

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

MEETING DATE: July 21, 2014

AGENDA TITLE: Public hearing and consideration of recommendations to City Council to adopt the Lower Bear Creek and Upper Boulder Slough floodplain mapping revisions.

PRESENTER/S:

Jeff Arthur, Director of Public Works for Utilities
Bob Harberg, Principal Engineer - Utilities
Annie Noble, Flood and Greenways Engineering Coordinator
Katie Knapp, Engineering Project Manager

EXECUTIVE SUMMARY:

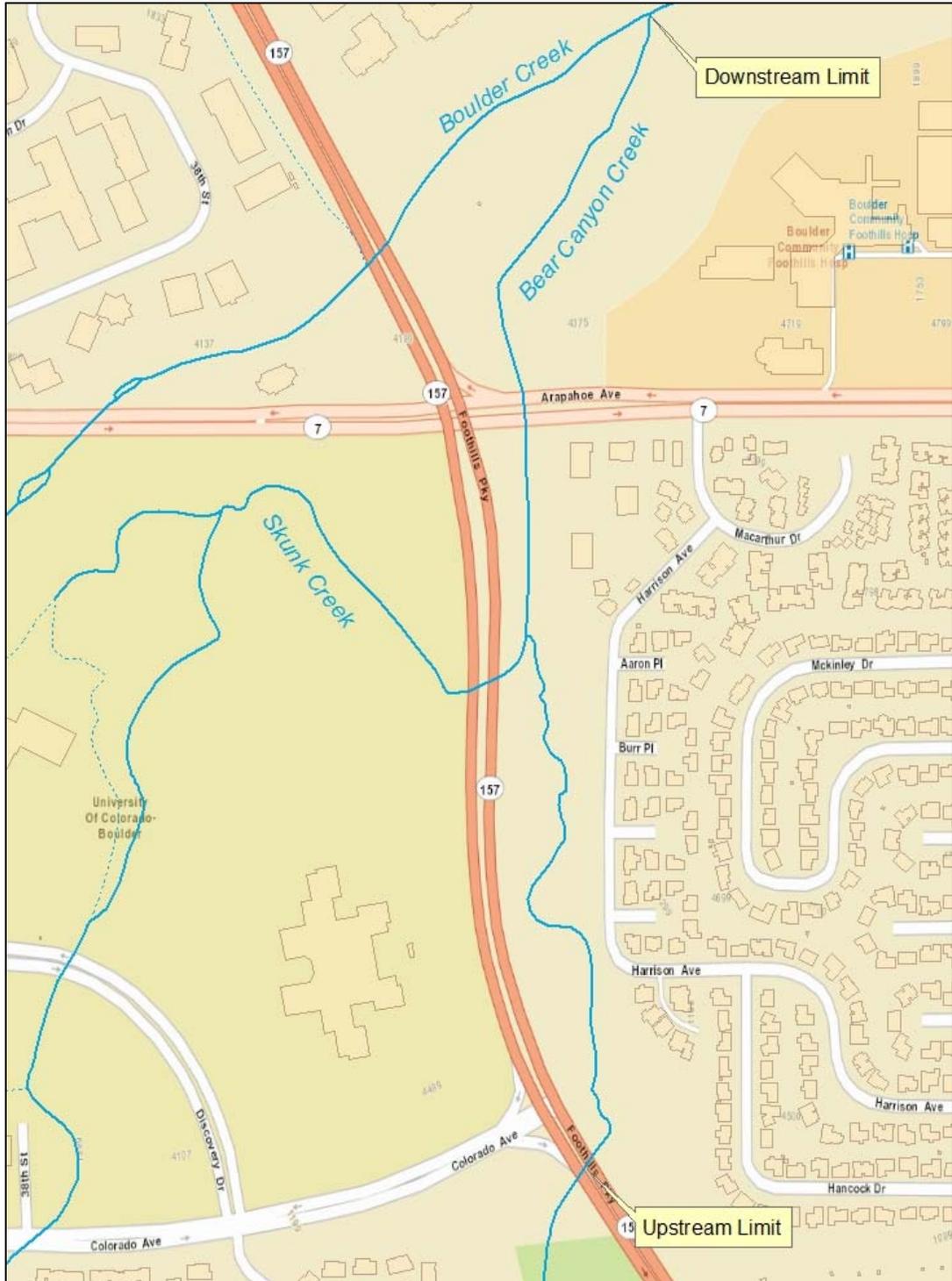
The city has a comprehensive floodplain management program designed to identify flood risks, mitigate the risks of flooding, minimize loss of life and property damage and support recovery following a major flood event. Floodplain mapping provides the basis for the city's floodplain management program by identifying the areas at the highest risk for flooding. Changes in land use, updated topographic mapping and upgrades to hydrologic and hydraulic models warrant periodic mapping updates. This memorandum presents two proposed floodplain mapping revisions:

