



# Flood Hazard News

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**Editor's Note: Most of the articles in this issue of *Flood Hazard News* will at least touch on the 2013 floods. The UDFCD is in the process of compiling a detailed account of what happened. A "coffee table" version of that account will be published in early spring, 2014.**

## Denver Metropolitan Area Fares Well During Severe Precipitation Event in September 2013

By

Andrew Earles, Ph.D., P.E., D.WRE, Jonathan Jones, P.E., D.WRE, Shannon Tillack, P.E., CPESC, Ken Wright, P.E., D.WRE, all Wright Water Engineers, Inc. and Ken MacKenzie, P.E., UDFCD

### Introduction

Flood damages and loss of life in the September 2013, Denver-Boulder Colorado area were significantly less than would normally be anticipated for the enormous and prolonged rainfall that fell—rainfall claimed by some as “one in 1,000 year” rainfall. One of the major reasons for this lies in key policy statements in the widely-cited *Urban Storm Drainage Criteria Manual*, maintained by the Urban Drainage and Flood Control District.

The Front Range of Colorado, including the Denver metropolitan area, has a long history of flooding. Contributing factors include:

- Intense summer thunderstorms,
- Heavy snowmelt combined with heavy spring rain on saturated soil,
- Steep, mountainous terrain causing runoff to collect rapidly and leading to flash floods,
  - Large quantities of easily loosened soil, boulders and debris that are flushed down canyons into urbanized areas.
  - Wildfires that ruin the soil's ability to soak in the rainfall, increasing flooding and debris flows.
  - Cities that were settled on the banks of flood-prone creeks and at the mouths of canyons where flood and debris flows spread out and inundate large areas.

The effects of these factors are dramatic. The 1965 South Platte River flood devastated everything in its path for 30 miles, including a wide swath through Denver and adjoining communities.



Flood waters on Sand Creek at the confluence with the South Platte River eroded approximately 100 feet of the outside bend into the Metro Wastewater Reclamation plant property, leaving a 25 foot vertical bank.

## Actions Taken After 1965 South Platte River Flood

The 1965 South Platte River flood triggered many significant actions, including

(1) construction of two large flood control reservoirs (Chatfield Dam and Bear Creek Dam) immediately upstream from Denver by the U.S. Army Corps of Engineers, (2) publication of the *Urban Storm Drainage Criteria Manual (Criteria Manual)* in 1969 and, (3) in 1969, formation of the Urban Drainage and Flood Control District (UDFCD) by the Colorado State Legislature and Governor.

The UDFCD was established to respond to widespread recognition that drainage and flood control activities among the local governments in the Denver metropolitan area were fragmented and inconsistent. The primary responsibilities of the UDFCD were to map floodplains and assist with floodplain regulation, master-plan major drainageways, provide technical guidance and assistance to the planning and engineering community and construct and maintain drainage facilities, working closely with local governments.

In 1970, the UDFCD assumed responsibility for implementing and promoting use of the *Criteria Manual* within the UDFCD region, which encompasses over 1,600 square miles and 40 local governments. The *Criteria Manual* was a landmark document—never before had such broad-based information pertaining to drainage and flood control been compiled in a single reference. At the time, guidance was not available that clearly stated the problem, formulated goals and objectives, and provided detailed design criteria for wide-ranging drainage and flood control facilities. The *Criteria Manual* has been widely cited in the engineering literature and in drainage design manuals by other governments nationally and internationally.

### Key Policies in the Urban Storm Drainage Criteria Manual

The foundation for the *Criteria Manual* is Chapter 1, “Policy,” which lays out the guiding philosophy, policies and principles for drainage and flood control within the UDFCD. The authors and advisors (including Kenneth Wright, P.E., Jack Schaeffer, Ph.D., P.E., D. Earl Jones, Jr., P.E., and Gilbert White) recognized that it is essential to establish solid policies and principles as the foundation for detailed design criteria.

The foresight and wisdom of this was readily apparent during an extraordinary period of rain that occurred from



**Fourmile Canyon Creek in Boulder, CO reclaimed its natural easement in what was previously a residential street and front yards during the September 2013 flooding. A major drainage system was planned for this creek but not implemented before the flood.**

September 9 to 15, 2013, in much of the Colorado foothills and Front Range, where rainfall return frequencies at times exceeded the 100- to 500-year event. The nature of the flooding, including, tragically, loss of life and property damage, has been extensively evaluated, and one widely shared observation is that within the UDFCD, loss of life and damages would have been far worse if the policies, principles and design criteria articulated in the *Criteria Manual* had not been implemented. Examples of this follow; more are found in the Policy chapter of the *Criteria Manual*.

### Promoting General Health and Welfare

Policy Statement: *Adequate drainage for urban areas is necessary to preserve and promote the general health, welfare and economic well-being of the region. Drainage is a regional feature that affects all governmental jurisdictions and all parcels of property. This characteristic of drainage makes it necessary to formulate a program that balances both public and private involvement. When considered in a comprehensive manner—on a regional level with public and private involvement—drainage facilities can be provided in an urban area in a manner that will avoid uneconomic water losses and disruption, enhance the general health and welfare of the region, and assure optimum economic and social relationships.*

This policy statement links sound drainage practices to the protection of public health and welfare and economic vitality, emphasizes the regional nature of storm drainage, speaks to the need for comprehensive approaches and defines the importance of public/private partnerships, all which helped to mitigate loss of life and damages during the 2013 flood.

### Initial and Major Drainage Systems

Policy Statement: *Every urban area has an “initial” and a “major” drainage system, whether or not actually planned and designed.*

The *Criteria Manual* states that urban drainage planners should recognize that two separate and distinct drainage systems exist: the “initial” and “major” drainage systems. The initial or “convenience” system collects and conveys smaller day-to-day runoff events and consists of local swales, streets, gutters and inlets and storm drains. The major system conveys large infrequent events and, when well

designed, protects the urban area from extensive property damage, injury and loss of life. The major drainage system will exist whether or not it has been properly planned and designed and whether or not development is situated wisely with respect to it.

A design frequency for the initial system of 2-10 years, 100 years is suggested for the major system, and for “critical facilities” such as hospitals, police and fire stations, and emergency communications centers, potentially 500 years. These conservative return frequency recommendations coupled with freeboard requirements for channels and detention basins and the recommendation to carefully manage floodplain development unquestionably limited damage during the 2013 floods and facilitated the ability of emergency responders to reach those in need of help (although not addressed by this paper, the emergency



**Exposition Park and Regional flood Detention Facility in Aurora, CO; a city park under dry-weather conditions served its dual purpose as a flood storage detention basin during September.**

response network throughout Colorado was extraordinarily effective).

#### **Runoff Management Requires Space**

Policy Statement: *Runoff routing is primarily a space allocation problem.*

If adequate provision is not made for drainage volume and space demands, stormwater runoff will conflict with other land uses, and result in damages and impair or disrupt the functioning of other infrastructure.

#### **Drainage Facilities Should Be Multi-objective and Multipurpose**

Policy Statement: *An urban storm drainage strategy should be a multi-objective and multi-means effort.*

Storm drainage facilities that fulfill multiple objectives will be viewed as community assets by the public. The many competing demands placed upon space and resources within an urban region argue for a drainage management strategy that meets multiple objectives, including water quality enhancement, groundwater recharge, recreation, wildlife habitat, wetland creation, protection of landmarks and amenities, control of erosion and sediment deposition and creation of open space, among others. This policy emphasizes the paramount need to protect public health, safety and welfare, and provides design guidance for channels, ponds, water quality controls and other structures related to safety. Within the UDFCD region, the only two deaths that occurred during the September 2013 flood were the result of driving a vehicle into floodwaters.

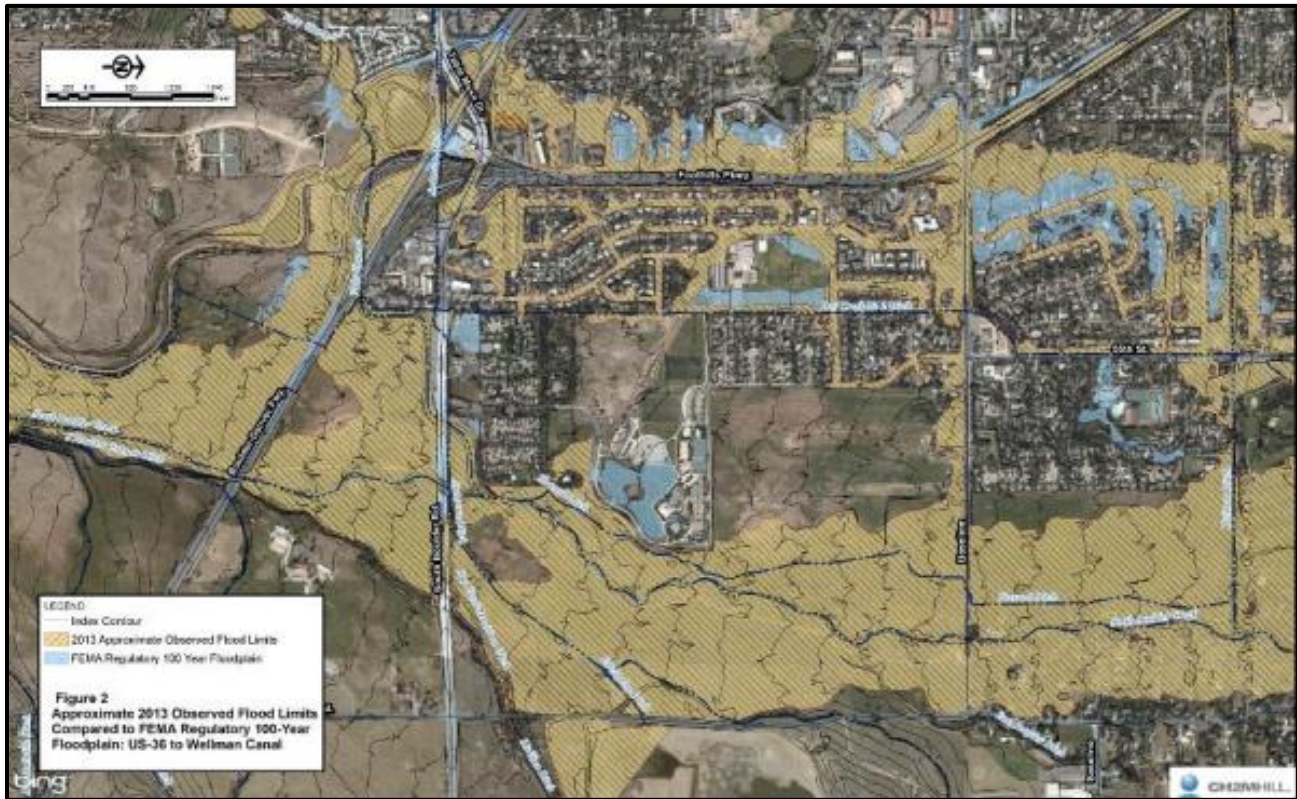
#### **Preservation of Floodplains**

Policy Statement: *Floodplains should be preserved whenever feasible and practicable.*

The need to preserve floodplains is a dominant theme. This policy has been adopted by the local governments within both the Denver metropolitan area and along the Colorado Front Range. This is unquestionably a major reason why flood damages were not much worse during the September 2013 flooding. Nature has claimed a prescriptive easement for floods, via its floodplains, that cannot be denied without public and private cost. Floodplains often provide a natural order to the land surface, with drainageways that serve as outfalls for urban drainage, bottomland for wildlife habitat, riparian corridors and specialized vegetation. The UDFCD and local governments have mandated that floodplain encroachment can occur only after competent engineering and planning have been conducted to assure that the flow



**Multipurpose detention facilities have significant social benefits. For example, this park in Aurora features baseball, tennis, soccer, passive recreation and on September 11<sup>th</sup>, 135 acre-feet of flood storage.**



**South Boulder Creek FEMA-mapped floodplain in blue, vs. September 2013 observed floodplain in tan. This shows the extent of the 2013 flooding in a large preserved floodplain and in older residential areas that are located in the floodplain and which experienced damage in 2013. Source: City of Boulder and CH2M Hill.**

capacity is maintained, risks of flooding are defined, and risks to life and property are strictly minimized.

#### **Reserve Sufficient Right-of-Way to Permit Lateral Channel Movement**

Policy Statement: *Reserve sufficient right-of-way for lateral movement of incised floodplains.*

The September 2013 flooding in the UDFCD provided convincing evidence of the need to reserve sufficient right-of-way to permit stream channels to migrate laterally, and to convey massive quantities of sediment and debris from high-gradient, mountainous watersheds. The amount of lateral movement (migration) in stream channels in September 2013 was remarkable. Outside the UDFCD, flood flows tore through the channel banks into adjoining reclaimed gravel pit lakes, which led to uncontrolled cascading overflows and extensive damage to public and private facilities. UDFCD has developed specific criteria for gravel mining in the alluviums of rivers and streams which specify a combination of wide separation distance between, and armoring of, the stream

and the adjacent gravel pit embankments to minimize this risk.

In closing, the *Urban Storm Drainage Criteria Manual* has steadily evolved over time, with regular updates in response to field experience; technical developments (such as new computer models); legal, regulatory and policy precedents; increased emphasis on environmental protection and low impact development practices; and many other factors. The UDFCD early flood warning system, with over 200 real-time flood detection rain and stream flow gages throughout the region, all of which are telemetered into sophisticated computers that issue warnings to first responders, was not even a concept in 1969, when the *Criteria Manual* was originally published. In September 2013, this system was critically important in saving lives and mitigating property damage. The *Urban Storm Drainage Criteria Manual* and UDFCD will continue to evolve in response to many factors, but with the protection of public health, safety and welfare always as the paramount goal.

# Hind' sight

By Paul A. Hindman

*Timely Comment from the District's Executive Director*

As 2013 finished up, it gave everyone at the District, and in the flood control community, a time to reflect on one of the biggest flood events we have witnessed in recorded history. Many things have, and will continue to be, written about it not only in this publication, but in many others. Some will write about the technical aspects of the flood but many will focus on the emotional toll of such a catastrophic event. Since my article is about **hindsight**, I'll go way back to the 60's, when I was growing up in Prescott, Arizona. As everyone knows, it doesn't rain much in Arizona but when it does, most of it runs off. In 1966, an incredible amount of rain fell out of the sky and flooded many parts of Prescott. To get to my house, you had to cross a dry gulch, which had quickly transformed into a raging stream during this particular storm. My neighbor, a policeman, was coming home that stormy night with his family. He drove into the water, like so many people do, and his truck quickly became buoyant then began to float downstream. He literally tossed his three kids, wife, and dog safely to shore before the truck was wrapped around a tree. Obviously, at a young age, that made a huge impact on me but little did I know I would embark on a career of protecting people from floodwaters.

Thirteen years later, I graduated from CSU and started work with CDM, doing flood insurance studies for FEMA. Performing that work, which included visiting the nine Colorado communities for whom the studies were being performed, gave me a new appreciation of how vital it was to educate people of the potential damage that major flooding can cause, and how to prepare for it both structurally and non-structurally. A few years later, I came to work at the District focusing mainly on the structural side of the equation, but always keeping foremost in my mind, the devastation that could occur. **Fast-forward to 2013, and with all the destruction and families that were impacted by the September floods, it would have been much worse within the Denver Metro area, were it not for all the work that the District and local governments have accomplished.**

I know the District staff, along with the staff working for our partner local governments, have their own reasons for why they chose a career in flood control; but whatever that may be, the one common desire we all share, is to keep people from harm's way during a flood. I've always said "don't get into this line of work unless you like serving your fellow man." It's easy to let the mundane activities of our workday (permit applications, emails, phone calls, and other activities that fill up our day) distract us from the importance of what we do. But last September, it brought it right back into focus. I witnessed firsthand, the many professionals who

went above and beyond the call of duty, to just help someone out. Not because it was their job, but because their help was needed, and it was the right thing to do.

I mentioned earlier that the devastation would have been worse in the District were it not for the many structural and non-structural projects that were implemented with the help of our partner local governments. Each month, at the District's Board meeting, I give a short presentation focused around one process or program of the District's, put in place to protect the public. Here are a few of those items:

- **Maintenance Eligibility**-Encourages local governments to follow District criteria when permitting development within floodplains.
- **Floodplain Preservation**-Partners with local governments to purchase flood prone properties
- **Stream Stabilization**-Prevents drainageways from aggrading or degrading so that property during a major flood is not severely damaged
- **Master plan to Maintenance**-The full cycle of master planning a drainageway, designing improvements, construction, and then maintaining those improvements.
- **Natural and Beneficial Uses of Floodplains**-Incorporating all aspects of floodplains during design to maximize improvements not only financially but socially and environmentally.
- **Flood Warning**-A network of monitoring equipment used by engineering and meteorological professionals to alert first responders of a pending flood.
- **Floodplain Regulation**-Coordinating with local governments to responsibly develop flood prone areas.

None of the programs or processes mentioned above could, alone, protect the public from major damage during a flood, but combined the end result will be a safer community for all of the citizens within the District boundaries. This is an ongoing challenge for all the professionals that are dedicated to protecting the public. We know we will have succeeded when the next major flood occurs and there are no tragedies to headline the news. Not very glamorous, but very satisfying.



# Changes in Floodproofing Certification for Flood Insurance

Michael K. Gease, CFM, Floodplain Management Specialist, FEMA Region VIII

Among all the confusion about the National Flood Insurance Program (NFIP) Biggert-Waters 12 legislation, on October 1, 2013 the NFIP published the latest revisions to the Flood Insurance Manual. One change in the manual may impact non-residential building construction or improvements in FEMA-identified Special Flood Hazard Areas. Many of you may be familiar with the NFIP regulations for dry floodproofing a building, provided a licensed Engineer or Architect certifies that the design, construction methods, and materials make the building watertight at flood depth exposure. Because such buildings may be constructed with a lowest floor below the base flood elevation (BFE), NFIP insurance rates do not provide a rating credit unless the building is certified to at least one foot above the BFE. FEMA has a Floodproofing Certificate form to be sealed by the design professional. The guidance for floodproofing certification is found in FEMA Technical Bulletin No. 3, Non-Residential Floodproofing Requirements and Certification at <http://www.fema.gov/media-library/assets/documents/3473?id=1716>.

However, a little noticed change in the Flood Insurance Manual effective October 1, 2013 now requires additional documentation not only for new business, but policy renewals as well (beginning effective December 1, 2013). Without the documentation, suddenly a non-residential building permitted in compliance by a community floodplain administrator with a valid Floodproofing Certificate now would be rated as if it was non-elevated, resulting in potential huge increases in flood insurance premiums. Prior to this change, the Floodproofing Certificate was the standard documentation. NFIP discovered that the floodproofing certification for rating needed to be reconciled with the documentation listed in the guidance under NFIP Technical Bulletin No. 3. The basic floodproofing certification requirements are:

- Written verification that the building envelope is watertight
- Written certification that the Engineer of Record's design and construction are in accordance with American Society of Civil Engineers ASCE 24-05 requirements to meet FEMA criteria

- A comprehensive Maintenance Plan for the entire structure including the materials used for floodproofing, shields, gates, etc.
- An Emergency Action Plan for the installation of flood shields and other measures
- Written certification that all components and systems when installed meet the requirements of ASCE 24-05
- Documentation or certification from the Authority Having Jurisdiction (permitting official) that they have reviewed and inspected the structure with all floodproofing measures in place and provide evidence of approved final inspection and certificate of occupancy.

The above items are required in addition to the Floodproofing Certificate for all new business and renewals. The impact of this on the community floodplain manager is a greater need to ensure the documentation is collected as part of the permit process. Engineer of Record certifications may have to be revisited, in some cases years after the building construction. And at policy renewals, policy holders should be notified by NFIP 90 days prior, and must have the documentation submitted no closer than 45 days from renewal to avoid actuarial rating by elevation. For the complete text of the changes, see the NFIP Specific Rating Guidelines, pp. 5-2 and 5-3. To access the Specific Rating Guidelines:

<http://www.fema.gov/media-library-data/e89943abe296767c5579d37c7d24dc90/SRG+October 2013 508.pdf>

# Floodplain Management Program

Bill DeGroot, PE, Program Manager

## I'm retiring!

This is my last column for *Flood Hazard News*. I am retiring in early February. David Mallory has been designated as the new manager. I am confident that he will do a great job, with the capable help from Terri Fead and Joanna Czarnecka. As I write this David is in the process of hiring the "new David."

As I reflect on the last 40 years I feel confident in saying that the Denver metro area is less prone to major flood disasters than it would have been if the UDFCD floodplain management program had not existed. The September floods proved that to be true. I hasten to add that our local government partners were also key to this accomplishment. In 40 years as a floodplain manager I have never issued a floodplain development permit. That is the purview of local governments. Together we have been very successful.

