Twomile Canyon Creek and Upper Goose Creek Floodplain Remapping Study
Frequently Asked Questions

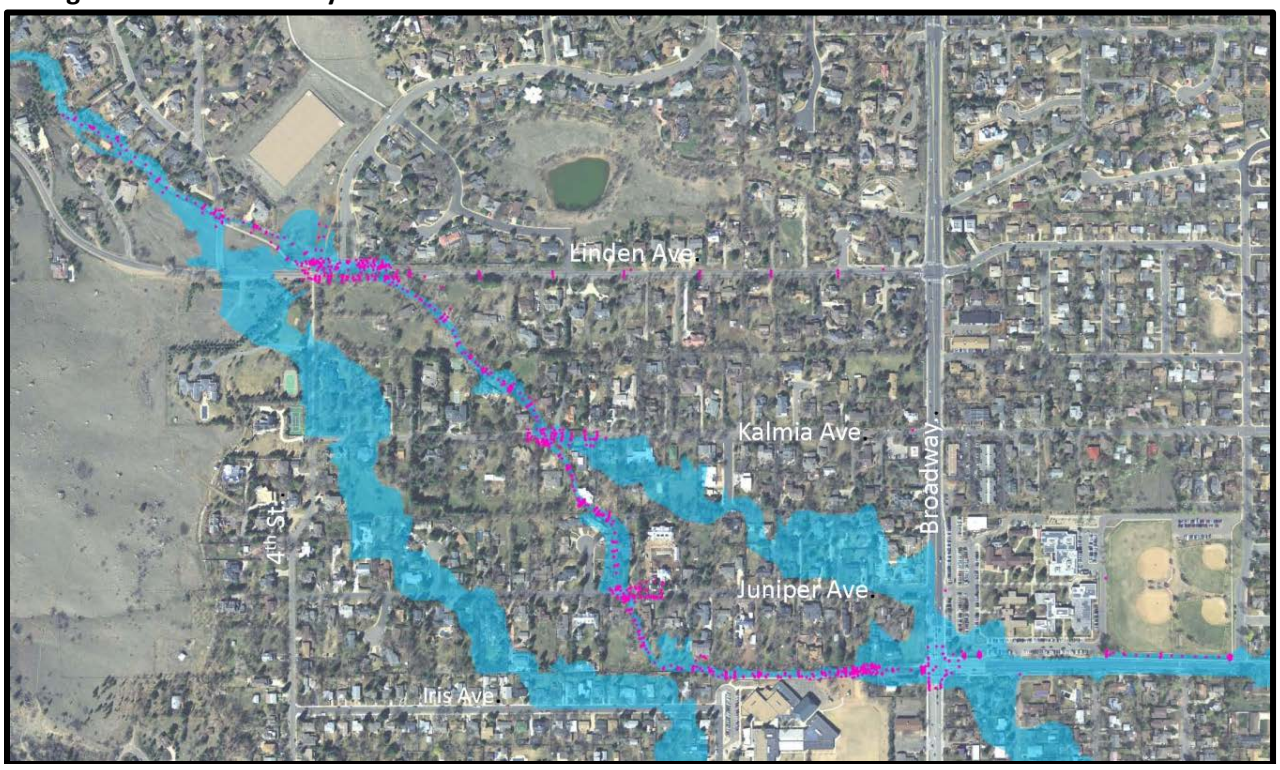
Why was this mapping study initiated at this time?

The last time these creeks were mapped was more than 20 years ago. The city's Comprehensive Flood and Stormwater Utility Master Plan and Multi-Hazard Mitigation Plan recommends the city work toward updating floodplain mapping on Boulder Creek and the 14 tributaries on a ten-year cycle. The mapping update was included in the Utilities Division's work plan for 2011.

What topographic mapping was used for the draft study?

The current study uses one-foot contour mapping that was developed in 2003. Additionally, the study consultant team supplemented the 2003 base mapping with 1,464 ground survey points collected along the main stream channel (Figure 1 below). Under a separate initiative, the city began collecting new topographic data for all of Boulder in early 2013. This new mapping uses state-of-the-art Light Detection and Ranging (LiDAR) technology to produce high-resolution topographic mapping and is anticipated to be completed in fall 2013. To help address concerns about the draft floodplain delineations, the city will compare the new LiDAR mapping to the 2003 base mapping. If substantial topographic changes are observed, city staff will revise the draft floodplain mapping using the new LiDAR base mapping.

