



Flood Hazard News

An annual publication of the Urban Drainage and Flood Control District

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Montclair Storm Drainage Project

*Colorado Association of Stormwater and Floodplain Managers
Grand Award Winner for 2008*

By Mike Galuzzi, WH Pacific
Tom Blackman, City of Denver
David Bennetts, UDFCD

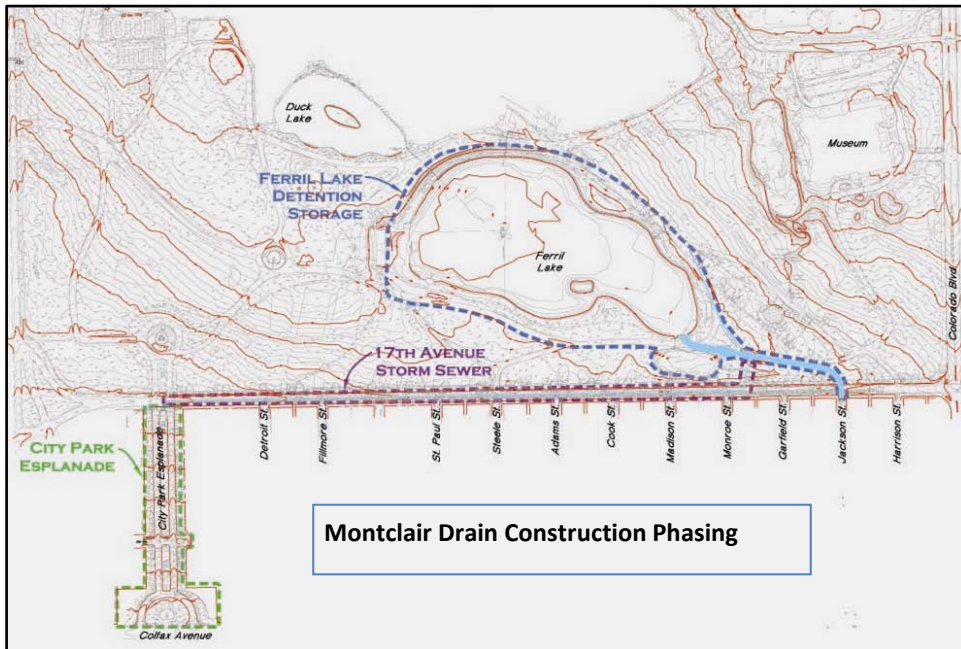
Project Background

The Montclair Storm Drainage Project was a \$25 million endeavor by the City of Denver to improve the drainage in the Montclair Basin and to improve Ferril Lake in City Park. The project includes the conversion of Ferril Lake into a dual use facility (stormwater detention and recreation), associated park improvements, installation of a new storm sewer system in 17th Avenue, and a new storm sewer/road reconstruction on the City Park Esplanade in front of East High School.

The Montclair Basin consists of 9 square miles of fully developed urban land located east of downtown Denver. The basin is approximately 8.2 miles long, extending north from Fairmont Cemetery at its southern limit, to the outlet at the South Platte River near the Denver Coliseum. There is not a single open channel drainageway in the entire basin. Storm drainage is conveyed entirely in the streets and through the existing storm sewer system, which is predominantly brick and was



Ferril Lake in Denver's City Park



\$25 million in upsizing costs for the existing storm sewer system.

The Montclair Storm Drainage project was constructed in three phases over a two-year period. The first phase involved reconstruction of the City Park Esplanade in front of East High School. The Esplanade is the historic “gateway” to City Park and is approximately 1,400 feet long, extending from Colfax Avenue to 17th Avenue. The project included removal of the entire street, installation of a storm sewer system, construction of an Entry Plaza at East High School, and reconstruction of the irrigation system and landscaping. The project design required the review and approval of Denver’s Landmark Commission to ensure that the project was

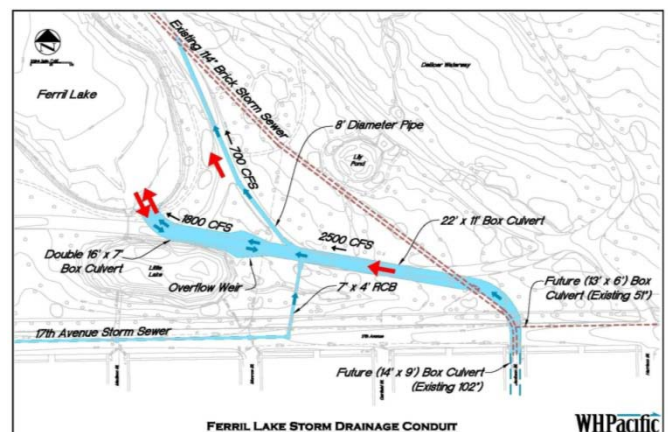
constructed in the 1930s. The storm sewer ranges in size from 10-inch lateral pipes to a 10-ft diameter main line at the outlet to the Platte River. Little has been done in the past to improve the drainage in the basin for the simple reason that the existing pipe system has less than a 2-year storm capacity. Enlarging the main stem, including the outfall, would be an expensive and difficult project. The main objectives of the Montclair Storm Drainage Project were to create adequate stormwater detention while also improving the park for recreational use.

The Park Planner for City Park was involved from the onset in the planning and design of the project. The conversion of the lake into a stormwater detention facility would have to improve the park aesthetically and functionally in order for it to be viewed as a success by the public. In addition to the Park Department representatives, other agencies were also involved in the planning and design of the project. These agencies included the Urban Drainage & Flood Control District, the State Engineer’s office, the Landmark Commission (for historic considerations), the East High School staff and parent organizations, Denver Zoo representatives, Museum of Nature and Science representatives, City Park Jazz, and local neighborhood groups. Two public meetings and a design charrette were held to present the results of the planning and design processes and to receive public input.

WHPacific was selected to work with the City to create a Drainage Master Plan for the Montclair Basin. The Master Plan was completed in 2005, and project improvements were prioritized for the basin. The selected plan for the basin wide improvements revolved around construction of a regional stormwater detention storage facility in City Park, which is centrally located in the Montclair Basin. Construction of a 120 acre-foot stormwater detention facility at City Park would dramatically reduce flows to downstream basin areas for 5-yr (and larger) storm events, thereby eliminating the need for

reconstructed within the “historical context” of the City Park Esplanade.

The second phase of the project involved the 17th Avenue Storm Sewer, which included installation of 3,500 feet of new storm sewer ranging in size from 24-inch RCP to 7-ft x 4-ft concrete box culvert. The 17th Avenue storm sewer connects to the new storm sewer in the City Park Esplanade, runs east along 17th Avenue, and enters City Park near the east end of Ferril Lake. The storm sewer upgrades were accompanied by street improvements which consist of reconstruction of eight intersections along a major city arterial. Upgrades also included rebuilding curbs, gutters, walks, handicap ramps, and



40 new inlets. This project utilized slotted drains, which serve as temporary inlets to augment the inlet capacity until upstream phases of storm sewer systems are installed.

The third phase of the project involved construction of the stormwater detention facility in Ferril Lake which includes an approximately 1,000 feet long cast-in-place drainage conduit that ranges in size from a 22-ft x 11-ft box culvert to a double



Construction of diversion structure to existing brick storm sewer

16-ft x 7-ft box culvert. The conduit collects water from the upstream storm sewer systems and conveys flow into Ferril Lake via a large underground overflow weir structure. Designing an underground conduit/overflow weir structure that can divert 1,820 cfs into Ferril Lake during a 5-yr storm event was challenging; however, converting the historic Ferril Lake into a multi-use recreational/stormwater detention storage facility was equally as challenging.

POND IMPROVEMENTS

In order to provide 120 acre-feet of temporary stormwater detention storage in Ferril Lake, the entire lake had to be reconstructed. This required some innovative design solutions. Due to the physical site constraints and other aesthetic considerations, the storage volume required had to be provided within the “footprint” of the existing lake. The lake level could not be lowered more than two feet below its normal pool elevation without noticeable visual impacts. Consequently, the “additional” storage volume had to be obtained by raising the embankment height. Existing landforms and mature trees did not allow space for placement of additional fill on the embankment.

Constructing the pond to get the required storage volume involved a two step approach. The normal lake level was lowered by 2 feet by means of excavation, muck removal, and reconstruction of the entire lake edge. Lowering the lake level also required that the Electric Fountain and irrigation intake structure be reconstructed. The effective embankment height was raised by adding an 18-inch high concrete seat wall, designed to run along the top of the embankment on the west and north sides of the lake. The seat wall would provide the “effective embankment” height needed for the storage volume, while preserving the existing trees and landscaping around the lake. The wall was incorporated into the landscape design to be an attractive amenity that would enhance the beauty and form of the concrete walkway around the lake.

CONDUIT IMPROVEMENTS

Another innovative design solution involved the inflow conduit at the east end of Ferril Lake. The inflow conduit collects stormwater from the upstream storm sewer systems, diverts flow into Ferril Lake for temporary detention, and bypasses smaller flows via an 8-ft diameter diversion pipe into the existing 114-inch brick storm sewer that runs through City Park. Due to the constraints of the normal pool elevation in Ferril Lake and the elevation of the existing 114-inch storm sewer and the adjacent ground elevation, the hydraulics of the underground spill/diversion into Ferril Lake was challenging. Minimum head was available for the overflow spill into the lake. Conventional hydraulic analysis did not provide adequate understanding of the losses involved in the spill/diversion structure.

To avoid a “conservative” approach that might oversize the structure and add considerable costs to the project, WHPacific used “FLOW-3D” modeling software to simulate a 3-dimensional model of the proposed Inflow Conduit and spill/diversion structure. Utilizing FLOW-3D, different shapes and sizes of the spill/diversion structure were modeled to determine the minimize size structure needed to spill the required flow of 1,820 cfs into Ferril Lake while minimizing hydraulic losses through the system.

PARK IMPROVEMENTS

The lake is the major focal point of City Park and renovation of the lake required careful planning, coordination, and design to ensure that the changes to this 100-year old lake would not be perceived negatively. The project provided major upgrades to Denver’s historic City Park, the crown jewel of the City Park system. The upgrades include: a modern automated irrigation system, new concrete bike/pedestrian paths, several new plaza areas, a variety of lake edge treatments, reconstructed park roads, reconstructed historic wall and railing, reconstructed historic Electric Fountain, and renovation of the DeBoer Waterway.

The reconstructed lake provides improved areas for fish habitat and fishing, enhanced wetlands, and riparian habitat for wildlife around the lake edge. The Parks Department was heavily involved in selecting the different lake edge treatments that included wetlands, cobbles, blue grass with a concrete edger, and reconstruction of a portion of the historic wall. Other elements of the project included building the Pavilion Plaza, the Grand Staircase Plaza, and the View shed Plaza, and reconstructing Little Lake. The project also significantly upgraded the City Park Esplanade in front of East High School. This portion of the project entailed removal of the unsafe “back-in” diagonal parking. The road was reconstructed, with the addition of new curbs, gutters, and a new entry plaza. The irrigation system was rebuilt, and a storm sewer system was added.

FOUNTAIN IMPROVEMENTS

The most unique aspect of the project was the reconstruction of the prismatic Electric Fountain in Ferril Lake. The fountain was originally constructed at the time of the



Lake edge treatment

Democratic National Convention that was held in Denver in 1908. It was recognized that the entire fountain structure needed to be reconstructed in order to maintain the historical appearance of the fountain with the new lower lake level. The original fountain was replaced with a replica that was identical in shape and dimension to the original design. The dedication of the rebuilt fountain took place on April 30, 2007. Mayor Hickenlooper, Bill Vidal (the Manager of Public Works), and Kim Bailey (the Manager of Parks and Recreation) were present to celebrate the rededication of the fountain. The reconstruction of the Electric

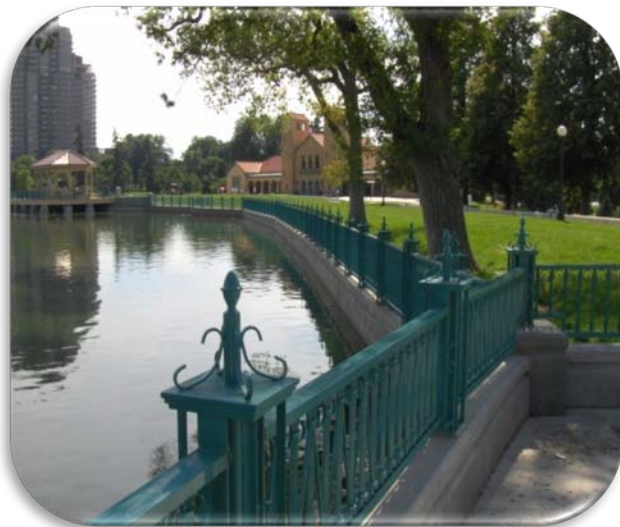


Seat wall and concrete path along Ferril Lake

being developed to implement Phase 1 of the Montclair Basin Master Plan, the City embarked on the Integrated Construction Program. The IC program enabled the city to hire a construction management contractor (IC contractor) to handle multiple projects simultaneously. The IC program removed many delays from the usual city “process” and allowed Denver the flexibility to quickly select contractors and begin work quickly, even before plans were entirely completed. The first implementation of the IC program in the Montclair Basin was on the City Park Esplanade.

Since the Esplanade is located in front of East High School, the project had to start on June 1 when school was no longer in session, and be complete by the time school started in early August. Normal contracting procedures would have delayed

this project for at least an additional year. The flexibility of the IC program allowed the IC contractor to put the project out for bid while WHPacific finalized plans. Concrete Works of Colorado was selected for the project. The work was completed in early August, a week before school was back in session.



Reconstructed historic wall

Fountain, the irrigation intake structure, and the historic wall all met the historic preservation requirements and final approval of the Landmark Commission.

CONSTRUCTION OF IMPROVEMENTS

The Montclair Storm Project used an innovative process for contracting the construction activities. While plans were

One of the more challenging aspects of the project construction involved the completion of the work in Ferril Lake over a relatively short time frame (end of October to middle of April). Since Ferril Lake is the source of irrigation water for the entire City Park, work had to be completed during the non-irrigation season. Originally, it was assumed that the work would be completed over two construction seasons. Ultimately, we were able to complete the project in one season. To accomplish this, the contractor had to drain the lake at the end of irrigation season, remove 90,000 cubic yards of material (sediment and muck), reconstruct the lake edge, reconstruct the historic Electric Fountain, the irrigation intake structure and the historic wall, and refill the lake so that the park could be irrigated at the start of the following irrigation season.

