

**Boulder City Council
STUDY SESSION**

**Tuesday
September 30, 2014**

**6-9 PM
Flood Management**

**Council Chambers
Municipal Building
1777 Broadway**

Submit Comments to City Council
Email: [council @bouldercolorado.gov](mailto:council@bouldercolorado.gov)

or

Attention: Alisa Lewis, City Clerk
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**CITY OF BOULDER
STUDY SESSION**

MEMORANDUM

TO: Members of City Council

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DATE: September 30, 2014

SUBJECT: Flood Management Study Session

I. PURPOSE

The purpose this study session memo is to provide City Council with background information about the city's flood management program and upcoming agenda items. This memo also includes information about an assessment of the September 2013 flood magnitude, impacts to private property, and Federal Emergency Management Agency (FEMA) insurance/disaster relief payments.

The risk of significant flooding is an important issue for the City of Boulder, primarily due to its location at the mouth of Boulder Canyon and other canyon creeks. The city has a comprehensive flood management program designed to reduce the risks of flooding, minimize loss of life and property damage, and support recovery following a major flood. City Council is regularly asked to take action on measures to support these efforts, including consideration of capital projects, floodplain mapping studies and mitigation plans, and ordinance changes.

During the next year, City Council will be asked to consider floodplain mapping updates for seven major drainageways, four flood mitigation plans and funding of several Capital

Improvement Program (CIP) projects. The schedule for floodplain mapping, mitigation planning and capital improvement projects is provided as [Attachment A](#).

Staff is requesting council's input to determine the most efficient means to present these flood-related items for consideration and action. This study session provides an opportunity for council members to ask questions and provide input prior to formal consideration of those items in the coming months.

II. QUESTIONS FOR COUNCIL

1. Does City Council have any questions or feedback about the overall flood management program or the draft reports analyzing the Sep. 2013 flood event?
2. Does City Council have questions about upcoming flood mapping and mitigation items? Would Council support consolidating items or using the consent agenda to help reduce redundancy?
3. What questions and feedback does City Council have about the South Boulder Creek recommended flood mitigation alternative, including project phasing, impacts and next steps?

III. BACKGROUND

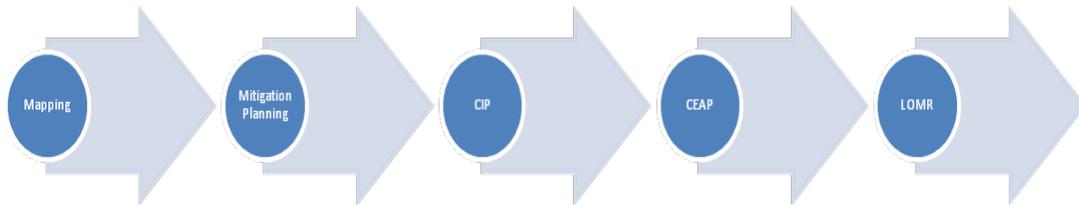
The city has a comprehensive flood management program designed to identify flood risks along major drainageways, reduce those risks, minimize loss of life and property damage, and support recovery following a major flood. The [Flood Management Program Overview](#) is intended to provide council with background information related to the topics discussed in this memo. The information provided in the Flood Management Program Overview includes:

- A map of the major drainageways in the city;
- The city's historical and present flood risks;
- The impact of wildfires on flooding risks;
- A synopsis of the city's flood emergency preparedness efforts;
- A description of the four regulatory flood zones and how they are mapped;
- An overview of the floodplain mapping, mitigation planning and capital improvement process, including the Community and Environmental Assessment Process (CEAP);
- An overview of the Urban Drainage and Flood Control District (UDFCD);
- Detailed information about floodplain regulations;
- A brief explanation of the National Flood Insurance Program (NFIP) and the Community Rating System (CRS); and
- An overview of the types of flood recovery and outreach efforts that have been implemented since the September 2013 flood.

A. Flood Mapping and Mitigation Planning Process

The overall process for implementing a flood mitigation project begins with a floodplain mapping study. Once a mapping study has been approved by FEMA, the city develops a mitigation plan to evaluate the feasibility of reducing the flood risk. Flood mitigation studies include an evaluation of costs and benefits. A standard methodology approved by FEMA is generally utilized to maximize grant funding opportunities.