Lower Bear Canyon Creek

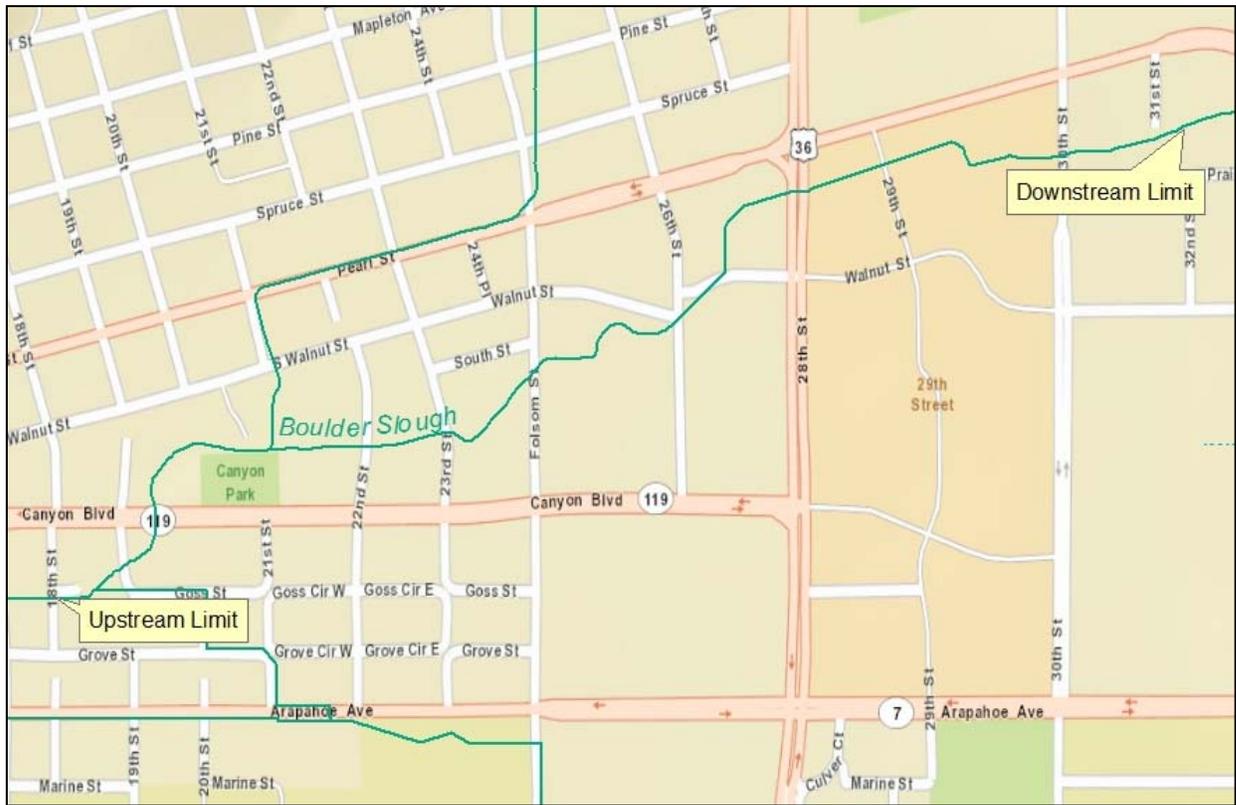
The Lower Bear Canyon Creek study area extends from the confluence of Bear Canyon Creek and Boulder Creek (downstream) to Foothills Parkway (upstream) as shown on the map below. The study includes the data and documentation required for accreditation of the Harrison Levee. The Harrison Levee is provisionally accredited on the current 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 to increase the conveyance of Bear Canyon Creek.

Upper Boulder Slough

The Boulder Slough study will update the hydraulic models and flood hazard mapping for the reach of Boulder Slough from 30th Street to 18th Street, including two split flow paths north of the Slough, west of 26th Street. The study limits are shown on the map below. 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 the completion of the improvements that are currently under construction.



Lower Bear Canyon Creek Study Limits



Upper Boulder Slough Study Limits

The proposed mapping for both floodplains would result in a net decrease of 9 structures in the 100-year floodplain, a net increase of 11 structures in the conveyance zone and a net increase of 2 structures in the high hazard zone. Following input from WRAB, the mapping study will be considered by the City Council for approval to submit to FEMA and adoption for city regulatory purposes. The WRAB acceptance of the study does not require board members to verify the analysis and calculations, but indicates the overall study process and results are reasonable and acceptable.

STAFF RECOMMENDATION:

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

Motion to recommend that City Council adopt the Lower Bear Canyon Creek floodplain mapping revision.

Motion to recommend that City Council adopt the Upper Boulder Slough floodplain mapping revision.

COUNCIL FILTER IMPACTS:

- Economic: Flood insurance is required for properties located in the 100-year floodplain if they are financed by a federally-backed mortgage. Flood insurance

rates are set by FEMA based on the flood risk as shown on the flood insurance rate maps. Accurate floodplain mapping helps facilitate accurate flood insurance rates. The average annual rate for flood insurance within the city in 2013 was \$760 (3,830 policies). Flood protection land use regulations also create costs for the property owners in the form of permit fees, increased costs of remodeling and restrictions on development. Flood insurance and land use regulations do, however, provide protection from potentially catastrophic losses due to floods.

- Environmental: Flood events can result in damage or destruction to buildings and corresponding release of man-made contaminants. Flood waters can also cause erosion and damage to areas of the natural environment that are not capable of conveying high-velocity stormwater. The updated mapping will more accurately identify the areas with the greatest flooding risks.
- Social: Floodplain mapping provides the basis for flood management by identifying the areas subject to flooding. This information is essential for determining areas where life safety is threatened and property damage is likely. Land use regulations help reduce risks to people and property in these high flood-risk areas. Accurate mapping of flood risks also helps implement effective flood preparedness and response programs, thereby increasing the safety of people living, working or visiting the City of Boulder.

OTHER IMPACTS:

- Fiscal: Funding for this study is included in the Department of Public Works Utilities Division budget.
- Staff Time: Time for completing the study is included in existing work plans.

BOARD AND COMMISSION FEEDBACK:

The Bear Canyon Creek and Boulder Slough mapping Revisions have not been brought to any Boards or Commissions prior to WRAB. Following input from WRAB, the mapping revisions will be presented to City Council.

PUBLIC FEEDBACK:

Open house meetings were held in early July 2014 to inform the public about the mapping revisions. Most questions and concerns were about flood insurance requirements and plans for future drainageway improvements.

BACKGROUND:

The risk of flash 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. Approximately 13 percent of the city is located within the 100-year floodplains of Boulder Creek and its 14 tributaries. Nearly 2,600 individual structures are located within this flood zone. Additional information about the city's floodplain management program, floodplain regulations and flood insurance can be found at: **Floodplain Management Overview**.

Floodplain mapping provides the basis for the city's floodplain management program by identifying the areas at the greatest risk for flooding. Changes in land use, updated topographic mapping and upgrades to hydrologic and hydraulic models warrant periodic mapping updates. The city has recently updated or is in the process of updating all of the floodplain mapping. Current mapping studies include Upper Goose Creek and Twomile Canyon Creek, Skunk Creek, Kings Gulch and Bluebell Canyon Creek. The city delineates four flood zones:

- 500-year floodplain: The 500-year floodplain delineates the flood limits resulting from a storm that has a 0.2 percent chance of occurring in any given year.
- 100-year floodplain: The 100-year floodplain delineates the flood limits resulting from a storm that has a one percent chance of occurring in any given year (26 percent chance over a 30-year mortgage).
- Conveyance zone: The conveyance zone is defined as the areas in the floodplain that are reserved for the main passage of the entire 100-year flood flow when the 100-year floodplain is artificially narrowed until a maximum six-inch increase in flood water depth is created. This zone is delineated to allow development to occur up to the narrowed floodplain and still provide passage of 100-year storm flows.
- High hazard zone: The high hazard zone defines the area of the floodplain where water depth and velocity pose a threat to life and safety. This area is delineated for areas in the floodplain where water depths are four feet or greater or where the water velocity multiplied by water depth equals or exceeds the number four.

