

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

**MEETING DATE: NOVEMBER 16, 2015**

**AGENDA TITLE:** Public Hearing and consideration of a recommendation to City Council regarding the Boulder Creek Restoration Master Plan

**PRESENTER/S:**

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

**EXECUTIVE SUMMARY**

The purpose of this memorandum is to present the Draft Boulder Creek Restoration Master Plan for the WRAB's consideration, input and recommendation to Council. The Executive Summary of the plan is included as **Attachment A** and the full plan is available at <http://www.iconeng.com/project/boulder-creek/>.

The City of Boulder joined regional partners, including the Urban Drainage & Flood Control District (UDFCD), Boulder County, and the City of Longmont on the development of the Boulder Creek Restoration Master Plan. This study was also partially funded through the Colorado Water Conservation Board (CWCB) grant program. The purpose of the master plan is to develop guidance in planning ongoing and long-term watershed recovery efforts.

This project encompasses nearly 24-miles along Boulder Creek, extending from the confluence with Fourmile Creek, located within Boulder Canyon upstream of the City of Boulder, downstream to the confluence with the St. Vrain River, in the City of Longmont, as shown in the Project Overview Map (**Attachment B**). The master plan area crosses through the City of Boulder and also includes city-owned open space lands outside of the city limits.

The focus of this master plan is to provide a planning tool for stream and ecological restoration along Boulder Creek. As such, this master plan does not comprehensively evaluate Boulder Creek through the City limits given that Boulder Creek through this reach resembles more of an urban stream corridor. Instead, the plan addresses specific areas of concern identified by the city staff and other interested parties who participated in the planning processes. Similarly, the plan does not reevaluate the current 100-year floodplain limits regulated by FEMA, although it is likely that the implementation of some proposed projects would improve flood conveyance and the regulatory floodplain limits.

Icon Engineering was retained by the project team to develop and evaluate alternatives for Boulder Creek and prepare the draft master plan, which identifies and prioritizes

feasible drainage, flood management, and restoration opportunities. Icon Engineering is requesting input on the draft master plan prior to finalization. City staff is recommending that the Civic Area Flood Information (**Attachment C**) be incorporated into the master plan.

The draft master plan is now being presented to the WRAB for consideration, input and a recommendation to City Council. After consideration and input from the WRAB and the Open Space Board of Trustees (OSBT), the master plan will be finalized and presented to City Council for acceptance.

### **STAFF RECOMMENDATION:**

The development of the Civic Area Plan has included establishing guiding principles around the life and safety concerns due to the flood risks. This information was compiled into the Civic Area Flood Information (**Attachment C**) and includes flood regulatory considerations, flood policy considerations and site opportunities and flood constraints. It is recommended that these items be included in the final Boulder Creek Restoration Master Plan.

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

Motion to recommend Council acceptance of the Boulder Creek Restoration Master Plan with the inclusion of the Civic Area Flood Information.

### **BOARD AND COMMISSION FEEDBACK**

Information on the Boulder Creek Restoration Master Plan was provided to the WRAB on May 18, 2015 and the OSBT on October 15, 2015. The WRAB and OSBT did not express any concerns about the master plan.

### **PUBLIC FEEDBACK**

There have been many opportunities for public involvement and feedback throughout this master planning process. Public meetings were held on March 10, 2015, March 18, 2015 and Sept. 29, 2015. Most attendees were property owners from Boulder County east of the city limits with specific questions about their properties.

Public notification post cards about the public meetings were sent to property owners in the study area, emails were sent to all interested parties whom have signed up for email notifications and a project website was developed to provide information: (<http://www.iconeng.com/project/boulder-creek/>). The project website also provided opportunities for comments to be submitted electronically. All public comments received were compiled and are included in Appendix B of the draft Boulder Creek Restoration Master Plan.

### **BACKGROUND**

The Boulder Creek watershed is approximately 440 square miles. It extends west of the City of Boulder to the Continental Divide with elevations exceeding 13,000 feet.

Boulder Creek generally flows east, and then northeast across the city. Boulder Creek is tributary to 14 other major drainageways.

Boulder Creek has experienced several major flooding events, with the earliest reports dating back to the 1840's. The flood of record is reported to have occurred in 1894, where nearly 3 days of rainfall washed out bridges and resulted in major damages to homes and businesses. In 2013, between Sept. 9<sup>th</sup> and Sept. 15<sup>th</sup>, a large rainfall event resulted in widespread flooding along the Colorado Front Range. Boulder Creek experienced peak flows ranging from approximately 5,000 cubic feet per second (cfs) in downtown Boulder, to over 9,000 cfs downstream of US Highway 287, equating to a 25- to 50-year flood event. Although emergency flood repairs were completed, portions of Boulder Creek were left in a state of disrepair, highlighting the need for a restoration master plan.

Planning for floods within the City of Boulder and Boulder County dates back to the early 1900's. In 1910, Fredrick Law Olmsted, Jr. recommended against allowing development to encroach upon the creek channel. Since then, Boulder Creek has been the focus of numerous flood studies and master plans.

The City of Boulder completed a [floodplain mapping study update for Boulder Creek](#) from the area west of 61st Street, upstream to the mouth of Boulder Canyon, west of Boulder city limits. The study area encompassed a reach length of five and a half miles. The new floodplain mapping was adopted by City Council on Sept. 18, 2012 and is currently regulatory. FEMA began reviewing the mapping on Oct. 30, 2012. In November 2013, FEMA indicated acceptance of the study results and initiated the adoption of the new mapping through the Physical Map Revision process, a multi-year process expected to be completed in December of 2016. Floodplain mapping provides the basis for flood management by identifying the areas subject to the greatest risk of flooding. Flood mitigation master planning is typically scheduled to follow floodplain mapping updates.

There are many master planning documents with policies and guidance related to floodplain management, preservation, development and mitigation, including:

- [Boulder Valley Comprehensive Plan \(BVCP\)](#)
- [Comprehensive Flood and Stormwater Utility Master Plan](#)
- [Greenways Master Plan](#)
- UDFCD [Drainage Criteria Manual](#)

These various master plan guiding principles and policies helped form the foundation for the draft Boulder Creek Restoration Master Plan.

## **ANALYSIS**

Icon Engineering was retained by the project team to develop and evaluate alternatives for Boulder Creek and prepare the draft master plan, which identifies and prioritizes feasible drainage, flood management, and restoration opportunities. The Executive Summary of the plan is included as **Attachment A** and the full plan is available at <http://www.iconeng.com/project/boulder-creek/>.

The plan provides general guidance for stream and ecological restoration among other multiple objectives including:

- Identification of immediate project needs;
- Provide general guidance for stream restoration;
- Identify ecological needs and benefits;
- Identify floodplain management strategies;
- Identify transportation improvements at Boulder Creek stream crossings;
- Identify concurrent recreation and open space access planning;
- Identify an improvement prioritization plan;
- Develop cost estimates for financial planning.

The draft Boulder Creek Restoration Master Plan divides the Boulder Creek corridor into 10 different reaches, with reaches 8 and 9 running through the City of Boulder. The draft master plan recommendations for these two reaches are included below:

### **Reach 8 – From Valmont Rd. to 30th St.**

This reach is approximately 2.3 miles in length and primarily located within the City of Boulder. The channel characteristics generally include a combination of riparian habitat, roadway, and trail crossings. Wonderland, Goose, and South Boulder Creeks enter Boulder Creek within Reach 8, and several small ponds are located adjacent to the stream. For Boulder Creek, Reach 8 reflects the transition to an urban flood channel and for the most part, Boulder Creek has been locked in place through urbanization. The Burlington Northern and Santa Fe (BNSF) railroad embankment presents a significant obstacle for Boulder Creek and its connectivity with upstream and downstream floodplain areas. The BNSF crossing also has significantly less conveyance capacity than the larger span bridges within Boulder.

Master plan improvements within Reach 8 are comprised of stream restoration, improving the railroad crossing conveyance capacity, access to the Boulder Community Health (the hospital), and management of accumulated sediment. Stream restoration is proposed from the downstream limit of Reach 8 at Valmont Road through Foothills Parkway. No improvements are proposed for the 55th Street crossing as the existing bridge structure conveys the 100-year discharge. As described above, the BNSF railroad is a significant obstacle for Boulder Creek. The crossing is proposed to be increased to a 180 ft. span bridge to better convey flood flows and accommodate geomorphic channel conditions.

To ensure safe access to the hospital during major floods, up to the 500-year event, an alternate access point from 48th Street has been recommended. This access point would only serve emergency vehicles and would not provide routine access.

Frequent sediment deposition has been observed throughout Reach 8 along Boulder Creek and pedestrian trail crossings. Maintenance level sediment removal projects (up to 200 cubic yards per year) has been incorporated into the master plan at various crossing locations.

## **Reach 9 – From 30th St. to City of Boulder Limits**

Reach 9 extends through the City of Boulder from 30th St. to upstream of Arapahoe Avenue. This reach also includes the University of Colorado (CU) Campus, between 17th Street and Folsom. Many roadway crossings exist through this reach as well as Boulder Creek trail bridges. The Boulder Creek trail also follows the creek for the entire reach. Many buildings are located within the Boulder Creek floodplain. Both FEMA and the City of Boulder have designated additional regulatory zones to manage existing development and redevelopment. Strategic plans, including CU's North of Boulder Creek study have also been developed to identify management strategies to reduce overall flood risk. Similarly, the City of Boulder is currently in the process of planning for redevelopment surrounding the Civic Center area, and is evaluating this plan with respect to flood management.

Master plan improvements within Reach 9 include mitigating flood hazards, improving access near Boulder Creek, modifying diversions, and sediment maintenance. Downstream of 28th Street, along Cordry Court, realignment of the Boulder Creek Trail is proposed to increase conveyance and mitigate the high hazard conditions near residences. In accordance with City greenway's objectives, property acquisition in this area should be considered as a means to eliminate high hazard designation and improve overall public safety. Near the CU campus, two new pedestrian bridges are proposed to improve access to the North of Boulder Creek campus. These bridges, or walkways, will provide emergency access to areas otherwise susceptible to isolation during flood events.

To mitigate flood hazards along the Boulder Slough, an overflow diversion structure is proposed at 14th Street. This diversion system will divert flows in excess of the conveyance capacity of the ditch back into Boulder Creek, reducing flood risk to adjacent properties. A 48" RCP pipe underneath 14th Street is proposed to convey the flows from the diversion structure south to Boulder Creek.

Changes to the diversion structure at Broadway are also proposed to accommodate aquatic and habitat passage.

Similar to other locations, six areas have been identified for annual sediment removal (up to 200 cubic yards per year) in Reach 9.

No new alternatives have been developed for the Civic Center area in this master plan study; however changes to Boulder Creek at this location should consider implementing recommendations discussed in 9.3 Improvement Alternative Categories, including:

- Removing the Park Central and New Britain building from the 100-year floodplain, conveyance zone, and high hazard zone;
- Adding conveyance capacity at the Broadway Bridge;
- Overbank grading of Boulder Creek between the Library and Broadway to reduce high hazard and conveyance zones on the north side of Arapahoe.

It should be noted that with these changes, higher flows along the creek would persist downstream to west of 30<sup>th</sup> Street and cause higher 100-year flood levels

that would need to be mitigated. Given that these increases in flood levels would be relatively small, they could likely be mitigated through: select grading of overbank areas, reducing the potential for debris obstruction at bridges, and/or increasing conveyance under road crossings.

Although the Civic Area Plan is still being developed, guiding principles and development constraints related to flood safety were developed to help guide the development of the Civic Area Plan. This information was compiled into the Civic Area Flood Information (**Attachment C**) and includes flood regulatory considerations, flood policy considerations and site opportunities and flood constraints. It is recommended that these items be included in the final Boulder Creek Restoration Master Plan.