After the flood mitigation plan has been approved, potential projects are programmed into the CIP. The CEAP is used to evaluate construction alternatives and minimize environmental and community impacts. After a project is constructed, a Letter of Map Revision (LOMR) is submitted to FEMA to officially update the mapping so that property owners will either be subject to floodplain regulations or will no longer need to purchase flood insurance. The diagram below outlines this process.



During the review process for mapping studies and mitigation plans, there are numerous opportunities for public involvement, including open houses, Water Resources Advisory Board (WRAB) meetings and City Council meetings. Owners of properties that are directly affected by the mapping studies or mitigation plans are notified by mail about upcoming meetings. Project Web pages are also created and updated with current plans, meeting dates, and meeting materials. Once a mitigation project is identified for construction, staff proactively engages with individual property owners, residents, businesses, and homeowners’ associations that are affected to ensure that their concerns and ideas are considered. Mapping, mitigation planning and construction of capital improvements can take many years to complete, depending on the scope and complexity of the project. [Attachment A](#) provides a schedule of current and recently completed mapping, mitigation planning and capital improvement projects.

IV. ANALYSIS AND ISSUES

Several floodplain mapping, mitigation master planning and construction projects are currently underway and described in detail below. A map showing the location of each project is provided as [Attachment B](#).

A. Floodplain Mapping Updates

Floodplain mapping provides the basis for the city’s flood management program and the implementation of flood mitigation projects by identifying the areas at the greatest risk for flooding from a major drainageway. Flooding can also occur from other sources that are not identified on floodplain maps, such as groundwater, sanitary sewer backups, irrigation ditches, and local street drainage.

Floodplain mapping studies consider both “hydrology” and “hydraulics.” Hydrology considers the amount of rainfall and runoff generated by a calculated “design storm.” Hydraulics describes how this flow is likely to travel over the topographic features of the land. The “design storm” used for flood mapping on the Colorado Front Range, including Boulder, is based on a short-duration, high-intensity rainfall. This “design storm” is very different from the long-duration storm that lead to flooding in September 2013, as described in the “2013 Flood Disaster Rainfall Runoff Analysis” section of this memorandum. More information about the methodologies for the modeling and analysis used in floodplain mapping is included in the [Flood Management Program Overview](#).

Floodplain mapping updates incorporate land use changes and take advantage of improvements in technology, such as state-of-the-art Light Detection and Ranging (LiDAR), to produce high-resolution topographic base mapping. Current floodplain studies also utilize two-dimensional hydraulic modeling to determine major flow paths prior to developing one-dimensional hydraulic models.

Flood studies eventually result in a Flood Insurance Rate Map adopted by FEMA. Both FEMA and the UDFCD impose a number of specific parameters to maintain consistency in risk delineation across communities, and there is generally limited ability to change mapping assumptions solely based on public feedback. The current process for updating a floodplain study provides opportunities for public involvement at various stages.

Stage 1: First, an open house is held to present the draft floodplain mapping changes to the public, answer questions and consider comments about the proposed changes. The open house format allows members of the public to speak with city staff and engineering consultants about their specific property. Input from residents and businesses in the project area helps identify potential errors in the floodplain mapping, such as identifying areas with a history of flooding that may not have been identified in the proposed floodplain mapping.

Stage 2: The mapping study is then presented to WRAB at one or more meetings. Prior to making a recommendation to council on adoption of a study, WRAB holds at least one public hearing. Input obtained from WRAB and the public at these meetings may identify areas that require additional analysis prior to consideration by council. The WRAB review of floodplain mapping updates is not intended to verify the analysis and calculations, but to accept the overall mapping study process and that the results are reasonable and acceptable.

Stage 3: Following a WRAB recommendation for council adoption, the mapping study is presented to council as either a public hearing item or consent agenda item.

Stage 4: Once a mapping study is approved by council, it is then sent to FEMA for review and approval. The FEMA adoption process includes a review by the UDFCD and a 90-day appeal process. When the mapping study is approved by FEMA, a Letter of Final Determination is issued.