ANALYSIS:

A Letter of Map Revision (LOMR) updates floodplain mapping and hydraulic models. There are two LOMR requests currently under consideration:

Lower Bear Canyon Creek

This LOMR request is being made to update a short reach of the Bear Canyon Creek floodplain. A LOMR is required to formalize flood mitigation improvements and to update hydraulic models. The hydrology used in the mapping update is from the 2012 FEMA Flood Insurance Study and is based on a 1-hour storm event.

The City previously submitted a LOMR for Bear Canyon Creek from Foothills Parkway (downstream) to the city limits (upstream) to reflect changes authorized by City floodplain permits and update hydraulic models based on better, more detailed topographic information. This LOMR was submitted to FEMA in 2002 and approved on February 27, 2003.

The study area for the current LOMR addresses the remainder of Bear Canyon Creek within the City limits, extending from the confluence of Bear Canyon Creek and Boulder Creek (downstream) to Foothills Parkway (upstream). This study includes the data and documentation required for accreditation of the Harrison Levee. The Harrison Levee is provisionally accredited on the current Flood Insurance Rate Maps. The LOMR will also incorporate the updated hydraulic model for Boulder Creek at the downstream tie-in location and incorporate the additional culverts below Arapahoe Avenue that were installed to increase the conveyance of Bear Canyon Creek.

Upper Boulder Slough

This LOMR updates a reach of the Boulder Slough floodplain from 30th Street (downstream) to 18th Street (upstream).

In 2013, the city completed a floodplain study for Boulder Creek to reflect changes authorized by city floodplain permits and update hydraulic models based on better, more detailed topographic information. The Boulder Creek floodplain study did not include the flow path for the Boulder Slough. The Boulder Creek study was submitted to FEMA in September of 2013 and is currently going through the Physical Map Revision (PMR) process.

The Boulder Slough LOMR study will update the hydraulic models and flood hazard mapping for the 100-year flood, conveyance zone and high hazard zone for the reach of Boulder Slough from 30th Street to 18th Street, including two split flow paths north of the Slough, west of 26th Street. Modeling and mapping of this reach, as well as the split flow paths, utilizes 2013 LiDAR-based topographic data. The Boulder Slough downstream (east) of 30th Street will be updated as a separate effort after the completion of the improvements that are currently under construction.

Results

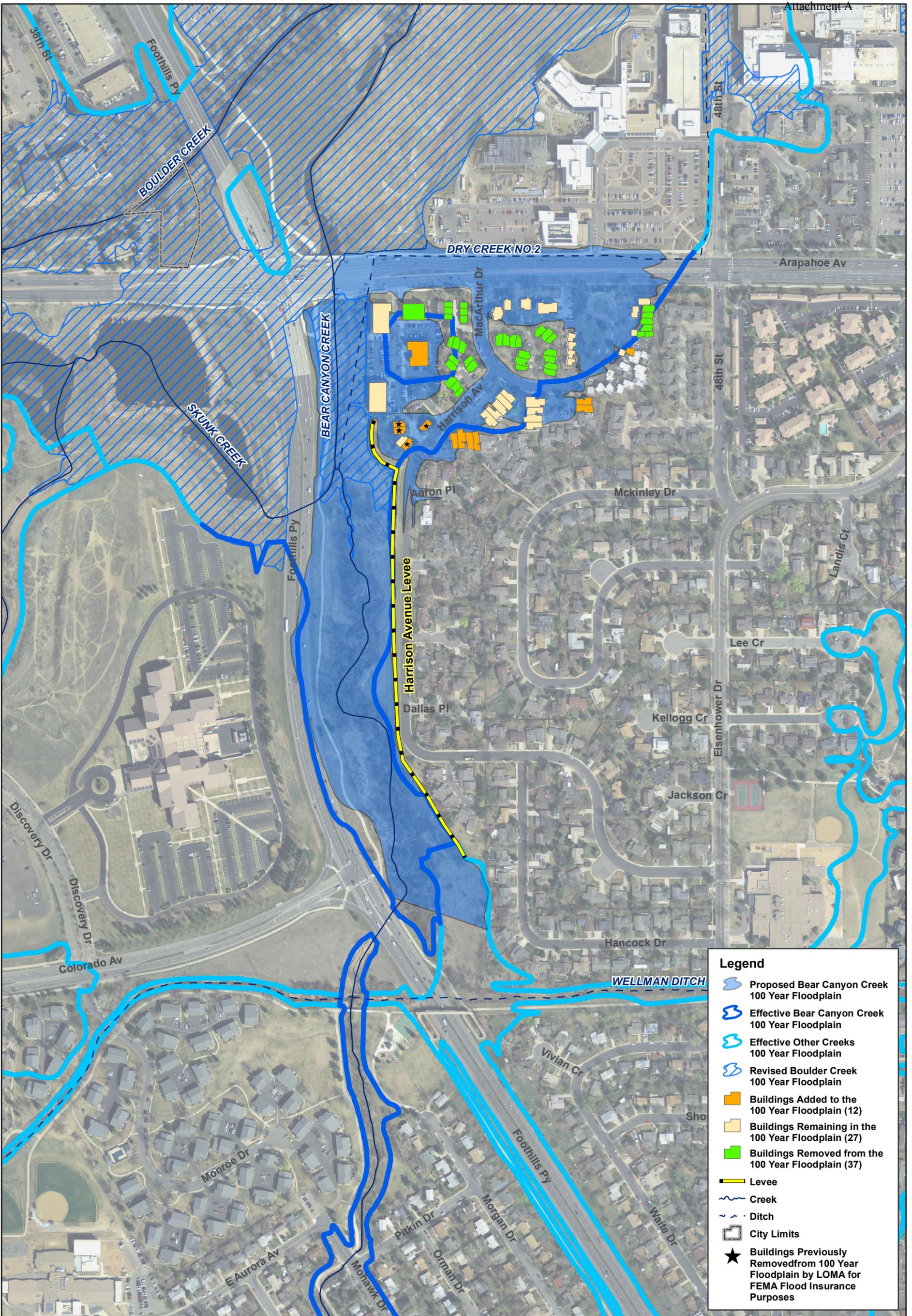
Attachments A through G present figures showing a comparison between existing and proposed floodplain mapping. A summary of how these changes impact existing structures is included in **Attachment H**.