I thought about writing a column revisiting the highlights of the last 40 years but decided that the deadline for this issue didn't give me time to do a thoughtful piece. I do plan to write that piece in 2014. Perhaps the new editor will publish it next year. So, in the remainder of this column I'm going to summarize the major activities of the floodplain management program in 2013.

## The 2013 Floods in the UDFCD

After the UDFCD was established, its first major activity was to inventory drainage basins and sub-basins to determine the extent of problems and to develop a plan to attack those problems. The initial study indicated that approximately 26% of the major drainageway miles within the District were developed, with the remaining 74% undeveloped and amenable to preventive approaches.

In probably the most important policy decision in its history the UDFCD Board of Directors adopted a two pronged approach to develop a comprehensive floodplain management program to prevent new problems from being created by new development, while "fixing" existing problems. The 2013 floods were the first real test of the two pronged approach.

My assessment of the floods within the UDFCD is as follows. In areas developed after about 1975; after floodplain maps became available and local governments adopted floodplain regulations; there were no major damages reported. In areas developed before about 1975, where floodplains had been mapped, master plans had been developed, and mitigation projects had been constructed; damages were also minor, and much less than they would have been without the master planning and construction.

Finally, areas developed before about 1975, where floodplains had been mapped and master plans developed

but not yet implemented suffered the most damage. There were also several areas where diversions caused either by sediment and debris or manmade structures flooded structures outside mapped floodplains.

My assessment: The two pronged approach is working, and prevented significant property damage within the UDFCD in 2013. More detailed analyses of the floods are published elsewhere in this *Flood Hazard News* and others are coming.

## Floodplain preservation videos

Following up on our award winning floodplain preservation brochure, we partnered with the National Association of Flood and Stormwater Management Agencies (NAFSMA) to create three short videos which convey the same basic message. The videos can be seen [here](#).

## NAFSMA Award

The National Association of Flood and Stormwater Management Agencies presented the L. Scott Tucker Award for Member Service to the Organization to me at their annual meeting in December. As many readers know Scott was the UDFCD's executive director for many years. He hired me 40 years ago to develop and manage a floodplain management program. He gave me a lot of rope and a lot of support over the years. He is my mentor and my friend.

Scott is the one who encouraged me to be active in NAFSMA. I have spent the last 18 years as either a committee chair or co-chair, or board member. It's a great honor to receive an award named after Scott, and for him to be there when it happened.



Bill DeGroot with NAFSMA President Dusty Williams.

## **National Flood Insurance Program**

Last year in this space I told you about the reauthorization of the National Flood Insurance Program (NFIP), called Biggert-Waters 2012 or BW12 for short. I mentioned two provisions in BW12 that were of special interest. The first was the creation of a Technical Mapping Advisory Council (TMAC). This will be a 20 member organization with quite a bit of influence. I certainly thought this would be up and running by now, but it's still a work in progress. Stay tuned.

The other area I mentioned was 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 said at the time that, "I expect that there will be quite a furor in the making when people start experiencing these higher premiums."

That prediction turned out to be true as many members of Congress rushed to undo the premium increases. To date all efforts to change the law have failed.

I'm all for moving from subsidized flood insurance premiums to actuarial rates. However, the reason subsidized rates were offered in the first place was to soften the blow on structures constructed before floodplains were mapped and flood insurance requirements existed. The impacts of BW-12 Section 205, as it is being implemented, are turning future potential flood losses into immediate financial disasters in many instances. For example, whenever a policy lapses or a new policy is required (transfer of ownership for example), the new premium is going to be the full actuarial rate. For a house with a basement this can be thousands of dollars, a financial hit that many people simply cannot afford.

For another example, a pre-FIRM structure never mapped in the floodplain is now mapped in the floodplain due to an updated FIS. For a house with a basement this can be an actuarial premium in the thousands of dollars, again a financial hit that many people simply cannot afford. Under the additional impacts of BW-12 Section 207, I must confess that I am reluctant, as are many local government staffers, to re-map a floodplain if the result is going to be the addition of structures to the mapped floodplain, along with the requirement that owners of these structures buy flood insurance at actuarial rates.

I'm not suggesting that subsidies be continued for the examples given above. I am saying that there has to be a way to allow for a gradual, affordable increase in premiums. Whether that is means tested vouchers, a longer phase in time or some other way is not for me to say (see the ASFPM paper "Flood Insurance Affordability-Update"). I will, however, repeat that in many cases potential future flood losses are being turned into immediate financial disasters. We can't allow that to continue. We are a better people than that.

There is also a misconception in the media that subsidized rates encourage new development in the floodplain. Not true. The subsidized rates are only for structures that had already been built in the floodplain before the floodplain was mapped. A developer cannot build a structure today in an already mapped floodplain, and expect to sell it to someone who then obtains subsidized flood insurance. If the system has worked as designed, that structure will be subject to actuarial rates which will be low because the structure will have been constructed in accordance with NFIP requirements at a minimum, and many communities have adopted higher standards.

## **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 41 cases received in 2013. We ran out of FY 2013 grant money after two years of cuts from what we had requested. We filled the gap in funds by assigning 20 of the cases to Baker. This got us through FY 2013. We have received an increase in our FY 2014 funding and are now back on solid financial footing. I want to acknowledge the excellent cooperation we received from Baker through this difficult period.

Once again most of the cases we have reviewed are for government funded projects. I like to think that our efforts to promote safe development have had an impact on the number of private sector 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 9 cases under review and only two were private sector cases.

## **Floodplain delineation**

We collaborated with the Master Planning Program to complete six digital flood hazard area delineation (DFHAD) studies this year; Sand Creek in Aurora and Arapahoe County; Sanderson Gulch in Denver, Lakewood and Jefferson County; West Toll Gate Creek in Aurora, Centennial and Arapahoe County; Toll Gate Creek and Lower East Toll Gate Creek in Aurora, ; Senac Creek in Aurora; and Cherry Creek in Denver, Glendale and Arapahoe County.

We have DFHAD's underway; 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; Coal Creek in Aurora and Arapahoe County; Box Elder Creek in Adams County, Denver, Aurora and Arapahoe County; Weir Gulch in Denver and Lakewood; Upper Westerly Creek in Denver and Aurora and Big Dry Creek in Englewood, Cherry



Hills Village, Greenwood Village, Centennial 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 DFHADs are done to our standards and FEMA's.

We are negotiating an agreement with FEMA Region 8 to put together a timeframe of when DFHADs 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 DFHADs into the DFIRM database and onto the National Flood Hazard Layer quicker. The first two PMRs, consisting of seven DFHADs, are underway.

#### **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 2013 Broomfield is complete with an effective date of October 2, 2013. Denver is also complete with an effective date of November 20, 2013; and Jefferson County is in the six month compliance period, with an effective date of February 5, 2014. The only one I have to leave to David to finish is Douglas County, and we are hoping for preliminary maps to be delivered to local governments in April, 2014.

#### **Risk MAP moves ahead**

FEMA is now well into its fifth year of Risk MAP. The Colorado Water Conservation Board (CWCB) has taken the lead for studies for the Clear Creek and St. Vrain Creek watersheds, parts of which are in the UDFCD.

Also, as part of the City and County of Denver's forthcoming Multi-Hazard Mitigation Plan, FEMA performed a HAZUS flood analysis for use in the City's risk assessment phase. FEMA created a robust online GIS map to showcase the results which include damage estimates for structures located in the 1% and 0.2% annual chance floodplains. The risk assessment and associated GIS map also include information on other hazards including earthquake, wildfire, tornado, dams, etc... The GIS map is publicly available at the following webpage: <http://bit.ly/14PWEF5>.

#### **FasTracks Coordination**

FasTracks does not take as much time now as it did last year and early this year. The West Corridor is done and trains are running. All the Eagle P3 construction drawings have been reviewed and approved and most of the construction has been substantially completed. There will be time involved in the final maintenance eligibility acceptance process.

#### **Maintenance Eligibility**

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

#### **DFHAD guidelines**

Our DFHAD Guidelines have been undergoing some additional modifications, with seemingly every new draft DFHAD submittal raising new issues. Check with Terri Fead for the status of the latest revisions. There is a lot of good information in the guidelines for anyone doing any kind of digital floodplain mapping.

#### **DLOMC guidelines**

We unveiled Digital Letter of Map Change (DLOMC) guidelines at the UDFCD seminar in April, 2010. DLOMCs are voluntary and we haven't received very many, but we believe they will save both applicants and the UDFCD time and money, and we continue to encourage DLOMC submittals.

#### **LOMC database**

We now have a database that allows us to easily track all of the completed LOMCs since 2001. 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 PDFs of all recent LOMCs in the database for easy viewing. The database can be accessed from the UDFCD web site home page.

## **APWA Awards in 2013**



**UDFCD received three APWA Colorado Chapter Awards in 2013. Brantner Gulch at Holly Street managed by Dave Skoudas, Standard Construction Specifications managed by Dave Bennetts and Alexx & Michael's Pond Pump Station in Broomfield managed by Bryan Kohlenberg. Shown above (L to R) Bryan Kohlenberg, Rebecca Baker (Broomfield), UDFCD Chair Nancy McNally, Dave Skoudas and Dave Bennetts.**

# Maintenance Eligibility Program

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

## ***The Mighty Mitigator***

This year's article will be a departure from the usual discussion of projects and trends because I want to offer an appreciation of the life and career of Bill DeGroot, the Mighty Mitigator. In late December, Bill and Mary celebrated 40 years of marital bliss and Bill will mark 40 years with the District in late January. Bill's career in floodplain management is remarkable, legendary and very effective.

Bill moved to Denver in 1974, to administer the District's new Floodplain Management Program. *"Why does anyone take up Flood Plain Management as a career?"* Bill asked in his first contribution to *Flood Hazard News*. He goes on to describe the enormous impact of the 1972 Rapid City, SD flood; it was literally a career-changing event for Bill. Non-structural floodplain management was in its infancy at that time. The Rapid City recovery effort included wide use of flood-prone property acquisition as a way to mitigate flood risk and build a more resilient future. Bill's call to action from that first article: *"We must learn from Rapid City's experience. We must stop repeating the mistake of unchecked development in areas which we know will someday be flooded."*

As Bill and Mary settled into their new home town they signed up for some walking tours. One tour in particular, *The Saloons of Denver* made a lasting impression. A developer was busy renovating an historic warehouse into shops on street level and residential units above. When asked by one of the folks on the tour why he would undertake such a seemingly civic-minded project, he replied simply, "To make money." This motivational tool stuck with Bill for his entire career.

Bill came to believe that floodplain preservation, with all the benefits that accrue to communities and the environment, is fundamental to sound floodplain management. He also believes that leveraging the legitimate profit motive of developers and the legitimate growth motive of communities is the way to convince folks to embrace floodplains as assets rather than a hindrance. The result was the widely acclaimed Floodplain Preservation Brochure that highlights dozens of good examples and five business cases of projects that practiced floodplain preservation and made money in the process. We recently released the video version of the brochure with segments that speak directly to communities and developers, and has a national reach.

The Big Thompson Canyon flash flood occurred on July 31, 1976 on the eve of Colorado's centennial. The flood was horrific, resulting in the deaths of 143 people. Bill led an investigation into where people were when they died. Turns

out most people were in their vehicles. The now familiar *Climb to Safety* campaign was born out of collaboration with the social science community.

The Maintenance Eligibility Program became an integral part of the District's two-pronged approach to floodplain management; fix what is already broken (structural or capital projects) and work to guide new development away from flood-prone areas. The two-pronged approach has been successful; four decades later, with the District's service population three times greater and all the challenges that come with that growth, there are now 5,000 fewer structures in the Special Flood Hazard Area (aka 100-year floodplain) than in the early 1970s. Of course you need to map the Special Flood Hazard Area in order to identify flood prone zones. Bill managed scores of Flood Hazard Area Delineation studies in cooperation with local governments in an effort to get out ahead of development. Other important initiatives of the Floodplain Management Program include the Flood Warning Program and the Flood Risk Brochure annual mailings.

Working in close cooperation with local governments has been a fundamental policy at the District and Bill has been a leader in growing that policy. An outgrowth of working with communities was the emerging notion of multi-use stream corridor systems. These corridors occasionally convey storm runoff; however they function everyday as trails, wildlife habitat, recreation retreats and parks. This approach eventually became known as the District's Good Neighbor Policy.

Every community within the District that has identified Special Flood Hazard Areas, now 35 units of local government, is participating in the National Flood Insurance Program (NFIP). Bill worked with many of those communities to craft floodplain regulations; resulting in the availability of federally backed flood insurance is available to everyone in the participating communities. He has also worked with FEMA to turn District floodplain maps into federally recognized Special Flood Hazard Areas. In 1999, the District became the first agency in the nation to enter into a Cooperating Technical Partnership with FEMA. That partnership resulted in early inclusion of all seven District counties in FEMA's digital mapping program. In 2001, the District again became the first in the nation to process Letters of Map Change for FEMA. Local processing continues to be an enormous benefit to developers and communities, and interfaces very nicely with the Maintenance Eligibility Program.

Bill has been a strong national advocate for sensible floodplain management with decades of service in ASCE, ASFPMP and NAFSMA. He has delivered scores of presentations, authored or coauthored a number of peer-reviewed papers on floodplain management, and served on several FEMA advisory councils such as the Technical Mapping Advisory Council and the Operating Partners Group. Through these venues, Bill has strongly advocated for important issues such as future conditions hydrology, non-structural approaches and wider use of local/state/federal partnerships. Bill has been honored with a number of awards, including:

- Meritorious Lifetime Achievement in Floodplain Management, ASFPMP
- L. Scott Tucker Award for Member Service to the Organization, NAFSMA
- Friend of the River, Greenway Foundation
- Fellow and Lifetime Member, ASCE

In addition, the UDFCD received two awards that can be directly attributed to Bill's work:

- James Lee Witt Local Award for Excellence, ASFPMP (for the Floodplain Preservation brochure)
- Safe Development Leadership Award, NHMA

Bill was a founding member of CASFM and served on the Board during the early formative years. He received a prestigious service award at the last Annual Conference.

Bill could not have seen what lay ahead when he embarked on his career in Floodplain Management, however through his hard work and dedication he has left us a lasting legacy of a comprehensive Floodplain Management Program. It takes many hands to work towards our shared goal of reducing the death and misery associated with flood disasters. It takes daily dedication and action. We suffered an unprecedented rainfall and flood event last fall. In-depth reports on the damage and recovery are available elsewhere. I believe the loss of life and misery would have been worse were it not for the collective work of our local governments and state agencies to build a safer and more resilient Colorado. It's time to rededicate our work to learning from Rapid City's example, natural hazard mitigation makes a difference.

Some of Bill's favorite quips of late are *"Ask the new manager."* and *"I love making commitments that David will have to make good on."* We wish Bill and Mary the very best as they glide into retirement. Bill plans on remaining active in floodplain management and that's welcome news. You may be interested to know that Bill and Mary's daughter, Sara is also a licensed civil engineer working in floodplain management for a national firm in the Washington D.C. area. So I'll close my appreciation of Bill, my boss, mentor and friend by saying **"Thank you"**.

### ***Parker Jordan Centennial Open Space Project***

Stream restoration is a tricky endeavor from conception through construction and site restoration. The open space parcel is located on Cherry Creek and adjacent to the 17-mile House property and Ecological Park. The project sponsors were the Parker Jordan Metropolitan District (PJMD) and the City of Centennial. Both the District and SEMSWA were minor funding partners. I discussed the design process last year and Susan Brown offered an excellent article as well. I predicted that this project will become an example of sound design, regional cooperation and environmental restoration. The project team delivered a great presentation at the CASFM Annual Conference and won the Honor Award. Joanna has contributed an excellent article this year discussing the very successful revegetation effort and the use of wetland sod. Innovations in pre-construction weed control and post-construction site restoration are gaining wider use in DCM projects and I believe have a place in projects that local governments submit for UDFCD maintenance eligibility.

### ***In Other MEP News***

We are delighted to report that development proposals as well as public sector work have both made strong comebacks this year. We have worked on a number of Southeast Metro Stormwater Authority (SEMSWA) projects including Little Dry Creek Reach 6 and Regional Detention Basins L2 and D2. We might need to partner with SEMSWA on a naming contest in order to give these projects more sizzle! Joanna has observed the construction of large-scale projects in Arapahoe, Douglas and Jefferson Counties, including the Hawthorn Project along Van Bibber Creek, Sierra Ridge along a tributary to Happy Canyon Creek and Morning Star along Windmill Creek. And let's not forget the Thornton Cabela's retail store that is adjacent to McKay Lake Drainageway.



**Recently constructed drop structure into Detention Basin L-2.**

# Strength in plants – a tree-hugger’s story

By Joanna Czarnecka E.I., CFM, Construction Manager

During my six years of work as a Construction Manager at Urban Drainage and Flood Control District (UDFCD) I have seen many different methods for revegetation of the project site. Some were more successful than others and some left a lot to be desired. I want to focus on what I noticed was especially successful and I would like to share this information with you. This short report is all about the success story which truly shows the strength in plants.

I would like to introduce you to the Cherry Creek stream reclamation project at Parker Jordan Centennial Open Space (PJCOS) located in Arapahoe County near the intersection of Broncos Parkway and Parker Road. This project was designed by J3 Engineering Consultants with multiple parties involved as stakeholders. The project was submitted for the UDFCD Maintenance Eligibility Program (MEP) which has proved its success over the years by providing local governments with control over the development projects and also granting the maintenance assistance for these projects. Part of the MEP program is the vegetative cover requirement of the improved areas in order to gain final acceptance.



**Wetland sod two weeks after installation.**

Construction on the site started in spring of 2011. The project included raising a stream to connect to a floodplain, building five grouted sloping boulder drop structures, adding trail crossing and multiple park improvements to help people enjoy the full nature experience. It included improvements to over 6500 feet of the channel which was greatly degraded. All these items were pretty typical for a stream stabilization and reclamation project except for implementing a little different landscaping approach. Susan Brown with Valerian and Deb

Keammerer with the Restoration Group, Inc. partnered to propose an innovative and interesting design of the landscape and amenities for this site that was geared towards many different types of users.

The site was vulnerable from the very beginning of the construction due to sandy soils. Erosion control was taken seriously, and it proved to be quite a challenge during and immediately after the construction. This probably was the reason for considering wetland mats as a part of revegetation efforts by restoration experts. I was very excited to hear that this was the chosen option for this site as it was my first hands-on experience with this product. As defined by North Fork Native Plants company: wetland sods are coir erosion control mats grown with pre-vegetated native wetland plants.

Wetland sod mats are considered a very successful approach by multiple sources. There is a lot of information supporting their performance voiced by the USDA, North Fork Native Plants company, Intermountain Aquatics and also UDFCD. UDFCD is adding new information about them into our updated *Urban Storm Drainage Criteria Manual* Volume I which is now under review. There are many advantages to using wetland sod mat: it provides a bioengineering approach, immediate stabilization of the erosion prone areas, immediate aesthetics, weed suppression, available variety of wetland plants, and instant enhancement for the habitat.

When compared to the traditional seeding, wetland sod mats offer immediate results with minimal maintenance. Installation is very simple. Trucks deliver pre-cut sod mats that can be easily placed. Cost comparison initially shows wetland sod to be slightly higher but it pays for itself in the long run. As Deb Keammerer said, typical “10T wetland plants do not provide the sort of erosion protection a solid mat of sod can deliver”. Based on my observations, I strongly agree with this statement. The above mentioned project (PJCOS) was hit with a few storms during the construction phase. After a

June 2012 storm, Josh Duncan with J3 Engineering Consultants together with Deb Keammerer with the Restoration Group prepared a flood damage assessment document which proved the success of freshly planted wetland sod. Wetland sod mats also protected the biologists and other plant material installed on the site.

My observations of the wetland sod performance on the PJCOS site agree with this assessment. Not only did the project perform well during the flooding event right after the



**Wetland mats three months after installation.**

installation of wetland mats, but less than a year later, the site is covered with thriving vegetation. I would credit the wetland sod greatly with this success. Just to put things in perspective, based on my experience, typical time frame for the project to reach the required revegetated status and be granted final acceptance in the MEP is 2-4 years; yet this site is ready for final acceptance in just one year. I think this speaks more about the success of the project than anything else. The main goal for all drainage improvement projects is to have the vegetation growing strong as soon as possible to provide adequate protection for the stream bed, banks and also provide home to the critters. Vegetation is critical in flood control. If we can achieve stable vegetation immediately, why not consider the wetland sod? It just makes more sense in this tree-hugger's point of view.