During the FEMA review and approval process (which can take from six months to four years to complete), it is typically recommended that the more restrictive of the existing and proposed mapping be used for regulatory purposes. This means that developments within newly identified flood zones would be subject to the city's floodplain regulations. In order to comply with FEMA requirements, developments within areas that are being removed from the floodplain are still subject to the city's floodplain regulations until FEMA officially adopts the new floodplain mapping. Following formal adoption by FEMA, the city regulates solely based on the new mapping.

There are a number of floodplain mapping studies that will be on council's agenda in the near future. Staff requests council's input as to the most efficient means to present this information for consideration and action, including potentially consolidating items or using the consent agenda to help reduce redundancy? Current floodplain mapping studies are described below.

1. Boulder Slough

The Boulder Slough study updates the hydraulic models and flood hazard mapping for the reach of Boulder Slough between 30th and 18th streets, including two split-flow paths north of the slough and west of 26th Street. Modeling and mapping of this reach, as well as the split-flow paths, utilize 2013 LiDAR-based topographic data. The Boulder Slough downstream (east) of 30th Street will be studied as a separate effort after construction of the improvements along [Pearl Parkway](#) is completed.

2. Bear Canyon Creek

The lower Bear Canyon Creek floodplain mapping update includes the area from the confluence of Bear Canyon Creek and Boulder Creek (downstream) to Foothills Parkway (upstream). The study includes the data and documentation required for accreditation of the Harrison Levee. The Harrison Levee is provisionally accredited on the current FEMA Flood Insurance Rate Maps. This study also incorporates the updated hydraulic model for Boulder Creek at the downstream tie-in location and the additional culverts below Arapahoe Avenue that were installed in 2006-2007 to increase the conveyance capacity of Bear Canyon Creek. A separate [flood mitigation study](#) is also being completed for Bear Canyon Creek.

3. Skunk Creek, Bluebell Canyon Creek, and King's Gulch

The Skunk Creek Floodplain Mapping Update includes the King's Gulch, Skunk Creek and Bluebell Canyon Creek floodplains between the western city limits and east of Foothills Parkway, at the confluence of Skunk Creek and Bear Canyon Creek. Engineering consultants have provided hydraulic modeling to update the existing FEMA Flood Insurance Rate Map, City of Boulder floodplains, conveyance and high-hazard zones, and water surface elevations.

An open house for this project was held on Aug. 18, 2014. Immediately following the open house, the remapping project was presented to WRAB as an information item at their regularly scheduled meeting. Public input was received at both the open house and

the WRAB meeting. There were some concerns about the Bluebell Canyon Creek flow distribution downstream from 15th St., so staff is working with the engineering consultant to re-evaluate the floodplain mapping at this location. At the Sept. 15, 2014 WRAB meeting, the board passed a motion to recommend that City Council adopt the Skunk Creek floodplain mapping update including potential additional refinements made prior to Council's consideration, with the understanding that should such additional refinements result in substantial modifications to affected properties that the WRAB will have the opportunity to review the results prior to Council's review.

4. Upper Goose Creek and Twomile Canyon Creek

The city has contracted with ICON Engineering to develop updated floodplain maps for Upper Goose Creek and Twomile Canyon Creek. Anderson Consulting Engineers is providing peer review of the engineering study. An open house for Twomile Canyon Creek is scheduled for mid-November 2014. WRAB is scheduled to receive an update on this study on Nov. 17, 2014 and is tentatively scheduled to hold a public hearing and make a recommendation to City Council on Dec. 15, 2014.

B. Current Flood Mitigation Studies

Flood mitigation studies are conducted to evaluate opportunities to reduce flood risks along drainageways. During the studies, different alternatives for mitigation are analyzed and presented for review and comment at public open houses and meetings with the WRAB. All flood mitigation master plans are submitted to City Council for review and acceptance. Current flood mitigation studies are summarized below.

5. South Boulder Creek

The South Boulder Creek Flood Mitigation Plan was initiated in 2010 after the floodplain mapping was updated in 2007. The study is focused on developing and evaluating alternatives designed to mitigate flood hazards affecting areas within the current incorporated city limits, primarily within the West Valley area between Foothills Parkway and 55th Street.