The contractor did an outstanding job in removal of the lake material by using excavators on steel mats, so that they would not sink into the muck. Haul roads were constructed on the lake bottom, and trucks were run 12 hours each day to remove the material. Multiple construction crews worked concurrently within the lake to lay pipelines, construct concrete walls, place rock riprap and cobbles, and construct the Electric Fountain.



The reconstructed fountain showing off with a light show

CONCLUSION

The Montclair Storm Project was highly successful in creating a cost-effective solution to provide detention in a large, underserved basin. Construction of the Ferril Lake Detention Storage Facility saved the city \$25 million in upsizing costs for the downstream storm sewer system. The project also provided major upgrades to Denver's historic City Park,

the crown jewel of the City Park system, and serves as an outstanding example of successful multiple-objective effort.

A longer version of this article, with more photos, is available on the District's website.

Hindman recognized for land stewardship

Executive Director Paul Hindman was recently selected as the 2008 Jane Silverstein Ries Foundation's award winner. The annual award honors one individual, group or organization that demonstrates a pioneering sense of awareness and stewardship of the land in the Rocky Mountain region. The Foundation is the charitable arm of the American Society of Landscape Architects Colorado Chapter.

The foundation honors pioneer landscape architect Jane Silverstein Ries, FASLA, by promoting the quality of the built environment and the conservation and stewardship of our natural environment.

Paul Hindman with JSR Foundation Board members Kimberly Douglas, and Pat Mundus, President



South Platte River Flood Control Project Dedicated in June

In the 2007 edition of *Flood Hazard News*, Nancy Love and David Love from Love & Associates, Inc. described in detail the South Platte River North Globeville Area flood control project, the single largest flood control project undertaken by either the District or the City and County of Denver.

On June 9, 2008, community leaders celebrated the completion of the three-phase, 13-year, \$25 million project that removes over 300 acres of land in north Denver and south Adams County from the 100-year floodplain. It also connects Adams County and Denver trail systems with a new pedestrian bridge over the river and an underpass at Franklin Street and the Denver Rock Island Railroad (DRIRR).



Denver Councilwoman Judy Montero; Nancy Love; US Senator (now Secretary of the Interior designate) Ken Salazar; and Denver Deputy Mayor, Manager of Public Works and District Board member Bill Vidal



Denver Mayor John Hickenlooper



Bryan Kohlenberg, District Senior Project Engineer and Frank Kemme, Denver Public Works



Nancy McNally, Westminster Mayor and District Board Chairwoman; Dave Lloyd, former District Executive Director; and Ben Urbonas, former Manager of the South Platte River Program

Hind' sight

By Paul A. Hindman

Timely Comment from the District's Executive Director

Wow. As quoted from David Byrne with the Talking Heads, "Well, how did I get here?" At the start of 2008, I was content co-managing the Design, Construction and Maintenance Program with Mark Hunter and fully intended to continue in that role for many years. Then, just shortly after the New Year, Dave Lloyd announced his retirement. After considerable reflection, I decided to "throw my hat in the ring" for the position of Executive Director. After a long process of applications, interviews, and telephone discussions, the Board of Directors entrusted me with the position of Executive Director. My term began in July following Dave's official retirement date. I did not take this task lightly knowing that I was following a line of great leaders. The District has been formed by them into an institution of stewards of the land of which I trust I can continue to advance. I know this can only be accomplished through the support and energy of a great staff. I'm fortunate to have both.

One question I seem to get a lot is "What are you going to change at the District?" My first response is "if it ain't broke, then don't fix it". The philosophy of a minimal staff and to be a service organization to the local governments is what has made the District the effective organization it is. I plan to continue this policy throughout my tenure as Executive Director.

The first six months have been a bit daunting while at the same time very rewarding. One of the greatest challenges I faced was leaning the budget process along with calculating and certifying next year's mill levy. With help from Dave Lloyd, Mark Hunter (Manager of Design, Construction, and Maintenance), and Frank Dobbins (Director, Finance and Accounting) I was able to get through all the Board meetings with both the budget and the mill levy being approved and certified.

Next year will be our 40th anniversary. As alluded to above, my predecessors guided the District and formed it into the great organization it is today. During my time as Executive Director I want the District to build on their visions and take it to new levels while at the same time continuing our reputation as one of the top flood control districts in the

nation if not the world. To accomplish this, a mission plan, vision plan, and strategic tasks were needed to guide the District. Last fall the staff was polled on a variety of issues, followed by an all day meeting of the managers to formulate a mission statement for the District. The result is as follows:

"The Urban Drainage and Flood Control District works with local governments to solve and prevent multi-jurisdictional drainage and flood control problems in order to protect people, property, and the environment."

At the start of 2009, a vision plan will be formulated followed by strategic tasks. This will guide the District into the future. One of the key strategic tasks the District will continue to improve on is to allow the public to access our published information through electronic means via the internet. Starting in spring of 2009, an interactive GIS (graphic information system) map will be accessible from the District's website that will allow the user to find and retrieve information by pointing and clicking on the District map. Our goal is to have most, if not all, of our published information eventually to be retrievable by clicking on a map. The first phase of the process will be to access as-builts of constructed projects in the Cherry Creek basin.

To close, I want to thank all of my staff for supporting me in my new role of Executive Director. I also look forward to working with all of the local, state, and federal government staffs on the challenging issues we all will face in the upcoming years.



Master Planning Program

Ken MacKenzie, PE, Program Manager

Staff Changes

After 31 years with UDFCD, my close friend and mentor Ben Urbonas retired in April. After working closely with him since 1995, I am honored to take his position as the manager of the Master Planning program and I am humbled by the vast amount of work he accomplished in his career here at the District.

Shea Thomas, P.E. has chosen to assist me in the Master Planning program as a project engineer. Shea has many years of engineering experience in this region and has already proven to be a tremendous asset to our organization. I look forward to our continued collaboration on this important work.

Master Planning Projects

We completed five planning projects in 2008 with nine additional projects under way; and we hope to begin seven new planning projects in 2009.

We now have a total of 140 completed watershed-level major drainageway and outfall system plans in our inventory, including updates of master plans completed in the past.

Urban Storm Drainage Criteria Manual

We have just begun a major update to the *Urban Storm Drainage Criteria Manual Volume 3: Best Management Practices*. This manual is considered by many as the standard by which other stormwater best management practice manuals are measured, and is one of the most respected stormwater management criteria manuals nationally and around the world.

Having said that, Volume 3 had its last major rewrite in 1999. While it has been continually updated since that time, it is now time for another major revision to address the technological and philosophical changes that are ongoing in

this dynamic field of practice. I have contracted with Wright Water Engineers to provide technical support and research for this project and I have hired Michelle DeLaria, an environmental scientist, to work with me on a part-time basis to perform the primary function of technical writer and to

STATUS OF PLANNING PROJECTS

Project	Sponsors	Consultant	Status
Baranmor Ditch MDP	Aurora	Olsson	10% Complete
Big Dry Creek MDP & FHAD	Adams, Broomfield, Thornton, Westminster	None Yet	Starting in 2009
Clear Creek MDP & FHAD	Adams, Denver, Golden, Jefferson, Wheat Ridge	Icon	Completed in 2008
Coal Creek MDP & FHAD	SEMSWA/Arapahoe & Aurora	None Yet	Starting in 2009
Cottonwood Creek (Lower) OSP Update	SEMSWA	Muller	25% Complete
Dutch Creek, Coon Creek, Lilley Gulch MDP & FHAD	Denver, Columbine Valley, Jefferson, SEMSWA	PBS&J	95% Complete
East Toll Gate (Upper) MDP and FHAD	Aurora, SEMSWA	None Yet	Starting in 2009
First Creek (Upper) MDP & FHAD	Aurora, Denver	Moser	33% Completed
Four Mile Canyon Creek & Wonderland Creek MDP	Boulder	Love	65% Complete
Hidden Lake / Bates Lake MDP	Adams, Arvada, Westminster	Matrix	Completed in 2008
Hoffman Drainage MDP & FHAD	Adams, Thornton	Moser	Completed in 2008
Lafayette / Louisville Boundary OSP	Lafayette, Louisville	McLaughlin	25% Completed
Lone Tree, Windmill, & Dove Creek MDP & FHAD	Douglas, SEMSWA	Icon	33% Completed
Lena Gulch (Lower) MDP & FHAD	Wheat Ridge	Cotton	Completed in 2008
Murphy Creek OSP & FHAD	Aurora	Moser	Completed in 2008
Park Hill (Lower) Drainage MDP	Denver (& Denver Water), Commerce City	None Yet	Starting in 2009
Pine Gulch Dam Analysis & Plan	Parker, Douglas County	None Yet	Starting in 2009
Piney Creek Stabilization Update	SEMSWA/Arapahoe & Aurora	None Yet	Starting in 2009
S. Boulder Creek Flood Mitigation Study	City of Boulder	None Yet	Starting in 2009
Westerly Creek (Lower) MDP	Aurora, Denver	Kiowa	50% Completed
Willow Creek, Little Dry Cr & Greenwood Gulch OSP	Douglas, Greenwood Village, Lone Tree, SEMSWA, SSPRD	CH2M Hill	40% Completed

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

provide coordination among the many collaborators and reviewers involved in this project.

I hope to release the new Volume 3 in early 2010. All three volumes of the *Urban Storm Drainage Criteria Manual (USDCM)* are available in pdf format on our website (www.udfcd.org) for download. Each chapter is marked with the revision date and I encourage you to check the website frequently for the latest updates.

UDFCD Computational Tools and USDCM Support Group

You too can be a member of the UDFCD cyber-community by subscribing to this internet discussion group at: <http://groups.google.com/group/UDFCD-support>. 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 software program *Colorado Urban Hydrograph Procedure (CUHP)* and other free software, including the new *UDSEWER 2008* that includes a profile plotter, and many other free design aid workbooks from our website at www.udfcd.org. To download the CUHP companion EPA SWMM program, we have placed a hyperlink from our software site to the EPA website.

UDFCD Annual Seminar

At our 2008 annual seminar we had over 250 registrants. The proceedings are available at: <http://udfcd.org/conferences/conferences.htm>.

On February 24, 2009 we will have our next annual seminar. This one-day program is still in development, but

we know that it will be at the Stapleton Doubletree Hotel and the registration fee will be in the \$50 to \$60 range, including refreshments and lunch! Register early and join us to find out what is going on regionally and nationally in drainage, stormwater, and floodplain management.

Thomas joins District Staff

As noted above, Shea Thomas has joined the District as a Project Engineer in the Master Planning Program. Shea has a B.S. degree in Engineering from the Colorado School of Mines (where she was the recipient of a basketball scholarship!) and is a licensed Professional Engineer in Colorado. Her previous experience includes work with the engineering firms of Sellards and Grigg, BRW/URS, and Matrix. Please join me in welcoming Shea to the District.



Ken Wright Receives 2008 Friend of UDFCD Award

In 2007 the District initiated the Friend of UDFCD award with the intent to recognize individuals who have significantly and selflessly contributed to the field of stormwater and flood management and its technology in the Denver Region and within the State of Colorado

The 2008 award winner, announced at the District's annual seminar in February, is Kenneth Wright, PE of Wright Water Engineers. Ken was the lead author of the original *Urban Storm Drainage Criteria Manual* in 1969. He then served as the District's technical staff for its first 1 ½ years. Over the intervening years his firms successfully completed a number of additional assignments for the District. In 2001 Wright Water assisted the District with a complete overhaul of the manual.

Ken has continually given his service for nearly 50 years to the Denver Metropolitan Area and the State of Colorado.

In his spare time Ken has taken on research work in the field of paleohydrology. His field research in Peru, and many resulting publications, have caused two of the leading universities in Lima, Peru, to award him an honorary professorship; and he was recently awarded a *gold medal* authorized by Peru's President Garcia for distinguished service to the Republic of Peru.



Former Executive Director Dave Lloyd presents the 2008 Friend of the UDFCD Award to Ken Wright.

Seen in recent referral documents:

One development proposal was described this way. "A 10,000 square foot building is proposed, in which exotic legal reptiles will be bread."

Also:

Another developer proposed ". . .incorporating a future Rapture Education Foundation facility" in his project.

Floodplain Management Program

Bill DeGroot, PE, Program Manager

Staff changes

I'm pleased to announce that Terri Fead and Joanna Czarnecka are joining the Floodplain Management staff as regular part-time employees. They will both be reporting to David Mallory, and his column below contains a description of their areas of responsibility.

Digital Flood Insurance Rate Maps

Federal Fiscal Year 2008 marked the last year of appropriations to the Federal Emergency Management Agency (FEMA) for the Map Modernization Program to prepare Digital Flood Insurance Rate Maps (DFIRM's). This was a 5-year, \$1 billion commitment by the Congress and the Administration to upgrade the nation's flood hazard mapping. While many DFIRM's have been completed, and many more are in the pipeline, FEMA is moving on to a new mission, which includes the maintenance of the new maps and databases.

Within the District, countywide DFIRM's have been completed for the City and County of Broomfield, City and County of Denver, Douglas County, Adams County and Jefferson County; and Arapahoe County and Boulder County should be effective by the end of 2009.

For Fiscal Year 2009 \$44 million has been appropriated to FEMA specifically for maintenance of DFIRM's that were completed by a Cooperating Technical Partner (CTP) and are at least three years old. The funding requires a 25% local match. The District is a CTP; the DFIRM's for Broomfield, Denver, Douglas and Jefferson counties are at least three years old; and we have budgeted sufficient funds in 2009 to handle any required local match. I have already been in touch with FEMA Region 8 to let them know of our interest in updating all four counties.

One benefit of FEMA being located within the Department of Homeland Security (DHS) is that their budget is usually one of only two or three that Congress passes by the time the new fiscal year starts. One downside of being in DHS is that it takes five to six months for the money to trickle down to FEMA, so we probably won't know anything until March.

