City of Boulder Multi-Hazard Mitigation Plan
2015 Annual Review

INTRODUCTION

The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premium rates for community members are discounted based on the community's efforts to reduce flood losses beyond the minimum requirements. The City of Boulder participates in the CRS program and currently has a community rating of 5 out of 10 (1 being the highest rating). This rating provides an annual flood insurance premium discount of approximately 25 percent for property owners. The city's rating has steadily improved since 2010, when the rating was a seven and only provided for a 15 percent discount for property owners.

Participating communities must submit documentation annually to the Federal Emergency Management Agency (FEMA) for recertification by Oct. 1. One program element the City of Boulder elected to participate in was the preparation of a Multi-Hazard Mitigation Plan. The plan was prepared pursuant to the requirements of the federal Disaster Mitigation Act of 2000 so that the city would be eligible for the FEMA Pre-Disaster Mitigation and Hazard Mitigation Grant Program in addition to achieving CRS credits. The original Multi-Hazard Mitigation Plan was adopted by City Council on Aug.19, 2008, and a comprehensive update was adopted by City Council on April 2, 2013 and approved by FEMA on May 24, 2013.

More information about Boulder's multi-hazard mitigation strategy can be found on the city's website, as can the full Plan.

While the comprehensive update was prepared and adopted prior to the September 2013 flood, many of the action items in the plan have been implemented as a response to that event, improving the city's and county's preparation for and response to natural hazard events in the future.

BACKGROUND

The Multi-Hazard Mitigation Plan is required to include a description of mitigation goals that reduce or avoid long-term vulnerabilities to identified hazards. Goals were defined as broad-based public policy statements that are stated without regard for implementation, that is, implementation cost, schedule and means are not considered. For the purposes of the plan, goals are defined before considering how to accomplish them so that the goals are not dependent on the means of achievement. Goal statements form the basis for objectives and actions that will be used as means to achieve the goals.

The City of Boulder Multi-Hazard Mitigation Plan has three goals:

Goal 1: Increase Community Awareness of Boulder's Vulnerability to Natural Hazards

- This goal will be accomplished through actions that inform and educate the community about the types of hazards the City of Boulder is exposed to, where they occur and recommended responses.

Goal 2: Reduce Vulnerability of People, Property, and the Environment to Natural Hazards

- This goal will be accomplished through mechanisms that enhance life safety and by reducing impacts to critical facilities, existing infrastructure, future development, natural and historic resources and public health. Provide mechanisms to enhance life safety.

Goal 3: Increase Interagency Capabilities and Coordination to Reduce the Impacts of Natural Hazards

- This goal will be accomplished by continuing to collaborate and coordinate with other agencies on planning, projects, hazard response and funding opportunities.

To meet identified goals, the plan recommends 33 mitigation actions: twelve multi-hazard, twelve flood, one human health, six wildfire and two drought actions.

The full plan includes a description of each action, identification of alternatives if applicable, the responsible office, the priority, a cost estimate, estimated benefits, potential funding sources and schedule.

EVALUATION OF PLAN ACTIONS

Each of the 33 actions was reviewed by the responsible office. The review includes a statement on how much has been accomplished, when the action is scheduled to be addressed, or if modifications to the action are recommended. The following presents the annual review by action item.

Multi-Hazard Actions

Action #1: Outreach Efforts Associated with BoCo911Alert.com

Action Background: Now that many families have stopped using telephone land lines, efforts to ensure that emergency notifications can be sent to people potentially impacted by emergency situations need to be made. Public safety agencies throughout Boulder County are switching to a new emergency notification system which is accessible at BoCO911Alert.com. This system will allow residents of the county and all cities within the county to be notified of an emergency situation in a variety of ways, including on their cell phone, home and work phones, by text messaging and e-mail. This project would include outreach efforts to raise awareness about BoCO911Alert.com to increase the number of subscribers.

Reviewer / Responsible Office: Boulder Office of Emergency Management (OEM)

Action Status: This action is ongoing. The Boulder OEM website has been updated to include BOCO911Alert.com as a link to allow for community sign up. Media releases throughout 2014

included not only the current topic but also included the BOCO911 sign up message. Three community meetings related to flooding in the City of Boulder were held with the BOCO911.Alert message in the agenda. Social media is also being used to push the BOCO911.Alert message. As part of flood outreach efforts in 2014, more than 1,000 households were visited, which included information on signing up for BoCo911altert.com, and canvassers carried iPads to sign up residents they spoke with.

Action # 2. Develop Updated City Continuity of Operations and Emergency Evacuation Plans

Action Background: The city has outdated or incomplete plans for staff evacuation and continuity of operations following a disaster. These plans need to be updated and/or developed to ensure adequate safety and services.

Reviewer / Responsible Office: Boulder OEM

Action Status: This action is in progress. Small updates to the city's Continuity of Operations Plan (COOP) and emergency evacuation plans were completed in May 2015. Evacuation information for every city facility was posted on the employee intraweb in 2014. Evacuation maps will continue to be posted in all city facilities within the floodplain. The city updated the employee all-hazards alert notification system in the spring of 2015, and it completed outreach with each department to train employees on the updates to the system, including a training video that was sent to all city employees which was viewed more than 440 times. The September 2013 flood was a real application of these plans, and the lessons learned will be applied and plans will be revised and updated. Flood recovery and Office of Emergency Management staff teams are continuing to assist in coordinating updates to the COOP and facility emergency plans in conjunction with a multi-departmental staff team. COOP and Emergency Evacuation Plan updates are scheduled to begin at the end of 2015.

Action #3. Preplan Prime Evacuation Points/Shelter Locations for Emergency Situations (fire, flood, snow, etc.)