**The project one year after completion. Vegetation is thriving.**

*The project that is the subject of this article received an Honor Award from the Colorado Association of Stormwater and Floodplain Managers (CASFM) at their annual conference in Steamboat Springs in September, 2013.*

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## UDFCD receives Blue Gramma award

The Colorado Open Space Alliance (COSA) gave the UDFCD a Blue Gramma award for Outstanding Achievement by an Organization at its annual conference in Crested Butte. The award presentation was reenacted at the October Board meeting. Pictured (L to R) Heather Cronenberg (COSA), Executive Director Paul Hindman, UDFCD Board Chair Nancy McNally, Linda Strand (COSA) and Marc Predrucci (COSA).



# Information Services and Flood Warning Program Notes

Kevin Stewart, PE, Program Manager



**September 2013 flood damage along Fourmile Canyon Creek in Boulder County near UDFCD border.**

Many Coloradans' lives were changed forever by the rains that fell during the last week of the "official" 2013 flood season, traditionally defined as

being coincident with UDFCD's long-running Flash Flood Prediction Program from April 15 through September 15. Over 18,000 homes and businesses in the state were damaged or destroyed by the ensuing floods, with a high percentage of those properties uninsured. News reports stated that more than 17 percent of the affected properties in Boulder, Larimer, Logan and Weld counties are not within defined floodplains. The effect on public transportation was immense with the destruction of many public and private roadways, railroads, bridges and culverts. Steep mountain slopes slid to their canyon floors, streambanks failed, and the floodwaters carried huge rocks and debris as they carved new channels and created new floodplains. Statewide flood losses are anticipated to exceed \$2billion. Other accounts have referred to this record-setting rainstorm as a 1000-year event and some have even described it as being "biblical." While the last comparison may be a bit of a stretch—the rains did not last 40 days—it certainly was the event of a lifetime for many.

Sadly, nine Colorado fatalities were caused by the storm according to the National Weather Service. Two in El Paso County, one in Clear Creek County, two in Larimer County from flooding on the Big Thompson River and four in Boulder County. Knowing that the 1976 Big Thompson Canyon flash flood claimed over 140 lives, news stories quickly surfaced crediting early flood warning systems with saving hundreds. UDFCD is proud to have played its part in delivering warning messages and real-time data through its close partnership with the NWS and local offices of emergency management, but the real heroes that deserve the credit are many including: behavioral scientists who taught us how people respond to warnings and what could be done to improve the local warning process; community leaders who took this advice seriously, which resulted in developing better early flood detection capabilities, specialized flood prediction services, siren deployments and other enhanced public

warning methods; public safety, public works and other local officials that delivered the message to those at highest risk; mountain community alliances that helped citizens know how to survive a wildland fire or flood disaster and established emergency communications for times when normal methods fail; the countless number of skilled emergency service personnel who risked their lives to save others; neighbors helping neighbors; and finally, to the people who believed the flood risk message and took appropriate actions when warned.

A specific report later in this article is devoted to shedding more light on the nature of the rainstorms and floods of September 9-15, 2013 to better understand just how rare this event really was and how UDFCD local governments were impacted. The report will attempt to answer questions like was this or was this not a 100-year or greater flood. Readers may be surprised by some of the findings.

Information services require a strong IT foundation. UDFCD's Derrick Schauer continues to make that a priority for all District programs by updating computer equipment and software, administering system security features, and assisting staff when asked and at times of desperation. Efforts in 2013 included development of a disaster recovery plan and procedure that will be tested periodically, annually reviewed and updated when necessary. The UDFCD website will undergo a major facelift and modernization in 2014. A website committee of UDFCD staff volunteers lead by Derrick is tasked with guiding this process. Keep an eye on [www.udfcd.org](http://www.udfcd.org) as these changes begin to roll out and then, be sure to view this page using your favorite handheld device or smartphone. We believe you will be pleased with the results.

UDFCD's Julia Bailey has been the gatekeeper of our electronic information and GIS data since 2010. Julia's talents include making UDFCD publications and other documents easily accessible via the Internet. Be sure to read Julia's article in this issue of *Flood Hazard News* to learn about the most recent enhancements. Julia also continues to work closely with Amelia, our Administrative Services Manager, and Krystle, our Electronic Document Administrator, to improve UDFCD's records management procedures. All UDFCD programs and partner agencies will benefit from new work flow and record retrieval processes that evolve from the efforts of this dedicated threesome.

Jeremy Deischer has made excellent contributions over the past few years as one of UDFCD's most gifted student interns. The IS/FWP has benefited from his talents since 2012, but as with all good interns, the bittersweet time finally

arrived to say farewell and extend our best wishes as Jeremy begins his fulltime pursuit of a promising engineering career with Icon Engineering. Congratulations Jeremy! With Jeremy's departure comes a new opportunity for IS/FWP staff to work with another very capable and enthusiastic student from the University of Colorado at Denver, Devin Keener. We are confident that great things lie ahead for Devin. Welcome Devin!

### 2013 Flood Season Recap

Prior to the epic floods of September, UDFCD's Flash Flood Prediction Program was experiencing an unusually wet and long monsoon season with the stormy weather continuing past Labor Day. By the end of the first week in September, local governments served by the program had safely weathered 47 days of heavy rain potential with 43 of those days producing at least some localized flooding. By the end of September the program logged a record number of threat days since its inaugural season in 1979.

The ALERT System generated rainfall rate alarms for 31 threat days in 2013 compared to only 13 days the prior year. Specific alarm dates are noted in the table below:

#### Record 58 days with flood potential in 2013

May	8, 15, 29	3
June	15, 18, 23, 28, 30	5
July	10, 11, 12, 13, 14, 15, 18, 19, 20, 24, 25, 27, 28, 29, 30	15
August	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 18, 21, 22, 23, 24, 25, 26, 27, 30	21
Sept	3, 4, 5, 9, 10, 11, 12, 13, 14, 15, 16, 18, 22, 23	14

Red dates are when rainfall measured by automated gages exceeded alarm thresholds. Yellow highlighted dates indicate heavy rainfall only in affected areas outside UDFCD's main area of concern such as the Hayman Burn Area in SW Douglas County and watersheds in northern Boulder County. Blue boxes are when a NWS flash flood watch was the highest threat level reached and red designates a flash flood warning.

Twenty-four hour measured rainfall totals from the ALERT/CoCoRaHS combined dataset exceeded 3 inches on six days in 2013 (July 13, August 3, September 9, 11, 12&14). Eight other days (May 8, July 14, August 8&22, September 4, 10, 15&22) had 24-hour rain totals between from 2 to 3 inches. A [storm summary table](#) and corresponding maps are available for every day that heavy rainfall was predicted.

By late April reports of near normal mountain snowpack conditions were welcome news for NE Colorado communities. The subsequent runoff in May and June was well-behaved. No flood warnings for the snowmelt season were needed this year for the Denver area—a good start!

May rains were uneventful with the first threat day of the year (May 8) producing quarter-inch per hour amounts in Boulder County's Fourmile Burn Area with no consequence. Precisely one-week later, Aurora experienced some minor street flooding from a short-duration rainstorm. Looking back now, the most ominous event of the month may have been the rare early morning thunder on the 29<sup>th</sup> that produced little rain but lasted an unusually long time...possibly a harbinger of what lay ahead.

By mid-June the region had dried-out and El Paso County was dealing with the worst wildfire in Colorado history, the Black Forest Fire, destroying over 500 homes and surpassing the prior-year's record held by the Waldo Canyon Fire, also in El Paso County. In 2010, Boulder County's Fourmile Canyon Fire owned this unwanted record. Subsequent to each of these fires tragic floods followed. By the end of June the UDFCD had experienced a few bouts of severe weather with a small tornado reported near DIA on the 18<sup>th</sup>, but very little rain fell over the metro area during June with Friday, June 28 producing the most.

This dry trend continued into July until the summer monsoon arrived on July 7 when heavy rainfall occurred over the Hayman burn area and other parts of southern Douglas County. By July 10 the metro area started receiving the welcome rains and the 2013 fire season appeared to be nearing its end. For six consecutive days (July 10-15) flood threats prevailed causing the NWS to issue flash flood warnings for the 12<sup>th</sup> and 13<sup>th</sup> followed by a flash flood watch on Sunday, July 14. The ALERT system logged 63 rainfall rate alarms over a 4-day period beginning Friday, July 12.

The Fourmile Burn Area (FMBA) in Boulder County was the primary target for many of the NWS flash flood warnings and advisories, much like the prior two years. While experts agreed that the watershed had experienced excellent vegetative recovery since the 2010 fire and is less prone to flooding from half-inch rainstorms, the concern remained that larger hillside debris still posed a threat and that the lack of a healthy forest and deep duff layer would warrant careful watch during rainstorms capable of approaching an inch or more in less than one-hour. Flash flood warnings were issued for the FMBA on **July 12** and **July 18** with little consequence. At this point it certainly seemed that conditions in the FMBA had improved substantially.

On Saturday, **July 13**, multiple thunderstorms moved through the District during afternoon hours. This was the first storm of the season with rainfall totals exceeding 3-inches. Flash flood warnings were issued for central Jefferson County that included Arvada, Wheat Ridge and Lakewood. The storm caused Lakewood Gulch in Denver to rise over 6 feet in a short period setting a new record for the USGS gage that has operated continuously since 1981. July 13 was also the second anniversary of the FMBA flash flood that destroyed nearly a dozen homes and threatened many lives.

In hindsight, one might see this day as the second harbinger of 2013.

For the 21-day period between July 24 and August 13, only 3 days were forecast as having no flood potential. On Saturday, **August 3**, slow moving severe thunderstorms during the afternoon and evening flooded portions of Boulder, Adams and Arapahoe counties. Every UDFCD county experienced moderate to heavy rainfall with the worst storms concentrating over the SE and NW portions of the District. The town of Erie in eastern Boulder County had considerable damage from high winds and flooding, and measured the largest rainfall amount of 3.4 inches. On the following Thursday, **August 8**, flash flood warnings were issued when a line of strong storms became stationary across the District between 5 and 7pm, dropping 2 to 3 inches on Aurora. The final flash flood warning for August occurred precisely two weeks later on **August 22** when the Ken Caryl Ranch area of



Jefferson County (photo) and portions of northern Douglas County received 2 to 3 inches of rain accompanied by copious amounts

of hail. That same day, our friends to the south in El Paso County experienced a 3-4 inch intense downpour that flooded Woodland Park, narrowly missing the Waldo Canyon burn area. Had that storm occurred over Waldo instead, the impact to Manitou Springs—an area familiar with deadly post-fire flash floods—would likely have been horrific.

#### **SPECIAL REPORT: The Rains & Floods of September 2013**



With flood warnings credited for saving hundreds of lives during the floods of September, early media attention focused on this part of story. A news release by the National Hydrologic Warning Council observed that Colorado Front Range communities were committed to a “different outcome” than what happened on July 31, 1976 in the Big Thompson Canyon. Thirty seven years of preparing for flood disasters using various techniques, not just early warning, undoubtedly saved lives and surely will help Coloradans recover and be ready for the next big one. This special

report, however, will attempt to address another perplexing question...*how big was this flood really?*

#### *Historical Perspective*

Before trying to describe how rare this event was or was not, it may be helpful to recall a few other large floods from the past and draw some comparisons. Colorado’s Front Range has experienced many flood disasters since the gold rush in the late 1850’s. Denver’s Cherry Creek flood of 1864 was one of the more notorious events. Subsequent floods in the late 1800’s and early 1900’s lead to the construction of the familiar concrete-walled flood channel along Speer Blvd. in downtown Denver. The late 1800’s also brought two major floods that originated in the mountains of Jefferson and Boulder counties, the Boulder Creek Flood of 1894 and the Bear Creek “Black Friday” Flood of 1896. Both of these events remain record-holders with the late May 1894 flood considered equal to the 100-year flood on Boulder Creek. The estimated peak flow on Boulder Creek from September (5,000 cfs) was less than half the estimated magnitude of the 1894 flood and roughly twice the magnitude of a more recent Boulder Creek flood that occurred in early May of 1969. The 1896 flash flood on Bear Creek claimed 27 lives and occurred in late July, the same time of year as the deadly Big Thompson flood. This mid-summer period is now commonly referred to as Colorado’s summer monsoon when flash floods are most likely.

The 1965 South Platte River flood that led to the construction of Chatfield Dam upstream of Denver remains Colorado’s most costly flood in terms of property damage after considering inflationary adjustments. This historic flood occurred in mid-June prior to the monsoon season and was also caused by a 10-inch plus rainstorm. However, most of this rain fell in just over 3-hours. The character of the 2013 storm was quite different.

Generally the upper level flow of tropical moisture from Arizona ends for Colorado by mid to late August. But on rare occasions this condition has been known to persist. During the Dust Bowl period of the 1930’s, one major September rainstorm in 1938 produced totals that exceeded 10-inches, causing severe flood damage to the small towns of Morrison in Jefferson County and Eldorado Springs in Boulder County in particular. Considering all the historic flood accounts of the past 150 years, the 1938 flood stands out as the single September event that most closely resembles what just took place in 2013.

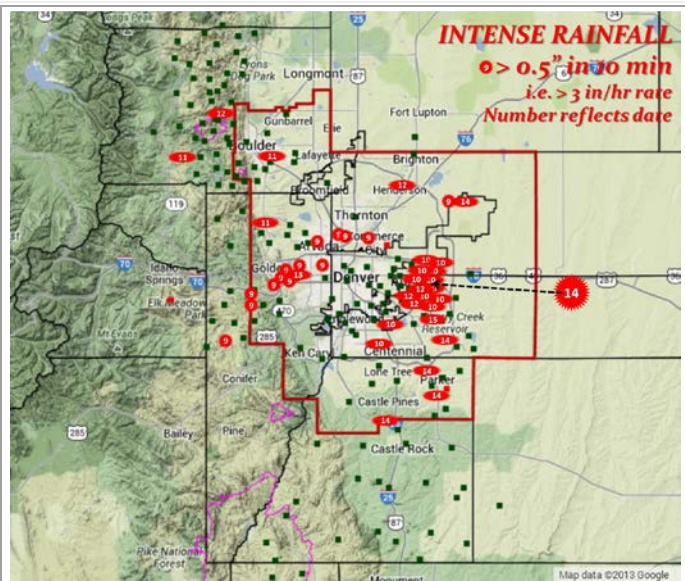
#### *The Timeline*

The following map and corresponding table shows when the heaviest rainfall occurred during the 7-day period that began on Monday, September 9. The ALERT system logged 242 rainfall rate alarms during the storm but relatively few of those alarms reflect the 10-minute peak intensities shown below. It is interesting to note that Boulder County, where four fatalities and much of the worst flooding occurred,



sustained the lower intensity rainfall compared to the other locations in the District.

**Periods of Heavy Rainfall (September 9-15, 2013)**

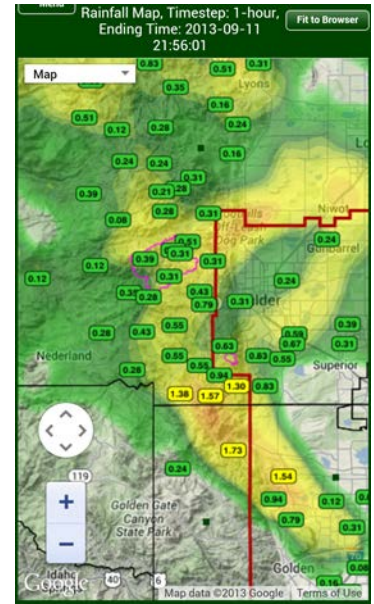


9	2 – 5pm	Lakewood, Wheat Ridge, Arvada, DIA and parts of Adams and Boulder Counties
	7 – 9pm	Bear Creek and Little Dry Creek in Jefferson and Adams Counties
10	4 – 6 pm	Denver & Aurora
11-12	9pm – 2am	Boulder County
12	4 – 9am	Boulder County
	5am – 1pm	Westerly Creek, Toll Gates and Sand Creek in Denver, Aurora and Commerce City
	4 – 10pm	Boulder County
13	5 – 6pm	Lena Gulch area of Lakewood & Wheat Ridge
14	3 – 6pm	Aurora & Douglas County
15	10am – 2pm	Denver & Aurora

On **Day 1 (9/9)** the storms were accompanied by hail and lightning with minor flooding reported in Lakewood, Wheat Ridge and Arvada where 2 to 3 inches of rain fell in a short time. Prior to the storm’s arrival a flash flood watch had been issued for the Fourmile Burn Area of Boulder County. Maple Grove Reservoir on Lena Gulch in Lakewood rose about 3-feet, an early sign of what lay ahead for the region. The Boulder Office of Emergency Management later reported that the NWS had called this day to tell officials to expect lots of rain this week. By Wednesday night (9/11) this proved to be an understatement.

**Day 2 (9/10)** was relatively uneventful with the exception of some intense rains the struck Denver and Aurora during the late afternoon rush hour. No serious problems were reported as light rain continued throughout most of the day over much of Boulder and Jefferson counties with 24-hour accumulations between 0.5” and 1.0” at many locations.

By noon of **Day 3 (9/11)** rainfall totals since Monday approached and exceeded 3 inches at many mountain locations and over the adjacent plains. Watersheds were becoming saturated while the rains continued. The upper Left Hand Creek basin in the central Boulder County high country measured some of the largest totals with five gages in that area reporting over 3 inches. Morning forecasts alerted officials that storms this day could produce upwards of 3 inches in 2 to 3 hours if the worst happened. Local emergency managers diligently monitored the situation throughout the day. During the afternoon another half-inch fell over large areas with some isolated locations receiving more than an inch. Between 6 and 7pm, an intense storm developed in eastern Boulder County prompting the NWS to issue its first flash flood warning of the day by 6:50pm. This warning area did not include either the City of Boulder or the mountains. The remainder of the day would test everyone involved. Emergency Operation Centers (EOC’s) were soon fully staffed. Between 7 and 10pm an additional 2 to 3 inches of rain fell over SE Boulder County. The map shows a one-hour snapshot of rain amounts and radar at 9:56pm. Between 10pm and 5am the flooding reached its climax in the City of Boulder and throughout much of Boulder County. Forecasters, emergency managers, first responders, public works agencies and many other local officials were dealing with reports of fatalities, missing persons, 30-foot walls of water in canyons and dam failures. Many lives would soon be changed forever by the events of this day.



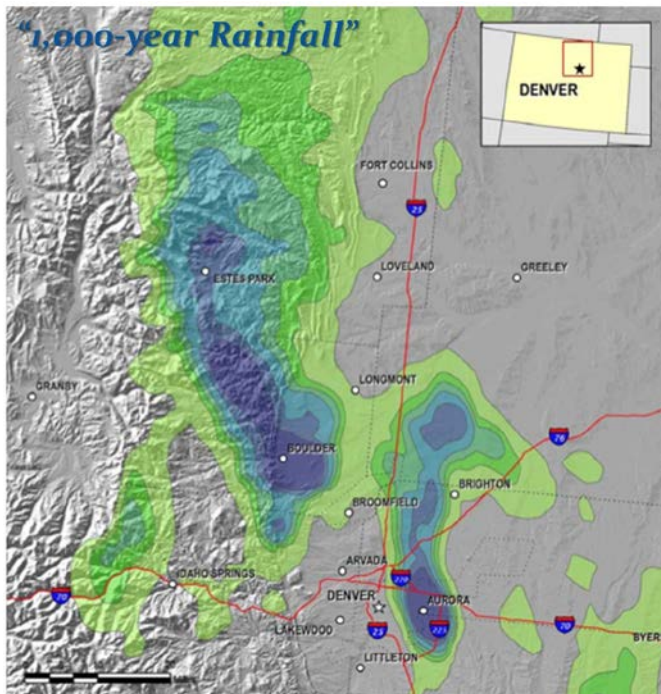
As the dawn of **Day 4 (9/12)** approached, the rain in Boulder County refused to end, but became less intense while the destructive flooding continued unabated. At this time the storm redirected its energy at the Sand Creek watershed in Denver, Aurora and Commerce City. Between 5am and noon more than 5 inches fell over the Westerly Creek basin, a left bank tributary to Sand Creek. A dam failure at the Rocky Mountain Arsenal National Wildlife Refuge forced a partial evacuation of Commerce City. Fortunately an old railroad embankment downstream of the dam held the surge of water and prevented serious damage to the city. In the Westerly Creek basin, four flood control impoundments prevented more serious damages from occurring. Floodwaters on Sand Creek caused considerable bank erosion that threatened the Metro Wastewater Treatment Plant near its confluence with

the South Platte River. At the end of the day, thanks to a number of flood control and major drainageway improvements completed by local governments and UDFCD over the years, the flood losses that occurred here were not too bad and no lives were lost.

The rains continued over the next three weekend days but the worst of the flooding was over for UDFCD jurisdictions. The heaviest amounts occurred in Douglas County, Aurora and Broomfield with Saturday and Sunday measurements nearing 3-inches at some isolated locations. No serious problems were reported during this episode of rain from the September Storm of 2013.