FEMA restructuring

When FEMA started the Map Modernization effort it elected to use one contractor, or National Service Provider (NSP), for essentially all of the work. That contractor is Mapping on Demand, a joint venture of Michael Baker Jr., Inc. and several other firms. Now that Map Modernization funding has run its course, and FEMA is back to a year-to-year appropriation situation, it has elected to break the functions of the NSP into three major components. Customer and Data Services has been transferred to the Map Service Center contractor. Production and Technical Services (new studies, re-studies and Letters of Map Change) has been divided among three joint ventures, and as this is written I don't

know who will have Region 8. A Program Management component has yet to be awarded.

You will soon be hearing the term Risk MAP from FEMA. This stands for risk mapping, assessment and planning. To learn more about this program go to <http://www.fema.gov/plan/ffmm.shtm>.

You should also be aware of the National Flood Hazard Layer (NFHL) if you are not already. The NFHL consists of all of the effective DFIRM databases. It is available in several different formats accessible from the home page of the Map Service Center at <https://msc.fema.gov>. The NFHL is updated daily to add new countywide maps as they become effective, and also to add Letters of Map Revision. I encourage you to try these tools out and take advantage of them.

FEMA has published a notice in the Federal Register that beginning October 1, 2009, for new FIRM panels they will send only one printed copy of each new FIRM panel to the affected local governments. All other distribution will be by digital means.

National Committee on Levee Safety

The Water Resources Development Act of 2007 created a National Committee on Levee Safety with the charge: "The committee shall develop recommendations for a National Levee Safety Program, including a strategic plan for implementation of the program." The committee report is due to the Corps of Engineers on January 15, 2009, and it will then be forwarded to Congress for their consideration. I've been following the work of the committee only as an interested party. One thing is clear to me. We have a serious levee safety problem in this country.

I've had the opportunity to review a draft of the report. It's about 40 pages long and it made my hair hurt to read it. That's not a criticism of the committee at all, but my reaction to the serious nature of the problem.

Last year in this space I said: "Fortunately we have very few levees in the District and we would like to keep it that way. In January (2007) the Board of Directors adopted a levee policy which discourages local governments from authorizing or permitting levees for new development, and states that these levees would not be eligible for District maintenance assistance. It would allow the use of levees as a last resort to protect existing structures."

No one can know what the Congress will do with the recommendations and options provided in the report. However, I am more convinced than ever that, regardless of the direction Congress takes, we as a nation will never get ahead of the problem until we stop permitting new levees to promote new floodplain development.

Floodplain delineation

We completed one flood hazard area delineation (FHAD) study this year for Dutch Creek and Tributaries in Jefferson

County and two “mini-FHAD’s” to clean up portions of old FHAD’s that we know have changed but the changes were never documented. These studies were for Greenwood Gulch in Greenwood Village and Centennial, and Little Dry Creek in Centennial

We have FHADs underway for Lone Tree, Windmill and Dove Creeks in Centennial and Arapahoe County; First Creek in Denver and Aurora; Upper East Toll Gate Creek in Aurora; and Big Dry Creek in Adams County, Thornton and Westminster.

All of these studies are prepared in digital form compatible with FEMA’s DFIRM specifications, and have been or will be incorporated into the appropriate DFIRMs.

Digital Flood Hazard Area Delineation Studies

In the future, all of our Flood Hazard Area Delineation Studies will be published in digital form only (DFHAD’s). No more paper reports will be published.

Moser and Associates is putting the finishing touches on DFHAD Guidelines which will guide our consultants through the process of publishing DFHAD’s in pdf format. Distribution will be by CD and website.

DFIRM conversion projects

With the aid of grants from FEMA’s Map Modernization Program and the Colorado Water Conservation Board (CWCB), as well as some of our own funding, we have completed DFIRM conversion projects for Broomfield, Denver, Adams County and Douglas County. We also distributed revised preliminary maps to Arapahoe County and incorporated areas in December which should mean effective maps in late 2009. Finally, we have updated the Jefferson County DFIRM database and are hopeful that some of the map maintenance money discussed above will be available to complete new FIRM panels.

The Boulder County DFIRM conversion project, which is being managed by the CWCB has also been delayed, but should go effective sometime in 2009.

More Digital stuff

Leonard Rice Engineers is helping us prepare a GIS layer that will incorporate all proposed facilities from all of the Outfall Systems Plans (OSP’s) we have completed. This is being prepared primarily for internal use to assist us in reviewing development referrals from local governments. Because OSP’s cover an entire watershed, with many proposed facilities located outside any defined floodplain, it is easier to miss the potential impact of proposed development on these facilities. This GIS layer will help us avoid any misses.

Several local governments have started to do some or all of their development referrals on-line. Several more allow referral comments by email. When they do this they are saving postage, trees and my aching back.

Maintenance Eligibility

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

LOMC pilot project

We have been reviewing requests for Letters of Map Change (LOMC) for FEMA since July 1, 2001. We pretty much handle the entire process now, including technical review, drafting the letters and exhibits and uploading all of the backup material to the Mapping Information Platform (MIP).

As we have taken on the added responsibilities the costs to us obviously increase. In the early days we could just about break even in terms of cases that cost more than the fee FEMA charges and those that cost less. Now, it has to be a pretty simple case, well prepared by the applicant, for us to complete the case for the fee amount. Fortunately, FEMA reimburses us for our actual costs or we would have to think hard about dropping the effort.

We have identified a number of advantages to the District being in the position of reviewing the LOMC requests at the local level. These are contained in our annual reports to FEMA that are posted on our website.

FasTracks Coordination

We have continued to work with the Regional Transportation District (RTD), Denver, Lakewood, Golden and Jefferson County on RTD’s West Corridor light rail project. We are currently reviewing RTD’s construction drawings for drainage projects for District maintenance eligibility. We are also working with RTD and their consultants on environmental impact statements for four other transportation corridors.

We lost a friend recently

Bill Taggart passed away the week before Christmas. Bill was as smart, and conscientious and ethical as anyone I have known. He designed a number of projects for us as well as for many other clients in the Denver area, and those projects are a part of his legacy. We have used photos of several of his projects in our good examples publications.

Many of you who have used our criteria manual to design a Grouted Sloping Boulder (GSB) drop structure probably didn’t realize that Bill developed that design process for us. We wanted a “cookie cutter” design procedure that could be used by anyone proposing channelization that we could feel confident could be successfully constructed and would function as intended. I don’t know how many GSB’s have been built but it is a bunch. It has been a great success for us and one more successful assignment for Bill.

Check these out on our website

We have an Activity Summary map that identifies all District studies completed or in progress that we update quarterly. Anyone working on a drainage study in the District should check this map for existing or on-going studies that might affect their work.

All of our FHAD’s (and master plans) are posted on our website under the Publications tab. You can save yourself some time and gasoline by looking there first rather than heading for our library, although the library is still open and fully stocked.

Maintenance Eligibility Program

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

Construction Plan Reviews

Everyone is aware of the near total collapse of real estate markets and the effects on property values and land development activities. We typically receive between 250 to 300 construction plan submittals each year from communities within the District. This last year, we received less than half that number. We have, however, had a very busy year in the Floodplain Management Program as detailed in Bill DeGroot's column and below.

Terri Fead, PE, CFM continues to provide effective support in completing plan reviews. Terri's work is a great benefit to the program and local governments because we can provide very in-depth reviews of construction plan submittals and attendant reports. She also works on LOMR/CLOMR reviews and the Arapahoe County DFIRM conversion. We will apply everything learned this year in prepping digitally prepared FHADs for inclusion in DFIRMs. Terri will provide review and wise counsel as we complete the DFHAD Guidelines project early next year.

I'm delighted to announce that after five years of contract service, Terri has accepted a regular part-time position as Project Engineer with the District's Maintenance Eligibility Program starting January, 2009.

In the Field

Joanna Czarnecka, EIT, joined our staff last year on a contract basis to provide construction phase support. She has earned high praise and genuine respect from the construction and local government communities for her efforts over the last year. And while she was once mistaken for a Texan, she actually earned undergraduate and graduate degrees in her native Poland prior to completing a degree in civil engineering at UCD. Joanna was on maternity leave for three months during the late summer and fall, but has now returned to a regular schedule.

Earlier this year Joanna completed construction observation of the Sand Creek confluence project. This project was challenging politically, legally and technically, but resulted in the transformation of a concrete bone yard into a viable stream system that also accommodates a Commerce City regional trail.

Another major field assignment in 2008 was the Cornerstar project in the City of Aurora. I report in last year's article on the controversial floodplain encroachment and ultimate resolution. Construction was completed earlier this year and sequenced with the LOMR submittal, a prerequisite to the grand opening.

RTD has initiated early construction activity on their FasTracks West Corridor light rail line. We are currently observing drop structure construction on Dry Gulch in the City and County of Denver.



Sand Creek between the South Platte River and the Burlington Ditch siphon was a difficult and contentious project that we were ultimately able to accept for maintenance eligibility.

In summary, we completed final certificates of eligibility for over 50 projects for inclusion in the Maintenance Eligibility program in 2008.

I'm delighted to additionally announce that Joanna has accepted a regular part-time position as Construction Manager in the District's Maintenance Eligibility Program. Please join me in welcoming Terri and Joanna to the District's permanent staff, and congratulate Joanna on the addition to her family.

Maintenance Eligibility Program on GIS

Tiffany Ewing was hired this fall to fill in for Joanna while she was on leave. Tiffany was assigned, among other duties, the task of converting our Maintenance Eligibility data base into a graphical representation. The Maintenance Eligibility Program has certified over 600 projects for District maintenance assistance over the years. We have digitized eligible stream reaches and regional flood control facilities in each of the seven counties included within the District's boundaries. The next phase will deal with projects that have

received a construction, or initial acceptance. And finally, we will include projects that have received a design approval.

The District's Maintenance Program maintains a GIS data base for routine maintenance contracts. We can now view eligible and routine layers together with the National Flood Hazard Layer served up through FEMA's Map Service Center. This GIS tool is immensely useful in project reviews, and inter-program coordination. We'll make a full presentation on this project at the District's Annual Seminar in February.

The Maintenance Eligibility GIS data base will be a part of the District's Electronic Data Management Program or electronic library. The end point is a web-based EDM interface that is accurate, accessible and paperless.

Marketing Brochure Update

As reported last year, we have been working with many communities throughout the District to develop a "marketing brochure" for development teams to receive from the community early in the planning process. The brochure advocates the concept of floodplain preservation.

The final product was completed in April with a second printing in August and was well received. Michelle Leach Matrix Design Group, project consultant, and I presented the brochure at the ASFPM national conference in Sparks Nevada in May. We also received a project award at the CASFM annual conference in September. The brochure is hosted on the District, ASFPM and NAFSMA web sites. We will attempt to make presentations in the upcoming year to Metro Mayors and other decision makers in the public and private sectors.

With the economic downturn, there's the temptation to do whatever it takes to stimulate development. However, the experience of the last major Denver metro-area development slump taught differently. Highlands Ranch developed a large area with great deference to its natural surroundings. Highlands Ranch experienced steady sales during the mid 1980s when the rest of the Denver market was stagnant.

The brochure highlights projects like Highlands Ranch that we believe exemplify a thoughtful development approach. In 2008, we completed final approval of five projects that I thought were worthy of mention in this context. These developments have all been in the works for several years, yet the review and approval process contributed to concepts presented in the brochure. All five developments set aside large tracts of open space in order to preserve floodplains, riparian areas and wildlife habitat, as depicted in the accompanying photographs.

Villages at Riverdale and Marshall Lake, along Horizon Tributary to Brantner Gulch in the City of Thornton. These two projects include stream stabilization, low flow drop structures, regional water quality, rehabilitation of a jurisdictional dam, and regional trails.

Saddle Brook, along Moon Gulch in the City of Arvada includes stream stabilization and regional water quality and flood control.

Sunrise Creek, along Coon Creek in Jefferson County provided natural developed open space uses along the stabilized stream.

Canyon Creek Filing 3, in the Town of Erie implemented master plan components, including stream stabilization and regional detention.

I have truly appreciated the opportunity to be of service to our shared vision of a better built environment. I look forward to the opportunities and challenges in the year ahead. In the meantime be good and stay out of the floodplain.



Marshall Lake Dam, flood control was provided above the permanent water surface as a result of dam rehabilitation under the supervision of State Engineer's Office. Horizon Tributary to Brantner Gulch was stabilized throughout this development. 136th Avenue is visible in the background.



Villages at Riverdale regional water quality pond. An existing agricultural pond was rehabilitated with a new water quality outlet structure and discharge pipe, embankment repairs and high level outlet control. The trail crossing is above the 10-year water surface, more infrequent discharges overtop the trail. The forebay is visible upper-left. The area between the forebay and dam embankment was not disturbed.

Information Services and Flood Warning Program Notes

Kevin Stewart, PE, Program Manager

2008 Flood Season Marks 30 Years of Service

The year 2008 was noteworthy in many respects, not the least of which being the culmination of 30 years of community service by the District in providing local governments with early notification of flood threats. A program with its origin being the aftermath of the devastating 1976 Big Thompson Canyon flash flood, has matured through its unique partnership with the National Weather Service; local emergency managers and other public safety and public works officials; local news media; and the elected officials that have continually supported the program over that past three decades. The private meteorologists that have provided the District with professional forecast services also deserve much credit for building the program's reputation and advancing the science of hydrometeorology.

Special recognition is given to Bill DeGroot (manager of the District's Floodplain Management Program) and Scott Tucker (former Executive Director) who helped light the spark that led to the development of the program. Credit is also given to Eve Gruntfest and Tom Downing, back then with the University of Colorado at Boulder, who researched what people did that night of July 31, 1976 that resulted in the loss of over 140 precious lives, and what might have happened if that monster storm had been centered 25 miles further south over Boulder Creek instead of the Big Thompson. John Henz, currently with HDR Engineering in Denver, is the flash flood pioneer that first served the District's program in 1979 and continued to do so for over a quarter century. John devoted much of his career as a private meteorologist toward advancing the art of quantitative precipitation forecasting and predicting when and where these flood producing heavy rainfalls are most likely to occur. And finally, tribute is given to the visionaries from Boulder County and the City of Boulder who partnered with the District in 1978 to deploy one of the earliest automated flood detection networks in the United States and helped develop a community-based flash flood warning program that has served as a model for many others dedicated to protecting lives and property.