Action Background: The city and county have developed systems to alert the public when there is an emergency or disaster. These mass notification systems are effective tools to use when evacuating the public out of harm's way. Currently there is not a plan or infrastructure to identify locations or facilities as pre-designated evacuation sites. There is a shelter plan, and this is managed through the OEM by Essential Support Function (ESF) 6 Mass Care and the local Red Cross. Shelters take 2 to 3 hours to establish, and evacuation sites or locations are to be the intermediary locations for the public to gather safely and obtain information with little assistance provided except for immediate life-threatening and safety issues. This project would entail preplanning prime evacuation points/shelter locations for emergency situations (fire, flood, snow, etc.).

Reviewer / Responsible Office: Boulder OEM

Action Status: This action is in progress.

Boulder OEM has worked with the Red Cross to verify shelter locations and Americans with Disabilities Act compliance. The shelter list and locations were updated in 2014. ESF 6- Mass Care has performed an After Action Report from flood disaster and is making improvements. An improvement plan is pending the hiring of additional staff. ESF 6- Mass Care created an Emergency Operation Center summary sheet describing the roles, responsibilities and operational concepts of operations. ESF Planning involves evacuations, mass care and unmet needs.

Operational Planning has emergency notification areas with evacuation points identified. Having areas predetermined makes it is easier to launch messages and also know the size of evacuation for shelter capacity and location of the shelter. This was completed in 2015.

Three access and functional needs shelters in the county exist right now. North Boulder Recreation Center is currently in the inventory, and East Boulder Recreation Center is becoming an access functional needs site and was scheduled to be completed in 2015. However, this was delayed due to grant funding problems. There is still a possibility that it will be completed in 2015. The Boulder County Amateur Radio Emergency Services (BCARES) is a volunteer radio organization that eploys to all shelter sites for communications between the EOC and shelter.

Action #4. Prepare pre-disaster forms to facilitate public infrastructure mitigation through the FEMA public assistance program during post-disaster recovery

Action Background: Following a disaster there is a 60-day filing time to complete project sheets to qualify for funding under the Public Assistance (PA) program within a Stafford Act (Presidential Disaster) Declaration. Having the critical infrastructure project sheets completed in advance and updated yearly ensures that the City of Boulder will qualify to the maximum benefit under a disaster declaration within reimbursement cost sharing guidelines. In addition, if mitigation projects are included in the assessment and written into the project sheets, it will increase opportunities to apply mitigation projects into the recovery process. This project would entail assembling, in a pre-disaster environment, data for PA forms for infrastructure that would be expected to be impacted by flood, fire or technological hazards.

Reviewer / Responsible Office: Boulder OEM

Action Status: This action is in progress. The city experienced challenges with damage assessment following the 2013 flood for public infrastructure because of a lack of a standardized process and understanding of necessary forms. In September 2015 the city and county acquired a subscription to Crisis Track, cloud-based damage assessment software that allows for the documentation of damage for public infrastructure and private property, as well as the tracking of staff time and equipment. The software then compiles and completes the Preliminary Damage Assessment FEMA forms. Implementation and testing will continue through 2016. The city and county are updating the damage assessment annexes to reflect the new processes and procedures.

Additionally, because of the 2013 and 2015 Presidential Disasters, the city is currently engaged in the PA process. The city has 59 Project Worksheets with FEMA for the 2013 Disaster, and an

anticipated 2 Project Worksheets for the 2015 Disaster. The city is documenting lessons learned and procedures necessary for PA eligibility in a city FEMA Handbook to inform future disaster recovery programs.

Action #5. Recovery Plan Development

Action Background: The joint recovery plans for the City of Boulder and Boulder County are currently under development and will integrate the efforts of the Urban Area Security Initiative (UASI) Wide Area Recovery Plan and the State of Colorado Recovery Plan. Recovery planning is important because mitigation projects and efforts post disaster are coordinated through the recovery coordination group.

Reviewer / Responsible Office: Boulder OEM

Action Status: This action is in progress. A Recovery Plan and a Damage Assessment Plan were completed prior to the 2013 flood. Lessons learned from the 2013 flood highlighted several areas where a more robust recovery structure and recovery plan is necessary. The city completed a Flood Recovery after action report on Sept. 11, 2015, identifying best practices and lessons learned in the recovery process to date. Development of the recovery plan and associated annexes are underway and will continue into 2016.

Action #6. Become a StormReady Designated Community

Action Background: The National Weather Service (NWS) provides a StormReady assessment for local communities that develop their severe weather monitoring capability, public warning systems and rain and stream gauge monitoring systems. If a community obtains this rating they can receive credits under the Community Rating System, which could potentially lower the cost of flood insurance for residents. Boulder OEM has been working with the NWS to prepare and submit this application in 2012.

Reviewer / Responsible Office: Boulder OEM

Action Status: This action is complete. The City of Boulder and Boulder County were designated as StormReady in 2013.

Action #7. Increase Web-based Public Outreach

Action Background: Increasing public awareness of hazards in the city and county is a goal of this plan and an ongoing activity of Boulder Office of Emergency Management (OEM). This project would continue and supplement existing community outreach efforts, with additional Web-based information on hazards and personal preparedness measures.

Reviewer / Responsible Office: Boulder OEM/City of Boulder Public Works

Action Status: This action is in progress. In spring 2014, the city launched an eight-week campaign to increase public awareness of flood safety and personal preparedness measures. The campaign was paired with online advertising, social media posts and an integrated Web presence.

The advertisements and messages pointed users to Boulder's Community Guide to Flood Safety, a comprehensive guide about preparation before, during and after a flood. Based on campaign metrics, a total of 311,184 Boulder County residents saw some iteration of the Web-based public outreach. The information continues to remain on the boulderfloodinfo.net web page and the content is kept current.

