat enhancement. Most notable was the removal of Xcel Energy's old inflatable diversion dam, the last major obstruction to boatability on the river in Denver.

The original inflatable dam was built to divert and pass cooling water through the Zuni Power Plant and immediately back into the river. In its inflated position it was a major obstacle to flow, causing much of the overbank flooding downstream and mass sediment loading when deflated for maintenance flushing. In cooperation with Xcel Energy, the plant's cooling towers were retrofit by Xcel with a closed-loop circulation system that required more cooling but much smaller river water demand. This allowed the inflatable dam to be removed and replaced with a new grouted sloping boulder drop structure with boat chute and small water intake structure.

The design of channel improvements to the Lower Lakewood Gulch portion, over 1,600 linear feet, included realignment and restoration of a narrow, walled channel section that could only convey approximately the 10-year storm event. To facilitate these improvements, Denver's 70,000 square foot fleet maintenance facility building was demolished to make room. The channel was greatly widened and vegetated to create a more natural floodplain corridor. Improvements included a meandering low flow channel, utility protection, extensive wetlands and upland vegetation, and a new concrete multi-use trail system with two pedestrian bridges to provide the community access to the revitalized waterway. All these improvements vastly improved public safety and recreational opportunities.

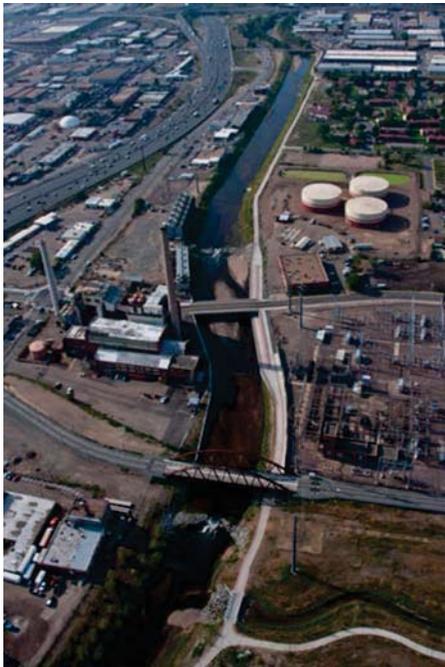
Other notable improvements to Lower Lakewood Gulch included removing the small Decatur Street culvert and



Old Inflatable Diversion Dam at Zuni Power Plant



New Diversion Dam with boat chute



Completed South Platte River Reach



Completed Lower Lakewood Gulch Reach

replacing it with a new bridge approximately 10 times wider. A new drop structure upstream of Decatur was designed as a series of wetland planted aesthetic ponds for visual interest and to improve water quality (more on this structure below). Ultimately, Lower Lakewood Gulch, once a narrow walled corridor, was completely reconstructed into a broad natural open space corridor using native plant and tree species to provide urban wildlife habitat and visual interest to park visitors and light rail users.

Early construction of a portion of the South Platte reach was begun in 2007 by Edge Contracting Inc. This work included the lowering of a large concrete electrical distribution duct and the protection of a shallow depth power transmission line crossing the river just downstream of Colfax and upstream of the proposed light rail bridge. This work was completed early to facilitate the early construction of the light rail bridge. Lawrence Construction Company (LCC) was awarded the combined overall construction project on November 2, 2009. Total project cost for design and construction was approximately \$20 million.

Innovation

This project utilized innovative approaches to work in an active river channel. Approximately 3000 feet of sheet pile were installed in the river to temporarily control surface and ground

water. Installing this much sheet pile was a massive undertaking by LCC but it allowed them to meet water quality regulatory requirements and phase construction activities in the river. This sheet pile remained in place for over a year and allowed LCC to switch the river flow from one side to the other as work progressed.

Another innovative approach by LCC was to modify the retaining wall design to allow work to proceed during the flood season and minimize the work effort. The change in construction involved a “top-down” approach which utilized drilled caissons. Ultimately pre-cast concrete panels were attached to the caissons to form the finished wall. This eliminated the need for a large traditional spread footing and allowed for construction to occur on

both sides of the river at the same time. This approach saved money, time and reduced the risk of high water damage during construction.

At the request of the Corps for the Section 404 permit approval, the Gulch channel needed to allow for fish passage. Typical grade control drop structures create waterfalls that become barriers for aquatic life to migrate upstream. Matrix Design Group designed the Lakewood Gulch drop structure to

be fish passable using a set of 6-inch drops and pools. The plan went through a few iterations and ended with a unique concept of interlocking sculpted concrete rings. The pools were then planted with wetland species for a softer appearance.

Conclusion

Construction of the \$20 million South Platte River and Lower Lakewood Gulch Improvement Project through Denver’s Upper Central Platte Valley was completed in April 2012. The 3½-year construction project involved extensive earthwork and environmental restoration for the purpose of flood control, recreation, habitat creation, and general enhancement of the river corridor for the community. This was a massive local effort that removed obstructions on the river and reconstructed the entire river channel to safely contain a 100-year flood event and create a more natural, vibrant, recreational



Sheet pile water control within the South Platte River

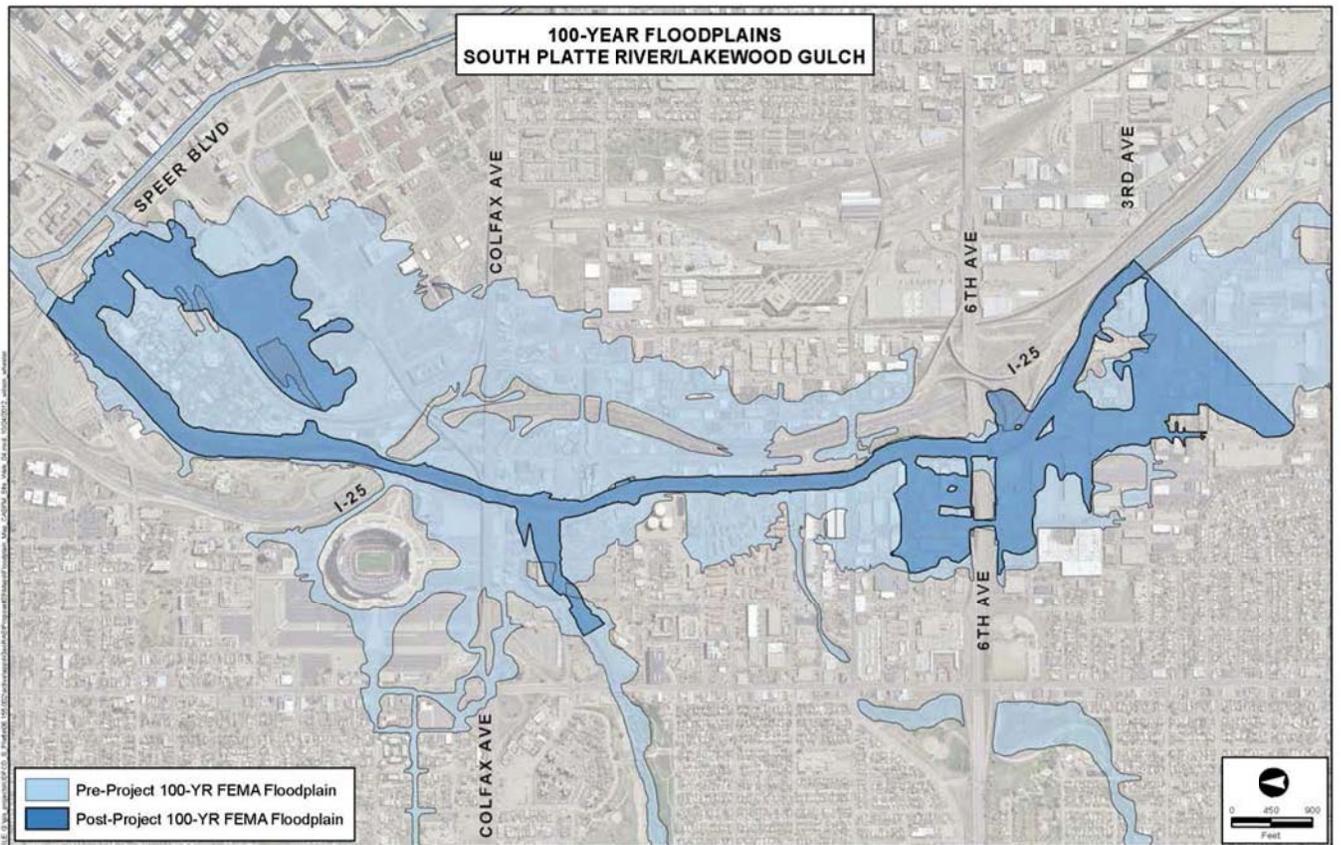


Completed Lakewood Gulch Ring Drop

river amenity. As a result, over 365 acres (496 properties) located between Speer Boulevard and 8th Avenue are now outside of the 100-year regulatory floodplain.

The planning, design and construction of this project required significant coordination and cooperation between the UDFCD, Denver Public Works, Denver Parks and Recreation, RTD, Xcel Energy, Denver Water, Metro Wastewater Reclamation District, the Metropolitan Football Stadium District, and others. This project was a finalist for the 2012 Colorado Association of Stormwater and Floodplain Manager’s Grand Award for Engineering Excellence and was awarded the 2012 Safety Award in the Engineering News Record’s Mountain States, Best Projects competition for the Colorado-Wyoming Region.

Congratulations to all involved for over 30 years of successful planning, design and construction!!!



The pre- and post-project 100-year floodplains

Hind' sight

By Paul A. Hindman

Timely Comment from the District's Executive Director

The year 2012 was an active year for the Urban Drainage and Flood Control District (District). We had a lot of successes but we also had an "oops". Since everyone is attracted to bad stuff like moths are to a light, I'll start with that.

In March we were notified by the EPA that we had violated the Clean Water Act on a project we completed on Piney Creek, and they would be contacting us to determine the penalties that would be assessed. The project was removing sediment that had washed down Piney Creek and deposited so that the trail and nearby area was unusable by the public. We applied for a Nationwide 404 permit from the U.S. Army Corps of Engineers and got it. Then when we went to construction we went over and above what the nationwide permit allowed. We took a proactive approach and contacted EPA to discuss how to remedy the situation.

In the end we ended up with a minimal fine, an on-site environmental enhancement project and an agreement to discuss the whole process at our annual seminar in 2013. The seminar requirement was our suggestion but the EPA loved it. So come to our annual seminar on April 2, 2013 and you can hear all the details. Again, moths to a light.

Now the fun stuff. In February we hosted a group of public works professionals from Curitiba, Brazil. The population is about 1.8 million in Curitiba, and like most cities around the world, have a couple of rivers running through their metro area that have been ignored for many years, much like the south Platte River in the 1960's and '70's. They were here because they had heard how our area has

transformed the South Platte into an amenity that the population is now drawn to. We rented a van to take them up and down the river as well as other sites within the District to show them how we manage stormwater and have revitalized the river and its tributaries. A lot of information was exchanged and since the visit the group has followed up with me and other staff members to continue the dialogue. This type of international exchange is incredibly rewarding for both parties.

Within the office, we've been moving toward an electronic document and records management system for the past several years. We tried one path and ultimately determined that path was like walking through the mud. We got out of the mud and are now trying a new path with a software system called SIRE. We negotiated the contract and starting in January of 2013 we are going full steam ahead. It will allow us to not only file our documents in electronic format, but will allow us to strategically manage them so that we can all be more productive. The interesting thing that I discovered was that in today's electronic world, our society is really in the infant stage in knowing how to manage all the electronic data that we receive daily.

I assumed, wrongly, that there were companies out there that have this all figured out and we would just have to learn how to use their system and we would no longer be strapped to a large file room filled with paper, kind of like QuickBooks for accounting. What I found was that there are many companies, and even individuals, that will tell you they have a system all worked out but in reality their system or program has numerous holes that they either haven't thought about or ignore because they don't know how to fix it. SIRE is a product that is customizable and has been constructed specifically for public organizations so I'm optimistic.

On the State and Federal front, our staff has been engaged in understanding and commenting



Our visitors from Brazil along the South Platte River.

on stormwater regulations and laws that affect our local governments. In March, Ken MacKenzie and I traveled to Kansas City to attend one of EPA's listening sessions on their proposed integrated permitting process for wastewater and stormwater. We relayed to EPA, on behalf of our local governments, that any change should be only implemented if it were to decrease the cost to the local governments. Since then the EPA has allowed integrated permitting and a few

communities across the nation have submitted a plan. It is too early in the program to determine if this will benefit local governments. No communities in the District boundaries have submitted an integrated plan. Everyone is taking a "wait and see" approach.

As always, I continue to look for ways to better serve our local governments and welcome any suggestions or comments anyone may have.

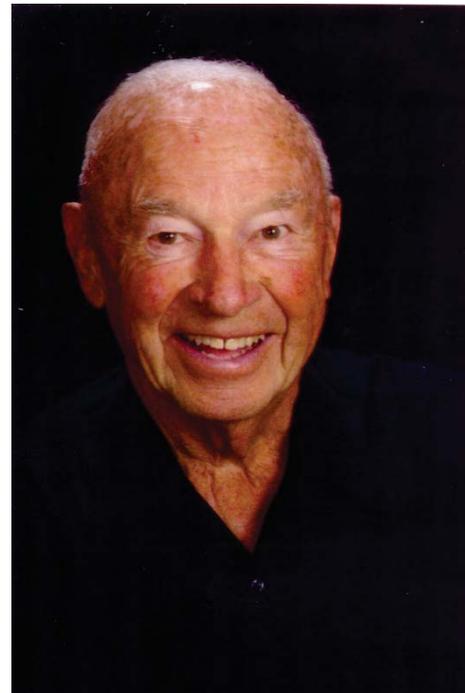
In Memory of Joe Shoemaker

W. Joseph "Joe" Shoemaker passed away in 2012 on his 88th birthday. He is remembered as a naval officer, Manager of Public Works for the City and County of Denver, State Senator and Chairman of the Joint Budget Committee, founder and chairman of the Greenway Foundation, founder and chairman of the Foundation for Colorado State Parks and a devoted family man. He loved Denver, he loved Colorado and he loved the South Platte River.

Joe was instrumental in the creation of the Urban Drainage and Flood Control District. Following the disastrous 1965 flood on the South Platte River, and many other drainageways in Colorado, the Five County Engineers organization, of which Joe was a member, began searching for ways to deal with drainage and flood control issues regionally, since water pays no respect to corporate boundaries.

By 1969, Senator Joe Shoemaker had drafted and introduced legislation to create the District. With the help of some flooding in the Denver-Boulder area during the legislative session, the legislation passed and the District became a reality. Joe then served as the District's legal counsel for many years.

In recognition of his many years of service to the District and the South Platte River; the District, the Greenway Foundation and Wright Water Engineers will establish the **Joe Shoemaker Endowed Research Fund** with the University of Colorado Foundation, for the benefit of the Hydrology and



Hydraulics Graduate Program in the Civil Engineering Department at the University of Colorado Denver.

Distributions from the Fund will be used to provide research and educational support for studies on urban hydrology and environmental preservation, and graduate studies that focus on moving the practical science of urban hydrology and stormwater management into a new era. Research and academic endeavors will typically be in the field of civil engineering, but may extend to other disciplines such as political science and law.

Joe will be missed by many people, but he leaves a lasting legacy, including the Urban Drainage and Flood Control District.

"He loved the District. Of Joe's many accomplishment's he was most proud of the District."

Jeff Shoemaker, Executive Director of the Greenway Foundation.

Floodplain Management Program

Bill DeGroot, PE, Program Manager

National Flood Insurance Program reauthorized

The National Flood Insurance Program (NFIP) was reauthorized for a five-year period in late July. The legislation is called Biggert-Waters 2012, or BW12 for short. There are many analyses of what is in the bill available on the web, including one by ASFP, and I'm not going to give my interpretation here.

I do want to make you aware of two provisions in BW12. The first is the creation of a Technical Mapping Advisory Council (TMAC). This will be a 20 member organization with quite a bit of influence. FEMA is in the process of getting the council started. That includes writing a charter and determining how to seek nominations for membership. Stay tuned.

The other area I wanted to mention is the loss of subsidized insurance premiums for many different situations, including non-primary residences and severe repetitive loss structures. Premiums will go up 25% per year on these and many other structures. I expect that there will be quite a furor in the making when people start experiencing these higher premiums.

Natural Hazard Mitigation Association award

The Natural Hazard Mitigation Association (NHMA), at its annual International Hazard Mitigation Practitioners Workshop in Broomfield in July, presented its inaugural *Safe Development Leadership Award* to the UDFCD. I really like the name of the award, because that's what we have been



Bill DeGroot and David Mallory with the NHMA *Safe Development Leadership Award*

trying to promote: safe development. David Mallory and I accepted the award on behalf of the UDFCD.

LOMC delegation

We have been reviewing requests for Letters of Map Change (LOMC) for FEMA since July 1, 2001. We have had a pretty busy year again; with 40 cases received in 2012. As

was the case the last couple of years, most of the cases we have reviewed are for government funded projects. I'm sure that one reason for the lack of private sector projects is the economy; but I like to think that our efforts to promote safe development have also had an impact on the number of cases. I say this because local government referrals of development proposals are definitely increasing, but private sector LOMC's are not.