Few headlines this past year had much to do with floods in the District. Tornadoes seemed to be the primary weather threat that captured media attention starting with the deadly May 22 Windsor Tornado that left a 34-mile path of destruction and ending with the far less damaging August 24 Lemon Gulch Tornado (pictured) in

Douglas County on the eve of Denver's historic Democratic National Convention. One flood event on Cherry Creek in Denver did get some attention when fire departments documented 30 water rescues the evening of August 8. Although not noted at the time, subsequent investigation revealed that this event was Denver's largest flood on Cherry Creek since Cherry Creek Dam was completed in 1950. Looking back even further, 8-8-8 proved itself the largest flood since the 12:10 AM failure of Castlewood Canyon Dam sent a 15-foot wall of water down Cherry Creek through Denver on August 3, 1933.

Heavy rainfall was usually scarce in 2008 with the District's flash flood prediction program recording a record low number of threats. April and September produced no flood threats and the months of May and June only had two periods of concern each. While August 8 produced the most notable flood peak of the year, the general rains that occurred over August 15-16 caused the greatest volume of runoff and the largest number of reports (>2000 per hour) from the ALERT system without triggering a single rainfall rate alarm. These and other notable events are highlighted in the flood season recap section of this article.

A record low 26 days with flood potential

May	7, 22	2
June	2, 4-5*	3
July	6, 8, 17, 18, 23-26	8
August	5, 6-7, 8, 9-10, 14, 15-16*, 17, 23-25	13

Bold dates denote days when rainfall measured by automated gages exceeded alarm thresholds. Blue boxes designate NWS flash flood watch days and the red box signifies a flash flood warning. An asterisk (*) indicates a single multi-day storm period.

Meteorological Support

The team of Genesis Weather Solutions and Skyview Weather was selected by the District for a second consecutive year of providing local governments with heavy precipitation forecasts and flood threat notifications. Project manager and chief meteorologist Bryan Rappolt completed his 15th year of service to District's flash flood prediction program (a.k.a. F2P2). Bryan is the president and founder of GWS. Prior to forming GWS, he gained his F2P2 experience working for Henz Meteorological Services and HDR Engineering. Skyview Weather is headed by Tim Tonge of Castle Rock. Brad Simmons with Skyview served his second operational flood season as one of the team's lead forecasters. The met support team was rounded out nicely by the employment three students of meteorology – Dann Cianca, Chris Anderson and Nick Tarantola who proved themselves worthy technicians well on their way to promising careers in meteorology. The F2P2 operates during the flood

season from 15 April to 15 September. Information about the F2P2 can be found at f2p2.udfcd.org.

CoCoRaHS Update

The Community Collaborative Rain, Hail and Snow network is operated by the Colorado Climate Center at Colorado State



University in Fort Collins. The network's popularity continues to expand nationally with daily precipitation measurements being made by an army of volunteers from 37 states. Nine additional states will likely be added in 2009 with 20,000 observers being projected by 2010. There are currently over 300 active observers from the seven District counties.

The District continues to support CoCoRaHS as a sponsor and routinely makes use of this valuable data source. Creative new ways are being developed by the District for viewing and comparing CoCoRaHS measurements with precipitation data from other sources including the ALERT system (see article by Chad Kudym). In 2009 Kevin Stewart will begin serving on a newly formed coordinating committee established under the auspices of the Western Association of Agricultural Experiment Station Directors. This committee is tasked with addressing needs and opportunities for [managing and utilizing precipitation observations from volunteer networks](#).

CoCoRaHS is truly a community-based initiative that would not be possible without the help of people just like you. So please consider becoming a CoCoRaHS volunteer or sponsor today, and visit www.cocorahs.org for the latest news.

EMWIN-Denver Update

The Emergency Managers Weather Information Network has matured this past year as a reliable source of weather alerts for local governments in the 10-county North Central All-Hazards Region, which includes Adams, Arapahoe, Boulder, Broomfield, Clear Creek, Denver, Douglas, Elbert, Gilpin and Jefferson Counties. Weather alerts from EMWIN-Denver are sent automatically to email distribution lists established by local governments. A subscribe/unsubscribe process developed by the District's GIS Administrator Chad Kudym is available for participants that prefer not to administer their own lists. The District provides further assistance by supporting the EMWIN receiver that sends the notifications.

Each weather alert is county-specific. Users may sign-up to receive alerts affecting one or more counties. Two types of messages are sent: a short message service (SMS) designed for cell phones and pagers, and a long message that includes the entire text originated from the NWS Forecast Office in Boulder.

Other uses for EMWIN include interoperable communications between emergency managers concerning non-weather situations, EAS activation requests to NWS by

authorized local officials, and NWS notifications concerning conference calls about developing dangerous weather situations. EAS is the national public warning system that stands for Emergency Alert System. Some work is still needed on these applications, but completion is expected in 2009. The NWS would also like EMWIN-Denver to extend the email notification process to include all 22 counties in NW Colorado served by their warning and forecast office in Boulder. Summit and Grand Counties have already been added.

EMWIN-Denver area is guided by a steering committee that meets quarterly. Rick Newman from Adams County Emergency Management is the current chair. [ARES](#) Hams provide technical support for the communications equipment and assist their respective jurisdictions with training and other needs. For more information about EMWIN visit emwin.udfcd.org.

ALERT System News

The District's ALERT system currently collects hydrologic data in real-time from 178 rain gages, 90 stream gages and 21 weather stations. Six new stations were added to the network in 2008 including: an hourly-reporting weather station installed by the City of Aurora Water Department at the Aurora Airpark; two rain/stream gages in the Piney Creek basin—one at the Liverpool Road crossing of Piney Creek and



the other at the Aurora Regional Pond on Sampson Gulch (pictured); a rain/stream gage on Cherry Creek downstream of the Bayou Gulch confluence—this station replaces the one previously located at Castle Oaks Road; a stage gage on Ferril Lake at City Park in Denver; a rain gage at the Lakewood Country Club in the Lakewood Gulch drainage basin.

Additional network expansion will occur in Douglas County in 2009. Rain gages and weather stations will be installed in the upper Cherry Creek and Plum Creek watersheds. Locations include: Lehigh Gulch, Douglas County Public Works in Castle Rock; Reed Hollow, Jackson Creek, East Cherry Head (Wx), and County Road 5/SH 67. The repeater at West Creek near the Hayman Burn Area will also be upgraded to full weather station status. Two rain/stream gages will be installed on Cherry Creek near Stroh Road and the Apache

Plume confluence. These stations, located in Parker, were originally planned for 2008.

OneRain, Inc. (formerly DIAD) of Longmont completed their 17th consecutive year of field maintenance services. A change for this year involved adding a second maintenance contractor, Water and Earth Technologies (WET) of Fort Collins, to service the gages in Douglas County. As part of WET’s service agreement, they continued to provide the District with monthly system-wide performance reports that now include a useful rainfall-intensity-duration analysis, a monthly total rainfall accumulation map, a timer performance map that rates each individual station, and a plot of average and peak hour data traffic received by the District’s base station.

OneRain’s role was further expanded in 2008 by deploying new equipment on repeaters and conducting more rigorous field tests of a new protocol being developed for ALERT. Last year’s newsletter addressed the concern of system capacity limitations caused by continued use of 1960’s data communication technology. Hopefully, ALERT-2 will offer a viable alternative for large systems like the District’s.

Leonard Rice Engineers (LRE) continued to assist the District by supporting real-time hydrologic models for Boulder Creek in Boulder County; Lena Gulch in Jefferson County; and Harvard Gulch and Goldsmith Gulch in Denver. A hydro model being developed for the Cherry Creek basin above Cherry Creek Reservoir will be operational in 2009. The models activate automatically whenever flood threat notifications are issued by the F2P2 meteorologist. New innovations for 2009 include developing better ways to recognize and evaluate streamflow information based on a familiar NWS Internet application known as AHPS – Advanced Hydrologic Prediction Service. LRE will also develop and support a “Hydrologic Data Service” to integrate data from various sources and make it easier to accomplish one-stop-shopping web applications.

2008 flood season recap

In retrospect, the 2008 storm behavior was anything but normal. April through July produced very few storms with any flood potential. Then August arrived and tried to make up for the lack of moisture from the previous four months over a 13-day period beginning on August 5. After August 17, it grew quiet again with September closing out the flood season with no threats.

Heavy rainfall caused the ALERT system to set off alarms on only 11 days in 2008 including five days in August (9, 11, 15, 23 & 24) that only impacted the Hayman Burn Area in southwestern Douglas and southern

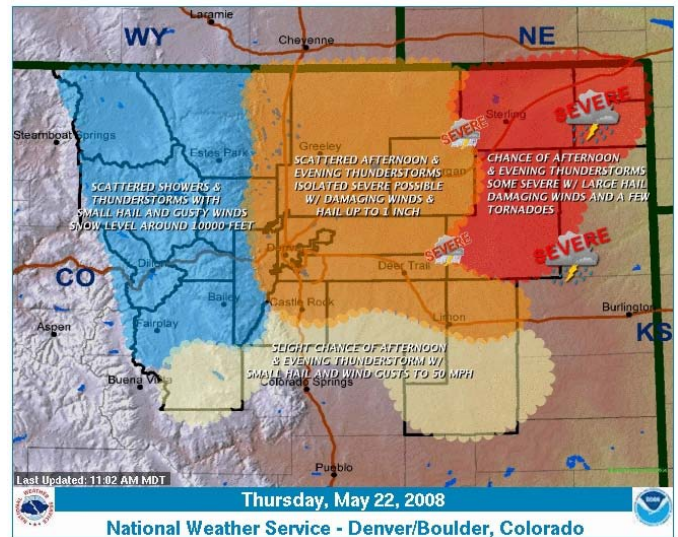
May	7
July	6, 8
August	5, 6, 8

Jefferson Counties. The six days shown in the table were days that affected the District’s primary area of interest. Comparing this table to previous years further illustrates just how unusual the 2008 flood season was. The following briefly describes the more notable events:

Wednesday, May 7

The first flood threat day of the year arrived unusually early in the morning without warning or notice by the public, and somewhat indicative of the atypical flood season to come. Heavy rainfall began at about 4:30 a.m. in southwest Denver and three ALERT gages measured rainfall totals that ranged from 1.34” to 1.85”, which agreed closely with radar estimates. Rainfall rate alarms were triggered by the Marston Lake and Sanderson at Xavier gages between 5:08 and 5:12. Stream gages also recorded annual peaks for Sanderson Gulch and Bear Creek at Sheridan.

Some minor flooding occurred in Columbine Valley at a District project on Normandy Gulch when stormwater that entered the Nevada Ditch spilled at three locations. The ditch carried debris to its crossing of Fairway Lane. There floodwaters overtopped the road and flowed east to the South Platte River. Fortunately no homes were flooded and the event received little notice due to the early hour.



Thursday, May 22

This was the only other flood threat day in May and it passed by without incident for the District. However, a severe storm that formed just north of Denver International Airport became deadly in Weld County when a large 150 mph/EF3 tornado touched down near the town of Gilcrest and began its 34 mile, one mile-wide path of destruction passing through eastern Windsor and ending just north of Fort Collins near the town of Wellington. Tornadoes of this size, magnitude, duration and direction of movement are quite rare for Colorado—another example of how unusual this severe weather and flood season was looking to become.

Wednesday/Thursday, June 4-5

With the possible exception of some very small hit-and-run storms that occurred on June 2, this storm period was arguably the first and last heavy rain hurrah for the whole month. A general rainfall with embedded thunderstorms began around 3 p.m. on Wednesday lasting overnight and into the afternoon of the second day. Rainfall amounts of up to 2¼ inches occurred across the District over a 36-hour period. The heaviest rains of ¾” to 1.6” occurred during a

2.5-hour period on Wednesday afternoon when three thunderstorms lined-up, each producing between ¼" and ½" in 10 to 20 minutes over northern Jefferson, SE Boulder, Broomfield and NW Adams Counties. The NWS issued an urban and small stream flood advisory for Boulder and reported 1.5-inch diameter hail near Standley Lake in Jefferson County.

While the ALERT system remained relatively quiet with no rainfall alarm thresholds (½" in 10min, 1" in 1hr) exceeded anywhere in the network, June 4 turned out to be Boulder's biggest rain day of the flood season. One more remarkable weather fact to note!

Sunday, July 6

With the summer monsoon's arrival apparently delayed, this storm day produced the only rainfall alarms within the District for the entire month of July. Unbelievable! This may really be a first. It should be noted, however, that a very heavy downpour did skirt the District just two days later when the Castle Rock/Franktown area of Douglas County received over 2 inches. Other "nearby hits" occurred on other days during July, but the District boundary seemed to act like a barrier to heavy rain during this month when flash floods are most likely.

Back to July 6...a small but intense storm in Aurora near C-470 dropped nearly 2 inches in just over 30 minutes. The upper Toll Gage Creek and Murphy Creek basins were affected and the stream gage on No Name Creek at Quincy Ave. recorded its high water mark for the year.

Tuesday, August 5

It took a while, but beginning this day the summer monsoon appeared ready to take a full swing at the District. Messages were issued for six consecutive days with this day having the lowest threat potential of the period, followed by two flash flood watch days, then a flood warning (more on this later), and two more flash flood watch days.

Intense storms accompanied by large hail developed during the afternoon affecting eastern Douglas and central Arapahoe and Adams Counties. Later more storms developed across SE Denver and Aurora, and another line of activity impacted NW Jefferson and SW Boulder Counties. Together the storms caused alarms at 8 ALERT stations including: 2 South Boulder Creek sites upstream of Eldorado Springs; 3 Westerly Creek sites in Denver and Aurora; 1 site on Toll Gate Creek at 6th Avenue in Aurora; and 2 upper Cherry Creek sites in Douglas County. Streets and low lying areas experienced nuisance flooding. No major flood problems were reported.



Wednesday, August 6

With yesterday's storms causing some concern and with 300 acres of Green Mountain blackened from a large grass fire this past Monday, today's heavy rain

threat was elevated causing the NWS to issue its first flash flood watch of the year affecting the District.

Measured rainfall totals exceeded the previous day's rain by about an inch. Alarms thresholds were exceeded at the District's Diamond Hill office at 4:39 p.m. and gages near Brighton were measuring heavy rain between 6 and 7:30 p.m. The largest storms occurred outside the District with some dropping over 3 inches. The flooding impact to the District was once again minor and the Green Mountain burn area was fortunately spared.