Figure 1: Ground Survey Locations



How does this plan differ from the existing study?

The original study was done in 1983 using two-foot contour mapping. The current study uses one-foot contour mapping that was developed in 2003. In addition, the modeling capabilities changed greatly over 20 years. Both of these changes can have a large impact on floodplain mapping. As an example, Figure 2 below shows the mapping used to define the floodplain in the original study near Linden Street. As shown on this figure, the two-foot contour mapping does not show the ground sloping to the south along the extension of 4th Street. As a result, the original mapping does not show a spill to the south. Figure 3 (next page) shows the same location with the 2003 mapping. As shown on this figure, the mapping now shows the ground sloping to the south along the extension of 4th Street. This is just one example of the mapping differences that may exist throughout the study area.

Under a separate initiative, the city began collecting new topographic data for all of Boulder in early 2013. This new mapping uses state-of-the-art LiDAR technology to produce high-resolution topographic mapping and is anticipated to be completed in fall 2013. To help address concerns about the draft floodplain delineations, the city will compare the new LiDAR mapping to the 2003 base mapping. If substantial topographic changes are observed, city staff will revise the draft floodplain mapping using the new LiDAR base mapping.

Figure 2: 1983 Mapping Study

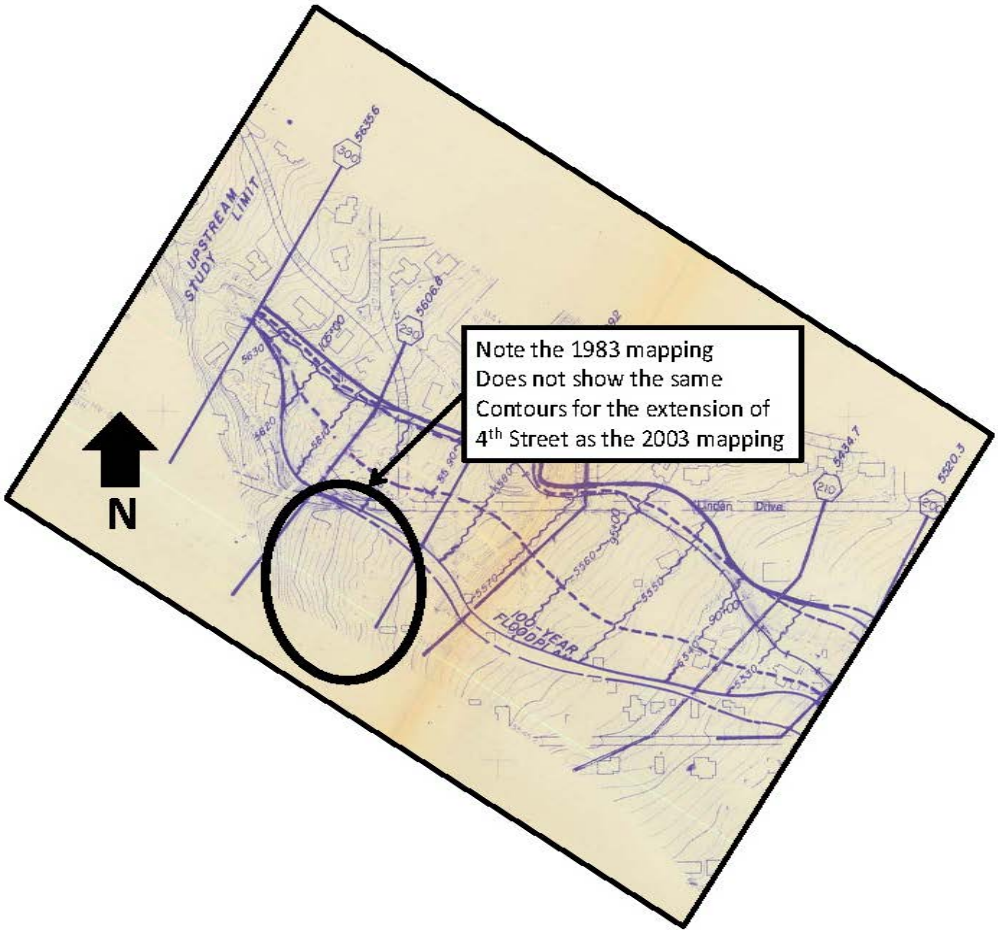
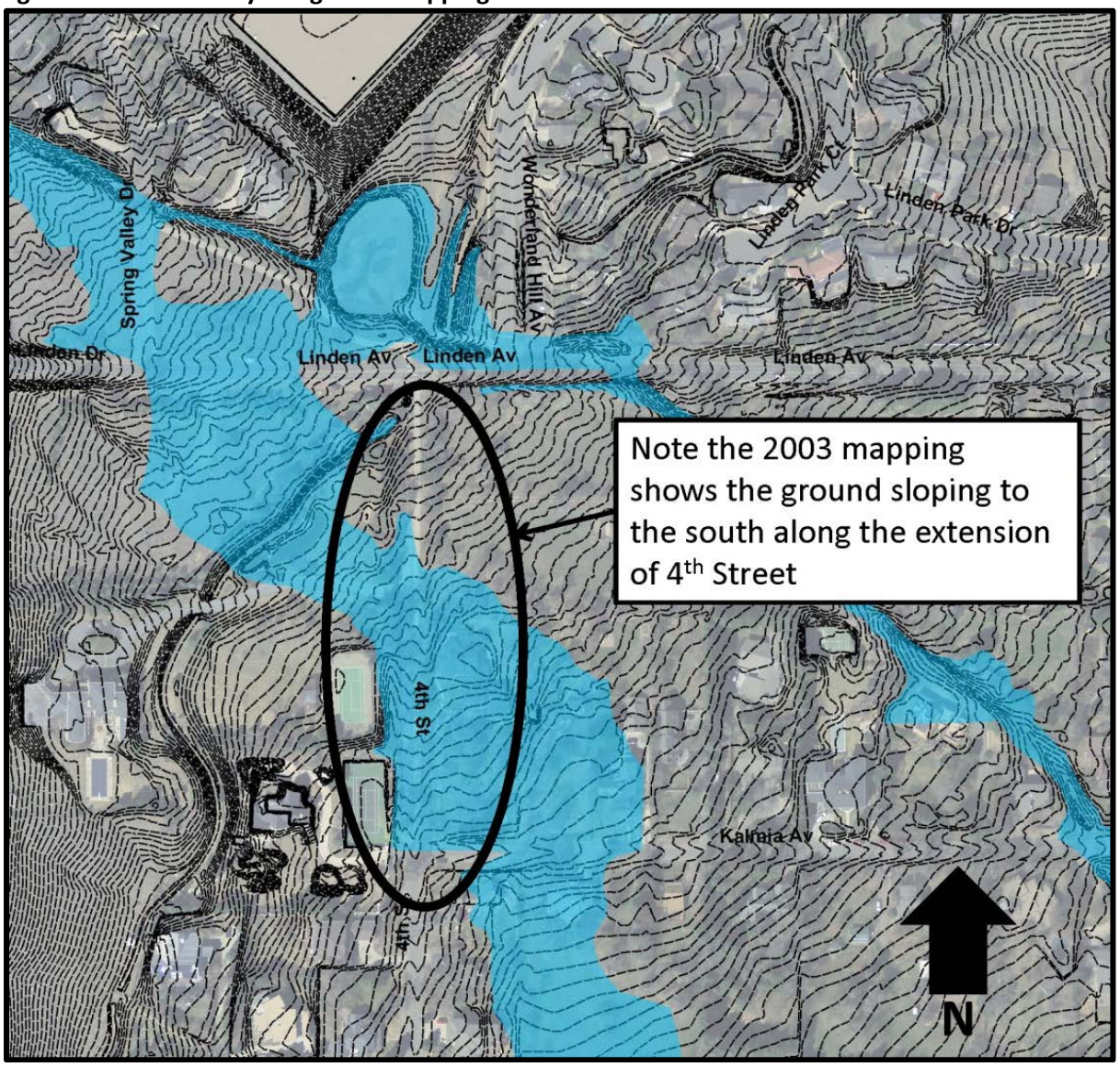


Figure 3: Revised Study using 2003 Mapping



Can the city work to mitigate the flood risk and then conduct the mapping study?