### **NEXT STEPS**

The draft Boulder Creek Master Plan will be revised to incorporate feedback received. Following input and a recommendation from WRAB, the Boulder Creek Restoration Master Plan will be presented to City Council for acceptance. After acceptance, the master plan will help guide restoration and redevelopment projects within the master plan area. It will be a planning tool to help identify projects for future funding through the CIP, grants, UDFCD funding requests and other funding opportunities.

### **ATTACHMENTS**

Attachment A: Executive Summary of the Draft Boulder Creek Restoration Master Plan

Attachment B: Project Overview Map

Attachment C: Civic Area Floodplain Information

# Boulder Creek Restoration Master Plan

DRAFT Conceptual Design Report - October 2015

Urban Drainage and Flood Control District  
Boulder County, City of Boulder, City of Longmont



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# Boulder Creek Restoration Master Plan

## DRAFT – Conceptual Design for Boulder County, Weld County, and City of Longmont

**ICON**ENGINEERING, INC.

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October 20, 2015

Ms. Shea Thomas, P.E.  
Urban Drainage and Flood Control District  
Senior Project Engineer, Master Planning Program  
2480 W. 26<sup>th</sup> Avenue, Suite 156B  
Denver, Colorado 80211-5304

**RE: Boulder Creek Restoration Master Plan – Master Plan Report**

Dear Ms. Thomas:

ICON Engineering, Inc. is pleased to submit this Master Plan Report for Boulder Creek. Overall this plan can be used as a guide for future restoration activities and drainage improvements along Boulder Creek. This submittal incorporates items from the previous Alternatives Analysis and Recommended Plan, in addition to those discussed as part of the Selected Plan, provided by the UDFCD on September 14<sup>th</sup>.

Following issuance of the selected plan, modifications were made to reflect input provided by project sponsors at the confluence with the Saint Vrain Creek, 95<sup>th</sup> Street, and near Cordry Court in the City of Boulder. Additional input was provided at public open houses and workshops. These modifications and input are now reflected by the conceptual design and within the master planning document.

We would like to acknowledge the projects team's assistance in the preparation of this study. This report could not have been prepared without input from yourself, Boulder County, the Cities Boulder and Longmont, and other stakeholders to this project.

We believe that this report will provide a solid frame work for the conceptual design phase of this project.

Sincerely,  
**ICON ENGINEERING, Inc.**

Craig D. Jacobson, P.E., CFM  
Principal, Project Manager

Brian J. LeDoux, P.E., CFM  
Project Engineer

Jeremy K. Deischer, EI  
Project Engineer



<b>ES</b>	<b>EXECUTIVE SUMMARY</b>	
ES.1	Purpose and Objective .....	1
ES.2	Planning Process .....	1
ES.3	Project Area Description .....	1
ES.4	Alternative Analysis.....	4
ES.5	Master Plan .....	4
<b>1.0</b>	<b>INTRODUCTION</b>	
1.1	Funding and Authorization .....	12
1.2	Background .....	12
1.3	Purpose, Scope, Limitations.....	12
1.4	Planning Process .....	12
1.5	Mapping & Survey.....	13
1.6	Data Collection.....	13
1.7	Acknowledgements.....	13
<b>2.0</b>	<b>PROJECT BACKGROUND</b>	
2.1	Project Area .....	14
2.2	Flood History.....	14
2.3	September 2013 Flood Event.....	16
2.4	Previous Studies.....	17
<b>3.0</b>	<b>HYDROLOGY AND HYDRAULICS</b>	
3.1	Hydrology.....	19
3.2	Hydraulics.....	19
3.3	Climate Change and Uncertainty .....	20
<b>4.0</b>	<b>STREAM MORPHOLOGY AND EXISTING SITE CONDITIONS</b>	
4.1	Stream Classification.....	22
4.2	Reach Descriptions.....	23
4.3	Recreation and Public Access.....	30
<b>5.0</b>	<b>HISTORIC STREAM EVALUATION</b>	
5.1	Background .....	33
5.2	Channel Straightening.....	33
5.3	Sinuosity Changes .....	34
5.4	Prior Stream Realignment.....	34
5.5	Conclusions .....	35
<b>6.0</b>	<b>NATURAL RESTORATION OBJECTIVES</b>	
6.1	Background .....	36
6.2	Characteristics of a Natural Channel.....	36
6.3	Typical Channel Geometries .....	36
<b>7.0</b>	<b>BOULDER CREEK RIPARIAN ZONE</b>	
7.1	Background .....	38
7.2	Importance of the Riparian Zone.....	38
7.3	Land use and Vegetation Cover Types.....	38
7.4	Riparian Zone Vegetation Community and Reference Standard.....	39
7.5	Riparian Zone Post Flood.....	39
7.6	Wetlands.....	41
7.7	Riparian Zone Restoration Guidelines .....	41
<b>8.0</b>	<b>THREATENED AND ENDANGERED SPECIES, AND AQUATIC HABITAT ASSESSMENT</b>	
8.1	Background .....	43
8.2	Species Protected Under the Endangered Species Act of 1973 .....	43
8.3	Migratory Bird Treaty Act .....	43
8.4	Aquatic Life .....	44
8.5	City of Boulder’s Open Space & Mountain Parks (OSMP) Closures.....	44
<b>9.0</b>	<b>PROJECT FOCAL AREAS / RESTORATION PROJECTS</b>	
9.1	Project Focus.....	45
9.2	Criteria and Constraints .....	45
9.3	Improvement Alternative Categories .....	46
9.4	Summary of Project Alternatives.....	51
9.5	Alternative Cost Estimates.....	51
9.6	Qualitative Evaluation Process .....	54
9.7	Water Quality Impacts .....	54
<b>10.0</b>	<b>RECOMMENDED PLAN</b>	
<b>11.0</b>	<b>CONCEPTUAL DESIGN</b>	
11.1	Plan Development Overview .....	67
11.2	General Recommendation.....	67
11.3	Conceptual Design Cost Estimates.....	68
11.4	Master Plan Description .....	68
11.5	Stream Restoration Recommendations.....	72
11.6	Ecological Recommendations .....	72
11.7	Recommended Bridge Improvements.....	73
11.8	Recreation.....	73
<b>12.0</b>	<b>PRIORITIZATION</b>	
12.1	Stream and Ecological Restoration .....	93
12.2	Bridge Replacement & Emergency Access .....	93
12.3	Public Safety.....	93
12.4	Maintenance .....	93
12.5	Prioritization by Jurisdiction .....	94
<b>13.0</b>	<b>REFERENCES</b>	



**List of Tables**

Table ES- 1: Project Participants .....1

Table ES- 2: Peak Flow Summary .....2

Table ES- 3: Prioritization Summary.....8

Table ES- 4: Cost Estimate Summary (Reach 1-6) .....9

Table ES- 5: Cost Estimate Summary (Reach 7-10) .....10

Table 1-1: Project Participants .....13

Table 2-1: 2013 Flood Discharge Observations .....16

Table 3-1: Summary of Boulder Creek Flood Discharges.....19

Table 4-1: Existing Reach Properties.....30

Table 6-1: Bankfull Flows and Stream Classifications at Locations with Estimated Flows .....36

Table 6-2: Target Width/Depth Ratios, and Entrenchment Ratios for Each Stream Classification .....36

Table 6-3: Geometries for Primary Stream Types at Each Flow Location.....37

Table 7-1: Post-flood Riparian Zone conditions.....40

Table 7-2: Representative Native Riparian Zone Tree Species .....42

Table 7-3: Representative Native Riparian Zone Shrub Species.....42

Table 7-4: Representative Native Riparian Zone Herbaceous Species .....42

Table 8-1: Federal Threatened or Endangered Species .....43

Table 9-1: Alternative Ditch Diversion Structures .....46

Table 9-2: Bridge Information and Replacement Locations .....50

Table 9-3: Summary of Project Alternatives .....51

Table 9-4: Minimum Improvement Alternative Costs (Reach 1 – 6) .....52

Table 9-5: Minimum Improvements Alternative Costs (Reach 7 - 10) .....53

Table 9-6: 100-yr Crossing Improvements.....53

Table 10-1 : Summary of Recommended Plan Project Alternatives (Reach 1-6) .....60

Table 10-2: Summary of Recommended Plan Project Alternatives (Reach 7 - 10).....61

Table 11-1: 95th Street Interim Conditions Improvements.....70

Table 11-2: Recommended Geometries for Primary Stream Types .....72

Table 11-3: Recommended Bridge Replacement .....73

Table 11-4: Conceptual Design Cost Summary by Jurisdiction .....73

Table 11-5: Conceptual Design Cost Estimate by Reach (1-6) .....74

Table 11-6: Conceptual Design Cost Estimate by Reach (7-10) .....75

Table 12-1: Stream Restoration Prioritization Summary .....93

Table 12-2: Bridge Replacement & Emergency Access Prioritization Summary .....94

Table 12-3: Public Safety Prioritization Summary.....94

Table 12-4: Maintenance Prioritization Summary .....94

Table 12-5: Prioritization Summary by Jurisdiction .....94

**List of Figures**

Figure ES- 1: Watershed Map .....3

Figure ES- 2: Master Plan Interactive Map .....11

Figure 2-1: Boulder Creek Watershed Map .....15

Figure 3-1: 1%-Annual Chance Projections for the United States, 2060 (AECOM, 2013) .....21

Figure 3-2: 1%-Annual-Chance Projections for the United States, 2100 (AECOM, 2013) .....21

Figure 3-3: Colorado Statewide Annual Average Temperature, 1900-2012 (CWCB 2014) .....21

Figure 3-4: Projected Monthly Precipitation Change for Denver Metro Sub-region .....21

Figure 4-1: Rosgen Classification System System Schematic (from Rosgen 1996).....22

Figure 4-2: Boulder Creek Reach Map .....24

Figure 4-3: UP Rail Trail.....32

Figure 5-1: Loss of Stream Length over Time as a Percentage .....33

Figure 5-2: Loss of Stream Length .....33

Figure 5-3: Depiction of Modification to Channel Meanders.....34

Figure 5-4: Stream Sinuosity .....34

Figure 5-5: Change in Stream Sinuosity .....34

Figure 5-6: Straightening Trends in Reach 5 .....34

Figure 6-1: Typical Geomorphic Cross-section .....37

Figure 6-2: Typical Riffle/Pool Schematic .....37

Figure 7-1: Components of a properly functioning riparian zone .....38

Figure 7-2: Components of a Riparian Community .....39

Figure 7-3: Boulder Creek: Example Riparian Reference Standard .....39

Figure 7-4: Example of varying riparian zone widths through the project area.....40

Figure 9-1: City of Boulder Civic Area Plan [Reference 65].....49

Figure 9-2-9-6: Alternative Maps.....55

Figure 10-1-10-5: Recommended Plan Maps .....62

Figure 11-1: Conceptual Design Interactive Map .....76

Figure 11-2: Conceptual Design Map (Reach 1-3) .....77

Figure 11-3: Conceptual Design Map (Reach 4).....78

Figure 11-4: Conceptual Design Map (Reach 5-6) .....79

Figure 11-5: Conceptual Design Map (Reach 7-8) .....80

Figure 11-6: Conceptual Design Map (Reach 9-10) .....81

Figure 11-7: Typical Channel Cross Sections.....82

Figure 11-8: Typical Bridge ImprovementCross Section.....83

Figure 11-9: Conceptual Design Rendering – Reach 1 .....84

Figure 11-10: Conceptual Design Rendering – Reach 2/3 .....85

Figure 11-11: Conceptual Design Rendering – Reach 4 (Sheet 1) .....86

Figure 11-12: Conceptual Design Rendering – Reach 4 (Sheet 2) .....87

Figure 11-13: Conceptual Design Rendering – Reach 5 (Interim Conditions) .....88

Figure 11-14: Conceptual Design Rendering – Boulder Valley Hospital & Boulder Slough Diversion.....89

Figure 11-15: Conceptual Design Rendering – Reach 10.....90

Figure 11-16: Typical Details (Sheet 1) .....91

Figure 11-17: Typical Details (Sheet 2) .....92



**Appendices**

**APPENDIX A - Legal Opinion**

**APPENDIX B - Meeting Minutes**

**APPENDIX C - CDOT Hydrology Profile**

**APPENDIX D - Historic Investigation & Alternate Restoration Alignments**

**APPENDIX E - Alternative Cost Summaries**

**APPENDIX F - Riparian Zone and T&E Species Summary**

**APPENDIX G- Conceptual Design Information**



**ES EXECUTIVE SUMMARY**

**ES.1 Purpose and Objective**

The purpose of this master plan is to provide planning guidance to improve resiliency along Boulder Creek from the confluence with Fourmile Creek, in Boulder Canyon, to the confluence with the Saint Vrain Creek in the City of Longmont. This plan provides general guidance for stream and ecological restoration among other multiple objectives including:

- Identification of immediate project needs;
- Provide general guidance for stream restoration;
- Identify ecological needs and benefits;
- Identify floodplain management strategies;
- Identify transportation improvements at Boulder Creek stream crossings;
- Identify concurrent recreation and open space access planning;
- Identify an improvement prioritization plan;
- Develop cost estimates for financial planning.