Action #8. Enhance Outdoor Emergency Warning System - add sirens to northwest, east and southeast areas of the city

Action Background: There are 11 outdoor warning sirens operating in the City of Boulder currently. The sirens should be evaluated for risk placement to ensure coverage serves the identified hazard message capability of the system. For example, the sirens in Sector 5 may need to be moved farther west to increase coverage capability. The movement may require additional sirens toward the core of the city in the Northern corridor. In addition, to cover the entire city, it possibly could require six additional sirens.

Reviewer / Responsible Office: Boulder OEM

Action Status: This action is in progress. A siren inventory has been verified to determine coverage gaps and determined approximate six locations where sirens should be installed; three sirens west of Broadway (one west of Lee Hill Road and Broadway, one west of Linden Avenue and Broadway, and one in the vicinity of Boulder Community Hospital); the neighborhood southeast of the intersection of Baseline Road and Foothills Parkway (near the East Boulder Recreation Center or Manhattan Middle School); the area around 55th Street and Valmont Road; and also the city properties in Gunbarrel, as there are no nearby sirens in that area at all. Sirens are intended for outdoor warning, so they don't necessarily need to be placed only in neighborhoods but anywhere the active Boulder citizens play outdoors. The cost estimate is $45,000 dollars per siren. Yearly verification of the functional status of all sirens is performed and the sirens are remotely tested once a month from April to August with silent testing weekly.

Action #9. Implement Replacement Planting Program to Meet Tree Criteria

Action Background: Target a 2:1 replacement ratio for the planting program and target species diversity such that no tree species comprises more than 10 percent of the current population (consistent with City of Boulder Environmental Management Audit 2001).

Reviewer / Responsible Office: Parks and Recreation Department

Action Status: This action is in progress. The current annual Parks and Recreation Forestry tree planting budget is $18,500. This budget allows approximately 65 trees to be planted per year. The workgroup removed on average 310 trees annually (this figure does not account for losses

due to Emerald Ash Borer (EAB)). A minimum of a 2:1 planting-to-tree-removal ratio should be implemented to maintain the urban tree canopy. In 2010 thru 2014, the city Urban Forestry work group has achieved a minimum of a 2:1 planting ratio using funding from the Tree Mitigation program. The Forestry workgroup receives reimbursement for trees removed or destroyed per B.R.C, 6-6-7. However, this funding source varies from year to year and therefore not stable.

It is important to maintain tree diversity in all tree planting related to city projects as well as through development to make local ecosystems more resilient to threats from invasive tree pests and to canopy impacts due to climate change. Parks and Recreation Forestry planted more than 35 different tree species in 2014 and 2015.

There are 6,000 ash trees (12 percent of the total) on public property. It is estimated there are an additional 66,000 ash trees on private property and naturalized along creek corridors. In 2015-2018, Parks and Recreation Forestry will receive an additional $230,000 annually from Capital Improvement Program funding for EAB management, including tree planting.

Action #10. Increase Urban Forest Canopy from 7 Percent to 9 Percent in Commercial Areas and from 31 Percent to 35 Percent in Residential Areas to Provide Maximum Flood Reduction Benefit

Action Background: Extensive research conducted worldwide provides evidence that stream degradation occurs with as little as 10 percent impervious cover. During storms, accumulated pollutants are quickly washed off and rapidly delivered to aquatic systems as stormwater runoff. In a typical small-scale storm event (0.5 inches), highly concentrated and polluted stormwater would, without interference, flow directly into Boulder's waterways. These small storms are responsible for most pollutant washout, also known as the "first flush" effect. Urban stormwater runoff is the second most common source of water pollution for lakes and estuaries and the third most common source for rivers nationwide (From Calculating the Value of Boulder's Urban Forest, October 2002, Chapter 1, page 2).

Trees in urban areas can protect water quality by substantially reducing the amount of runoff from the more frequent but less extreme storm events that are responsible for most annual pollutant runoff. Infiltrating and treating stormwater runoff on site can reduce runoff and pollutant loads by 20 to 60 percent. Trees' extensive fibrous root systems also hold soil in place, reducing further impacts on water quality caused by erosion (From Calculating the Value of Boulder's Urban Forest, October 2002, Chapter 1, page 4).

Reviewer / Responsible Office: Parks and Recreation Department

Action Status: This action is in progress. The numbers stated in the action item were extrapolated from a series of plots within the city. Parks and Recreation Forestry staff is exploring options to gain a more accurate analysis of the urban tree canopy using existing LiDAR data. The Forestry Division received additional funding starting in 2009 for tree planting and maintenance in the commercial areas. Forestry planted 255 trees in the Business Improvement District since spring 2008 (23 trees in 2008, 19 trees in 2009, 33 trees in 2010, 25 trees in 2011, 24 trees in 2012, 21 trees in 2013, 63 trees in 2014, and 47 trees in 2015).

Ash trees comprise at least 12 percent of the urban tree canopy, and it is estimated the City of Boulder has more than 72,000 ash trees on both public and private property. In September 2013, City of Boulder Parks and Recreation Forestry staff discovered an emerald ash borer (EAB) infestation within the city. The subsequent delimitation survey showed EAB is well established within a corridor in central Boulder. Over the next decade, EAB management, including tree removal, tree replacement, wood disposal and pesticide treatments, will have a significant direct budgetary impact to the City of Boulder and private residents. The loss of urban tree canopy will have considerable economic, social and environmental impacts for decades.