NEXT STEPS:

Following input from WRAB, the mapping revisions will be considered by City Council. If City Council approves the map revisions, the city will submit the LOMR requests to FEMA for review. During the FEMA review and approval process it is recommended that the new mapping be used for regulatory purposes by regulating to the more restrictive of the existing and new mapping. This would mean that development within the newly identified flood zones would be subject to the city floodplain regulations. In order to comply with FEMA requirements, development within the areas that are being removed from the floodplain would still be subject to the city's floodplain regulations until FEMA officially adopts the new floodplain mapping. Following formal adoption by FEMA, the city would regulate solely based on the new mapping.

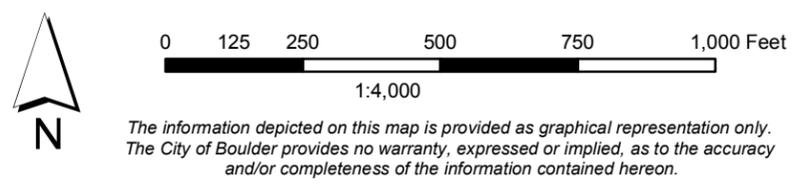
ATTACHMENTS:

- A. Bear Canyon Creek: Existing and Proposed 100-Year Floodplain
- B. Bear Canyon Creek: Existing and Proposed Conveyance Zone
- C. Bear Canyon Creek: Existing and Proposed High Hazard Zone
- D. Bear Canyon Creek: Existing and Proposed 500-Year Floodplain
- E. Boulder Slough: Existing and Proposed 100-Year Floodplain
- F. Boulder Slough: Existing and Proposed Conveyance Zone
- G. Boulder Slough: Existing and Proposed High Hazard Zone
- H. Summary of Impacts to Existing Structures



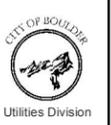
Legend

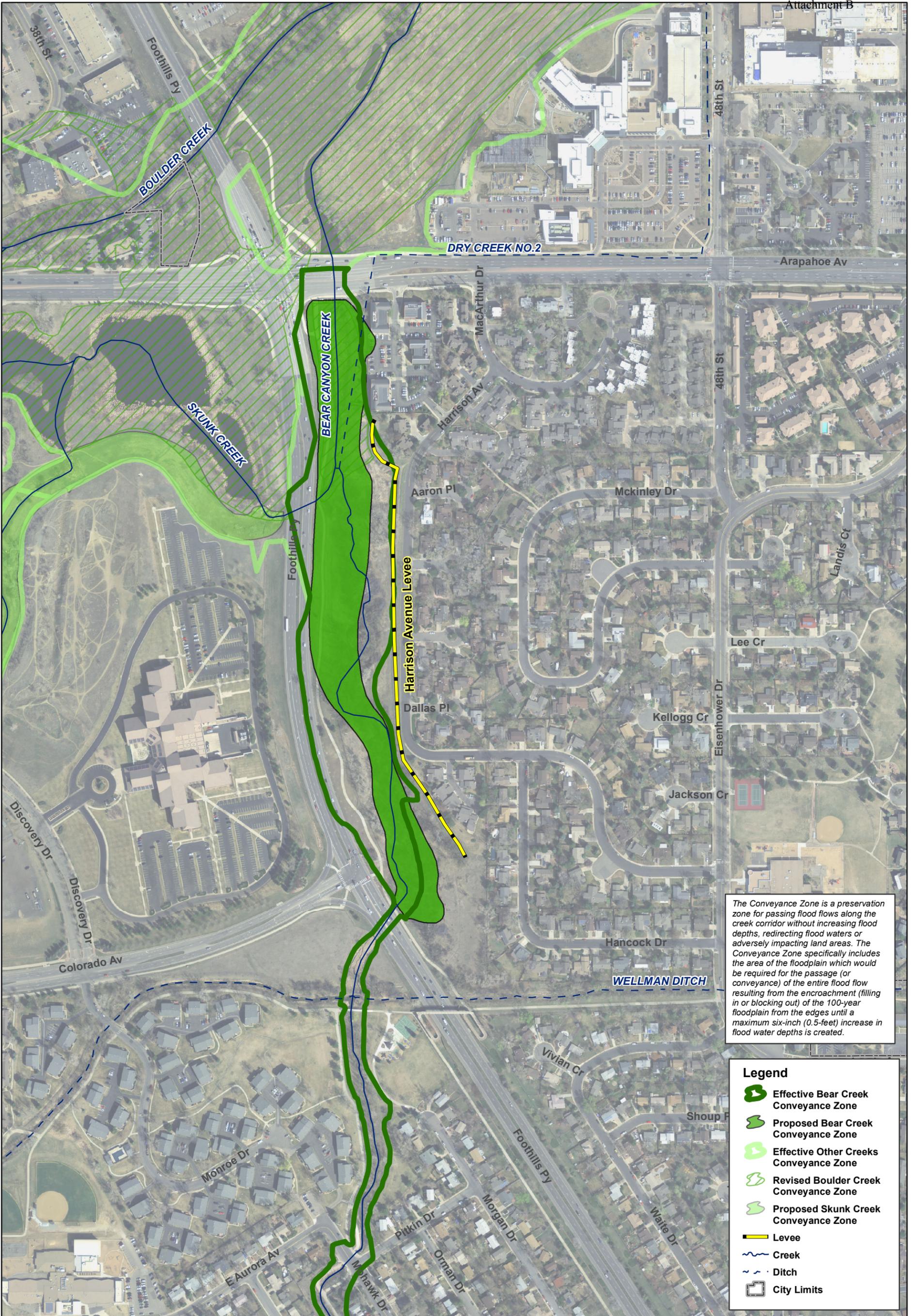
- Proposed Bear Canyon Creek 100 Year Floodplain
- Effective Bear Canyon Creek 100 Year Floodplain
- Effective Other Creeks 100 Year Floodplain
- Revised Boulder Creek 100 Year Floodplain
- Buildings Added to the 100 Year Floodplain (12)
- Buildings Remaining in the 100 Year Floodplain (27)
- Buildings Removed from the 100 Year Floodplain (37)
- Levee
- Creek
- Ditch
- City Limits
- Buildings Previously Removed from 100 Year Floodplain by LOMA for FEMA Flood Insurance Purposes



Bear Canyon Creek

Proposed 100-Yr Floodplain Compared to FEMA Effective





The Conveyance Zone is a preservation zone for passing flood flows along the creek corridor without increasing flood depths, redirecting flood waters or adversely impacting land areas. The Conveyance Zone specifically includes the area of the floodplain which would be required for the passage (or conveyance) of the entire flood flow resulting from the encroachment (filling in or blocking out) of the 100-year floodplain from the edges until a maximum six-inch (0.5-foot) increase in flood water depths is created.