It is important to note that this master plan provides general guidance for restoration efforts, but it does not re-evaluate the current 100-year floodplain limits regulated by FEMA. Although the implementation of some proposed projects presented in this master plan will also improve the regulatory floodplain, the focus of this master plan is to provide a planning tool for stream and ecological restoration.

Within the City of Boulder, Boulder Creek resembles an urban stream corridor. This master plan does not comprehensively evaluate Boulder Creek through the City limits. Instead, the plan addresses specific areas of concern identified by the city staff and other interested parties. General guidance for Boulder Creek is also presented by the City’s Greenway’s Master Plan [Reference 4, City of Boulder].

**ES.2 Planning Process**

Planning for this report began in December 2014. The consultant team collected information related to stream characteristics and existing infrastructure, as well as observations related to 2013 flood event. Data was collected from multiple sources, including the Federal Emergency Management Agency (FEMA), the Colorado Water Conservation Board (CWCB), the Urban Drainage and Flood Control District (UDFCD), and the Colorado Department of Transportation (CDOT), and local counties and municipalities.

Once background information was obtained, the consultant team identified focal areas, and prepared geomorphic and riparian field assessments. This information was presented to the project team and interested stakeholders at monthly progress meetings.

Public awareness of the master planning effort was developed through a combination of direct mailings to adjacent property owners and the development of a project website. The project website included interactive features allowing individuals to subscribe to a mailing list or to leave site specific comments through an interactive comment map.

The project team was able to gather input from the public at four separate public meetings and workshops over the course of the project:

- March 10, 2015: Boulder Creek MDP Public Meeting held in the City of Boulder
- March 18, 2015: Boulder Creek MDP Public Meeting held in Weld County
- September 16, 2015: FEMA Boulder Creek PMR Public Workshop
- September 29, 2015: Boulder Creek MDP Public Meeting held in the City of Boulder

The minutes for all project meetings along with all public comments received can be found in [APPENDIX B](#)

**Table ES- 1: Project Participants**

<b>Name</b>	<b>Representing</b>
Craig D. Jacobson	ICON Engineering, Inc., Project Manager
Brian LeDoux	ICON Engineering, Inc., Project Engineer
Jeremy Deischer	ICON Engineering, Inc., Project Engineer
Eben Dennis	ICON Engineering, Inc., GIS Specialist
Troy Thompson	Ecological Resource Consultants, Inc.
David Blauch	Ecological Resource Consultants, Inc.
Diane Krzysztof	Ecological Resource Consultants, Inc.
Mark Wilcox	DHM Design
Shea Thomas	Urban Drainage and Flood Control District
Julie McKay	Boulder County Creek Recovery & Restoration Program Manager
Diane Malone	Boulder County IT Project Manager
Kristine Obendorf	Boulder County Transportation Engineer
Varda Blum	Boulder County Floodplain Manager
Yige Gao	Boulder County Floodplain Permitting Specialist
Jesse Rounds	Boulder County Parks and Open Space Planner
Claire DeLeo	Boulder County Parks and Open Space Senior Resource Specialist
Katie Knapp	City of Boulder
Annie Noble	City of Boulder
Marianne Giolitto	City of Boulder Open Space and Mountain Parks
Dan Wolford	City of Longmont
Jonathan Akins	University of Colorado
Naren Tayal	FEMA
Dan Marcucci	Colorado Department of Transportation
Scott Holwick	Lyons Gaddis - Attorneys & Counselors
Diana Aungst	Weld County
Steve Stanish	Town of Frederick



**ES.3 Project Area Description**

The Boulder Creek watershed has a drainage area of approximately 440 square miles, and is located within Boulder and Weld Counties. The majority of the watershed is located within Boulder County. The watershed is bounded to the west by the continental divide, to the north by the Saint Vrain Creek watershed, and to the south by the Clear Creek watershed. This study focuses on the main stem of Boulder Creek from the confluence with Fourmile Creek, approximately 2 miles west of the City of Boulder, to the confluence with Saint Vrain Creek, located within the City of Longmont. The study encumbers over 24 miles of channel length along Boulder Creek.

Boulder Creek is a perennial stream which generally flows from west to northeast. The study area generally lies within the South Central Semi-Arid Prairie ecoregion of the Great Plains; while a small portion of the upstream project reach occurs within the Northwestern Forested Mountain ecoregion of the Southern Rockies. The topographic elevation ranges from approximately 5,700 feet above mean sea level (AMSL) at the confluence with Fourmile Creek to approximately 4,800 feet AMSL at the downstream end of the project area.

West of the City of Boulder, Boulder Creek is confined within the steep canyon terrain of Boulder Canyon. Boulder Canyon generally shares the stream corridor with State Highway 119. East of Boulder Canyon, Boulder Creek enters the City of Boulder, where the stream reflects more of an urban waterway and greenway than a natural stream system. Although, through this reach, Boulder Creek does incorporate some degree of natural landscapes, the encroachment from urban development has occurred over many years. The channel is more confined and numerous bridges, diversions, and stabilization structures exist along its path. East of the city, within Boulder and Weld Counties and the City of Longmont, Boulder Creek resembles a plains stream with a broad floodplain. Although this stretch has fewer bridges than within the urban areas of the City of Boulder, over time, the stream also has experienced significant channel modifications as a result of farming, diversions, sand and gravel ponds, and aggregate mining. As a result, in many areas sinuosity has decreased and the stream lacks natural meanders and bends.

The predominant land cover type within the study area is cultivated cropland, which includes grazing, alfalfa and other crop production. As noted above, aggregate mining of sand and gravel since the mid 1950’s has visibly shaped the project area landscape as open water ponds are scattered within the floodplain. Natural vegetation cover exists within the riparian zone and a variety of wetland habitats also exist. However, riparian and wetland habitat only occupies a small percentage of the project area. Other land uses include high and low density development within the City of Boulder, roadways and transportation infrastructure.

The Boulder Creek corridor contains a variety of wildlife, threatened or endangered species, and aquatic habitat. Both the City of Boulder Open Space and Mountain Parks and Boulder County Parks and Open Space maintain land restrictions or seasonal closures throughout the project area.

Finally, the floodplain areas along Boulder Creek are regulated by local floodplain administrators and the Federal Emergency Management Agency (FEMA) over the entirety of the study reach. Regulatory floodplain areas include a variety of flood zones for riverine and shallow flooding locations. Base Flood Elevations (BFEs), and shaded Zone X designating the 0.2%-annual-chance, or 500-year floodplain area has been identified within Boulder County. A regulatory floodway has also been designated along a portion of Boulder Creek from Valmont Road through 61<sup>st</sup> Street. Within Weld County the regulatory floodplain consists of an approximate study designation. It should be

noted that the City of Boulder is undergoing a floodplain remapping effort for the reach of Boulder Creek and Boulder Slough through the city limits. Although the City is still awaiting the formal adoption of the study on the FEMA FIRM maps, concurrence from FEMA has been given to the technical data, and these changes have therefore been considered with this master plan where applicable.

A map of the study area can be found in [Figure ES- 1: Watershed Map](#).

**ES.3.2 Project Area Hydrology**

Hydrologic information for the Boulder Creek Watershed has been documented from a variety of sources, initiating with the initial U.S. Army Corps of Engineers (COE) Floodplain Information Report in 1969 [Reference 17, U.S. Army Corps of Engineers], updates by the COE in 1977, more recent Flood Hazard Area Delineation (FHAD) reports [References 18 & 19, Muller Engineering Company] for the City of Boulder and Boulder County, and current FEMA Flood Insurance Studies (FIS) [Reference 20, FEMA]. In general, the current regulatory discharges are based on the 1977 COE findings.

In 2009, the City of Boulder initiated an update to the FEMA flood maps. As part of this study, an evaluation was completed to review and confirm previous hydrologic values [Reference 21, Anderson Consulting Engineers, Inc.]. This evaluation concluded that the regulatory discharges are reasonable.

For the purposes of this master plan, the current FEMA regulatory discharges were maintained for evaluating flood control aspects of each project alternative. These discharges are presented in Table 3-1, below. It should be noted that the regulatory discharges presented were confirmed within the referenced regulatory flood studies at each location.

**Table ES- 2: Peak Flow Summary**

Location	Drainage Area (sq. mi.)	10-Year (cfs)	25-Year (cfs)	50-Year (cfs)	100-Year (cfs)	500-Year (cfs)
Fourmile Creek Mouth <sup>2</sup>	129	2,050	-- <sup>1</sup>	7,960	11,660	21,180
Boulder Creek Canyon Mouth <sup>2</sup>	130	2,050	-- <sup>1</sup>	7,960	11,660	21,180
6th Street <sup>3</sup>	130 <sup>5</sup>	2,200	5,830	8,100	12,150	22,100
55th Street <sup>3</sup>	155 <sup>5</sup>	3,600	7,070	9,300	13,050	22,056
75th Street <sup>4</sup>	305	3,350	-- <sup>1</sup>	9,600	13,800	28,800
U.S. Highway 287 <sup>4</sup>	331	2,800	-- <sup>1</sup>	8,600	12,700	27,600
County Line Road <sup>4</sup>	431	2,850	-- <sup>1</sup>	9,150	13,750	31,700
County Road 16.5 <sup>6</sup>	443	-- <sup>1</sup>	-- <sup>1</sup>	-- <sup>1</sup>	13,750	-- <sup>1</sup>
County Road 20.5 <sup>7</sup>	446	-- <sup>1</sup>	-- <sup>1</sup>	-- <sup>1</sup>	12,250	-- <sup>1</sup>

<sup>1</sup> Data Not Available

<sup>2</sup> Floodplain Information Report, Upper Boulder Creek & Fourmile Creek, Gingery Associates, 1981

