

**CITY OF BOULDER
WATER RESOURCES ADVISORY BOARD
AGENDA ITEM**

MEETING DATE: October 17, 2016

AGENDA TITLE: Public Hearing and consideration of a recommendation to City Council regarding the Bear Canyon Creek Flood Mitigation Plan

PRESENTERS:

Jeff Arthur, Director of Public Works for Utilities
Annie Noble, Acting Principal Engineer for Flood and Greenways
Christin Shepherd, Flood and Greenways Engineer

EXECUTIVE SUMMARY:

The purpose of this memorandum is to present the final Bear Canyon Creek Flood Mitigation Plan (**Attachment A**) for the WRAB's consideration, input and recommendation to City Council.

In 2014, the city retained Amec Foster Wheeler to evaluate potential improvements along Bear Canyon Creek. Over time, flood improvements have been made at various locations along the drainageway, but the September 2013 flood highlighted areas of hydraulic limitation that prompted the public to request additional flood mitigation.

Recommendations were developed, analyzed and presented to the public and the WRAB throughout this study. Feedback and comments were collected and incorporated into the final flood mitigation plan where feasible.

The final recommended plan includes a combination of maintenance and capital improvements that yield the greatest reduction in flood risk. In general, the recommended improvements include increased capacity in 13 culverts, channel grading and widening, channel maintenance including sediment and debris removal, and reconfiguring three stormwater outfalls. The recommended improvements are detailed in the table in the Analysis section of this memo and shown on maps in Appendix G of **Attachment A**.

A Benefit Cost Analysis (BCA) was also performed on the recommended improvements and a Benefit Cost Ratio (BCR) of 0.02 was calculated. Although the BCR was low, the recommended improvements result in other benefits including: decreased property damage, increased emergency access during major storm events, and improved safety for multi-use path users.

STAFF RECOMMENDATION:

Staff requests the Water Resources Advisory Board's consideration of this matter and action in the form of the following motion:

Motion to recommend the Bear Canyon Creek Flood Mitigation Plan be recommended to City Council for acceptance.

BOARD AND PUBLIC FEEDBACK

Information items providing status updates of the Bear Canyon Creek Flood Mitigation Plan were submitted to the WRAB in April and November of 2015, and June of 2016. There was one open house in 2014, two open houses in 2015 and an open house was held prior to the WRAB meeting on June 20, 2016. An additional open house was held prior to the October 17, 2016 WRAB meeting to display the final recommended improvements. Notification postcards were mailed to property owners in the study area, emails were sent to parents of children attending elementary schools in the study area, and a [project web site](#) was developed to provide information. The project website also contains a comment collection tool that has received fifty comments.

Most public comments indicate support for the recommended improvements. General themes that were raised are listed and addressed in **Attachment B**.

BACKGROUND

Since initial development, Bear Canyon Creek has undergone numerous improvements and continues to benefit from good maintenance within the improved reaches. The September 2013 flood brought to light some key issues which contributed to property damage and safety concerns. In general, problems stemmed from areas of hydraulic limitation, in which the creek experienced limited conveyance capabilities, debris blockage or lack of effective flow return zones. These pinch points are illustrated on page five of **Attachment A**.

After the 2013 flood, the community expressed a strong desire for flood mitigation improvements along Bear Canyon Creek. In 2014, Amec Foster Wheeler was selected as the engineering consultant to develop flood mitigation alternatives and mitigation plan. In order to fully analyze flows and potential improvements in the area of Bear Canyon Creek, a complete model of the entire drainageway was needed. A Best Available Information model was created and detailed descriptions of the data used and model development begin on page seven of **Attachment A**. Initially, the mitigation alternatives focused on three distinct areas (illustrated in **Attachment C**) based on performance concerns during the 2013 flooding event:

- Reach 1: City Limits to Lehigh Street
- Reach 2: Lehigh Street to Broadway
- Reach 3: Moorhead Avenue to Baseline Road

Preliminary hydraulic model results indicated the need to expand the study area to evaluate the impacts of the proposed improvements on downstream areas not originally

included in the study. The scope of analysis was expanded to include Broadway to Moorhead Avenue and Baseline Road to Wellman Ditch. Please see page 11 of **Attachment A** for a map of the expanded study area.