Flood mitigation plans need to be based on the best available estimate of current flood risks. Twomile Canyon Creek and Upper Goose Creek were last mapped more than 20 years ago using mapping data collected prior to 1983. For this reason, the city is working toward developing the most realistic snap-shot of flood risks along these two creeks. Following approval of the revised mapping, the city will initiate a flood mitigation planning study to investigate the feasibility of reducing or eliminating the flood risks along both creeks. This planning effort is currently scheduled to begin in 2016. Impacts of the proposed flood mitigation projects would need to be evaluated through the city's Community and Environmental Assessment Process (CEAP) and approved by City Council. The city would then need to secure funding to construct any of the recommended improvements. The floodplain mapping study will represent flood risk conditions until the time when improvements are constructed. Once improvements are made, the city will then revise the floodplain maps to reflect the new conditions.

How does the Pine Brook Hills Reservoir impact the flood hydrology of Twomile Canyon Creek?

The Pine Brook Hills Reservoir, which was completed in 2005, is used for water supply in the Pine Brook Hills community. Although approximately 15 percent of the Twomile Canyon Creek watershed flows into the water supply reservoir, it is considered full during a 100-year event. This assumption is made whenever reservoirs are used for water supply (Gross and Barker reservoirs) and not flood control (Cherry Creek Reservoir in Denver).

How was the predicted spill identified at Linden Street?

The first major upstream spill along Twomile Canyon Creek is predicted to occur at Linden Street. At this location, the two existing culverts are undersized and have shown significant sedimentation. As part of the study, the consultant team reviewed all culverts within the project area and assigned estimated debris blockages by storm events. The consultant noted this area in particular as having a high risk for debris blockage during the 100-year event due to the proximity to the foothills. The spill was identified based on a combination of high-storm flows, existing topography and the likelihood that the undersized culverts would be blocked with debris during a 100-year event. A two-dimensional model was used to identify this spill and distribution of flood water in all directions at this location. The base mapping used to create the model was developed in 2003 and shows ground elevations using a one-foot contour interval. The base mapping was supplemented with 1,464 ground survey points collected along the main stream channel.

Can the city account for private flood walls?

The Federal Emergency Management Agency (FEMA) does not allow the city to show flood protection behind privately-owned flood walls or other flood control structures. Only structures that are levee-certified by FEMA can be considered. Levee certification requires meeting stringent design criteria, maintenance and public ownership requirements. Privately-owned structures are represented in the remapping study if they are large enough to be identified by the base mapping. The models show the hydraulic influence of these structures on floodwaters, but anything located downstream or behind the structure will be shown in the floodplain.

Has the city incorporated the recent improvements along Broadway into the study?

The draft floodplain remapping study does take into account the recent improvements that have been made to both the roadway and corresponding storm drain system in the modeling effort. The storm drain system upgrades included in the Broadway project, however, ended at Elder Avenue due to funding constraints. As a result, the storm drain system has a limited stormwater conveyance capacity. The existing condition of the Broadway storm drain system is reflected in the draft remapping study models.

Does the city consider the existing culverts free from sediment and debris?

Floodplain mapping studies are meant to represent existing conditions during a flood event. The city determines culvert capacities based on their existing condition, including consideration of how damaged or crushed the culverts are and how much sediment exists at each culvert. In addition, a major storm event will result in substantial debris movement within the watershed. This debris will clog existing culverts to varying degrees. The primary engineering consulting firms, a third-party engineering review team, the city and Urban Drainage and Flood Control District (UDFCD) have agreed on estimated debris blockages based on the culvert sizes and watershed conditions for each of the simulated storm events.

These estimates are meant to represent what is believed to be the culvert condition that would occur during these storm events. The city has a maintenance program designed to help ensure the system functions during minor storm events. However, with 14 major tributaries to Boulder Creek a particular drainageway can go some length of time between maintenance operations.

Can the city remove sediment in the existing culverts? How will this affect the study results?

The existing stream systems and corresponding culverts along both Twomile Canyon Creek and Upper Goose Creek are undersized. Cleaning out existing culverts would only provide a temporary increase in conveyance capacity until the culverts are again blocked by sediment or debris during a storm event. Overestimating the capacity of these culverts by simulating them as free from sediment and debris during a major storm event would underestimate the true flood risk. The long-term solution is likely to replace undersized culverts and increase channel capacity. These alternatives will be evaluated by the city in a flood mitigation planning study, following adoption of revised floodplain maps.

Why are culverts less than two-feet in diameter not included in the study?