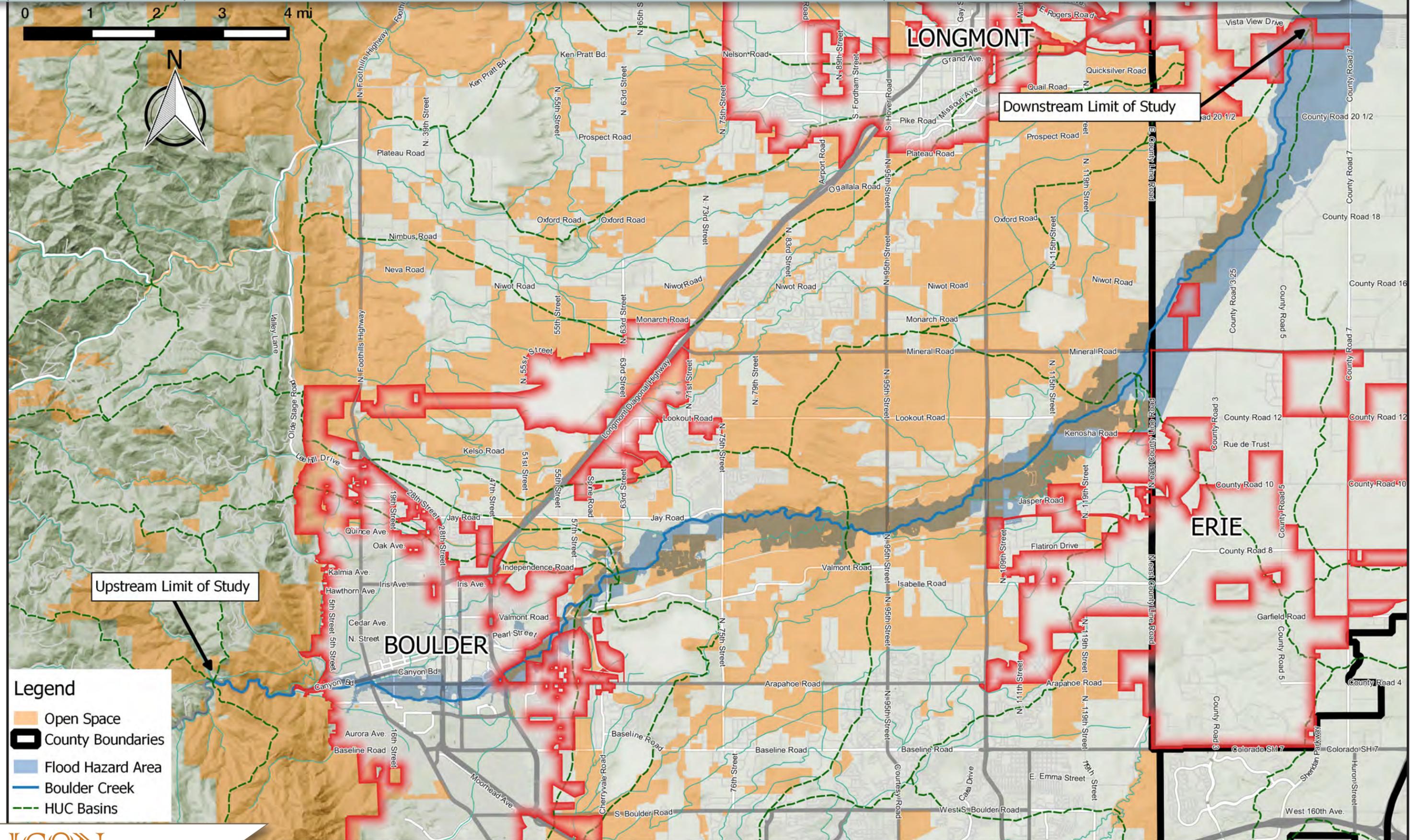
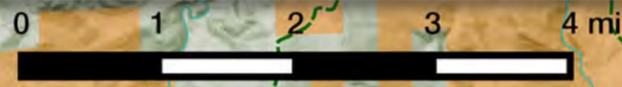
<sup>3</sup> Boulder Creek Floodplain Mapping Study, Anderson Consulting Engineers, Inc., 2013

<sup>4</sup> Flood Hazard Area Delineation, Lower Boulder Creek, Muller Engineering Company, Inc. 1983

<sup>5</sup> Flood Hazard Area Delineation, Boulder Creek, Muller Engineering Company, Inc. 1983

<sup>6</sup> Letter of Map Revision 12-08-0198P at 16.5 Road, Weld County

<sup>7</sup> Letter of Map Revision 12-08-1047P at 20.5 Road, Weld County



Upstream Limit of Study

Downstream Limit of Study

- Legend**
- Open Space
  - County Boundaries
  - Flood Hazard Area
  - Boulder Creek
  - HUC Basins



### ES.3.3 Project Area Hydraulics

The focus of this study is stream restoration and ecological enhancement along Boulder Creek. The study does not re-evaluate the current 100-year floodplain limits as regulated by FEMA. For those reasons, a comprehensive floodplain model has not been generated for this study. However, hydraulic information was collected from a variety of sources.

### ES.4 Alternative Analysis

The majority of the developed alternatives were a part of four main alternative categories:

- **Sediment Maintenance:** Although restoration activities recommended with this master plan will alleviate several of these routine problem areas over time, ongoing maintenance, particularly with existing trail underpasses is still needed. Maintenance activities generally include removal of sediment on an annual basis.
- **Natural Stream / Channel Restoration:** In order to allow Boulder Creek to return to a more natural state, channel restoration projects have been proposed along Boulder Creek. These projects consist of providing an appropriate channel width, bank full depth, stream sinuosity, overbank floodplain connection, and ecological / habitat enhancements. Alternatives presented apply the stream restoration principles at locations with immediate restoration needs and a higher likelihood of implementation in the future. These projects are generally focused in areas where property has already been acquired, such as public lands, or locations where changes to private infrastructure could be more easily implemented. However, the geomorphic and ecological principles presented can be applied uniformly for Boulder Creek, as property and funding become available.
- **Roadway Crossing Improvements:** It is typical for roadway crossings of Boulder Creek, particularly east of the City of Boulder, to experience overtopping while the bridge structure, itself, remains perched over the main channel. In accordance to Boulder and Weld County criteria, new bridges are required to be elevated above the 100-year flood level. Overtopping is allowed elsewhere, often hundreds of feet from the bridge location. Per discussions with Boulder County transportation staff, it was determined that all bridges over Boulder Creek would need to meet this criteria, at a minimum. Boulder County also requested that additional alternatives be evaluated for 61<sup>st</sup> Street, 75<sup>th</sup> Street, 95<sup>th</sup> Street, and East County Line Road, which would convey the 100-year event without overtopping in order to provide emergency services during flooding. A summary of major roadway crossings along Boulder Creek is presented in [Table 9-2: Bridge Information and Replacement Locations](#). This table compares the existing bridge elevations and estimated bridge deck thicknesses with FEMA's regulatory 100-year water surface elevations along Boulder Creek to determine if a bridge currently meets criteria. Bridges outside of criteria were selected to be replaced by this master plan. Bridge replacement recommendations can be found in [Table 11-3: Recommended Bridge Replacement](#).
- **Stream Stabilization and Ditch Diversions:** Numerous water diversion points exist in Boulder Creek. Currently very few of the existing diversions structures also accommodate fish passage or macro-invertebrates common to the region. Improvements are recommended to retro-fit or rebuild diversions to satisfy this multi-objective need. Specifically these systems are proposed to be replaced with sloped drop faces and fish passage measures. Each diversion point would still be required to also maintain adequate

depth to satisfy the decreed discharge for water diversion. These conversions will allow the adjacent channel to exist in a more natural state while also providing the long term ability to divert water at the diversion point. Plans to modify any diversion structure should be coordinated with the representative of the ditch company. The diversion structures proposed to be modified to allow for aquatic and habitat passage while maintaining the efficiency to divert water to the water rights holder can be found in [Table 9-1: Alternative Ditch Diversion Structures](#). Drop structures, and other existing stabilization measures, which present obstruction to fish passage or macro-invertebrate habitat, have also been proposed to be replaced in a similar manner.

### ES.5 Master Plan

The Conceptual Design for this master plan generally follows the alternatives proposed in the recommended plan with exception of three areas noted by sponsors in the Selected Plan Letter.

At the confluence with the St. Vrain Creek, Boulder Creek has breached along the north bank at a different location since the Alternative Analysis was submittal. The project plan would reflect maintaining the current stream alignment with the Boulder Creek / St. Vrain Creek confluence remaining at its existing location. Given the stream segment and breach occurs on City of Longmont Open Space, improvements in this area will be more related to maintenance of the existing stream configuration and ecological enhancements.

Flooding events have become more common at 95<sup>th</sup> Street. At the request of Boulder County, an interim improvement was developed to help prevent overtopping of the roadway during these more frequent storms, while still maintain the current bridge configurations and relation to downstream private property. This interim plan proposes changes to the roadway and integrates with stream restoration needs upstream of 95<sup>th</sup> Street on City of Boulder Open Space property. Although the interim condition is presented with the conceptual design, the master plan improvements and cost estimate reflect a more long term solution.

At Cordry Court, improvements to the Boulder Creek Trail and grading between the trail and the Cordry Court residences have been added as a recommended improvement to eliminate the high hazard on the residences. In accordance with City greenway's objectives, property acquisition in this area could be considered as a means to eliminate high flood hazard and improve overall public safety.

#### ES.5.1 Reach 1 – Confluence with St. Vrain Creek to approximately 3,300 ft. upstream of the City of Longmont

Beginning at the confluence with the Saint Vrain Creek, Reach 1 extends upstream along Boulder Creek for just over a mile of channel length. All of Reach 1 is contained within Weld County and within City of Longmont Open Space towards the downstream end. There are no channel crossings within this reach with the exception to a gravel pit conveyor crossing and several non-formalized low-water crossings for vehicles. This reach includes gravel pit ponds on either side of Boulder Creek that currently hold water. The riparian area within Reach 1 is approximately 700 feet wide near the confluence with Saint Vrain Creek and narrows to approximately 250 feet at the upstream end. Beyond the riparian area the floodplain overbanks generally consist of active and fallow farm lands. Sporadic residential and farm structures are also present within the overbanks along with several petroleum well pads.



During the 2013 flood, the Saint Vrain Creek breached its banks, avulsing through nearby gravel pit ponds. A further breach of the pond bank between the Saint Vrain Creek and Boulder Creek redefined the confluence location of the two streams, moving it approximately 1,300 feet upstream of the original location. In 2015, following spring runoff, Boulder Creek also breached the same pond bank further west. This again modified the confluence. The streams continue to change over time. Given the changes are occurring on City of Longmont Open Space property, there is less risk to private property or infrastructure; therefore, the master plan recommendations reflect maintaining the creek in-place and providing additional ecological enhancements along the original stream alignment. Gravel pond spillways have also been recommended for ponds adjacent to Boulder Creek.

#### **ES.5.2 Reach 2 – From approximately 3,300 ft. upstream of the City of Longmont to CR 16 ½**

Reach 2 is approximately three miles long and includes bridge crossings at Weld County Roads 20½ and 16½. Although Reach 2 is located in Weld County, upstream locations are also co-managed through Boulder County Conservation Easements. Two major diversion structures to the Rural and Idaho Creek ditches are located within this reach. Disturbances from historic land use practices and channel alterations are widespread. Similarly, floodplain overbanks throughout Reach 2 generally consist of sand and gravel ponds, and aggregate mining operations. The channel within Reach 2 is relatively straight as a result of encroachment on both banks.

Master plan improvements through this reach include: replacement of the bridge crossing at Weld County Roads 20½ and 16½ with 180 foot span bridges compatible with baseline geomorphic conditions; retro-fit of the two ditch diversion structures to accommodate aquatic and habitat passage; modification of a grade control structure for aquatic and habitat passage; and the installation of gravel pond spillways to reduce the chance of failure during flood events. Downstream of CO Rd. 16 ½, general stream restoration is also recommended to repair bank erosion and revitalize Boulder Creek and the surrounding environment. Through this reach Boulder Creek is more confined by adjacent land uses; therefore a more confined approach to stream restoration would be anticipated.