We also have to remember that many of the public sector LOMC's are for transportation projects that have to cross floodplains, as well as projects intended to modify the floodplain to mitigate flood hazards.

At the end of December we had 19 cases under review and only three were private sector cases.

LOMC database

We now have a database that allows us to easily track all of the LOMC applications since 2001, and maintenance eligibility projects in one place. This helps us do several things. We can assure that a LOMR has followed a CLOMR within a reasonable period of time. We can see whether a CLOMR or LOMR project has been submitted for District maintenance eligibility, or vice versa. We can sort projects by drainageway or local government. Finally, we are filing PDF's of all recent CLOMR's and LOMR's in the database for easy access.

The database is available to the entire District staff. It will be on-line and available to our local governments and the public in early 2013.

DLOMC guidelines

We unveiled Digital Letter of Map Change (DLOMC) guidelines at the District seminar in April, 2010. So far we haven't had many submittals, which has been a bit of a disappointment. DLOMC's are voluntary, but we believe they will save both applicants and the District time and money, and we continue to encourage DLOMC submittals.

Floodplain delineation

We collaborated with the Master Planning Program to complete four digital flood hazard area delineation (DFHAD) studies this year; for Big Dry Creek in Adams County, Thornton and Westminster; Little's Creek in Littleton and Centennial; ; Sand Creek in Aurora and Arapahoe County; Marston Lake North Drainageway in Denver and Jefferson County.

We have DFHAD's underway for West Toll Gate Creek in Aurora, Centennial and Arapahoe County; Toll Gate Creek and Lower East Toll Gate Creek in Aurora, Goose Creek in Boulder; Happy Canyon Creek and Badger Gulch in Arapahoe County, Douglas County Lone Tree and Parker; Coal Creek and Rock Creek in Boulder County, Erie, Lafayette, Louisville,

Broomfield and Superior; Sanderson Gulch in Denver, Lakewood and Jefferson County; Senac Creek in Aurora; and Box Elder Creek in Adams County, Denver, Aurora and Arapahoe County.

All of these studies are compatible with FEMA's DFIRM specifications, and will be provided to FEMA for incorporation into the appropriate DFIRMs. Terri Fead does an excellent job of assuring that the DFHAD's are done to our standards and FEMA's.

We have reached an informal agreement with FEMA Region 8 to put together a schedule of when DFHAD's will be completed so that they can be scheduled by the region for Physical Map Revision (PMR) funding as they are completed. This will help get the DFHAD's into the DFIRM database and onto the National Flood Hazard Layer quicker. See Risk MAP below. The first two PMR's, consisting of seven DFHAD's, have just been funded and Baker, FEMA's contractor, is starting work on them.

Wise Use of Floodplains

David Mallory and I attended a conference on the Wise Use of Floodplains, sponsored by the University of California, Berkeley and the Corps of Engineers in March. I presented a paper, *Wise Use of Floodplains, The Denver Area Experience*; and David participated in a panel discussion. The results of the conference will be the subject of a session at the Natural Hazards conference in Broomfield in July, 2013.

DFHAD guidelines

Our DFHAD Guidelines have been undergoing some additional modifications, with seemingly every new draft DFHAD submittal raising new issues. New guidelines were posted on our website in mid-2012. Terri Fead did a great job with the revisions. There is a lot of good information in the guidelines for anyone doing any kind of digital floodplain mapping.

DFIRM projects

In 2009 we received four grants from FEMA to update existing DFIRM's for the City and County of Broomfield, City and County of Denver, Jefferson County and Douglas County. At the end of 2012 Broomfield was nearing completion, with Denver and Jefferson County both in the 90-day appeal period. The Douglas County project has picked up speed and we now expect to be in the 90-day appeal period in mid-2013.

The Boulder County DFIRM conversion project, which is being managed by the Colorado Water Conservation Board became effective on December 18, 2012. With its completion all of the District's local governments have effective DFIRM's and all should be available on the National Flood Hazard Layer (NFHL).

Risk MAP moves ahead

FEMA is now well into its fourth year of Risk MAP. Last year we participated in discovery meetings for the Clear Creek and St. Vrain Creek watersheds. The Colorado Water Conservation Board (CWCB) has taken the lead for studies in these two watersheds.

While we are cooperating with the CWCB on these studies, our emphasis has shifted from applying for FEMA grants to trying to get our completed DFHAD's (see above) incorporated into the DFIRM's as quickly as possible. We are also talking to FEMA about getting our master plans incorporated in some way into non-regulatory Risk MAP products.

In the case of the St Vrain study, we were planning to begin a master planning and FHAD study for Coal and Rock Creeks in 2012. Since FEMA had just acquired new LIDAR mapping for the watershed, including Coal and Rock Creeks, we agreed to provide the new FHAD to the Risk MAP effort in return for FEMA providing the new mapping to us. This is another route to getting our FHAD's into the NFHL.

FasTracks Coordination

FasTracks continues to take a lot of our time, as David Mallory discusses elsewhere in this issue. In addition to the design and construction work David discusses, we formed a group of the local governments impacted by the Eagle P3 corridors. We met monthly early on to address common issues and develop common positions for all of the communities. The group was able to resolve issues on unified drainage criteria for the CRT corridors as well as unified BMP's for the corridors. Ken MacKenzie was very helpful to the group. This proved to be a very successful effort, and regularly scheduled meetings are no longer necessary.

Maintenance Eligibility

Our maintenance eligibility program continues to flourish under David Mallory's direction. See David's column.

Maintenance Eligibility Program

David Mallory, PE, CFM, Senior Project Engineer, Floodplain Management Program

The Maintenance Eligibility Guidelines (aka Maintenance Eligibility Program Guidelines For Flood Control Facilities Constructed By Others) were updated this year and presented at the District's Annual Seminar. Everyone in the Floodplain Management Program contributed as well as folks in our Design Construction and Maintenance (DCM) and Master Planning programs. Changes of note include:

- Provision for digital submittals,
- Inclusion of the Floodplain Preservation Brochure,
- Inclusion of the District's Good Neighbor Policy,
- New trail criteria, especially at grade separated roadway crossings,
- Clarification on field operations and grouted boulder pre-grout inspections,
- Clarification for acknowledging the flood attenuation effects of existing detention basins that are not eligible for District maintenance assistance,
- New requirement for Maintenance Site Plans for regional detention basins.

The guidelines do not address as-built plans directly as we simply require whatever the local government requires. However, certified as-built plans are required for a LOMR submittal. Terri completed an exhaustive review of FEMA requirements and current standard of care. The resulting memo will be available for distribution in early 2013.

Private sector development is still slow; however we see signs of a mild resurgence. Several older projects were resubmitted for re-approval along with several new projects. Among those in the works are Solterra in Lakewood, Pinery West in Douglas County, Eastgate in Aurora and Parker Homestead. Most of our time this year was spent on several large public sector projects:

RTD FasTracks West Corridor Project

We have worked with RTD, the City and County of Denver, the City of Lakewood and Jefferson County on this project since the summer of 2004. Denver Transit Construction Group JV (DTCG) commenced construction in the spring of 2009. Joanna Czarnecka continues to do a fabulous job of keeping this large, long and complicated project on track (pun intended) for District Maintenance Eligibility. Most of our effort this year was focused on final details, and punch list activities. We have now issued construction acceptance for all project elements related to the impacted stream corridors.

The West Corridor Project involved eight years of hard work and touched most of the District staff in one way or another. Through patience, perseverance, skilled negotiations and strong local government support, we achieved the desired outcome. Bill DeGroot served as the

District's lead policy liaison to RTD. His leadership was important in shaping the final project

RTD FasTracks Eagle P3 Project

The Eagle P3 Project includes the East Corridor to DIA, the Gold Line to Arvada and Wheat Ridge and a starter segment of the Northwest Rail Corridor to Westminster. Eagle is an acronym for those corridors and P3 stands for public private partnership. The Eagle P3 Project is a competitive concessionaire arrangement where the selected team, Denver Transit Partners (DTP) (Fluor, HDR, PBS&J, Parsons Brinckerhoff and others) will design, build, finance, operate and maintain the project with a long-term lease back to RTD.

There are significant drainage and floodplain management issues throughout the corridors. For example, the proposed commuter rail track (CRT) alignment impacts every regional detention pond along Pena Boulevard. We negotiated a Memorandum of Understanding (MOU) with RTD concerning the design approach as it affects Irondale Gulch, Blue Grama Draw and the West Fork of Second Creek.

We received an astonishing number of large submittal packages. Fortunately, John Pflaum was available to help with the engineering review tasks in order meet RTD's demanding review and issue resolution schedule. Joanna downloads the submittals and performs a cursory review in order to determine the District's interest in each submittal. She also maintains the tracking spreadsheet to monitor progress and deadlines. John follows with the detailed review and written comments that are uploaded to the RTD comment portal.

One little bump in the road this year was the so called Big Deal that the City and County of Denver negotiated with RTD. The agreement affected the East Corridor, providing



Drainage structures for the East Corridor CRT to DIA went in very quickly in late 2012.

additional double tracking and expanding the CRT embankment and structures to accommodate future continuous double tracking to DIA. The agreement also provided for additional grade separations at Green Valley Ranch Boulevard and Tower Road. Impacts on drainage features included doubling the width of the First Creek Bridge and additional fill and/or retaining structures at most of the regional detention sites. Everyone's work load increased while the schedule remained unchanged. Nicole Harwell with RTD and Rich Thornton with HDR proved effective partners in resolving the various issues and concerns on the East Corridor. Anyone traveling to DIA recently has undoubtedly noticed bridge construction in the Second Creek/E-470 area and First Creek as well as embankment and drainage work along the east side of Pena Boulevard.

The Eagle P3 Project has been the catalyst for several DCM projects including the Montclair Basin Outfall and First Creek Restoration projects in Denver, the Westminster Little Dry Creek improvements, Baranmor Ditch in Aurora, and the Ridge Road storm drain and interim detention basin in Wheat Ridge and Arvada. In addition to requiring internal District coordination with various DCM project managers, there was also significant coordination with our local government colleagues and other stakeholders. Similar to the West Corridor, the Eagle P3 project was faced with challenging drainage and floodplain management issues that required hard work from all the stakeholders. Everyone involved and the agencies and interests they represent want a successful transit project that holds public safety as the overarching goal.

First Creek Restoration Project

The First Creek DFHAD identified a significant overflow of 56th Avenue between Pena Boulevard and Tower Road. We believe the First Creek channel was relocated several decades ago in order to facilitate farming operations. The overflow affected RTD's East Corridor and Denver's 56th Avenue widening projects as well as several adjacent landowners. RTD's original proposal was a nearly 1,800 foot long structure starting south of 56th Avenue and ending north of First Creek. Correcting the 56th Avenue overtopping would have required additional culverts and higher profile grades for both the roadway and CRT, while landowners would still be in the floodplain. In 2011, we proposed an alternate approach to partially restore the historic First Creek alignment and fully utilize the existing 56th Avenue bridge capacity.

The stakeholders and funding partners include RTD, Denver, DIA, several private landowners, two metropolitan districts the Rocky Mountain Arsenal Wildlife Refuge and the District. Denver is in charge of right-of-way acquisition and funding arrangements. The District contracted with Short Elliott Hendrickson (SEH) to prepare the final construction documents, cost estimates, land acquisition documents and so forth. Danny Elsner is the SEH project manager and

Barbara Chongtoua is the DCM Manager. I believe that when completed, this project will be a great example of stream restoration, regional cooperation, and shared transit and floodplain management interests.

A number of private sector projects will also spin off as a result of Eagle P3. Expect a plethora of Transit Oriented Development (TOD) projects to come along in the future. Two private sector flood risk reduction projects along the East Corridor follow:

Aviation Station at Blue Grama Pond

The Big Deal mentioned above also paved the way for one additional East Corridor station along Pena Boulevard that is currently referred to as Aviation Station. DIA selected the Fulenwider proposal for siting Aviation Station, thus the CRT platform and bus interface will be located between 61st and 63rd Avenues. This selection will kick start the adjacent TOD project. Blue Grama Draw runs through the project, crosses the CRT in a culvert and continues into Blue Grama Pond. We believe this will facilitate the completion of Blue Grama Draw and Pond between Tower Road and Pena Boulevard.

Bolling Tributary Completion Project

The other CRT station along Pena Boulevard is located just south of 40th Avenue in the Gateway Park East development at the existing Park and Ride. The 40th Avenue under-crossing of the CRT is currently under construction. Also under construction is the Bolling Tributary Completion Project, between Tower Road and Silverado II Detention Pond. Silverado II is a past DCM endeavor that is being partially rebuilt as a result of the CRT project. The culvert at Tower Road is scheduled for replacement next year, which is also a DCM project. The completion project will link these two features. Project elements include four drop structures, several storm drain outfalls and a lot of earthwork.

In the Field

Joanna continues to do an outstanding job observing the construction phase of projects that will ultimately be eligible for District maintenance assistance. Joanna oversaw the completion of the Parker Jordan Centennial Open Space, and West Corridor projects. New projects include the East Corridor, Bolling Tributary and Parker Homestead projects. SEMSWA sent several remedial regional detention pond projects along for eligibility, including Windmill Creek Pond W-1, Dove Creek Pond D-2, Caley East Detention Pond and Lone Tree Creek Pond L-2.

Joanna has been invited to address the APWA Colorado Chapter Construction Inspection Conference at the end of January. The title of her presentation will be *When Maintenance Eligibility is On the Line*. I recommend this discussion to anyone who is curious about or needs to better understand the the critical construction phase element to project eligibility for District maintenance assistance.

Parker Jordan Centennial Open Space – a consultant’s story

By Susan Brown, Valerian, llc

One morning, at sunrise, I went to the Parker Jordan Centennial Open Space (PJCOS) to photograph our completed reclamation project. As I was walking to the amphitheatre along Cherry Creek, I noticed a woman walking down the same path. We started talking while walking and she said she visits the open space every morning and likes to explore different areas and experience each open space amenity individually. When she asked me why I was taking pictures I told her I was on the Parker Jordan Metropolitan District and City of Centennial design team. As the sun began to rise, she described how much this area means to her. She recently retired after a 38 year career in nursing and she said she comes to PJCOS every day to look for her soul. She has sat on the benches, interacted with the kiosk, and walked along all the different pathways and trails. We exchanged e-mail addresses and parted ways. The following day this is what I received from her.

“I just love the way you respected the natural beauty of that area and provided places of rest and solace in magnificent wood and stone. There is wonderful variety with the paved paths and soft paths and places to cross the creek and places to just sit quietly and marvel at nature and catch up with our souls. What a gift you have designed for all of us to be able to access the beauty of these treasured open spaces. Thank you so very much.”

Vonnie

Although this story describes the experience of one woman, this open space is important to a variety of visitors because of its size, adjacency to Cherry Creek, and its recreational and ecological improvements. Until the purchase of this property by the Parker Jordan Metropolitan District the entire site was closed to the public and the Cherry Creek Regional Trail stopped on the south property line and picked up again on the north property line leaving a one mile gap in the 83 mile trail. The sale of the 80-acre site to Parker Jordan Metropolitan District was restrictive in terms of the amount of developable land that was requested to be kept out of the floodplain designation.

As a result, we had some significant design issues concerning the stream corridor reclamation from the beginning. The original design prepared by the engineer was responsive to the previous owner’s desires and hence the direction by the Parker Jordan Metropolitan District. After thorough examination, Urban Drainage and Flood Control

District determined that the submitted design contained too much disturbance and would not be eligible for UDFCD maintenance eligibility without a re design. The design team went back to the drawing boards. At this point, without the help and support of UDFCD, the Cherry Creek Basin Water Quality Authority (CCBWQA), and Southeast Metropolitan Stormwater Authority (SEMSWA); the Parker Jordan Metropolitan District and the City of Centennial would never have received maintenance eligibility and consequently this open space never would have been improved. Thankfully, everyone came to the table and worked closely with the design team to create a reclamation plan that was effectively implemented. We all met at UDFCD and strategically determined the best approach to maintain the most developable land, while proceeding with an engineering solution that created fewer disturbances to the riparian corridor. The new plan represented compromises but it

saved money and enhanced recreational opportunities and natural habitat. Paul Hindman wrote “When all parties come together a solution can be found.” I wholeheartedly agree with this sentiment. It is of utmost importance that our public and private partnerships have a common goal of completing great projects so that the larger visions of healthy ecosystems are realized.

There are times when it appears that the amount of work necessary to “do the right thing” seems overwhelming. We must resolve conflicting schedules, budgets, agendas, and multi faceted design teams to negotiate the best solutions to project issues as they arise. In the case of PJCOS, the hard work and collaboration of the public entities and the design consultants culminated in a project that turned an unsafe and ecologically challenged 80-acre open space into a haven for visitors of all ages. In addition to creating inviting spaces for human interaction the stream corridor reclamation also incorporated natural habitat improvements encouraging healthy system equilibrium.

We are fortunate to live in an area where our desires to provide people like Vonnie and the rest of the community safe accessible places to become healthier in body and spirit are shared by so many decision making organizations like UDFCD, SEMSWA and the CCBWQA. One of the most rewarding aspects of our profession is that we can help facilitate stream corridor reclamation; since it has been proven that healthy communities are directly related to healthy environments.