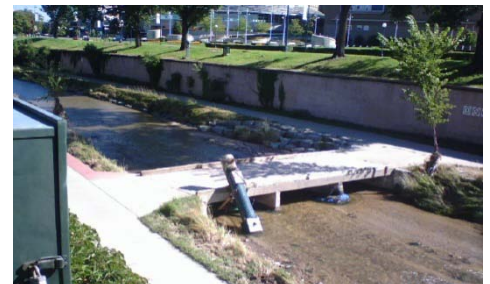
Friday, August 8

With yesterday being the third consecutive flood threat day and having nothing of consequence occur (rain <0.2"), this morning's outlook was less threatening and therefore, the NWS did not issue a flash flood watch. Nuisance flood advisories (a.k.a. Message 1) were issued by the F2P2 meteorologist for Jefferson and Douglas Counties effective from 1 to 8 p.m. calling for the possibility of ½" to 1¾" in 10-40 minutes and up to 2½" in 45-60 minutes. The worst case scenario warned that a 60 to 90-minute ¾-inch rainfall was also possible.

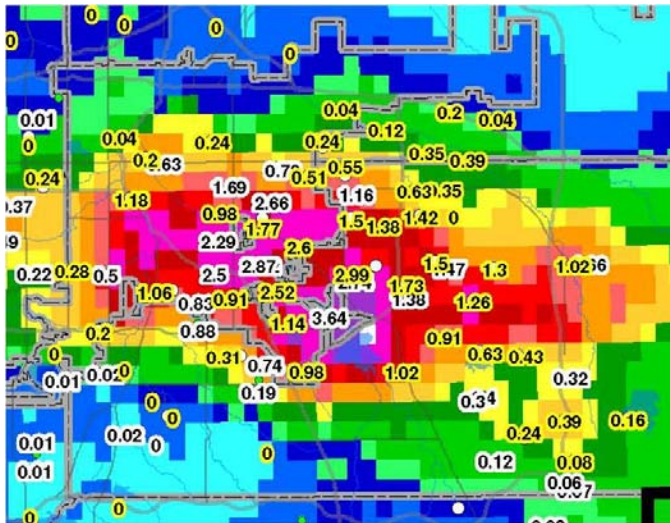
The afternoon passed without incident, but as conditions started to change in the early evening, new messages included Arapahoe County, Aurora and Denver by 6:50 p.m. This set the stage for a somewhat surprising thunderstorm that hit SE Denver very hard at about 7:30 p.m. and lasted approximately one hour. While this storm produced rainfall amounts approaching 4 inches, the most notable consequence...besides the 30 water rescues reported by the media...was that Cherry Creek through downtown Denver experienced its largest flood since the Castlewood Canyon Dam failed on August 3, 1933.

It is also worth noting that in 1933, Cherry Creek Dam did not exist and because of the dam, the effective uncontrolled drainage area of Cherry Creek since 1950 has been just over 25 square miles. The largest floods on Cherry Creek in Denver's 150+ year history date back to 1864 and 1885. Both of these events had estimated flood magnitudes exceeding 20,000 cfs and there were no large dams in the 414 square mile Cherry Creek watershed. The 1933 Castlewood Dam failure had an estimated peak discharge at Denver between 15,000 to 17,000 cfs from a "wall of water" 15 feet deep. By comparison, the maximum water depth for the "8-8-8 flood" was 7 feet at the gage with a peak discharge of 4,100 cfs.

The 8-8-8 flood damaged the stream gage near Champa Street requiring a field survey to determine the peak gage height of 9.97 feet. The USGS performed the survey and estimated that the peak flow was at least 4,100 cfs. This discharge equals the 10-year flood



published in the FEMA Flood Insurance Study. Based on the partial gage record captured by the ALERT system, it is estimated that the Champa gage failed at about 10:10 p.m. with the crest likely occurring within the next 30 minutes.



The storm rainfall totals are shown in the figure. Twenty-six rainfall rate alarms occurred in Denver and Aurora between 7:39 and 8:29 p.m. The storm also caused annual peaks at 13 stream gage locations on Cherry Creek, Westerly Creek, Harvard Gulch, Goldsmith Gulch, Toll Gate Creek and the South Platte River.

Eye witness reports aired by local news stations gave testament to just how quickly floodwaters can rise and how dangerous that can be if trapped within a walled section of channel like Cherry Creek (see the short news clip on District website).

Fortunately, no one was seriously injured thanks to the Denver Fire Department swift water rescue personnel that gave aid to victims caught in floodwaters.

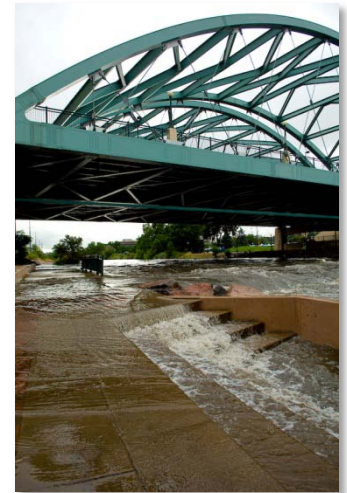


It is also remarkable that the Cherry Creek channel did not require any major repairs due to the flood. The District has worked closely with the City and County of Denver over the past four decades to assure the integrity of this channel. It looks like their hard work paid dividends in 2008.

Friday/Saturday, August 15-16

A general rain began falling early Friday morning and continued through Saturday afternoon. Rainfall accumulations over this period ranged from 1¾" to 3½". Rivers and streams were running high by Saturday morning while low lying areas and streets experienced some minor flooding. The NWS issued a flood watch at about 3 p.m. on Friday valid until noon Sunday. A very wet weekend was definitely in store for the District.

During the 24-hour period starting shortly after 3 a.m. on August 16, ALERT stream gages at 28 locations recorded their annual peaks. Affected streams included: Ralston Creek, Leyden Creek and Van Bibber Creek in Arvada; Harvard Gulch, Goldsmith Gulch, Lakewood Gulch, Westerly Creek and Marston Lake North Drainageway in Denver; Granby Ditch and Murphy Creek in Aurora; Lena Gulch in Jefferson County; Broomfield Basin 3207; Slaughterhouse Gulch in Littleton; Englewood Dam on Willow Creek and Holly Dam on Little Dry Creek in Arapahoe County; South Platte River in Littleton, Englewood and Adams County (photo of South Platte River flooding taken by Tim Tonge at Confluence Park showing Speer Blvd. bridge); Sand Creek in Commerce City and Aurora; Niver Creek in Thornton; upper Bear Creek in Jefferson County; Sulphur Gulch in Parker; and upper Cherry Creek through Douglas and Arapahoe Counties. The final alarm occurred at 2:28 a.m. on August 17 from the detention pond at the Louisville Recreation Center.



This widespread event produced the greatest runoff volume of the 2008 flood season, the largest number ALERT reports, and the highest radio traffic loading of the year (>2000 reports/hour between 10 and 11 a.m. on August 16) according to a monthly data analysis report by WET—and all this happened without triggering a single rainfall alarm.

Hungry for more?

Storm summaries for 2008 are available at f2p2.udfcd.org as PDF maps depicting 24-hour gage-adjusted rainfall estimates derived from radar data overlaid by corresponding surface measurements from the ALERT system and CoCoRaHS. By inspecting the single device data from individual ALERT gages, a general sense of storm duration, temporal distribution and time of day can be determined. These maps are routinely prepared by Chad Kudym for every day of the flood season (15 April through 15 September) in which flood threat notifications were issued by the F2P2 meteorologist.

Annual reports by Genesis/Skyview, OneRain and WET are also available from the ALERT System website Bulletin Board page. Broadcast news reports are captured, clipped and available for viewing at the District. Detailed maintenance records are also available for inspection upon request, but please call to make an appointment if you are planning to dig this deep.

Our student intern Stephanie LaCrue continues to assist the IS/FW Program by compiling statistical summaries from the ALERT system and developing a one-stop-shop of historical flood accounts from the seven District counties. This information will eventually be integrated into the

District's electronic data management system, a.k.a. E-library, with easy to use map navigation features.

Tables that summarize annual peak flow measurements and record peaks from the ALERT system are available at alert.udfcd.org. ALERT water level and streamflow records date back to 1986 when data from the Lena Gulch network in Jefferson County was first archived. The entire record is available from the District and most of it can be downloaded from the ALERT system website.

Readers wanting more information about past storms and floods in the Denver region should visit the [Flood Warning Program Bulletin Board](#) webpage.

New look coming soon

Keep an eye on the District's website as some interesting changes will soon be unveiled. Our IT guru and webmaster, Derrick Schauer, has been developing a new look and feel that should greatly simplify finding information.



The homepage is being designed to minimize the need to scroll and will look something like the one above. As the District continues its quest to improve services to local governments, engineering consultants, contractors and the public; this updated website will play a key role.

District Seminar draws 250 attendees, Next one set for February 24, 2009

Check our website for details and to register. We will have room for 300 this year.



Doug Harrison addresses the 2008 seminar on stormwater management issues.

New Developments Related to GIS and Information Services

Chad A. Kudym, GIS Administrator, Information Services and Flood Warning Program

During the fall and winter months the staff of the Information Services and Flood Warning Program have been working on enhancements for ALERT system and Flash Flood Prediction Program (F2P2) users. Below are some of the highlights from our development projects.

data over the user's choice of a street map, aerial photography or a terrain map. The dynamic nature of the map allows the user to zoom to their area of interest, choose a background map type and then select the type of gage data

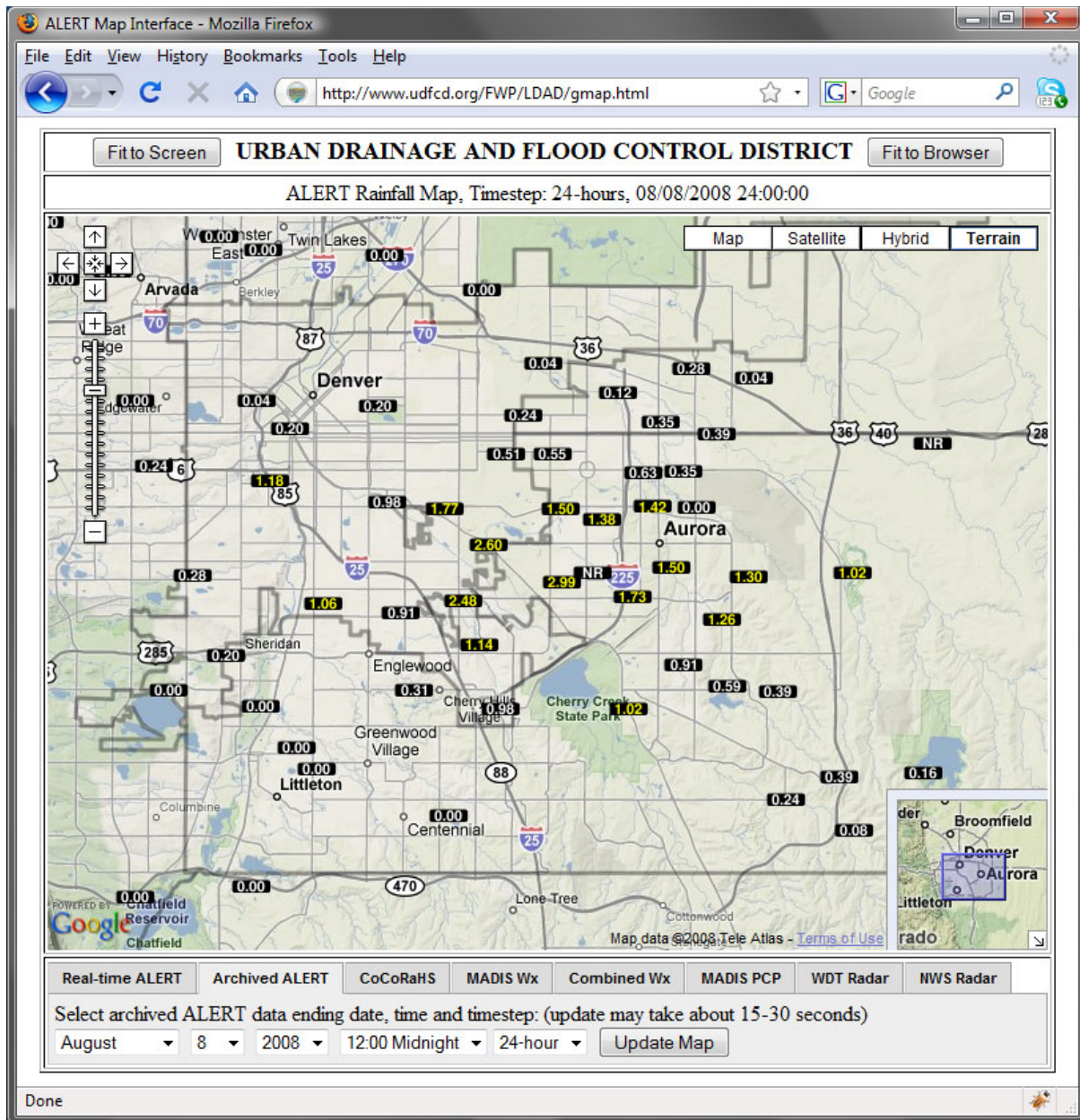


Figure 1 – Dynamic Mapping Interface Example

One of the main limitations of the maps on the ALERT website (<http://alert.udfcd.org>) is the static map background and geographic area. The maps work well for monitoring conditions but don't allow the users to customize their environment. To address these limitations we are working on a dynamic mapping interface for ALERT data. The interface uses open source code based on Google Maps to display gage

(weather, rainfall or streamflow). In addition to District ALERT data, the interface also includes tabs to display radar data from the National Weather Service and Weather Decision Technologies, our weather data vendor. Other gage data sources such as CoCoRaHS (Community Collaborative Rain, Hail & Snow Network) and MADIS (Meteorological Assimilation Data Ingest System) are also available. Figure 1

illustrates the new interface by showing a map of 24-hour rainfall totals from August 8, 2008.

The Google Maps ALERT interface is still under development but it will be ready for use for the 2009 flood season. The interface is processor and bandwidth intensive so it does require a relatively new computer and a high speed internet connection to work properly. The latest version of the map can be found on the District website at <http://www.udfcd.org/FWP/LDAD/gmap.html>, as always, we welcome your feedback.