Staff and Amec Foster Wheeler then analyzed two alternatives, a maintenance and a capital improvement alternative to accommodate the 100-year storm. The maintenance alternative analyzed sediment and debris removal within all culverts, invasive species removal at various locations along the channel and improving culvert inlet/outlet conditions by grading and clearing. The capital improvement alternative proposes increased culvert and channel capacity to pass the 100-year storm event. The two alternatives concluded that neither maintaining nor upsizing culverts alone is enough to mitigate risk.

ANALYSIS

The recommended improvements are a combination of the maintenance and capital improvement alternatives and include sediment and debris removal, channel grading and increased culvert capacity. A map outlining the final recommended improvements can be found in Appendix G of **Attachment A**. The final recommended improvements and their associated costs are described in the table on the following page.

Amec Foster Wheeler performed a Benefit Cost Analysis (BCA) and calculated a Benefit Cost Ratio (BCR) of 0.02 for the final recommended improvements. A BCR is the ratio of benefits, which are the monetary value of damages prevented due to mitigation implementation, relative to the cost to construct those mitigation measures. It is not uncommon for flood improvement projects to have a BCR of less than 1.0 because of the higher cost of capital improvements in an urban environment compared to the relatively lower cost to reconstruct residential structures. Additionally, in this study, the structures removed from risk primarily experience shallow flooding, which results in a lower benefit value.

The Best Available Information Model highlights areas of flood risk not previously identified in the current 100-year floodplain. Where the current 100-year floodplain identifies approximately 35 structures within its bounds, the Best Available Information Model identifies 194 structures that would potentially sustain damage, the majority of which are located in the area between Broadway and Moorhead Avenue. Please see **Attachment D** for a comparison of the floodplain boundaries.

The recommended improvements would reduce the number of potentially damaged primary structures from 194 to 154. The BCA for this study only accounts for losses avoided to residential structures and did not quantify other social and environmental benefits such as emergency access during a storm event, safer routes to schools, reduced flood insurance premiums, or improved habitat and vegetation. Amec Foster Wheeler's BCA calculations can be found in Appendix H of **Attachment A**.

Bear Canyon Creek Recommended Flood Mitigation Improvements

Reach	Location	Recommendation	Estimated Cost
Reach 1	Wildwood Road	Remove sediment in culvert, including gravel bars and vegetation blocking inlet and outlet	<i>*work completed by UDFCD</i>
	Wildwood Road	Grade channel and widen floodplain from Wildwood Road to Ithaca Drive	\$467,000
	Ithaca Drive	Remove steel culvert and grade channel in conjunction with stormwater improvement project at Ithaca Drive	\$47,000
Reach 2A	Lehigh Street	Increase culvert size to 7.5ft x 28ft concrete box	\$1,454,000
	Table Mesa Drive	Remove sediment in culverts at Ithaca Drive, Yale Road, Gillaspie Drive and Stanford Avenue including gravel bars and vegetation blocking inlet and outlet	\$25,000 (each)
	Stanford Avenue	Increase channel capacity from Stanford Avenue to Harvard Lane	\$307,000
	Harvard Lane	Increase culvert size to (2) 7.5ft x 10ft concrete boxes	\$711,000
Reach 2B	Broadway	Modify inlet conditions to increase capacity	\$67,500
	Broadway	Sediment and debris removal from Broadway to Martin Drive	\$1,057,000
	Martin Drive	Continue good maintenance	-
Reach 3A	Moorhead Avenue	Continue good maintenance	-
	US 36	Increase culvert size to (2) 8.5ft x 14ft concrete boxes and reconfigure pedestrian separator wall in underpass and grade multi-use path and channel downstream to improve the inlet and outlet condition	\$950,000
	US 36 to CDOT right of way	Increase channel capacity and reconfigure multi-use path	\$30,600
	University of Colorado	Increase channel capacity in conjunction with CU Master Plan	\$1,584,000
	Upstream of Church	Increase channel capacity	\$56,000
	Saint Andrew Church	Replace culverts with 40ft driveway bridge	\$493,000
	Downstream of Church	Increase channel capacity	\$52,000
Reach 3B	Baseline Road	Increase culvert size to (2) 7.5ft x 28ft concrete box	\$2,730,000
	Gilpin Drive	Increase channel capacity near Gilpin Drive	\$102,000
	Gilpin Drive	Increase culvert size to (2) 8ft x 20ft concrete boxes	\$785,000
	Mohawk Drive	Continue good maintenance	-
TOTAL			\$11,000,00