Master Planning Program

Shea Thomas, Senior Project Engineer and Ken MacKenzie, Program Manager

Master Planning Projects

We completed seven planning projects and four flood hazard area delineation studies in 2012 with 13 additional projects under way; and we plan to begin five new planning projects in 2013.

To date, UDFCD has completed a total of 93 major drainageway planning (MDP) studies, 85 outfall system planning (OSP) studies, and 91 flood hazard area delineation (FHAD) studies, including many updates of studies completed in the past.

Urban Storm Drainage Criteria Manual

Progress continues on an update of the *Urban Storm Drainage Criteria Manual* (USDCM), Volumes 1 and 2, with an admittedly optimistic release date of early 2014. One of the most respected drainage criteria manuals nationally and around the world; all three volumes of the USDCM are available in pdf format on our web page (www.udfcd.org) for download. We encourage you to check the website frequently for the latest updates

Join UDFCD on LinkedIn

We've created a LinkedIn group and already have over two hundred members. We would love to have you join the conversation!

Share your experience, or ask a question about the criteria manual, software, or spreadsheets and hear what we and other users have to say. We post messages to this group whenever a new version of the spreadsheets, software or manual is posted so this is a great way to be alerted to new releases on our website.

UDFCD Software

You may download the UDFCD unit hydrograph program *Colorado Urban Hydrograph Procedure (CUHP)*, and other free software, including *UDSEWER* that includes a profile plotter, and many other free design aid workbooks from our website at www.udfcd.org. To download the CUHP companion EPA SWMM program, we have placed a hyperlink from our software site to the EPA website.

STATUS OF PLANNING PROJECTS

Project	Sponsors	Consultant	Status
Big Dry Creek MDP & FHAD	Adams, Thornton, Westminster	Wright Water	Completed in 2012
Cherry Creek Stabilization Plan	Joint MP-DC&M Programs	Matrix	Completed in 2012
Coal Creek & Rock Creek MDP & FHAD	Erie, Lafayette, Louisville, Broomfield, Superior, Boulder Co.	RESPEC	30% Complete
Dry Gulch OSP Update	Lakewood, Denver	ICON	5% Complete
East Toll Gate Creek (Lower) MDP and FHAD	Aurora, Buckley	J3	70% Complete
Easterly Creek OSP	Aurora	SEH	Completed in 2012
Erie OSP	Erie	WRC	10% Complete
Globeville-Utah Junction OSP Update	Denver, Adams County	CH2M Hill	80% Complete
Goose Creek & Twomile Canyon Creek Floodplain	Boulder	ICON	90% Complete
Happy Canyon Creek MDP & FHAD	SEMSWA, Doug. Co., Lone Tree, Parker	Muller	25% Complete
Little's Creek MDP and FHAD	SEMSWA	AMEC	Completed in 2012
Marston Lake North Drainageway MDP Update	Denver, Denver Water, Lakewood, Jefferson	Olsson	Completed in 2012
Newlin Gulch MDP Update	Parker, Douglas Co.	Muller	5% Complete
North Dry Gulch OSP	Lakewood	Muller	35% Complete
Park Hill (Lower) Drainage OSP	Denver, Denver Water	Enginuity	Completed in 2012
Piney Creek OSP & FHAD	SEMSWA, Aurora, Douglas	WRC	Completed in 2012
Sand Creek MDP & FHAD	Aurora, SEMSWA	Matrix	75% Complete
Sanderson Gulch MDP & FHAD	Denver, Lakewood	Matrix	40% Complete
South Boulder Creek Flood Mitigation Study	City of Boulder	CH2M Hill	75% Complete
West Toll Gate Creek MDP & FHAD	Aurora, SEMSWA	Michael Baker	95% Complete

MDP = Major Drainageway Plan, OSP = Outfall Systems Plan, FHAD = Flood Hazard Area Delineation

UDFCD Annual Seminar

At our 2012 annual seminar we had 330 registrants, making it the best attended UDFCD seminar ever. The proceedings are available at: <http://udfcd.org/conferences/conferences.htm>

On April 2, 2013 we will have our next annual seminar. This one-day program will be at the Stapleton Doubletree Hotel, and early registration will be \$69. Please mark your calendar and join us to find out what is going on regionally and nationally in drainage, stormwater quality, and floodplain management.

Stormwater Quality & Permitting Support Activities

Holly Piza, Senior Project Engineer and Ken MacKenzie, Manager, Master Planning Program

UDFCD continued to be active in the stormwater quality arena in 2011, with commitments to the following organizations and activities:

Best Management Practices (BMP) Advancements:

UDFCD continued to make detailed reports available to the public via the website (www.udfcd.org) for specific sites within the UDFCD monitoring program. A report spanning 2001-2011 for the extended detention basin (EDB) at Grant Ranch has been posted on the website. Full history reports on the porous asphalt and permeable interlocking concrete pavement (PICP) sites in Denver and the pervious concrete site in Lakewood can also be found on the website.

UDFCD BMP Monitoring Program:

UDFCD In addition to making detailed reports available to the public, information on all of the UDFCD stormwater research sites is now available on our website. Sites currently monitored by UDFCD include the following BMPs:

- Green Roof,
- Rain Garden,
- Extended Detention Basin (EDB),
- Slotted Concrete,
- Permeable Interlocking Concrete Pavement (PICP)
- Rainwater Harvesting system.

Additionally, UDFCD monitors runoff from an aggregate rooftop in downtown Denver. Although this is not a BMP, the data provide information descriptive of stormwater runoff from an aggregate rooftop and could be considered as a reference point for the green roof. These data are also used by EPA Region 8 as a control for their green roof (located across the street from this site).

New Discoveries:

UDFCD partnered with Water Environment Research Foundation (WERF), Denver Public Schools, and the Urban Watershed Research Institute to construct a rainwater harvesting system on a new school building. The system has a connection to NOAA weather forecasting and will evacuate prior to an event and commensurate with the forecast so that the cistern volume is available for stormwater capture. This type of automated system can be used to address stormwater treatment using a smaller footprint than would be required using conventional methods.

Additionally, measurements will include volume collected; volume used for irrigation and volume drained to make storage available for forecasted rainfall. This is part of a nationwide WERF study and an important site within that

study as rainfall patterns in the UDFCD region are much different than at other sites currently in the study. We will monitor the system for five years in an effort to determine the following:

- Can this specific type of BMP configuration, utilizing automated controls at the outlet, be an effective tool in managing stormwater in this region, and
- Is rainwater harvesting in general an effective practice for managing on-site stormwater in Colorado?

Education and Outreach:

After UDFCD applied for and received a \$60,220 Colorado State water quality improvement fund grant. This grant will be used to develop a statewide stormwater education and outreach program, housed within the Urban Water Center of the Colorado Water Institute and delivered throughout the state via the CSU Extension program.

Colorado MS4 Stormwater Group:

The UDFCD continues to host monthly meetings of the Colorado Stormwater Council, an MS4 permittee-only group comprising more than 92% of all permit holders in Colorado.

The Colorado Water Quality Control Division is now holding MS4 permittee meetings at their offices, allowing for additional State personnel to attend and contribute to the discussion. These meetings are open to all interested parties and consist of MS4 permittees with few exceptions. The Colorado Stormwater Council has a significant role in these meetings and has presented a list of topics to be discussed over the coming year. UDFCD attends these meetings, provides input in an effort to aid the discussion and provides technical expertise where appropriate.



Ken MacKenzie and Holly Piza at the seminar.

How to Discuss the Probability of Flooding with a Lay Person

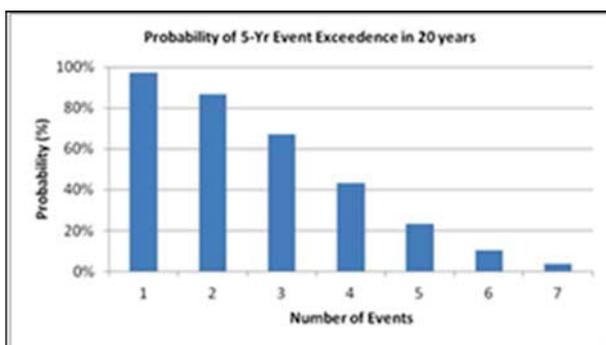
By Ken MacKenzie, Manager, Master Planning Program

Earlier this year, one of our board members asked me to describe in lay terms what the impacts would be of designing commuter rail that would remain serviceable during a 5-year storm vs. a 10-year storm or even a 100-year storm. Most adults are capable of understanding that the 100-year flood is actually an event having a probability of occurrence of 1/100 (or 1%) in any given year and not necessarily an event that occurs once every 100 years; but even highly educated decision makers often get hazy on the implications of designing to a specific level of service with the understanding that flooding events larger than that level of service may

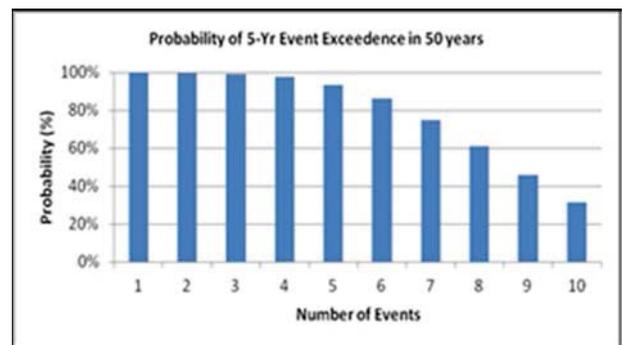
occur multiple times during the service life of the facility. The following is a description of the probability of the tracks for a commuter train being overtopped in the next 20 or 50 years, by storms larger than the 5-year design storm to which the track elevations and crossings were designed.

There is a probability of occurrence that correlates with the number of times a design threshold will be exceeded; which is a technical way of saying the following:

For a 5-year design storm

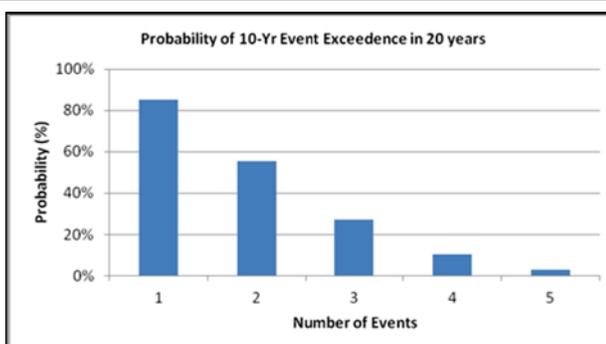


If the tracks are designed to accommodate the runoff from a 5-year storm, is almost certain (> 90% probability) that the tracks will be overtopped once in the next 20 years. In fact, there is a good chance (> 60% probability) that it will be happen three times in 20 years.

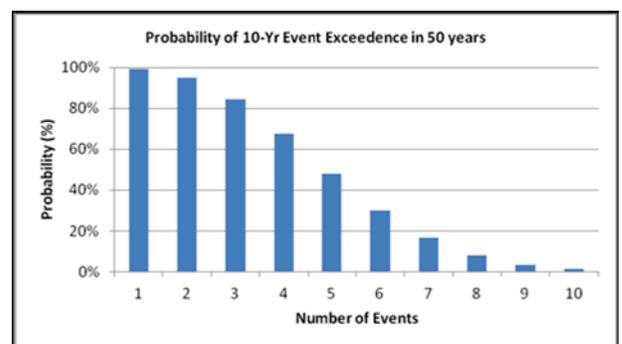


For the same 5-year storm design, it is almost certain (> 90% probability) that the tracks will be overtopped five times in the next 50 years, and a good chance (> 60% probability) that it will happen eight times in 50 years.

For a 10-year design storm

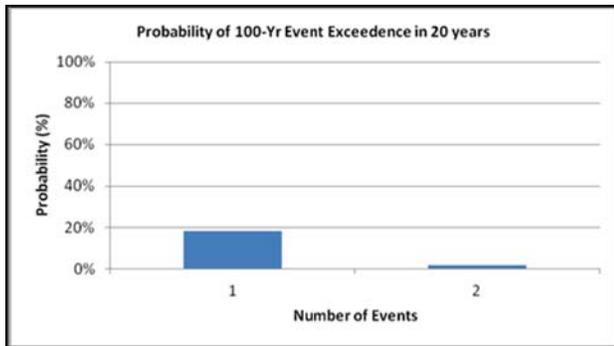


If the tracks are designed to accommodate the runoff from a 10-year storm, there is a good chance (> 80% probability) that the tracks will be overtopped once in the next 20 years, and about a 50/50 chance of happening twice in 20 years.

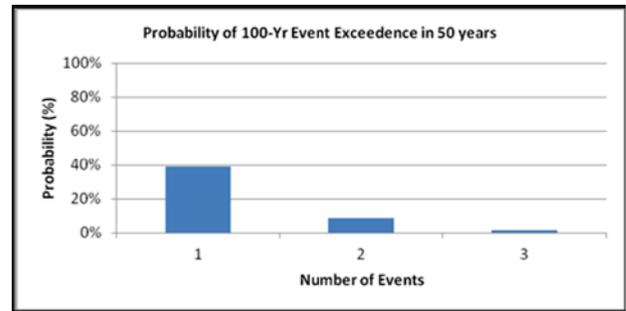


For the same 10-year storm design, it is almost certain (> 90% probability) that the tracks will be overtopped twice in the next 50 years, and about a 50/50 chance of happening five times in 50 years.

For a 100-year design storm



If the tracks are designed to accommodate the runoff from a 100-year storm, there is a small chance (< 20% probability) that the tracks will be overtopped once in the next 20 years, and practically no chance of it happening twice in 20 years.



For the same 100-year storm design, there is a less-than 50/50 chance (40% probability) that the tracks will be overtopped once in the next 50 years, and about a 10% chance of happening twice in 50 years.

District Receives Financial Reporting Certificate

For the twenty-third year in a row the District has received a *Certificate of Achievement for Excellence in Financial Reporting* from the Government Finance Officers Association of the United States and Canada. The certificate is presented to government units whose comprehensive annual financial reports achieve the highest standards in government accounting and financial reporting. The District's auditor was Johnson, Holscher & Co., P.C.

Congratulations to Frank Dobbins, Manager of Finance and Accounting, and assistant Wanda Salazar for continuing this string of awards.



From left, Board Chairman Susan Beckman, Wanda Salazar, Frank Dobbins and Paul Hindman

District Receives award from Colorado Chapter of APWA

The Colorado Chapter of APWA presented its Public Works Project Award for Environmental Design for a Large Community to the District for its revisions to the *Urban Storm Drainage Criteria Manual, Volume 3- Best Management Practices*. The revision effort was led by Holly Pizza, Senior Project Engineer in the Master Planning Program. Consulting services were provided by Wright Water Engineers. Holly represented the District at the awards luncheon.



Paul Hindman and Holly Pizza

Using Rainwater Harvesting and Cloud-Based Infrastructure as a Stormwater BMP

By Holly Piza, P.E., Senior Project Engineer, Master Planning Program

Introduction

Although rainwater harvesting systems capture and treat stormwater, use of this practice as a stormwater best management practice (BMP) in Colorado is rarely seen as a viable alternative. First, the practice doesn't typically provide the volume required to capture the water quality capture volume (WQCV) when it rains because the tank may already be full. Second, western water law dictates that diverting and using rainwater for beneficial use (outside of free river conditions) is illegal without a water right. Exceptions to this include systems meeting the physical criteria and permit requirements under HB-1129 or SB-09-80. HB-1129, or the "Pilot Project Bill", allows for up to ten pilot installations as approved by the Colorado Water Conservation Board. The permit obtained through this bill includes rather extensive monitoring and reporting requirements. SB-09-80 allows for greater use of this type of practice; however, it requires a permit and its use is limited given the criteria to be eligible. For example, the landowner must not have a tap from a water supplier. Due to these reasons very little research has been done in Colorado on the effectiveness of this practice in reducing the pollutants in receiving streams or as a water conservation measure.

In 2012 UDFCD applied for a permit from the State, outside of both HB-1129 and SB09-80, which allowed for the construction of a 3000 gallon, above ground rainwater harvesting system on a new school building owned by Denver Public Schools (DPS). This was done through a provision in the State statutes (37-92-308(5)) that allows temporary approval for up to five years. The statute does not allow for consumptive use credit by pre-existing vegetation to be used as an offset for total depletions for the project. This means, rainwater captured out of priority must be replaced to the stream system. UDFCD presented this project to Denver Water, requesting a temporary lease agreement. An agreement was reached, whereby UDFCD is responsible for calculating water for replacement and Denver Water replaces this water each month based on that calculation.

Project Overview

This project is a partnership consisting of UDFCD, Water Environment Research Foundation (WERF) and DPS. The project is also made possible by an Urban Watershed Research Institute research grant; Denver Water's augmentation of rainwater used for irrigation; and the Denver Green School (DGS), who participates in the research.

A 3,000 gallon cistern collects rainwater from the roof of a new building at DGS and uses it for irrigation of the adjacent landscape areas. The new building, containing 6th, 7th, and 8th grade class rooms is 8,000 square-feet and most of the roof drains to this cistern. When available, the cistern will capture

a rainfall depth of approximately 0.7 inches. The part of this design that makes it both unique and specifically designed for treatment of stormwater is that the system has a connection to NOAA weather forecasting and it will drain prior to an event and commensurate with the forecast so that the volume is available for stormwater capture. The controls for this system are fully automated and can also be controlled remotely. The equipment assembly used to release and measure water evacuated from the system, as well as the software utilized for this purpose, was developed by Geosyntec Consultants. Geosyntec is WERF's consultant as part of a national study being conducted on high-performance BMPs that utilize cloud-based infrastructure similar to the DGS rainwater harvesting system. This is an important site within that study as rainfall patterns in Denver are much different than at other sites currently in the study.