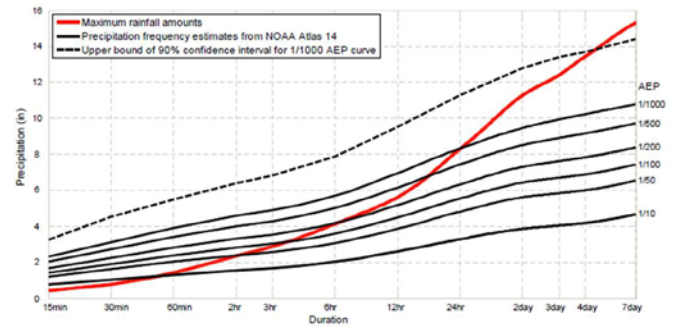
**Rainfall Amounts & Frequency**

An early technical analysis prepared by NOAA officials categorized the September 2013 rainstorm as a 1000-year event (see map below). Statements were also made to news reporters suggesting that the storm was of “biblical” proportions. Having struggled to answer many difficult questions during the storm from forecasters, emergency managers and others, this writer can certainly understand the biblical reference, but knowing that the rain did not last for 40 days, it is probably safe to conclude that its magnitude was less than biblical. The next logical questions to emerge related to the flood itself. Specifically, was this a 100-year flood...a 1000-year flood...or something worse? The remainder of this special report section will try to address these questions but as details continue to surface about this flood, the opinions expressed herein may change.

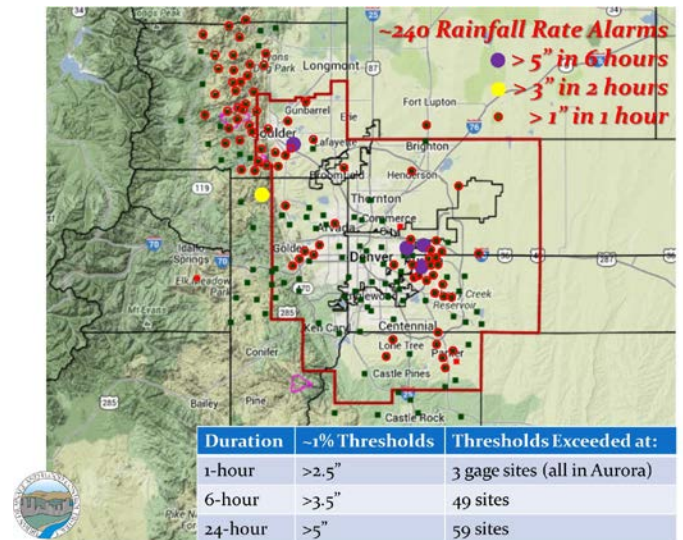


The map represents a comparison of the 24-hour maximum rainfall measurements with NOAA’s recently updated precipitation frequency atlas for this region (NOAA Atlas 14). The darkest blue areas are where those

measurements exceeded 0.1-percent annual exceedance probability (AEP) values. It is clear from this analysis that the September event was extremely rare with respect to the rainfall that occurred over a 24-hour period. To better understand how this rainfall affected the flooding, the storm’s temporal distribution must be considered. The following AEP curve helps explain this by showing the maximum rainfall amounts (red line) measured by an automated rain gage located near the mouth of Boulder Canyon at the Boulder County Justice Center.



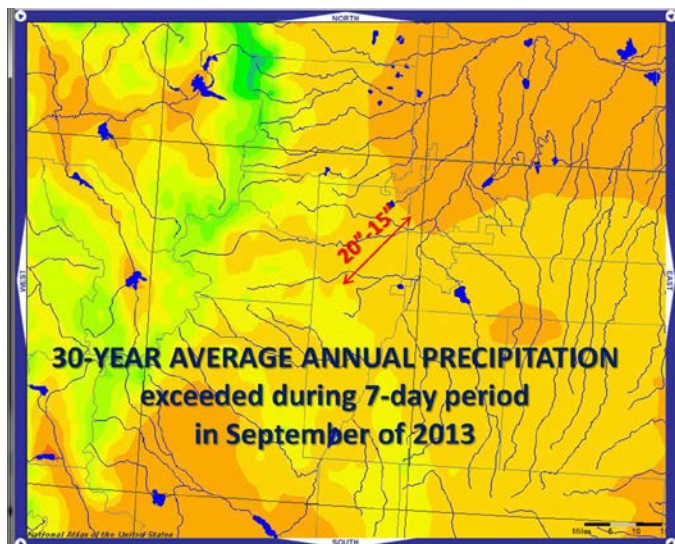
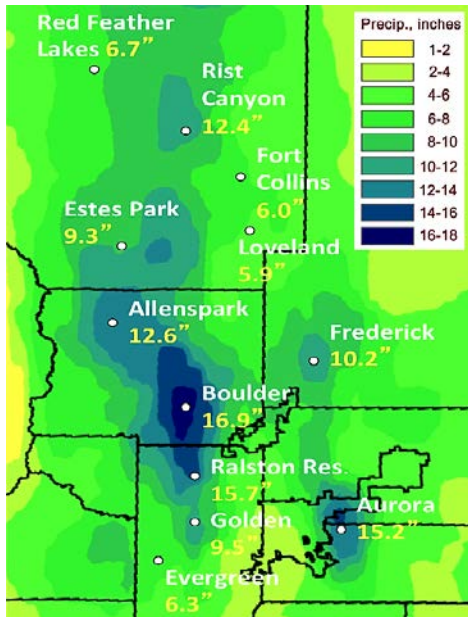
Note that the measured rainfall does not exceed the 1-percent (100-year) threshold until the storm’s duration is greater than 6-hours. This may also be a good time to point out that a 1% AEP rainfall at a point does not imply that a flood of equal probability will occur downstream. Also, flood magnitudes are strongly influenced by high rainfall intensities over relatively short time periods and not by rainfall totals exclusively. Rainfall averages over upstream watershed areas are also important. No simple answer here!



Another way to consider rainfall frequency is to take a closer look at the rainfall rate alarms generated by the ALERT system and the maximum accumulations per unit time. The above map shows gage locations where various alarm thresholds were exceeded during the week of September 9. The thresholds in the legend do not include the 0.5"/10-minute (3 in/hr) rate that was discussed earlier in this report.

The table lists approximate 1% annual chance rainfall amounts for each corresponding duration. The right column indicates the number of gage sites that exceeded the corresponding 100-year thresholds during the 7-day period. This finding is consistent with the NOAA AEP graph for the Justice Center gage.

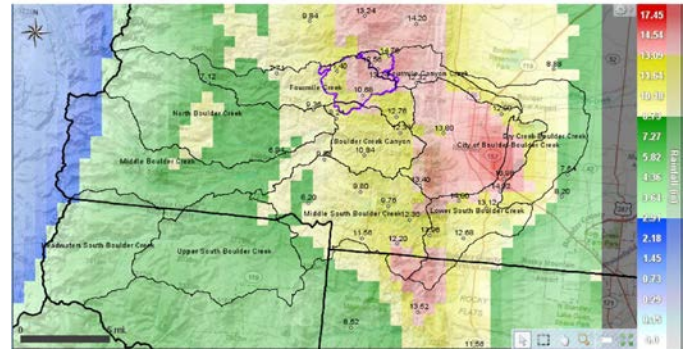
Comparing the 7-day rainfall totals to the annual average rainfall for the region illustrates how unusual this event was relative to climatic norms. Note that the larger amounts shown on the map to the right exceed the 30-year annual averages for the same location.



The following gridded rainfall map for the Boulder Creek watershed reveals where some of the larger storm totals occurred during the week. These 1km grids represent a summation of incremental 5-minute radar-rainfall estimates that were bias corrected in real-time using rain gage observations from the ALERT system. The top scale value of 17.45 inches reflects the maximum grid estimate for the 7-day period.

## September 9-15, 2013

Radar-Rainfall estimates for Boulder Creek watershed



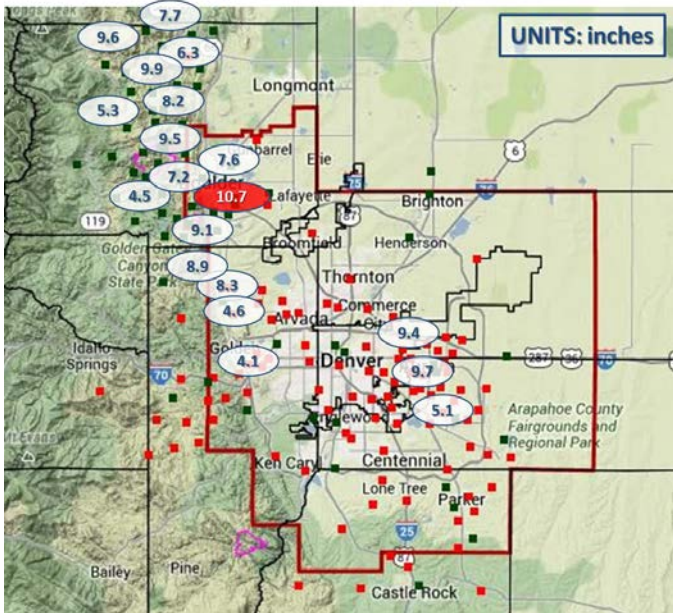
A closer look at the rainstorm temporally and spatially helps explain some of the observed flood conditions. The subsequent series of 4 maps (next page) shows where 24-hour, 6-hour, 1-hour and 10-minute maximums were measured. Notice that both the 24-hour maximum and the 10-minute peak intensity occurred at the same gage location



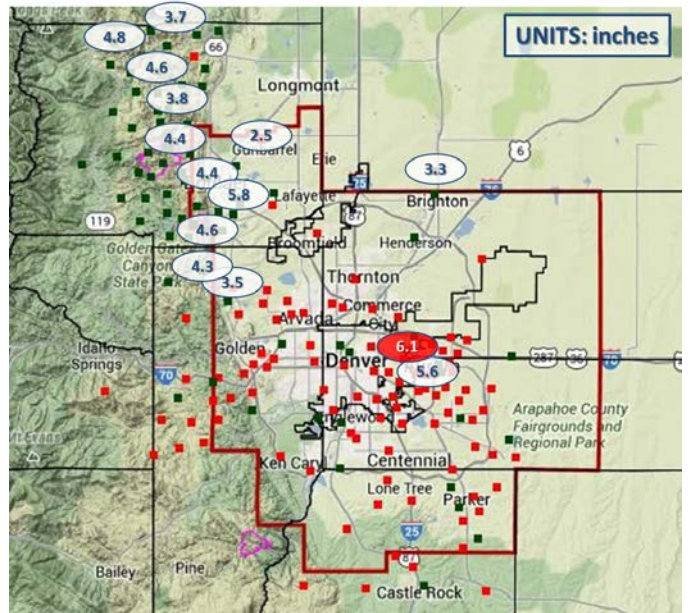
Westerly Creek Dam flood pool two days after the rain

in Boulder—the South Boulder Road crossing of South Boulder Creek. This is consistent with the above map and helps explain the observed flooding along South Boulder Creek including the area adjacent to Foothills Parkway known as the “West Valley Overflow.” The 24-hour and 6-hour peaks also correlate well with other areas that experienced some of the worst flooding. The short duration peaks (1-hour and 10-minute) prove that the mountains of Boulder County did not experience the most intense rainfall, however, that area did tally many of the largest storm totals. Intense rainfall with very large accumulations also fell on the Westerly Creek basin in Denver and Aurora, putting four flood control impoundments to the test—Utah Park, Expo Park, Westerly Creek Dam and Kelly Road Dam.

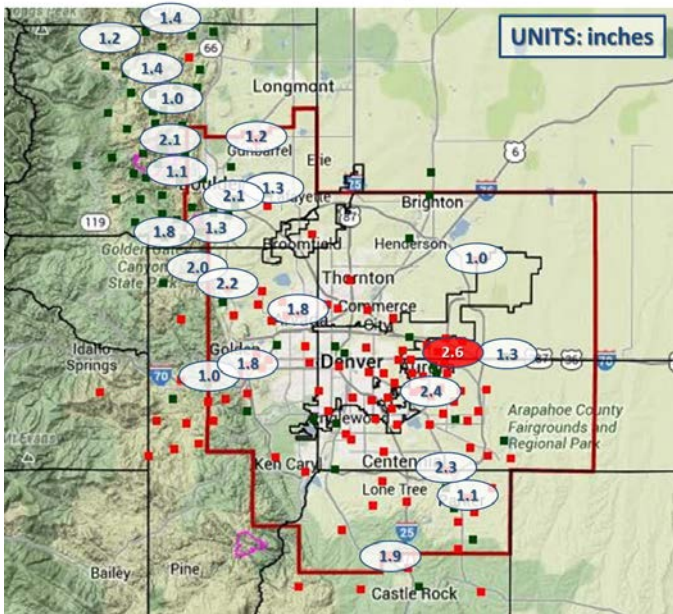
**Peak 24-hour Rain Totals**  
September 9-15, 2013



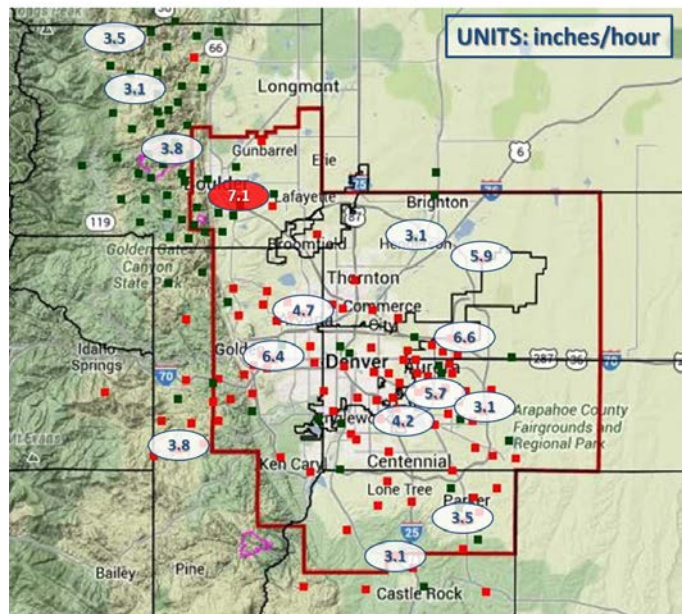
**Peak 6-hour Rain Totals**  
September 9-15, 2013



**Peak 1-hour Rain Totals**  
September 9-15, 2013



**Peak 10-minute Rain Intensities**  
September 9-15, 2013

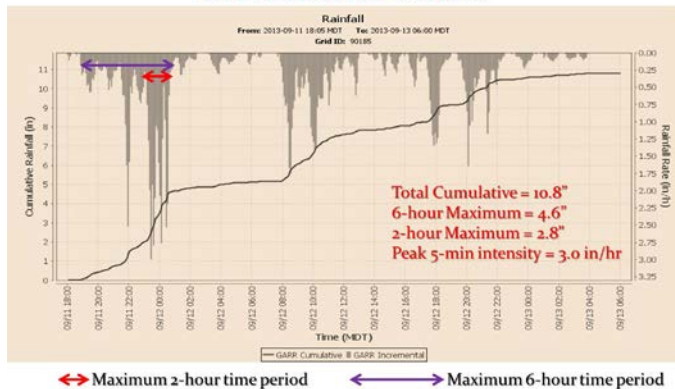


The preceding maps and related discussion presents a somewhat static perspective on the storm. The following graph illustrates how rainfall progressed over a 36-hour time period. This plot of gage-adjusted radar-rainfall (GARR) runs

from 6pm on Wednesday (9/11) to midnight Thursday (9/12) and is typical of observations made at many other locations. The intense periods of the storm occur in waves that are not sustained. This storm pattern does not resemble what engineers use to design flood control projects or delineate

floodplain limits. Although the 2- and 6-hour maximums in this example nearly equal 100-year thresholds, the peak 5-minute intensities do not. Standard rainfall distributions used in major drainage design contain peak rates approaching 8 in/hr, which is 2.5 times more intense than the example below.

### Fourmile Canyon Creek Radar-Rainfall 36-hour Time Series



In summary, the rainfall that caused Colorado’s September 2013 flood disaster came in waves, accumulated amounts over a 24 to 48-hour period that greatly exceeded 100-year (1% AEP) thresholds, and covered large areas. Each wave of rainfall activity produced amounts that were far more common to the region with the exception of a few isolated areas. Boulder County’s 1-hour rainfall maximums illustrate this well with the largest measurements ranging from 1.0 to 2.1 inches, corresponding respectively to 5-year (20% AEP) and 50-year (2% AEP) frequencies. Consequently, peak flood flow estimates at many locations were surprisingly lower than expected. Other factors affected the flood magnitudes and impacts.

#### Flood Peaks & Frequency



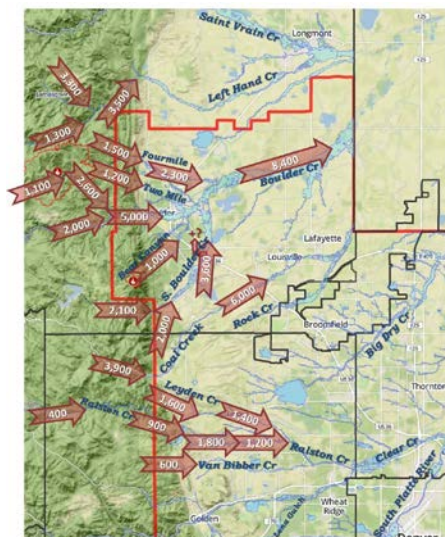
**New channel cut by Fourmile Canyon Creek in Boulder County near UDFCD border. Actual creek channel is left of photo. Damaged parking area served the Anne U. White Trailhead prior to the flood.**

Normally peak flood flows are relatively easy to estimate from maximum recorded gage heights at stream gages. This was not the case for this particular flood for a number of reasons. Many stream gages were destroyed or damaged by the floodwaters. At some locations stream channel banks and beds were reshaped by

the flood and at other locations old channels were completely obliterated and their paths rerouted. Some gages measured water depths that exceeded their published discharge ratings. Consequently, indirect flow measurements became the best option for estimating flood peaks.

To accomplish this monumental task, the District sought help from a world-renowned research scientist with over 40 years of experience making peak flow estimates of this type. Thanks to Robert D. (Bob) Jarrett, Ph.D., estimates were obtained for many locations of interest. Bob is a paleoflood hydrologist recently retired from the USGS who spent his federal service career evaluating evidence left by floods that in some cases date back 100’s of years. Given the massive amounts of rock and debris that were displaced by the floodwaters, Bob’s contributions have certainly proved vital in trying to better comprehend the actual magnitude of this flood. By achieving this task, engineers will have the critical information they need to help the region recover effectively and limit damages that future floods will cause.

The map shows some of the preliminary peak flow estimates of particular interest to the District. Assuming these estimates are reasonable, the next difficult task is trying to understand the corresponding flood extents and damages that resulted.



For many locations this flood may best be described as both a geologic and hydrologic disaster. As steep mountain slopes gave way, thousands of tons of sediment, large rocks and fallen trees reached valley floors and flooded streams. Stream banks, roadways and buildings collapsed adding to the debris being carried by floodwaters. At points where the movement of debris was either obstructed or slowed, temporary dams formed and the water backed-up until the failure point was reached. Then a large surge of water would impact a relatively short distance downstream where walls of water were reported by witnesses. Eventually the debris load would be deposited. This condition was commonly observed throughout the high country and adjacent plains during the flood.



**Landslide in Two Mile Canyon in Boulder County.**



**Fourmile Canyon Creek in Boulder County.**



**Fourmile Canyon Creek near canyon mouth in Boulder County.**



**Fourmile Canyon Creek in City of Boulder.**

While news reports and articles were quick to state that Colorado had just experienced a 100-year or 1000-year flood, such generalizations are often misleading. The actual flood magnitudes and corresponding frequencies vary quite widely and are stream/location specific. Many peak discharge estimates fall well-below 100-year (1%) thresholds. For example, the 5,000 cfs estimate for Boulder Creek at the canyon mouth is considered a 25-year flood, which has a 4% annual chance of occurring. The 2,100 cfs on South Boulder Creek at Eldorado Springs is also classified as a 4% chance event. A 30 to 40-year (2-3%) peak was estimated for Fourmile Canyon Creek that runs through north Boulder, while the next canyon to the south—Two Mile Canyon Creek—may have exceeded the 500-year (0.2% chance) threshold. All of the above examples are either within or near the City of Boulder.