Another development in the Information Services and Flood Warning Program is in the Flash Flood Prediction Program (F2P2). Typically, message products developed by the F2P2 meteorologists are only available in PDF format. In 2009 message products will be available in three different message formats (HTML, full text and short text) for email delivery and posted on the website in PDF and HTML format. F2P2 users will be able to subscribe to the message format that best suits their needs. The short text format will be county specific, concise versions of the full text document and are developed for use with cell phone text messaging. The F2P2 website (<http://f2p2.udfcd.org>) will also include a new tool to search for and view both current and archived messages. The intent for the new F2P2 message generator is to increase the efficiency of producing messages, shorten delivery time and customize the message product to the recipient's device.

Near the end of the 2008 flood season the Information Services and Flood Warning Program staff created ALERT rainfall alarm zones. These zones are used in association with an email list server to allow users to subscribe to their area of interest and limit the number of alarms they receive from other parts of the District ALERT system. If you were already receiving these rainfall alarms, your email has been subscribed to one or more of these zones. If you have not received alarms in the past but would like to, please contact District staff for a link to the subscription page. Figure 2 illustrates the alarms zone boundaries.

District staff from all Programs have also been working with CH2M-HILL to develop a new mapping interface. The interface was initially developed to help users find District

publications such as major drainageway planning reports, flood hazard area delineation reports, as-built drawings and outfall system planning reports but it continues to evolve into a tool to display a variety of District data. The interface uses Google Maps together with an assortment of drop-down lists to help users find documents. The primary goal of the tool is to allow someone to find a document based on either spatial location or properties such as basin name, type, municipality or county. Future developments will involve the inclusion of floodplain data, ALERT station locations, maintenance eligibility and routine maintenance segments along with other data sources that may be useful to users. The interface is still under development and a presentation on the topic will be included in the 2009 District Seminar.

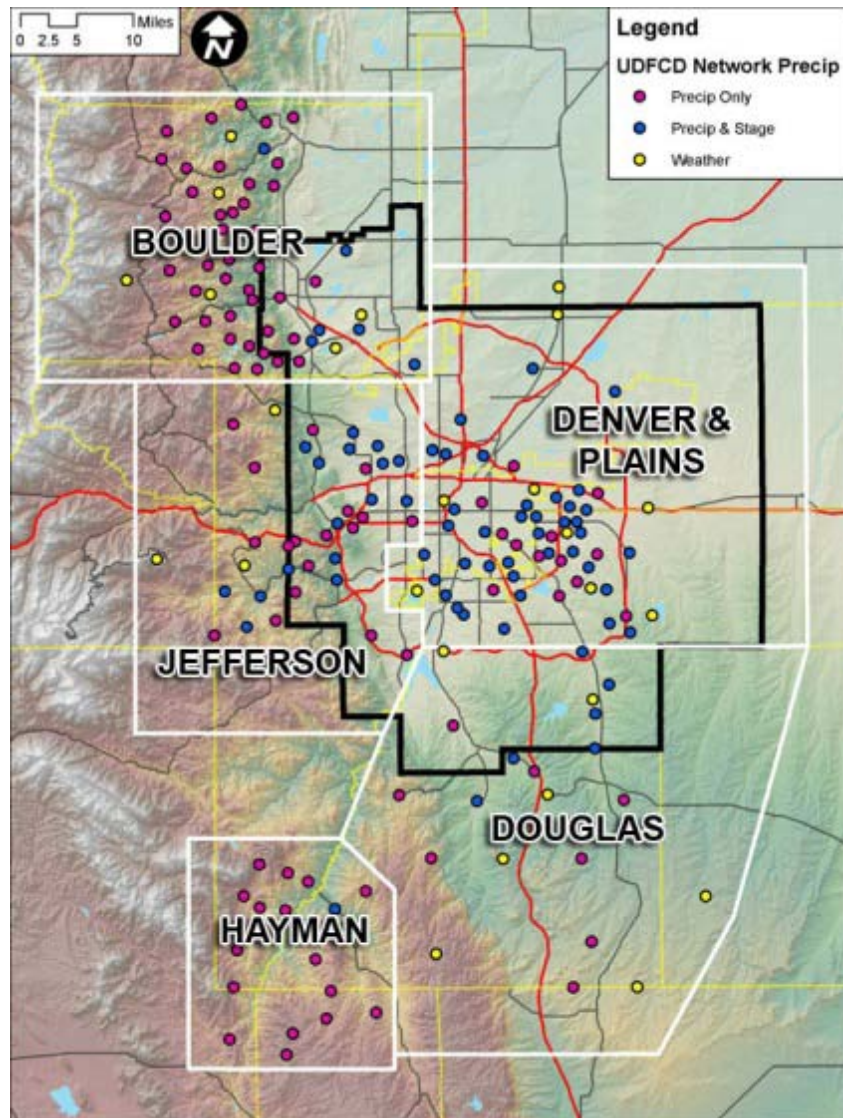


Figure 2 – ALERT Rainfall Alarm Zones

Design, Construction & Maintenance Program

Mark Hunter, PE, Program Manager

Since the beginnings of the Design and Construction Program in 1974, the Maintenance Program in 1981, and the South Platte River Program in 1985, the three programs had operated independently with separate staff carrying out separate work programs. Part of the logic of this was that the funding and budgeting for the three program funds must remain independent in order to satisfy our legislative requirements.

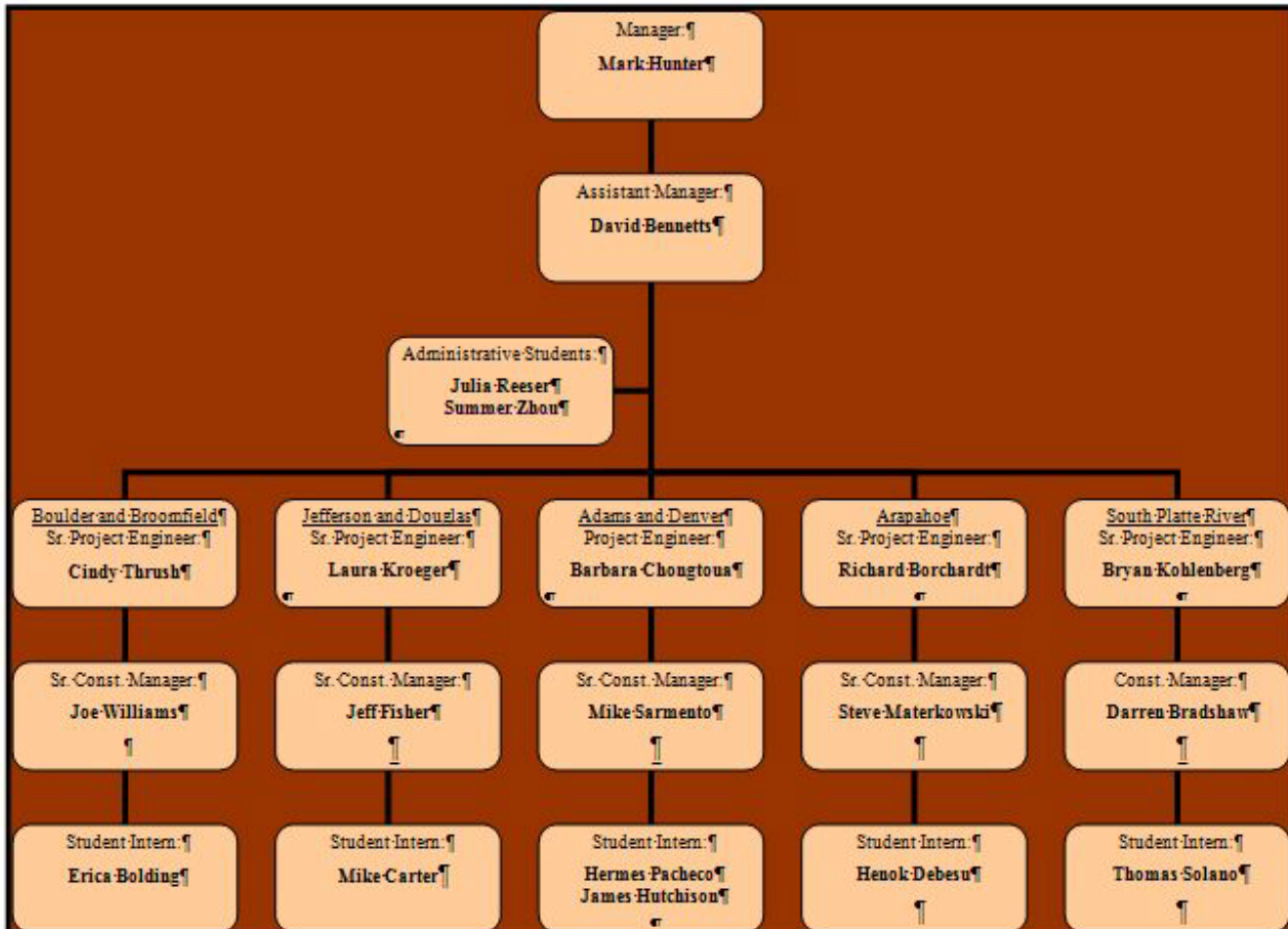
In 2006 it was decided to combine these three separate construction-oriented programs into a single organizational structure called the Design, Construction, and Maintenance (DCM) Program. The managers, project engineers, and construction managers were regrouped so they would deal with all construction-related activities within their assigned territories rather than dealing with just a single category of work spanning many local governments.

The advantage of this change is that it now provides a single point of contact at the District for our local governments with the goal of providing consolidated and streamlined design, construction, and maintenance for all construction work within their jurisdiction. One of the main

advantages for the District is that it will simplify the hand-off from the construction of a project to the maintenance of that same project. We believe this allows us to be more comprehensive in our day-to-day operations and provide better relationships with our local government partners.

The DCM Program consists of a manager, an assistant manager, four senior project engineers and one project engineer, four senior construction managers and one construction manager, and eight student interns. The accompanying organizational chart shows the layout of the DCM.

Even though all construction activity is now organized under the DCM Program the three original separate legislative authorizations require that the funding, budgeting, and project accounting for the three program funds must remain independent. In 2008 \$7.2 million in Capital Fund money will be committed to projects. The Maintenance Fund will encumber \$6.6 million for maintenance and construction work. The South Platte River Fund will spend \$1.8 million in its field activities.



DCM Organizational Chart

Routine Maintenance

In 2008 we awarded nine contracts for debris pickups and native-grass mowing under our routine maintenance agenda. Six of those contracts were awarded as renewals of the prior year contract while the other three contracts were competitively bid. The value of each of the renewed contracts was limited to match the change in the regional Consumer Price Index over the prior year.

Within the routine maintenance category we do some noxious tree and weed control and some revegetation efforts in addition to mowing and debris pick-up. During the year routine maintenance work was done on about 300 different sections of urban native-grass-lined drainageways. The contractual value of the work by the end of the year is expected to be \$1,060,000. The table below summarizes the miles of drainageways within each territory of the District on which we performed regularly scheduled mowing and/or debris pickup maintenance.

2008 Routine Maintenance Summary

Adams County	21.1 miles
Arapahoe County	43.5 miles
Boulder County	22.6 miles
Broomfield County	0.2 miles
Denver County	47.1 miles
Douglas County	14.4 miles
Jefferson County	33.7 miles
South Platte River	41.0 miles
TOTAL	223.5 miles

Construction Projects

Adams County

The District and the City of Westminster constructed improvements along **Cozy Corner Tributary Number 5** (Cozy Corner) from Sheridan Boulevard to approximately 1,000 feet east of Wolff Street. The Tributary emerges from existing culverts under Sheridan Boulevard into a straight, narrow ditch that did not have the capacity to pass the 100-year flood event. Cozy Corner Tributary flows east to Wolff Street where the invert of the existing box culvert was four feet lower than the upstream and downstream channel inverts resulting in significant ponding.

From Sheridan Boulevard to Wolff Street, the project improvements consisted of upgrading the Tributary capacity by steepening the channel gradient and by enlarging the channel cross section. Improvement east of Wolff Street consisted of re-grading the existing Clover Creek Detention Pond so that during a 100-year flood event, approximately 625 cfs would be routed through the pond for water quality enhancement and 375 cfs would safely overflow to the existing channel. The pond, designed with a water quality capture volume, entailed a unique approach to diversify the riparian zone along the edge of the pond. A six foot deep permanent pool was established with a clay liner which allows for the submergence of a diverse species of wetlands plants within the littoral bench. Up gradient from the littoral