The Gilpin Drive and Baseline Road box culverts are the key pinch points in the drainageway. Without upsizing these culverts, improvements upstream of Baseline Road will create negative impacts downstream of Gilpin Drive. Recommended phasing for improvements is shown on page 17 of **Attachment A**. Generally, improvements go from

downstream to upstream in accordance with engineering best practices. However, there are some recommended improvements that can be constructed out of sequence with no negative downstream impacts. These projects include; sediment removal at the Wildwood Culvert, removal of the Ithaca Drive steel culvert and sediment and debris removal throughout the drainageway.

When prioritizing and budgeting flood mitigation projects throughout the city the benefits previously mentioned should be taken into account in addition to the BCR. The city's flood management program is comprised of Boulder Creek and fourteen major drainageways, where over \$160M of flood mitigation improvements have been identified city wide. Based on current funding levels, it is anticipated that it will require more than 80 years to complete these projects. In the Stormwater and Flood Management Utility, the majority of the project funding is prioritized by life safety (high hazard) and critical facility (vulnerable population) hazard mitigation issues but other factors apply, such as:

- Flood emergency response capability
- Property damage mitigation
- Collaboration with other Greenways Program Objectives
- Potential for operation and maintenance cost savings
- Accommodating new growth and development
- Opportunities to leverage outside funding

The current six-year Capital Improvements Program (CIP) includes approximately \$500,000 for Bear Canyon Creek.

NEXT STEPS:

Next steps include:

- If recommended by the WRAB, the final Bear Canyon Creek Flood Mitigation Plan will be presented to City Council for acceptance.
- Once accepted by City Council, recommended improvements in the Bear Canyon Creek Flood Mitigation Plan will be scheduled into the CIP as funding is available.

ATTACHMENTS

Attachment A: Bear Canyon Creek Flood Mitigation Plan

Attachment B: Public Comment General Themes and Responses

Attachment C: Initial Scope of Flood Mitigation Analysis

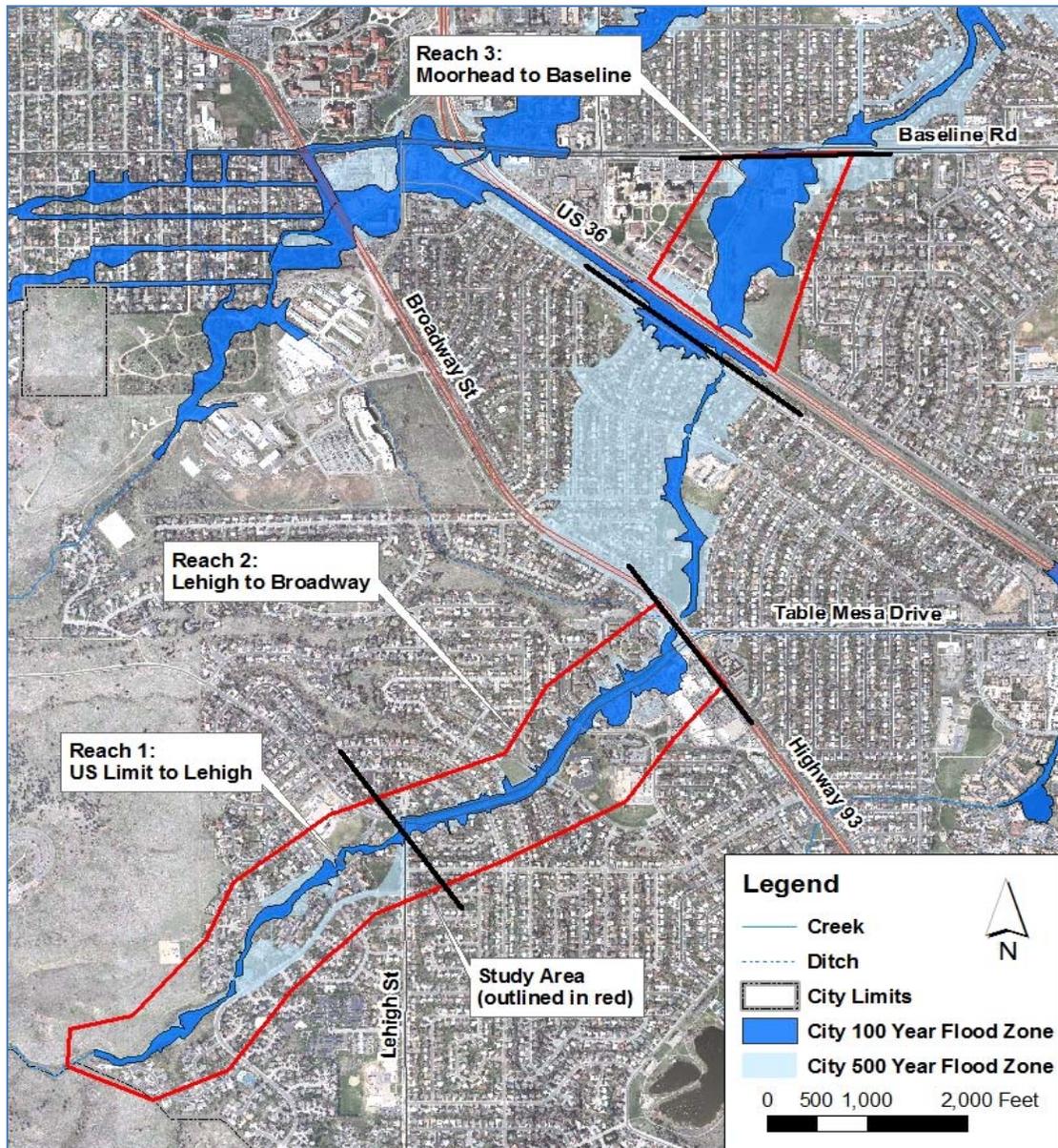
Attachment D: Existing Conditions FLO-2D and Current Floodplain