Streams reaches and locations within UDFCD where flood peaks either approached or exceeded the 100-year (1%) threshold include:

County	Streams/Locations
<b>Boulder</b>	Two Mile Canyon Creek, Coal Creek
<b>Jefferson</b>	Coal Creek, Leyden Creek
<b>Denver</b>	Westerly Creek (Kelly Road Dam to Colfax Ave.)
<b>Arapahoe</b>	Upper Westerly Creek basin in Aurora

Considering the extreme amounts of rainfall, this short list of streams may seem too short. Many other smaller drainageways as well as developed areas outside of mapped floodplains bore heavy damage from the floodwaters, but the peak flows that caused these losses are still unknown. The above table only lists major drainageways where flood peaks

are known to have topped 100-year levels inside District boundaries.

The Saint Vrain Creek watershed lies north of the District in Boulder County. Many locations there experienced severe flood conditions, most notably the communities of Jamestown, Lyons and Longmont. Preliminary flood peak estimates for Left Hand Creek and James Creek (see map on previous page), North and South Saint Vrain Creeks, and the main stem of the Saint Vrain through Lyons and Longmont approached 500-year (0.2%) levels. Areas further north in Larimer County along the Big Thompson River and its tributaries also sustained massive flood damage.

Ongoing efforts will further refine the peak discharge estimates for the September floods. As difficult as this task is, it may be far more difficult to explain why some numbers are so large and considered extremely rare, while “more frequent” flood peaks caused some of the worst damages and inundation extents. The debris impacts will certainly be part of this conversation. Bob Jarrett believes that some of the larger landslides carried huge water volumes that surged upon reaching streams causing flow rates to spike. This effect would be compounded when debris dams formed as previously described. After debris-related surges occur, flood peaks can quickly attenuate because the surge lacks the volume of water necessary to sustain high flow rates for long distances downstream. As rain keeps falling, more runoff is added to the stream flow. When the rainfall becomes intense, the peak runoff rates increase causing stream levels to rise more rapidly. As floodwaters begin to slow down, the huge debris loads find their final resting spots in and adjacent to creek channels. When channels become obstructed, the floodwaters seek new paths creating new channels. All of these factors contributed to the floods of September 2013.

#### Dams & Reservoirs



When a foot of rain falls, large reservoirs and impoundments are bound to fill and spill, and that’s precisely what they did during the floods of September. Dam spillways are intended to handle large flood flows safely. Occasionally

dams fail. Only one dam failure (Havana Pond at the Rocky Mountain Arsenal National Wildlife Refuge) on Thursday, September 12 caused public safety concerns in the District, resulting in an evacuation of Commerce City's Irondale neighborhood. Thanks to an old railroad embankment 1.5 miles downstream that held back the floodwaters, the threatened homes were not impacted by this breach. One other small dam failed on Leyden Creek upstream of Colorado Highway 93 but this incident went unnoticed due to all the other flood problems that were occurring at the time.

At other locations, dam spillways that rarely overtop operated safely. When this happened it attracted considerable media attention. News reporters frequently used the term "breach" to describe an operating spillway. This was alarming news for many who associate the word "breach" with a dam failure, knowing that the potential consequences can be catastrophic particularly where large dams are involved.

Some large dams that concerned District local governments during the September floods include: Evergreen Lake on Bear Creek at Evergreen; Ralston Reservoir on Ralston Creek west of State Highway 93; Arvada/Blunn Reservoir on Ralston Creek east of SH-93; Leyden Dam on Leyden Creek in Arvada west of SH-72 (Indiana Street); Maple Grove Reservoir on Lena Gulch in Lakewood; and Kelly Road Dam on Westerly Creek south of East 11<sup>th</sup> Avenue. All of these structures stored tremendous amounts of floodwater, had damages downstream and performed precisely as intended. Had these dams not existed, flood damages would have been far worse.

#### *Some Closing Thoughts*

There is little doubt that Colorado experienced an extremely rare flood event at a time of year when it was least expected. The magnitude of the multi-day rainstorm was "off-the-charts," being described as a 1000-year event and even biblical. The 24- and 48-hour totals were very rare indeed, resulting in huge runoff volumes, thus explaining why high spillway flows occurred at so many dams and reservoirs. The storm's 1-hour maximums, however, were far more common to the region with the exception of a few isolated areas of more intense rain (James Creek in Boulder County; South Boulder Creek in SE Boulder; Coal Creek Canyon and Leyden Creek in Jefferson County; and Westerly Creek in Aurora & Denver). Other heavily-damaged areas in and near the mountains experienced flash flood conditions aggravated by landslides and debris that temporarily dammed streams, then after weakening, freed enormous destructive surges of floodwater. Channel banks gave way destroying roadways, bridges and culvert crossings. New channels and floodways were formed, disregarding the many homes and buildings that lay in the flood's path.

While the September 2013 flood was unquestionably disastrous, past floods have been worse. The fatalities (9

total statewide including 4 in Boulder County, 2 of which within the District) were tragic but the number was low by comparison to past floods. Many factors contributed to this outcome including: 30+ years of preparing for the "next Big Thompson Canyon flash flood"; advances in communication technologies; early advisories given to local authorities concerning developing threats; early flood warnings; real-time rainfall and stream level information; radar and other storm tracking technologies; wildland fires that lead to increased flood awareness and community preparedness; deployment of sirens and other means of public warning; training of first-responders and decision-makers; coordination of information during the event; cooperation amount the agencies involved; and an appropriate response to warnings by those at highest risk.

Although flood-related losses within UDFCD boundaries were significant, many completed drainage and flood control improvements performed quite well and prevented damages. Over the past 40 years UDFCD has worked with its local governments to define flood hazards, to educate people about flood risks, to deploy technologies for detecting floods, to improve early warning capabilities; and to increase the capability of rivers, creeks, gulches and urban drainageways to safely transport floodwaters. After the September floodwaters had receded, one citizen familiar with UDFCD's work may have said it best when he tweeted that this was the District's "finest hour."

#### **Meteorological Support**

The Flash Flood Prediction Program (F2P2) operates from April 15 through September 15 in close partnership with the National Weather Service and focuses primarily on threats from heavy rainfall. The U.S. Army Corps of Engineers provides notifications of high releases from Chatfield, Cherry Creek and Bear Creek dams that are subsequently disseminated by F2P2 meteorologists to affected UDFCD jurisdictions. Flood advisories and warnings concerning mountain snowmelt runoff during late spring and early summer are provided by NWS.

The 2013 flood prediction and notification services were provided by Genesis Weather Solutions in partnership with Skyview Weather for the 7th consecutive year. This program has served UDFCD local governments for the past 35 years with early predictions of potential and imminent flood threats along with a variety of related forecast products like daily heavy precipitation outlooks, quantitative precipitation forecasts (QPF), and storm track maps. GWS President Bryan Rappolt has participated actively as an F2P2 forecaster for the past 20 years through various business enterprises. Bryan's Skyview partners included lead forecaster and 7-year veteran Brad Simmons supported by Jeffrey Auger, Chris Brinson, Alan Smith, David Bruggeman and Skyview's President Tim Tonge. The F2P2 was established after the devastating July 31, 1976 Big Thompson Canyon flash flood that claimed 143 lives.

With the September flood disaster occurring on the final week of the program, the District extended F2P2 services to the end of the month. During that 2-week period messages concerning low level threats were issued for four days, September 16, 18, 22 and 23. Of these four days, 9/22 produced the greatest rainfall totals with 1.5 to 2-inches occurring over much of Aurora. What a year this has been!

With the 2013 flood season forecast operations presumed to be nearing completion in late August, UDFCD once again asked Judy Peratt to evaluate the services provided. After the shock of the September floods, additional work was requested to capture any new observations. As a former director of emergency management for Jefferson County, Judy's interviews continue to help UDFCD discover what works well and possible changes to consider. UDFCD greatly values the feedback from all the participating local officials that represent emergency management, communications, public works and emergency services.

The floods proved helpful in revealing where attention should be focused to fine-tune the program slightly, but the general consensus was that UDFCD local governments were well-served in 2013 and that no major operational changes are needed. Training needs will remain a high priority for 2014 and criteria for low flood threshold notifications will be revisited. Notifications are now delivered by so many methods that the number of phone contacts being made to busy 911 communication centers could effectively be reduced without compromising critical information flow. For a complete archive of F2P2 messages and related products visit [f2p2.udfcd.org](http://f2p2.udfcd.org).

**CoCoRaHS Update**

UDFCD has been a CoCoRaHS sponsor since 2001 and routinely makes use of this valuable resource. The storm summary maps available from the F2P2 webpage are an excellent example. UDFCD worked with CoCoRaHS staff in the aftermath of the September floods to document rainfall amounts collected throughout the storm period. Their efforts were instrumental in preparing a number of very helpful and interesting publications and maps. Be sure to visit [www.cocorahs.org](http://www.cocorahs.org) to check out all that they have concerning the 2013 flood and past events. And if you are not already a highly-valued CoCoRaHS observer, please consider becoming one today.

**EMWIN-Denver Regional Update**

The EMWIN-DR steering committee continued to meet quarterly in 2013 under the leadership of Rick Newman, Deputy Director of Emergency Management for Jefferson County. UDFCD's Julia Bailey and Kevin Stewart are active members of Rick's committee. A recent move by the Adams County Office of Emergency Management provided an opportunity to upgrade and relocate the satellite downlink equipment. Because the dissemination software is being supported by UDFCD at its Diamond Hill office, it made sense

to eliminate the Internet link between Adams County and UDFCD by developing downlink capabilities at Diamond Hill. New smaller dish antennas helped make this feasible with the rooftop placement nearly impossible to see from the ground. The new installation was completed in December with assistance from Amateur Radio Emergency Services (ARES) volunteers. The Emergency Managers Weather Information Network provides 22 northeast Colorado communities with timely NWS weather warnings and advisories. During the week of September 9-15, EMWIN-DR distributed over 440 alerts to subscribers engaged with the flood emergency.

**ALERT System News**



**East Toll Gate at Hampden Rain/Stage Gage.**

The ALERT system currently collects real-time data from a network of six repeaters that receive transmissions from 219 gaging stations accommodating 195 rain gages, 103 stream gages and 26 full weather stations. Two new stations were installed by the City of Aurora in 2013—a combination rain/stage gage on East Toll Gate Creek at Hampden Avenue and a rain gage at the Blackstone Golf Course. Both sites employ a new more robust data protocol known as ALERT2™.

OneRain and Water & Earth Technologies (WET) provided preventative maintenance and repair services for 2013, enabling base stations to successfully process well over 9 million ALERT data reports. Annual reports and other documents are available concerning 2013 maintenance activities (for links see Resources box at end of article).

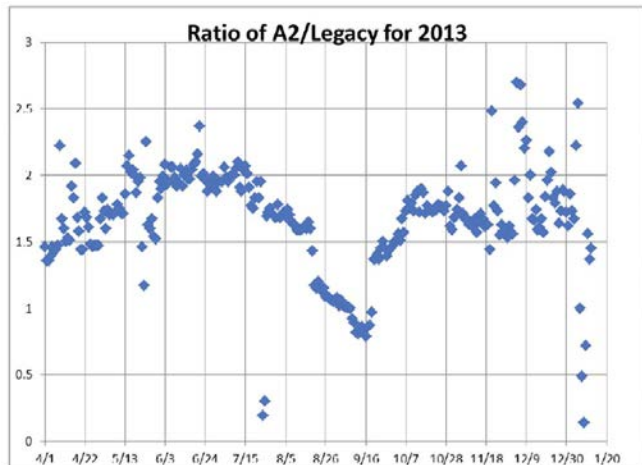
Record high water measurements were set in 2013 at 40 of the 103 stage gages, 39 of which occurred during the floods of September. Annual peaks occurred at 69 sites between September 9 and 15. The following table further illustrates the unusual nature of the September rains. The 229.74 tip count represents a 9-inch average rainfall total over the entire rain gauge network of 195 sites. Comparing this to the prior 7 years shows that the September 2013 rainfall was 8 times greater than the 7-year September average and 2.5 times more than the maximum average for any single month with May 2011 in second place.

*Monthly Average Tip/Count Summary*

Year	Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*
2006	4.62	5.92	18.39	20.47	19.44	13.75	74.03	46.89	24.17	41.13
2007	11.56	5.40	29.75	65.03	68.30	15.87	36.20	46.38	22.13	29.50
2008	4.05	7.38	12.26	20.57	54.82	26.06	16.43	90.20	37.54	19.59
2009	6.33	3.11	11.37	59.26	63.45	68.00	65.00	20.00	27.29	30.24
2010	5.97	11.90	32.54	70.57	39.63	56.04	50.23	31.01	4.18	18.31
2011	6.78	7.45	7.54	33.94	92.68	39.42	90.87	18.25	37.67	25.73
2012	4.89	13.57	2.35	30.17	38.97	19.35	73.03	11.31	48.81	22.32
2013	2.96	14.31	21.86	35.96	45.87	16.39	52.33	50.63	229.74	



Two primary websites were supported during 2013. The public website uses a software package developed and maintained by OneRain called [Contrail Web](#). UDFCD's homepage links directly to this service. The second website is designed for use by UDFCD Flood Warning Program partner agencies. It displays ALERT data collected by a NovaStar-5 base station located at UDFCD and developed by [HydroLynx Systems](#). The website and NS-5 platform are maintained by WET. Both base stations also ingest data from satellite-monitored stream gages operated by the USGS. In 2013 a new procedure was developed for NS-5 to collect data from Colorado Division of Water Resources (DWR) stream gages.



As a reminder that we don't live in a perfect world, one system glitch did occur that went undetected until after the September floods. It started in mid-July when a new ALERT2 radio receiver at Diamond Hill began to gradually deteriorate. On August 19 it took a nose dive (see above plot), but the significant decrease in performance was yet unnoticed because the legacy data continued to flow in reliably. Fortunately this backup data communications system carried us through one of the worst floods many of us will witness in a lifetime. Given how important the real-time ALERT data was during the flood, this "failure" serves as a reminder that diligent monitoring and redundancy are vital components for critical systems.



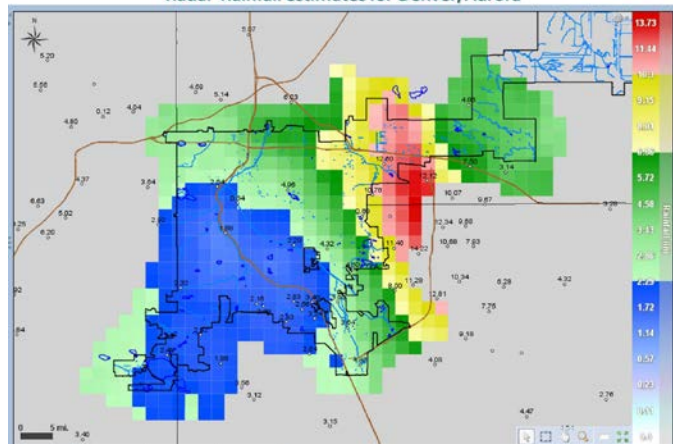
Some other failures also occurred in 2013 that are not easy to guard against. The September floods damaged or destroyed 15 ALERT stream gages, 10 of which were located

in Boulder County. The photo shows what happened at the James Creek stream gage near Jamestown. Streams affected include Boulder Creek, Fourmile Creek, South Boulder Creek, North Saint Vrain, South Saint Vrain, Left Hand Creek and

James Creek—all in Boulder County; Sand Creek through Aurora, Denver and Commerce City; Cherry Creek in Denver; Westerly Creek in Aurora; and Bear Creek in Jefferson County.

## September 9-15, 2013

Radar-Rainfall estimates for Denver/Aurora



As technology continues to advance, many ideas long dreamed of are now possible. By integrating ALERT rainfall data with NWS radar, innovators can provide more useful ways to recognize threats and alert decision-makers when critical thresholds are exceeded anywhere within a pre-defined area. The above map shows gage-adjusted radar rainfall (GARR) estimates over Denver available to local officials during the September floods. The red grids are over the Westerly Creek basin in Aurora and the maximum grid estimate for this area was 13.73 inches for the 7-day storm period. Five-minute rainfall intensity thresholds were pre-selected for automated notification via email or text message. The 2-month Denver test was scheduled to stop at the end of August, but the firm that developed this application—[Vieux, Inc.](#) of Norman, Oklahoma—extended the service through September.

UDFCD will continue to provide quality information services to all of our partners and the public. Your ideas on how we can better serve you 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/wl/annual\\_peaks.xlsx](#) for a 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/](#) & [www.udfcd.org/FWP/F2P2\\_Reports/](#). Read the NOAA report on [exceedance probability](#) for the 9/2013 Storm. Learn more about the [weather system](#) that delivered the 9/2013 Storm.

# Electronic Data Management (EDM) Application Update

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

In January 2013 we rolled out great changes to the web map application as promised. The old document hyperlink dots were replaced with a line feature layer (Projects) and a Polygon feature (Studies). The projects layer represents reaches of the stream network where the District has completed design, construction, or maintenance projects. Related as-built drawings and design reports are returned in the document search results window when you click on a feature from this layer. The studies layer represents the study areas of master plans and flood hazard area delineation (FHAD) reports. You can click on a shaded polygon and find master plan and FHAD reports in the search results. If there are overlapping studies, a pop-up window will allow you to select the intended study.

Additionally, the District updated the consolidated 100-year floodplain layer. The layer is a patchwork of features from Digital Flood Insurance Rate Map (DFIRM) and FHAD data. The layer has been somewhat difficult to update in the past because the source data was not identified. The first step was to request the official floodplain layers from the Federal Emergency Management Agency (FEMA) National Flood Hazard Layer (NFHL). Then we compared the District layer with the NFHL and preliminary DFIRM data. We identified features on the District's floodplain layer that were not represented on either the NFHL or the preliminary DFIRM data. The next step was to review 40 years of FHAD reports in order to source the features that were not on a DFIRM. It was a big help to trim down the list by eliminating reports that had been superseded. We also found flood risk areas in FHAD reports that were not digitized and added those to our layer.

The next update to the EDM was an outcome of the September flood of 2013. Photos were "flooding" in and we are still organizing them. Some of the photos we received were GPS enabled and that allowed us to generate a GIS point layer to add to the map (Fig 1). If you hover over a point you will be able to see a thumbnail preview of the photo. Furthermore, if you click on the point the photo will open full size in a new browser tab. We expect to add many more photos and photo search capabilities in the future.



Fig 1: The new 2013 flood photo layer allows you to preview photos available through the EDM map.

Another development in 2013 is the ability to either download or open documents in a browsing window. In 2012 we encountered a problem where one of our documents was too large to open in a browsing window. Users were getting errors and no one was able to view the document on the web. So, our first solution was to change the functionality from web viewing to direct download. Some users who had preferred viewing the smaller files in a web browser disliked the change. To accommodate the two situations we decided it was best to add buttons. One button (the disc) starts a download and the other button (the doc) opens documents in a browsing window (Fig 2).

We hope that having both options will make everyone happy.

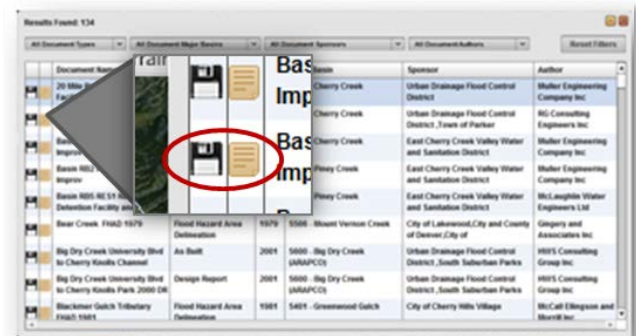


Fig 2: Click the disc button to download the document and click the document button to view it in a browsing window.

Thanks to GIS Workshop Inc. for providing hosting, development, and support services. As always, comments are appreciated. (Email: [Jbailey@udfcd.org](mailto:Jbailey@udfcd.org))

# Master Planning Program

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

## Master Planning Projects

We completed four planning studies, six flood hazard area delineation studies, a floodplain mapping study and a criteria manual update in 2013 with fifteen additional projects under way; and we plan to begin five new planning projects and two smaller alternatives analysis studies in 2014.