Before – Cozy Corner Tributary looking west



Immediately after – Cozy Corner Tributary looking west



Before - Cozy Corner Tributary, Clover Creek Pond



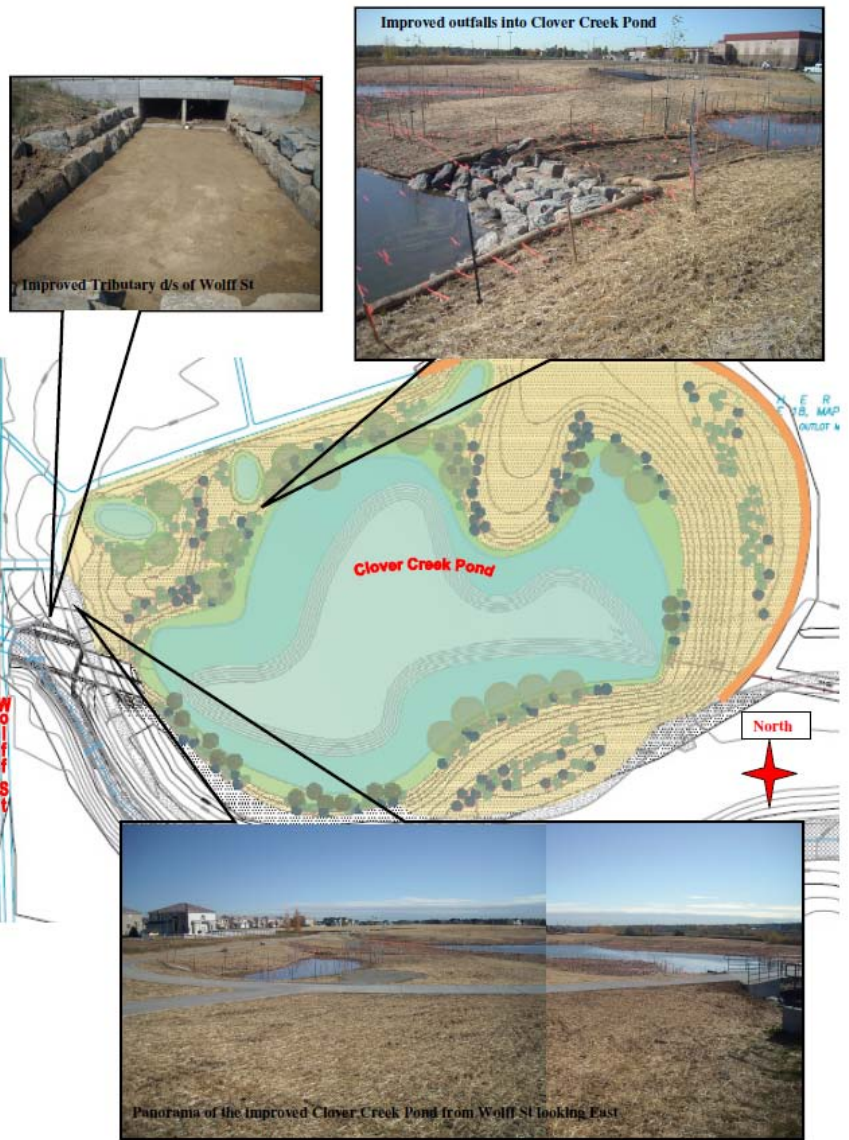
After - Cozy Corner Tributary, Clover Creek Pond

bench, shrubs and trees were planted to promote a diversity of riparian species along the pond edge. Three forebays, planted with similar wetland plants to the pond, were constructed at the existing storm sewer outfalls to further promote water quality enhancement. Two pedestrian bridges constructed over Cozy Corner and the Clover Creek Tributary and a pedestrian trail located along the perimeter of the pond should encourage the recreational use of this enhanced amenity. A series of overlooks was constructed around the perimeter of the pond to provide vantage points and access to the varying ecosystem. Construction of the project was completed in the fall of 2008 with hopes of a promising spring to invigorate growth in the trees, shrubs, and wetlands plants.

Arapahoe County

In 2007, the DCM, the City of Littleton, and South Suburban Parks and Recreation District completed a Maintenance Needs Assessment on **Lee Gulch**. The first priority project from this study to be implemented was identified southwest of Ridge Road and Windermere Street. In 2008, the design has been completed and construction is underway on Lee Gulch to replace two drop structures and install bank protection. This maintenance project provides vertical and lateral stabilization of the creek, in order to help protect the trail through the open space area and to reduce erosion along adjacent private residences.

The DCM and Southeast Metro Storm Water Authority completed construction on the **Southwood Village Storm Sewer Outfall to Big Dry Creek**. This capital project is located northeast of Broadway and Orchard Road. The new storm sewer system reduces the



flooding hazards in the area. This project was constructed in response to neighborhood flooding, including two private residences with frequent flooding problems. The work



Water control is a major project element on Lee Gulch as a drop structure is rebuilt and the trail stabilized



The 36-inch storm sewer outlet to Big Dry Creek is protected from erosion with grouted boulders

included jacking approximately 123 feet of 36 inch diameter pipe in a side-yard easement between two homes. The nearby home was within 15 feet of the jacked pipe at the closest point.

Boulder County

During this past year there was the opportunity to get acquainted with the local government staffs in Boulder County and to work on both big and little projects for each local government. Often the little projects don't get much recognition, so the following paragraphs will focus on a few of these projects.

Within the City of Boulder two repair projects were completed. One replaced a collapsed section of a pedestrian/maintenance access trail on **Bear Canyon Creek at Martin Drive**, and the other replaced a drop structure on **Goose Creek at 47th and Pearl**. For Boulder County, on a reach of **Drainageway A at Twin Lakes Road** in the Twin Lakes Subdivision, we cleaned out sediment underneath a roadway box culvert and constructed a concrete trickle channel through an irrigated blue grass area to allow the culvert area to drain.

For the City of Lafayette, we constructed two bank



Community Drainageway West during sediment Removal operations



stabilization projects, one on **Rock Creek upstream of S. 120th St.**, and one on **Coal Creek** at five locations upstream and downstream of Highway 287. For the City of Louisville, we constructed a bank stabilization project on **Coal Creek just east of Jefferson Ave.** In the Town of Erie we completed sediment removal projects on six **regional detention/water quality ponds**. For the Town of Superior we completed a sediment removal project on a boulder edged trickle channel on **Community Drainageway West near Mt. Sopris Parkway.**

Broomfield County

Broomfield County has a lot of diversity in their drainageways, and part of the past year was spent studying this diversity. We are currently constructing Phase 1 of the **City Park Drainageway outfall into Big Dry Creek** at the intersection of 120th and Lowell Blvd. This is a large capital improvement project being constructed with both Broomfield and the City of Westminster. Phase 2, the outfall phase of the project, will be constructed in 2010.



Windmill Tributary, grouted boulder rundown, after construction

We also completed two maintenance projects for Broomfield. The first was a sediment removal project on **City Park Drainageway off 6th Avenue and Burbank**. This project included cleaning a 2-foot high box culvert with a jet/vacuum truck. This was a very interesting and challenging method, but there aren't a lot of alternatives to clean a 2-foot high culvert. We also completed a grouted boulder rundown channel from a thirty-inch storm sewer pipe that was perched 15 feet above the channel bottom. This project was on the **Windmill Tributary to Big Dry Creek** near the intersection of W. 125th Ave and Big Dry Creek Drive.

Denver County

The District and the City of Denver reconstructed Drop Structure Number 1 on **Cherry Creek at University Blvd** in early 2008. Replacement of the failing wood drop structure was necessary to stabilize the reach of Cherry Creek upstream of University Boulevard. This Maintenance project entailed a design which provided longitudinal slope stability to Cherry Creek while upgrading the drainageway corridor leading into



Original Cherry Creek wood drop structure

the Denver Country Club. Grading and landscaping emphasis within the project site enhance the grouted boulder drop structure so that the structural elements are less pronounced and blend with the adjacent landscape.

Cherry Creek at University Blvd has a large tributary area with a 100-year flood event of 10,600 cfs. The average daily flow rate in Cherry Creek, based on the USGS gauge at the Cherry Creek Reservoir (Reservoir), is approximately 9 cfs. With releases from the Reservoir and a large tributary area, however, the flow rate can increase to a few hundred or thousand cfs within a relatively short period. Construction in Cherry Creek was very challenging and required innovation and adaptation during construction. Construction of the drop structure began in January 2008 with the implementation of a diversion system to route the active channel around the site of the proposed drop structure. The diversion system used for the project was a combination of pipes and a sheet pile cut-off wall that was very effective at maintaining the appropriate sub grade condition.

The boulders for the drop structure were arranged and placed on compacted sub grade. A dry and firm sub grade is critical for the placement of the grout. If pumping of the sub grade or water intrusion is observed, placement of grout should be delayed until this problem has been resolved. An understanding of the working conditions by the contractor and an effective and adaptive diversion system allowed the construction of the grouted sloping boulder drop structure to proceed to completion with very few problems.

The project was completed in time for spring which provides the vegetation an ideal time to grow. The vegetation has thrived this year and has an excellent start. As a part of our on-going Maintenance Fund activities, we plan to introduce willow stakes to both channel banks downstream of the drop structure in the Spring of 2009.

Douglas County

The District partnered with the Town of Parker to build channel improvements to stabilize a reach of **Cherry Creek near Stroh Ranch**. This capital project is located north of Stroh Road and includes 3500 linear feet of work. The design team was headed by Muller Engineering and included Restoration Ecology, Wenk Associates, and ERO.



Cherry Creek at University, after the improvements

The goal of the project was to stabilize Cherry Creek and reconnect the hydrology with the existing vegetation. Seven “riffle” drop structures were constructed with three traditional drop structures locking in the riffle drops. One of the three traditional structures was selected to be a feature drop that would be visible to the trail and open space users. Muller Engineering had experience in using Glass Fiber Reinforced Concrete (GFRC) panels on high-end drop structures for private clients and we utilized that knowledge to design a more affordable structure that could be publically bid. The aesthetic advantage of the GFRC panels is they are made from molds of real rock outcroppings and therefore have a realistic rock look and feel. Another new approach we added to the project was to stain/paint the sculpted drop like the feature drop instead of using an integral colored concrete. Approximately four colors are used to give more visual depth to the structures.

The construction cost of the project was just under \$1,000,000 and Naranjo Civil Constructors won the bid. There were definite challenges during construction, mostly due to the unusually high flows in Cherry Creek. During the construction of the feature drop, Cherry Creek was completed diverted around the construction area, which lead to some sleepless nights for Naranjo. For most of the duration of construction four 8-inch pumps were utilized on site. Naranjo did an excellent job executing the design and their ability to limit the area of disturbance is helping in healing of the project area at a more rapid rate. This project serves as a prime example of true partnering between the project sponsors, the design team and the contractor.

The **Dad Clark Gulch, Unnamed Tributary** Outfall Improvements were constructed with District Maintenance funds. On behalf of Douglas County the District worked with JF Sato and Associates to design a boulder drop structure that tied the invert of the existing 48-inch CMP’s to the established channel invert. The existing condition had about an 8-foot drop that was causing continued erosion and vertical banks near the outfall, resulting in a safety hazard. This project made use of a standard and proven structure, which gave the project the result it needed. Left Hand Excavating did an outstanding job tying the structure into the



Dad Clark Gulch, Unnamed Tributary, looking upstream toward the twin 48-inch CMPs

surrounding area to try and reduce the visual impact of the structure.

Jefferson County

In 1992 a capital project to install channel improvements on **Lena Gulch at Isabell Street** was initiated. At that time the project sponsors, Jefferson County and the District, teamed with Sellards and Grigg to design and construct box culverts to convey the 100-year flow in Lena Gulch under Isabell Street. Unfortunately at that time the downstream improvements could not be constructed due to inadequate right-of-way. It was decided at that time to build the 100-year box structures, but then partially fill them for an interim condition that tied to the existing grades downstream. The intent was to come back once the downstream property was publically owned and then lower the channel to the needed invert under Isabell Street and do downstream channel improvements to convey the 100-year flows.



Lena Gulch at Isabell, looking downstream from the boulder drop structure which is downstream of the box culvert under Isabell Street

With the development of Denver West, the District and Jefferson County now had the elements in place to proceed with the ultimate design intent of the box culvert. The project sponsors went back to Sellards and Grigg, Inc., now SEH, for the final design conditions. The design consisted of a boulder drop structure downstream of the box culverts and

hauling off approximately 13,000 cubic yards of material to create the 100-year channel. The design included tying in a 60-inch storm sewer outfall and creating a wetland enhancement area.

Tarco Inc, was award the \$400,000 project on Lena Gulch and construction went well. Jefferson County assisted Tarco in utilizing a haul site for the 13,000 cubic yards of earth. It took quite a bit of coordination as CDOT also had a project going in the area and the installation of water lines changed the access point several times. Good communication was a key component of the successful construction of this project.

The District coordinated with the City of Golden to do maintenance restoration and improvements to the **East Fork of Kenney’s Run**. The District hired Icon Engineering to head up the design. The project is located along the west side of Johnson Road adjacent to the Fossil Trace Golf Course. Improvements had been installed on this reach of Kenney’s Run, but they did not appear to have been constructed per plan. This resulted in failure of the drop structures. This was a prime example of why cutoff walls are so important in drop structures.

Due to the large amount of grade that needed to be made up (approximately 54 vertical feet of fall in 1600 linear feet) 10 drop structures were needed. The goal of the design team was to reduce the size of the individual drop structure footprint and try to hide the structures as much as possible. Icon developed a drop structure that conveyed the low flow (2-year) in a sculpted structure and then provided soil riprap protection up to the 100-year discharge. The drops incorporated 100-year cutoff walls. Boulders were grouted in downstream of the crest that tie in with the sculpted portion of the drop. This design softens the structures, allowing for vegetation to establish on the sides while providing solid check points between the drops.

Naranjo Civil Constructors was the contractor. This project was designed for two phases of construction. After the first phase of work the project sponsors were so pleased with the construction that it was decided to rearrange priorities and fund the second phase without remobilizing.

South Platte River

In 2008 the South Platte River group made tremendous advances on two major flood control projects within the City and County of Denver. First, the \$25 million **North Globeville Area Flood Control Project** was completed in May and officially dedicated on June 9 (See Article in this issue). This \$25 million project, constructed in three phases over thirteen years, will remove approximately 300 acres of urbanized area from the 100-year floodplain once the Letter Of Map Revision is completed (See 2007 FHN for details).

The second major flood control project within the City and County of Denver is the on-going **Upper Central Platte Valley – Zuni/Sun Valley reach** channel lowering/widening project between 8th Avenue and Lakewood Gulch. This work will eliminate the 100-year overbank flooding through the Upper Central Platte Valley of Denver. The work is 90% designed and estimated to cost \$20 million. This year the District and



South Platte River rock weir before repair



South Platte River after repairs

Denver completed the first phase of the project by lowering a large electrical distribution duct bank and encasing a power transmission line that crosses the river at Xcel's Zuni Power Plant. Total cost was approximately \$1.2 million. These relocations will make room for the future channel improvements that are expected to be under construction in October, 2009 and completed in 2012.

In 2008 several restoration maintenance projects were completed along the **South Platte River**. Most notably we rehabilitated a rock weir habitat structure within South Platte Park near C-470 in Littleton. This structure had deteriorated as a result of the large scour hole that had developed below the structure. Due to the lack of adequate toe depth and cutoff wall the large boulders shifted which caused two problems. The structure became impassible to boaters at low-flows and the structure was no longer able to control the river grade, thus resulting in upstream degradation and bank instability. The repair consisted of installing a sheet pile cutoff and partially grouted boulder slope. Muller Engineering designed the repair and Left Hand Excavating performed the construction.