A risk assessment completed in 2009 estimated that a 100-year flood would result in approximately \$215 million in damages in the South Boulder Creek drainage basin. The September 2013 flood caused floodwaters to overtop US 36 and flow through the West Valley. The 2013 flood is estimated to have resulted in flows above a 50-year flood but below the 100-year flow used in the risk assessment to estimate damages.

Since this major drainageway mitigation study was initiated, 15 flood mitigation alternatives have been evaluated to address flooding associated with South Boulder Creek. Following an extensive evaluation process, the alternatives were narrowed from 15 concepts down to four. Consultants for the study recommend an alternative referred to as the "Regional Detention at US 36 with Downstream Improvements," which would eliminate the overtopping of US 36 during a 100-year flood and provide flood protection for 362 structures (893 dwelling units), at a cost of \$46 million. This recommended alternative would include:

1. A 560 acre-foot regional flood detention facility near US 36;
2. A 58 acre-foot stormwater detention facility near Flatirons Golf Course (the “Arapahoe Detention”); and
3. A 25 acre-foot stormwater detention facility near Manhattan Middle School, a nine acre-foot detention facility near the intersection of Foothills Parkway and Baseline Road; and piping along a segment of Dry Creek No. 2 Ditch. All of these improvements are collectively referenced as the “West Valley Improvements.”

The recommended alternative could be constructed in three independent phases, as listed above. Construction of the “Regional Detention at US 36” phase of the project would require numerous federal, state and local permits; agreements with the University of Colorado (CU); use of Open Space and Mountain Parks (OSMP) land; and would need to be permitted by the Colorado Office of the State Engineer. Construction of only this phase would result in approximately 212 structures no longer being mapped in the 100-year floodplain. While the two downstream phases are not as comprehensive as the full recommended alternative, it is anticipated that they could be designed, permitted, funded, and implemented in the relatively near future. Construction of only these two phases (the Arapahoe Detention and West Valley Improvements) of the recommended alternative would result in approximately 190 structures being removed from the 100-year floodplain.

One of the Boulder Valley Comprehensive Plan general policies states the city’s commitment to open space preservation and the use of open space buffers to define the community. Construction of the regional detention facility at US 36 portion of the recommended alternative would impact OSMP land with some of the highest ecological values in the Boulder Valley. The project area on OSMP lies entirely within the South Boulder Creek Scenic Natural Area ,which was designated by the State of Colorado in recognition of the statewide significance of this exceptional riparian and floodplain ecosystem, including the federally threatened Preble’s meadow jumping mouse and Ute ladies’- tresses orchid (ULTO) habitat; tallgrass prairie; wetlands; habitat for declining grassland and riparian bird species; habitat for declining amphibians such as the northern leopard frog; and habitat for declining native fish. Tallgrass prairie is considered one of the most endangered plant communities in the world, and OSMP land in the project area contains some of the highest-quality remaining tallgrass prairie in the state and region.

The final four alternatives for flood mitigation along South Boulder Creek were presented to the public at an open house and WRAB meeting on Aug. 18, 2014. The WRAB made a motion that was unanimously approved (5-0) to recommend that City Council accept the “Regional Detention at U.S. 36 with Downstream Improvements” as the recommended alternative to mitigate flood risks associated with South Boulder Creek. The WRAB recommended proceeding with the regional detention facility at US 36 component of the alternative after evaluating other alternatives that may have lesser potential for environmental impacts, and that may provide faster and less-costly opportunities for equivalent mitigation in that area, such as use of CU property, private property and eminent domain options.

The Open Space Board of Trustees (OSBT) met on Aug. 20, 2014 to review the recommended mitigation plan and consider its environmental and open space impacts. On Sept. 10, 2014, OBST held a public hearing and passed the following three motions, 4-0 (Shelley Dunbar was absent for this vote):

1. A motion to recommend proceeding with the “West Valley Improvements” and “Arapahoe Detention” phases of the “Regional Detention at U.S. 36 with Downstream Improvements” flood mitigation alternative at this time;
2. A motion to recommend investigating alternatives to the “Regional Detention at U.S. 36” component that may have lesser potential for environmental impacts; and
3. A motion that the OBST make a statement to City Council: the board believes that constructing a regional detention facility at US 36 would require a significant disposal of open space lands, which would be subject to all applicable open space charter provisions.