The DGS rainwater harvesting system is designed, in part, for student involvement. DGS utilizes project-based learning through the lens of sustainability. Students can view differences in volume associated with usage, rain events, and cistern evacuation in anticipation of forecasted rain events. See photo 1 for the dashboard view of the system components. They can use this system to expand understanding of math and science while becoming aware of water issues in Colorado. The WERF partnership has enhanced this aspect of the project, providing components for real time monitoring of the cistern via the web.

This type of automated system can be used to address stormwater treatment using a smaller footprint than would be required using conventional methods because it better utilizes the volume of BMPs in series. Additionally, measurements will include volume collected; volume used for irrigation and volume drained to make storage available for forecasted rainfall. UDFCD will monitor the system in an effort to determine the following:

- Can this type of BMP configuration, utilizing automated controls at the outlet, be an effective tool in managing stormwater in this region, and
- Is rainwater harvesting an effective practice for managing on-site stormwater in Colorado?

Construction

One challenge in construction of this system was finding a Colorado contractor experienced in the construction of rainwater harvesting systems. The construction of the DGS system utilized the expertise of three different contractors in addition to the portion of the system installed by Geosyntec. Many parts of the system were also designed during construction, with UDFCD coordinating all work and installing part of the system as well. See photo 2. System components include the following:



Photo 1 - Dashboard view of the system components

- The cistern can be drained in three ways, by the irrigation pump, by an orifice located at the very bottom of the cistern (primarily for winterization of the system), and by the discharge pipe (the pipe used to evacuate the cistern commensurate with the rain forecast). The 1-inch diameter discharge pipe

- Water drains through the 8-inch by 8-inch aluminum downspout at the corner of the building. The downspout has been built to house a 6-inch PVC valve. When this valve is closed, rain water is directed into through a screen filter into a 3,000 gallon high density poly-ethylene (HDPE) cistern.
- Flow into the cistern is measured in two ways. A rain gauge has been installed on the roof of the building allowing the predicted flow into the cistern to be calculated based on the roof area and a runoff coefficient. Additionally, a level logger has been placed at the end of the discharge pipe (the pipe used to evacuate the cistern commensurate with the rain forecast) from the cistern. This measures head and allows for a calculation of increased volume over the period of the rain event.
- A pump that pressurizes the irrigation system is located exterior to the cistern and fed by a 2-inch diameter pipe from the bottom of the cistern. The irrigation system consists of three zones, irrigating a total area of approximately 2,600 square-feet. The irrigation system is on a timer and is set up to run daily for a total time of about 15 minutes.
- In the event that there is not enough water in the cistern to run the pump and water in the cistern drops to a depth of approximately one-foot, gravity will open a float valve located inside of the cistern allowing water from the domestic system to fill the cistern to a minimum depth which allows the pump to run. This float valve is set just below the pipe used to evacuate the cistern due to a forecast for rain. This is to ensure that the evacuation of the water doesn't cause the float valve to open. A pulse output meter measures the volume of water added from the domestic supply line.

exits the cistern just above the elevation of the float valve and includes a level logger followed by a solenoid valve. The solenoid valve opens automatically when a rain event is forecasted (or manually as needed).

Data Collection

Typically UDFCD monitors BMPs from April to October, however; this system was not fully in place until late September of 2012. Three rain events supplied all of the irrigation water needed in September and part of October. A couple small events (less than 0.2 inches each) provided enough irrigation water for the remainder of the month. In total, 3,223 gallons of rainwater was used for irrigation, which both completely eliminated stormwater runoff from the building and provided all of the irrigation water needed during that time. UDFCD will continue to monitor this system for the term allowed by the State.



Photo 2 – System components

Design, Construction & Maintenance Program

Dave Bennetts, PE, CFM, Program Manager and Laura Kroeger, PE, Assistant Program Manager

CIP and Work Plan

The DCM program is funded by three different legislative authorizations; the Construction Fund, the Maintenance Fund, and the South Platte River Fund. Each year the District prepares a work plan for each of the funds. The 5-year Capital Improvement Plan (CIP) lists capital construction projects by county for the Construction and South Platte River funds. The CIP shows the District's financial participation, which will be matched by the participating local governments, for a 5 year window of time. This allows both the District and local government partners to plan funding levels into the future.

The Maintenance Work Plan lists projects for the Maintenance and South Platte River funds. Work is listed by county, category of work, the local government where the work is located, project location, description of work, and the estimated cost. Maintenance work is funded entirely by the District. Both the 5-year CIP and Maintenance Work Plan are developed based on prioritized project requests from local governments. Copies of both of these plans are available on the District's website:

http://www.udfcd.org/design_const_maint/dcm_home.html.

New Consultant Selection Process

The DCM program is implementing an alternative process for selecting design engineers for District projects. The District's traditional Qualification Based Selection (QBS) procedure is based on the guidelines established by ASCE. While the District and the local governments will still have the option of going through the traditional process, this new Modified QBS process will offer more flexibility to expedite the selection process, and have the confidence a qualified drainageway engineering consultant will be awarded the work.

Most are likely familiar with the traditional selection process of sending a Request for Proposal (RFP) to ten engineering consultants selected by the District and local government representatives. Based on the proposals received, a short list is developed and interviews conducted. The selected firm then enters into negotiations with the District and the local government to develop a scope and fee for the project.

Over the last several years the District has seen the traditional QBS process become more intense with the increased competition. The amount of time consultants invest researching and assembling a comprehensive proposal, and then developing and detailing a design approach for an interview takes significant consulting hours. This additional time ultimately results in increased overhead costs, which are passed onto the District and the local governments.

The District has not seen this expanded effort during the selection process add any substantial benefit to the project. With the recognition that the traditional QBS process no longer fully serves the District, local governments, consulting firms, nor the public; a Modified QBS process is being introduced to expedite the selection process and minimize overhead costs.

The Modified QBS process selects a pool of prequalified drainageway engineering consultants to whom projects will be given. The engineering firms will be selected based on a Statement of Qualification (SOQ), and the District's experience with that consultant. The number of engineering firms on the list will vary from about five to ten depending on District project work load. It is the intent that each engineering firm on the list will have at least one active project. Annually, one or more engineering firms on the prequalified list will need to resubmit their SOQ at which time the selection process will also be opened up to new engineering firms to submit their qualifications for consideration.

Quarterly meetings will be held with District project engineers to look at upcoming projects and distribute the work load, as well as coordinate providing opportunities for firms not on the prequalified list to gain experience by working on smaller projects. The District is committed to providing opportunities to those firms who market and can provide skills/services needed on projects but not on the prequalified list.

Routine Maintenance

Routine work provides basic flood control maintenance along the major drainageways within the District. Services typically performed include mowing, trash and debris removal, weed control, and tree thinning. The District is currently maintaining over 320 drainageways and spent \$1,371,620 in 2012 for Routine Maintenance. Private contractors are hired each year to perform the maintenance on a unit price basis. The District's website has maps of the routine work broken down by county, major drainageway and reach.

Restoration Maintenance

Restoration work is site specific construction work to address isolated drainageway problems that are included in the Maintenance Eligibility Program. This work often mitigates the need for more costly improvements in the future. Types of restoration activities include: sediment removal, local erosion repair and bank protection, drop structure repair, and channel grading, stabilization, and revegetation. All of this work is accomplished using private contractors either through a public bidding process or a pre-

qualified contractor selection process. In 2012, the District completed \$ 9,576,882 of restoration work.

Design and Construction Projects

Design and construction projects implement master planned improvements. Generally, the District manages final designs prepared by consulting engineers. The local governments are involved in all aspects of the design process, and usually acquire any necessary ROW. Projects are publically bid for construction. In 2012 the District authorized approximately 11,875,000 for construction projects. Below is a brief outline of a few capital and maintenance projects that have been recently completed:

Adams County

The **Brantner Gulch at Holly Street** culvert in the City of Thornton was significantly undersized, and the road embankment was not wide enough to accommodate a major arterial road section. The existing dual 48-inch culverts were no match for the 100-year runoff of approximately 3,500 cfs,



Brantner Gulch at Holly St. before (above) and after construction.



and the road would overtop during just a 2-year storm. North and south of Brantner Gulch, Holly Street included two traffic lanes in each direction, but only one lane of traffic in each direction at Brantner Gulch. In addition, the Brantner Gulch trail system had no safe crossing of Holly Street, an important missing connection with a nearby middle school.

This capital improvement project included the installation of a 24'x11' ConSpan arch structure to convey 100-year flows underneath Holly Street, and to accommodate a pedestrian underpass that will remain dry for up to a 2-year flood event. Holly Street had to be raised by five feet to accommodate the larger culvert, and to provide a safer sag vertical curve geometry. A high pressure Xcel gas line had to be temporarily re-routed to accommodate construction, in addition to many other utilities that had to be temporarily supported. Construction was completed in November.

The District and Adams County partnered to replace a failing **pedestrian bridge along the Clear Creek trail** system. This pedestrian bridge across the Colorado Agricultural Ditch



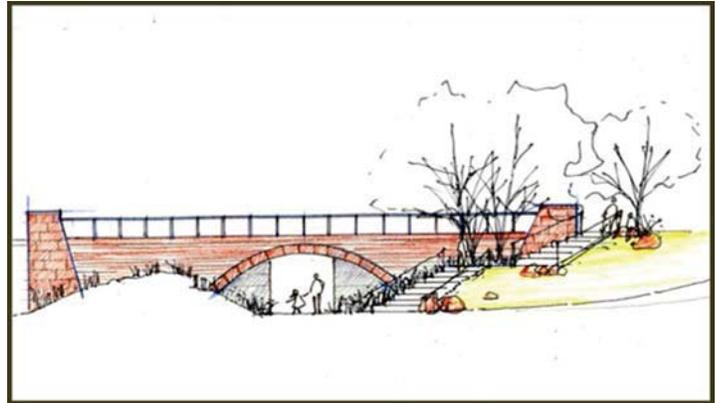
New Clear Creek Trail bridge.

was rusting out and in dire need of replacement in order to maintain adequate maintenance access along Clear Creek, and to maintain the regional trail system. A prefabricated steel beam bridge was placed on drilled piers, and the trail was re-aligned to soften the approach curves to the new skewed bridge. Construction was completed in March.

Grange Hall Creek crosses Washington Street in Northglenn near 106th Avenue. An existing regional detention pond just upstream of Washington Street has only a 30-inch pipe outfall. With a 100-year flood of around 2,100 cfs, this pipe outfall is frequently overwhelmed and the dilapidated emergency spillway conveys flood flows. Washington Street is just downstream of the emergency spillway, and has only a pair of 24-inch culverts. As a result, Washington Street is frequently overtopped, such that the downstream side of Washington Street has been paved with asphalt to act as a spillway back into the creek (see photo below). In addition, the regional trail along Grange Hall Creek has no safe crossing At Washington Street, as the nearest



Existing Grange Hall Creek crossing



Proposed Grange Hall Creek crossing

stoplights are several blocks away. Pedestrians frequently dodge traffic to cross Washington Street.

The City of Northglenn and the District are partnering to construct a new pond outlet structure and a new 100-year crossing and pedestrian underpass across Washington Street. Construction of this project is underway, with a planned completion in the fall of 2013. Utilities have been a major challenge on this important project, as many of the City's main sanitary sewer trunk lines run along Grange Hall Creek. Additionally, a 48-inch water conduit along Washington Street will need to be lowered to accommodate vertical clearance on the pedestrian underpass. The concept for the pedestrian underpass is shown above. This will be a signature project for the City of Northglenn, as it will provide flood protection for one of their busiest streets, in addition to providing a safe and aesthetically pleasing pedestrian underpass.

Arapahoe County

The District and the Southeast Metro Stormwater Authority (SEMSWA) have started construction on the capital project on **Cherry Creek at Eco Park**, located northeast of Broncos Parkway and Jordan Road. Cherry Creek's main channel has cut down several feet and the stream banks are actively eroding. The adjacent vegetation on the overbanks has been left high and dry and the native grasses have begun to disappear and the willows are dying off on the overbanks. During the June 6, 2012 storm; areas on the overbank were washed out due to the lack of vegetation. This project rehabilitates the channel by installing several grade control structures (5 riffle drops, 5 sculpted concrete drop structure, and 1 boulder drop structure). In addition, the banks were protected with a combination of plantings, willow bundles, erosion control mats and blankets, traditional riprap, and void filled riprap. A secondary channel for slightly higher flows was added. The project includes seeding of native grasses and species and returning frequent smaller flood events to the over-banks to help re-establish the vegetation. In addition to the project work, two volunteer seeding

projects were done to help restore the health and vitality of this reach of Cherry Creek.



Cherry Creek degradation had separated the low flow from the floodplain vegetation (above). A grouted sloping boulder drop structure, under construction, will help re-connect the low flow with the floodplain.



The District and City of Englewood completed a maintenance project on **West Harvard Gulch** upstream of Tejon Street located southwest of Vassar Avenue and Tejon Street. One drop structure failed and a second structure developed evidence of water moving under the structure during the June 6, 2012 storm. This project replaced the two sloping concrete drop structures with two grouted boulder drop structures. The project was completed in just over 3 months, from observed failure of old sloping concrete drop structures on June 7, 2012 to the two new grouted boulder drop structures that were tested by the September 12, 2012 storm.



Boulder Creek drop structure and fish passage.

section of the structure has a longitudinal slope of around 4.5%, the main body of the drop structure on the right has a 4:1 longitudinal slope. The fish passage portion is slightly lower at the crest and will convey the low flows. A 5-foot deep pool at the downstream end gives fish a refuge area prior to attempting the swim upstream. Construction was completed in November.



June 7, 2012

Coal Creek at 120th Street

A vertical bank had formed along the south side of Coal Creek, just downstream of 120th Street. This vertical bank was threatening an RV storage facility. Additionally, the Coal Creek trail system from the west ended at 120th Street, with no safe connection across 120th Street and no trail constructed downstream to the east. Local governments in the area have plans to extend the Coal Creek trail several miles downstream, and the lack of a safe crossing at 120th Street was a large impediment. The existing 3-cell 120th Street culvert consisted of a 16-foot by 8-foot cell flanked by two 13-foot by 8-foot cells.



September 12, 2012

The District partnered with the City of Lafayette to re-align a portion of Coal Creek to eliminate the threat to the RV facility, and converted the south cell of the existing 120th

Boulder County

A sanitary sewer encasement had become exposed in the bed of **Boulder Creek** in the City of Boulder near the Humane Society at 55th and Pearl Parkway. Upstream of this crossing, concrete had been poured in several layers along the east bank of the creek, presumably as bank protection. As the creek has lowered in this section, the sewer encasement was exposed and the concrete along the bank started to become undermined.

The City of Boulder and the District partnered to install a grouted boulder drop structure to protect the sanitary sewer, and also removed concrete from the bank so that it may be revegetated. At the request of the City Open Space staff, we incorporated a generic fish passage section into the drop structure, which is evident on the left side of the photo. This



Coal Creek at 120th after construction.

Street culvert into a pedestrian underpass. A series of boulder walls were installed to bring the trail down through the south culvert cell. A stem wall was added to keep the south cell dry for pedestrians, and excess sediment in the creek bottom was removed to provide a 1-foot drop at the culvert outlet so the underpass will drain. There are plans to replace this culvert within the next five years, so the flat trail approaches to the culvert were lengthened in anticipation of a larger future structure. Construction was completed in October.

City and County of Broomfield

Alexx & Michael's Pond is located at the southwest corner of West 132nd Avenue and Zuni Street. Originally called West Lake Pond, this facility was constructed in the late 1970's to provide regional detention for the 100-year event, as well as irrigation water storage for surrounding properties. After the City and County of Broomfield took over operation and maintenance of the pond in 1986, it was discovered that the only outlet from the pond exists approximately 7 feet above the historic pond bottom. Therefore the permanent water surface elevation is controlled by rate of inflow, infiltration, and evaporation. The good news is that the pond currently has adequate capacity for the 100-year storm volume above the outlet invert.

The north and southwest portions of the pond are densely populated cottonwood groves, associated with sediment deposited by flows from stormwater outfalls as development has occurred. Over the last few years the pond water level has inundated these cottonwoods for extensive periods. Without the ability to control the water surface, these forested areas are vulnerable to rot, decay, poor drainage, odors, poor water quality and mosquito infestation. This fluctuating water level and lack of water movement in the pond resulted in Broomfield receiving many complaints about the dying vegetation and a "smelly pond."

ICON Engineering, Inc. was hired by the District to explore options to stabilize the fluctuating water surface to improve the environmental health of the pond. Several alternatives

were formulated but it was determined that a pumped outfall system would best address all concerns. More specifically, the pump system could drain the pond and allow for future sediment removal to create a water depth less conducive to mosquito breeding. The entire system includes: pump house with two 1500gpm pumps, intake structure, wet well, a 12-inch diameter drain down pipe outfall, and two 6-inch diameter recirculation pipes. The pumps are controlled by floats which are manually set by Broomfield operators to an elevation deemed most desirable to the environmental health of the pond in any given year. Recirculation pipes, fed by alternating pump cycles to minimize potential pump burn-out, were installed to outfall at opposite ends of the pond perimeter in order to promote circulation and help improve water quality.