Forestry staff developed EAB Workplans for 2014-2015 to respond to the infestation within the city and potentially slow the spread throughout Boulder and to nearby communities. Long-term strategies and recommendations will be discussed with City Council in a Study Session in 2015.

Action #11. Implement a System of Automatic Vehicle Location for Police, Fire and Snow Removal Vehicles

Action Background: City snow removal vehicles now have GPS vehicle locators; however, this information is not shared with police, fire and other agencies. Police and fire vehicles, if equipped with automatic vehicle location (AVL), will enable better tracking and dispatching of resources. Tracking of resources during flood warnings will enable police, fire and snow vehicles potentially at risk to flooding to be mobilized. During a major flood event on Boulder Creek, the city will be cut in two. The AVL system will help the tracking and dispatching of resources on the north and south sides of Boulder Creek. Sharing of snow removal vehicle movement during winter storms and blizzards will assist fire and police personnel with emergency response access and evacuation needs.

Reviewer / Responsible Office: Boulder Office of Emergency Management

Action Status: This action is in progress.

Action #12. Increase Rotational Pruning of Street Trees to Eight Years

Action Background: The current pruning rotation of ten years places undue stress on the urban forest. Increasing the pruning rotation from 10 years to eight years will improve structure, reduce sight clearance problems, remove deadwood, mechanically remove insect and disease problems and, most importantly, reduce potential liability. An eight-year pruning rotation would make trees stronger and more resistant to storm, freeze and snow damage, thus reducing post-storm cleanup costs and liability exposure.

Note that Boulder's urban forest, when maintained in a healthy condition, returns benefits of $56 per tree or $2 million annually. Furthermore, for every $1 spent on tree care, Boulder receives $3.64 in benefits (E.G. McPherson, et al. September 2005).

Reviewer / Responsible Office: Parks and Recreation Department

Action Status: This action is in progress. The current city pruning rotation of 10 years for trees in the public street rights-of-way and eight years for city park trees was based on the 2000 tree inventory of 35,502 total public trees. An additional $30,000 was allocated to the Parks and Recreation Forestry Division in 2014 and is on-going to ensure the current pruning rotation could be maintained given additional public trees added through development projects. An updated inventory of the public city park and street right-of-way trees was completed in July 2015 and showed an increase of 14,822 trees (to 50,324 total trees) over the 15-year period. Parks and Recreation Forestry staff is currently analyzing the new tree inventory figures to determine the pruning rotation for the next five years.

Flood Mitigation Actions

Action #13. Enhance Flood Warning System on Smaller Tributaries

Action Background: There are 14 tributaries to Boulder Creek that flow through the City of Boulder. The city has an extensive network of rain and stream gages that provide real-time data for Boulder Creek and South Boulder Creek. The city also has cameras showing stream conditions on Boulder Creek and Fourmile Creek. The city is 'blind', however, on most of the smaller tributaries. Storm flows in these tributaries peak too quickly to make installation of stream gages effective. Installation of cameras, however, would greatly enhance the city's knowledge of flood conditions along the smaller tributaries. Installation of additional rain gages located within the city's smaller tributary watersheds would also provide reliable real-time information that could be accessed by the Urban Drainage and Flood Control's ALERT network.

Reviewer / Responsible Office: Public Works Department

Action Status: This action is in progress. The city installed a camera along Bear Canyon Creek in spring of 2013. The city will continue to evaluate the need and location options for additional cameras such as along Fourmile Canyon Creek.

Action #14. Relocate Fire Station out of 100-year Floodplain

Action Background: As noted in the City of Boulder's 2011 Operations and Management Assessment, Fire Station #3 at Arapahoe Avenue and 30th Street is currently located in the 100-year floodplain. The city's 2012 Fire Master Plan also recommends that a new station include administrative staff space and records storage. This project would entail relocation of the station to a location outside of the 100- and 500- year floodplains.

Reviewer / Responsible Office: Public Works Department/Fire-Rescue Department

Action Status: This action is in progress. In August 2013, the critical facilities ordinance was approved by City Council which identified requirements for critical city facilities in the 500-year floodplain, which a fire station would be subject to.

The Fire Department and Information Resources have mapped out response times of existing stations with current and expected growth in the city to identify optimal station locations. Per City Council's request, the Fire Department is also looking at smaller fire response vehicles, which will affect station sizing. Public Works and the Fire Department will conduct a space study for sizing a new Fire Station 3 and it was anticipated that this study will be completed in spring 2015. The goal is to identify the cost of a new station in preparation for a possible 2016 bond to go to the citizens of Boulder.

In April 2015, Boulder City Council approved an update to the Fire Master Plan that included a space needs study for a new Fire Station #3. A new station would be 13,600 square feet in size, not including circulation and a possible community use space. Current construction costs range from $4.8 million to $6 million, not including land costs. City staff are now identifying funding options for this large capital project (which may necessitate voter approved bonding) and discussing potential sites for relocation.

Action #15. Flood Hazard Prioritization

Action Background: The city prepares flood mitigation studies for each of the major drainageways. The flood mitigation studies prioritize capital improvements within each drainageway. The city, however, has not conducted an evaluation to prioritize flood mitigation efforts citywide.

Reviewer / Responsible Office: Public Works Department

Action Status: No action has been taken to date. However, funding for this study is scheduled for 2017.

Action #16. Update the Comprehensive Flood and Stormwater Master Plan (CFS)

Action Background: The city prepared a Comprehensive Flood and Stormwater Master Plan (CFS) in 2004. The plan provides a framework for evaluating, developing and implementing programs and activities related to the city's flood management, stormwater quality and stormwater drainage systems. The plan is nearly eleven years old and requires updating.