#### **ES.5.3 Reach 3 – From CR 16 ½ to approximately 5,800 ft. upstream**

Reach 3 is located completely within Weld County with the majority of the property managed through Boulder County Open Space Conservation Easements. This is a short reach with a stream length of only 5,800 ft., spanning a distance of approximately 3,900 ft. The most significant, and ongoing, problem within Reach 3 occurs upstream of Weld County Road 16.5, where a breach in the adjacent Williams Reservoir No. 1 diverts flow from Boulder Creek further to the east. This has led to overtopping of 16.5 Road well east of the bridge.

Master plan improvements in this reach focus on stream restoration and protection of the gravel pit pond from further failure. Stream restoration improvements propose to relocate Boulder Creek further west, reestablishing more historic stream alignment and providing additional buffer between the creek and reservoir. Installation of gravel pond spillways will reduce the opportunity for failure of the reservoir embankment.

#### **ES.5.4 Reach 4 – From approximately 5,800 ft. upstream of CR 16 ½ to U.S. 287**

Reach 4 is the longest reach with a stream length of 4.5 miles. Reach 4 is located in both Weld County and Boulder County with portions of the land owned or managed by Boulder County Parks and Open Space. The downstream most section is flanked by past aggregate mining activities; the Town of Erie's sanitary and Re-use facility; and areas under active gravel operations. The remaining overbanks include active and fallow farm lands and minimal

residential development. There are six stream crossings that span Boulder Creek through Reach 4, some of which have capacity exceeding the 100-year event. Others are more limited in size, dilapidated, or un-usable. Several irrigation diversions also exist within Reach 4. Finally, downstream of 109<sup>th</sup> Street, Boulder County is pursuing a stream restoration project with the U.S. Army Corps of Engineers. This project extends from 109<sup>th</sup> Street to Kenosha Road.

Several different improvements are recommended through Reach 4 including: modifications to ditch diversions; improvements at roadway crossings; and stream restoration. At the downstream limits, an existing project is underway to stabilize channel banks adjacent to the Town of Erie's Re-use facility. Downstream of County Line Road the conceptual design proposes to modify the Godding A. and D. Plumb Ditch to accommodate aquatic and habitat passage, in addition to installing gravel pond spillways at adjacent reservoirs. The County Line Road Bridge is proposed to be improved to a 220 ft. span bridge, improving the crossing to a 100-year conveyance level consistent with the upstream Mineral Road Bridge. Bridge improvements at County Line Road should also address stream restoration needs immediately downstream where concrete rubble has been used to stabilize stream banks. No improvements are proposed for the Mineral Road crossing as the existing crossing already meets the 100-year conveyance criteria.

Upstream of Mineral Road, stream restoration is proposed throughout the Wheeler Ranch property. Although a more unimpacted approach restoration can be performed in this area, the final restoration plan should consider constraints defined by the land owner and needs for the confluence with Coal Creek. Upstream of the Wheeler Ranch property, channel bank have eroded and exposed the pipe outlet from the Bailey-Kenosha Pond. Stabilization is proposed along the east bank of Boulder Creek in this area. Upstream of the Bailey-Kenosha Pond, additional stream restoration is recommended upstream to the proposed U.S. Army Corps of Engineers project limits located upstream of Kenosha Road. The existing Howell Ditch Diversion, as well as local grade control, are also proposed to be modified for aquatic and habitat passage. Several gravel pond spillways have been proposed to reduce the chance of failure during flood events. At Kenosha Road and 109<sup>th</sup> Street, 180 ft. span bridges are proposed to increase the conveyance capacity and accommodate geomorphic channel conditions. Alternate stream alignments for restoration between U.S. 287 and 109<sup>th</sup> Street should be considered during final design to best balance the historic stream alignment, with current land uses and transition to the downstream U.S. Army Corps of Engineers project.

#### **ES.5.5 Reach 5 – From U.S. 287 to approximately 4,200 ft. upstream of 95<sup>th</sup> St.**

This reach is located completely within Boulder County and has a stream length of approximately 3 miles. Within Reach 5, Boulder Creek crosses 95<sup>th</sup> Street, which washed out during the September 2013 flood event and nearly again in 2015. Diversion structures feed the Boulder and Weld County Ditch and the Lower Boulder Ditch. The overbanks generally consist of inactive gravel pit ponds and both active and fallow farm fields. A vast majority of this reach follows Boulder County Parks and Open Space, including the Alexander Dawson Open Space, or conservation easements. Past stabilization efforts have been implemented in this reach, although damage was extensive following recent floods.



Master plan improvements for Reach 5 consist of stream restoration, modifications to ditch diversions, and improving the roadway crossing at 95<sup>th</sup> Street. No improvements are proposed to the roadway crossing at U.S. 287 as the bridge crossing already exceeds the 100-year conveyance capacity.

Upstream of U.S. 287, stream restoration is proposed through Alexander Dawson Open Space, with aquatic and habitat passage improvements at the Boulder and Weld County Ditch diversion and upstream grade control. A more unimpacted approach to restoration is recommended through this area given the open space designation.

Upstream and downstream of 95<sup>th</sup> Street, stream restoration has been proposed to reestablish geomorphic channel geometry and improve riparian habitat. Similar to between U.S. 287 and 109<sup>th</sup> Street, several options for restoration may exist, including changes to both public and private property. Costs for the master plan improvements at this location generally reflect the restoration of Boulder Creek to the north of the current alignment, including: reestablishment of Boulder Creek through the 95<sup>th</sup> Street Pond (City of Boulder Open Space), new 100-year crossing of 95<sup>th</sup> Street at the roadway low point; construction of a new channel and easements across the Boulder Valley Farms property; and diversion to the current Lower Boulder Ditch at its current location. The master plan improvements represent a long term solution for the area.

Given the many entities involved and challenges of implementation for the long term solution, Boulder County requested that an interim solution be developed to address more frequent flooding problems at 95<sup>th</sup> Street. The interim solution will maintain the existing bridge, raise the roadway elevation to prevent frequent overtopping, and provide conveyance from the pond to the bridge through a vegetated spillway. This interim solution is depicted in [Figure 11-8: Interim Improvement at 95th Street Rendering](#).

#### **ES.5.6 Reach 6 – From approximately 4,200 ft. upstream of 95<sup>th</sup> St. to 75<sup>th</sup> St.**

Reach 6 is approximately 4.5 miles long and is completely contained within Boulder County. The stream corridor itself is located on land managed by the City of Boulder's Open Space and Mountain Parks Division. This reach appears to remain in a natural state with little encroachments on either overbank. Gravel mining operations on the south side of the creek have left several small gravel ponds in the floodplain. Hydraulic drop structures exist both upstream and downstream of 75<sup>th</sup> Street and the diversion structure for the Leggett Ditch is centrally located.

Master plan improvements for this reach include modifying Leggett Ditch for aquatic and habitat passage and improving the 75<sup>th</sup> Street crossing to a 220 ft. span bridge.

#### **ES.5.7 Reach 7 – From 75<sup>th</sup> St. to Valmont Rd.**

This reach is approximately 3.5 miles in length and covers areas of both City of Boulder Open Space and Mountain Parks and Boulder County Parks and Open Space properties. Through this reach, the channel is nearly completely flanked by sand and gravel ponds, and mining operations. Most of these operations are no longer active and the excavated ponds remain full of water. The City of Boulder wastewater treatment plant is located just south of the creek, upstream of 75<sup>th</sup> Avenue. The wastewater treatment plant is protected from flooding by a ring levee. Private stream crossings, minor arterial (61<sup>st</sup> Street), bike path, and a major arterial (Valmont Road) crossings, are all located within Reach 7.

Projects within Reach 7 include the installation of gravel pond spillways, protection of the City of Boulder's sanitary sewer trunk line, improved roadway crossings, stream restoration, and modification of existing diversion structures.

Seven gravel pit spillways are proposed to protect Walden Ponds near the downstream limit of Reach 7. Several gravel pond spillways are proposed within the Walden Ponds Wildlife Habitat area and along private ponds within Reach 7. Stream stabilization and bank protection is proposed to provide additional protection from erosion and degradation in the vicinity of the City of Boulder's central sanitary interceptor. These locations will be protected using grade control structures and bank stabilization.

The master plan improvements do not include stream restoration downstream of 61<sup>st</sup> Street, as this reach is currently being addressed by ongoing City of Boulder Open Space and Mountain Parks improvements; however general restoration guidance for this area is provided. Master plan improvement through this reach do, however, include modifying the two irrigation ditch diversion structures to accommodate aquatic and habitat passage.

The existing 61<sup>st</sup> Street bridge is proposed to be replaced with a 220 ft. span bridge to accommodate the 100-year event. Upstream of 61<sup>st</sup> Street to Valmont Road, stream restoration has been proposed to reestablish baseline geomorphic conditions, increase channel sinuosity, and improve overall riparian vegetation and habitat. This reach is also currently being evaluated by City of Boulder Open Space and Mountain Parks.

The existing trail crossing of Boulder Creek at Old Valmont Road is currently undersized. During the 2013 flood, the crossing was an obstruction to flow and a significant amount of blockage developed from debris and other items. This bridge is proposed to be replaced with a 180 ft. span pedestrian bridge to better convey flood flow, debris, and accommodate geomorphic channel conditions and habitat.

Finally, improvements through Reach 7 include improving the Butte Mill Ditch Crossing across South Boulder Creek. For this ditch, which originates from Boulder Creek, modifications include siphoning the canal flows underneath South Boulder Creek in a 54" RCP.

#### **ES.5.8 Reach 8 – From Valmont Rd. to 30<sup>th</sup> St.**

This reach is approximately 2.3 miles in length and primarily located within the City of Boulder. The channel characteristics generally include a combination of riparian habitat, roadway, and trail crossings. Wonderland, Goose, and South Boulder Creeks enter Boulder Creek within Reach 8, and several small ponds are located adjacent to the stream. For Boulder Creek, Reach 8 reflects the transition to an urban flood channel and for the most part, Boulder Creek has been locked in place through urbanization. The Burlington Northern and Santa Fe (BNSF) railroad embankment presents a significant obstacle for Boulder Creek and its connectivity with upstream and downstream floodplain areas. The BNSF crossing also has significantly less conveyance capacity than the larger span bridges within Boulder.

Master plan improvements within Reach 8 are comprised of stream restoration, improving the railroad crossing conveyance capacity, access to the Boulder Valley Hospital, and management of accumulated sediment. Stream restoration is proposed from the downstream limit of Reach 8 at Valmont Road through Foothills Parkway. As described above, the BNSF railroad is a significant obstacle for Boulder Creek. The crossing is proposed to be increased to a 180 ft. span bridge to better convey flood flows and accommodate geomorphic channel conditions.

To ensure safe access to the hospital during major floods, up to the 500-year event, an alternate access point from 48<sup>th</sup> Street has been recommended. This access point would only serve emergency vehicles and would not provide routine access.



Frequent sediment deposition has been observed throughout Reach 8 along Boulder Creek and pedestrian trail crossings. Maintenance level sediment removal projects (up to 200 cubic yards per year) has been incorporated into the master plan at various crossing locations.

#### **ES.5.9 Reach 9 – From 30th St. to City of Boulder Limits**

Reach 9 extends through the City of Boulder from 30<sup>th</sup> St. to upstream of Arapahoe Avenue. This reach also includes the University of Colorado (CU) Campus, between 17<sup>th</sup> Street and Folsom. Many roadway crossings exist through this reach as well as Boulder Creek trail bridges. The Boulder Creek trail also follows the creek for the entire reach. Many buildings are located within the Boulder Creek floodplain. Both FEMA and the City of Boulder have designated additional regulatory zones to manage existing development and redevelopment. Strategic plans, including CU's North of Boulder Creek study have also been developed to identify management strategies to reduce overall flood risk. Similarly, the City of Boulder is currently in process of planning for redevelopment surrounding the Civic Center area, and is evaluating this plan with respect to flood management.