6. Gregory Canyon Creek

A flood mapping study of Gregory Canyon Creek was adopted by City Council on Nov. 17, 2009 and by FEMA on Oct. 10, 2010. Staff and consultants (CH2M HILL) are currently developing alternatives for flood mitigation improvements along Gregory Canyon Creek. The study is considering impacts from the September 2013 flooding, as well as more frequent storms, to determine mitigation options and prioritize future work along the creek.

An open house was held on June 12, 2014 to gather suggestions and hear public concerns about the project. Comments are also being collected via the project Web page. The different mitigation alternatives will be presented to the public and WRAB this fall.

7. Bear Canyon Creek

Staff will use this study to evaluate opportunities for flood mitigation improvements along Bear Canyon Creek. This study will focus on the area upstream of Broadway and the reach between Moorhead Avenue and Baseline Road. Impacts from the September 2013 flooding, as well as more frequent storms, will be evaluated to determine mitigation options and prioritize future work along the creek.

8. Boulder Creek

The UDFCD is initiating a watershed master plan to identify potential drainageway improvements for Boulder Creek, in partnership with the City of Boulder, Boulder County, City of Longmont, Colorado Water Conservation Board and Town of Firestone. A funding agreement is currently being developed and an engineering consultant has not yet been selected for this project.

C. Capital Improvement Program and Funding for Flood Mitigation Projects

At a Study Session held on Aug. 12, 2014, council reviewed the Draft 2015-2020 Capital Improvements Program (CIP). A summary table of funding for major drainageway improvements is included with this memo as [Attachment C](#). In addition to Utilities Division funding, the summary table includes funding from the Greenways Program and

outside funding sources such as the federal Transportation Improvement Program (TIP). Funding from the UDFCD is not shown in this table as a separate funding source, but is included with the Utilities Division funding. Greenways funding is intended to be utilized to meet the other objectives of the Greenways Program, such as habitat and multi-use path improvements, in conjunction with flood mitigation projects.

As a result of public input following the September 2013 flood, potential new major drainageway improvement projects have been identified in the 2015-2020 Stormwater and Flood Management CIP for the following drainageways:

- Boulder Creek;
- Bear Canyon Creek;
- Gregory Canyon Creek;
- Skunk Creek, Bluebell Canyon Creek and King's Gulch; and
- Upper Goose and Twomile Canyon Creek.

The details of these improvements will be determined through the major drainageway mitigation planning and CEAP, which may also identify future Greenways projects. Therefore, funding has not yet been included in the 2015-2020 Greenways CIP for any of these improvements. The CEAP is described in greater detail in the [Flood Management Program Overview](#).

The Wonderland Creek and Fourmile Canyon Creek Greenways improvements projects are slated to begin construction and implementation in 2015. An overview and status of each project is discussed in detail below.

9. Wonderland Creek

Two Greenways improvements projects located along Wonderland Creek are currently in the final phase of design. The purpose of both projects is to provide flood mitigation and improved multi-use path connections. The projects were developed separately, but are now being combined into a single design project that extends from Foothills Parkway at the south end to Winding Trail Drive at the north end. The CEAPs were completed in 2010 for the downstream reach and 2012 for the upstream reach. The final design for the Wonderland Creek Greenways Improvements project was presented to the public at an open house on Aug. 25, 2014 and construction is anticipated to begin in 2015. The project is estimated to cost approximately \$21 million, with funding in the current CIP that includes federal TIP grant money, UDFCD funding and bond money. The city has begun to purchase the required easements and so far has no indication of unwilling sellers. However, if the city is not able to acquire all of the easements by the required June 1, 2015 deadline, the project and federal funding will be jeopardized. Due to the lengthy process associated with eminent domain proceedings, City Council will be asked to consider a motion to order an ordinance authorizing and directing the acquisition of property located along the Wonderland Creek, by purchase or through eminent domain proceedings, to facilitate construction of the Wonderland Creek Greenways Improvements project.

10. Fourmile Canyon Creek

Per the 2015-2020 CIP, it is anticipated that the design of the Fourmile Canyon Creek Greenways Improvements at 19th Street project will continue in late 2014, with a CEAP for the reach upstream from Upland Avenue to be completed in 2015. This project is in the preliminary design phase, but was delayed following last year's flood.