The construction was awarded to Naranjo Civil Constructors with the building and electrical work completed by sub-contractors. Icon provided construction engineering while the District provided overall construction management.

City and County of Denver

Many projects were completed in the City and County of Denver (Denver) this past year but two are notable because of their history: Babi Yar Improvements and West Harvard Gulch Stabilization. The **Babi Yar Tributary Improvements** were implemented within the Babi Yar Park located in southeast Denver the intersection of Havana Street and South Parker Road. A severely degraded channel with tall and steep channel banks was compromising check structures, park infrastructure, and the memorial it serves.

In 1969, Babi Yar Park was designated by Denver as a memorial to the Jews, Ukrainians, gypsies and others who lost their lives during World War II on the outskirts of Kiev, Ukraine. The Babi Yar Tributary resembled a ravine where their bodies were dumped from railroad boxcars. Babi Yar Park was transformed from an open space to an official park in 1983 to serve as a place for education, walking, biking, and quiet remembrance. Five years ago, Denver, the Mizel Museum, and community leaders paved the way for the next phase of development, a September 11 Memorial.

The next phase commenced with a project to stabilize the tributary channel. The challenge was to insure stability to the Babi Yar Ravine while preserving the elements symbolic to the tragedies. Working with ICON Engineering and Sabells Enterprises, a successful channel stabilization project ensued while preserving the elements of the ravine that memorializes the events of 1941. Multiple drop structures were constructed along the length of the ravine to mitigate for 40 feet of vertical fall along the 1900 feet length of channel. The ten steel sheet pile and grouted boulder drop structures, sinuous low flow channel, straight and contemporary box car pedestrian bridge, 74 trees, and upland/wetland grasses are in harmony as seen in the photos.



Alexx & Michael's Pond and new pump house.



Babi Yar Park channel improvements:
Above left is low flow channel restoration and plantings,
Above right shows sheet pile and grouted boulder drop structures, and
Right shows the pedestrian bridge replica boxcar.

The planning for the **West Harvard Gulch Channel and Trail Improvements** near the confluence with the South Platte River began in the mid 1990's. It has taken nearly 20 years, but in spite of many obstacles, the project team consisting of the District, Denver, and the City of Englewood achieved success in 2012 with construction of the improvements. Englewood completed the trail section within their jurisdiction in the mid 1990's. Planning began in 1997 to continue the trail east in Denver towards the South Platte River Trail. With a degraded channel corridor, private property, and the Burlington Northern Santa Fe (BNSF) Railway as obstacles, the planning did not get very far. Milestone success was achieved with the acquisition of parcels and a permanent easement from adjacent property owners in 2004.

The remaining hurdle was getting approval from the BNSF Railway to construct channel improvements within their right-of way and a pedestrian tunnel beneath their tracks. The discussion related to the channel improvements was

straightforward. The tunnel discussion was more interesting. With limited vertical separation of just a few feet between the bottom of the track and the top of the tunnel, trenchless technology was a challenging and expensive option, so open cut was the proposed construction method. Eight years and many project managers later, the BNSF Railway issued a License Agreement agreeing to cease operations for three days to enable construction of the tunnel.

With the assistance of Mike Sarmiento, Muller Engineering, L&M Construction, and BTC Construction, the channel and trail improvements have been completed. West Harvard Gulch now winds gently towards the South Platte River anchored by a riffle drop structure, a cascading boulder drop structure, and a 100-year old cottonwood tree. A secondary channel, bank improvements, and the plantings of 40 trees complete the improvements. The project restored 1000 feet of channel, 1.5 acres of grass land, and preserved one of only a few sites of original Colorado prairie grassland. A series of photos highlights the project.

Play Video



Views of the West Harvard Gulch project.



Douglas County

Laura Kroeger and I (Barbara Chongtoua) were scouting a project in Douglas County one afternoon when two residents approached us. We had noticed them previously but they seemed distant and suspicious of our presence. I believe they finally relented and decided to approach us. "What are you looking at?" one of them asked in an inquisitive tone. I explained that the channel was experiencing bed degradation and bank erosion and we were evaluating the improvements necessary to protect the resources in the area. With a sigh of relief, they chuckled. "We thought you were assessing the area for development. Well, we like what you have done so far." they exclaimed and with that, they were off, not needing further explanation. As I was writing this piece for the Flood Hazard News, I thought of this encounter as a summary of our year; uneventful (whew...) yet very meaningful. Although this was not the year of large projects, it has been a year of meaningful projects resolving "the everyday" nuisances.

The **Kinney Creek Tributary C** project retrofit an existing detention pond outlet structure and spillway. As a result of the project, private property was removed from the floodplain downstream of the detention pond. A second detention pond retrofit project was implemented in the Town of Parker for the **Twenty Mile Detention** at the confluence of Baldwin Gulch with Cherry Creek. The existing outlet structure was not functional which resulted in frequent blockage of the water quality orifices and retention of stormwater. The improvements removed the frequent nuisance ponding thus returning the open space provided by the pond to the adjacent homeowners.

A tributary outfall to **Willow Creek** in the City of Lone Tree was restored. A head cut resulting from a failing stilling basin was migrating upstream towards a trail and road crossing. Mike Sarmiento and his contractor team design built a stilling basin to arrest the head cut and facilitate energy dissipation. Among many other small projects were sediment removal projects for a series of regional detention ponds in Douglas County. Working closing with ERO Resources and the US Army Corps of Engineers, these facilities were restored to

their original capacity with minimal disruption to adjacent commercial business owners and homeowners. These were simple fixes that achieved very meaningful results. With such great partners to work with in Douglas County, getting work done has been simple and satisfying, so thanks to everyone that was involved.

Jefferson County

Early 2012 saw the completion of the **Clear Creek Improvements at Oulette Ditch**, located west of Kipling Avenue, just downstream of Prospect Park in Wheat Ridge. The Oulette Ditch, partially owned by the City of Wheat Ridge, provides irrigation water to several city parks located downstream of the project site. Clear Creek has been down-cutting over the years to the point that the river bottom was below the ditch bottom at the diversion point. As a result river flows during mid to late summer were not high enough to supply the much needed irrigation water to the City. The City requested District maintenance funds to remedy this problem.

Muller Engineering, under their on-call services contract, was selected by the District to design a grouted sloping boulder drop structure that would raise the invert of Clear



Clear Creek Improvements at Oulette Ditch

Creek high enough to check the on-going river degradation, allow low-flows to be diverted into Oulette Ditch, and not cause a rise to the regulatory 100-year floodplain elevations along Clear Creek. A boat chute was incorporated into the structure for safety concerns. On each side of the boat chute, small spill channels with pools were incorporated into the structure as water features and fish passage structures. A sediment cleanout gate was also added to the design to allow the ditch company to flush sediment that accumulates at the point of diversion.

Naranjo Civil Constructors was selected to construct the project. The first phase of construction consisted of the southern half of the drop including the boat chute. Temporary water control for this phase utilized the existing ditch and downstream wasteway to bypass river low-flows around the construction zone. Consequently, during construction of the north half of the drop, including the ditch cleanout facility, the river low-flows were flipped back to the newly constructed boat chute. Much fun was had by all while placing boulders to look as natural and pleasing to the eye as possible.

South Platte River

In 2011, the South Platte River Program addressed the unstable east bank upstream of 104th Avenue in Adams County. The bank was vertically cut, approximately 10' high and was very active. Several large trees had fallen into the scour hole at the base of the bank, creating a huge debris pile. The eddy created was a constant trash magnet and was getting steadily worse. The District contracted with Respec Water and Resources (Moser and Associates at the time) to design the bank stabilization project. The consultant was already well familiar with the area since they were in the process of designing the new 104th Ave Bridge for CDOT. The plan was to construct the stabilized bank in the fall of 2012.

Shortly after work started on the design, a maintenance request was received from Metro Wastewater Reclamation District, to stabilize that specific bank. Metro's concern was the potential impact of the river migration to the adjacent constructed wetlands, approximately 100 lf from the eroded bank. Shortly after that, Aggregate Industries (AI) also called to express their unease of the vertical bank and its proximity

to their conveyor system. AI had previously obtained a 404 Permit and had stabilized approximately 200 lf of bank, but sections upstream and downstream of this stabilized reach continued to fail. Given the maintenance request and concerns from AI, it was determined to move construction up to the spring of 2012.

Naranjo Civil Constructors was selected for the construction of the project. Since significant fill would be required to bring the toe of slope to its previous alignment, Naranjo began preparatory work to secure a dirt source several weeks before construction was scheduled.

The 404 Permit was received in early April and work began on April 19th. It is worth noting that the normal construction season, for the South Platte River runs from October 1st to April 1st of the following year. Due to significantly reduced snow pack, and the critical nature of the bank repair, it was reasonable to allow the contractor to work outside the normal date range. Naranjo was aware of the potential risks for spring events and accounted for it in their construction approaches. For example, the river was diverted to the west side using a combination of concrete barriers, riprap and in-situ material; and the majority of the work was done from the banks. Approximately 18" of well graded Type L Riprap was installed along the slope and to a depth of approximately 5' below the channel bottom. River material was washed into the voids of the riprap and the riprap along the slope was bucket compacted to present a uniform appearance. Both ends of the stabilized bank were secured with the installation of a riprap flank section that ran from the toe to the top of bank, basically creating a riprap filled trench that was 3' x 3'in width and depth.

During the duration of the project, fortunately no high flows were experienced. The project was tested during two instances over the summer of 2012. Flows reached to within 6" of the top of bank. After the flows subsided, it was gratifying to see that the washed in sand/gravel/coble mixture had held in place as designed. To date, little riprap can be seen on the stabilized slope, creating a quite natural appearance. Volunteer plants have taken root over the entire reach and cottonwood poles will be installed in February of 2013.



South Platte River before and after

The following DCM staff members contributed to this column: Bryan Kohlenberg, P.E., CFM, Senior Project Engineer; David Skuodas, P.E., CFM, LEED AP, Senior Project Engineer; Richard Borchardt, P.E., CFM, Senior Project Engineer; Barbara Chongtoun, P.E., CFM, Senior Project Engineer; Steve Materkowski, E.I., Senior Construction Manager

Information Services and Flood Warning Program Notes

Kevin Stewart, PE, Program Manager



The Lower North Fork Fire in Jefferson County destroyed 23 homes and caused \$11 million in damages. (The Denver Post | Helen H. Richardson)

Ten years ago once familiar names like Missionary Ridge, Coal Seam, and Hayman (Colorado's largest recorded wildfire) were headline news items

that prompted Colorado's governor to tell reporters, "It looks as if all of Colorado is burning." This past year—2012—was reminiscent of that terrible 2002 wildfire season when two Front Range wildfires, High Park in Larimer County and Waldo Canyon near Colorado Springs, forced the evacuation of thousands and respectively destroyed 259 and 345 homes. Both of these events surpassed the property losses experienced in Boulder County's 2010 Labor Day blaze known as the Fourmile Canyon Fire, which until this past year was considered Colorado's most costly wildfire. Closer to Denver three lives were tragically lost in Jefferson County in March in the Lower North Fork Fire that also claimed 23 homes. Another ominous-looking wildfire near Boulder in June, the Flagstaff Fire, seriously threatened nearby residents but fortunately, no homes were lost due to the rapid response of firefighters and support personnel.

The connection between wildfires and floods is generally well accepted with regard to the heightened potential for mud/rock/debris slides and the increased flash flood threat due to the absence of vegetative cover previously offered by a healthy forest; the transformation of a once deep forest duff layer to ash; and in some extremely high temperature burns, the creation of hydrophobic soil conditions. However, not all fires are created equal and consequently, knowing precisely which rainstorms pose real flash flood danger remains a challenge for forecasters as well as emergency managers. The District continues to grow in its understanding of this phenomenon and in 2012, implemented some more proactive ways to predict and detect the onset of flash floods. This experience and other accounts from the 2012 flood season are highlighted in this article.

Information services provided by the District rely heavily on a strong IT foundation. Derrick Schauer has made that

happen and continues to serve as the District's IT master, implementing equipment updates, new operating systems and software applications, and website enhancements. System security and disaster recovery remain a priority for Derrick as we roll into 2013. Be sure to visit www.udfcd.org to see Derrick's handiwork and watch for future changes.

Julia Bailey has been is the District's Information Services Engineer since 2010. Accessibility of District publications and other information via the Internet are among Julia's talents and responsibilities. She also oversees District GIS activities and facilitates staff trainings. Julia is currently working very closely with Amelia in the front office on developing new and better ways of maintaining and accessing official District records. Some useful changes to the EDM (Electronic Data Management) mapping interface are also underway. Be sure to read Julia's related article to see what lies ahead.

Jeremy Deischer is one of the District's gifted student interns who began working with the IS/FWP in 2012 and was instrumental in analyzing the ALERT system streamflow data to determine weekly, annual and record peaks (see <http://www.udfcd.org/FWP/ALERT/wl/>). He also became our executive producer for UD-Tube flood videos. Jeremy is a civil engineering graduate student at the University of Colorado at Denver.

2012 Flood Season Recap

Like the wildfire experience of 2012, the corresponding flood season also felt very similar to the notorious 2002 drought with a near record-low number of threat days (see table), high summer temperatures, and precipitation totals

26 days/25 periods with flood potential in 2012

April	26	1
May	5, 19	2
June	2, 6-7 , 7-8 , 15, 16, 27 Note: Total of six time periods over 7 days	7
July	5 , 6 , 7 , 8 , 9 , 16 , 24, 25, 27 , 29, 30 , 31	12
August	1 , 2 , 23	3
Sept	12	1

Red dates are days when rainfall measured by automated gages exceeded alarm thresholds. **Yellow highlighted dates** indicate that heavy rainfall measurements only affected areas outside the District's main area of concern, i.e. Hayman Burn Area in Douglas and Jefferson Counties, and the St. Vrain Creek basin in northern Boulder County. **Blue boxes** designate NWS flash flood watches that affected the District and **red boxes** designate flash flood warnings.

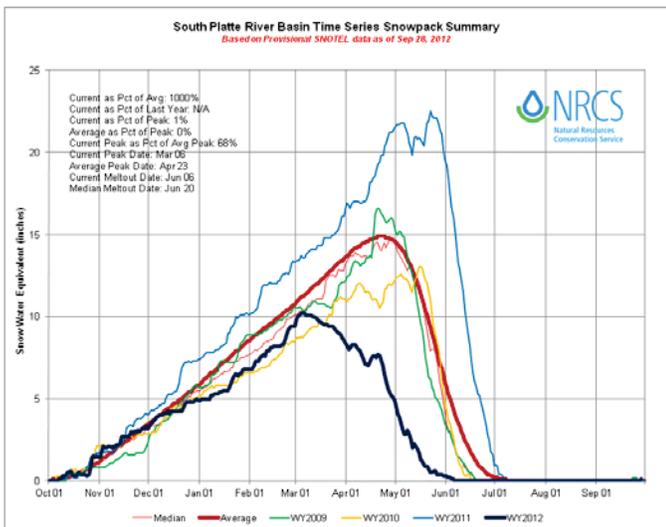
running well below average. The late evening storm of June 6-7 in Arapahoe, Douglas and Jefferson Counties was the most notable of 2012; and a much smaller event on July 30 did raise a few eyebrows when another surge of water occurred on Fourmile Creek and Fourmile Canyon Creek in Boulder County due to runoff from the Fourmile Burn Area.

Heavy rainfall activity exceeded ALERT System alarm thresholds on only 13 days in 2012 between April 15 and September 15 compared to 34 days the prior year. Specific alarm dates are shown in red in the table above. Rare post flood season rainfall rate alarms (not shown in the table) were also logged for 3 consecutive days in late September.

Twenty-four hour measured rainfall totals from the ALERT/CoCoRaHS combined dataset exceeded 3 inches on four days in 2012 (June 6; July 7, 9 & 30). Only two other days (July 6 & 8) had 24-hour rain totals between from 2 to 3 inches. A [storm summary table](#) and corresponding maps are available for every day identified as having flash flood potential. Alarm maps and tables were newly added this year to show where and when various ALERT System rainfall rate thresholds were exceeded.

The 2012 Snowpack

In stark contrast to the prior year's notably high and long-lasting mountain runoff, 2012 was uneventful for the Denver area as shown on the graph below.



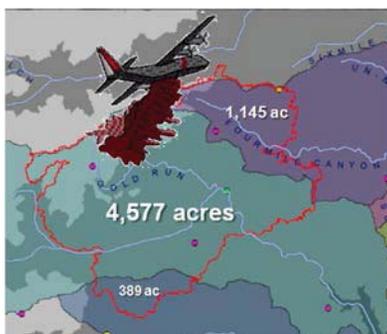
forecasters all seem well-prepared to face future threats. The Fourmile community and their neighbors have also taken significant steps to prepare for a repeat performance and other possibilities. While county officials, mountain fire districts and other support agencies deserve much credit for implementing mitigation measures, improving early warning systems and educating the citizens at highest risk, another highly motivated advocacy group—the InterMountain Alliance—merits special recognition. The IMA has played a huge part in helping the Fourmile community and other mountain towns in Boulder County prepare for the next disaster, be it fire, flood or other misfortune, and to education people on how to keep safe and accept personal responsibility when emergency situations arise. Be sure to read the article by Rebecca Lawrence in this issue of *Flood Hazard News* to learn about what the IMA has accomplished.