Master plan improvements within Reach 9 include mitigating flood hazards, improving access near Boulder Creek, modifying diversions, and sediment maintenance. Downstream of 28<sup>th</sup> Street, along Cordry Court, realignment of the Boulder Creek Trail is proposed to increase conveyance and mitigate the high hazard conditions near residences. In accordance with City greenway's objectives, property acquisition in this area should be considered as a means to eliminate high hazard designation and improve overall public safety. Near the CU campus, two new pedestrian bridges are proposed to improve access to the North of Boulder Creek campus. These bridges, or walkways, will provide emergency access to areas otherwise susceptible to isolation during flood events.

To mitigate flood hazards along the Boulder Slough, an overflow diversion structure is proposed at 14<sup>th</sup> Street. This diversion system will divert flows in excess of the conveyance capacity of the ditch back into Boulder Creek, reducing flood risk to adjacent properties.

Changes to the diversion structure at Broadway Street are also proposed to accommodate aquatic and habitat passage.

Similar to other location, six locations have been identified for annual sediment removal (up to 200 cubic yards per year) in Reach 9.

No new alternatives have been developed for the Civic Center area in this master plan study; however changes to Boulder Creek at this location should consider implementing recommendations discussed in [9.3 Improvement Alternative Categories](#).

#### **ES.5.10 Reach 10 – From City of Boulder Limits to Fourmile Creek**

Reach 10 reflects the reach of Boulder Canyon between the City of Boulder and the confluence with Fourmile Creek. This reach has much steeper overbank slopes and narrower cross section than the reaches to the east. The reach length is approximately 2 miles and the riparian zone is narrow at less than 100 feet wide. Through the canyon, State Highway 119 parallels the creek, crossing it twice. The Boulder Creek trail also parallels Boulder Creek along the opposite bank of the highway. In general, the stream banks are steep and stable, and have been armored with cobble, rock, and riprap. Boulder County is currently in process of repairing sections of the Boulder Creek trail and extending the path up to Fourmile Creek.

Reach 10 improvements consist of modifying the Farmers' Ditch diversion for aquatic and habitat passage. Restoration of Boulder Creek has also been proposed in areas of disrepair following the 2013 flood event. Restoration locations have been depicted by the project conceptual design renderings.

#### **ES.5.11 Master Plan Prioritization**

In general, projects presented by this master plan are isolated in nature and can be implemented in any order without affecting adjacent projects upstream and downstream. Stream restoration and ecological enhancement will be most affected when Boulder Creek has been restored in a consistent manner across the entirety of the study length.

Since many of the alternatives in this study are not directly comparable, each recommended alternative has been grouped into a distinguishing category for prioritization. The four categories reflect: stream and Ecological Restoration, Bridge Replacement & Emergency Access; Public Safety; and Stream Maintenance. Within each category, projects were ranked in terms of a high, medium, or low priority. Top priority was given to project which serviced an immediate need; high level of stakeholder interest or collaboration; and presented higher levels of feasibility for implementation. Lower priority was assigned to locations posing less immediate threat to public safety, or integrated more long term planning goals.



**Boulder Creek Restoration Master Plan**

**DRAFT – Conceptual Design for Boulder County, Weld County, and City of Longmont**

**Table ES- 3: Prioritization Summary**

Reach	ID	Prioritization by Project	Project Type	Jurisdiction	Priority
<b>HIGH PRIORITY PROJECTS</b>					
2	E	CO Rd. 16.5 - Replace Bridge with 180 ft. Span Bridge	Bridge Replacement	Weld County	High
2	G	Stream Restoration Downstream of CO Rd. 16.5	Stream Restoration	Weld County	High
3	A	Stream Restoration Upstream of CO Rd. 16.5	Stream Restoration	Weld County	High
3	B	Protect Gravel Pond Inlet & Outlet During Storm Flows, Typical	Public Safety	Weld County	High
4	B	County Line Road - 100-yr Option: Replace Bridge with 220 ft. Span Bridge	Bridge Replacement	Boulder County	High
4	G	Stabilize Howell Ditch Diversion System, Modify Diversion for Aquatic and Habitat Passage	Stream Restoration	Boulder County	High
4	H	Kenosha Rd. - Replace Bridge with 180 ft. Span Bridge	Bridge Replacement	Boulder County	High
4	J	109th St. - Replace Bridge with 180 ft. Span Bridge; Restore Adjacent Channel	Bridge Replacement	Boulder County	High
4	K	Stream Restoration Through Wheeler Ranch	Stream Restoration	Boulder County	High
5	H	Stream Restoration from Upstream of 95th St. to White Rocks Trail	Stream Restoration	City of Boulder	High
7	E	61st Street - 100-yr Option: Replace Bridge with 220 ft. Span Bridge	Bridge Replacement	Boulder County	High
7	F	Replace Old Valmont Pedestrian Crossing with 180 ft. Span Bridge	Bridge Replacement	Boulder County	High
7	H	Protect Sanitary Interceptor Sewer	Public Safety	Boulder County	High
8	C	BNSF Railroad - Replace Bridge with 180 ft. Span Bridge	Bridge Replacement	City of Boulder	High
8	F	Sediment Maintenance along Boulder Creek Path	Maintenance	City of Boulder	High
9	C	North of Boulder Creek Access Improvements	Bridge Replacement	City of Boulder	High
9	D	Boulder Slough Mitigation	Public Safety	City of Boulder	High
9	F	Sediment Maintenance along Boulder Creek Path	Maintenance	City of Boulder	High
<b>MEDIUM PRIORITY PROJECTS</b>					
1	B	Protect Gravel Pond Inlet & Outlet During Storm Flows, Typical	Public Safety	City of Longmont / Weld County	Medium
2	A	CO Rd. 20.5 - Replace Bridge with 180 ft. Span Bridge	Bridge Replacement	Weld County	Medium
2	F	Protect Gravel Pond Inlet & Outlet During Storm Flows, Typical	Public Safety	Town of Frederick / Weld County	Medium
4	C	Protect Gravel Ponds / Town of Erie Reuse Pond / Wittmeyer Ponds Inlet & Outlet During Storm Flows, Typical.	Public Safety	Town of Erie / Weld County / Boulder County	Medium
4	D	Stabilize Bank at Bailey-Kenosha Pond Outlet	Stream Restoration	Boulder County	Medium
4	F	Stream Restoration Through Doniphan, Wittmeyer Ponds, Bailey-Kenosha Ponds, and Open Space	Stream Restoration	Boulder County	Medium
5	C	Protect Boulder Valley Ponds Inlet & Outlet During Storm Flows, Typical.	Public Safety	Boulder County	Medium
5	F	Stream Restoration Downstream of 95th Street	Stream Restoration	Boulder County	Medium
5	G	95th St. - 100-yr Option: Replace Bridge with 220 ft. Span Bridge	Bridge Replacement	Boulder County	Medium
6	B	75th Street - 100-yr Option: Replace Bridge with 220 ft. Span Bridge	Bridge Replacement	Boulder County	Medium
7	A	Protect Walden Ponds Inlet & Outlet During Storm Flows, Typical	Public Safety	Boulder County	Medium
7	B	Protect Ponds Inlet & Outlet During Storm Flows, Typical	Public Safety	Boulder County	Medium
7	G	Modify Butte Mill Ditch Crossing on South Boulder Creek	Maintenance	Boulder County	Medium
7	I	Stream Restoration from Valmont Rd to 61st Street	Stream Restoration	City of Boulder	Medium
8	D	Stream Restoration from Foothills Pkwy to BNSF RR	Stream Restoration	City of Boulder	Medium

Reach	ID	Prioritization by Project	Project Type	Jurisdiction	Priority
<b>LOW PRIORITY PROJECTS</b>					
1	A	Stream Maintenance and Ecological Enhancements City of Longmont Open Space	Stream Restoration	City of Longmont / Weld County	Low
2	B	Replace Existing Grade Control for Aquatic and Habitat Passage	Stream Restoration	Weld County	Low
2	C	Modify Rural Ditch for Aquatic and Habitat Passage	Stream Restoration	Town of Frederick / Weld County	Low
2	D	Modify Idaho Creek Ditch for Aquatic and Habitat Passage	Stream Restoration	Weld County	Low
4	A	Modify Godding A. and D. Plumb Ditch for Aquatic and Habitat Passage	Stream Restoration	Weld County	Low
4	E	DS of Kenosha Rd. - Remove Washed Out Bridge	Maintenance	Boulder County	Low
4	I	Replace Grade Control for Aquatic and Habitat Passage	Stream Restoration	Boulder County	Low
5	A	Stream Restoration at Alexander Dawson Open Space	Stream Restoration	Boulder County	Low
5	B	Modify Boulder and Weld County Ditch for Aquatic and Habitat Passage	Stream Restoration	Boulder County	Low
5	D	Modify Grade Control Structures for Aquatic and Habitat Passage	Stream Restoration	Boulder County	Low
5	E	Modify Lower Boulder Ditch for Aquatic and Habitat Passage	Stream Restoration	Boulder County	Low
6	A	Modify Leggett Ditch for Aquatic and Habitat Passage	Stream Restoration	Boulder County	Low
7	C	Modify Diversion for Aquatic and Habitat Passage	Stream Restoration	Boulder County	Low
7	D	Modify Green Ditch Diversion for Aquatic and Habitat Passage	Stream Restoration	Boulder County	Low
8	A	Stream Restoration from 55th St. to Valmont Drive	Stream Restoration	City of Boulder	Low
8	B	Stream Restoration from BNSF RR to 55th St.	Stream Restoration	City of Boulder	Low
8	E	Hospital Access Improvements for 500-yr Event	Public Safety	City of Boulder	Low
9	A	Cordry Ct, High Hazard & Flood Mitigation	Public Safety	City of Boulder	Low
9	E	Modify Boulder Ditches Diversion for Aquatic and Habitat Passage	Stream Restoration	City of Boulder	Low
10	A	Modify Farmers' Ditch for Aquatic and Habitat Passage	Stream Restoration	Boulder County	Low
10	B	Boulder Canyon Stream Restoration	Stream Restoration	Boulder County	Low



**Boulder Creek Restoration Master Plan**

**DRAFT – Conceptual Design for Boulder County, Weld County, and City of Longmont**

Table ES- 4: Cost Estimate Summary (Reach 1-6)