To date, UDFCD has completed a total of 98 major drainageway planning (MDP) studies, 91 outfall system planning (OSP) studies, and 93 flood hazard area delineation (FHAD) studies, which includes many updates to 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 a hopeful release date of late 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](http://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](http://www.udfcd.org). To download the CUHP

## STATUS OF PLANNING PROJECTS

Project	Sponsors	Consultant	Status
Big Dry Creek MDP & FHAD	SEMSWA, Greenwood Village, Englewood	Ayres	5% Complete
Box Elder Creek MDP & FHAD	Adams Co., Aurora, DIA, SEMSWA, Arapahoe Co.	Olsson	70% Complete
Cherry Creek FHAD	Denver, SEMSWA	Matrix	<b>Completed in 2013</b>
Coal Creek & Rock Creek MDP & FHAD	Erie, Lafayette, Louisville, Broomfield, Superior, Boulder Co.	RESPEC	60% Complete
Dry Gulch OSP Update	Lakewood, Denver	ICON	70% Complete
East Toll Gate Creek (Lower) MDP & FHAD	Aurora, Buckley	J3	70% Complete <b>FHAD Completed in 2013</b>
Erie OSP	Erie, Boulder Co., Lafayette	RESPEC	90% Complete
Fourmile Canyon Creek & Wonderland Creek Floodplain	Boulder	ICON	5% Complete
<b>Globeville-Utah Junction OSP Update</b>	<b>Denver, Adams Co.</b>	<b>CH2M Hill</b>	<b>Completed in 2013</b>
<b>Goose Creek &amp; Twomile Canyon Creek Floodplain</b>	<b>Boulder</b>	<b>ICON</b>	<b>Completed in 2013</b>
Happy Canyon Creek MDP & FHAD	SEMSWA, Doug. Co., Lone Tree, Parker	Muller	85% Complete
Kalcevik Gulch MDP	Adams Co., Westminster	Engenuity	15% Complete
<b>Louisville Criteria Manual Update</b>	<b>Louisville</b>	<b>WHPacific</b>	<b>Completed in 2013</b>
Newlin Gulch MDP Update	Parker, Douglas Co.	Muller	20% Complete
North Dry Gulch OSP	Lakewood	Muller	35% Complete
<b>Sand Creek MDP &amp; FHAD</b>	<b>Aurora, SEMSWA</b>	<b>Matrix</b>	<b>Completed in 2013</b>
<b>Sanderson Gulch MDP &amp; FHAD</b>	<b>Denver, Lakewood</b>	<b>Matrix</b>	<b>Completed in 2013</b>
Senac Creek MDP & FHAD	Aurora, SEMSWA	Matrix	5% Complete <b>FHAD Completed in 2013</b>
South Boulder Creek Flood Mitigation Study	Boulder	CH2M Hill	75% Complete
Weir Gulch MDP & FHAD	Denver	SEH	35% Complete
<b>West Toll Gate Creek MDP &amp; FHAD</b>	<b>Aurora, SEMSWA</b>	<b>Michael Baker</b>	<b>Completed in 2013</b>
Westerly Creek (Upper) MDP & FHAD	Aurora, Denver	CH2M Hill	25% Complete

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

companion EPA SWMM program, we have placed a hyperlink from our software site to the EPA website.

## UDFCD Annual Seminar

At our 2013 annual seminar we had 325 registrants. The proceedings are available at: <http://www.udfcd.org/resources/conferences.htm>

On April 15, 2014 we will have our next annual seminar. This one-day program will be at the Stapleton Doubletree Hotel, and early registration will be \$79. 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 2013, with commitments to the following organizations and activities:

## UDFCD BMP Monitoring Program

UDFCD has been monitoring stormwater BMPs since the late 1990's. This year UDFCD continued monitoring on six stormwater research sites. Information for each is 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), and a Rainwater Harvesting system

## New Studies

UDFCD lead two new studies this year related to stormwater. The first included a detailed analysis of the sediment removed from stormwater detention and retention facilities. This study, which included collection of composite sediment samples from 10 different sites having diverse watershed characteristics, is due to be posted on our website this coming February. The study explores disposal and reuse of sediments both from an environmental and legal standpoint.

The second study was completed through a partnership with the Colorado Stormwater Council and addresses requirements related to Regulation No. 85 Nutrients Management Control Regulation (5 CCR 1002-85). This study includes statistics for water quality runoff data collected throughout the state over the past 30 plus years. It also explores the approximate nitrogen and phosphorus contribution to state waters due to discharges from MS4s.

## Education and Outreach:

The Colorado Stormwater Center at Colorado State University provides stormwater-related education, training, and research with the goal of maintaining and improving the health of lakes, rivers, and streams through proper stormwater management. Last year, UDFCD applied for and received a \$60,220 Colorado State water quality improvement fund grant to develop this statewide stormwater education and outreach program, followed by an additional \$28,333 this year. In 2013, UDFCD staff assisted with instruction of two BMP Inspection and Maintenance courses. UDFCD will continue to assist with instruction within

the UDFCD boundary and serve on the steering committee to help ensure the success of the Colorado Stormwater Center throughout the State. See

<http://stormwatercenter.colostate.edu/> for information on upcoming classes and certifications.

## Colorado MS4 Permit Assistance

UDFCD continues to host monthly meetings for the Colorado Stormwater Council, an MS4 permittee-only group comprising 98% of all permit holders in Colorado. This year, UDFCD worked closely with the Colorado Stormwater Council and with the Colorado Water Quality Control Division in anticipation of the new draft permit for Phase 2 communities. UDFCD also provided oral comments for the MS4 permit on December 16, 2013.

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## District Receives Financial Reporting Certificate

For the twenty-fourth 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 CliftonLarsonAllen, LLP.

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



Frank Dobbins, Wanda Salazar, Executive Director Paul Hindman and UDFCD Chair Nancy McNally.

# Design, Construction & Maintenance Program

David 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](http://www.udfcd.org/design_const_maint/dcm_home.html).

## A New Approach to Deliver Projects - Project Partners Delivery

Project Partners Delivery is an alternative project delivery option to the traditional design-bid-build process that engages owners, consultants, and contractors at the onset of a project to work collaboratively to deliver project goals in the most effective and efficient manner.

The UDFCD selects a customized team from the prequalified list of consultants and contractors to include all services and expertise needed to meet project goals. Members of the Project Partners team would be involved in the development of goals and all aspects of execution and monitoring to ensure goals are met. This includes involving contractors during the design process and consultants in the field during construction.

## Development of the Project Partners Delivery Model

The construction trend across the country is moving towards the increased use of alternative delivery methods and the design-bid-build model is quickly becoming obsolete. The UDFCD performed thorough research of the various alternative delivery methods that have been implemented, and then customized a system that meets the strengths and uniqueness of the organization. For example, the UDFCD has a consistent source of income, very similar types of projects, and has built solid, trusted relationships with many consultants and contractors. Therefore, the Project Partners Delivery model is customized to work for the District based

on motivating consultants and contractors by offering consistent long term work if they continually provide the best value product.

The UDFCD has conducted several pilot projects implementing some of the concepts of Project Partner Delivery and has written case studies for each. The Project Partner Delivery process, along with case studies, was introduced to local governments to solicit their input and help shape the Project Partners Delivery method. The case studies document the advantages and disadvantages of the different delivery approaches. Following are a number of FAQs regarding this new approach

## Will All Projects Be Awarded through the Project Partners Delivery Method?

No, this method is just another option that the UDFCD has to deliver a project. The standard design-bid-build model is also available.

## How do I get on the prequalified list of consultants or contractors?

The prequalified list of Design Engineering Consultants (DEC) is open annually for consideration based on the consultant's Statement of Qualifications (SOQs).

The prequalified list of Special Services Consultants (SSC) is open every other year, and similar to the DEC, consideration is based on the consultant's SOQs. The SOQs for both DEC and SSC are based on the following:

- ✓ Team structure and staffing
- ✓ Current staff experience working with the UDFCD
- ✓ Current staff experience working on drainageway projects with other local governments within the UDFCD
- ✓ On-call contract experiences
- ✓ Unique qualifications of consultant

The prequalified list of Drainageway Contractors (DC) is open every other year. An advertisement for contractor SOQs is placed in the *Daily Journal* and sent to the UDFCD's list of Disadvantaged Business Enterprises (DBE). Information on how to submit an SOQ can be found on our website, [www.udfcd.org](http://www.udfcd.org).

## Why Have an Alternative Project Delivery Option?

Projects are best approached through a collaborative process, being proactive, and having a common goal. Traditionally, project management during design has embraced this philosophy, but once construction begins it can be a struggle to deliver a project's goals using the low-bid process.

Many organizations are recognizing the limitations of the linear design-bid-build process resulting in little collaboration

with contractors, limited value-engineering opportunities, and increased risk for change orders. Alternative delivery methods are being implemented by many organizations to provide options to better match up delivery methods with project goals, opportunities, and challenges.

Drainage and flood control projects have become more complex due to permitting requirements, multi-agency/program involvement, budget limitations, and the increased demand for a more holistic approach to maintaining stream health along with flood conveyance. These more complex projects are not linear in nature; therefore requiring a team of proactive experts guiding the process, performing value engineering at all levels, and being able to identify and minimize risk.

The UDFCD has researched several alternative delivery methods and has developed a customized system that fits the UDFCD's management philosophy of forming partnerships through collaboration and fairness. This alternative delivery option capitalizes on the District's ability to have consistent work of similar construction activity and its trusted experience with consultants and contractors.

#### **Why Project Partners Delivery?**

Each person involved in the design and construction of a project provides value to the overall success of the final product and process. It's time to formally recognize, harness, and utilize each team member's talent and experience to deliver high-quality projects at the best value. Soft project costs (all project costs outside of construction) have been rising due to the increased complexity of projects. The complexity is also increasing due to permitting requirements, advanced design approaches and limited budgets. This results in increased risk of unknowns, such as environmental clean-up; water, erosion and sediment control; and construction costs, all of which, if not addressed, means increased project costs. Project Partners Delivery allows the right experts at the right time to make decisions to identify, then eliminate, mitigate, or assign risk and provide value-based solutions throughout the entire project process.

#### **How Does Project Partners Delivery Work?**

Based on the UDFCD's guidelines for selecting drainageway consultants and contractors from the prequalified lists, a team is assembled at the onset of the project. The team develops project goals that give focus through a unified project purpose, which then enables better decision-making and efficiencies in delivering the project. The team collectively identifies the project solutions, schedule, permitting needs, key project elements, risks, and other unknowns. During design, the contractor is actively involved in offering input to means and methods, material selection, access, developing alternatives, and obtaining permits. The engineer, in return, will have more of a presence in the field to assist with decision making, adapting

to field conditions, ensuring the design vision is materializing, and taking advantage of value engineering opportunities.

#### **How Does Contracting Work?**

The DEC will contract directly with the UDFCD for design and services during construction. Special services will typically be subcontracted by the DEC, however, there may be some situations where the special service consultant would contract directly with the UDFCD. During design, the contractor will use an hourly billing rate for their time and be contracted directly with the District. Once a construction bid schedule and unit prices have been accepted, a new contract with the contractor will be signed with the District for construction.

#### **How are Costs Controlled?**

The UDFCD has several cost-control measures in place for both consultants and contractors. Based on their past history in the consulting industry, the UDFCD's project engineers are knowledgeable project managers with a proven background of developing detailed project scopes and accurate hour and cost estimates. In addition, each month the consultant submits an Earned Value Report with their invoice. The Earned Value Report is a tool to help track project costs in comparison to actual progress made based on established tasks. This allows the consultants and UDFCD staff to proactively manage changes in scope, cost, and schedules. The UDFCD also annually maintains a Consultant Rate Tracking report, which establishes a range that the consultant's rates have to fall within. This ensures the UDFCD is paying Denver market hourly rates.

Construction costs are also controlled in a variety of ways depending on the size and nature of the project. The District's experienced staff of construction managers are highly knowledgeable in material and labor costs for drainageway construction. The UDFCD maintains a bid tabs program that stores bid items and prices from all projects. This program is a useful tool to compare unit prices for new projects to that of similar past projects to ensure fair market pricing. On larger projects or those that have unique situations, a third-party evaluator can be used to complete an independent cost estimate. If the third party's estimated total project costs are within 5% of the contractor's total cost, the contractor's price is considered acceptable. If not, a discussion is opened up about the assumptions made and eventually a price is settled on. If there is a large discrepancy that cannot be settled, the UDFCD is under no obligation to stay with the contractor. The third approach to controlling costs is the Best Value Bid process, where the UDFCD's prequalified DCs submit bids which are evaluated on price as well as the following criteria: past experience; proposed construction team; ability to identify, manage, and mitigate risks; and value engineering approaches. The design team assigns weights to all of these elements based on the specific

project needs and the DC with the highest score is awarded the contract.

#### **Is There a Similar Model Being Used by Another Agency?**

The City of Fort Collins Utilities Department implemented a similar process called the Alternative Product Delivery System (APDS). The implementation and use of this approach has proven to be successful for over 15 years. Their project philosophy is in line with the UDFCD's and they have been extremely helpful in assisting the UDFCD in developing the Project Partners Delivery model.

#### **Conclusion**

The Project Partners Delivery method provides an alternative project delivery model that has the following advantages:

- ✓ Does away with the lengthy and costly consultant and contractor selection processes, because the partners are selected from the pre-qualification lists.
- ✓ A collaborative team comprised of trusted engineering and construction partners, focused on best-value solutions.
- ✓ Allows the right experts, at the right time, to identify and eliminate or mitigate risks.
- ✓ Allows new consultants /contractors to enter the process on low risk projects.

#### **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 330 drainageways and spent \$631,280 in 2013 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 2013, the District completed \$ 7,655,980 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 2013 the District authorized

approximately 11,700,000 for construction projects. Below is a brief outline of a few capital and maintenance projects that have been recently completed:

#### **Adams County Projects**

##### **Grange Hall Creek at Washington Street**

An existing regional detention pond just upstream of 106<sup>th</sup> and Washington Street had only a 30-inch pipe outfall. With a 100-year flood of around 2,100 cfs, this pipe outfall was frequently overwhelmed and the dilapidated emergency spillway conveyed flood flows. Washington Street is just downstream of the emergency spillway, and had only a pair of 24-inch culverts. As a result, Washington Street was frequently overtopped, such that the downstream side of Washington Street was paved with asphalt to act as a spillway back into the creek. In addition, the regional trail along Grange Hall Creek had no safe crossing. At Washington Street, the nearest stoplights are several blocks away. Pedestrians frequently had to dodge traffic to cross Washington Street.

The City of Northglenn and the UDFCD partnered to construct a new pond outlet structure and a new 100-year crossing and pedestrian underpass across Washington Street. Construction of this project was completed in late 2013. Utilities were 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 was lowered to accommodate vertical clearance on the pedestrian underpass. This is a signature project for the City of Northglenn, and now provides flood protection for one of their busiest streets, in addition to providing a safe and aesthetically pleasing pedestrian underpass.

##### **Kenwood Outfall**

In the summer of 2013 Adams County and the District partnered to construct Phase I of the Kenwood Outfall storm sewer. This project originally started with the Dahlia Outfall



**The Grange Hall Creek culvert and underpass after construction.**

project, which was constructed in many phases over the course of two decades. The Kenwood Outfall storm sewer discharges to the Dahlia Pond near 78<sup>th</sup> Avenue and Highway 85, which discharges to the Dahlia Outfall storm sewer. The Kenwood Outfall Phase I construction included approximately 1,800 linear feet of 84-inch RCP installed via open cut along the west Frontage Road along Highway 85, and approximately 400 linear feet of 48-inch RCP and 60-inch steel pipe installed approximately one half mile away at the intersection of 76<sup>th</sup> Avenue and the Union Pacific Railroad (UPRR). The UPRR would not allow open cut across the railroad tracks, so the section of 60-inch steel pipe was installed using guided boring machine/pipe ram trenchless technology. The two separate sections of the outfall were constructed in the same project to take advantage of existing agreements that were set to expire. An agreement with an existing business owner along the Frontage Road allowed for their access to the Frontage Road to be cut off temporarily as the 84-inch open cut construction took place. An agreement



**Guide rod installation for trenchless construction of the 60-inch storm sewer.**

with the UPRR allowed for the trenchless portion of 60-inch pipe to be installed. The open cut construction of the 84-inch RCP involved trench depths of up to 30 feet. Future phases of the project will extend the Kenwood Outfall storm sewer east across Highway 85 along 77<sup>th</sup> Avenue and along Kenwood Avenue to connect with the section at the UPRR and 76<sup>th</sup> Avenue.

#### **Sand Creek at the Metro Wastewater Treatment Plant**

Sand Creek experienced a peak discharge of over 10,000 cfs during the flood of September 2013. Metro Wastewater has a wastewater treatment plant (WWTP) at the confluence of Sand Creek and the South Platte River, with the plant situated along the south bank of Sand Creek along a bend in the creek. During the flood, Sand Creek eroded a width of approximately 100 feet of the south stream bank, threatening the WWTP. This area of Sand Creek has a history of being used as a dump site for construction debris, with the main channel filled with concrete rubble. A 48-inch diameter

concrete water supply pipe owned by Denver Water was buried within this bank, and fell into Sand Creek littering the area with additional rubble. In an effort to provide some assistance to Metro Wastewater, the District removed the damaged 48-inch pipe, and redirected the low flows along Sand Creek to the pre-flood main channel in order to move it away from the continually threatened WWTP. Metro Wastewater will be leading a much larger effort to return the south bank to its pre-flood configuration.

#### **Arapahoe County Projects**

##### **2013 Flood Highlights**

The September 2013 flooding hit sections of Aurora the hardest. The Toll Gate Creek, Westerly Creek, and Sand Creek basins were some of the hardest hit. Fortunately, several projects were completed over the last decade that greatly reduced the impact and risks to the public and adjacent properties. These projects included regional stormwater pond improvements on Westerly Creek at Expo Park and Utah Park, on East Toll Gate Creek at Hampden, and on Sable Ditch at Colfax. These facilities performed as designed and required minimal maintenance after the storm (debris cleanup, small erosion repairs, a trash rack repair, and sediment removals). There was significant damage to conveyance systems between projects, and Aurora responded well. Upon visiting sites after the flooding, everywhere we visited we saw Aurora staff cleaning up and making repairs.

The flooding tested the recently completed construction on Cherry Creek at Eco Park, located northeast of Broncos Parkway and Jordan Road. The project didn't see the record rainfall and runoff that other areas did, but managed to see an estimated 1300 cfs ( $Q_{100}$  ranges 45,722 to 47,733 cfs through Eco Park). This was a large enough event to spill out of the low flow channel and overtop a low flow trail crossing, testing the construction that had been completed a few weeks earlier.

Flood response included removing debris, repairing erosion, and reseeding areas. The repairs were completed by Thanksgiving.

#### **East Toll Gate Creek**

The UDFCD and the City of Aurora completed construction of the capital project on East Toll Gate Creek at Hampden,



**Low flow trail crossing at Cherry Creek at Eco Park.**





**During 2013 flood – East Toll Gate Creek Stormwater Pond at Hampden.**

located south of Hampden Avenue and 0.5 miles west of E-470. The project consisted of a stormwater pond (Extended Urban Runoff Volume of 20.7 Acre-feet with 21.5 Acre-feet of flood storage) and check structure to reduce channel degradation. The stormwater pond improves water quality and provides flood storage.

**Lee Gulch**

The District and City of Littleton completed a maintenance project on Lee Gulch at Heritage High School located northeast of Geddes Avenue and Gallup Street. Lee Gulch was suffering from degradation and bank erosion that threatened the adjacent trail and loss of private property. Four check structures were installed to mitigate further channel degradation and a combination of grouted boulder wall and soil riprap were used to protect the trail and private property.

**Boulder County Projects**

In the months after the September flood we were quite busy with flood recovery efforts. All told, we did more than a year’s worth of work in Boulder County in just two to three months. Below is a sampling of a few of the flood recovery projects we worked on.



**Post-flood aerial photo of Boulder Creek channel migration at 109<sup>th</sup> St.**

**Boulder Creek at 109<sup>th</sup>**

The reach of Boulder Creek adjacent to 109<sup>th</sup> Street in Boulder County has a history of being modified to support gravel mining operations. During the flood, the creek re-aligned itself to a historic channel location, evident on a 1937 aerial photograph, such that it broke through the 109<sup>th</sup> Street embankment approximately 500 feet north of the Boulder Creek bridge. The District assisted Boulder County by re-establishing the stream bank to put creek flows back into the pre-flood main channel, and by addressing erosion upstream and downstream of the bridge.

**Boulder Creek at 95<sup>th</sup>**

The reach of Boulder Creek adjacent to 95<sup>th</sup> Street in Boulder County also has a history of being modified to support gravel mining operations. During the flood, the creek re-aligned itself at an oxbow upstream of 95<sup>th</sup> Street such that the creek flowed into a gravel pit and then across an 800-foot width of 95<sup>th</sup> Street. Flow along the creek no longer



**Boulder Creek flowing across 95<sup>th</sup> Street.**

reached the 95<sup>th</sup> Street bridge for Boulder Creek, or a large water supply head works located just east of 95<sup>th</sup> Street. The UDFCD assisted Boulder County by constructing a temporary diversion channel to route the creek back into the pre-flood main channel and back to the 95<sup>th</sup> Street bridge. A more permanent channel restoration project is planned for early 2014.

**Twomile Canyon Creek**

Twomile Canyon Creek completely re-aligned itself in the vicinity of Spring Valley Road and Linden Avenue in the City of Boulder during the flood of September 2013. Two teenagers were killed in this area, as their car overturned along Linden Avenue as they attempted to drive across the flooded creek. The post flood conditions left the creek flowing in a completely different alignment than previously; with the result being that the creek flowed around existing culverts on Spring Valley Road and Linden Avenue. The District assisted the City of Boulder with re-establishing the historic creek

alignment and installing bank protection measures to protect damaged utilities.