Legend

- Effective Bear Creek Conveyance Zone
- Proposed Bear Creek Conveyance Zone
- Effective Other Creeks Conveyance Zone
- Revised Boulder Creek Conveyance Zone
- Proposed Skunk Creek Conveyance Zone
- Levee
- Creek
- Ditch
- City Limits

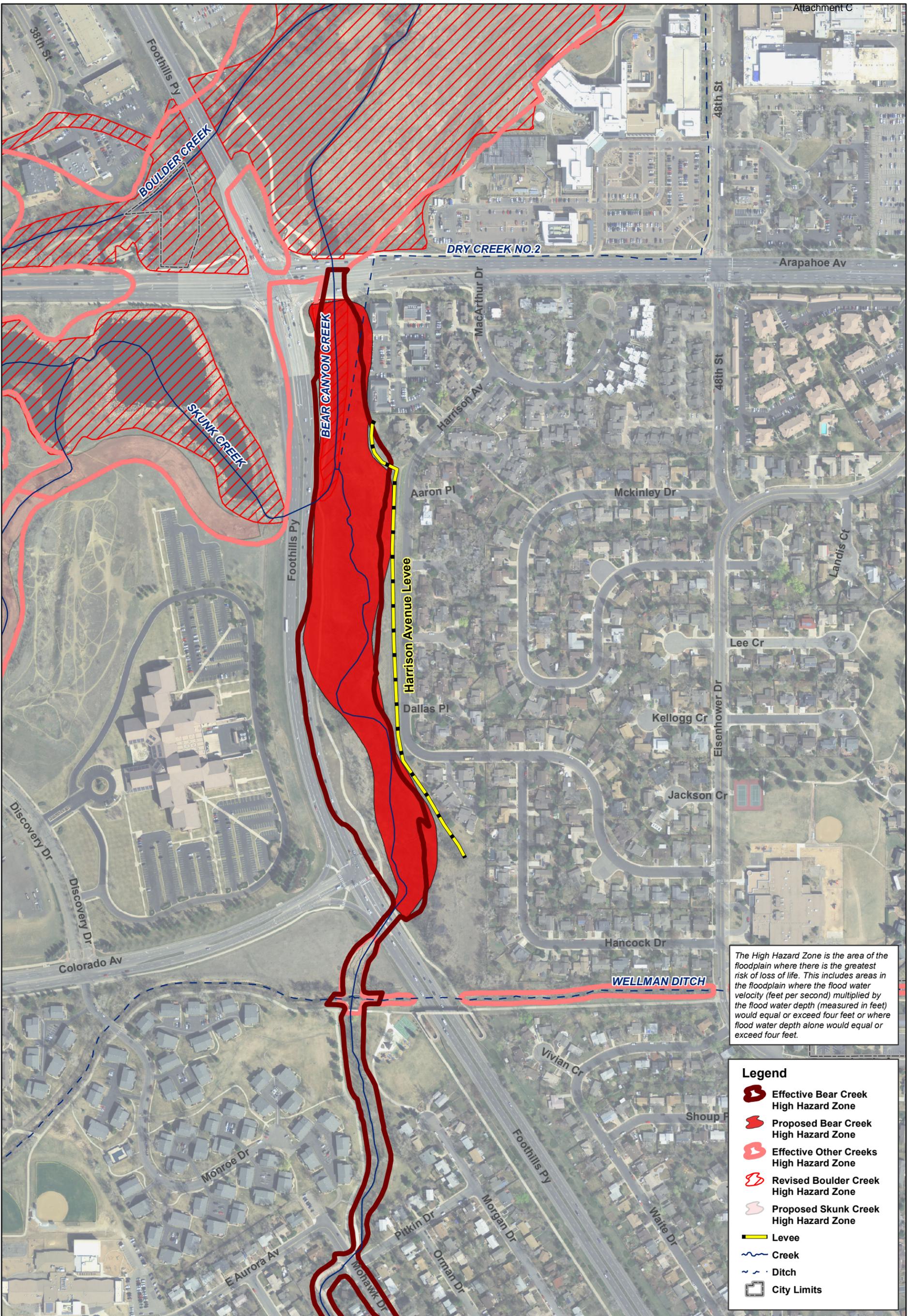


The information depicted on this map is provided as graphical representation only. The City of Boulder provides no warranty, expressed or implied, as to the accuracy and/or completeness of the information contained hereon.

Bear Canyon Creek

Proposed Conveyance Zone Compared to FEMA Effective

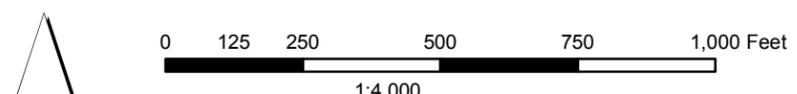




The High Hazard Zone is the area of the floodplain where there is the greatest risk of loss of life. This includes areas in the floodplain where the flood water velocity (feet per second) multiplied by the flood water depth (measured in feet) would equal or exceed four feet or where flood water depth alone would equal or exceed four feet.

Legend

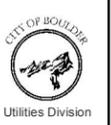
- Effective Bear Creek High Hazard Zone
- Proposed Bear Creek High Hazard Zone
- Effective Other Creeks High Hazard Zone
- Revised Boulder Creek High Hazard Zone
- Proposed Skunk Creek High Hazard Zone
- Levee
- Creek
- Ditch
- City Limits