ATTACHMENT A: Bear Canyon Creek Flood Mitigation Plan

ATTACHMENT B: General Public Comments and Responses

General Theme	Response
Storm sewer outfall issues	Storm sewer outfalls have been identified at Bear Creek Condominiums, Ithaca Drive and Gilpin Drive. Recommendations for reconfiguration are included in the final mitigation plan document.
Sanitary sewer backup in Frasier Meadows neighborhood	The sanitary and storm sewer system in Frasier Meadows neighborhood is complex. The area was historically used for farming and agriculture, has shallow groundwater and is topographically lower than surrounding areas. The neighborhood has potential connection to Bear Canyon Creek via an inlet located on CU property (a historical natural spring that was used to fill Thunderbird lake). It is believed that by containing the 100-year floodplain within the channel on CU property, flows from the creek will not enter the Frasier Meadows neighborhood at this location.
Construction timeline is too long	Some recommended improvements will undergo public process during the design phase which can include; a Community and Environmental Assessment Process (CEAP), input and recommendation from the WRAB, input and recommendation from other advisory boards such as Planning Board, and City Council. This process can take time for design to be fully approved, at which point funding for construction can be pursued. There may be opportunity for collaborative funding efforts with transportation projects, the University of Colorado or FEMA.
Inadequate funding	
Remove steel culvert at Ithaca Drive	Included in recommended improvements.
Do not decrease traffic lanes on Table Mesa Drive	The recommended improvements increase capacity at the Lehigh Street and Harvard Lane culverts without altering the number of traffic lanes on Table Mesa Drive. This approach reduces flows in the roadway and would not increase vehicular congestion to and from Bear Creek Elementary School.
Increase capacity at Saint Andrew Church driveway	Included in recommended improvements.
Do not remove habitat, vegetation and trees	Increased channel capacity can sometimes require removal of vegetation and trees, but it is also essential to the success of the recommended improvements. Every effort will be made to protect the natural habitat during design and construction of the recommended improvements.
Remove trees and vegetation	
Deepen the channel	
Provide a concrete lined channel	Concrete lined channels technically stabilize against erosion, but would not work to create natural streams and well-vegetated floodplains that are physically and biologically healthy. Concrete lined channels remove vegetation and habitat, increase flow velocity and can create negative impacts to property and habitat downstream.

ATTACHMENT C: Initial Scope of Flood Mitigation Analysis



ATTACHMENT D: Existing Conditions FLO-2D and Current Floodplain