Proposed capital improvements along Fourmile Canyon Creek have been scheduled in two phases:

1. Fourmile Canyon Creek at Crestview Elementary School and 19th Street (between 22nd Street and Upland Avenue); and
2. Fourmile Canyon Creek between Upland and Violet avenues.

Funding for the Fourmile Canyon Creek at Crestview project was included in last year's CIP and budgeted in 2014 for a total project budget of \$2.3 million, including funding contributions from both the Greenways Program and Stormwater and Flood Management Utility budgets. The UDFCD also committed \$300,000 towards this project in 2012 and 2013. The project CEAP was completed in 2012 and includes a flood conveyance/ pedestrian and bicycle underpass at 19th Street and a combined emergency access and multi-use path connection between 19th Street and Tamarack Avenue.

The second phase of the project will be funded from both the Greenways Program and Stormwater and Flood Management Utility budgets, and totals \$6.1 million. Based on information obtained from the September 2013 flood, a new CEAP is being initiated to look at opportunities to mitigate impacts from the spill flow from Fourmile Canyon Creek to Wonderland Creek. Detention and sediment ponds to help mitigate downstream impacts, as well as trail alignment alternatives between Violet Crossing and Upland Avenue, may be considered through this process.

11. Boulder Slough

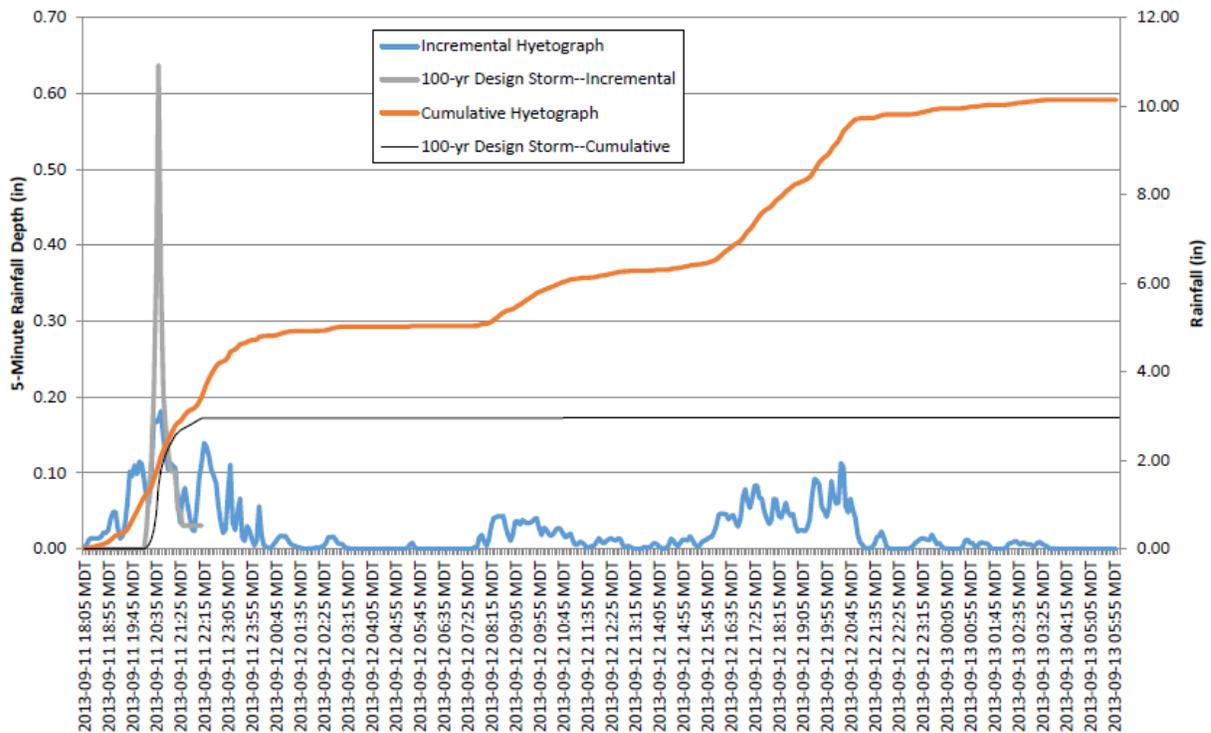
Flood improvements to the Boulder Slough downstream (east) of 30th Street are currently under construction as part of the [Pearl Parkway](#) project. Improvements to increase the capacity the Boulder Slough were funded by the Stormwater and Flood Management Utility.