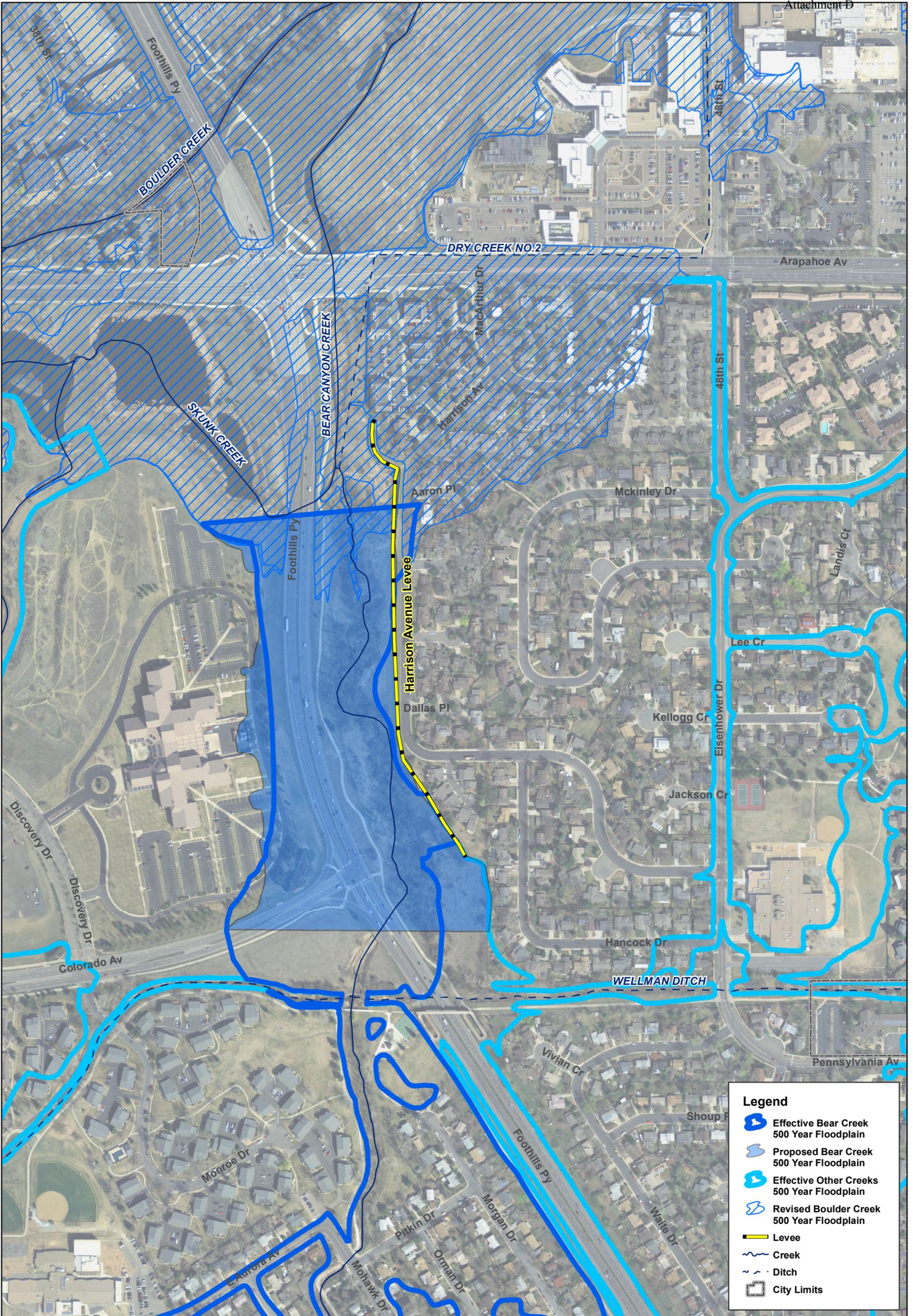


The information depicted on this map is provided as graphical representation only. The City of Boulder provides no warranty, expressed or implied, as to the accuracy and/or completeness of the information contained hereon.

Bear Canyon Creek

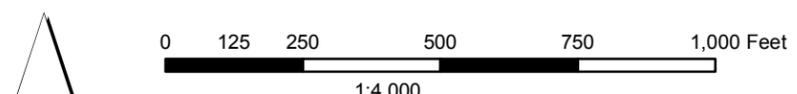
Proposed High Hazard Zone Compared to FEMA Effective





Legend

- Effective Bear Creek 500 Year Floodplain
- Proposed Bear Creek 500 Year Floodplain
- Effective Other Creeks 500 Year Floodplain
- Revised Boulder Creek 500 Year Floodplain
- Levee
- Creek
- Ditch
- City Limits