Reviewer / Responsible Office: Public Works Department

Action Status: No action has been taken to date. However, funding for this study is scheduled for 2017.

Action #17. Update Flood Preparedness Web Mapping Site

Action Background: The Flood Preparedness website is a primary tool for city flood preparedness. The site brings together a large amount of city GIS data with real-time rain and stream gages along with National Weather Service radar information. ESRI, the GIS software company, will sunset the WebADF API in future releases of software, meaning the Flood Preparedness site will not work with newer versions of ESRI's ArcServer web server software.

Reviewer / Responsible Office: Public Works Department

Action Status: This action is complete. The city has reprogrammed the site using JavaScript, HTML5 and CSS. The updated Flood Preparedness website is now available on a desktop, tablet or mobile device.

Action #18. Develop Flood Mitigation Plans After Flood Mapping Updates

Action Background: Develop major drainageway flood mitigation plans following floodplain mapping updates.

Reviewer / Responsible Office: Public Works Department

Action Status: This action is in progress. Following the 2013 flood, the city accelerated its flood mitigation plan work program. Floodplain mitigation studies have been developed for Fourmile Canyon Creek and Wonderland Creek. A floodplain mitigation plan was recently approved for South Boulder Creek, and planning efforts are underway for Gregory Canyon Creek and Bear Canyon Creek. A watershed master plan for Boulder Creek is currently being developed by the Urban Drainage and Flood Control District. A flood mitigation master plan is scheduled to begin in 2016 for Twomile Canyon Creek and Upper Goose Creek.

Action #19. Implement Mitigation Plan for Fourmile Creek and Wonderland Creek

Action Background: Fourmile Canyon Creek and Wonderland Creek exhibit a significant flood risk to a number of residential neighborhoods in Boulder. The existing system is undersized along most reaches of both creeks. Fourmile Canyon Creek spills to Wonderland Creek during storms greater than the 50-year event, increasing the flood risk along Wonderland Creek during major events. In addition, approximately 20 percent of the Fourmile burn area that occurred in 2010 is tributary to Fourmile Canyon Creek. The burn area will increase the flood risk along Fourmile Canyon Creek for up to the next 10 years. The Fourmile Canyon and Wonderland Creek Flood Mitigation Final Plan presents background information and recommended flood mitigation measures.

Reviewer / Responsible Office: Public Works Department

Action Status: This action is in progress. A Community and Environmental Assessment Process (CEAP) was approved in March 2012 for flood improvements and multi-use path enhancements from 19th Street to Tamarack Avenue along Fourmile Canyon Creek. The recommended improvements include constructing a new underpass at 19th Street with a path connection to Tamarack Avenue. The improvements are in the final design phase with construction to start in the summer 2016. A CEAP evaluating upstream mitigation alternatives is currently underway and will focus on increased channel and crossing capacity at Upland Avenue and Violet Avenue,

as well as detention and sediment capture possibilities. Recommended alternatives are slated to be presented to City County in early 2016 through a final CEAP.

Flood and multi-use path improvements along Wonderland Creek from Foothills Parkway to Winding Trail Drive are scheduled to be constructed in 2016. Improvements include underpasses at the Burlington Northern Railroad, Kalmia Avenue and 28th Street, which all serve both a flood mitigation and bicycle and pedestrian access benefit.

Action #20. Update City's Floodplain Mapping

Action Background: The city recognizes that floodplain maps need to be periodically revised to incorporate changes in development, modeling techniques and improved topographic data. The city's goal is to update floodplain mapping every 10 years. The city is currently updating the mapping for Boulder Creek, Skunk Creek, Kings Gulch, Bluebell Canyon Creek, Boulder Slough, Upper Goose and Two Mile Canyon Creek. The city's goal is to keep all 14 tributaries to Boulder Creek current within a 10-year timeframe. Other basins that will need future updating include Sunshine Canyon Creek.

Updates to floodplain mapping should include the development of depth grids which can be imported and used to refine loss estimation for benefit/cost analyses.

Reviewer / Responsible Office: Public Works Department

Action Status: This action is in progress. Mapping for Boulder Creek, Bear Canyon Creek, Upper Goose and Twomile Canyon Creek, and Boulder Slough has been updated and adopted through City Council. Those mapping studies have been submitted to the Federal Emergency Management Agency (FEMA) for final approval.

Flood mapping for Skunk Creek, Bluebell Canyon Creek and Kings Gulch are currently going through analysis. A floodplain mapping update for Sunshine Canyon Creek was initiated in 2013 by the Colorado Water Conservation Board and is still in process.

Action #21. Acquire Properties in the High Hazard Flood Zone

Action Background: Numerous structures are located in the City of Boulder's High Hazard Flood Zone where there exists the potential for risk to life and safety. In 1989, Boulder created a floodplain ordinance that prohibits new construction of structures intended for human occupancy in the High Hazard Zone. As part of this objective, community acquisition and removal of high hazard structures has been a key component of mitigating floodplain impacts in the city. The High Hazard Zone acquisition program has been in place for many years with funding by the flood management utility. Available funds are leveraged with matching funds from other organizations such as the Urban Drainage and Flood Control District, and purchases are made as high hazard properties become available on the market.

Reviewer / Responsible Office: Public Works Department

Action Status: This action is in progress. The city budgets $500,000 a year to purchase property from willing sellers in flood prone areas. This is an on-going effort. The following properties have been acquired for the sole purpose of removing them from flood risk and not for the purpose of completing a drainageway improvement project:

- 299 Arapahoe
- 810 Marine
- 1228 17th St.
- 1800 Violet
- 1650 Alpine
- 2400 Topaz
- 2435 Topaz
- 2446 Sumac
- 2490 Topaz
- 2650-2660 13th St.
- 4018 26th St.