Prior to the 2012 flood season the District upgraded its lightning detection capabilities to assist with storm tracking and recognizing storm intensity with respect to heavy rainfall potentials. This new technology was also able to estimate strike coordinates and display archived data. Soon after the March 26 Lower North Fork Fire in Jefferson County, the District shared this capability with both Jefferson and Boulder Counties with the hope the wildfire suppression activities could also benefit. Subsequently, the Boulder Office of Emergency Management acquired their custom designed web-based application and informed State OEM officials and the governor's office of this action. News about this capability spread very quickly as the High Park and Waldo Canyon fires were raging. It is likely that many other Colorado communities have by now adapted similar tools.



The 2012 flood season had an extremely quiet start for the entire District, but this was particularly true with respect to the Fourmile Burn Area where officials stood ready for more flooding from relatively small rainstorms. April, May



SPECIAL REPORT: The Fourmile Burn Area Flood Threat Two Years Later

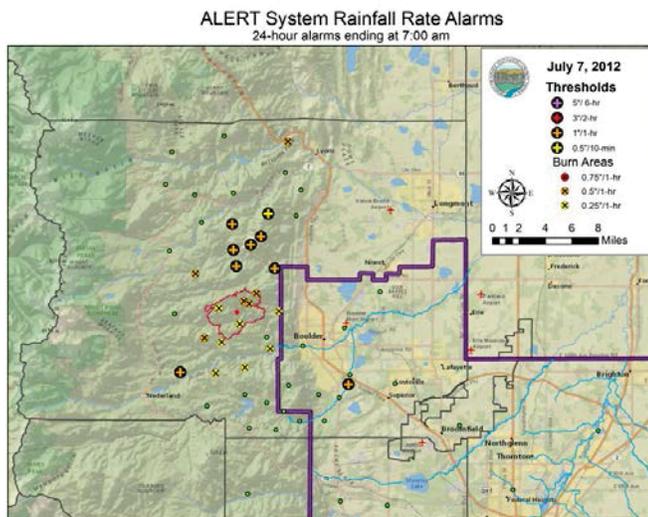
With the July 13 flash flood experience now behind us (see [2011 Flood Hazard News](#)), Boulder County's first responders, emergency managers, and flood

and June passed without incident in Boulder County and then the summer monsoon made its appearance the day after July 4th with a string of five consecutive threat days.

On Thursday, **July 5**, the NWS issued its first flash flood warning of the season for the FMBA at 4:17 PM. Ten-minute rainfall intensities of 3.5 inches/hour were measured over the burn area with rain totals approaching 1-inch. Fourmile Creek rose 1.3 feet at the Salina gage, peaking at 5 PM. Only minor flooding was reported from this event with a mudslide forcing the closure of Fourmile Canyon Drive (see [UD-Tube news video](#)).

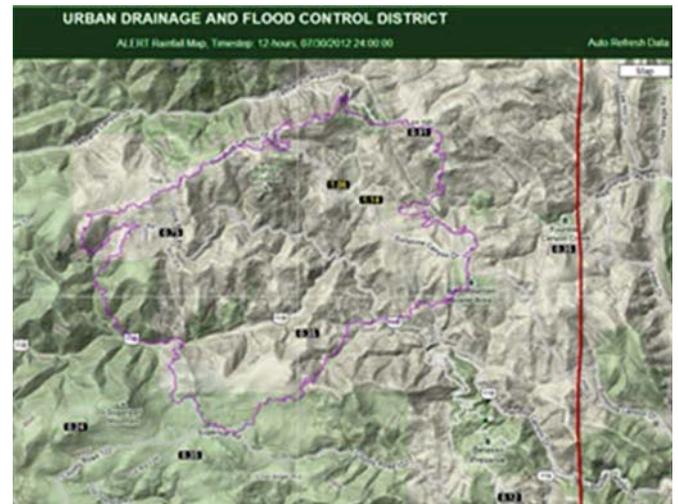
The next day, **July 6**, was a repeat performance with another FMBA-only flash flood warning being issued at 9:06 PM. While rain totals this day exceeded 1-inch, the rainfall rates were much less than the preceding day (maximum 10-minute intensities < 1 inch/hour). Many low threshold rain alarms occurred within a 5-mile radius of the FMBA, but no flooding was reported.

Saturday, **July 7**, produced the greatest flooding threat of the 5-day period. Runoff from rainfall (not snowmelt) caused Boulder Creek to experience its highest peak flow rates of the year with flows through the City of Boulder rising from about 200 cfs to over 650 cfs by 6:30 PM causing streamside trails to overtop. Earlier the NWS issued a flash flood warning at 3:41 PM for the Nederland area and another warning at 4:53 PM for the FMBA, although no noteworthy flooding happened there. A 3.19-inch measurement was reported by the St. Antons rain gage northeast of Nederland while gauges in the FMBA once again approached the 1" mark, with the Lee Hill gauge reporting the highest total of 1.06". Peak 10-minute intensities in the FMBA were less than 1.7" per hour. Many rainfall alarms were triggered by this close-call event.



By Sunday, **July 8**, the forecast heavy rain threat was more focused on the plains, prompting the NWS to issue an area-wide flash flood watch beginning at 11 AM. The City of Boulder was the best target this day, thus giving the

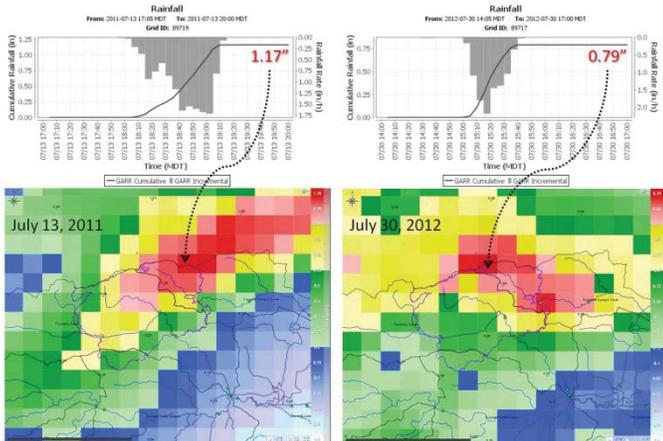
mountain communities a break from the past 3 days. One CoCoRaHS observer in Boulder recorded a 24-hour rainfall amount of 2.15", but no serious flood problems were reported. The next day, **July 9**, the heavy rain threat moved to south out of Boulder County beginning a week-long dry spell. On Monday, **July 16**, an uneventful short-lived intense thunderstorm passed over the FMBA prompting the NWS to issue another flash flood warning for just the burn area at 4:34 PM. Measured rainfall totals were under 0.6"



After a 2-week hiatus another relatively small rainstorm (see map above) produced the largest runoff of the year from the FMBA. This event occurred on Monday, **July 30**, between 3 and 4 PM, once again prompting the NWS to issue a FMBA-only flash flood warning at 3:27 PM. The rainfall totals were about the same as earlier events, but the rainfall intensities were significantly higher. Peak 10-minute intensities (>5"/hr) were more than twice as high as the storms in early July. Boulder's OEM Director, Mike Chard, requested flood forecasting assistance from District staff at 3:23 PM. The real-time hydromodels that were calibrated after the July 13, 2011 flash flood proved valuable in making accurate flood predictions. Once this information was communicated to EOC officials, field personnel were sent to monitor the situation well ahead of the flooding enabling Boulder County Sheriff's Department and Open Space officials to close public access to trails and capture a very nice [video](#) (use Chrome browser) of flooding along the Anne U. White trail on Fourmile Canyon Creek.

Post flood season analysis was completed by Vieux, Inc. of Norman, Oklahoma at the request of the District. They were asked to compare hydromodel results from the July 13, 2011 event to July 30, 2012, and to evaluate the potential for increasing forecast lead times by using radar-derived 60-minute future rainfall estimates as opposed to real-time estimates. Initial findings suggest that an additional 40 minutes of lead time is possible depending on the availability of radar data for an approaching storm. For storms that

Rainfall Comparison



essentially form over the FMBA like the July 30 event, the additional lead time from QPF (Quantitative Precipitation Forecast) radar would be far less. [Click here](#) to read the Vieux report.

Vegetative recovery in the FMBA appears to be progressing well-ahead of expectations as compared to 2002-Hayman and 1996-Buffalo Creek according to paleoflood expert Bob Jarrett, USGS Scientist Emeritus retired. This is certainly good news for the affected residents, but Bob also cautions that it is still a bit too early to let our guard down completely.

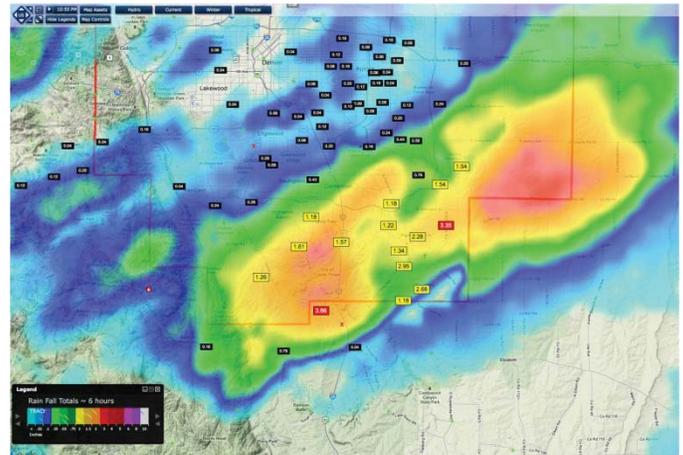
One final note—the District, the Colorado Water Conservation Board, the Boulder Office of Emergency Management, and Boulder County provided funding for a video website entitled: “Building Resilient Communities in the Wildland Interface.” This project examines recent Front Range wildland fires and uses the 2010 Fourmile Fire in Boulder County as a case study of risk preparedness, response and recovery. Issues like wildfire and flash flood risk and public water supply are reviewed as well as agency coordination, recovery management, community engagement, and mitigation efforts for specific risks. The website will be released for public viewing soon. The District will post a link from our [Flood Safety](#) webpage.

Noteworthy Events Elsewhere in the District

In a gallant attempt to make up for an extremely dry spring, a late evening storm arrived on D-Day, **June 6**, and carried on during the early AM hours of Thursday, **June 7**. This storm primarily affected Jefferson, Douglas and Arapahoe Counties; and to a lesser degree Denver. It was clearly the District’s biggest event of the year with lots of hail, a tornado warning for Jefferson County and record flooding for the Town of Parker. Five-inch precipitation totals were reported in the Castle Pines area of Douglas County. Tallman Gulch in Parker produced record flooding and the highest estimated flow rates in terms of flood frequency.

High water impacted the City of Aurora in the Piney Creek and Sand Creek basins. Many ALERT gages experienced their annual peaks from this event. Leonard Rice Engineers prepared a report of the flood damages, conducted high water surveys and estimated flood peaks at many locations at the District’s request. [Click here](#) to view this report.

The **June 7-8** event was also the first NWS flash flood warning that affected the District in 2012. The initial warning was issued at 7:16 PM for NW Elbert County, NE Douglas County and western Arapahoe County. A maximum 5-minute rainfall intensity of 7.5” per hour was reported by the ALERT weather station at Salisbury Park in Parker with 0.63 inches falling in that short time period ending at 8:43 PM. The following map shows where the heaviest rainfall occurred:



Monday, **July 9**, was the fifth consecutive day of monsoon rainfall. On this day an unusual morning event occurred in Denver prompting F2P2 forecasters to issue a low impact flooding message. The peak flow measured on Cherry Creek at Champa Street at 10:50 AM was the annual high water event of the year at that location.

Wednesday, **September 12**, was the last hurrah for the 2012 F2P2 with Denver being issued a special “Cherry Creek Trail Flood Advisory” for low impact flooding due to a general wide-spread low-intensity rainfall over the region.

For more [Message Day](#) information on rainfall amounts, alarms, and areas impacted visit the Flash Flood Prediction Program [2012 Season Summary](#) webpage. [Streamflow](#) and [rainfall](#) intensity summaries are also available online.

Early Flood Prediction and Notification Services

Meteorological support was provided by Genesis Weather Solutions in partnership with Skyview Weather for the sixth consecutive year. This program provides District local governments with early predictions of potential and imminent flood threats along with a variety of related forecast products like daily heavy precipitation outlooks, area-specific quantitative precipitation forecasts (QPF), and storm track maps. Project manager and chief meteorologist

Bryan Rappolt completed his 19th year of service. Bryan's Skyview partners included lead forecaster Brad Simmons, met-techs Jeffrey Auger, Chris Brinson, and Jorel Torres, with Skyview's President Tim Tonge providing backup from his business location and forecast center in Castle Rock. This District program was established after the deadly 1976 Big Thompson Canyon flash flood and has served the Denver/Boulder metropolitan area for the past 34 years.

The Flash Flood Prediction Program, a.k.a. F2P2, operates from April 15 through September 15 in close partnership with the National Weather Service Forecast Office in Boulder. The F2P2 forecasts and early notifications focus primarily on heavy rain threats over approximately 3,000 square miles covering the District and watersheds upstream. During the mountain snowmelt runoff season from late spring to early summer, local governments are also kept advised concerning stream conditions and how those high flows increase the flood potential when heavy rain threatens. F2P2 notifications concerning high reservoir releases by the Tri-Lakes Office of the U.S. Army Corps of Engineers from Chatfield, Cherry Creek and Bear Creek dams are also disseminated to affected jurisdictions downstream.

F2P2 products and services were evaluated for the sixth consecutive year by Judy Peratt of JP Consulting, located in Windsor, Colorado. Judy was the director of emergency management in Jefferson County for many years. Her face-to-face interview process has helped the District learn more about what works well and what could use improvement from an end-user perspective. The District greatly appreciates the valuable time taken by all the participating local officials representing emergency management, communications, public works and emergency services.

Upon completion of Judy's survey, the program changes made for 2012 were declared a success. All standard message forms were revised and sectioned to more clearly communicate where, when, and what predicted flood threats means. Use of plain language was made a priority with terms like "Red Flood Alert" being replaced by "Low Impact Flooding." While more individualized training for 911 dispatchers is desired, the F2P2 message products have certainly set a new high standard with only very minor formatting changes being suggested for 2013. A complete archive of these and other F2P2 products can be found at f2p2.udfcd.org.

CoCoRaHS Update

The Community Collaborative Rain, Hail & Snow Network continues to grow in popularity national-wide and now has over 10,000 volunteers in all 50 states and Canada. New to CoCoRaHS in 2012 is a unique relationship with the PRISM Climate Portal developed by Oregon State University. This exclusive feature is only available to CoCoRaHS participants. It helps connect daily precipitation measurements (*weather*) to seasonal patterns, long term averages and year to year

variations (*climate*). This portal provides access to estimates of "normal" precipitation for any location in the contiguous United States. PRISM also provides estimates of total precipitation for each month and year since 1895. So if you are not currently a volunteer, this may motivate you to sign up today.

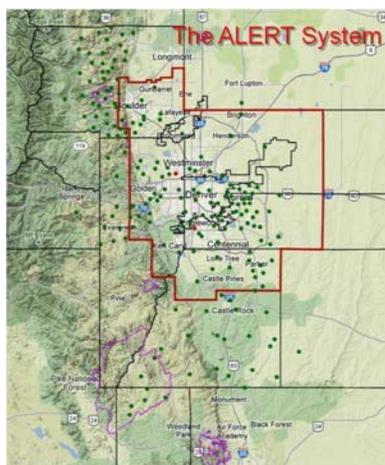


[Click here](#) to view a series of slides illustrating how PRISM can be used at a specific CoCoRaHS station (red star above) in Douglas County by putting into context the rainfall event of June 6, 2012.

The District has been a long-term sponsor of CoCoRaHS and routinely makes use of this valuable resource. The past 6 years of [storm summary maps](#) are good examples. See also the ALERT/CoCoRaHS display feature at the District's [ALERT Rainfall Map](#) webpage. And finally, be sure to visit www.cocorahs.org to become a CoCoRaHS volunteer.

EMWIN-Denver Update

The Emergency Managers Weather Information Network continues to provide 22 northeast Colorado communities with timely NWS weather warnings and advisories. EMWIN-Denver's steering committee meets quarterly under the



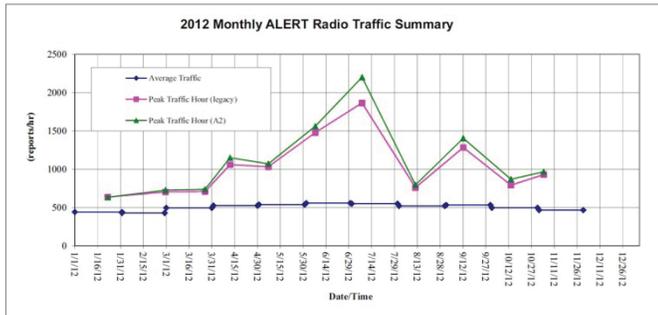
leadership of Rick Newman, Deputy Director of Emergency Management for Jefferson County. Julia Bailey and Kevin Stewart of UDFCD's staff are members of the steering committee. Adams County hosts the satellite downlink equipment, which is linked to a message dissemination server hosted by the District.