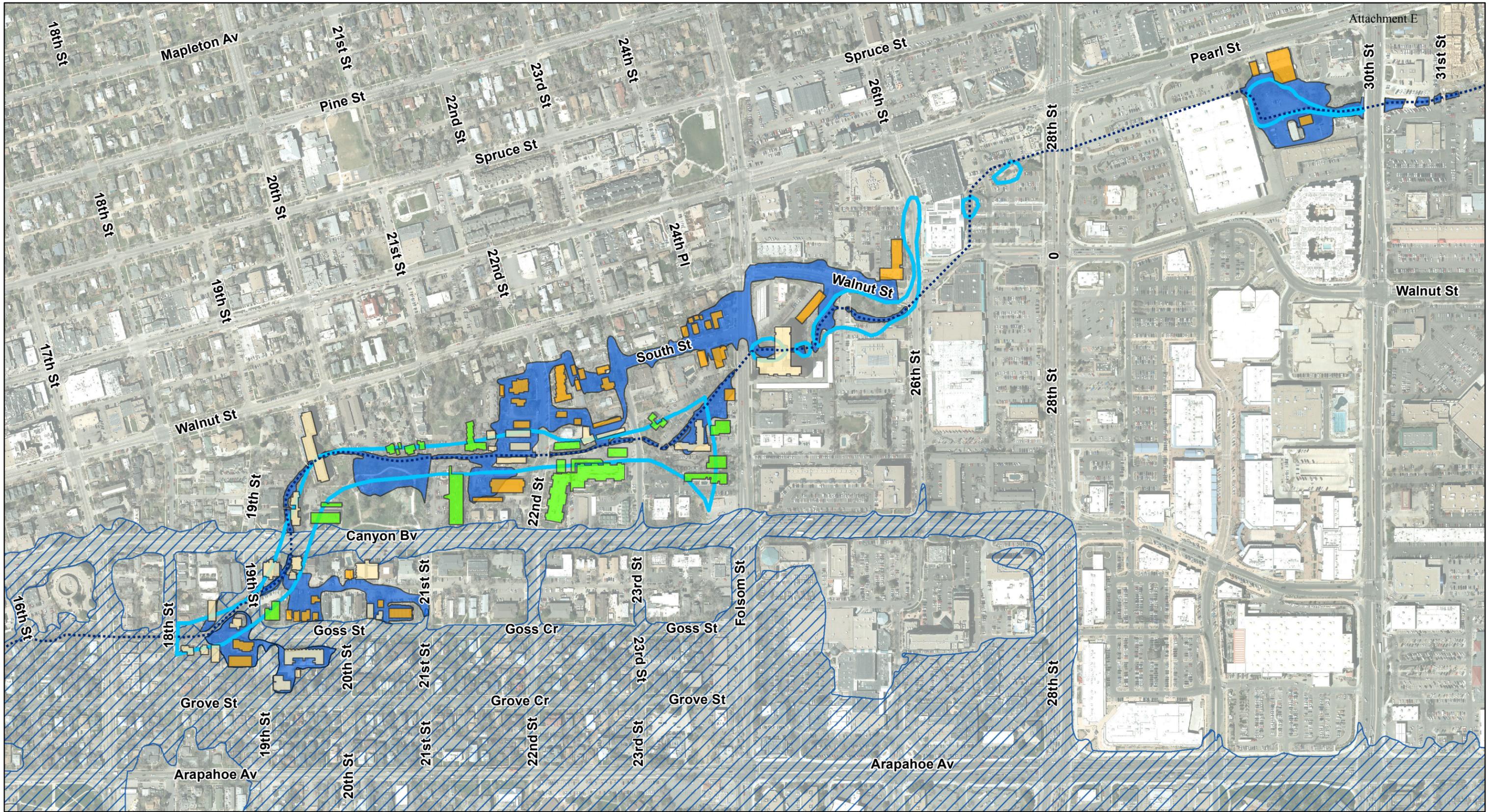


The information depicted on this map is provided as graphical representation only. The City of Boulder provides no warranty, expressed or implied, as to the accuracy and/or completeness of the information contained hereon.

Bear Canyon Creek

Proposed 500-Yr Floodplain Compared to FEMA Effective





Legend

- Proposed Boulder Slough 100 Year Floodplain
- Effective Boulder Slough 100 Year Floodplain
- Revised Boulder Creek 100 Year Floodplain
- Buildings Added to the 100 Year Floodplain (40)
- Buildings Remaining in the 100 Year Floodplain (25)
- Buildings Removed from the 100 Year Floodplain (19)
- Boulder Slough

1:4,500

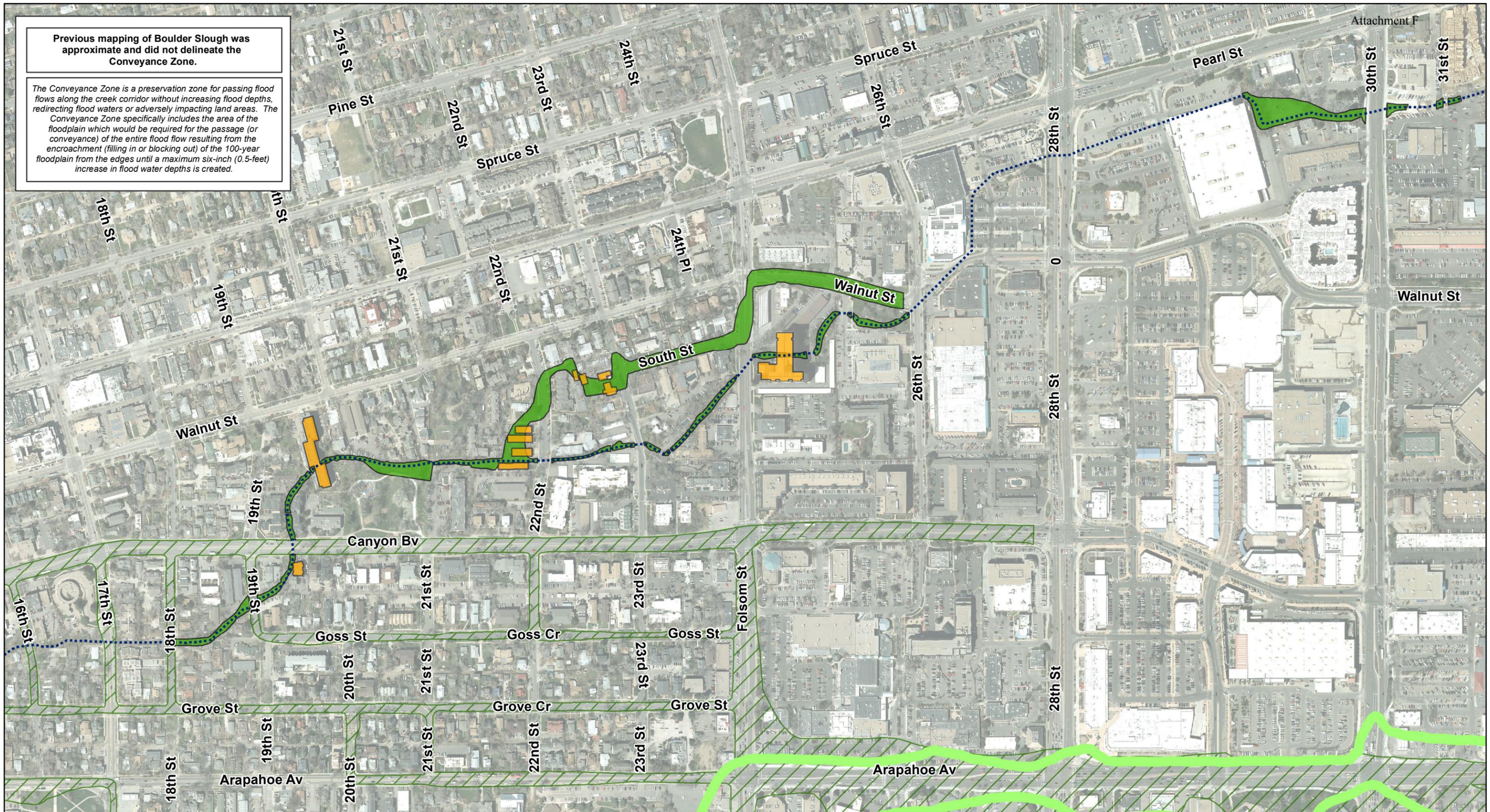
The information depicted on this map is provided as graphical representation only. The City of Boulder provides no warranty, expressed or implied, as to the accuracy and/or completeness of the information contained hereon.

Boulder Slough
Proposed 100 Year Floodplain Compared to FEMA Effective

CITY OF BOULDER
 Utilities Division
 Rev: 7/14/2014

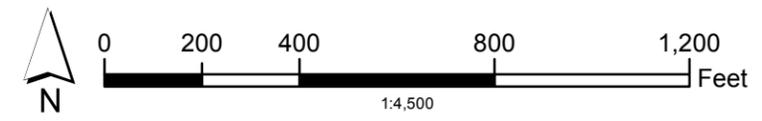
Previous mapping of Boulder Slough was approximate and did not delineate the Conveyance Zone.

The Conveyance Zone is a preservation zone for passing flood flows along the creek corridor without increasing flood depths, redirecting flood waters or adversely impacting land areas. The Conveyance Zone specifically includes the area of the floodplain which would be required for the passage (or conveyance) of the entire flood flow resulting from the encroachment (filling in or blocking out) of the 100-year floodplain from the edges until a maximum six-inch (0.5-foot) increase in flood water depths is created.