The 100-year flood peak flows at the upstream end of Twomile Canyon Creek is approximately 700 cfs. A culvert that is two-feet in diameter has the capacity of approximately 20 to 40 cfs. These small culverts would likely be clogged with debris during a major storm event, further limiting their capacity. For these reasons, small culverts are not typically included in 100-year floodplain mapping studies.

Some draft floodplain limits show a straight line, why is this?

Straight line floodplain delineations can occur when the estimated flooding depth becomes shallow enough to no longer be considered 100-year floodplain. This occurs when average water depths become less than one-foot deep as floodwaters spill out and flow downstream.

Is the two-dimensional model was used as part of the study a proven technology?

The two-dimensional model used to define the draft split flows is approved by FEMA for use in floodplain studies. Two-dimensional modeling is now recognized in the profession as helpful to define alluvial-fan split-flow conditions.

Only half of my house is in the draft flood zone. How can this be?

The floodplain is sometimes shown partway through a structure based on the elevation of the 100-year floodwaters and the elevation of the ground below the building, as defined by the project mapping. Structures were included in the draft study models based on current city building footprint

information. The models simulate the hydraulic influence the structures have on the floodplain but water is assumed to enter the structures during a major storm event.

What storm event was used to develop the draft 100-year floodplain maps?

A two-hour storm event having a total rainfall amount of 3.0 inches was used to develop the draft 100-year floodplain mapping. Data for this event is based on rainfall criteria established by the UDFCD. The two-dimensional model was run for a 20 hour period. This run time was selected to ensure that the simulation ran long enough to achieve steady state conditions and better correlate the peak inflow to the system with the peak outflow.

If the results do not match historic flood records, does that indicate it is incorrect?

Not necessarily. Information about past flood events can be helpful in determining general areas of flooding, but records rarely include specific details such as limits of flooding, depth of flooding, or size and intensity of the storm. Additionally, changes in land use and topography over time can greatly affect how current flooding will likely occur.

Can there be narrow bands of high hazard zone?

The high-hazard zone is a City of Boulder flood zone that defines the area of the floodplain where there is the greatest risk for loss of life. The high-hazard zone represents those areas in the 100-year floodplain where the depth or velocity of floodwaters is great enough to sweep people off their feet and wash them downstream. The high-hazard zone is defined as all areas in the floodplain where the floodwater velocity (feet per second) multiplied by the floodwater depth (measured in feet) would equal or exceed four or where floodwater depth alone would equal or exceed four feet.

An example would be a flood depth of three feet with the water moving 1½ feet per second, which would result in a product number of 4½, thus placing the area within the high-hazard zone. The high-hazard zone takes many shapes within a floodplain, depending on whether that area of the floodplain meets or exceeds the water depth and velocity criteria.

Were the irrigation ditches considered in the draft study?

Stormwater runoff enters irrigation ditches at numerous locations. The city, UDFCD and FEMA assume irrigation ditches are flowing full during a 100-year storm event. The landforms surrounding the irrigation ditches are, however, simulated in the models if captured in the mapping. These land forms can influence how floodwaters move across a full ditch. The resolution of the new LiDAR mapping may allow the city to even better capture the influence of these landforms.

Was the draft conveyance zone delineated arbitrarily?

The conveyance zone is synonymous with FEMA's floodway. The establishment of a conveyance zone recognizes that development activities are expected to occur in the 100-year floodplain, but places limits on these activities to prevent adverse impacts to the floodplain. The conveyance zone is preserved for passing floodwaters along the creek corridor without increasing flood depths, redirecting floodwaters or adversely impacting other land areas.

The conveyance zone is delineated using two methods. If there are no publically-owned lands, the creek is encroached equally from both sides. If there is publically-owned land adjacent to the flow path or creek, then these areas are used first to define the conveyance zone. If the public lands are not large enough to fully delineate the conveyance zone, the remainder of the zone will be delineated on private land.

Proposed development can occur in the conveyance zone but must demonstrate that improvements will not result in a rise in the water surface elevation. Proposed developments are also subject to a Planning Board call-up and must meet the 100-year floodplain requirements.

Why doesn't the draft mapping show flow continuing down Broadway?

The draft remapping study does show flow continuing down Broadway, but it becomes too shallow to be considered a 100-year flood (the city only shows a switch from 100-year floodplain to 500-year floodplain if the average water depth is less than one foot). Figure 4 (below) shows the draft 100-year floodplain in blue and the 500-year floodplain in green.

Figure 4: Broadway Flooding