UDFCD also supports the email subscription service for this regional system.

ALERT System News

The ALERT system currently collects data from 225 gaging stations that host 194 rain gages, 107 stream gages and 26 full weather stations. The gaging network experienced some growth in 2012. On the District’s south side, the Douglas County Public Works Department installed two new stations in the upper Cherry Creek watershed above Castlewood Canyon State Park at the Colorado Highway 83 crossings of Antelope Creek and West Cherry Creek. Both stations measure water levels of their respective streams. The West Cherry Creek station also hosts a suite of weather sensors including a rain gage. In Boulder County the District installed two new rain gages at Lee Hill and Whispering Pines in the Fourmile Burn Area to further enhance early flood detection for this high risk area.

OneRain and Water & Earth Technologies (WET) provided preventative maintenance and repair services for 2012, enabling the District to successfully process a high volume of ALERT data reports. For example, the storm activity on July 7 caused a peak 10-minute traffic rate that exceeded 2,946 reports per hour (RPH) between 5:07 and 5:17 PM. Another noteworthy event was a 1,000-plus RPH rate that was sustained for more than 6 hours between 4 and 11am on 9/12. The figure below shows the peak and average hourly ALERT radio traffic for the year. Annual reports and other documents concerning 2012 maintenance activities can be downloaded from the ALERT_Reports directory.



In 2012 the District made some significant changes with regard to how ALERT base stations will be managed in the future with the transition from NovaStar4 to NovaStar5 nearing its final stages. Most of the 12-year-old NS4 platforms previously supported by the District have already been discontinued. These include the base stations located in Boulder, Denver and Lakewood. The new NS-5 platforms make Internet data communications the preferred delivery method, thus eliminating the need to maintain a large number of radio receivers and data collection points. When completed, the District will maintain only three radio reception stations with their corresponding data collection platforms. For critical facility end-users like local government

EOC’s and dispatch centers, redundant Internet links can be established using either cellular or satellite communications.

Two different types of servers are currently supported. The public website that can be accessed from the District’s homepage is a [Contrail Web](#) platform developed and maintained by OneRain. Two redundant NS5 platforms were developed primarily for public safety agency use. These platforms are maintained by WET. Both base station types ingest data from satellite-monitored stream gages operated by the USGS. In 2013 we may also include data collected by the Colorado Division of Water Resources (DWR), or at least provide convenient links to this data from our websites.

Text/email messaging continues to be a popular means for receiving alarm notifications from the ALERT System. The USGS also provides a convenient way to receive alarms from their stations known as WaterAlert. Anyone interested in receiving USGS stream level alerts should sign up at <http://water.usgs.gov/wateralert>.



The District believes it is well-positioned to continue providing quality information services to all of our partners and the public. Your ideas on how we might better serve are always welcome.

Resources

A complete archive of daily forecasts, flood threat notifications, storm track predictions, storm summary maps, and other products can be found at f2p2.udfcd.org. See www.udfcd.org/FWP/ALERT/wi/annual_peaks.xlsx for an up-to-date table of annual and record water level/streamflow peaks measured by the ALERT system. For detailed operation and maintenance reports visit:

- www.udfcd.org/FWP/ALERT_Reports/ and
- www.udfcd.org/FWP/F2P2_Reports/

Electronic Data Management Application Update

Julia Bailey, Information Services Engineer, Information Services and Flood Warning Program



Developmental symbology of new project lines and study areas.

Exciting new updates to the District's web map application will be ready for testing in January 2013. The application has been used to find and retrieve District report documents since 2010. The current application has three different ways to find documents using the web interface: enter text attributes in the search form, click on a stream or basin feature to return all related documents, or click on a report specific feature to open one of the three report types: Outfall Systems Plan, As Built, or Design Report. The report specific features are color coded dots that represent the centroid of a report drawing. When reports are opened using this search method, they open to the page represented by the centroid dots. This process will soon be replaced.



Page centroid dots do not adequately describe the study or project areas.

There are three reasons to replace the report dots. First, lines and polygons better describe project and study limits. Second, some report formats have changed and now embed drawing pages which cannot be linked to directly. Third, dot layers do not exist for all report types.

In an effort to simplify the design while providing more accurate map information, the report dots are being replaced by a Design, Construction, and Maintenance Projects line layer and a Master Planning Studies polygon layer. Multiple documents can be linked to a single feature. For example, both the As Built and Design Report for a project can be linked to from the same project line.

Also new in this development phase, the Maintenance Eligibility layers are now clickable. A popup will appear and display the project name, acceptance level, and District identification numbers.



This airport feature is covering up aerial information that is important in defining a maintenance eligibility project on the property.

Users have the ability to control whether a layer is visible or not through the table of contents (TOC). There are several new layers being added to the TOC. Currently the map includes lake and airport features, however, these features are opaque and not part of the TOC. Since these layers are opaque, users are not able to obtain ground information from the map as shown in Figure 3. Four layers will be added to the TOC with 50% transparency: Lakes, Airports, Municipalities, and Counties. As always comments are appreciated (Email: Jbailey@udfcd.org).



Like The Phoenix Rising Out of the Ashes

By Rebecca Lawrence, [InterMountain Alliance](#), Ward, CO

On Labor Day Monday, September 6th, 2010, a wildfire broke out in the rural Fourmile Canyon area west of Boulder, Colorado. Dry conditions combined with excessively high winds fanning the flames, led to an explosive situation. By the time total containment was reached 6,200 acres had been consumed, 168 homes were completely destroyed and thousands of residents had been displaced/evacuated. Fortunately no lives were lost. This unexpected Class 1 Federal Disaster has taught the rural Rocky Mountain residents a lot about emergency preparedness.

In March of 2011 mayors and citizen leaders from six surrounding mountain communities; Nederland, Gold Hill, Ward, Jamestown, Allenspark and Lyons, held the first meeting of the InterMountain Alliance (IMA). Unincorporated historic Gold Hill (population-230, altitude- 8,300 feet) lost over 20 homes and had been directly threatened by a 100' wall of flame. Because of this, the IMA convened to learn lessons from the leaders in Gold Hill about their emergency response; what was in place prior to the fire, what was put in place during the fire, and what was being created after the fire. The IMA participants began to review and share their community preparedness plans.

The first step was to meet with local fire chiefs and law enforcement officials to present the desire to create volunteer action groups that would complement and support their efforts. It needed to be done in a way that would insure public safety and allow them to focus on the situation at hand. One chief shared a scenario in which he wished he could have called someone when one of his volunteer fire fighters was worried about his dog, who been left behind in his home and was potentially in harm's way. The chief wanted someone in his community he could contact to evacuate the dog so his firefighter could continue to focus on his own safety and the front line of the fire. This example led the group to

look at the many ways community members could assist and simultaneously maintain public safety. The following emerged:

Basic Preparedness

1) Individual Family

Citizens cannot reach out to assist their communities until they know their own families are safe. Staff from the [Boulder Office of Emergency Management](#) (OEM) made themselves available to present information to community groups about individual/family emergency preparedness planning. This included lists of items to pack in a "go kit" (i.e. paperwork such as car titles, insurance information, prescription medication, family photos, clothing, water, snacks).

Being familiar with the school district's emergency evacuation plans is an important part of family planning, as well as designating a safe location where the family will meet if they are separated when an emergency occurs.

2) Neighborhood

Knowing one's neighbors, the number of members in the household, any special needs (i.e. disabilities, medical conditions and critically needed medications), the number of animals in the household that may require evacuation, and contact information (work/cell phone numbers) is key in an emergency situation. Gold Hill developed a Neighbor Link Program which has a "pod" leader for every 8 to 10 households. The leader gathers pertinent information about the members within his/her "pod". A phone tree is also set up within that "pod" and between other "pods" in town. The other IMA members took this Neighbor Link concept, made modifications to better suit their locales and applied them to their own communities.

During this process it became apparent that it is important to respect individual privacy and allow community members to select their level of

involvement. Many of the rural inhabitants chose their living situation to protect/maintain their privacy. Their choice not to participate has to be respected. No matter how important this seemed to the organizers it was important to remember that “not everyone has to play if they don’t want to.”

3) Community

The communities participating in the IMA vary greatly in population (from 150 to 2,033), geographical terrain and local governmental infrastructures (two are unincorporated). Each one began taking inventory of local assets. The larger towns have schools, community centers, local summer camps, etc. that can be used as information centers (Safe Sites) or even Red Cross shelters. It became apparent that the local rural populations prefer to stay in the mountains, if at all possible, making local resource exploration a crucial task.

The Boulder County Sheriff’s Office, OEM and local fire departments stepped forward to support the IMA efforts with the attitude of “what do you need from us?” vs. “here is what you have to do.” They were instrumental in helping make connections to county offices/staff, resource information and training opportunities.

Trainings were offered to local residents in Weather Spotting (see Flood Preparedness), HAM Radio operation (see MERN) and First Aid/CPR. These classes continue to be offered as citizen interest increases.

Large and small animal evacuation scenarios were reviewed. The Boulder County Sheriff’s Department Animal Protection staff members shared resource information with local organizers. An agreement between the Sheriffs of Boulder County and neighboring Gilpin County was reached in regards to using the Gilpin County Fairgrounds, located in the mountains, as an alternate animal evacuation site in the event that routes to the Boulder County Fairgrounds, down in the plains, were cut off.

Three sheds were provided by the OEM to selected rural mountain locations. These sheds house backup generators and emergency supplies in the event that access is temporarily cut off from the resources down in the plains. Lists of locally accessible large equipment (i.e. backhoes, earthmovers, large trucks) and licensed operators were compiled, again in the event that supply routes

were cut off and the equipment was needed during the emergency response effort.

As leaders emerge to organize specific areas, the planned approach is to build the leadership role two to three people deep so the onus doesn’t fall on any one person. This is done to insure that the success of implementation doesn’t hinge on one individual’s presence. It was important to ask each organizer if his/her portion could stand alone, without their being in the lead.

The Fourmile Canyon Fire exposed how quickly neighborhoods and communities are scattered in the event of an evacuation. Preserving that cohesiveness and support for victims is a challenge both during and after an evacuation. Some of the neighborhoods were totally destroyed. Some returned to rebuild afterwards and others never came back. Some didn’t lose their homes, but as neighboring houses were lost they lost their community. During the fire, as well as after, the town websites had been either created or modified to keep people informed and to maintain the sense of community despite physical separation. Residents are able to stay informed about evacuation status, community meeting locations in other parts of the county, emergency supply centers for food/clothing/shelter, links to related websites and services.

Communication

Information is gold in an emergency situation. The IMA members looked at the various levels of communication:

- Between the fire chiefs/fire department to local residents
- Between the residents/among neighborhoods
- Between Law Enforcement/Emergency Services and communities
- Between mountain communities/IMA members

The loss of communication for residents at the onset of the fire due to downed telephone and power lines along with already sporadic cell phone coverage in the rugged mountain terrain made it difficult to provide or receive accurate information. In this age of social media it was difficult to stop the “rumor mill”, which in this scenario as people were looking at evacuation routes, could have cost lives.

In reviewing the Fourmile Canyon Fire operations, the key role Boulder County Amateur Radio Emergency Services (BCARES) members played

in providing information to emergency services was apparent. At one time during the fire two BCARES members were able to radio in and provide authorities with GPS coordinates for a slurry drop to save a house from the encroaching fire. It was a situation that only they could see from their vantage point, at a safe distance, high above the fire. BCARES has their own table in the OEM Command Post to provide information through their network of HAM radio volunteers.

The IMA began to look at this BCARES model of collecting and providing accurate, updated information by using equipment that can work in the mountains when other forms of communication are lost. Also key is the fact that it is a volunteer staffed effort. This was the beginning of the Mountain Emergency Radio Network (MERN).

Mountain Emergency Radio Network (MERN)

Since communication can be so easily lost in the mountains it made sense to turn to BCARES given their established success in providing accurate information to the OEM and law enforcement during emergencies. The idea emerged to train volunteers in the mountain communities in HAM radio operation. Classes were held in basic radio operation to obtain an FCC license. These classes were taught by BCARES members, who also administered the subsequent licensure test. Additional training was then provided regarding equipment operation and how the MERN participants can dovetail with BCARES and the OEM during an emergency situation.

Because emergency radio frequencies were changed from wideband to narrowband as the result of an FCC directive, many of the local fire departments had obsolete equipment. Thus they were able to donate radios to the MERN project. These older radio sets were converted for HAM radio use, making it possible to give equipment to the newly licensed volunteer operators, thus avoiding excessive personal out of pocket expenditures.

Grant money and private party donations also funded the installation of repeaters at strategic mountain locations. This effort is ongoing to ensure HAM radio connection between the mountain communities and emergency personnel in Boulder. There are currently over 60 licensed HAM MERN operators and the goal is to reach 100 by the spring of 2013.

Flood Preparedness in the Fourmile Burn Area

The community emergency preparedness efforts for potential wildfires also led to planning for eminent flooding danger in the Fourmile Canyon Fire burn area caused by loss of vegetation. The OEM developed a warning system through Everbridge, the local reverse 911 calling service, to contact homes in high flood risk areas giving one of four possible warning messages, which range from “flood watch” to “immediate evacuation- seek higher ground.” Updated information is also provided to OEM and the National Weather Service by the network of 50+ trained Weather Spotters from the nearby communities of Nederland, Gold Hill and Ward (all situated at elevations above and west of the Fourmile burn area). One hundred twenty weather radios were given to households identified by the Fourmile Fire Chief as being directly in harm’s way during a flood. These radios were funded by Foothills United Way in Boulder as part of their Fourmile fire recovery efforts.

Gold Hill, which is the closest community to the Fourmile area, combined their Neighbor Link Program with their Safe Site efforts to create Safe Link. This gives evacuated flood victims a short term place to convene away from flood danger to get a cup of coffee, a snack, and most importantly, obtain information. The Safe Link volunteers will keep track of who has utilized the Safe Link facilities and share that information with the OEM and local emergency personnel. This will help authorities account for those who have evacuated and those whose whereabouts are still unknown. In addition, the evacuees can be matched with pre-identified Gold Hill residents (approximately 20) willing to open up their private residences to those who need immediate housing. This also addresses the reluctance of residents to leave the mountains by giving them shelter in a neighboring community located away of the flood’s path.

Mitigation Efforts

In 2013 the IMA will also begin focusing their efforts on fuel mitigation in the mountainous regions of western Boulder County that encompasses the IMA communities. Predictions for continuing drought conditions combined with trees downed by recent beetle-kill make this a high priority. The effort will begin by sitting down with staff from the Boulder County Forest Health office and representatives from the U.S. Forest Service to explore ways in which all levels of effort can be

combined. This would include local grassroots “Saws and Slaws” events (where neighbors gather to mitigate properties followed by a potluck) and to formalized approaches in reducing slash on USFS land.

Conclusion

The IMA continues to meet monthly and has been recognized by state senators and county agencies as a means for opening dialog with the rural mountain communities. This has also created an avenue to provide needed human resources in previously unidentified regions. Efforts to promote community emergency preparedness plans are ongoing and ever evolving. It is important to adhere to the KISS (Keep It Simple and Sustainable) approach on all levels.

The greatest benefit has been the open communication that now exists between the individual mountain communities. This continues to grow as word spreads about the IMA activities. It has fostered respect and an understanding regarding the varying strengths each town has to offer each other. Our definition of “community” has broadened beyond town limits and personal boundaries, like the Phoenix from the Ashes.

Related Web Sites

For updated information on Mountain Community Resources, IMA meetings, the MERN project, and IMA community member activities visit bouldermountainresources.org.

For information on organizing a “Saws and Slaws” event go to sawsandslaws.com.