Legend

-  Proposed Boulder Slough Conveyance Zone
-  Effective Boulder Creek Conveyance Zone
-  Revised Boulder Creek Conveyance Zone
-  Buildings Added to the Conveyance Zone (11)
-  Buildings Remaining in the Conveyance Zone (0)
-  Buildings Removed from the Conveyance Zone (0)
-  Boulder Slough



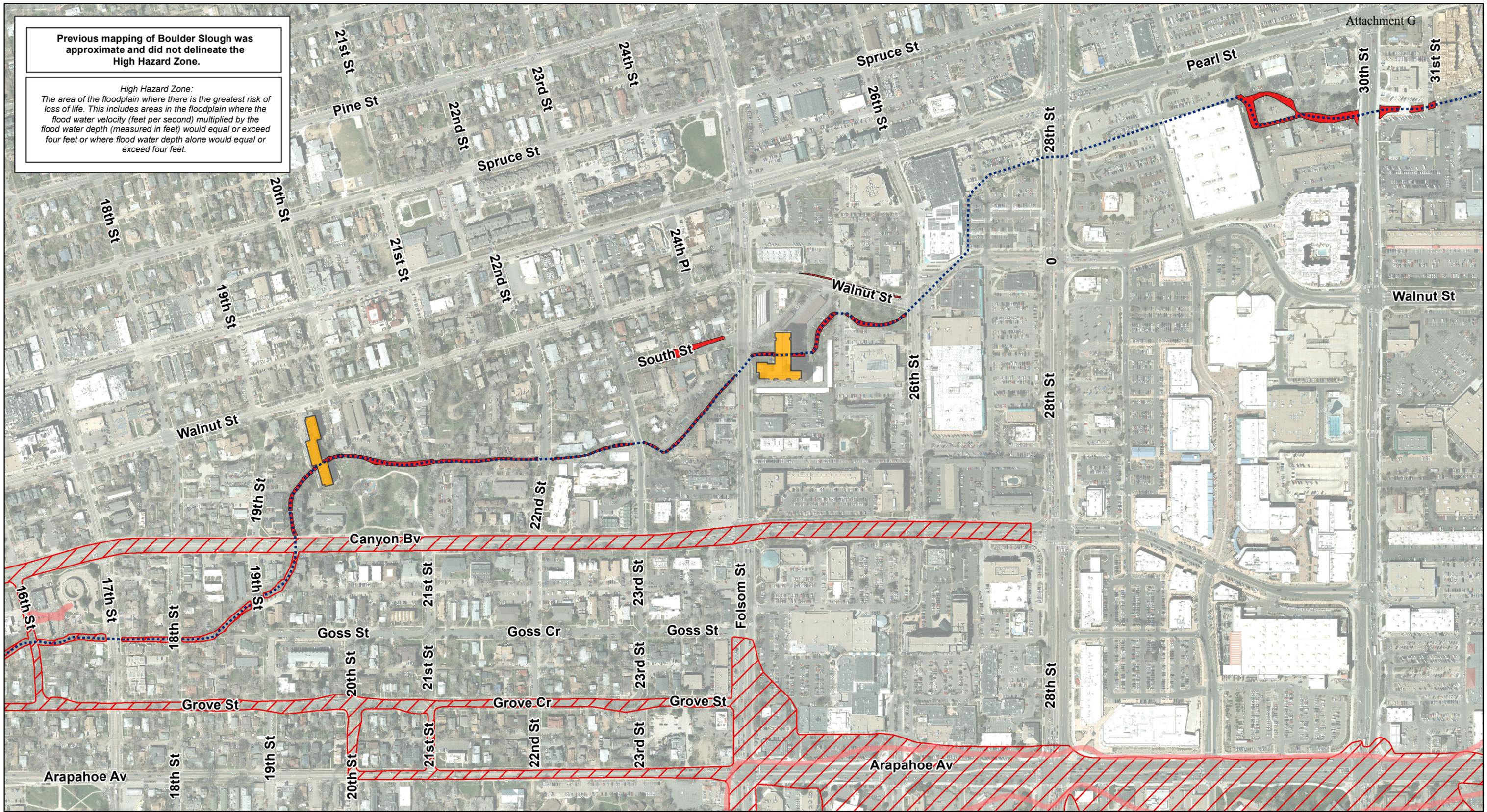
The information depicted on this map is provided as graphical representation only. The City of Boulder provides no warranty, expressed or implied, as to the accuracy and/or completeness of the information contained hereon.

Boulder Slough

Proposed Conveyance Zone Compared to FEMA Effective

Previous mapping of Boulder Slough was approximate and did not delineate the High Hazard Zone.

High Hazard Zone:
 The area of the floodplain where there is the greatest risk of loss of life. This includes areas in the floodplain where the flood water velocity (feet per second) multiplied by the flood water depth (measured in feet) would equal or exceed four feet or where flood water depth alone would equal or exceed four feet.



Attachment G

Legend

-  Proposed Boulder Slough High Hazard Zone
-  Effective Boulder Creek High Hazard Zone
-  Revised Boulder Creek High Hazard Zone
-  Buildings Added to the High Hazard Zone (2)
-  Buildings Remaining in the High Hazard Zone (0)
-  Buildings Removed from the High Hazard Zone (0)
-  Boulder Slough



The information depicted on this map is provided as graphical representation only. The City of Boulder provides no warranty, expressed or implied, as to the accuracy and/or completeness of the information contained hereon.

Boulder Slough
 Proposed High Hazard Zone
 Compared to FEMA Effective

Lower Bear Canyon Creek and Upper Boulder Slough Floodplain Mapping Revisions

The tables below present a summary of how the proposed floodplain mapping revisions impact existing structures.

Summary of Proposed Changes

Lower Bear Canyon Creek			
Number of Structures	100-Year Floodplain	Conveyance Zone	High Hazard Zone
Existing Floodplain	64	0	0
Proposed Floodplain	39	0	0
Change	-25	0	0
No Longer Affected	37		
Newly Affected	12		
No Change	27		

Upper Boulder Slough			
Number of Structures	100-Year Floodplain	Conveyance Zone	High Hazard Zone
Existing Floodplain	38	0	0
Proposed Floodplain	65*	11	2
Change	+25*	11	2
No Longer Affected	19	0	0
Newly Affected	40	11	2
No Change	25*	0	0

* Includes 6 structures that are within the Boulder Creek 100-year Floodplain.