Action #22. Mitigate Flooding in the South Boulder Creek Floodplain

Action Background: Updated floodplain mapping has identified several hundred residential structures to be subject to South Boulder Creek flooding that are located in the city and were previously not determined to be in the floodplain. These structures were developed without flood protection measures. The large residential area is primarily "built-out" and is referred to as the West Valley. Flooding along South Boulder Creek within the city stems primarily from large storm events that result in overtopping of US 36 and corresponding flooding in the West Valley area. Flooding also results from 'local' basin contributions.

Reviewer / Responsible Office: Public Works Department

Action Status: This action is in progress. A draft South Boulder Creek Major Drainageway Plan has been completed along with a study recommendation and presented to the Open Space Board of Trustees, the Water Resources Advisory Board, and City Council. City Council accepted the flood mitigation plan on Aug. 4, 2015. The recommended alternative includes three phases and would provide significant flood protection within the West Valley area, including eliminating the 100-year floodplain designation that currently affects approximately over 500 structures. The estimated cost of all three phases of the recommended alternative is approximately 44 million dollars. Construction of the project would require numerous permits, agreements with the University of Colorado Boulder, the Colorado Department of Transportation and the Boulder Valley School District, and would be regulated by the State Engineer's Office. Funding in the 2015-2020 Department of Public Works Utilities Division CIP budget for this project is $11,750,000. Staff will recommend increasing the budget in the 2016-2021 CIP by $15 million (in 2018) to a total of $26,750,000. The city would also seek grants to fund this project.

Action #23. Develop a Critical Facilities Floodplain Ordinance

Action Background: The 500-year floodplain affects approximately 20 percent of the incorporated lands in the City of Boulder. As a result, many of the community's critical facilities

are located in the 500-year floodplain. There is a significant concern with the location of critical facilities given the need to ensure that these facilities are operational and accessible during a major flood event. Adoption of an ordinance that regulates new construction and improvements for critical facilities to the 500-year flood level will offer a higher level of protection for these facilities from flood losses and damage that could render them unusable during times of need. In addition to adopting flood protection standards, the critical facilities ordinance offers a mechanism to support funding opportunities to flood proof existing facilities that are subject to flood impacts. Given the vital nature of critical facilities, protection from flooding is of particular interest to the community.

Reviewer / Responsible Office: Public Works Department

Action Status: This action complete. The ordinance was approved on Oct. 1, 2013 and became effective on March 1, 2014.

Action #24. Institute a Community Assisted Floodproofing Program Focusing on Critical Facilities

Action Background: Evolving trends and philosophies in national and regional floodplain management have outlined alternative approaches and measures for addressing flood hazards in the future. These trends focus on the "wise use of the nation's floodplains" and "no adverse impacts." In an effort to allow possible development and flood mitigation flexibility that would avoid the need to implement publicly funded drainageway improvements to contain flood waters, the City of Boulder is interested in establishing opportunities to permit limited applications of floodproofing of critical facilities. City assistance under the program would involve development and adoption of local floodplain regulations to approve floodproofing applications for property owners to implement improvements to their facilities. The program would be consistent with nonstructural measures endorsed under the Comprehensive Flood and Stormwater Master Plan. This action would be focused on critical facilities in the floodplain.

Reviewer / Responsible Office: Public Works Department

Action Status: This action is in progress. The city provided assistance to help critical facilities complete emergency operations plans required by the 2014 Critical Facilities Ordinance by developing templates and guidelines that are available on the city's website.

Human Health Mitigation Actions

Action #25. Continue the City of Boulder West Nile Virus Mosquito Monitoring and Control Program

Action Background: West Nile Virus is a mosquito-vectored disease first detected in the United States in 1999 in New York City, which has since spread westward across the United States. While many people who contract the virus experience very mild symptoms, infection can result in severe and sometimes fatal illnesses. In 2003, Colorado led the country in West Nile cases and deaths. Colorado experienced a significant decrease in cases in 2004 and 2005. During the 2006

mosquito season, Colorado had a resurgence of cases and ranked second only to Idaho in the national case count. Boulder and Weld Counties reported the highest number of cases (74 and 68) in Colorado. As in years past, the City of Boulder and Boulder County continued to conduct a very intensive mosquito testing program. With the widespread and frequent testing throughout the county, 107 pools of mosquitoes tested positive for the virus, which was significantly more than most other Colorado counties.

The city's West Nile Virus Mosquito Management Plan was first adopted by City Council in 2004. Further refinements were adopted in 2006. The primary goal of the program is to reduce the risk of West Nile Virus infection while minimizing environmental impacts. The plan is directed at controlling the larval stages of vector mosquitoes and their sources. The objectives that have been used to accomplish this goal are categorizing the habitats that support mosquitoes that most effectively transmit WNV to humans; applying the larvicide (*Bacillus thuringiensis subspecies israelensis*, or *Bti*) to all sites where *Culex* species are found; using adult mosquito monitoring to provide an early warning system of the occurrence of West Nile Virus within and near city limits; developing trigger mechanisms to respond to early larval detection and/or heightened mosquito activity to appropriately increase management activity; utilizing thresholds for initiating adult mosquito control in emergency cases; and continuing the program to educate the public about West Nile Virus and increase awareness of the city's West Nile Virus Mosquito Management Plan.

Reviewer / Responsible Office: Planning, Housing and Sustainability Department

Action Status: This action is in progress. The management plan has been successful. The WNV risk index has not reached levels to warrant further action or response. Public education and outreach is crucial to reduce WNV risk by advising residents to drain standing water on their properties to reduce mosquito breeding habitat and to take personal protective measures to avoid mosquito bites.