More photos of Parker Jordan Centennial Open Space



2012 Professional Activities of District Staff

Paul Hindman, Executive Director

- *Co-Chair of Cherry Creek Stewardship Partners annual “Run for the Watershed”
- *Chapter Delegate, American Public Works Association (APWA) Colorado Chapter
- *Chair, APWA National House of Delegates
- *Chair, APWA National Water Resource Committee
- *Appointed “Public Works Leadership Fellow”, APWA Donald C. Stone Center
- *Board Member, Colorado County Officials and Employees Retirement Association

Bill DeGroot, Manager, Floodplain Management Program

- *Board Member of the National Association of Flood and Stormwater Management Agencies (NAFSMA).
- *Attended the ASFPM annual conference in San Antonio in May.
- *Presented *Keeping Track of CLOMR's, LOMR's and the Projects that Drive Them* with Joanna Czarnecka at the CASFM Annual Conference in Steamboat Springs, Colorado in September.
- *Attended NAFSMA's annual meeting in August in Coeur D'Alene, ID.
- *Represented NAFSMA as a member of FEMA's Operating Partners Focus Group, which meets quarterly with representatives from FEMA, their Risk MAP contractors, NAFSMA and ASFPM to discuss Risk MAP and other mapping issues.
- *Presented *Wise Use of Floodplains, The Denver Area Experience* at the Wise Floodplain Use Conference hosted by the University of California at Berkeley and the Army Corps of Engineers, March.
- *Presented *Maintenance Eligibility Program Updates* with David Mallory at the District's annual seminar in April.
- *Attended the Natural Hazards Workshop held in Broomfield, July.
- *Became a Life Member of American Society of Civil Engineers (ASCE)
- *Member of Association of State Floodplain Managers (ASFPM), Colorado Association of Stormwater and Floodplain Managers (CASFM), Natural Hazard Mitigation Association (NHMA) and American Public Works Association (APWA)

Kevin Stewart, Manager, Information Services and Flood Warning Program

- * National Hydrologic Warning Council (NHWC) Board Member and Past President
- *U.S. Department of the Interior Advisory Committee on Water Information, Subcommittee on Hydrology
- *Member of ASCE, APWA, ASFPM, CASFM, American Meteorological Society (AMS), and Colorado Emergency Management Association
- *Participant at AMS Weather & Climate Enterprise Commission Steering Committee meeting in New Orleans, LA in January.
- *Presented *When the Flood Threat is Imminent—in the Aftermath of the Fourmile Canyon Fire* at National Flood Workshop in Houston, TX in February.
- *Presented *When the Flood Threat is Imminent—in the Aftermath of the Fourmile Canyon Fire* at National Flood Workshop in Houston, TX in February.
- *Participant at National Weather Service Interactive Weather Team Workshop in Colorado Springs in April.
- *Presented *The 2010 Fourmile Canyon Fire—One Year and One Flood Later* at UDFCD Annual Seminar in Denver in April.
- *Invited panelist at 37th Annual Natural Hazards Research and Applications Workshop in Broomfield and interpretive tour guide at the evening social hosted by NCAR's Mesa Lab in Boulder in July.
- *Featured speaker on the increased flash flood threat following Front Range wildfires at Denver-Boulder AMS Chapter meeting in Boulder in November.

Ken MacKenzie, Manager, Master Planning Program

- * Participated in U.S. Environmental Protection Agency's (EPA) *National Workshop on Achieving Water Quality Objectives through Integrated Municipal Stormwater and Wastewater Plans* on February 15 in Kansas City, KS.
- *Moderator of the UDFCD Annual Seminar on April 10 in Denver, CO; presented *Physical Modeling of Median Inlets* with Dr. James Guo, presented *Full Spectrum Detention Sizing Methods* with Jim Wulliman and Ryan Taylor (Muller Engineering)
- *Presented EPA's Integrated Municipal Stormwater and Wastewater Planning Approach at the NAFSMA annual meeting in August in Coeur D'Alene, ID.
- *Presented *What is the Correct Volume of Runoff to Retain? A Simple Free Tool Removes The Guesswork* on August 22 at StormCon in Denver, CO.
- *Presented *“Stream Stabilization: the “Best(est)” Management Practice”* with Laura Kroeger on October 10 at the Colorado Watershed Assembly in Avon CO.

- *Served on the board of directors of the Urban Watershed Research Institute (UWRI).
- *Co-instructor for training course on *Urban Flood Channel Design and Rehabilitation* for UWRI in September.
- *Co-instructor for training course on *Stormwater Best Management Practices* for UWRI in October.
- *Served on the Urban Water Resources Research Council and Low Impact Development Committee of the ASCE Environmental & Water Resources Institute.
- *Served on Water & Environment Research Foundation (WERF) committee creating a model to link stormwater BMP systems performance to receiving stream protection.
- *Co-chaired the NAFSMA Stormwater Committee with Brent Johnson (Knoxville, TN).
- *Served on the CASFM Stormwater Committee.
- *Member of ASCE, ASFP, CASFM, & NAFSMA.

David Bennetts, Manager, Design, Construction & Maintenance Program

- *Co-presented *Temporary Diversion Sizing When Working in Drainageways* with Shannon Tillack at the District's annual Seminar in April
- *Attended ASFP's Annual Conference in May in San Antonio
- *Attended APWA's Annual Management Conference in May in Denver
- *Attended NAFSMA's Annual Conference in August in Coeur d'Alene
- *Attended the StormCon Annual Conference in August in Denver
- *Co-Presented *Babi Yar Tributary Project* with Barbara Chongtoua at CASFM Metro Social in September in Denver
- *Co-Presented *Temporary Diversion Sizing When Working in Drainageways* with Shannon Tillack at CASFM's Annual Conference in September in Steamboat Springs
- *Co-Presented *West Harvard Gulch Rehabilitation – Tale of a Creek, a Railroad, a Cottonwood, and Bricks* with Carolyn Roan, Deb Keammerer, and Jim Wulliman at CASFM's Annual Conference in September in Steamboat Springs
- *Panelist on *Protecting & Restoring Our Watersheds Practitioner Dialogue* Panel Discussion at the Sustaining Colorado Watersheds Conference in October in Vail
- *Council Member, CU Denver Engineering Leadership Council and Construction Engineering and Management Advisory Board
- *Served on the NAFSMA Flood Management Committee
- *Chair, Colorado Association of Stormwater and Floodplain Managers (CASFM)
- *Member of ASCE, APWA, ASFP, CASFM

Laura A. Kroeger, Assistant Manager, Design, Construction & Maintenance Program

- * Colorado Chapter APWA At-Large Board Member
- *Colorado Chapter APWA Education Chair
- *ACEC Scholarship Committee
- *Presented *Stabilizing Marcy Gulch, Importance of Stream Stabilization in Urban Watershed Management* with Forrest Dykstra (Highlands Ranch Metro District), Derek Johns (Muller) and Andy Pultorak (Muller) at StormCon in Denver in August
- *Presented *Stream Stabilization: The Best(est) Management Practice*, with Ken MacKenzie at Colorado Watershed Assembly Conference in Avon in October

Bryan Kohlenberg, Senior Project Engineer, Design, Construction & Maintenance Program

- * Continued as National Society of Professional Engineers' (NSPE) scoring coordinator for the Jefferson County, North Metro and Colorado State MATHCOUNTS competitions for 6th, 7th and 8th graders
- *Member of American Society of Civil Engineers (ASCE), Chi Epsilon, Colorado Association of Stormwater and Floodplain Managers (CASFM), American Public Works Association (APWA), Association of State Floodplain Managers (ASFP), and International Erosion Control Association (IECA)
- * Co-presented *South Platte River and Lower Lakewood Gulch Improvement Project* at CASFM Annual Conference in Steamboat, September, in consideration for 2012 Grand Award
- *Obtained certification for ASFP Certified Floodplain Manager (CFM)

David Mallory, Senior Project Engineer, Floodplain Management Program

- * Co-chair of the Floodplain Management Committee of the National Association of Flood and Stormwater Management Agencies (NAFSMA).
- *Board Member of the Natural Hazard Mitigation Association (NHMA).
- *Additional Memberships in the Association of State Floodplain Managers (ASFP), and the American Public Works Association (APWA).

- *Member of the Core Writing Team for the National Mitigation Framework Plan pursuant to Presidential Policy Directive 8, National Preparedness signed by President Obama on March 8, 2011. Participated in the Stakeholders Workshop and Writing Event in Kansas City, January.
- *Participated in the Flood Technologies panel discussion at the Wise Floodplain Use Conference hosted by the University of California at Berkeley and the Army Corps of Engineers, March.
- *Presented *Maintenance Eligibility Program Updates* with Bill DeGroot at the UDFCD Annual Seminar in Denver, April.
- *Presented “*Digital Letter of Map Change Guidelines*” with Terri Fead at the CASFM Lunch and Learn session in Denver, April.
- *Presented *Ode to Riparian Floodplains, Protect and Be Protected* with Julie Ash at the Boulder County Nature Association Ecosystem Symposium in Boulder, April.
- *Presented *Ode to Riparian Floodplains, Protect and Be Protected* with Julie Ash at the ASFPM Annual Conference in San Antonio, May.
- *Attended the Natural Hazards Workshop held in Broomfield, July.
- *Participated in the Presidential Policy Directive 8 panel discussion with Jim Schwab and Darrin Punchard and moderated by Roy Wright at the International Hazard Mitigation Practitioners Symposium held in Boulder, July.
- *Attended the NAFSMA Annual Meeting in Coeur d'Alene, Idaho, August.
- *Presented *Negotiations for Floodplain Managers* with Ed Thomas and *Communicating Floodplain Preservation Values in Land Use Decisions* at the NHMA Salt Lake City Workshop, September.
- *Attended CASFM Annual Conference held in Steamboat Springs, September.
- *Presented *Cooperating Technical Partners (CTP) Lessons Learned* at the NAFSMA Agency to Agency Mentoring Session held in Chicago, November.

Rich Borchardt, Senior Project Engineer, Design, Construction & Maintenance Program

- * Chair of the Water Resource Committee for the Colorado Chapter of the American Public Works Association (APWA)
- *Attended UDFCD’s annual seminar
- *Presented *Creating Amenities: Retrofitting Urban Regional Detention Facilities for Multi-Use Purposes* with Kyle Hamilton CH2M Hill at StormCon 2012 Stormwater Conference and Expo in Denver, August
- *Attended APWA 2012 International Public Works Congress and Exposition
- *Presented *Double Duty or Double Trouble: Combining Pedestrian and Drainage Crossings* with Teresa Paterson RESPEC at Colorado Association of Stormwater and Floodplain Managers (CASFM) 2012 Conference in Steamboat Springs, September
- *Attended Cherry Creek Stewardship Partners Conference

Shea Thomas, Senior Project Engineer, Master Planning Program

- * Presented *2D or Not 2D? Guidance for 2-Dimensional Floodplain Modeling* at the annual UDFCD seminar in Aurora in April.
- *Elected for a second term as Secretary of CASFM in September.
- *Served as the Conference Program Chair for CASFM.
- *Served on the Scholarship Committee for CASFM.
- *Served on the Stormwater Management and Floodplain Management Committees for NAFSMA.

Barbara Chongtoua, Senior Project Engineer, Design, Construction and Maintenance Program

- * Speaker on the Generational Diversity Panel at the APWA 2012 Congress
- *Participated in the CU Boulder Senior Design Class Project as a Lecturer and a Mentor
- *Control Group Member for the ASCE EWRI Stormwater Infrastructure Committee
- *Chair and Moderator of the Naturalized Stormwater Structures Track at the ASCE EWRI 2013 Congress
- *Member of ASCE Urban Water Resources Research Council, Water, Wastewater, and Stormwater Council, Stormwater Infrastructure Committee and National Safety Standards for Storm Water Facilities Sub-committee
- *Attended StormCon 2012 in Denver, Colorado
- *Attended ASCE EWRI Congress 2012 in Albuquerque, New Mexico
- *Attended APWA National Congress in Anaheim, California
- *Attended Cherry Creek Stewardship Partners Annual Congress in Englewood, Colorado
- *Active Member of ASCE, APWA, Chi Epsilon, ASFPM, and CASFM

Holly Piza, Senior Project Engineer, Master Planning Program

- * Authored *Lessons learned from Seven Years of Monitoring Pervious Concrete* for the February issue of the APWA Reporter
- *Presented *Our Role with Water* to 7th graders at a public school in Denver in February;
- *Presented Updating Volume 1 and 2 of the USDCM at the UDFCD Annual Seminar in Denver in April;
- *Presented *Lessons learned from Seven Years of Monitoring Pervious Concrete* at StormCon in Denver in August and at CASFM in Steamboat Springs in September;

- *Presented Rain Garden Design, Construction, and Vegetation considerations at the Mountain States Chapter IECA 2012 Annual Winter Conference; and
- *Served as the CASFM Water Quality Committee Chair and member of the CASFM training committee.
- *Member of ASCE, CASFM, and CSC.

Dave Skoudas, Project Engineer, Design, Construction & Maintenance Program

- * Member of ASCE, CASFM, ASFPM, APWA
- *Co-Chair of the local chapter of ASCE's Environmental and Water Resources Institute (EWRI)
- *Member of the EWRI National Section/Branch Advisory Council
- *Helped organize an ASCE field trip the USBR Hydraulics Lab in Lakewood
- *CASFM Conference Co-Presenter of *Grange Hall Creek in Thornton – A Plethora of Issues all Rolled into One Project*
- *Attended APWA Management Conference
- *Attended StormCon Conference & Exposition

Terri L. Fead, P.E., CFM, Project Engineer, Floodplain Management Program

- *Member of the Colorado Association of Stormwater and Floodplain Managers (CASFM), Association of State Floodplain Managers (ASFPM), American Society of Civil Engineers (ASCE) and the National Society of Professional Engineers (NSPE).
- *Attended the UDFCD Seminar held in Denver in April.
- *Attended 2012 Annual CASFM Conference, September 2012
- *Attended Flo-2D Web Short Course (Flo-2D Software, March 2012), Working Smart with Microsoft Outlook (MSEC/Priority Management, April 2012), Urban Channel Design and Rehabilitation (UWRI, September 2012),CWCB-CASFM Floodplain Workshop (CWCB/FEMA Region VIII, December 2012)
- *Attended webinars on Revised Credits for Flood Warning In the NFIP Community Rating System (NHWC, November 2012) and ASFPM LIDAR Series, Session 4: Using LIDAR Data (ASFPM, December 2012)
- * Member of Cherry Creek High School Engineering Physics Advisory Committee

Julia Bailey, Information Services Engineer, Information Services and Flood Warning Program

- *Attended the ESRI Annual International Users Conference in San Diego, CA in July.
- *Attended the DRCOG Annual GIS Data Summit in Denver, CO in January.
- *Participant in the North Central Region GIS steering committee.
- *Steering Committee member for EMWIN-Denver (Emergency Managers Weather Information Network).

Mike Sarmento, Senior Construction Manager, Design, Construction & Maintenance Program

- * Attended Construction Inspectors Conference Feb 2012
- *Attended OSHA 8 Hr Re-Certification June 2012
- *Co-Presented *Simplifying Stormwater Permitting for Maintenance Activities and Small Projects in Waterways* at StormCon in Denver, Aug 2012
- *Presented *Urban Drainage and Vegetation Management* at Colorado Weed Network: in Sep.
- *Member American Public Works Association, American Institute of Hydrology, National Institute for Certification of Engineering Technicians, Society of Wetlands Scientists

Steve Materkowski, Senior Construction Manager, Design, Construction & Maintenance Program

- * CO State All Hazards Advisory Committee – Voting Representative, CO APWA
- *APWA Emergency Management - Preparedness Subcommittee – Member
- *Attended Emergency Management Table Top Exercise – Douglas County
- *Completed Hazardous Material Refresher – HAZWOPER – RMEC
- *Attended 2012 APWA Congress, 2012 APWA Inspectors Conference and 2012 Emergency Management Summit

Jeff Fisher Senior Construction Manager, Design, Construction & Maintenance Program

- * Continued membership in American Public Works Association (APWA)
- *Attended the APWA Construction Inspection Conference in February
- *Attended the UDFCD annual Stormwater & Floodplain Management Seminar in April

Joe Williams, Senior Construction Manager, Design, Construction & Maintenance Program

- * Attended the UDFCD annual seminar in April 2012
- *Continued membership into the American Public Works Association (APWA)
- *New membership into the International Erosion Control Association (IECA)

Darren Bradshaw, Construction Manager, Jefferson and Broomfield County – Design, Construction & Maintenance Program

- * Continued membership in Association of State Floodplain Managers (ASFPM)
- *Continued membership in American Public Works Association (APWA)
- *Continued certification for the ASFPM Certified Floodplain Manager (CFM)
- *Attended the APWA Construction Inspection Conference in February
- *Attended the UDFCD annual Stormwater & Floodplain Management Seminar in April

Joanna Czarnecka, Construction Manager, Floodplain Management Program

- *Member of the Colorado Association of Stormwater and Floodplain Managers (CASFM), Association of State Floodplain Managers (ASFPM) and the American Public Works Association (APWA).
- *Attended the UDFCD Seminar held in Denver in April and CWCB-CASFM Floodplain Workshop (CWCB/FEMA Region VIII, December 2012) in Pueblo, Colorado.
- *Attended webinar on ASFPM LIDAR Series, Session 4: Using LIDAR Data (ASFPM, December 2012)
- *Presented *Keeping Track of CLOMR's, LOMR's and the Projects that Drive Them* with Bill DeGroot at the CASFM Annual Conference in Steamboat Springs, September.

New additions to District staff in 2012



Amelia Deleon

joined the District to replace our Administrative Services Manager, Sandy Gonzalez, who retired last year and moved to Iowa. Amelia has over ten years experienced in the Engineering industry, seven of which was working on an

Environmental Impact Statement for the RTD FasTracks Program. She has a Bachelor's degree in Advertising and Advertising Art. . She is also Egyptian by heritage and is first generation in the U.S., which will come in handy for us at Urban Drainage when we need an Arabic translator (haven't used it yet but waiting for the chance). Amelia has been a great addition and fit in immediately. We are looking forward to her being here for many years to come.

Wanda Salazar

joined us in our Accounting and Finance Program to assist Frank Dobbins with all the bills, invoices, agreements, and other financial activity. She has certainly made herself instantly useful and a valuable and welcomed



staff addition. Wanda has an Associate's Degree from Bismarck Junior College in Bismarck, ND. She has worked for several years in the bookkeeping and accounting world so she stepped into the role of Accounting Assistant with ease. Wanda is a welcome addition and has a wonderful personality. We are fortunate to have found her.



Urban Drainage and Flood Control District

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