### **Coal Creek at Highway 42**

The District had just completed improvements to the



**Sediment deposition and post-flood creek alignment (pre-flood alignment is left of photo).**

culvert and trail underpass for Coal Creek at Highway 42 when the flood occurred. The original District project installed a stem wall and drop structure in order to stabilize the creek and to reduce nuisance flooding and undue safety risks on the underpass. The stem wall and drop structure were undamaged by the flood, but severe erosion occurred downstream of the culvert, including a washout of the existing trail and damage to the culvert. The UDFCD assisted the City of Louisville by further fortifying the culvert outlet and repairing the downstream channel erosion.

### **Coal Creek at Flagg Park**

Boulder County partnered with several communities to complete the Coal Creek trail system in 2013. This trail system includes many stream crossings of the creek, some as underpasses and some as pedestrian bridge overpasses. A



**Post-flood location of pedestrian bridge at Flagg Park.**

pedestrian bridge at Flagg Park just east of 120<sup>th</sup> Avenue in Lafayette was constructed as a “break away” bridge so it would not impede flow during a flood. This bridge did in fact break away during the flood of September 2013, and was carried approximately 50 feet downstream of the bridge abutments where it settled along the bottom of the creek. The District assisted the County with inspecting the integrity of the bridge and its abutments and with mobilizing a crane to the site to extricate the bridge from the creek bottom and reset it on its abutments. Luckily, the bridge and abutments suffered no permanent damage during the flood, and the bridge could simply be reset on the abutments. The crane had to be situated on top of an adjacent landfill in order to pick the bridge. Several truckloads of stable base material had to be brought in and compacted for the crane setup, then removed after the bridge was reset.

### **City and County of Broomfield Projects**

#### **Nissen Reservoir Drainageway**

For the past two years the District has been participating in the funding and design of the Nissen Reservoir Drainageway crossing improvements at Lowell Boulevard. This project involves the reconstruction/widening of the US 287(120th Ave)/Lowell Blvd intersection at the location of the Nissen Reservoir Drainageway crossing of Lowell Blvd in the City and County of Broomfield. Currently the drainageway crossing consists of two approximately 6-ft by 3-ft corrugated steel pipes that carry low flows under Lowell.

Final construction plans, prepared by Muller Engineering, indicate that a double 32-foot span CON/SPAN structure will appropriately eliminate the frequent overtopping of Lowell and provide 100-year capacity with improved maintenance access/pedestrian underpass. Upstream and downstream channel improvements will be needed to transition to the existing channel and major roadway improvements will be needed to raise Lowell Blvd over the drainageway. All additional roadway elements will be funded by the Broomfield. Broomfield hopes to start construction this spring.

#### **Big Dry Creek**

Most of the drainageway work the District completed in Broomfield in 2013 was sediment removal and tree thinning along densely vegetated drainageway's such as Nissen Reservoir and Gay Reservoir Drainageways. Tree thinning became a high priority based upon observations of the September floods. One area of note is damage as a result of the flooding on Big Dry Creek near the eastern boundary of the Broomfield Waste Water Treatment Plant. During recent flooding, a portion of the west bank adjacent to the WWTP eroded and is need of a quick repair. The eroded bank is nervously close to the WWTP fence and a large sanitary sewer line that runs parallel to the fence just inside the property. Dense, woody vegetation exists upstream and downstream of the project site. Olsson Associates evaluated



**Big Dry Creek erosion at Broomfield WWTP.**

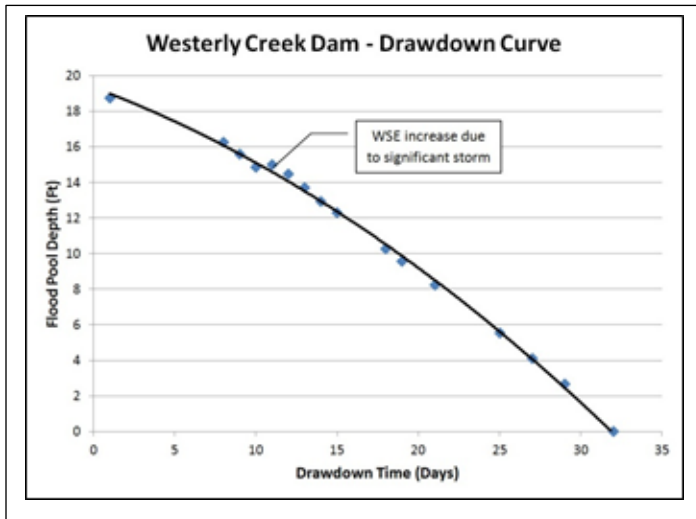
several bank repair options and selected a simple soil riprap bank repair. The repair is currently under construction by Valles Construction

**City and County of Denver Projects**

**Westerly Creek Dam**

Westerly Creek Dam, located at Alameda Avenue and South Havana Street (southeast Denver) and within the Westerly Creek watershed experienced a noteworthy event as it captured and released stormwater runoff from the September storms. Westerly Creek Dam was designed as a regional detention facility that releases approximately 98 cfs as its maximum release rate. This facility protects downstream residential and commercial areas within Denver and Aurora. Westerly Creek Dam is designated by the State of Colorado as a Class I High Hazard Dam. In addition to this dam there are several other flood control facilities located throughout the Westerly Creek watershed that assist in managing stormwater.

By September 13<sup>th</sup> approximately 2000 acre feet of water was impounded by Westerly Creek Dam. The pool reached a maximum depth of 21 feet above the inlet with the final water surface measuring nine vertical feet below the



emergency spillway crest. The resulting impoundment increased the surface area of the flood pool to approximately 125 acres which inundated a significant portion of the adjacent Common Ground Golf Course.

The upstream runoff brought with it a large quantity of organic and other debris. The majority of larger debris, such as wooden pedestrian footbridges, and benches came from the golf course located to the east and the adjacent flood pool. The subsequent debris removal cost was approximately \$8,000.

Westerly Creek Dam met design expectations during this event and, overall, experienced no structural damage. The progress of the drawdown was slightly delayed by subsequent storm events, the most significant of which occurred on September 22, 2013. The drawdown, which took approximately 30 days, was completed on October 14, 2013.

**Kelly Road Dam**

Located one mile downstream of Westerly Creek Dam is Kelly Road Dam (KRD). This facility, like Westerly Creek Dam, serves as regional detention, is a Class I Dam, and captures stormwater runoff from the downstream portion of the Westerly Creek watershed in addition to the flows released by Westerly Creek Dam. On September 12, 2013, the stormwater runoff resulted in the activation of Kelly Road Dam’s emergency spillway.

**Douglas County Projects**

**Timbers Creek**

A retrofit of Timbers Creek in unincorporated Douglas County was completed in summer 2013. The retrofit included the installation of a sheet pile cutoff at the upstream limit, renovation of the existing log drop structure, an additional sloping concrete drop structure, and soil riprap toe and channel protection. The improvements were constructed by Naranjo Civil Constructors with design and construction inspection services provided by CH2M Hill. Arrowhead Landscaping is providing the post-construction site maintenance for BMP and vegetation management.

**Newlin Gulch**

The improvements for Newlin Gulch at Stonegate included two sloping grouted boulder drop structures, channel and bank re-grading and stabilization, and a timber footbridge at the downstream project limit. The main channel was split into two low flow channels at two locations in order to protect a number of native Cottonwood trees and other riparian vegetation. This project was completed in summer 2013 with 53 Corporation providing construction services and Muller Engineering providing project design and construction inspection. Final project cost was \$743,856.

In Highlands Ranch, channel improvements were constructed by Naranjo Civil Constructor on a reach of the East Tributary of Dad Clark Gulch. These improvements included three sloping grouted drop structures to stabilize

the low flow channel and banks. These structures were designed to convey the 100-year runoff event. Unique to this project are the construction of several planting wells within the middle and lower drop structures. This project was designed by Icon Engineering and constructed by Naranja Civil Constructors. Total project cost was \$220,000.

### **Big Dry Creek and Dad Clark Gulch**

Also in Highlands Ranch two outfall stabilization projects were completed by Valles Construction. The sites were mirror images of each other one on Dad Clark Gulch at Highlands Ranch Parkway and the other on Big Dry Creek at University Blvd with extremely difficult access off of major roadways. The improvements included notching the existing energy dissipaters, tree and sediment removal, and construction of grouted boulder outfall protection to protect the downstream end of the existing box culverts. The Big Dry Creek improvements are the first step in a future design project by ICON Engineering, which will stabilize a larger reach of Big Dry Creek. The improvement cost for each site was approximately \$75,000.

### **Jefferson County Projects**

#### **Lena Gulch**

Several Jefferson County drainageways within the District received damage due to the September 2013 flooding. While fairly minor in most locations, several roadways were closed until maintenance crews could clear debris from culverts and fix roadway pavement before reopening. Just prior to the flooding the District and Jefferson County had initiated construction of a new 3-cell box culvert crossing for Lena Gulch at South Golden Road (SGR), a major connector between Lakewood and Golden. Enlargement of the crossing to 100-year capacity should reduce damages associated with roadway overtopping. This improvement should also prevent interruption of access along this thoroughfare in the event of a major flood.

Lena Gulch upstream and downstream of SGR channel reaches was previously stripped of dense vegetation in order

to open up the drainageway and facilitate the design process. Once the design was complete and construction had started in August it was quickly determined that a significant amount of sediment had filled the old box culvert to the point that even small storm events could easily overtop South Golden Road. In addition the previously removed dense vegetation would have further elevated this overtopping potential.

In order to create a temporary dewatering channel that would allow for safely passing the existing low-flows through the active construction area, one cell of the existing box culvert was cleaned out and the corresponding downstream channel was daylighted by removing sediment. It wasn't much later when the September flooding hit Lena Gulch. If it had not been for the cleaned out cell and removal of vegetation downstream Lena gulch would most likely have overtopped South Golden Road and flooded several adjacent businesses. We got Lucky!

Fortunately the only real damage during the event was the loss of a "milk truck" parked precariously close to the upstream channel bank. Luckily it didn't float downstream and wedge in the existing box culvert inlet just downstream. The channel erosion limits actually matched up nicely with the expected excavation needed to install headwall, wing walls, and the upstream drop-inlet structure.

Construction continues on the new crossing. The project, including roadway improvements, is anticipated to be completed in March.

### **South Platte River Projects**

#### **Flood Response**

The year 2013 was an interesting year for the South Platte River Program. It started out as a typical maintenance season, with the anticipated normal routine maintenance and various bank restoration projects. It ended with a reservoir breach, a huge deposit from Sand Creek and trash galore.

In a normal year routine maintenance consists primarily of 13 trash and debris removal cycles. These consist of six full cycles and seven short cycles. A full cycle runs from C-470 and the SPR to 168<sup>th</sup> Ave, in Brighton, a total of 39 miles of river. Considering both banks, maintenance crews walk almost 80 miles of bank during each cycle. A short cycle starts at the confluence of Bear Creek and the SPR, and finishes at the Denver City limit, at approximately Franklin St. A short cycle is approximately 19 miles of river or 38 miles of river bank. From our first cycle, in January, until our 10<sup>th</sup> cycle in August, the crews from Arbor Force collected approximately 448 cubic yards of trash and debris. They also assisted the Denver Trails Department in the removal of numerous abandoned homeless camps and noxious weed control. Crews also removed numerous downed trees from the river, chipped and removed cut material, thereby enhancing the river environment and providing a source of wood mulch for several Denver Trails projects.



**Milk truck lost in Lena Gulch.**



**An example of the debris deposited along the South Platte River.**

The flows in September brought quantities of trash and debris into the river system, in volumes not seen in decades. While debris levels through Denver were extremely heavy, Adams County received the majority of the impact, with huge quantities of debris as well as hundreds of trees down, on the banks and in the channel itself. The immense volume, difficult terrain and complexity of removal meant that normal debris cycles would not work for this event. Budget was limited so it was critical that priority be given to the areas hardest hit.

After a needs assessment was performed, it was determined that the most heavily impacted area of the river was downstream of the Metro Wastewater Plant, at the confluence of Sand Creek. Crews actually started with debris removal through Denver, and moved north towards Adams County. This effort resulted in the removal of several hundred cubic yards of trash. This phase was done in a similar manner as a normal debris cycle but at a much slower pace. It was critical to remove as much debris as possible from the Denver reach, given the volume of trail use and the high visibility of the SPR through Denver.

As the work moved north of the city, Arbor Force developed four distinct crews. Three of the crews concentrated on debris removal, while the fourth was tasked primarily with tree removal. Several pieces of heavy equipment were brought in to help with tree removal, as well as lifting large pieces of debris and lifting bags from the lower channel. Thirty-yard dumpsters were staged at various points in a given area of operation. A typical day saw dumpsters changed out two or more times. Crews worked for approximately 2 months on flood related debris and tree removal. These efforts resulted in over 1000 cubic yards of mixed organic and inorganic material being removed from the river, starting at Riverpoint, in the City of Sheridan and extending to 104<sup>th</sup> Ave, in Adams County. The task was daunting but the crews did a great job. Even given these efforts, there is still a lot of work to be done in the coming years, both in the areas already described, as well as north of 104<sup>th</sup> Ave. In 2014, we will continue these efforts, using our

normal debris cycles, as well as specific projects in areas still impacted by large accumulation of trash and debris.

### **Restoration Projects**

Two of the restoration projects that were completed in 2013 were the Phase II Bank Stabilization at 104<sup>th</sup> Ave, and the rehabilitation of an informal grade control near the Metro Waste Water Plant at York St and 58<sup>th</sup> Ave.

The east bank of the South Platte River, upstream of 104<sup>th</sup> Ave, was highly eroded and vertical in nature. The river bank in this area was also adjacent to a constructed wetland, as well as a conveyor servicing a local gravel operation. An area of unstable bank, just upstream of 104<sup>th</sup> had previously been stabilized and it was determined that another 1000 lf needed stabilization. With the help of Respec Engineering, a plan was developed to tie into the previously stabilized section and continue revetment further to the south. Permitting was accomplished with the help of ERO Resources Corporation. Phase II would give us an approximate total of 2000 lf of bank



**The “informal” grade control structure near the Metro WWTP.**

protection and would extend far enough to span the length of the constructed wetlands. Left Hand Excavating was selected as the contractor for the project. Excavation and installation of riprap was accomplished in approximately 60 days. Final stabilization of disturbed areas was accomplished with installation of native seed and hydro mulch by Arrowhead Landscaping.

With regard to the informal grade control, near Metro Waste Water, concrete rubble had been randomly dumped into the South Platte River from bank to bank. The result had become, in essence, a grade control structure, providing protection for both a downstream pedestrian bridge and an upstream gas line. The structure was a mess of large, slab sections of concrete, imbedded into the channel bottom several feet, and sticking up several feet above the water surface. The result was a somewhat unstable structure that captured debris and was a nightmare for routine maintenance.

With the help of Icon Engineering and ERO, and with advice from the U.S. Army Corps of Engineers, a plan was developed to remove concrete rubble to a specific elevation and veneer the remaining rubble with riprap. A low flow notch was also to be created to direct low flows away from bridge structures and also provide for aeration of the water during low flow conditions. Naranjo Civil Constructors was selected as the contractor for the project, which took approximately 30 days to construct. The concrete removed was typically free of structural steel and was therefore taken to a recycling facility for processing. Installation of erosion control BMP's was done by Arrowhead Landscaping and consisted of native seed and erosion control blanket.

### **Arapahoe County Update**

River Excitement in Arapahoe County! The South Platte Working Group 2 has been busy visioning the seven miles of the South Platte River from the confluence with Bear Creek to C-470. The purpose of the working group is to preserve and protect the river corridor as a community asset, and to enhance the quality of life in western Arapahoe County



**South Platte Park Phase one before and after construction.**

through an ongoing collaborative process to improve the natural environment, economic benefit, and recreational features of the South Platte River. A charrett was hosted by Stream Design, and a report has been published that captures the visioning ideas. The report is available through Arapahoe County Open Space.

Two short term projects are already underway. The first project is South Platte Park River Enhancements. The goals of the project are to restore the natural functions of the river system that have been disturbed by the construction of Chatfield Dam and the surrounding urbanization. A conceptual design identified over \$4 million dollars of improvements, which has been broken down in to three construction phases. Phase I was completed in the spring of 2013, and included river reshaping in the form of riffle, pool, glide series, and constructed point bars. Bank stabilization, wetland creation, and riparian habit areas were also included in the project. Phase II will continue work downstream of Phase I for over 2,000 linear feet of river enhancement to the park's northern boundary. It is anticipated that Phase III will start in the fall of 2014 and will complete the final reach of improvements, Mineral Avenue to the southern boundary of the park at C-470.

The designer for the South Platte Park Enhancements is Ecological Restoration Consultants (ERC), the contractor doing the river work is Naranjo Civil Constructors and the revegetation contractor is Arrowhead Landscaping. The funding partners are an expansive group as this project touches on several agencies' interest. Partners include, Arapahoe County Open Space, City of Littleton, South Suburban Park and Recreation District, Trout Unlimited, and the Colorado Water Conservation Board.

River Run is the second short term project and is located on the South Platte River between Oxford Avenue and Union Avenue in the City of Sheridan. The preliminary phase has been completed by McLaughlin White Water Engineers as the engineering lead along with DHM as the landscape architects and Bob Searns with the Greenway Team.

The three main components of River Run are river enhancements, trail conductivity, and establishment of a destination trailhead. The existing drop structures up and downstream of Oxford are in need of repair and this project will replace those drops with safer structures that also incorporate fish passage and enhanced recreational use. The trail piece of the project will be along the east bank of the river and be the final connection of the east bank trail of the Mary Carter Greenway Trail system from Union to Oxford. This new trail connection will relieve pressure from the overused west side trail, and provide underpasses at Union and Oxford on the east side as well. A formal trailhead is proposed at the Broken Tee Golf Course which includes increasing the parking lot, and providing ADA river access, a large picnic shelter, rest room facilities, and a play area.



**Existing Drop Structure upstream of Oxford Avenue to be replaced.**

River Run will be phased over the next four years and final design is scheduled to begin this spring. This project is also fortunate to have numerous project partners who currently include Arapahoe County Open Space, City of Englewood, City of Sheridan, South Suburban Park and Recreation District, and the Colorado Water Conservation Board.

**Denver County Update**

It has also been an exciting time for river improvements in Denver County as well, with a number of long-planned projects finally getting underway. In the Denver reach of the South Platte River, three new projects are going to construction in the 2014 construction season. These three projects were identified in the Greenway Foundations River Vision Implementation Plan (RVIP), and start to kick off the long term vision for this reach of the river. The goals of these projects include maintaining and improving the channel’s flood capacity, enhancing water quality, improving the aquatic and wildlife habitat, improving maintenance and emergency access to the river, and implementing long needed park and trail improvements. The projects include Johnson-Habitat Park Improvements, Grant Frontier/Overland Park Improvements, and Weir Gulch at Sun Valley Improvements.

The Johnson-Habitat Park Improvements and about half of the Grant Frontier/Overland Park Improvements are being

Project	Estimated Construction Cost
Johnson- Habitat Park	\$5,500,000
Grant Frontier/Overland Park	\$7,780,000
Weir Gulch	\$2,800,000
<b>Total</b>	<b>\$16,080,000</b>

built by the City and County of Denver with construction starting in early 2014.

The second half of improvements are planned to be built by the District with construction starting later this fall. In addition to these two projects, the UDFCD has started construction on the Weir Gulch at Sun Valley Improvements

in January. This project will take about nine months to complete, and is being built by Naranjo Civil Constructors. These three projects have an estimated value of over \$16 million.

In addition to these three projects, the UDFCD and Denver have been working on a forth project that was identified in the RVIP Confluence Park Improvements. The RVIP and subsequent Confluence Park Master Plan had identified a number of needed improvements including improved channel conveyance, water quality and habitat improvements, ramp and pedestrian bridge replacement, plaza and amphitheater improvements, additional outdoor seating areas, an improved whitewater course, and better tie in to the surrounding businesses and park areas. The first phase of these improvements will include replacement of the ramps on the west side of the river and replacement of the Shoemaker Plaza area. This work is estimated to be about \$4 million dollars and, with funding in place, construction is slated for the 2014 – 2015 construction season.

The second phase of the planned improvements will include increased channel conveyance, drop structure improvements, and water quality and habitat improvements. This phase is currently waiting on the additional funding needed, but should start in the next year or two. Future phases implementing the master planned improvements will be constructed as funding becomes available.