Wildfire Mitigation Actions

Action #26. Structure Protection Plan

Action Background: The City of Boulder communities are at risk to wildfire. A Structure Protection Plan would provide a common operating picture of the needs of protecting the communities on the west side of the city from wildfires.

Reviewer / Responsible Office: Fire-Rescue Department

Action Status: This action is complete. The Structure Protection Plan was completed in 2012. This plan will be updated periodically as needed. As an additional safeguard for new structures built in the wildland fire area, the city adopted the International Wildland-Urban Interface Code (IWUIC) on Oct. 1, 2013. The effective date of the IWUIC was Jan. 31, 2014.

Action #27. Construct New Wildland Fire Facility

Action Background: The city's current wildland cache is in a residential unit at 1888 Violet. Due to zoning restrictions, the facility cannot be remodeled for what's needed for a wildland fire facility. In the November 2011 ballot, voters approved $1.15 million to construct a new Wildland Fire Facility; however, the 2011 Fire Operations and Management Assessment identified a need that doubled the space requirements from today's wildland fire operations to include adding permanent staff due to year-round wildland fire hazards and new equipment. A shortfall of $1.3 million from the bond funding is anticipated.

Reviewer / Responsible Office: Public Works Department/ Fire-Rescue Department

Action Status: This action is complete. The Wildland Fire Station (Station 8) was completed in August 2015 at a cost of $2.46 million.

The existing wildland cache was damaged beyond repair in the September 2013 flood and the building was demolished.

FEMA Hazard Mitigation Grant Program (HMGP) funding was approved for a new generator for the wildland fire station in 2014. The FEMA HGMP funds will cover 75 percent of the $47,000 cost for the new generator and the state will pay for 12.5 percent with the city paying for the remaining 12.5 percent. The generator will be completed by the end of November 2015.

Action #28. Implement the City's Community Wildfire Protection Plan

Action Background: The City of Boulder is listed in the National Fire Plan as a community at high risk from wildfire. In 2007, the city worked with consultants to develop a Community Wildfire Protection Plan (CWPP) to address the wildfire threats to the community. The plan meets the requirements of the federal Healthy Forests Restoration Act and outlines steps the city can take to reduce and mitigate the threats of wildfire. The CWPP could be considered a parallel document to the city's Forest Ecosystem Management Plan (FEMP) in that the CWPP addresses areas within the city boundary, and the FEMP is focused on adjacent wildlands. The CWPP outlines steps the city and private property owners can take to both mitigate the threat of wildfire and increase public safety in the event of a wildfire. The plan makes recommendations for fuels modification projects, safety zones, evacuation routes, addressing and ingress/egress routes. Funding for the plan development came from a combination of city departments and a matching state grant.

Reviewer / Responsible Office: Fire-Rescue Department/Open Space and Mountain Parks Department

Several of the recommended fuels treatments have been accomplished. The training recommendation has been addressed and is ongoing, along with the defensible space evaluations of high risk communities. The fuels treatment recommendations are ongoing and should be completed within two years. As an additional safeguard for new structures built in the wildland fire area, the city adopted the International Wildland-Urban Interface Code (IWUIC) on Oct. 1, 2013. The effective date of the IWUIC was Jan. 31, 2014. The other projects and recommendations are ongoing and continue to be revised.

Action #29. Implement the City's Forest Ecosystem Management Plan

Action Background: The City of Boulder Open Space and Mountain Parks Department (OSMP) manages approximately 10,000 acres of forested land. Due to the land's close proximity to homes, dense forest conditions and risks of fire ignition, the forests of Boulder fall within the high hazard category of the wildland-urban interface. In June 1999, the City Council approved the Forest Ecosystem Management Plan (FEMP). The plan established a framework, policy guidelines and management direction for forest ecosystem management on city lands. One of the FEMP's primary goals is to "reduce the wildfire risk to forest and human communities." Part of this objective includes forest thinning and prescriptive burning as key components in mitigating the threat of large scale wildfire. Forest treatments are to be completed on a steady basis under the plan. Funding for projects completed to date has come from the annual OSMP budget.

Reviewer / Responsible Office: Open Space and Mountain Parks Department

Action Status: This action is in progress. OSMP has completed more than 1,400 acres of forest restoration and fire mitigation work during the past 10 years. The department continues to fund an annual seasonal crew of eight people that is solely dedicated to the implementation of the city's Forest Ecosystem Management Plan. All of the treatments to date have been located in high hazard areas and areas that decrease the risk of wildfire to the city, surrounding homes or private property, or serve as important emergency egress routes. OSMP has also secured over $250,000 in federal and state grant funds over the past six years to help fund forest management and fire mitigation operations on city lands. Forest work will continue on OSMP for the foreseeable future and will continue to include mitigation efforts in areas directly adjacent to the city and in areas where heavy fuel loads pose a significant risk in the event of a wildfire.

No additional resources are necessary at this time, but an ongoing budget item to support seasonal crews is necessary for the work to continue in the future. This will continue to be a regular part of the OSMP operating budget.

Action #30. Increase Boulder Wildland Fire Hazard Mitigation Crew Funding

Action Background: Since the 1990s, Boulder has maintained its own seasonal Wildland Fire Hazard Mitigation Crew through the City of Boulder Fire–Rescue Department Wildland Fire Division. Funding for the mitigation crew has historically come from Open Space and Mountain Parks and the Fire–Rescue Department. Constrained budgets are supplemented by crew assignment to fire incidents outside the local area for which the department is reimbursed by the federal, state or local agency. While this reduces Boulder's cost to maintain the crew, it also

reduces their availability to complete needed hazard mitigation on city-owned lands. The Utilities Division proposes to contribute to the Wildland Fire Hazard Mitigation Crew funding with the objective of increasing crew size and availability to:

- Identify and plan measures to protect infrastructure and access to Utilities Division properties,
- Complete hazard mitigation projects on lands owned and managed by the Utilities Division, and
- Participate in broader community hazard mitigation projects that would reduce risks to Utilities Division lands and facilities.