Reach	ID	Description	Jurisdiction	Reach Length (mi)	Capital	Eng / Admin / Legal	Contingency	Total Capital Cost	50-yr O&M Cost	
1	A	Stream Maintenance and Ecological Enhancements City of Longmont Open Space	City of Longmont / Weld County	0.13	\$ 39,146	\$ 11,744	\$ 9,787	\$ 60,677	\$ 9,800	
	B	Protect Gravel Pond Inlet & Outlet During Storm Flows, Typical	City of Longmont / Weld County	--	\$ 261,000	\$ 78,300	\$ 65,250	\$ 404,550	\$ 1,085	
	<b>Reach 1 Total</b>				<b>0.83</b>	<b>\$ 300,146</b>	<b>\$ 90,044</b>	<b>\$ 75,037</b>	<b>\$ 465,227</b>	<b>\$ 10,885</b>
2	A	CO Rd. 20.5 - Replace Bridge with 180 ft. Span Bridge	Weld County	--	\$ 1,792,200	\$ 537,660	\$ 448,050	\$ 2,777,910	\$ 35,420	
	B	Replace Existing Grade Control for Aquatic and Habitat Passage	Weld County	--	\$ 237,800	\$ 71,340	\$ 59,450	\$ 368,590	\$ 4,270	
	C	Modify Rural Ditch for Aquatic and Habitat Passage	Town of Frederick / Weld County	--	\$ 290,000	\$ 87,000	\$ 72,500	\$ 449,500	\$ 4,270	
	D	Modify Idaho Creek Ditch for Aquatic and Habitat Passage	Weld County	--	\$ 290,000	\$ 87,000	\$ 72,500	\$ 449,500	\$ 4,270	
	E	CO Rd. 16.5 - Replace Bridge with 180 ft. Span Bridge	Weld County	--	\$ 1,792,200	\$ 537,660	\$ 448,050	\$ 2,777,910	\$ 35,420	
	F	Protect Gravel Pond Inlet & Outlet During Storm Flows, Typical	Town of Frederick / Weld County	--	\$ 5,481,000	\$ 1,644,300	\$ 1,370,250	\$ 8,495,550	\$ 22,435	
	G	Stream Restoration Downstream of CO Rd. 16.5	Weld County	0.38	\$ 1,054,200	\$ 316,260	\$ 263,550	\$ 1,634,010	\$ 28,000	
<b>Reach 2 Total</b>				<b>3.14</b>	<b>\$ 10,937,400</b>	<b>\$ 3,281,220</b>	<b>\$ 2,734,350</b>	<b>\$ 16,952,970</b>	<b>\$ 134,085</b>	
3	A	Stream Restoration Upstream of CO Rd. 16.5	Weld County	0.38	\$ 1,058,840	\$ 317,652	\$ 264,710	\$ 1,641,202	\$ 28,000	
	B	Protect Gravel Pond Inlet & Outlet During Storm Flows, Typical	Weld County	--	\$ 261,000	\$ 78,300	\$ 65,250	\$ 404,550	\$ 1,085	
	<b>Reach 3 Total</b>				<b>1.03</b>	<b>\$ 1,319,840</b>	<b>\$ 395,952</b>	<b>\$ 329,960</b>	<b>\$ 2,045,752</b>	<b>\$ 29,085</b>
4	A	Modify Godding A. and D. Plumb Ditch for Aquatic and Habitat Passage	Weld County	--	\$ 290,000	\$ 87,000	\$ 72,500	\$ 449,500	\$ 4,270	
	B	County Line Road - 100-yr Option: Replace Bridge with 220 ft. Span Bridge	Boulder County	--	\$ 3,655,197	\$ 1,096,560	\$ 913,799	\$ 5,665,556	\$ 28,560	
	C	Protect Gravel Ponds / Town of Erie Reuse Pond / Wittemeyer Ponds Inlet & Outlet During Storm Flows, Typical.	Town of Erie / Weld County / Boulder County	--	\$ 3,915,000	\$ 1,174,500	\$ 978,750	\$ 6,068,250	\$ 16,030	
	D	Stabilize Bank at Bailey-Kenosha Pond Outlet	Boulder County	--	\$ 17,089	\$ 5,126	\$ 4,272	\$ 26,487	\$ 3,220	
	E	DS of Kenosha Rd. - Remove Washed Out Bridge		--	\$ 69,600	\$ 20,880	\$ 17,400	\$ 107,880	\$ -	
	F	Stream Restoration Through Doniphan, Wittemeyer Ponds, Bailey-Kenosha Ponds, and Open Space		--	\$ 4,477,600	\$ 1,343,280	\$ 1,119,400	\$ 6,940,280	\$ 118,999	
	G	Stabilize Howell Ditch Diversion System, Modify Diversion for Aquatic and Habitat Passage		--	\$ 399,308	\$ 119,792	\$ 99,827	\$ 618,927	\$ 7,490	
	H	Kenosha Rd. - Replace Bridge with 180 ft. Span Bridge		--	\$ 2,296,800	\$ 689,040	\$ 574,200	\$ 3,560,040	\$ 28,560	
	I	Replace Grade Control for Aquatic and Habitat Passage		--	\$ 237,800	\$ 71,340	\$ 59,450	\$ 368,590	\$ 4,270	
	J	109th St. - Replace Bridge with 180 ft. Span Bridge; Restore Adjacent Channel		--	\$ 2,834,752	\$ 850,426	\$ 708,688	\$ 4,393,866	\$ 28,420	
	K	Stream Restoration Through Wheeler Ranch		0.87	\$ 2,424,657	\$ 727,398	\$ 606,164	\$ 3,758,219	\$ 64,399	
<b>Reach 4 Total</b>				<b>4.59</b>	<b>\$ 20,617,803</b>	<b>\$ 6,185,342</b>	<b>\$ 5,154,450</b>	<b>\$ 31,957,595</b>	<b>\$ 304,218</b>	
5	A	Stream Restoration at Alexander Dawson Open Space		Boulder County	0.85	\$ 2,378,000	\$ 713,400	\$ 594,500	\$ 3,685,900	\$ 62,999
	B	Modify Boulder and Weld County Ditch for Aquatic and Habitat Passage			--	\$ 290,000	\$ 87,000	\$ 72,500	\$ 449,500	\$ 4,270
	C	Protect Boulder Valley Ponds Inlet & Outlet During Storm Flows, Typical.	--		\$ 1,305,000	\$ 391,500	\$ 326,250	\$ 2,022,750	\$ 5,355	
	D	Modify Grade Control Structures for Aquatic and Habitat Passage	--		\$ 237,800	\$ 71,340	\$ 59,450	\$ 368,590	\$ 4,270	
	E	Modify Lower Boulder Ditch for Aquatic and Habitat Passage	--		\$ 475,600	\$ 142,680	\$ 118,900	\$ 737,180	\$ 8,540	
	F	Stream Restoration Downstream of 95th Street	0.38		\$ 1,054,200	\$ 316,260	\$ 263,550	\$ 1,647,495	\$ 28,000	
	G	95th St. - 100-yr Option: Replace Bridge with 220 ft. Span Bridge	--		\$ 3,778,680	\$ 1,133,604	\$ 944,670	\$ 5,856,954	\$ 28,560	
	H	Stream Restoration from Upstream of 95th St. to White Rocks Trail	City of Boulder		0.85	\$ 2,371,947	\$ 711,584	\$ 592,987	\$ 3,676,518	\$ 62,999
<b>Reach 5 Total</b>				<b>2.83</b>	<b>\$ 11,891,227</b>	<b>\$ 3,567,368</b>	<b>\$ 2,972,807</b>	<b>\$ 18,444,887</b>	<b>\$ 204,993</b>	
6	A	Modify Leggett Ditch for Aquatic and Habitat Passage	Boulder County	--	\$ 290,000	\$ 87,000	\$ 72,500	\$ 449,500	\$ 4,270	
	B	75th Street - 100-yr Option: Replace Bridge with 220 ft. Span Bridge		--	\$ 3,097,220	\$ 929,166	\$ 774,305	\$ 4,800,691	\$ 28,560	
	<b>Reach 6 Total</b>				<b>2.53</b>	<b>\$ 3,387,220</b>	<b>\$ 1,016,166</b>	<b>\$ 846,805</b>	<b>\$ 5,250,191</b>	<b>\$ 32,830</b>

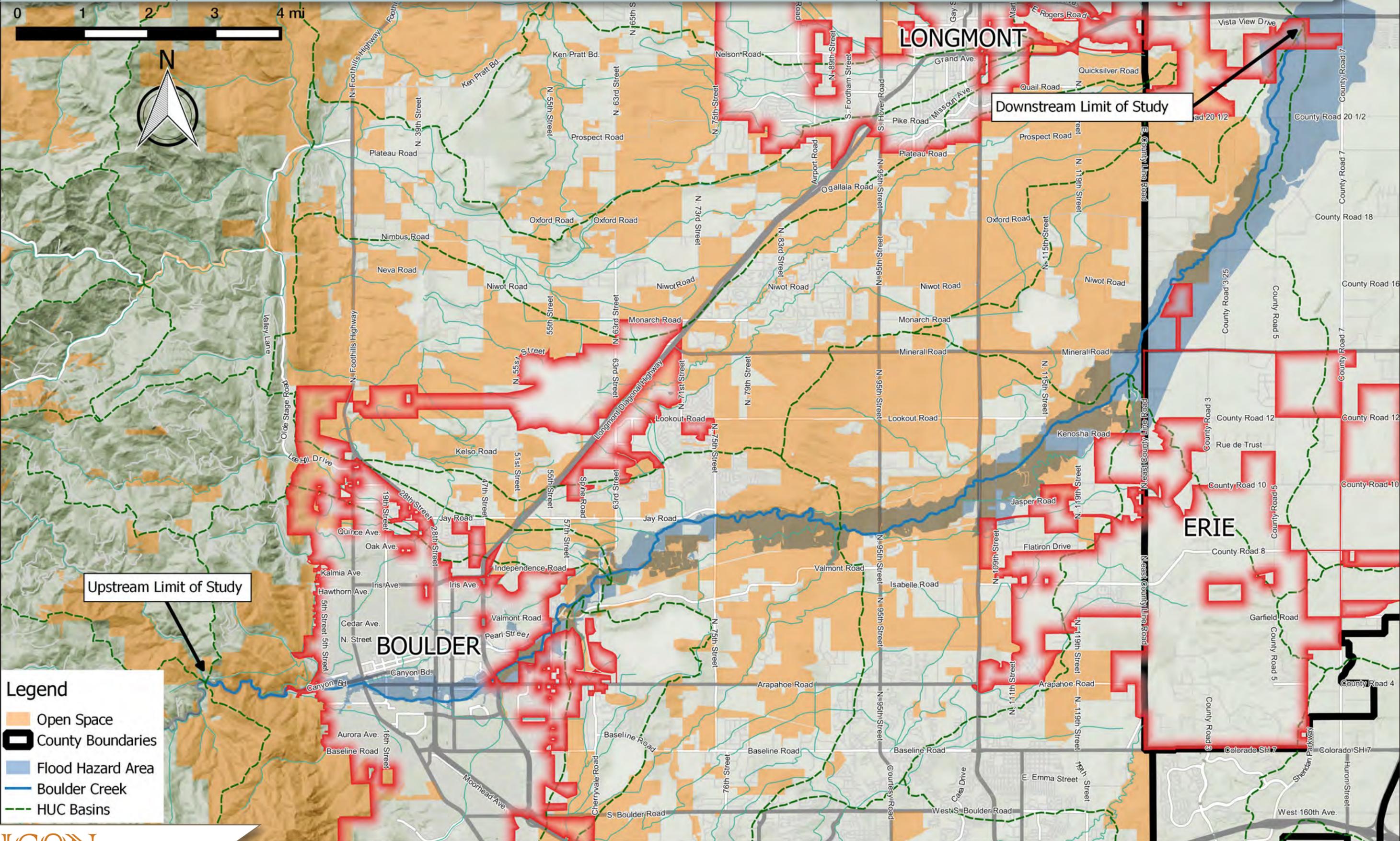


**Boulder Creek Restoration Master Plan**

**DRAFT – Conceptual Design for Boulder County, Weld County, and City of Longmont**

Table ES- 5: Cost Estimate Summary (Reach 7-10)