D. 2013 Flood Disaster Rainfall Runoff Analysis

Wright Water Engineers, Inc. (WWE), working with the City of Boulder and UDFCD, is conducting an analysis of the September 2013 storm to evaluate the amount of rainfall and associated runoff within each of the drainage basins that contribute to the major drainageways within the city. This analysis provides a comparison of how the 2013 flood differs from the "design storm," which is used in floodplain mapping to determine the 100-year floodplain. WWE will present a summary of their analysis at the study session. The final report of the rainfall runoff analysis is expected to be available in Oct.2014.

A “design storm” is a theoretical storm that emulates a flash flood and produces high peak flow rates from short periods of very intense rainfall. This is quite different from the long-duration, less-intense storm that led to the flooding in September 2013. The hyetograph below, which is a graphical representation of the distribution of rainfall over time, illustrates this difference for a sub-basin area of Skunk Creek during the September 2013 storm.

Figure 2. Hyetographs and 100-year Design Rainfall for Skunk Creek (Upper) Subwatershed



In the graph, the blue line shows the actual rainfall over five-minute increments from 6:05 p.m. on Sept. 11, 2013 to 5:55 a.m. on Sept. 13, 2013. The orange line represents the cumulative rainfall that fell over this period of time (about 10 inches). The gray line indicates the theoretical incremental rainfall of a 100-year “design storm,” which peaks much higher (0.65 inches) in a 5 minute period than was seen in the 2013 storm (0.19 inches). The 100-year design storm is “front loaded” with approximately 50% of the rainfall in the first 30 minutes, and with roughly 80% of the precipitation occurring in the first hour of the design storm, a characteristic that was not observed in the actual storm event in September. The black line represents the cumulative rainfall for a “design storm” (about three inches) which is significantly lower than the 10 inches that fell during this time in the 2013 storm.

The theoretical 100-year “design storm” which has a shorter duration, results in a much lower total volume of water over the duration of the storm, but has higher intensity rain creating higher runoff peak flow rates. Given the differences between the design storm

and the September 2013 storm, peak flow rates and the extent of flooding for drainageways in many cases were less than expected for a 100-year “design storm” event even though rainfall return periods for longer durations (e.g. > 24-hours) exceeded 1000-year return periods.

The study prepared by WWE analyzes how the intensity of the rainfall during the September flood (a low-intensity storm), in the various drainages and during various intervals of time, results in runoff and stream flows in comparison to what would be seen during a 100-year rainfall event (the “design storm”).

The table below summarizes preliminary results of the estimated runoff frequency for selected locations along major drainageways during the 2013 flood and compares those amounts to what is modeled for a 100-year flood based on the “design storm.” The information presented is for reference purposes only and should not be considered final. The preliminary results indicate that in certain locations, the estimated flow rates in September 2013 were similar to a 5 to 10-year flood (Wonderland Creek at Broadway), whereas in other locations, it was closer to a 100-year flood (Fourmile Canyon Creek at Broadway).

Rainfall-Runoff Analysis September 2013 Flood Disaster (Drainageways listed South to North)		
Rainfall-Runoff Analysis	Location	Estimated Runoff Frequency (Year)
South Boulder Creek	Eldorado Springs	10-25
South Boulder Creek	Highway 93	50-100
South Boulder Creek	South Boulder Road	25 -50
South Boulder Creek	West Valley Overflow	~100
Bear Canyon Creek	Broadway	~20
Bear Canyon Creek	Baseline Road	~20
Bluebell Creek	Chautauqua	~25
Kings Gulch	Chautauqua	~10
Skunk Creek	Baseline Road	~25
Gregory Canyon Creek	Baseline Road	~10-50
Boulder Creek	Broadway	~25
Boulder Creek	75 th St.	25-50
Two-mile Canyon Creek	Broadway	~100
Goose Creek	Folsom	50-100
Wonderland Creek	15 th St.	5 - 10
Fourmile Canyon Creek	Broadway	10-50
Fourmile Canyon Creek	Highway 119	50-100

Currently, the city uses rainfall data provided by the National Oceanic and Atmospheric Administration (NOAA) and analysis techniques approved by FEMA as the basis for the “design storm” and associated flood flows. As the data set of storm events increases and the understanding of rainfall-runoff relationships improves, the predicted rainfall amounts and analysis techniques will be updated.