Reviewer / Responsible Office: Public Works Department/ Fire-Rescue Department

Action Status: This action is complete. In 2014, the city completed a three-year plan to upgrade six seasonal wildland firefighting positions to fulltime. Additionally, Public Works pays the Fire Department mitigation crew to perform specified wildland fire mitigation near or around Public Works facilities as needed. The need varies from year-to-year.

Action #31. Develop a Wildland Fire Mitigation Program for the Middle Boulder Creek Watershed

Action Background: The city's Barker Reservoir and Middle Boulder Creek supply approximately 35 percent of Boulder's annual water needs. When considered in terms of both wildland fire hazard rating and structural density, the approximately 25,000-acre Middle Boulder Creek watershed contains large areas of high, very high and extreme danger for wildland fire. As has been experienced by other Colorado Front Range water providers, a major wildland fire can render a reservoir unusable for years when ash, sediment and debris from upstream fire-ravaged areas are washed into streams and reservoirs following a fire. Reservoir clean-up and rehabilitation costs can be in the millions of dollars, not including loss of use of the water or lost hydroelectric power revenues.

The city proposes partnering with the Front Range Fuels Treatment Partnership (FRFTP), a coalition of federal, state and local government agencies and private interests, to plan and implement a watershed-wide fire risk mitigation program targeted at the high and extreme risk areas within the Middle Boulder Creek basin. FRFTP exists to reduce wildland fire risks, protect communities from wildland fires and restore fire-adapted ecosystems in the 10-county Front Range corridor. The city has successfully partnered with the FRFTP in the past in the 38,000-acre Winiger Ridge Ecosystem Restoration Project just south of the Middle Boulder Creek basin.

The city will explore recent guidelines developed by the Colorado State Forest Service for Community Wildfire Protection Planning specific to prioritizing watersheds for fuels treatment.

Reviewer / Responsible Office: Public Works Department

Action Status: This action is in progress. In 2012, the city began a pre- and post-fire watershed planning study. The study is being headed up by City Utilities staff in association with consultant JW Associates and involves small scale watershed hazard quantification and prioritization,

establishment of watershed goals, identification of potential management projects, post-fire planning and collaboration with other stakeholders. Phase 1 of the study, in which watershed wildfire hazards ratings were developed, was completed in 2014. Phase 2 of the study will be completed in the 2015 to 2016 timeframe with future management projects to follow.

Drought Mitigation Actions

Action #32. Review City Landscape Codes for Drought

Action Background: The city's Drought Plan and reliability criteria are used to determine if water restrictions are needed and the appropriate level of response. Initially only voluntary reductions are required but in later stages outdoor watering for landscapes is limited and ultimately prohibited.

In addition to city planning documents and existing Water Conservation Program efforts,

- The 2010 Statewide Water Supply Initiative recommended the following actions be taken by municipalities for landscape water use restrictions: Targeted audits for high demand landscape customers
- Landscape transformation of some high water requirement turf to low water requirement plantings
- Irrigation efficiency improvements

City codes related to landscaping and water conservation already have some low-water requirements which are, in part, designed to increase the resiliency of the city during times of drought.

Reviewer / Responsible Office: Public Works Department and Planning Housing & Sustainability Department

Action Status: This action is in progress. As part of the city's Water Efficiency Plan update in 2016, staff will evaluate if city landscape codes are sufficient to help mitigate drought concerns. Any changes to the landscaping codes would go through a public process and be evaluated by city advisory boards and/or City Council.

Action #33. Identify and Implement Priority Projects Identified in the City's Drought Plan

Action Background: The City of Boulder is subject to drought due to its location in a semiarid climate. City Council adopted a Drought Plan in 2003 to mitigate the effects of drought on the municipal water supply. The plan applies principles of water conservation and reliability criteria for the city's raw water system. The reliability criteria specify acceptable levels of frequency and amount of reduction in water availability due to drought for the various classifications of use. Water provided by the city serves multiple purposes ranging from critical uses that require an assured supply, such as water for drinking or firefighting, to uses that can tolerate occasional restrictions, such as outdoor irrigation or car washing. The Drought Plan provides guidance for recognizing droughts that will affect water supply availability and responding to these droughts.

Strategies for responding to drought include increasing the water supply (e.g., eliminate leasing programs to farmers, lease water and trade water) and decreasing water demand (e.g. voluntary restrictions and mandatory restrictions). Each option presents its own unique issues and must be considered individually and with respect to drought severity.

Reviewer / Responsible Office: Public Works Department

Action Status: This action is in progress. Monitoring the city's water supply and demand conditions is a continuous and ongoing process. Drought status was evaluated in accordance with the city's drought plan in the spring of 2015. Key water supply factors such as snowpack and reservoir storage levels were adequate such that no water restrictions were required. The existing drought plan is adequate for the city's needs for the foreseeable future. The update of Volume 2 of the drought plan mentioned in the 2012 MHMP has been put on hold to allow the city to focus on flood recovery in addition to other planning studies, which will better inform future drought updates (e.g. climate studies and water conservation planning).

The city is due to update its Water Efficiency Plan (formerly the Water Conservation Plan) in 2016 in accordance with Colorado Water Conservation Board requirements. The plan will include information from the planning studies mentioned above.