Cooperative projects are constructed on **South Platte River** flowage and maintenance access easements dedicated to the District by private property owners adjacent to the river in exchange for river restoration work. The District can participate financially up to 75% of the total project cost. This year's co-op project consisted of 800 feet of soil riprap bank stabilization adjacent to the Hazeltine Sand and Gravel Pit located on the east bank just downstream of 104th Avenue. The pit is owned and currently being mined by Aggregate Industries. Ultimately, Aggregate Industries will be constructing a reservoir spillway in order to help protect the future water storage facility and the river from being damaged by high flows.

For more information concerning mining within 100-year floodplains see our publication entitled "Technical Review Guidelines for Gravel Mining Activities Within or Adjacent to 100-Year Floodplains" available on our website (www.udfcd.org).

The following DCM staff members contributed to this column: David Bennetts, P.E., Assistant Program Manager, Bryan Kohlenberg, P.E., Senior Project Engineer, Cindy Thrush, P.E., Senior Project Engineer, Laura Kroeger, P.E., Senior Project Engineer, Richard Borchardt, P.E., Senior Project Engineer, Barbara Chongtoua, P.E., Project Engineer

Barbara Chongtoua joins District

Barbara Chongtoua has joined the District as a Project Engineer in the Design, Construction, and Maintenance Program. She will be the District's Project Engineer in charge of all projects in Adams and Denver Counties. Barbara previously worked for the District from 1992 to 1994 as an Engineering Intern working with Ben Urbonas in the Master Planning Program. Barbara has a B.S. in Civil Engineering from the University of Colorado and is completing her studies for a M.S. in Civil Engineering in the spring of 2009.



She is a registered professional engineer and is professionally active in ASCE, CASFM, and Chi Epsilon. Her previous experience was in the private sector with CH2M Hill. Please join me in welcoming her back to the District.

Stormwater Quality & Permitting Support Activities

Ken MacKenzie, PE, Program Manager, Master Planning Program

UDFCD continued to be active in the stormwater quality arena in 2008, with commitments to the following organizations and activities:

Structural BMP Testing:

The District's program to monitor and test structural BMPs continued in 2007. We completed construction of a side-by-side porous asphalt and permeable interlocking concrete paver test site at the Denver Wastewater building, with funding and technical assistance from the Colorado Asphalt Paving Association and Pavestone, Inc. We began testing for pollutant load removal and for runoff volume reduction, but were only able to capture three storms in 2008. We will continue to monitor and hopefully will get more data in 2009.

We retrofitted our open-bed sand filter BMP at the Lakewood city shops with a pre-sedimentation baffle chamber in the hope of extending the service interval of the sand bed, which has been quick to plug. Because this site is heavy in nutrients and open to sunlight, we believe algae may be partly to blame for the surface clogging we have experienced. We were able to sample water quality through this BMP for a few storms in 2008 and will continue monitoring stormwater quality for this BMP, for an adjacent porous-concrete pavement site, and for an extended-detention basin at Grant Ranch in south Denver



New UDFCD side-by-side demonstration site for porous asphalt (left) and permeable interlocking concrete pavers (right) at the Denver Wastewater

for several more years. Additionally, we are hoping to install water level data loggers at two new porous pavement sites that will provide infiltration. The information we gather will enhance our knowledge of long-term infiltration capabilities of infiltrating pavement BMPs.

Colorado MS4 Stormwater Group:

The District continued to host quarterly luncheon meetings to discuss stormwater issues in 2008. These meetings are open to all Colorado communities affected by the Clean Water Act, which requires permits for municipal separate storm sewer system (MS4) discharges. The meetings serve as a forum to exchange ideas and experiences and to meet face-to-face with the Colorado Department of Public Health and Environment regulators.

Colorado Stormwater Council (CSC):

The CSC celebrated its two-year anniversary as a Colorado non-profit corporation in October 2008. The CSC is an organization for Colorado MS4 permit holders. It acts as a forum for municipalities and municipal permit holders; enables exchange of technical

information regarding stormwater regulations and compliance with permits; serves as a voice for its members at regulatory hearings or meetings; educates members; and aids in the development and implementation of stormwater programs at local and regional levels. For more information, visit the CSC website at www.coloradostormwatercouncil.org.

Random Notes from Your Humble Editor

Bill DeGroot

First of all, thanks to all of the contributors to this edition of *Flood Hazard News*, especially our outside contributors Mike Galuzzi and Tom Blackman (District staff members were ordered by the boss to deliver).

In recent years we have been printing and mailing close to 2000 copies of FHN. In 2006 and 2007 we posted the FHN in .pdf on our website and sent post cards to our subscribers notifying them it was available. This year we are notifying our subscribers by email only. If you found this issue through other means, and want future notifications, send an email to udfcd@udfcd.org and put *Flood Hazard News* in the subject line.

District award winning projects in 2008

The District participated in two activities which received Local Government Innovations Awards from the Denver Regional Council of Governments. The Northeast Metro Win-Win Coalition received a Silver Award in the Collaboration category. More than 24 public and private interests, including Adams County, Aurora, Commerce City, Brighton, Denver, Rocky Mountain Arsenal Wildlife Refuge and the District have met regularly for 10 years to identify opportunities, resolve disputes and cooperate in funding. These efforts have accomplished many regional drainage, transportation and open space/trails Improvements. Bill DeGroot, Manager, Floodplain Management Program, has chaired the Win-Win drainage committee for the entire 10 years.

The Coyote Gulch Restoration and Water Quality Enhancement project received a Bronze Award in the Planning with Vision category. Partners included Lakewood, Jefferson County, the U.S. Army Corps of Engineers, the Bear Creek Watershed Association, the Colorado Department of Public Health and Environment, and the Jefferson County Soil Conservation District. Design and construction phase services were provided by Ayres Associates.

Together the partners successfully provided grade and bank stabilization for Coyote Gulch at Bear Creek Lake in Lakewood, improving the quality of water entering the lake. The project maintained natural aesthetics, and the visitor experience was further enhanced through more trails, access to the channel, educational signage, and restored wetlands. Innovative measures were taken to design grade control structures that incorporated materials that appeared to be naturally occurring in the area. Beyond their natural appearance, these structures retain the natural look and sound of cascading water.

The District received an Honor Award for Outstanding Achievement from the Colorado Association of Stormwater and Floodplain Managers for its brochure "Preserving the natural and beneficial values of floodplains adjacent to development projects (A guide for creating project value and selection of amenity enhancements)." Bill DeGroot, David Mallory, Senior Project Engineer, Floodplain Management Program, and Michelle Leach, Matrix Design Group, authored the brochure.

For the nineteenth 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. Congratulations to Frank Dobbins, Manager of Finance and Accounting, and assistant Darla Reeves for continuing this string of awards.



Before and after views of Coyote Gulch



Darla Reeves holds the latest Certificate of Achievement, flanked by Board Chair Nancy McNally and Frank Dobbins.

2008 Professional Activities of District Staff

Paul Hindman, Executive Director

- *Recipient of the Jan Silverstein Ries, 2008 Award
- *Chair of the 2011 Denver Site Committee for the American Public Works Association (APWA) International Public Works Congress and Exposition.
- *Chapter Delegate, APWA Colorado Chapter
- *Committee Member, National APWA Water Resource Committee
- *Planned and facilitated "Pie Eating Contest", September, 2008, Western Snow and Ice Conference. Estes Park, Colorado
- *Co-Chair of Cherry Creek Stewardship Partners Annual Conference. Lone Tree, Colorado.

Bill DeGroot, Manager, Floodplain Management Program

- *Secretary of the Board of Directors and Chair of the Floodplain Management Committee of the National Association of Flood and Stormwater Management Agencies (NAFSMA).
- *Attended NAFSMA's annual meeting in Napa, CA in August. Chaired the Floodplain Management Committee meeting.
- *Presented "Floodplain Preservation/Marketing Brochure" with David Mallory and Michelle Leach for a project award at CASFM Annual Conference in Crested Butte Colorado, September 2008.
- *Member of a small focus group meeting quarterly with representatives from Michael Baker Jr., Inc., NAFSMA, ASFPM and FEMA to discuss map modernization issues.
- *Member of Association of State Floodplain Managers (ASFPM), American Society of Civil Engineers (ASCE), and Colorado Association of Stormwater and Floodplain Managers (CASFM).

Kevin Stewart, Manager, Information Services and Flood Warning Program

- *President of the National Hydrologic Warning Council (NHWC).
- *Member of the U.S. Department of the Interior's Advisory Committee on Water Information, Subcommittee on Hydrology.
- *Steering Committee member for the American Meteorological Society's (AMS) Commission on the Weather and Climate Enterprise.
- *Member of ASCE, AMS, APWA, ASFPM, CASFM and the Colorado Emergency Management Association.
- *Attended AMS annual meeting, conferences and exposition in New Orleans, LA in January.
- *Featured speaker at the Boulder Creek Watershed Public Flood Forum at the Boulder Public Library in April.
- *Speaker at the ALERT Users Group Conference and Exposition in Palm Springs, CA in May.
- *Guest instructor at COMET's International Hydrometeorological Analysis and Forecasting Course in Boulder, CO in June.
- *Guest speaker at the Cherry Creek Stewardship Partners 10th Annual Conference in Parker, CO in November.
- *Invited participant at the NWS Next Generation Warning Services Workshop in Norman, OK in December.
- * External reviewer of Manual on Flash Flood Risk Management for the International Centre for Integrated Mountain Development (ICIMOD) located in Kathmandu, Nepal.

Ken MacKenzie, Manager, Master Planning Program

- *Presented "The UDFCD Four-Step Process for New Development and Significant Redevelopment" at an AWARE Colorado seminar in February.
- *Presented "Porous Pavement Demonstration Project at the Denver Wastewater Building" at the Colorado Association of Stormwater and Floodplain Managers (CASFM) annual conference in September.
- *Presented "Developing a Drainage Master Plan" for the Dallas – Fort Worth International Airport Authority in August.
- *Presented "Post-Construction Best Management Practices" at the MS4 Audit and Inspection Training Seminar, EPA Region 8 in September.
- *Chaired the CASFM Outreach Committee.
- *Served on ASCE's Urban Water Resources Research Council.
- *Chaired the Colorado Stormwater Council Technical Review and Advisory Committee.
- *Served on the Colorado Stormwater Council Administrative Committee.
- *Served on the Water Environment Research Foundation (WERF) Panel to study "Linking BMP Performance to Receiving Water Protection to Improve BMP Selection and Design".
- *Served on the Denver Regional Council of Governments Water Quality Advisory Committee.
- *Served on the board of directors of the Urban Watershed Research Institute.
- *Taught courses on open channel hydraulics and design.
- *Member of ASCE and CASFM.

Mark Hunter, Manager, Design, Construction & Maintenance Program

- *Serves on the Board of Directors and on the Operations Committee of the Metro Wastewater Reclamation District.
- *Secretary on the Board of Directors of the International Erosion Control Association (IECA).
- *Co-Chairman of the IECA SOIL Fund Committee.
- *Member of IECA Awards Committee and the Stream Restoration Technology Section.
- *Member of the Mountain States Chapter of IECA.
- *Member of APWA and CASFM.

Bryan Kohlenberg, Senior Project Engineer, South Platte River – Design, Construction & Maintenance Program

- **Continued as National Society of Professional Engineers’ scoring coordinator for the Jefferson, North Metro and Colorado State MATHCOUNTS competitions for 6th, 7th and 8th graders.
- *Member of American Society of Civil Engineers, Colorado Association of Stormwater and Floodplain Managers and American Public Works Association.
- *Attended ASCE course on "Streambank Stabilization for Restoration and Flood Control Projects" in September.

David Mallory, Senior Project Engineer, Floodplain Management Program

- *Attended the National Levee Conference in St. Louis Missouri, March, 2008.
- *Presented on the Cornerstar CLOMR at the NAI Workshop, Rocky Mountain Land Use Conference hosted by Denver University, March 2008.
- *Presented "Floodplain Preservation / Marketing Brochure" with Michelle Leach, Matrix Design Group, at the ASFPM Annual Conference in Sparks Nevada, June 2008.
- *Presented "Floodplain Preservation / Marketing Brochure" with Bill DeGroot and Michelle Leach for a project award at CASFM Annual Conference in Crested Butte Colorado, September 2008.
- *Serves on the CASFM Board of Directors as Vice Chair.
- *Member of CASFM and ASFPM.

David Bennetts, Assistant Manager, Design, Construction & Maintenance Program

- *Program Chair for the 20th Annual CASFM Conference in September at Crested Butte
- *Moderated “Watershed Protection and Sustainable Stormwater Management” Technical Session at CASFM Conference in September at Crested Butte
- *Council Member, CU Denver Engineering Leadership Council
- *Member of ASCE, APWA, and CASFM

Chad Kudym, GIS Administrator, Information Services and Flood Warning Program

- *Conference Chair for the 2009 National Hydrologic Warning Council (NHWC) Conference
- *CASFM Treasurer through September
- *Member of AMS, CASFM and GIS in the Rockies
- *Speaker and paper co-author for the AMS annual conference in New Orleans, LA in January
- *Speaker at the ALERT Users Group Conference and Exposition in Palm Springs, CA in May
- *Attended the ESRI Users Conference in San Diego, CA in August
- *Co-author for presentation at the CASFM Conference in Crested Butte, CO in September
- *Received Geographic Information Systems Professional (GISP) certification from the GIS Certification Institute in November

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

- *Received NICET Level III certification in Land Management and Erosion Control
- *Received Certification as a Hydrologic Technician Level III (Water Quality) from American Institute of Hydrology.

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

- *APWA Water Resources Committee Chair
- *Attended 2008 CASFM Conference
- *Attended 2008 Cherry Creek Stewardship Conference

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

- *Presented “Meeting Challenges of Stormwater Management in Semi-Arid Climates with Low Impact Development” at the ASCE World Environmental and Water Resources Congress 2008 in Honolulu, Hawaii.
- * Co-authored the “Management of Dry Weather Flows in Semi-Arid Climates Using Low Impact Development Technology” paper that was presented at the ASCE World Environmental and Water Resources Congress 2008 in Honolulu, Hawaii.
- *Field Trip Coordinator for the CASFM 2008 Annual Conference in Crested Butte, Colorado.
- *Member of ASCE, Chi Epsilon, and CASFM.

District open house for retirees Ben Urbonas and Galene Bushor



Ben and Galene



Kevin Stewart and Tom Browning



Bill DeGroot with former Executive Directors Scott Tucker and Dave Lloyd