*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 Chongtoua, P.E., CFM, Senior Project Engineer; Steve Materkowski, E.I., Senior Construction Manager; Mike Sarmiento, SET, Senior Construction Manager; Will Comerer, Engineering Intern*



**Bald Eagle in South Platte Park after Phase I completion.**

# 2013 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
- \*Delegate for APWA Water Resource Committee to Washington, DC meeting with Senator Udall, Senator Bennet, House and Senate Sub-Committees, EPA, and ACOE.
- \*Board Member and 2014 Chair, Colorado Counties Officials and Employee Association
- \*Presented "Our Filing System West Electronic, We Failed! Then We Did it the Right Way" at the APWA International Public Works Congress & Exposition, Chicago, IL
- \*Judge, Denver Regional Science Fair
- \*Ambassador, Backpacks to Briefcases, Adams County School District
- \*Sponsor, 9 to 5 Adams County Commissioner's' Career Expo

## **Bill DeGroot, Manager, Floodplain Management Program**

- \*Board Member of the National Association of Flood and Stormwater Management Agencies (NAFSMA).
- \*Received the L. Scott Tucker Award for Member Service to the Organization from NAFSMA at the Annual Meeting in San Francisco in December.
- \*Attended the ASFPM annual conference in Hartford in June.
- \*Presented *Floodplain Management Aspects of the RTD West Corridor Project* with Joanna Czarnecka and David Mallory at the CASFM conference in Steamboat Springs in September.
- \*Presented *South Platte River Hydraulic Model* with Jason Messamer and Shea Thomas at CASFM in Steamboat Springs in Sept.
- \*Attended NAFSMA's annual meeting in December in San Francisco.
- \*Presented *Record Rainfall September 9-15, 2013* at NAFSMA Annual Meeting. Also introduced three short floodplain preservation videos completed by NAFSMA and UDFCD.
- \*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.
- \*Attended the District's annual seminar in April.
- \*Attended the Natural Hazards Workshop and the National Hazard Mitigation Association Practitioners Symposium held in Broomfield, July.
- \*Member of Association of State Floodplain Managers (ASFPM), Colorado Association of Stormwater and Floodplain Managers (CASFM), ASCE, 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: ASCE, APWA, ASFPM, CASFM, American Meteorological Society (AMS), and Colorado Emergency Management Association
- \*Attended Colorado Emergency Management Conference in Loveland, CO in February.
- \*Co-presented with Dr. Baxter Vieux on "Real-Time Flash Flood Forecasting Using New Hydrologic Models" at UDFCD Annual Seminar in Denver in April.
- \*Attended WERA-1012 Annual Conference on "Managing and Utilizing Precipitation Observations from Volunteer Networks" in Estes Park, CO in May.
- \*Presented "Working with Emergency Managers when the Flood Threat is Imminent—in the aftermath of the Fourmile Canyon Fire" at EWRI World Environment & Water Resources Congress, Technical Session on Emergency Stormwater Management in Cincinnati, OH in May.
- \*Speaker and session moderator MC at 11<sup>th</sup> Biennial NHWC Conference & Exposition in Ponte Vedra, FL in June.
- \*Presented on watershed and hydrology issues to the Wildfire Matters Review Committee at request of the Colorado Legislative Council in September and again to Water Resources Review Committee in October.
- \*Invited speaker on "Regional Flood Data and the September 2013 Storm Events" at Cherry Creek Stewardship Partners in Parker, CO in November.



- \*Met with delegation from Taiwan concerning rain and flood forecasting for local flood warning at UDFCD in November.
- \*ALERT2 discussion panelist and presenter on “Committed to a Different Outcome--The Colorado Floods of September 2013” at NHWC Texas Workshop in Conroe, TX in November.
- \*Invited speaker on “Nature of Conditions that Created Extreme Rainfall of September 2013” at Colorado Intergovernmental Risk Sharing Agency (CIRSA) in Glendale, CO in November.

#### **Ken MacKenzie, Manager, Master Planning Program**

- \*Co-instructor at the *Overview of Water Quality Regulation and Compliance Models* workshop on March 15 in Denver, CO.
- \*Organized, moderated, and presented *Current Research and Software Development* at the UDFCD Annual Seminar on April 2 in Denver, CO.
- \*Presented “*The Future of Municipal Stormwater Discharge Permits*” on April 18 at the APWA – CARMA Spring Street Conference Grand Junction, CO.
- \*Presented *Repurposing the High Line Canal for Stormwater Treatment* at the 2013 APWA Management Conference on May 2 in Denver, CO.
- \*Presented *A Standardized National Approach to Volumetric Stormwater Treatment* on May 22 at the 2013 World Environmental & Water Resources Congress in Cincinnati, OH.
- \*Participated in the National Roundtable on Water Quality Trading on July 17 in Cincinnati, OH.
- \*Co-instructor for training course on *Advances in Design and Monitoring for LID and Green Infrastructure Performance*; also presented *Crumbling Concrete and Impenetrable Asphalt – The Colorado Conundrum* on August 18-20 at the 2013 International Low Impact Development Symposium in St. Paul, MN.
- \*Presented with Dr. Andrew Earles *The Value of Urban Drainage Planning and Flood Hazard Reduction Projects in the 2013 Flood* to the Colorado General Assembly Water Resources Committee on October 10 in Denver, CO
- \*Participated as a panelist in the Community Summit on Green Infrastructure on October 20-22 in Syracuse, NY.
- \*Host and presenter at the Taiwan National Water Resources Agency Delegation Day at the District on November 11 in Denver, CO.
- \*Presented *UDFCD Drainage Planning and Infrastructure Assessment in the Wake of the 2013 Flooding* at the Colorado Intergovernmental Risk Sharing Agency’s 2013 Colorado Flood Seminar on November 19 in Glendale, CO, at the IECA Winter Conference on December 4 in Denver, CO, and at the NAFSMA Annual Meeting on December 10 in San Francisco, CA.
- \*Co-instructor for training course on *Urban Flood Channel Design and Rehabilitation* for UWRI on October 10 & 11 in Denver, CO.
- \*Co-chaired the NAFSMA Stormwater Committee with Brent Johnson (Knoxville, TN).
- \*Served as Treasurer on the Board of Directors of the Urban Watershed Research Institute (UWRI).
- \*Steering Committee Member for the 2013 International Low Impact Development Symposium in St. Paul, MN.
- \*Served on the Urban Water Resources Research Council and Low Impact Development Committee of the ASCE Environmental & Water Resources Institute.
- \*Served on ASCE Transportation & Development Institute’s Permeable Pavement Committee in development of a national standard on design of permeable pavements.
- \*Served on the Water & Environment Research Foundation (WERF) committee creating a model to link stormwater BMP systems performance to receiving stream protection.
- \*Steering Committee Member for the Colorado Stormwater Center.
- \*Member of ASCE, NAFSMA, ASFPM, WERF, & CASFM.

#### **David Bennetts, Manager, Design, Construction & Maintenance Program**

- \*\*Co-presented ‘How the District Violated the Clean Water Act and How You Can Avoid Doing the Same’ at the District’s annual Seminar in April
- \*Attended ASFPM’s Annual Conference in June in Hartford, CT.
- \*Attended APWA’s Annual Management Conference in May in Denver
- \*Co-Presented ‘Natural Bank Protection Treatments’ at ASCE EWRI conference in May in Cincinnati
- \*Attended APWA Conference in August in Chicago
- \*Co-Presented ‘How the District Violated the Clean Water Act, and How You Can Avoid Doing the Same’ at the Sustaining Colorado Watersheds Conference in October in Vail
- \*Panelist on ‘4<sup>th</sup> Annual Stream Restoration Panel Discussion’ at the Sustaining Colorado Watersheds Conference in October in Vail
- \*Moderator of ‘Restoration Case Studies: Urban Systems’ at the Sustaining Colorado Watersheds Conference in October in Vail
- \*Moderator of ‘Risk Mitigation Panel Discussion’ at Arid Regions Conference in October in Scottsdale
- \*Presented ‘2013 Flood Update’ at the Society of Marketing Professionals Services meeting in December in Denver
- \*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)

- \*Board Member Colorado Riparian Association
- \*Member of ASCE, APWA, ASFP, CASFM

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

- \*Rocky Mountain Public Works Institute Steering Committee Chair
- \*ACEC Scholarship Committee
- \*Wrote article in the APWA Reporter, February addition titled, "Building Relationships and Partners"
- \*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 IECA conference in San Diego, CA
- \*Presented "Restoring to What?" at the Colorado Watershed Assembly conference in Avon, CO
- \*Attended APWA Congress in Chicago, IL
- \*Attended NAFSMA Annual Conference in San Francisco, CA

**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 (WE NEED VOLUNTEERS – CALL ME !!)
- \*Member of ASCE, APWA, ASFP, Chi Epsilon Alumni, IECA, and CASFM
- \*Attended IECA 2013 Environmental Connection Conference in San Diego, February
- \*Co-presented *Lessons We Learned the Hard Way* with DCM Engineers at the UDFCD Annual Conference in Denver, April
- \*Attended CASFM Stream Restoration Workshop in Grand Lake, July
- \*Attended CASFM Annual Conference in Steamboat Springs, September

**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 & Treasurer of the Natural Hazard Mitigation Association (NHMA).
- \*Additional Memberships in the Association of State Floodplain Managers (ASFP), the Natural Floodplain Function Alliance (NFFA) and the American Public Works Association (APWA).
- \*Presented *When Maintenance Eligibility Is On The Line* with Joanna Czarnecka at the APWA Construction Inspection Conference in Douglas County, January.
- \*Participated in the formation of the Colorado Flood Technical Assistance Partnership (FTAP), February.
- \*Attended the UDFCD Annual Seminar held in Denver, April.
- \*Attended the Inaugural National Adaptation Forum held in Denver, April.
- \*Attended the NAFSMA Quarterly Board Meeting held in Tucson, April.
- \*Attended the ASFP Annual Conference held in Hartford, June.
- \*Attended the Natural Hazards Workshop held in Broomfield, July.
- \*Participated in the *Expanding Mitigation: Incorporating Ideas, Partnerships and Programs to Promote Resiliency* panel discussion with Michael McMahon, Beth Ellison and Thom Robinson, moderated by Erin Capps at the NHMA International Hazard Mitigation Practitioners Symposium in Broomfield, July.
- \*Presented *Cooperating Technical Partners (CTP) Lessons Learned* at the NAFSMA Agency to Agency Mentoring Session in Buffalo, New York, July.
- \*Presented *Negotiations for Floodplain Managers* with Ed Thomas and *Communicating Floodplain Preservation Values in Land Use Decisions* at the NHMA Montana Workshops, July.
- \*Attended the NAFSMA Quarterly Board Meeting held in Denver, August.
- \*Presented at the *NFIP Reform Workshop* with Michael Gease and Jamie Prochno at the CASFM Annual Conference in Steamboat Springs, September.
- \*Presented *Floodplain Management Aspects of the RTD West Corridor Project* with Joanna Czarnecka and Bill DeGroot at the CASFM Annual Conference in Steamboat Springs, September.
- \*Attended the NAFSMA Annual Meeting held in San Francisco, December.

**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)
- \*Presented "Lessons Learned about Fences" at UDFCD's annual seminar
- \*Presented "Partnering on Cherry Creek Projects" with Glen Poole from Arapahoe County to Cherry Creek Working Group in April.
- \*Presented "Upcoming Projects on Cherry Creek" with Vern Adam from Aurora, Jim Swanson from CCBWQA, and Molly Trujillo with SEMSWA to Cherry Working Group in September.
- \*Attended APWA 2013 International Public Works Congress and Exposition

- \*Attended Cherry Creek Stewardship Partners Conference
- \*Attended "Take Back Your Life" training in January.
- \*Attended "Speak Like You Need It" training in June.
- \*Attended "Defensive vs. Collaborative Communication" training in October.
- \*Attended "Leadership through Influence" training in December.

#### **Shea Thomas, Senior Project Engineer, Master Planning Program**

- \*\*Presented "*No Moss Growing Here*" at the annual UDFCD seminar in Denver in April.
- \*Presented "*South Platte River Hydraulic Model*" at the CASFM conference in Steamboat Springs in September.
- \*Presented "*Directing the Timing of Master Planned Improvements? Regional Collaboration Put to the Test*" at the Cherry Creek Watershed Conference in Parker in November.
- \*Elected Vice Chair of CASFM in September.
- \*Attended the NAFSMA annual meeting in San Francisco in December.
- \*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 West Harvard Gulch Project at the Colorado Riparian Association 2013 Conference, Avon, Colorado
- \*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, Urban Stream Restoration Committee
- \*Attended ASCE EWRI Congress 2013 in Cincinnati, Ohio
- \*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**

- \*Presented *Expanded Guidance on Storage Facilities* at the UDFCD Annual Seminar on April 2<sup>nd</sup> in Denver, CO.
- \*Presented *UDFCD Water Quality Research* on April 30<sup>th</sup> to students at University of Colorado Denver and lead a tour of the Denver Botanic Green Roof and Denver Green School Rainwater Harvesting System to the same group on May 5<sup>th</sup> in Denver, CO
- \*Moderated *Regulating Stormwater Regulations* session on May 22<sup>nd</sup> at the 2013 World Environmental & Water Resources Congress in Cincinnati, OH.
- \*Organized and led the annual field trip for the Colorado Association of Stormwater and Floodplain Managers (CASFM) on June 12<sup>th</sup>.
- \*Co-Presented the Mordecai Children's Garden Green Roof at the Denver Botanic Gardens as part of the GrowWest green roof tour on June 13<sup>th</sup>, Denver, CO.
- \*Instructor for training course on *Post-Construction Stormwater BMPs for Development Review Engineers*, July 23<sup>rd</sup>, August 27<sup>th</sup>, and September 24.
- \*Co-instructor for a short course on *BMP Maintenance and Inspection Colorado* held at the CASFM conference on September 10<sup>th</sup> in Steamboat Springs, CO.
- \*Presented *UDFCD Water Quality Research* at Colorado School of Mines on September 19<sup>th</sup> in Golden, CO
- \*Co-instructor for training course on *Advances in Design and Monitoring for LID and Green Infrastructure Performance*; on August 18<sup>th</sup> -20<sup>th</sup> at the 2013 International Low Impact Development Symposium in St. Paul, MN.
- \*Led a tour of water quality facilities for the Taiwan National Water Resources Agency Delegation Day at the District on November 11<sup>th</sup> in Denver, CO.
- \*Presented *Inspecting and Maintaining Permeable Pavement* for APWA Click, Listen, and Learn (webinar) on November 14<sup>th</sup>.
- \*Co-instructor for course on *BMP Maintenance and Inspection Colorado Stormwater Center* on November 20<sup>th</sup> & 21<sup>st</sup> in Denver, CO.
- \*Participated in the Adams County Commissioners' Career Expo, speaking to some of the 5,700 8<sup>th</sup> graders that attended this Expo, Adams Co. November 19<sup>th</sup>.
- \*Steering Committee Member for the 2013 International Low Impact Development Symposium in St. Paul, MN.
- \*Steering Committee Member for the Colorado Stormwater Center.
- \*Steering Committee Member for the Lower Bear Creek Watershed Project.
- \*Served as the CASFM Stormwater Quality Committee Chair.
- \*Member of ASCE, WERF, & CASFM.

**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
- \*Attended CASFM Annual Conference
- \*CASFM Conference Co-Presenter for *Brantner Gulch at Holly Street*
- \*CASFM Conference Co-Presenter for *Tunneling 101*
- \*CASFM Conference Co-Presenter for *Stream Restoration Using Natural Logs and Sculpted Concrete Logs to Mimic Natural Drop Structures*
- \*Rocky Mountain NASTT Conference Co-Presenter for *Contractor Selection & Collaborative Design on Three Utility Tunnels*
- \*UDFCD Seminar Co-Presenter for *Things We Learned the Hard Way*
- \*Attended APWA Management Conference

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

- \*Member of ASCE, NSPE, CASFM and ASFPM
- \*Attended Regional Statistical Hydrology and Flood Prediction (UWRI, February 2013)
- \*Attended UDFCD Annual Stormwater and Floodplain Management Seminar (UDFCD, April 2013)
- \*Attended 2013 CASFM Annual Conference (September 2013)
- \*Attended RASPLIT training (Michael Baker Jr., Inc., September 2013)
- \*Attended Design and Management Issues Related to In-Channel Safety (CASFM, July 2013)
- \*Attended CASFM Stream Restoration Workshop (CASFM, July 2013)
- \*Attended History of CUHP (CASFM, April 2013)
- \*Attended Overview of Water Quality Regulation and of Compliance Models (UWRI, March 2013)
- \*Attended webinars on Floodplain Mapping Using HEC-GeoRAS and RAS Mapper (ASCE, July 2013) and Social Media in Emergency Management (FEMA, April 2013)
- \*Member of Cherry Creek High School Engineering Physics Advisory Committee

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

- \*Member American Public Works Association (APWA) and ARMA International
- \*Attended the ESRI Annual International Users Conference in San Diego, CA in July.
- \*Participant in the North Central Region GIS steering committee.
- \*Steering Committee member for EMWIN-Denver (Emergency Managers Weather Information Network)
- \*APWA Emerging Leaders Academy – Class 7

**Mike Sarmiento, Senior Construction Manager, Design, Construction & Maintenance Program**

- \*Member of APWA, Society of Wetlands Scientists, NICET, American Institute of Hydrology
- \*Presented at May 2013 ASCE/EWRI conference in Cincinnati, Ohio on Natural Bank Protection Systems
- \*Presented at December 2013 Mountain State Chapter of IECA in Denver, Colorado on Overcoming Erosion Control Issues on East Tributary of Dad Clark Gulch
- \*Attended RMEC Annual Refresher Course for Hazardous Waste Site Safety
- \*Attended 13<sup>th</sup> Annual Cherry Creek Watershed Conference in Parker, Colorado

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

- \*APWA Emergency Preparedness Sub-committee Member
- \*CO APWA Representative – State All Hazards Advisory Committee
- \*CO APWA Emergency Management State Liaison
- \*South Platte PURE – Steering Committee Member
- \*2013 APWA Congress
- \*2013 APWA Inspectors Conference
- \*CO Emergency Management Conference
- \*Emergency Management Forum - Denver
- \*Permanent Stormwater Quality BMP Maintenance and Inspection, Course and Certification
- \*FEMA Independent Study Courses: IS-915 and IS-552

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

- Attended the UDFCD annual seminar in April 2013
- \*Attended the 2013 IECA Environmental Connection Conference

- \*Attended the 2013 APWA Construction Inspection Conference
- \*Attended the 2013 MSC Winter Conference/Mountain States Chapter IECA
- \*Continued membership into the American Public Works Association (APWA)
- \*Continued membership into the International Erosion Control Association (IECA)

**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
- \*Member of 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 the International Erosion Control Association (IECA)
- \*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 IECA Environmental Connection Conference in San Diego, February
- \*Attended the UDFCD annual Stormwater & Floodplain Management Seminar in April
- \*Attended the Mountain States Chapter of IECA Winter Conference in December

**Joanna Czarnecka, Construction Manager, Floodplain Management Program**

- \* Member of the Colorado Association of Stormwater and Floodplain Managers (CASFM).
- \*Member of the Association of State Floodplain Managers (ASFPM) and the American Public Works Association (APWA).
- \*Presented *When Maintenance Eligibility is on the Line* at APWA Construction Inspection Conference with David Mallory, Denver, January
- \*Attended UWRI *Regional Statistical Hydrology and Flood Prediction* class, Denver, February
- \*Attended the UDFCD Seminar, Denver, April.
- \*Attended CASFM *Stream Restoration Workshop*, Grand Lake, July
- \*Attended CASFM *Quarterly Lunch and Learn* at UDFCD, July
- \*Presented *Floodplain Management Aspects of RTD Project* at the CASFM Annual Conference with Bill DeGroot and David Mallory, Steamboat Springs, September
- \* Active with CASFM CRS Committee

**Shoemaker endowment established**

In recognition of Joe Shoemaker’s many years of service to the UDFCD and the South Platte River; the UDFCD, Wright Water Engineers, and the Greenway Foundation have established the *Joe Shoemaker Endowed Research Fund* with the University of Colorado Foundation. The fund will benefit the Hydrology and Hydraulics Graduate Program in the Civil Engineering department at the University of Colorado. Representatives of the organizations involved in the fund, along with friends of Joe’s were at the February Board meeting to honor Mr. Shoemaker and present the endowment to the University Foundation.



Pictured above (L to R) Dr. James Guo (CU), Scott Tucker, Noelle DeLage (CU Foundation), Kip Stastny (Greenway Foundation), Jeff Shoemaker (Greenway Foundation), Jonathan Jones (Wright Water Engineers), UDFCD Chair Nancy McNally, Ben Urbanas and Executive Director Paul Hindman.



**Urban Drainage and Flood Control District**  
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