Reach	ID	Description	Jurisdiction	Reach Length (mi)	Capital	Eng / Admin / Legal	Contingency	Total Capital Cost	50-yr O&M Cost	
7	A	Protect Walden Ponds Inlet & Outlet During Storm Flows, Typical	Boulder County	--	\$ 1,827,000	\$ 548,100	\$ 456,750	\$ 2,831,850	\$ 7,490	
	B	Protect Ponds Inlet & Outlet During Storm Flows, Typical		--	\$ 1,827,000	\$ 548,100	\$ 456,750	\$ 2,831,850	\$ 7,490	
	C	Modify Diversion for Aquatic and Habitat Passage		--	\$ 290,000	\$ 87,000	\$ 72,500	\$ 449,500	\$ 4,270	
	D	Modify Green Ditch Diversion for Aquatic and Habitat Passage		--	\$ 290,000	\$ 87,000	\$ 72,500	\$ 449,500	\$ 4,270	
	61st Street - 100-yr Option:									
	E	Replace Bridge with 220 ft. Span Bridge		--	\$ 2,843,416	\$ 853,025	\$ 710,854	\$ 4,407,295	\$ 28,420	
	F	Replace Old Valmont Pedestrian Crossing with 180 ft. Span Bridge		--	\$ 1,117,813	\$ 335,344	\$ 279,453	\$ 1,732,610	\$ 28,210	
	G	Modify Butte Mill Ditch Crossing on South Boulder Creek		--	\$ 235,238	\$ 70,572	\$ 58,810	\$ 364,620	\$ 4,200	
	H	Protect Sanitary Interceptor Sewer		--	\$ 511,010	\$ 153,304	\$ 127,753	\$ 792,067	\$ 8,540	
	I	Stream Restoration from Valmont Rd to 61st Street	City of Boulder	1.18	\$ 1,546,781	\$ 464,034	\$ 386,695	\$ 2,397,510	\$ 87,499	
<b>Reach 7 Total</b>				<b>3.51</b>	<b>\$ 10,488,258</b>	<b>\$ 3,146,479</b>	<b>\$ 2,622,065</b>	<b>\$ 16,256,802</b>	<b>\$ 180,389</b>	
8	A	Stream Restoration from 55th St. to Valmont Drive	City of Boulder	0.32	\$ 429,200	\$ 128,760	\$ 107,300	\$ 665,260	\$ 23,800	
	B	Stream Restoration from BNSF RR to 55th St.		0.91	\$ 1,194,800	\$ 358,440	\$ 298,700	\$ 1,851,940	\$ 67,199	
	C	BNSF Railroad - Replace Bridge with 180 ft. Span Bridge		--	\$ 2,697,000	\$ 809,100	\$ 674,250	\$ 4,180,350	\$ 28,280	
	D	Stream Restoration from Foothills Pkwy to BNSF RR		0.49	\$ 638,000	\$ 191,400	\$ 159,500	\$ 988,900	\$ 36,400	
	E	Hospital Access Improvements for 500-yr Event		--	\$ 46,932	\$ 14,080	\$ 11,733	\$ 72,745	\$ -	
	F	Sediment Maintenance along Boulder Creek Path		--	\$ -	\$ -	\$ -	\$ -	\$ 839,993	
<b>Reach 8 Total</b>				<b>2.3</b>	<b>\$ 5,005,932</b>	<b>\$ 1,501,780</b>	<b>\$ 1,251,483</b>	<b>\$ 7,759,195</b>	<b>\$ 995,672</b>	
9	A	Cordry Ct, High Hazard & Flood Mitigation	City of Boulder	0.06	\$ 65,589	\$ 19,676	\$ 16,397	\$ 266,662	\$ 13,650	
	C	North of Boulder Creek Access Improvements		--	\$ 3,496,000	\$ 1,048,800	\$ 874,000	\$ 5,418,800	\$ 69,999	
	D	Boulder Slough Mitigation		--	\$ 486,385	\$ 145,916	\$ 121,596	\$ 753,897	\$ 10,815	
	E	Modify Boulder Ditches Diversion for Aquatic and Habitat Passage		--	\$ 406,000	\$ 121,800	\$ 101,500	\$ 629,300	\$ 4,270	
	F	Sediment Maintenance along Boulder Creek Path		--	\$ -	\$ -	\$ -	\$ -	\$ 1,259,989	
<b>Reach 9 Total</b>				<b>2.87</b>	<b>\$ 4,453,974</b>	<b>\$ 1,336,192</b>	<b>\$ 1,113,493</b>	<b>\$ 7,068,659</b>	<b>\$ 1,358,723</b>	
10	A	Modify Farmers' Ditch for Aquatic and Habitat Passage	Boulder County	--	\$ 300,000	\$ 90,000	\$ 75,000	\$ 465,000	\$ 4,270	
	B	Boulder Canyon Stream Restoration		0.91	\$ 696,000	\$ 208,800	\$ 174,000	\$ 1,078,800	\$ 67,199	
<b>Reach 10 Total</b>				<b>1.64</b>	<b>\$ 996,000</b>	<b>\$ 298,800</b>	<b>\$ 249,000</b>	<b>\$ 1,543,800</b>	<b>\$ 71,469</b>	
<b>Total Costs</b>				<b>25.27</b>	<b>\$ 69,397,800</b>	<b>\$ 20,819,343</b>	<b>\$ 17,349,450</b>	<b>\$ 107,745,078</b>	<b>\$ 3,322,349</b>	



**Legend**

- Open Space
- County Boundaries
- Flood Hazard Area
- Boulder Creek
- HUC Basins

## **Civic Area Floodplain Information**

### **History of Floodplain Activities in the Civic Area**

1983 –Boulder Creek Floodplain studies prepared by Muller Engineering Company and used for the floodplain mapping for the Main Library South Wing project.

1986 - Citizen petition and election for a Library bond for new facilities; the ballot item prohibited expenditure of funds within the floodway.

1989 - A special election was held in December and it specified that the majority of the bond proceeds were to be expended in the area between Broadway and 9<sup>th</sup> and Boulder Creek and Arapahoe and re-affirming that the flood prohibition still applied to the use of the funds.

1990 – January a Floodplain Development Permit was issued for the new south wing of the library. The permit, associated study work and floodplain mapping at the time showed that the new facility was not located within the Boulder Creek floodplain (nor the high hazard zone). Gregory Creek floodplain also did not impact the site for the library. A condition of this permit required floodproofing be provided for the existing north wing of the library.

1992 – Library addition completed and Certificate of Occupancy Issued

2009 – November updated Gregory Canyon Creek Floodplain Mapping adopted by City (FEMA accepted October 2010)

2012 – September updated [Boulder Creek Floodplain Mapping](#) adopted by the City (FEMA acceptance expected in fall 2016). The Main Library North and Center Wings, New Brittan and Park Central remain in the HHZ, the Main Library South Wing is added to the HHZ, and the Muni Building and the Atrium are removed from the HHZ.

2013 – [Technical Analysis for Floodplain, Wetlands/Riparian Corridor and Water Quality Issues](#) completed by Wright Water Engineers

2013 – September floods impacted both the West Senior Center and the Main Library. Boulder Creek experiences a 25 year event and Gregory Creek experiences a 25-50 year event in the Civic Area.

### **Flood Regulatory Considerations**

The [Boulder Civic Area Guiding Principles](#) states “The Boulder Civic Area is located within the 100-year floodplain, and much of the land lies within the High Hazard Zone (HHZ). The city will meet or exceed existing flood standards, including avoiding placing new structures and parking in the HHA and will be proactive about planning for and educating about floods.” The city’s existing flood regulations include:

- No new buildings intended for human occupancy can be built within the High Hazard Zone (HHZ).
- A building that is touched by the HHZ is regulated as if the entire structure is in the HHZ.
- An existing building in the HHZ cannot have additional space intended for occupancy built nor can the footprint be increased.

- An existing building cannot be improved by more than 50% of the value of the building. Any improvements that are within the conveyance zone require evaluation and certification of no impact.

### **Flood Policy Consideration**

Public safety must be considered for flood potential, but does not prohibit activation of areas in the floodplain or HHZ. A hierarchy of activation and uses related to safety should be considered. Uses that are outdoors and that do not confine the ability of people to evacuate from the area are safer than occupied buildings. For buildings, those occupied by the same people on a daily basis (such as office space) and who are aware of their situation and trained on how to respond is less of a risk than the circumstance of buildings used for assembly space (such as performance and theater) where occupants are not routinely in the building, may not have situational awareness nor training on how to respond during a flood event (or flash flooding).

### **Site Opportunities and Flood Constraints:**

Difference in Risk – While all of the sites in the Civic Area are impacted by floodplain and/or high hazard zone determinations there are differences in the risks associated with potential flooding for each of the sites. Future uses of these sites have been considered in response to these different conditions.

#### West end of Civic Area

Floodplain issues have been a concern in this area and discussed over many years and included in different studies. Specific regulatory and policy issues are:

#### Main Library North Wing

This building is impacted by the Boulder Creek 100-year floodplain, conveyance zone and HHZ designations. The current “island” in the HHZ is created by the blockage of flood flows created by the location of the building, and the entire location would be HHZ without the building. For these reasons the site should be managed as a HHZ location.

The flood designations at this site create regulatory constraints that prohibit the expansion of either the footprint and/or increase in square footage of the building, and also limit the level of improvements that can be made to the building.

Appropriate uses of the current building should consider the acceptable level of risk with that use. For example, a regularly used performance/assembly center creates a higher risk to life safety and is not a use that would be appropriate for this location. More informal uses such as seating space for the café and small community groups have a lower risk potential. Any use of this building should include the implementation of an Emergency Management Plan and associated education and public information necessary to support the activation of the area in case of flood risk.

The lifespan of this building should be assessed along with its longer term use.

#### Main Library South Wing

This building is impacted by the Boulder Creek HHZ as it touches a portion of this building; however the site is not surrounded by the HHZ. This designation does subject the entire building to city’s high hazard floodplain regulations. It may be possible that mitigation measures for

Boulder Creek could change the HHZ mapping and remove this building from the designation. Addition analysis would be required to make a determination on this issue.

#### West Senior Center

The west edge of this building may be impacted by Gregory Canyon Creek HHZ; however the rest of the site is not within the 100 year floodplain. Access to this site is impacted by the Gregory Canyon Creek HHZ that extends east along Arapahoe. While this site is not mapped in the 100-year floodplain, this facility was impacted during the September 2013 floods and therefore flooding is a concern separate from the regulatory maps. It is possible that mitigation work for Gregory Creek could impact this site, and would also lower the flood risk to a portion of this site and Arapahoe Road. To accomplish this, it is likely that the current building would need to be removed. Examples of acceptable uses of this site with flood mitigation could be above ground parking garage or office space.

#### Muni Building

The 2012 updated Boulder Creek Floodplain mapping removed this building from the HHZ but the building remains in the 100-year floodplain and the conveyance zone. Additional floodproofing measures were recommended for this building in a 2013 structural and flood assessment. It is possible to exit this building without immediately placing people within the HHZ, which lowers flood risks.

### East End Civic Area

Floodplain issues on the east end are different from those found on the west end of the civic area. While this area is covered by the 100-Year Floodplain of Boulder Creek, the HHZ and conveyance zone designations are more confined in this area and have decreased in size with the recent mapping update. The HHZ are along Boulder Creek and also follow Canyon, 13<sup>th</sup> and 14<sup>th</sup> where flood waters are returning to the creek area.

#### Atrium Building

The recent floodplain mapping has reduced the HHZ for this property including removing the building from the HHZ. This building is also not in the conveyance zone, but is within the 100-year floodplain. Previous floodproofing recommendations include building a flood wall and adding flood gates around the building, which could impact access and future uses.

13<sup>th</sup>/14<sup>th</sup> Block - The developable area in this block is impacted by 100-Year floodplain for Boulder Creek, but most of the property is neither within the HHZ nor the Conveyance Zone so fewer regulatory constraints related to flood impact the ability to build new or improve existing buildings. The street corridors are HHZ in the new mapping, which impacts access during a flood event; however it is possible to design the sites so that people exiting the buildings are not placed in the HHZ.

### Parking Opportunities

Below grade parking structures are not recommended in the Boulder Creek area due to flood risk and ground water challenges. Below grade structures are at greater risk for flood damage to both the structure and the contents and are also a risk for people that may try to leave the area during a flood. Mitigation for groundwater will also likely increase the cost for both construction and long term operations of any below grade structure.