Another issue to consider is climate change. The city recently commissioned a study by the Institute of Climate and Civil Systems (iCliCS). This study suggests that the return frequency of floods may increase in the future due to climate change.

The city has adopted development standards that require flood protection measures for all development in the 100-year floodplain and for all critical and lodging facilities in the 500-year floodplain. To account for uncertainty, the flood protection standards include a safety requirement of two feet of clearance above the predicted 100-year water surface elevation and one foot of clearance above the predicted 500-year water surface elevation. This safety requirement has been selected to account for current and future uncertainty regarding climate change, rainfall, runoff and other factors affecting the estimated flood levels at defined locations.

E. 2013 Flood Disaster Damage Analysis

The property damage caused by the 2013 flood was extensive and costly. While FEMA was thorough in documenting the property claims, they did not attempt to determine the cause of the damage (surface flooding, sanitary sewer backup, groundwater infiltration, etc.). Therefore, the city solicited input through an online flood impact survey and received more than 1,200 responses from property owners. These survey results were then extrapolated to the larger FEMA dataset of about 8,500 individual property claims. A full summary of these results and the methodology used to obtain them is expected to be available in October 2014.

The City of Boulder, in partnership with a consultant team, is in the process of further analyzing the September 2013 flood survey responses and comparing with FEMA property claims data. The total damage costs listed below are for reference purposes only and should not be considered final. Preliminary results from the survey and from data collected by FEMA indicate that the total damages to private property from the 2013 flood amount exceed \$200 million.

Property owners’ reported out-of-pocket costs were compared to the total FEMA payments, which included both National Flood Insurance Program (NFIP) and Individual Assistance (IA) payments. The analysis suggests that FEMA paid less than 15 percent of the reported out-of-pocket costs. The probable reason for the relatively low amount of payments compared to out-of-pocket costs is likely due to several factors; most importantly that much of the reported damage costs were related to basement flooding. FEMA does not typically cover or make payments for basement finishes under either the NFIP or IA programs. It is possible that property owners were able to recover other out-of-pocket costs through standard homeowner’s insurance, since riders are typically available for sanitary sewer backups.

Boulder has by far the largest number of flood insurance policies (required on all federally backed mortgages) and largest insured property value of any municipality in Colorado as presented in [Flood Management Program Overview](#). City of Boulder residents and businesses pay nearly \$3 million in total annual flood insurance premiums. Community investment in flood mitigation reduces the associated risks and related insurance costs.

FEMA is in the process of implementing congressionally mandated reforms required by the Homeowners Flood Insurance Affordability Act of 2014. [Attachment D](#) summarizes important aspects of these reforms. An important aspect that will affect many Boulder property owners is the phase-out of subsidies, limited by an 18-percent increase limit for any individual policy until premiums reach their full-risk rates.

V. NEXT STEPS

Depending on feedback provided by City Council during the study session, possible next steps include scheduling public hearings and City Council consideration of the:

1. Boulder Slough Floodplain Mapping Study
2. Bear Canyon Creek Floodplain Mapping Study
3. Skunk Creek, Bluebell Canyon Creek and King's Gulch Floodplain Mapping Study
4. Two Mile and Upper Goose Creek Floodplain Mapping Study
5. South Boulder Creek flood mitigation plan;
6. Gregory Canyon Creek flood mitigation plan; and
7. Bear Canyon Creek flood mitigation plan.

VI. ATTACHMENTS

- [Attachment A: Floodplain Mapping, Mitigation Planning and Capital Improvements Projects Schedule](#)
- [Attachment B: Map of Mapping, Mitigation Studies, and Capital Improvement Projects](#)
- [Attachment C: 2015-2020 CIP Summary of Funding for Major Drainageway Improvements](#)
- [Attachment D: FEMA: Proposed Rate Changes](#)